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# "Supervisory Board Gender Diversity and Gender Quotas: Analysing the Impact on Financial Performance and Management Board Gender Diversity in Germany"

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**QUOTE**

"In God we trust; all others must bring data."

W. Edward Deming

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BoD – board of directors

CFI – Comparative Fit Index

CSR – corporate social responsibility

Df – degrees of freedom

DIW – German Institute for Economic Research

fd – first difference

FidAR – Frauen in die Aufsichtsräte e.V.

GMM – generalized method of moments

IV – instrumental variable

IZA – Institute of Labor Economics

ML-SEM – maximum likelihood structural equation modelling

OLS – ordinary least square

P2B – price to book

RMSEA – root mean square error of approximation

ROA – return on assets

ROE – return on equity

RQ – research question

SRMR – standardised root mean square residual

US – United States

$\chi^2$ – chi square

# 1 INTRODUCTION

## 1.1 RESEARCH PROBLEM

More than ten years after the financial crisis in 2007 corporate boards are again busy navigating through turbulent times. Today, the financial market and a globalized and interconnected world are not the only challenges they need to manage. For quite some time companies have been facing additional challenges such as digitalization, demographics, new technologies and competitors, changing customer behaviour, increasing regulation, and the consequences of the Covid-19 pandemic. These external factors have led to internal challenges such as a changing corporate culture (Wissmann et al., 2016), a shift in business activities, and new job and qualification profiles (Schley, Kohl, Müller, & Kranjčec-Sang, 2017; Stange & Reich, 2015).

Moreover, there has been a substantial flux in the internal and external environment for companies throughout the last decade. The pace of the change is steadily increasing and today the Covid-19 pandemic is acting as an accelerator and "game changer". Which is why the requirements for corporate governance are also shifting. The crucial question for companies in that respect is: How do we cope with a substantially changing environment?

One key aspect of the answer to this crucial question lies in the people agenda:

> Have "the right people, with the right capabilities, in the right place, for the right cost, doing the right things." (O'Beirne, Connellan, & Ryan, 2016, p.2)

These criteria are of paramount importance when it comes to the composition of the leadership of companies. At the same time, there is a general tendency among shareholders and boards to attach ever more importance to gender diversity as an important criterion for the board's composition (Beth, Dembowski, Hasensteufel, Kurtz, MacKenzie, 2017). Apart from the shareholders pressuring firms to adopt a meritocracy-based selection methodology for new directors with the focus on diversity aspects (Platt & Platt, 2012), there are also policy makers, interest groups,

and female activists clamouring for an increase of women in the boardroom and equal opportunities for men and women.

The board composition is seen as one of the key components of corporate governance because of the power and influence that the supervisory board exerts on the management board and eventually on firm performance. The board composition can impact on the effectiveness of decision-making and how the board works. Therefore, the implications of gender diversity are at the centre of corporate governance discussions. Some corporate governance codes even include guidelines for gender diversity and deem them to be necessary for good corporate governance (Terjesen, Aguilera, & Lorenz, 2015).

In theory, the advantages of diversity are manifold. The empirical literature emphasizes the potential of a diverse collective to be more efficient, creative, innovative, better in problem solving, to have new insights and perspectives, and to improve the monitoring ability (Bennouri, Chtioui, Nagati, & Nekhili, 2018; Byron & Post, 2016; Cabrera-Fernández, Martínez-Jiménez, & Hernández-Ortiz, 2016; Handschumacher & Ceschinski, 2020; Hoobler, Masterson, Nkomo, & Michel, 2018; Kirsch, 2018; Post & Byron, 2015; Velte, 2017). Accordingly, the idea that gender diversity on supervisory boards brings certain benefits for companies is a popular and often used argument in studies and public debates. Even policy makers justify gender quotas and policy interventions with the "business case" argument, which states that board gender diversity enhances the corporate performance (Adams, 2016).

One example for this "business case" argumentation is the proposal for a directive of the European Parliament to improve the gender balance among non-executive directors of companies listed on stock exchanges. The European Commission argues that board gender diversity improves both corporate governance and company performance. Furthermore, the European Commission argues that the potential benefits are not limited to the companies involved because they will also impact the whole European economy (European Commission, 2012).

> "The under-utilisation of the skills of highly qualified women constitutes a loss of economic growth potential. Fully mobilising all available human resources will be a key element to addressing the EU's demographic challenges, competing successfully in a globalised economy and ensuring a comparative advantage vis-à-vis third countries." (European Commission, 2012, p. 3)

Consequently, board gender diversity, its impact on corporate governance, and the firm's performance is a topic that has received significant attention from researchers and practitioners (Velte, 2017). However, diversity does not always lead to positive consequences. It can also bring negative effects such as communication and coordination problems, increased conflicts among directors, or longer decision-making processes (Velte, Eulerich, & van Uum, 2014).

In line with the conflicting and ambiguous theoretical implications of diversity, the empirical results cover a range extending from a positive relationship of diversity and performance (Brahma, Nwafor, & Boateng, 2020; Campbell & Mínguez-Vera, 2008; Carter, D'Souza, Simkins, & Simpson, 2010; Duppati, Rao, Matlani, Scrimgeour, & Patnaik, 2020), to the opposite, or even to no significant relationship at all (Adams & Ferreira, 2009; Ionascu, Ionascu, Sacarin, & Minu, 2018; Martinez-Jimenez, Hernández-Ortiz, & Cabrera Fernández, 2020; Rose, 2007; Shehata, Salhin, & El-Helaly, 2017; Shrader, Blackburn, & Iles, 1997; Zahra & Stanton, 1988). Also, there are concerns that the mixed results are driven by the heterogeneity of the research designs as well as methodological shortcomings of the studies.

> "Some researchers attribute the varied findings to the methodological shortcomings in many of the studies, including small sample size, short-term observations of performance, and the difficulty of controlling for reverse causation, endogeneity, and other omitted variables that may be affecting both board diversity and firm performance." (Rhode & Packel, 2014, p. 391).

The literature is dominated by studies analysing the relationship between women on boards and companies' financial performance measured by accounting and market performance indicators (i.e. Adams & Ferreira, 2009; Campbell & Mínguez-Vera, 2008; Carter, D'Souza, Simkins, & Simpson, 2010; Joecks et al., 2013; Post & Byron, 2015). However, when we look at the trends in this subject area there is also an increasing number of publications analysing the impact of board gender diversity on non-financial performance and corporate social responsibility issues (i.e. Byron & Post, 2016; Jain & Jamali, 2016; Rao & Tilt, 2016).

Despite all the attention, little research has been conducted on whether gender diversity on the supervisory board affects the gender diversity level of the management board (Kirsch, 2018). However, the same theoretical and empirical conflict

exists as with the "business case" argumentation of supervisory board gender diversity because theoretical implications and empirical findings do not uniformly indicate what the effects might be. One stream reasons that women tend to support other women and demonstrate solidarity (Mavin, 2006, 2008). Another stream argues based on the "queen bee" phenomenon and the assumption that women tend to be disloyal and therefore stop other women from progressing (Kanter, 1977a, 1987; Staines, Tavris, & Jayaratne, 1974). Hence, the theoretical implications regarding the effects of supervisory board gender diversity are ambiguous and facilitate opposing effects on the management board. Similarly, there are reservations about the validity of most studies on leadership and management because of "endogeneity problems" and methodological shortcomings (Antonakis, Bendahan, Jacquart, & Lalive, 2010, 2014; Arvate, Galilea, & Todescat, 2018; Wintoki, Linck, & Netter, 2012). Nevertheless, most studies argue based on a positive relationship, assuming that women have both the aspiration and the competence to support other women (Cook & Glass, 2015).

Therefore, experts highlight the need for more research in this field. They argue that the challenges of that line of research remain explaining, measuring, and confirming the impact of gender diversity on the supervisory board and how it is linked to the behaviour of the company in the market environment (Velte, 2017). Thus, the effects of board gender diversity on a firm's conduct and performance are still not clear.

Considering the "business case" and "women helping women" expectations placed on women on the supervisory board, is it necessary to examine whether there is also robust scientific evidence that supports this and whether this is a realistic expectation – especially after recent policy interventions in Germany. Once we understand this more clearly, expectations on board gender diversity and gender quota policies, may need to be relativized. This is even more important if the alleged effects of board gender diversity turn out to be a result of biased research. Several studies, produced by consulting companies and academics, report a positive impact based on regression analysis. However, these studies do not sufficiently emphasize that the results are not to be interpreted as causal relationships. Moreover, it is not transparent to the public and the media whether the studies apply robust and credible research designs (Adams, 2016).

Regardless of the uncertainty about the effects, the topic of board gender diversity remains a priority in the corporate governance and gender equality efforts. Sometimes the debate is driven by societal expectations or the theoretical advantages attached to it. Today, numerous policy makers are addressing the issue of women's underrepresentation in the boardrooms by enacting mandatory or voluntary gender quotas to increase their presence and to smash the metaphorical "glass ceiling". For example, Norway became a role model for gender quotas in the boardroom when it introduced a gender quota of 40 percent for listed firms in 2003. Since then, several countries have adopted this approach and also enacted laws for mandatory gender quotas that include sanctions in case of non-compliance (Belgium, France, Germany, and Italy). There are also other examples, such as Iceland, the Netherlands, Kenya, Slovenia, or Spain that have enacted less strict regulation by introducing gender quotas on a voluntary basis, where no penalties or sanctions are imposed. In some cases, the quota legislation also forces companies to define target quotas and to disclose them to the public (Kirsch, 2018).

In the case of Germany, an intensive and controversial public debate on how to increase the gender equality in the upper echelons of organisations has evolved over time. The public clamour for more gender diversity has led to state regulation. Starting in 2010 with an update of the German Corporate Governance Code, followed by a declaration of the DAX companies to increase the representation of women in leadership positions in 2011, a mandatory gender quota was finally introduced in 2015.

One aspect of the law is the legal requirement to achieve a gender quota of at least 30 percent on the supervisory board. Approximately 100 German corporations are affected and all of them must comply with this target either by maintaining the quota or by filling vacancies with female appointments. The second aspect of the law is the provision for a formulation of a target percentage of female representation on the management board and the two management levels below, including a respective deadline by when this target has to be achieved (German Government, 2015).

Despite this increase of gender quota policies, there is still only a limited number of studies analysing the impact of the quotas on companies. The most prominent studies focus on the Norwegian case and on the effects on financial performance (Ahern & Dittmar, 2012; Dale-Olsen, Schøne, & Verner, 2013; Matsa &

Miller, 2013; Nygaard, 2011). Accordingly, there is not much information on the effects of quotas on the company and its performance (Kirsch, 2018). Also, the efficacy of state regulation in this respect is discussed controversially. For example, Terjesen & Sealy (2016) raise the question of how a successful outcome of a quota legislation might look. Is it the formal achievement of a quota or should it rather be a general increase of gender equality in the business context? Overall, there is no clarity whether gender quotas can influence the role and perception of gender diversity, and whether its impact goes beyond the "mechanical effect" of a mandatory quota.

## 1.2 OBJECTIVES AND RESEARCH QUESTIONS

Both theoretical implications and empirical findings have led to conflicting reasoning and results regarding the effect of gender diverse supervisory boards on the financial performance and the level of gender diversity on the management board. Against this background, this study's purpose is to contribute to the discussion and understanding of what German society can really expect from women in the boardroom. Furthermore, this study is in line with experts' request that research designs be used to address endogeneity problems properly and to try to satisfy the conditions of causal inference. Moreover, this study aims to stress the robustness of the results by using different statistical methodologies to also demonstrate that the estimates might be sensitive to the statistical methodologies used. Apart from that, this study's purpose is also to analyse the impact of quota legislation in this context using the German set-up as a laboratory.

In general, the literature emphasises the "business case" argument for increasing board gender diversity. The argumentation is based on a mix of theories that make the case for a positive impact of female representation and a higher level of gender diversity in the boardroom. However, from a theoretical perspective there are arguments that forecast either a negative or positive impact on firm performance. The mixed empirical evidence might therefore be seen as indicating that the literature has tended to oversimplify the issue. Even though this might be the "age of the female director", it would be unrealistic to assume that they are "superheroes". Eventually, there are both theoretical and methodical doubts that call into question any claim for a causal impact (Adams, 2016).

Because of the challenges and uncertainty of the literature in this field, the first research question (RQ) asks:

RQ1: How does supervisory board gender diversity affect the financial performance in the German set-up, and is this effect dependent on the statistical methodology used?

This study also analyses whether gender diversity on the supervisory board impacts the presence of women on the management board. Accordingly, this study tests a firm outcome that is more in control of female directors compared to the firm's financial performance. In other words, one purpose of this study is to analyse if supervisory board gender diversity affects one of the board's core activities – recruiting the members of the management board. Considering the authority of the supervisory board to appoint and dismiss the management board members, it is plausible that the supervisory board's composition might influence its recruiting decisions (Cook & Glass, 2015). The theory that women are natural allies to their own gender and the findings of studies based on the US and Australian environment support the idea of a positive trickle-down effect of gender diversity. However, there are also theoretical considerations (e.g. the "queen bee" literature) that argue against a positive impact. The few studies analysing this relationship use different methodologies and heterogeneous samples. In addition, some of the studies are conspicuously at risk to suffer from endogeneity bias. Therefore, the same concerns arise as in RQ1 about the applied research designs and the robustness of the results in the literature.

Consequently, this study also seeks to address the following second research question:

RQ2: How does supervisory board gender diversity affect the gender diversity on the management board in the German set-up, and is this effect dependent on the statistical methodology used?

Hence, one major concern of this study is to contrast the results of the literature by applying different statistical methodologies and to test the relationships within the unique German set-up.

This study aims to elaborate how the German quota legislation, which was introduced in 2015, affected the firm performance and the gender diversity of the

management boards. Thus, this study tests the effects of the quota legislation beyond the "mechanical effect" of increasing the supervisory board gender diversity. Currently, there is no consensus given the results presented by empirical studies, which primarily focus on the case of Norway.

Consequently, this study asks the following additional research questions:

RQ3: How has the quota impacted the firm's financial performance in Germany?

RQ4: How has the quota impacted the female representation on the management boards in Germany?

As highlighted before, the scope of this dissertation is Germany. By focusing on the German environment, this study keeps certain contextual factors constant for all study objects. This is important because of national differences in corporate governance set-ups, cultural contexts, and legislation. This approach is also in line with the literature that argues that the respective mechanism do not work uniformly across countries (Johnson, Schnatterly, & Hill, 2013; Pye & Pettigrew, 2005). The companies within the scope are a set of the largest German companies, which are listed in the regulated market and the DAX Composite Index. The observation period from 2011 to 2018 allows for panel data analysis techniques and ensures the inclusion of a time interval of four years before and four years after the exogenous impact of the quota implementation.

Germany is an interesting laboratory for this study for several reasons. One of these reasons is that Germany has implemented the two-tier corporate governance system. In this set-up, the corporate governance structure consists of two bodies: the supervisory board (non-executives, also referred to as directors) and the management board (executives). Under the German Stock Corporation Act, this structure is required by law in Germany for stock corporations. The boards have different responsibilities, but eventually are jointly responsible and liable for managing the company's affairs. In general, research regarding the two-tier system is still underrepresented in the literature compared to research on the one-tier system. Another reason for choosing Germany is that it is one of the European member states that committed to foster gender equality in the upper echelons of organisations by introducing a mandatory gender quota for the supervisory board and the task of formulating a target gender quota (voluntary quota) for the management board in 2015. There are currently only a few studies that focus on Germany and

even fewer that consider the new gender quota legislation. Another particularity of the German case is that the composition of supervisory boards is impacted by co-determination legislation, which stipulates that one half or one third (depending on the size of the company) of the supervisory board members are elected by the employees.

## 1.3 THEORETICAL AND PRACTICAL CONTRIBUTIONS

In general, this study seeks to contribute to the understanding of the effects of supervisory board gender diversity and quota legislation on the financial performance and management board gender diversity in Germany. Consequently, this research is also relevant for German policy makers and corporate practice, particularly because it explores what firms and their stakeholders can expect from increased presence of women on the supervisory board. Moreover, it analyses the effects of the gender quota legislation beyond the supervisory board. Hence, the findings of the dissertation are relevant for policy makers because they reveal potential effects that go beyond the "mechanical effect" of the quota for the supervisory boards. This is also relevant for the evaluation of the efficacy of gender quota legislation because the analysis reveals whether legislation can shift the mindset about women in top management positions or whether it is a matter of compliance only. Thus, the findings of this dissertation contribute to the ongoing debate about expanding the scope of the quota legislation to additional firms and also to the management boards.

More specifically, this dissertation adds to theory and practise in the following ways:

**Scope:** The focus of this study is on Germany. Thus, this dissertation extends the research by focusing on the German context and explores the relationships based on German companies. The German corporate governance set-up (two-tier system, employee representation), cultural context, and legislation (civil law) are unique and different to the Anglo-Saxon countries, which are the focus of the studies in this field. Hence, this dissertation contributes to theory and practise by analysing whether the assumed relationships apply to the German set-up.

**Endogeneity problems, robustness of the results, and mixed evidence:** Furthermore, this study builds on the limitations in the literature to pave the way for

further research. Accordingly, methodological concerns mentioned in the literature are discussed. This research contributes to this discussion by specifically considering the stressed methodological shortcomings and by offering empirical examples that examine whether the results are dependent on the statistical methodology. In other words, this study complements the theoretical discussion by investigating whether the reported effects of supervisory board gender diversity are robust and whether they allow for a causal interpretation in the case of Germany while considering that empirical evidence based on a correlational analysis does not necessarily allow for a causal interpretation. This is particularly relevant because not all of the studies in this field address endogeneity problems enough, and, so, are particularly at risk to suffer from the sources of endogeneity highlighted in leadership and corporate governance research (Adams, 2016; Antonakis et al., 2010, 2014; Arvate et al., 2018; Wintoki et al., 2012). In addition, it is also noteworthy that many studies in this field apply a different methodological approach to model their results; moreover, the considered samples are very different. These circumstances might a be driver for the mixed evidence presented. Consequently, there is no consensus in the literature about the relationships that this dissertation analyses. Against this background, this dissertation contributes to theory by applying dynamic panel model techniques in this context, which allow for modelling the direction of causal relationships while controlling for time-invariant and unobserved confounders. More specifically, this dissertation introduces system generalized method-of-moments and also maximum likelihood structural equation modelling to handle endogeneity problems and to avoid that the results are driven by the statistical technique.

**Opposing theoretical implications:** Interestingly, also the theoretical framework is ambiguous as regards to implications of gender diversity in the supervisory board. Against this background, this dissertation contributes to theory by presenting the theories that are used in the literature to argue for a positive impact, but also the theories that argue against it. Consequently, this dissertation collects and introduces both arguments and counterarguments for the hypothesised relationships, and thereby also offers theoretically derived explanations for the inconclusive empirical evidence.

**Gender diversity beyond the supervisory board:** Less attention has been paid to the impact of supervisory board gender diversity on the presence of women

on the management board. This study adds to the existing empirical literature by exploring whether there is a positive trickle-down effect. By focusing on the trickle-down effects of supervisory board gender diversity, this study links the supervisory board composition to a variable that is less affected by external factors compared to firm performance.

**Gender quotas:** This study researches the effects of the gender quota legislation on the financial performance and management board gender diversity. So far, the case of Norway has almost solely been in the centre of the attention. Gender quotas force the companies to achieve a certain level of diversity in the boardroom. This might also have further unintended consequences for the companies within the scope of the quotas. As such, quotas restrict (self-)organization and corporate flexibility (Velte, 2017), which in turn might become an adverse trade-off when appointing supervisory board members for their gender rather than their qualifications. Moreover, the quota legislation also intends to positively impact the presence of women on the management board. However, it is not clear whether this is the case. This dissertation aims to add to the understanding of this situation.

## 1.4 STRUCTURE OF THE DISSERTATION

The remainder of the study is structured as follows. Chapter 2 provides an overview of the corporate governance system and legal environment in Germany. It presents key terms and definitions to set the scene for the dissertation. For example, the term corporate governance is defined and put into context to the German particularities. In addition, the German corporate governance framework is introduced by also referring to the interaction of the German Stock Corporation Act and the German Corporate Governance Code. Chapter 2 also highlights the characteristics of the two-tier corporate governance structure focusing on the tasks and responsibilities of the three main parties involved: the supervisory board, the management board, and the shareholder. Moreover, this chapter describes the normative framework in Germany, highlighting the gender quota provisions introduced in 2015 and also how the co-determination legislation affects the composition of the supervisory board. Finally, European gender quotas are presented, and their theoretical implications are discussed.

Chapter 3 focuses on the topic of board gender diversity to further set the scene for the dissertation and to build a to bridge between the more generic descriptions of the chapters 2 and 3 and the specific analyses in the chapters 4 and 5. At the beginning, the term diversity is defined. This dissertation understands gender diversity as a synonym for female board representation. After that, the relatively low gender diversity level at the top of the company's management is discussed and phenomena that explain this gender gap are presented. Subsequently, the relevance of supervisory board gender diversity in the context of board independence is elaborated. Because of the fact that female supervisory board members might also impact further dimensions of diversity of the supervisory board, such as tenure, age, and nationality, the respective theoretical implications of diversity in these dimensions are also introduced.

Chapter 4 presents the literature review of the studies analysing the effects of board gender diversity and the hypotheses development of this dissertation. This section begins with an analysis of the theoretical foundation. The selection as well as the basics of the theories, which are predominantly used in the empirical literature to argue the effects of board gender diversity, are introduced. After that, the empirical foundation is reviewed and discussed. More specifically, the process of the identification of the analysed empirical literature, its characteristics, and its main results are presented. Subsequently, the strategies and tools to address endogeneity problems in panel data settings are introduced and discussed. The chapters focusing on the theoretical and empirical foundation conclude with a presentation of the preliminary findings regarding the four formulated research questions. The dissertation's six hypotheses about the impacts of supervisory board gender diversity and quota legislation on the financial performance and the management board gender diversity are then developed on this basis.

Chapter 5 is dedicated to the empirical study of this dissertation. It begins with a presentation of the data collection process and data preparation for further analysis. In a next step, the independent, the dependent, and the control variables are defined. Subsequently, the descriptive statistics of the different samples are presented (full sample, sub-sample, matched and unmatched samples). In addition, this chapter presents the research design and methodological approach of the dissertation. It also summarises the main features of a panel data approaches and the

literature discussing the methodological requirements for causal inference. Accordingly, the main sources for endogeneity problems are presented. Afterwards, the specific approach to address endogeneity problems in connection with modelling the impact of supervisory board gender diversity is introduced. Then, the main features of the system GMM method are presented. Subsequently, the specific approach to address endogeneity problems in the context of modelling the effects of the gender quota is presented. Accordingly, the main features of the difference-in-differences estimation are presented. Eventually, the results of the model testing as well as the results of the robustness tests are presented and discussed.

Chapter 6 concludes the dissertation. It summarises the main findings and implications, focusing on the addressed research questions. Moreover, it discusses the main limitations of the study and offers suggestions for further research. Finally, the dissertation closes with an outlook regarding supervisory board gender diversity and quota legislation in Germany.

Figure 1 summarises the structure of the dissertation.

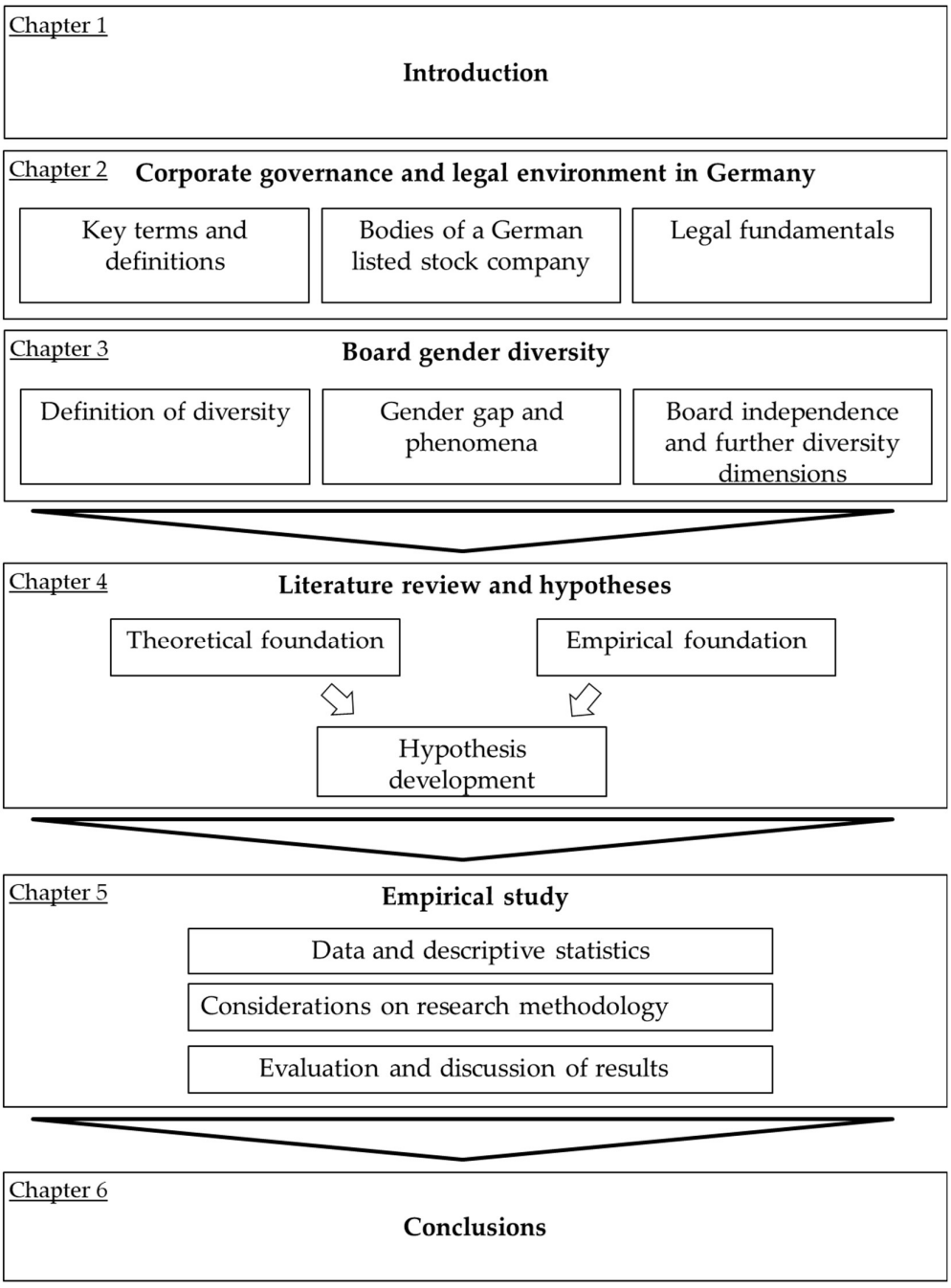



**Figure 1: Structure of the dissertation**

# 2 CORPORATE GOVERNANCE & LEGAL ENVIRONMENT IN GERMANY

## 2.1 CORPORATE GOVERNANCE IN THE GERMAN TWO-TIER SYSTEM

Corporate governance can be roughly defined as a matter of legal, institutional, and cultural mechanisms that support shareholders as well as other stakeholders (i.e. employees) to execute control over the company's management and activities (e.g. John & Senbet, 1998; Pearce & Osmond, 1999; Shleifer & Vishny, 1997). Moreover, corporate governance as such, can be understood as internationally recognized guidelines for corporate responsible leadership and monitoring (Velte, 2017). Since the mid-1990s, the term corporate governance has become increasingly relevant in Germany (Feddersen, Hommelhoff, & Schneider, 1996; Gerum, 2007) and one of the most discussed management topics in the literature(v. Werder, 2009). Furthermore, corporate governance concerns include both legally and factually relevant questions as regards the company's internal management practises as well as the integration in its environment. Accordingly, corporate governance addresses internal aspects (e.g. the relationships and competencies of the corporate bodies), and external aspects (e.g. the relationships with stakeholders like the shareholders and the capital market). Hence, one can distinguish between two sorts of corporate governance mechanisms; internal mechanisms, such as monitoring the management to reduce the risk of opportunistic behaviour, and external mechanisms, such as decreasing share prices as a response to unsatisfactory management performance (v. Werder, 2015).

The German corporate governance framework comprises two main elements to address corporate governance issues. On the hand, there are mandatory legal provisions, such as the legislation in the German Stock Corporation Act. On the other hand, there are corporate governance guidelines or "soft laws" (Kirchner, 2002, p. 100) that complement these mandatory legal provisions. These guidelines or "soft laws" are defined in the German Corporate Governance Code and companies are obliged to "comply or explain" their adherence to these provisions (German Corporate Governance Code, 2019, p. 2). Acting and behaving in accordance

with German Corporate Governance Code will not only lead to compliance with the law, it will lead to an improved share- and stakeholder perception, and eventually a better market valuation (Velte, 2017).

Compared to the one-tier board system, that reflects more a shareholder primacy, the German two-tier model reflects a more stakeholder oriented paradigm (Block & Gerstner, 2016). In particular, the stakeholder "employee" is treated very special because of the co-determination provisions in Germany. Laws like the German Co-Determination Act stipulate particular rights and competencies to the employees, such as the election of a workers' council and the mandatory representation of employee representatives in the supervisory board in order to defend their interests.

The two-tier structure is compulsory for German limited companies as per German Stock Corporation Act. The only alternative is the Societas Europaea (SE), which is the company form for European limited-liability companies. According to the German Stock Corporation Act and the German Corporate Governance Code, the two tiers are the "supervisory board" and the "management board". The first tier in the structure is the supervisory board, consisting of the non-executive directors. In turn, the management board is the second tier and consists of the executive directors.

In common law regulations, the board of directors has two primary fiduciary duties: duty of care and duty of loyalty. Case law and judges' decision in the past and in the present have led to these principles. On the other hand, in civil law countries like Germany the members of the supervisory and the management board shall conduct the business of the company as "prudent and conscientious managers" as stipulated by the law, i.e. in the articles 93 and 116 of the German Stock Corporation Act.

In Germany, the boards are jointly and severally liable based on the "business judgement rule" (article 93 para. 1 and 2 German Stock Corporation Act). This principle also applies the for common law regulations in cases of a breach of "duty of care", where courts mainly held directors liable collectively (Ibrahim, 2008). Both, in the one-tier as well as the two-tier board management system, the boards are responsible for setting the strategy, managing and monitoring the corporate affairs and the compliance with the law, and ensuring the company's sustainable value

creation and continued existence (Government Commission German Corporate Governance Code, 2019; Mallin, 2004; Monks & Minow, 2004).

However, in the two-tier system each board has its own tasks and responsibilities as exemplarily illustrated in figure 2 for a German listed stock company within the scope of the German Co-Determination Act. The respective tasks and responsibilities are stipulated by the German Stock Corporation Act, the German Co-Determination Act, as well as the German Corporate Governance Code. A more detailed explanation with respect to the tasks and responsibilities of the bodies follows in the next chapters.

According the German Corporate Governance Code, it is necessary that the two tiers, namely the supervisory board and the management board, work together "on a trust basis to the benefit of the enterprise" (principle 13, p. 10). Moreover, the code states that "good corporate governance requires an open dialogue" (principle 13, p. 10) between the parties as well as the individuals. "Comprehensive observance of confidentiality" thereby is a key factor of the relationship (principle 13, p. 10). Thus, a close and trustful cooperation of the supervisory board and the management board in the German two-tier governance structure is a necessary requirement for the efficacy of their performance.

To conclude, the composition of the boards, the characteristics of board members, and any other factors that improve its collective decision-making become important determinants of good corporate governance and the boards performance, which ultimately impacts the company's sustainable value creation and continued existence – in both common and civil law countries.

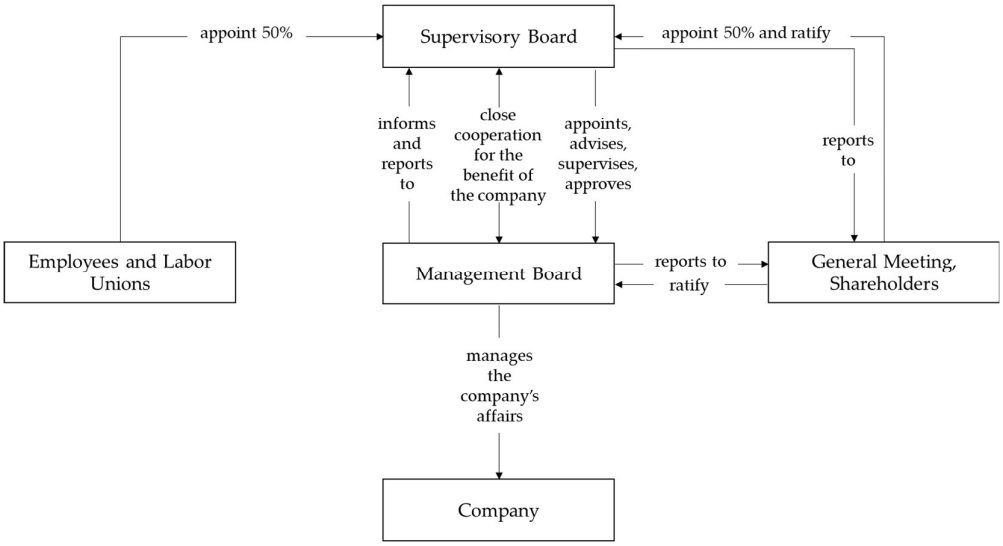



**Figure 2: Corporate governance structure of a German listed stock company within the scope of the German Co-Determination Act**

## 2.2 SUPERVISORY BOARD, MANAGEMENT BOARD, AND SHAREHOLDERS

### 2.2.1 Tasks and responsibilities of the supervisory board

The shareholder's representatives on the supervisory board are elected by the shareholders during the annual general meeting (article 119 para. 1 no. 1 German Stock Corporation Act). Depending on the company's size and the application of co-determination laws, one third (article 4 para. 1 One-Third Employee Participation Act) or one half (article 7 para. 1 Co-Determination Act) of the supervisory board members are elected by the employees.

In general, the supervisory board has the authority to control the management board. This authority is supported by several rights to information (i.e. articles 90; 111 para. 2; 170 German Stock Corporation Act). Moreover, the supervisory board has selective decision-making authority, which is graduated as regards autonomy. Firstly, it has the right of involvement with respect to defined specific issues (i.e. articles 59 para. 3; 58 para. 2; 172; 204 para. 1 sent. 2; 124 para. 3 German Stock Corporation Act). Secondly, the supervisory board can decide autonomously

with respect to the appointment of the management board. More specifically, the supervisory board can decide autonomously, amongst other things, to appoint management board members up to five years (article 84 para. 1 German Stock Corporation Act) and to decide on their remuneration (articles 87 German Stock Corporation Act).

The specific responsibilities and tasks of the supervisory board are defined by corporate law, such as the German Stock Corporation Act, and "soft law" provisions, such as the German Corporate Governance Code. These are also presented in below. However, there is no single provision that defines the scope and authority of the supervisory board; there are several different provisions. Nevertheless, the core tasks can be defined as monitoring, advising, and appointing the management board (v. Werder, 2015). In addition, there has been a trend to emphasize the active involvement of the supervisory board, and, so, the role now also includes proactive and accompanying control as well as a more active role with respect to strategy development (Engert, 2019).

Accordingly, the tasks of the supervisory board can be classified in ex post and ex ante activities. These are stipulated in article 111 of the German Stock Corporation Act. Furthermore, the German Corporate Governance Code incorporates

> "principles, recommendations and suggestions governing the management and monitoring of German listed companies that are accepted nationally and internationally as standards of good and responsible governance" (p. 2).

Ex post activities are, for example, supervising the management by reviewing the books (article 111 para. 2 sent. 1 & 2 German Stock Corporation Act) and the annual report (article 171 para. 1 sent. 1 German Stock Corporation Act), appointing an external auditor as well as controlling and communicating the results (article 111 para. 2 sent. 2, 171 para. 1 German Stock Corporation Act), evaluating the input provided by the management board (article 90 para. 1 German Stock Corporation Act), reporting to the shareholders in the general meeting (article 118 para. 3, 124 para. 3 sent. 1, 171 para. 2 German Stock Corporation Act) and taking legal proceedings against the management if necessary (article 112 German Stock Corporation Act).

The supervisory board is not permitted to directly interfere in the operational management of the company (article 111 para. 4 German Stock Corporation Act). However, ex ante influence of the supervisory board on the management board can

be ensured for defined actions, that are subject to approval of the supervisory board (article 111 para. 4 sent. 2 German Stock Corporation Act). Examples for such actions are transactions that fundamentally impact the assets and/or earnings of the company (principle 6, Government Commission German Corporate Governance Code, 2019). In addition, the supervisory board can influence the management board by setting objectives and incentivizing their achievement (article 87 para. 1 German Stock Corporation Act), and by regularly advising the management board in strategic concerns (principle 6, Government Commission German Corporate Governance Code, 2019).

One additional main duty of the supervisory board is the architecture of the management board, meaning the appointment (article 84 para. 1 German Stock Corporation Act) and dismissal (article 84 para. 3 German Stock Corporation Act) of its members. The German Stock Corporation Act stipulates in article 111 para. 5 that the supervisory board is obliged to define target quotas for the female representation on the management board (and the supervisory board if the company is outside the scope of the One-Third Employee Participation Act or the Co-Determination Act) and a time corridor – not longer than 5 years – by when these will be achieved.

Another special feature of the German normative climate is the above-mentioned co-determination legislation, that stipulates that up to one half of the members of the supervisory board are elected by the employees. This significantly influences the functioning of the supervisory board (v. Werder, 2017). Both, negative as well as positive effects on the efficacy of the board are justifiable (v. Werder, 2004). Positive aspects are, for example, that the employee representatives have relatively detailed knowledge of the company's operational activities, and that they can support the communication of the supervisory board's measures within the workforce. Negative aspects are, for example, that this restricts the possibility of optimising the composition of the board, and that the directors representing the stakeholder "employee" per se are not fulfilling the standard of independence (v. Werder, 2017).

However, Duran & Pull (2014) argue, that the employee representatives complete additional tasks besides the legally intended mandate of representing the employees' interests. Firstly, they add cognitive frames and perspectives to the board, resulting in an increased pool of know-how. For example, an "internal" employee

representative and an "external" employee representative representing a labour union are two different types of directors that potentially add perspectives to the board. Secondly, there are indications, that the comparatively higher number of female directors of the employee representing share of the board members may lead to and increased acceptance and legitimization of female directors in general (Duran & Pull, 2014).

Experts, recent journal articles, and studies discuss and analyse the development of the role of the supervisory board in the German two-tier system over time. They derive "best practices" and "success factors" taking into account the changes in the normative climate as well as empirical findings. Werder (2017) notes that the responsibilities and tasks of the supervisory board increased over time. Examples for that are the greater role of dedicated committees like the audit committee (Nonnenmacher, Wemmer, & v. Werder, 2016) or the evolved role of the chairman regarding stakeholder communication (principle 7, Government Commission German Corporate Governance Code, 2019). This increasing demand for the professionalisation of the supervisory board raises the question which characteristics regarding the composition and activities lead to efficient supervisory board work (Ruhwedel, 2018).

Werder (2017) identifies four clusters with ten success factors based on an explorative expert interview of 22 experts. The clusters identified are composition, organization, culture, and core tasks of the supervisory board. Ruhwedel, (2018) derives "formal enablers" and "qualitative success-critical characteristics" and focuses on the evaluation of 19 "enablers" in three dimensions. The three dimensions are functionality, transparency, and composition. Even though the focus and methodology of the studies is different, both authors highlight that the composition and the diversity of the supervisory board is a critical criterion for an efficient work of the board in the German two-tier structure.

To conclude, the German Corporate Governance Code (2019) defines the main duties of the supervisory board the following:

> "The Supervisory Board appoints and discharges the members of the Management Board; it supervises and advises the Management Board in the management of the enterprise and has to be involved in decisions of fundamental importance to the enterprise." (principle 6, p. 4)

Regarding the appointment of management board members, the code states that diversity shall be considered.

> "(…) the Supervisory Board defines the target percentage representation of female Management Board members." (principle 9, p. 6)

To fulfil these tasks, the code recommends establishing dedicated committees of members with the necessary specialist know-how, considering the individual set up of the company.

### 2.2.2 Tasks and responsibilities of the management board

Similarly, the specific tasks and responsibilities of the management board are also defined in the German Stock Corporation Act and the German Corporate Governance Code. The German Corporate Governance Code (2019) defines the main duties of the management board. Firstly, it stipulates that the management board is responsible for "managing the enterprise in its own best interests" (principle 1, p. 4). Secondly, the management board is responsible for the strategy development and implementation, subject to the consultation with the supervisory board (principle 2). Thirdly, the management board is responsible for defining target values for the gender diversity level in the two management layers below (principle 3). Fourthly, it is responsible for implementing an appropriate risk management and control (principle 4). Fifthly, the management board must ensure that the company complies with the law and the internal policies (principle 5).

Hence, compared to the supervisory board the management board's core task is to manage the company's affairs and run the business (article 76 sent. 1 German Stock Corporation Act). It also represents the company in and out of court (article 78 sent. 1 German Stock Corporation Act). The management board members are jointly responsible and liable (article 77 sent. 1 German Stock Corporation Act). Moreover, the management board is responsible for reporting to the supervisory board. The law stipulates a reporting obligation about the strategy and planning regarding financing, investing, and workforce at least once a year. Furthermore, the management board must report on the profitability and return on equity in the course of the supervisory board meeting that deals with the annual report. Apart from that, the management board is obliged to report on the development of sales

and the situation of the company at least quarterly. Transactions of "significant importance" must be reported in a timely manner (article 90 para. 1 and 2 German Stock Corporation Act).

In addition, the management board is responsible of maintaining the books of account (article 91 para. 1 German Stock Corporation Act), implementing measures and a monitoring system to identify risks to the company (article 91 para. 2 German Stock Corporation Act), convening the general meeting (i.e. article 121 German Stock Corporation Act), and keeping the shareholders (i.e. article 131 German Stock Corporation Act) and the federal authorities informed (i.e. articles 161, 181 and 184 and German Stock Corporation Act).

### 2.2.3 Role of the shareholders

The general meeting is the third body besides the supervisory and management board. The general meeting is the platform for the shareholders to exercise their rights as stipulated per law. In principle, the shareholders have two options to represent and defend their interests, which can be summarised as "voice" or "exit" (Hirschman, 1970). Hence, they can raise their voice to exert influence in the general meeting (article 118 para. 1 German Stock Corporation Act) or they can exit and sell their shares. Resolutions within the scope of the general meeting cover, for example, the appointment of the shareholder representatives of the supervisory board, the appropriation of net profits, the exculpation of the supervisory and the management board for the fiscal year, the appointment of an auditor, the amendment of the articles of association, or other major decisions like measures of capital procurement and capital reduction (article 119 para. 1 German Stock Corporation Act). In addition, the shareholders have further rights, such as the right to information (i.e. article 131 German Stock Corporation Act), the right to request a shareholders meeting (at least 5 percent share) (article 122 German Stock Corporation Act), or the right to vote on nominees for the supervisory board before the supervisory board proposes the candidates (at least 10 percent share) (article 137 German Stock Corporation Act), which support them by exerting influence.

To further illustrate the authority of the shareholders, one can take the so-called "shareholder activism" phenomenon as an example. It can be defined as an investment strategy that ultimately aims for drawing profit from accomplishing

changes of the management of a company by, for example, replacing board members, influencing the strategy, or enabling a takeover of the company (Engert, 2019; Stadler, Aufseß, & Schweizer, 2015). In general, shareholder activism campaigns have become an increasingly important part of the corporate governance landscape (Becht, Franks, Grant, & Wagner, 2017). Today, shareholder activism is also a well-established investment strategy with respect to German stock corporations (Langenbucher, 2017). There are several examples, such as the cases of the attempted takeover of London Stock Exchange by Deutsche Börse AG in 2005 or the successful takeover of Stada Arzneimittel AG in 2017/2018, demonstrating that shareholder activism campaigns are successful and that shareholders can influence corporate strategy and governance (Engert, 2019).

In addition, the shareholders have influence on the statute of the company, and thereby can ensure that their interests are considered. For example, they can influence the lines of business and the geographical scope by defining the object of the company. This means that the shareholders can limit the possibility to further increase the diversification of the company by specifying the product range and the market segments, and, so, they are able to avoid additional risks in this respect (v. Werder, 1986). Moreover, the shareholder can influence stipulations with respect to the business purpose of the company, which allows them to specify and complement the objectives of the company. Apart from that, the statute includes the amount of the share capital (article 23 para. 3 sent. 3 German Stock Corporation Act). As the amendment of the statue is subject to the approval of the general meeting, the shareholders have the competence to influence the capital resources of the company. In other words, the shareholders have the competence to fundamentally influence the objectives and the strategy of the company (v. Werder, 2015).

## 2.3 NORMATIVE FRAMEWORK – GENDER DIVERSITY PROVISIONS

### 2.3.1 Provisions for the supervisory board composition

The implementation of a gender quota in Germany is a result of several decades of discussions among different stakeholders. First political discussions start in 1980. In 1982, experts are invited to the German parliament to debate about gender

quotas. Since then, several initiatives and regimes lead to the enhancement of the legal framework in Germany.

The inclusion of the article on equality in the German constitution in 1994 is a milestone for the development of gender diversity in the boardroom. However, it takes more than 15 years until the German Corporate Governance Code includes a recommendation that companies shall formulate diversity targets for the supervisory board in 2010. Finally, the law for gender quotas is passed in 2015.

Figure 3 shows the timeline of the development of the law in more detail. In 2009, the mandatory quota was part of an election program. However, it was declined in 2010. Nevertheless, several companies declared to foster board gender diversity in 2011. After that, an alliance was formed by representatives of politics, economy, and unions who presented and signed the "Berliner Erklärung" to demand a mandatory gender quota of 30 percent for supervisory boards. This initiative was successful and eventually led to the gender quota legislation.

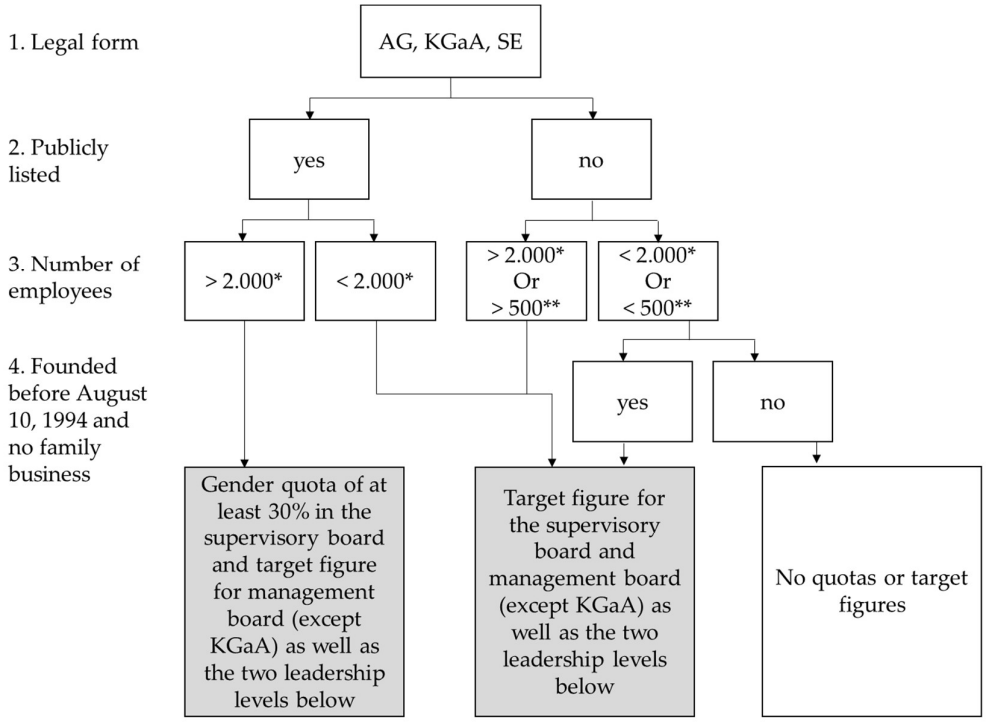

**Figure 3: Timeline quota legislation**

**Source: Adapted from Bundesministerium für Familie, Senioren, Frauen und Jugend (2016)**

The law for "equal participation of women and men in leadership positions in the private sector and in public service" consists of three pillars, whereby two of them affect the companies in focus of this study. Firstly, it stipulates the necessity of a gender quota of at least 30 percent on the supervisory board for the companies within the scope of the law (see figure 4). Secondly, it stipulates the provision of a formulation of a target percentage of female representation on the management board and the two management levels below, including a respective deadline by

when this target will be achieved. Thirdly, it contains similar provisions for the public sector.

The minimum gender quota of 30 percent, respectively for male and female members of the supervisory board, has to be considered in any new elections that become necessary for filling individual or several positions on the supervisory board (German Government, 2015). The German Corporate Governance Code refers accordingly to these provisions.




* In scope of application of Co-Determination Act
** In scope of application of One-Third Employee Participation Act

**Figure 4: Simplified illustration of companies within the scope of the law**
**Source: Adapted from Bundesministerium für Familie, Senioren, Frauen und Jugend (2016)**

As figure 4 indicates, there are different provisions for the companies based on their characteristics. Companies that are publicly listed and that are in scope of the German co-determination act (> 2.000 employees) have to comply with the gender quota of 30 percent on the supervisory board and the provision to articulate a target figure for the management board as well as the two leadership levels below.

This applies for approx. 100 of the largest German companies. The second group of companies within the scope of the law are those companies, that are in scope of the second level of application, namely the articulation of a target figure for the supervisory board, the management board, and the two leadership levels below.

The number of directors on the supervisory board is regulated in the German Stock Corporation Act. According to article 95, the supervisory board must consist of at least three members. The number is capped to a maximum of nine members for companies with a share capital up to EUR 1.5 million, fifteen members for companies with a share capital from EUR 1.5 million until EUR 10 million, and twenty-one members for companies with more than EUR 10 million share capital. Moreover, the number must be divisible by three if this is necessary to meet the provisions of the co-determination act.

Article 96 of the German Stock Corporation Act stipulates the composition of the supervisory board and refers, amongst others, to the German Co-Determination Act and to the One-Third Employee Participation Act. If the company falls under the Co-Determination Act (article 7 para. 1) or the One-Third Employee Participation Act (article 4 para. 1) one half or one third of the board members are elected by the employees. In addition, certain shareholders may have the right to name up to one third of the shareholders representing board members (article 101 para. 2 sent. 3 German Stock Corporation Act).

Besides the criteria co-determination, gender diversification, and size, there are additional factors regarding the regulation of the members of the supervisory board as stipulated in article 100 of the German Stock Corporation Act. There are, for example, provisions regarding the expertise in accounting or auditing of the board members for capital market-oriented companies (article 100 para. 5 sent. 3 German Stock Corporation Act), and the maximum amount of parallel supervisory board mandates of each member. The amount is limited to a maximum of ten mandates (article 100 para. 2 sent. 1 no. 1 German Stock Corporation Act). In addition, it is forbidden to sit simultaneously on the supervisory as well as the management board (article 105 para 1 German Stock Corporation Act). There are possibly additional requirements depending on the statute of the company (article 100 para. 4 German Stock Corporation Act) or on the further legal environment (article 100 para. 3 German Stock Corporation Act). The German Corporate Governance Code (2019) states that the supervisory board

"has to ensure that its members collectively possess the knowledge, skills and professional expertise required to properly perform their duties; furthermore, the legal gender quota must be considered." (principle 11, p. 7)

### 2.3.2 Quota legislation, ethical arguments, and theoretical implications

Why implement gender quota legislation? Gender quotas have become a hot topic for political and societal debates. As table 1 illustrates, several European countries followed the example of Norway and implemented gender quotas in the last years. The majority of the policy makers referred to the "business case" argument of an increased gender diversity to justify quota legislation.

Even the European Commission argues based on the "business case" of gender diversity in the proposal for a directive on improving the gender balance among non-executive directors of listed firms. The European Commission argues that board gender diversity improves both corporate governance and company performance. Furthermore, the European Commission argues that the potential benefits are not limited to the companies involved because they will also positively impact the whole European economy (European Commission, 2012).

Despite the "business case" argumentation of board gender diversity there are also the ethical implications that needs to be considered in this context. For a fact, the boardrooms are historically and presently dominated by men. Moreover, it still is an issue that women tend to encounter more problems in their careers than their male peers. Hence, gender inequality in the labour market might be a potential driver for the situation that there are fewer women in managerial positions of companies (Cabrera-Fernández et al., 2016). Therefore, from an ethical perspective, diversity in the boardroom should be the objective itself, arguing that it is unfair and unethical to exclude certain groups of the business elite by gender or other characteristics (Singh, Vinnicombe, & Johnson, 2001).

Consequently, many initiatives to increase gender diversity in the boardroom have been implemented on a national and international level. Policy makers even enacted legislation to foster the presence of women by implementing gender quotas for the supervisory boards and boards of directors. Cabrera-Fernández et al., (2016, p. 72) define quotas as follows.

> "Quota systems are a tool for positive action and are intended to ensure that women constitute at least 30 or 40 per cent of decision-making bodies."

However, the implementation of mandatory quotas is controversially discussed by corporate governance experts. Quotas can be interpreted as a form of tokenism and therefore imposing a gender quota to increase gender diversity in the boardroom is deemed not to be a best practise (Nekhili & Gatfaoui, 2013).

Besides the positive aspects, there are several negative theoretical implications of gender quotas presented in the literature. For example, the fact that there is a limited pool of adequately qualified female directors might be a challenge for implementing quotas. Because of legal requirements, companies are forced to appoint female directors to comply with the law, even though there might be no adequately qualified female director available. Consequently, there is the hazard that appointments due to quota legislation negatively impact the characteristics of the board towards disproportionally less experienced and younger board members (Ahern & Dittmar, 2012). In addition, the increased demand for minority directors may exceed the supply and hence the available directors tend to sit on more boards than their peers. Accordingly, they are more busy and potentially less effective (Ferreira, 2011). According to Adams & Ferreira (2009), imposing gender quotas for the boardroom might even decrease shareholder value for well-governed firms due to counterproductive additional monitoring.

| Country | Law in force since | Quota | Year of implementation | Board concerned | Sanctions |
|---|---|---|---|---|---|
| Norway | 2006 | 40% | 2008 | Supervisory Board | yes |
| Spain | 2007 | 40% | 2015 | Administrative Board | no |
| Iceland | 2010 | 40% | 2013 | Supervisory Board | no |
| Italy | 2012 | 20%<br>33% | 2012<br>2015 | Executive Board<br>Supervisory Board | yes |
| France | 2012 | 20%<br>40% | 2014<br>2017 | Administrative Board<br>Supervisory Board | yes |
| Belgium | 2012 | 33% | 2017 | Administrative Board | yes |
| Netherlands | 2013 | 30% | 2016 | Administrative Board<br>Executive Board<br>Supervisory Board | no |
| Germany | 2016 | 30% | 2016 | Supervisory Board | yes |
| Portugal | 2018 | 20%<br>33% | 2018<br>2020 | Executive Board<br>Supervisory Board | yes |
| Austria | 2018 | 30% | 2018 | Supervisory Board | yes |

**Table 1: Legal quota regulations in Europe**

**Source: Adapted from Wieser & Fischeneder (2019)**

# 3 BOARD GENDER DIVERSITY

## 3.1 DEFINITION OF DIVERSITY

Diversity has become a popular concept for academics, practitioners, and policy makers for ethical and/or economic reasons. However, a clear definition of that term is challenging to find in the literature. The term is defined in different ways, depending on the respective perspective. Some authors directly link diversity with race, gender, and ethnicity (Kossek & Lobel, 1996), while others consider age, nationality, religion, sexual orientation, values, and beliefs as factors of diversity (Norton & Fox, 1997). In the following, definitions of four selected authors are presented.

Blau (1977) defines diversity as the following:

> "Diversity refers to the great number of different statuses among which a population is distributed. It is the graduated-parameter equivalent of heterogeneity. Its minimum is when all persons occupy the same status; its maximum is when every person occupies a different status" (pp. 276).

Hence, diversity is seen as a result of a group of people with differing statuses.

Burton (1991) describes diversity as

> "… an expression of the broadening of the merit principle rather than an argument for representation" (pp. 43).

Burton (1991) argues that in this case, a merit is redefined to consider experience and qualities not included before. Focus shall be on diversity of values and experience rather than on representation.

Cox (2001) defines diversity as

> "…the variation of social and cultural identities among people existing together in a defined employment or marketing setting." (p. 3)

In addition to that, Harrison & Sin (2005) define diversity as a

> "… collective amount of differences among members within a social unit" (pp. 196).

They argue that diversity is a construct of collectivism and inclusion. It is applicable to teams, groups, or social units. The minimum diversity level occurs, if all members of a social unit are identical on all dimensions. Hence, a diversity level of zero is almost impossible (Konrad, 2003).

In the context of corporate governance, diversity of the board members is seen as one important criterion of "good corporate governance". Following the work of McGrath, Berdahl, & Arrow (1995), team diversity can be categorized into three sets, namely (1) personality, demographics, and traits, (2) values, beliefs, and attitude, (3) knowledge, skills, and abilities.

Specifically, the different characteristics of diversity in the boardroom include (not exhaustive) age, gender, nationality, culture, religion, professional background, knowledge, technical skills, and industry experience. Thus, diversity of the board refers to the mix of human capital that it embodies as a collective body and that they can make use of as governing committee of the firm (Milliken & Martins, 1996). The significance of boardroom diversity depends on the governance structure and the focus of the organisation. For example, in the public or non-profit sector, social justice is a top priority. On the other hand, in the private sector the increase of shareholder value might be the top priority (van der Walt, Ingley, & Diack, 2001). In Germany, the gender diversity as regards the top management of big companies has become a regulated issue. Hence, the attention and significance for gender diversity is influenced by German legislation and diversity provisions.

Against this background, this study considers gender diversity as a synonym for female board representation. For example, Hieker & Rushby (2017) define gender diversity as the ratio between men and women in a group. In line with this definition, this study measures supervisory board gender diversity as the share of female supervisory board members. The share of female supervisory board members is calculated as the number of female supervisory board members divided by the total number of members on the supervisory board.

To conclude, gender diversity affects businesses and organisations in today's world. The main drivers for the increased awareness of the topic mainly source from the following three factors (i.e. Cabrera-Fernández, Martínez-Jiménez, & Hernández-Ortiz, 2016):

(1) a legal obligation to fulfil a certain level of (gender) diversity in certain contexts

(2) a moral and ethical commitment to meet the expectations of the society and the company's stakeholders

(3) a practical concern that the positive implications of diversity may have economic effects and therefore positively influence the firm's performance

## 3.2 GENDER GAP

Despite the increasing attention of gender diversity in Germany, the private sector still has a gender gap compared to the objective of gender parity. In particular, the female representation in the boardroom, and the gender diversity respectively, is relatively underrepresented. This chapter describes this situation in more detail.

For example, the annual "Global Gender Gap" report issued by the World Economic Forum analyses the state of gender parity per country based on statistics from international organizations and a survey of executives. Its aim is to track relative gaps between women and men focusing on the dimensions health, education, economy, and politics to highlight the relative gap towards gender parity. Focusing on Germany, the 2020 edition of this report lists Germany in the tenth rank of 153 countries within the scope. This is driven by a relatively high score in the political empowerment dimension, which, in turn, is a result of the strong participation of women in politics (40 percent of German ministers, 31 percent of parliamentarians are women, long tenure of a female head of state). However, there still is a substantial gender gap in the dimension of economic participation and opportunity. The drivers for this score are wage and income disparities as well as the limited gender diversity in the boardroom and the management layers below (World Economic Forum, 2019).

When focusing on the share of female supervisory board and administrative board members of the largest listed companies per European country, Germany ranks number five with an average share of 36 percent in 2019 (see figure 5). However, this statistic includes only the companies listed in the primary blue-chip index in each country and hence, this share is not representative for all other companies

in the countries. Indeed, in the case of Germany, the average share decreases when additional companies below the blue-chip level are included. When looking at this even more granular, it becomes clear that there is also a substantial difference between companies that are affected by the quota legislation compared to those that are not.

Looking at the 200 largest companies (excluding the financial sector) the average share is at 28 percent in 2019. The more granular view shows that the share of female supervisory board members in companies affected by the law is at 34 percent whereas the unaffected companies have 23 percent. Thus, there is a substantial difference between these two groups of companies of 11 percent (Kirsch & Wrohlich, 2020a).

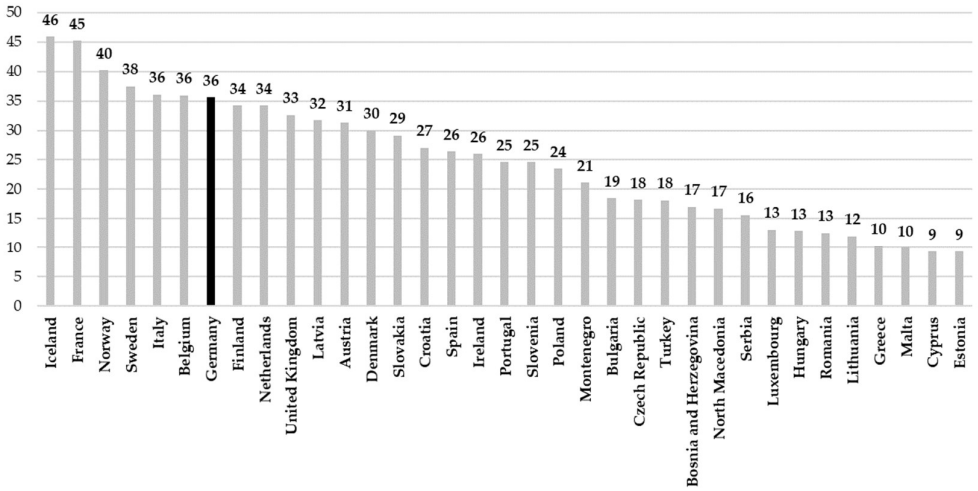



**Figure 5: Share of women on the supervisory board and administrative board in the largest listed companies per country (primary blue-chip index, max. 50 per country)**
**Source: Adapted from European Institute for Gender Equality (2020)**

The gender gap in Germany decreased over time, but there is still a way to go to achieve gender equality in the boardroom. Figure 6 illustrates this by showing an increase of female participation for the blue-chip companies in Europe for most of the countries comparing 2010 to 2019.

In particular, the management boards remain dominated by men. Despite some progress made over a longer period of time, the baseline is very low. In 2019, the top 200 German companies reached the ten percent mark for the first time (Kirsch & Wrohlich, 2020a).

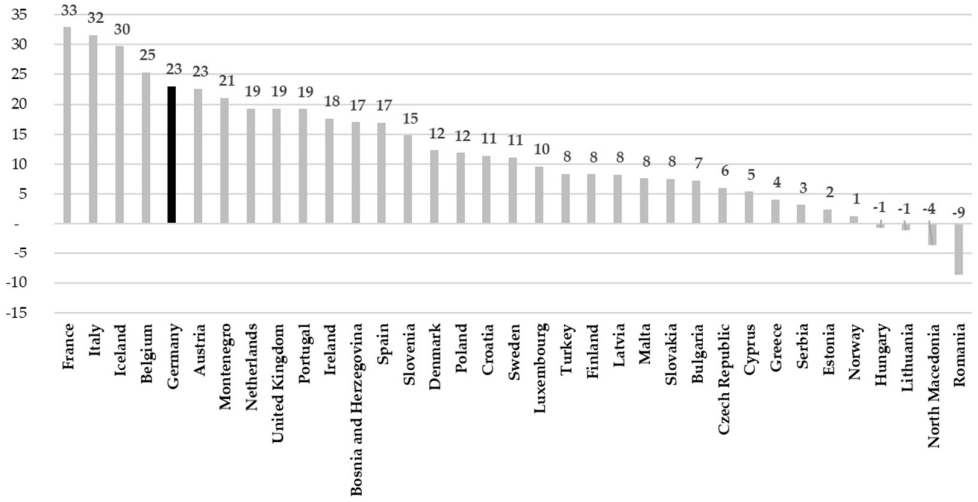



**Figure 6: Change of share of women on the supervisory board and administrative board in the largest listed companies per European Country 2010 vs. 2019 (primary blue-chip index, max. 50 per country)**

**Source: Author, adapted from European Institute for Gender Equality (2020)**

## 3.3 PHENOMENA EXPLAINING THE LOW GENDER DIVERSITY IN THE BOARDROOM

As described above, the boardroom is dominated by men, even though there has been increasing pressure to increase the board gender diversity. The EU Commission describes the reasons for the low gender diversity in decision-making positions as multiple and complex. The commission mentions that the main reasons for the under-representation of women are:

> "traditional gender roles and stereotypes, the lack of support for women and men to balance care responsibilities with work, and the prevalent political and corporate cultures" (European Commission, 2019)

The literature highlights several phenomena which try to explain the lasting low level of female presence in top management positions. Below they are briefly introduced. The first one is the so called "glass ceiling" phenomenon. This phenomenon is a metaphor for women being held back from advancing to the top of corporations due to an invisible barrier (see figure 7) caused by prejudice and discrimination against female candidates (Arfken, Bellar, & Helms, 2004; Bergeron, Block, & Echtenkamp, 2006; Broome, 2008; Terjesen, Sealy, & Singh, 2009).

For example, Burke (2000), Holton (2000), and Mattis (1993) highlight that the selection process for directors as such might create an invisible barrier for female candidates. The reason for that is a systematic gender bias in the recruiting process of directors, also impacted by the fact that women are traditionally not part of the necessary (male) networks (Nekhili & Gatfaoui, 2013). These powerful social networks, also referred to as "old-boys-networks" or "old-boys clubs", are an additional and often-cited barrier that prevent women to break the "glass ceiling". Members of the "old-boys-networks" are assumed to support the appointments of other members of these networks. Considering that women are, by definition, not part of these networks, they are systematically disadvantaged compared to their male peers.

**Figure 7: Glass ceiling cartoon**
**Source: European Commission (2019)**

Another phenomenon explaining the low gender diversity in the boardroom is the often quoted "tokenism" introduced by Kanter (1977a, 1977b). In the context of board gender diversity, the recruitment of a female director ("token") is a symbolic act rather than a real business decision for a female talent in this sense. Hogg & Vaughan (2008, p. 368) define tokenism as

> "practice of publicly making small concessions to a minority group in order to deflect accusations or prejudice and discrimination"

Therefore, in this view the appointment of a "token" woman is a sufficient concession in order to meet stakeholder expectations. Having said that, no additional female members are necessary, and thus the level of gender diversity remains at a low level.

"Think manager – think male" is an additional phenomenon mentioned in the literature. This phenomenon embodies the assumption of an association of successful leadership with stereotypical attributes of men. In other words, in order to be perceived as a successful leader, the manager must correspond to male stereotypical traits. Accordingly, female stereotypical traits are not associated with successful leadership, which is why they might not be neutrally evaluated (Becker, 2015).

## 3.4 BOARD INDEPENDENCE

Supervisory boards appoint and dismiss the management board. They also monitor and advise them, and they are to blame when things go wrong. Eventually, they are responsible for making sure that firms create value in the eyes of their stakeholders. Thus, the major question for good corporate governance is: what makes supervisory boards effective? In the past, the majority of academics and practitioners believed that independence is the main trait for good corporate governance because an enough independent board is likely to question the management when needed. Several theoretical considerations also support this view. However, it remains a challenge to define what independence means in this respect. The prevailing opinion of academics and policy-makers is that a board can be seen as independent when the majority of the members has no measurable conflict of in-

terest with the management (Adams, 2016). Unfortunately, there is no clear evidence that the conventional measures of board independence really matter (Adams et al., 2010; Hermalin & Weisbach, 2003).

Still, board independence and its effect on CEO and management monitoring is a key concern of corporate governance research (Finkelstein & Hambrick, 1996). It is seen as one of the major components of the efficacy of corporate governance. Therefore, research on board independence and effectiveness gains traction since the early 1970's (Mace, 1971). The number of articles and studies since then is voluminous. In summary, the identified four key levers in this respect are:

1) having outsiders on the board because they are expected to be better monitors and are less dependent on the CEO (Dalton, Daily, Ellstrand, & Johnson, 1998),

2) share ownership of the directors, assuming that this incentivizes the directors to pay close attention (Alchian & Demsetz, 1972),

3) avoiding too big boards to avoid inefficiencies (Zahra & Stanton, 1988), and

4) CEO duality to limit the power of the CEO (Finkelstein & D'aveni, 1994).

Finkelstein & Mooney (2003) define these criteria as the "usual suspects". They argue that, even though the US boards changed drastically to meet these criteria over time, this is not enough.

> "When one looks more closely at each of the classic indicators of board independence, it becomes apparent that their ability to clearly make corporate governance a success is misleading." (Finkelstein & Mooney, 2003, p.102)

They test how the "usual suspects" of board independence impact the firm performance and find that most boards of the S&P 500 are independent in this respect. Moreover, they analyse a set of stressed firms based on the same board independence criteria and find that these firms as well comply with the board independence criteria. However, both analyses come to the same result, that these criteria are not related to the firm performance and thus, the benefits of board independence seem to be rather theoretical. This view is also supported by the meta-analytic results on board composition, leadership structure, and financial performance from Dalton et al. (1998).

Consequently, this led to the debate about the so-called "old-boys' club" phenomenon, which states that boards are ineffective, if they are dominated by members of the "old-boys' club" – irrespective of being independent. Hence, the debate

turned to the question, if women on the board might increase the boards effectiveness, since female directors are not part of the "old-boys' club" by definition (Adams, 2016). According to Adams & Ferreira (2009, p. 28)

> "Female directors appear to have a similar impact as the independent directors described in governance theory do."

## 3.5 FURTHER DIMENSIONS OF DIVERSITY

The focus of the academic world has been on the gender diversity of the board of directors (Byron & Post, 2016; Post & Byron, 2015; Velte, 2017). Gender diversity may be only one of many diversity dimensions, but it is the most important variable based on its dominance in contemporary research and recent regulation initiatives (Terjesen et al., 2009). However, several studies indicate that female directors have different backgrounds and demographic characteristics compared to their male peers. For example, they tend to be younger, less experienced, and more international (Adams & Funk, 2012; Ahern & Dittmar, 2012; Singh, Terjesen, & Vinnicombe, 2008; Velte, 2017). Hence, adding female directors to the supervisory board likely also impacts these dimensions of diversity. Nevertheless, the different attributes that the women bring to the board do not appear to be the driver for the impact on the financial performance.

For example, Bennouri et al. (2018) analyse whether the impact of female directors on the financial performance is affected by the demographic and board relational attributes of the female directors. Firstly, they report that female directorship improves the financial performance measured by accounting based measures (return on assets, return on equity). They then include several variables to control for the attributes of the female directors, such as the nationality and the tenure. Nevertheless, their results remain robust as the relationship between female directorship and the accounting performance remains positive. They explain this result by arguing that female directors bring more to the board than their mere attributes. Moreover, they suggest that the women's individual traits or gender-related preferences are driving the result. Hence, their results support the idea that the gender matters.

In addition, it is likely that some of the reported differences between female and male directors, such as the age and the experience, will fade out over time.

Nevertheless, the effects of board gender diversity would still remain if characteristics that are stable over time are responsible for the impact (Adams, 2016).

While diversity as regards tenure, age, and nationality do not seem to be pivotal for the impact of board gender diversity, their potential effects are also presented below for the sake of completeness.

**Diversity of tenure** – Research on diversity of tenure and age indicates that these dimensions probably also matter. For example, Schnake, Fredenberger, & Williams (2005) argue that boards dominated by directors with longer tenure might negatively impact the board discussions because they are too conservative and not open to new views or opinions, and thus limit the potential of the board. This, in turn, limits the information processing and might adversely impact the management oversight. This view is supported by the findings of Vafeas (2003), who finds support for the management-friendliness hypothesis of directors with an extended board service time because they are more management friendly than directors with shorter tenures. In addition, the ability to track and make use of a changing environment might suffer, if a board is dominated by long-tenured board members (Oxelheim, Gregorič, Randøy, & Thomsen, 2013).

**Age diversity** – Age diversity of the supervisory board is another important attribute of its composition because the leadership and decision-making processes of homogeneous old-aged boards might be biased due to similar experience and attitudes of the directors. Hence, considering directors from heterogeneous age groups might improve the decision-making process and the board discussions by including different perspectives, which might increase the understanding of the needs of the stakeholders of the company (Abdullah & Ismail, 2013).

Traditionally, members of supervisory boards are senior-aged. The role of a director foresees per se a candidate who has and radiates experience, seniority, and wisdom to be able to advise and monitor senior management and to apply a holistic approach towards boardroom decisions. Becoming a director often is the next career step after being an executive and at the same time the last step before retiring. Thus, the average age of directors is closer to the retirement age.

Older directors often bring strong personal networks with them in addition to experience and wisdom. These networks can be important sources to the company in regard to building business relationships and acquiring or securing resources for the company (Thomsen & Conyon, 2012).

However, older board members might rely too much on their experience in complex business decisions and therefore be more hesitant to new ideas, more risk-averse, and less supportive for new strategic approaches. Such a reluctant attitude of homogeneously old-aged boards may have negative consequences for firms in the long run. Empirical evidence supports the expected negative effects on firm performance and future growth (Cochran, Wartick, & Wood, 1984; Rivas, Hamori, & Mayo, 2009; Rose, 2005). Older boards might also be perceived as less vigorous than younger boards (Cochran et al., 1984)

For example, Carter et al. (2003) report that younger boards are more likely to have female board members than older boards. Therefore, younger supervisory boards might be more open to new approaches compared to old directors who appear to be more interested in maintaining the status quo. Moreover, diversity of age appears to improve the problem-solving capabilities in the context of complex tasks (Wegge, Roth, Neubach, Schmidt, & Kanfer, 2008). In addition, age diverse supervisory boards may be more balanced because of diverse perspectives represented. Different generations may perceive different political, economic, and technological trends as important, which, in turn, may influence the boards opinion on new strategic questions (Bantel & Jackson, 1989; Mishra & Jhunjhunwala, 2013; Østergaard, Timmermans, & Kristinsson, 2011). Apart from that, age diversity might decrease the risk of conflicts in the boardroom because age similarity can lead to rivalry among the members due to potential career comparisons of the members of the same age (Pelled, Eisenhardt, & Xin, 1999).

However, there is also empiric evidence that states that there is no relationship between age diversity and innovation capability (Bantel & Jackson, 1989). There are also studies that have identified a significant negative relationship (Østergaard et al., 2011; Zajac, Golden, & Shortell, 1991). Even though the beforementioned studies focus on the effect of age diversity on the innovation capability, their findings are also relevant for the boardroom because innovative thinking is a prerequisite for complex decision-making in the context of boardroom discussions (Østergaard et al., 2011).

Following the argumentation of Bantel & Jackson (1989), the negative effects of age diversity likely materialise in case of very high levels of diversity only. At the same time, they report that the likelihood, that this very high level of diversity occurs, is less the case for the composition of top management teams.

For example, McIntyre, Murphy, & Mitchell, (2007) find that a moderate level of board age diversity is associated with better performance, whereas a low and a high level of age diversity can lead to a lack of communication and conflicts and therefore relate to a worse firm performance.

**National diversity** – Foreign directors likely stem from a different network and environment than the other members of the board and they therefore tend to be more independent of the management compared to their local peers, which in turn can improve their monitoring behaviour (Oxelheim & Randøy, 2003). In addition, heterogeneity in nationality may improve the discussion behaviour and subsequently the decision-making process because the directors represent different cultures, beliefs, values, perceptions, and preferences (Ciavarella, 2017). Sanders & Carpenter (1998) introduce and argue based on the "information economics argument" for appointing international directors. They suggest that the globalisation of a firm's operations increases the complexity of monitoring. Their assumption is that this leads to a higher asymmetry of information between the board and the management.

Moreover, international directors likely bring a network of cross-border contacts, that is different to the already existing one of the board members coming from the home country of the firm, and thus may have access to additional critical resources for the firm. Furthermore, they likely are more familiar with the regulatory framework, market dynamics, cultures, and political circumstances in the foreign markets (Oxelheim et al., 2013). The additional expertise and networks of international directors can result in better decisions and support the process of identifying new business opportunities such as growth in markets abroad (Daily, Dalton, & Cannella, 2003; Johnson, Hoskisson, & Hitt, 1993; Oxelheim et al., 2013; Stearns & Mizruchi, 1993). Furthermore, foreign directors particularly can add value in firms with substantial international operations or plans to increase their global presence. Due to the region-specific expertise of the foreign directors they can positively impact the firm performance through advising the management. This argumentation

is supported by empirical evidence, i.e. in the context of cross-border acquisitions (Adams, Hermalin, & Weisbach, 2010; Masulis, Wang, & Xie, 2012).

However, focusing on the monitoring function of the board, foreign directors tend to be less effective considering their inferior discipline of attending in board meetings (Adams & Ferreira, 2009; Masulis et al., 2012). Because of the importance of the board meetings for the effectiveness of the board, inferior board attendance can lead to less strict monitoring of the management's activities. Less attendance may lead to an informational disadvantage, which in turn reduces the ability of the directors to be effective monitors. For example, Masulis et al. (2012) results suggest that boards with foreign directors are less likely to act to replace underperforming CEO's or managers, and that the less strict monitoring leads to lower firm performance, if the company has no significant operations in the home country of the foreign directors.

Hence, the national diversity potentially impacts the board performance, the corporate governance effectiveness, and eventually the firm performance. Potential benefits of foreign directors are the international expertise and know-how about foreign markets, which can improve the advisory function of the board in the context of globally active or expanding companies (Masulis et al., 2012). In addition, the appointment of a foreign director can have a signalling effect of compliance with the governance system of a foreign capital market. This may be received as a commitment to shareholder rights and hence, may strengthen investor confidence (Oxelheim & Randøy, 2003). The potential downside of foreign directors is the negative impact on the monitoring function of the board because they are more likely to miss board meetings, for example, due to their geographic distance and time constraints (Masulis et al., 2012).

# 4 LITERATURE REVIEW & HYPOTHESES

## 4.1 THEORETICAL AND EMPIRICAL FOUNDATION

### 4.1.1 Theoretical foundation

#### *4.1.1.1 Multi-theoretical approach*

The German corporate governance framework describes the main duties of the supervisory and the management board. As described, the boards functions are versatile and complex. The supervisory board acts in place of the shareholders as well as the employees and supervises, advises, and appoints the management board. The management board is obliged to inform and report to the supervisory board and is responsible for managing the company.

Theoretically, there are several concepts that link board gender diversity directly or indirectly with firm outcomes. Hence, there is no single theoretical framework that completely explains the relationship between board gender diversity and financial performance. However, there are several theories stemming from different disciplines that help to understand this relationship (Carter et al., 2010).

Therefore, this dissertation makes use of a number of theories coming from different disciplines with the belief that each of the included theoretical frameworks brings certain elements that are relevant for understanding the effects of gender diversity in this context. Finally, this results in an interdisciplinary multi-theoretical approach. The different theoretical frameworks are derived from economics, organisation theory, and social psychology.

The strategy of formulating the hypotheses based on a mix of theoretical frameworks is in line with the approaches in the literature. For example, Carter et al. (2010) argue based on the agency theory, the resource-dependence theory, and human capital theory. Amongst others, Rose (2007) additionally focuses on institutional theory and stakeholder theory. Moreover, Miller & Triana (2009) use the signalling theory and behavioural theory of the firm, whereas Velte (2017) argues

based on the theoretical perspective of a mix of the agency theory and the stakeholder theory.

Table 2 lists the theories which are predominantly referred to in the literature. It also summarises the primary argument of each theory to explain the impact of female directors. Moreover, it also shows several studies that make use of these theoretical frameworks to develop their hypotheses.

In the following chapters, the theories listed in table 2 are introduced and described in more detail. They help to embed and understand the concept of gender diversity in this context and comprise the investigation levels individual, board, and firm. After the description of the theories, the empirical literature is discussed. The combination of the findings of the theories that are introduced in the following chapters and the findings of the empirical literature in chapter 4.1.2 build the basis for the hypothesis development of this dissertation later in chapter 4.2.

| Theory | Primary Argument | Example Studies |
|---|---|---|
| Gender-based differences (Eagly & Johnson 1990; Eagly & Johannesen-Schmidt 2001; Eagly et al. 2003) | Female directors have different preferences and leadership styles | Bennouri et al. (2018); Dezso, & Ross (2012); Gul, Srinidhi, & Ng (2011); Rose (2007) |
| Upper Echelon Theory (Hambrick & Mason, 1984) | Female directors impact firm's strategic choices | Bennouri et al. (2018); Kirsch (2018); Dezso & Ross (2012); Hafsi & Turgut (2013) |
| Similarity-Attraction Theory (Byrne, 1961) | Female directors prefer other women and help them to achieve management positions | Gould et al. (2018); Skaggs, Stainback, & Duncan (2012) |
| Agency Theory (Jensen & Meckling, 1976, Fama & Jensen, 1983) | Female directors are more independent and avoid agency losses | Handschumacher & Ceschinski (2020); Reddy, Jadhav, & Pai (2019); Adams, Ferreira (2009); Campbell & Minguez-Vera (2008) |
| Stakeholder Theory (Freeman, 1984) | Female directors better understand the needs of the diverse stakeholders; female directors are a sign of considering stakeholder expectations | Reguera-Alvarado, de Fuentes, & Laffarga (2017); Velte (2017); Liao, Luo, Tang (2015); Francoeur, Labelle, Sinclair-Desgagne (2008) |
| Resource Dependency Theory (Pfeffer, 1972) | Female directors reduce the firm's dependency on external resources | Handschumacher & Ceschinski (2020); Reddy, Jadhav, & Pai P (2019); Bear, Rahman, Post (2010); Carter, et al. (2010) |
| Signalling Theory (Spence, 1973) | Female directors signal social responsibility and ethical behaviour | Kirsch (2018); Terjesen & Sealy (2016); Bear, Rahman, & Post (2010); Miller, & Triana (2009) |
| Legitimacy theory (Suchman, 1995) | Women enhance the legitimacy of the firm in the eyes of stakeholders | E-vahdati, Zulkifli, & Zakaria, (2018); Liao, Luo, Tang (2015); Bilimoria (2006) |

| Theory | Primary Argument | Example Studies |
|---|---|---|
| Human Capital Theory (Becker, 1964) | Female directors provide additional/unique human capital for the benefit of the firm | Bennouri et al. (2018); Kirsch (2018); Carter, et. al (2010); Terjesen, Sealy, & Singh (2009) |
| Resource-based view of competitive advantage (Barney, 1991) | Women are internal resources that can be as used as a competitive advantage for the firm | Dienes & Velte (2016); de-Luis, Sánchez, Pérez, & Jiménez (2008); Shrader et al. (1997) |
| Critical Mass Theory (Kanter, 1977) | Once a critical mass of female directors exists, female directors can better contribute their unique competencies and perspectives | Brahma et al. (2020); Post, Rahman, & Rubow (2011); Joecks, Pull, & Vetter (2013) |

**Table 2: Selected theories**

#### *4.1.1.2 Gender-based differences, upper echelons theory, and similarity attraction*

The general assumption of theories regarding gender-based differences is that women and men think and behave differently. Research on differences between women and men suggests that women act differently and can be more effective in certain tasks than men (Eagly, Karau, & Makhijani, 1995). Further research suggests that female managers have a different leadership style than their male peers (Eagly & Karau, 2002).

Female leaders are assumed to have more emphasis on topics, such as interdependence, benevolence, and tolerance than their male peers (Adams & Funk, 2012). In addition, women tend to be more supportive with regards to the stakeholders of the company, such as communities (Hillman, Canella, & Harris, 2002), the environment (Post, Rahman, & Rubow, 2011), or the employees (Bernardi, Bosco, & Vassoll, 2006; Mallin & Michelon, 2011; Wieland & Flavel, 2015), and therefore are more sensitive to stakeholder related issues (Bear, Rahman, & Post, 2010). Further meta-analytic evidence suggests that women are more likely to apply stricter ethical standards (Pan & Sparks, 2012) and to classify questionable business practices unethical (Franke, Crown, & Spake, 1997). Moreover, decisions of women tend to be more long-term oriented (Silverman, 2003).

The gender-based differences of leadership styles are based on the different gender-typical attributes referring to agentic and communal traits (Eagly, Johannesen-Schmidt, & van Engen, 2003). Agentic traits are more attributed to male leaders. These traits include assertiveness, ambitiousness, aggressiveness, dominance, forcefulness, self-confidence, and competitiveness. In the daily business, this might lead to an assertive communication style, to a competition of attention, or to exerting influence on others. On the other hand, female leaders tend to have more communal traits. These traits are considered to be caring for others, being helpful, kind, sympathetic, interpersonally sensitive, and gentle. The working style according to these characteristics includes communicating tentatively, not drawing attention to oneself, accepting the standpoints of others, as well as supporting and encouraging others (Eagly & Johannesen-Schmidt, 2001).

The concept of agentic and communal leadership characteristics is based on the work of Bales (1950), who introduced the task-oriented and the interpersonally-oriented leadership styles. Bales (1950) and subsequently Hemphill & Coons (1957)

describe the task-oriented leadership style as behaviours, such as providing specific role descriptions to their employees, making explicit policies and procedures for performance evaluation, encouraging and motivating their employees, to be compliant with rules and regulations as prescribed by the firm. In contrast to that, interpersonally oriented leaders are kind and helpful to their employees, they explain policies and procedures, they do favours and look after the well-being of their employees while being friendly and approachable.

Moreover, according to Eagly's & Johnson's (1990) meta-analysis, women tend to be more democratic and participative while being less autocrative and directive compared to their male peers. Female leaders are also perceived to be less hierarchical, more cooperative and collaborative, as well as more enhancing the other's self-worth (Eagly et al., 2003).

Theories focusing on gender-based differences in leadership can be applied to the individual as well as to the team level. Boards with higher female representation are therefore likely to represent attributes typically associated with female leaders (Nielsen & Huse, 2010). This argumentation is in line with the upper echelons theory, which predicts that strategic decisions, organisational outcomes, and firm performance can be partially predicted by the manager's background characteristics (Hambrick & Mason, 1984). The first of the two central interdependent hypotheses of this theory is that managers act on the basis of their individual interpretation of the situation. The second hypothesis is that these personalised interpretations are a function of the managers' experiences, values, and personalities. These individual cognitive frames, in turn, influence how managers look for and digest information, form strategic choices and eventually impact the firm outcomes (Hambrick, 2007).

Apart from that, the similarity-attraction-theory suggests that female leaders have the aspiration and the competence to support other women's careers because it predicts that humans favour to collaborate with those who are socially and professionally similar to them (Berscheid & Walster, 1978; Byrne, 1961, 1971). In other words, the similarity-attraction-theory assumes that individuals like people, who share their values, agree with their views, and who validate their philosophies (Byrne, 1971). Certain characteristics, like the gender of a person, are often used as proxies for deriving similarity, irrespective of the fact that the person may actually

have completely different views and opinions. As long as the person is perceived to be similar, attraction still occurs (Montoya, Horton, & Kirchner, 2008).

However, some research also indicates that stereotypical traits are minimised in the context of management positions. The argumentation is that women, who untypically seek for a career in management, reject the feminine stereotypes and assimilate more male-typical traits (Powell, 1990). This argumentation is consistent with the structural interpretation of organisational behaviour (e.g. Kanter, 1977). Following this body of thought, men and women, who hold the same management position, potentially behave similarly.

Still, the majority argues based on the assumption that male and female managers in the same position act differently because the gender-typical characteristics influence their behaviours (Eagly & Johannesen-Schmidt, 2001). Accordingly, there might be no universally valid differences in effectiveness between male and female managers, but given a certain context, some gender-related differences are likely to occur (Yukl, 2002). For example, Adams & Ferreira's (2009) results provide evidence that women in the boardroom behave differently compared to their male peers and that this behaviour impacts corporate governance and board effectiveness.

To conclude, the studies referring to these theories argue that female directors are different compared to their male peers and therefore take different positions and decisions. For example, Bennouri et al. (2018) argue based on the assumption that female directors have different demographic characteristics, experience, expert knowledge, and preferences. They combine this view with the implications of the upper echelons theory and argue that the female directors' attributes drive their decision-making and eventually the firm performance. In addition, Gould et al. (2018) use the similarity-attraction theory and argue that female directors prefer to work with other women because some of the same gender is perceived to be similar and thereby explain the trickle-down effect of board gender diversity.

#### *4.1.1.3 Agency theory*

In the finance, economics, and accounting literature the agency theory is the dominantly applied theory to make and test predictions when it comes to board composition and firm performance (Gupta, Lam, Sami, & Zhou, 2014).

Overall, the agency theory is engaged with the relationships between and the behaviour of individuals within the firm (Williamson, 1998). If ownership and control are separated, the agency theory helps to understand organisational or individual behaviour. The theory is based on the so-called agency relationship. Jensen & Meckling (1976) define that relationship

> "as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision-making authority to the agent." (p. 308)

In other words, the agent acts on behalf of and takes decisions for the principal. Such situations, however, have inherent problems. Firstly, if the motivation or objective of the principal and the agent are not congruent, conflicts may arise (agency problem). If both parties act as rational utility maximisers, it is likely that the agent does not act in the best interests of the principal. According to Jensen (1994), people eventually are self-interested and the conflict therefore arises any time the principal and the agent try to cooperate. Secondly, it is a costly endeavour, if at all possible, for the principal to monitor and review the decisions and activities of the agent. Thirdly, the problem that the principal and the agent may have a different risk tolerance brings additional potential of conflict (Eisenhardt, 1989). Hence, it is typical for principal-agent-relationships that the principals and agents have different information and different interests. In addition, they do not have a unified understanding of the risk appetite (Beckmann, 2006; Grothe, 2006; Jensen & Meckling, 1976).

The principal may implement measures to limit the conflicts, such as incentivising the agent for maximising the principal`s welfare ("bonding costs") or monitoring the agent to avoid any opportunistic behaviour ("monitoring costs"). These or other measures help to minimise the opportunity costs but will not lead to a situation where the agent takes optimal decisions from the point of view of the principal ("residual loss"). The sum of these costs is defined as "agency costs". Because the relationship of the shareholders and the firm's management falls under the definition of an agency relationship it is likely that agency problems and costs arise (Jensen & Meckling, 1976).

Jensen (1983) and Eisenhardt (1989) mention two complementary streams of research, namely the principal-agent theory and the positivist agency theory. The latter concentrates on the relationship of shareholders and managers of (listed)

companies and discusses remedial measures like governance mechanisms to minimise the moral hazard of managers acting opportunistically. Examples for that are reducing the information asymmetry between the principal and the agent to enable the principal to better control and monitor the agent's behaviour, or to increase the ownership of the managers to decrease their moral hazard (Jensen & Meckling, 1976; Fama & Jensen, 1983). The principal-agent stream takes a more generic position and examines the principal-agent relationship in additional contexts like employer-employee or lawyer-client relationships (Harris & Raviv, 1978) with the ambition to identify the optimal contract, while considering different levels of outcome uncertainty, attitude to risk, information level, and other parameters (Eisenhardt, 1989).

| | |
|---|---|
| **Key idea** | Principal-agent relationships should reflect efficient organisation of information and risk-bearing costs |
| **Unit of analysis** | Contract between principal and agent |
| **Human assumptions** | Self-interest, bounded rationality, risk aversion |
| **Organisational assumptions** | Partial goal conflict among participants, efficiency as the effectiveness criterion, information asymmetry between principal and agent |
| **Information assumption** | Information as purchasable commodity |
| **Contracting problems** | Agency (moral hazard and adverse selection), risk sharing |
| **Problem domain** | Relationships in which the principal and agent have partly differing goals and risk preferences (e.g. compensation, regulation, leadership, impression management, whistleblowing, vertical integration, transfer pricing) |

**Table 3: Agency theory overview**
**Source: Eisenhardt (1989)**

The theoretical framework of the agency theory is relevant for this study particularly because of the separation of ownership and management of the corporations within the scope of the analyses. Management boards (agents) make decisions that impact the shareholders (principals, represented by the supervisory board) and there is a moral hazard triggered by the asymmetry of information between the management board and the supervisory board. The moral hazard materialises in cases where the management board is motivated to act in the managers' own

interests and not in the interests of the shareholders (Berle & Means, 1933; Jensen & Meckling, 1978). In other words, the problem that managers tend to strive for their personal wealth instead of maximising the shareholders' value arises (Baysinger, Kosnik, & Turk, 1991).

The literature highlights several phenomena that predict a conflict of interest and an agency loss, especially with regards to the long-term success of the company. In the following, the hypotheses of the "empire building", the "short-termism", the "quiet life", the "hubris", the "herding", and the "consumption on the job" phenomena are introduced.

- Following the "empire building" hypothesis, the management does not invest with the interest of increasing the value for the shareholder. In fact, the motivation is to increase the managements power and earnings.
- Another potential conflict is the result of "short-termism". A focus of the management on short-term successes, i.e. triggered by short-term oriented incentives, potentially leads to an increased risk acceptance that is negatively impacting the long-term success and therefore jeopardizes the sustainable value creation of the company (Mustaghni, 2012).
- Following the "quiet life" motive, managers strive for a quiet life and therefore want to avoid critical decisions even though they may be of crucial importance for the company's success (Marianne Bertrand & Mullainathan, 2003).
- According to Roll's (1986) "hubris" phenomenon, there is a hazard of overconfidence in the future development of investments that leads to the willingness to pay inappropriate high prices for the investment target. This phenomenon can result in bidding wars in company takeover negotiations and eventually leads to a "winners curse" because of the entered liabilities to finance the acquisition (Eulerich, 2009).
- Moreover, the "herding" phenomenon predicts that managers tend to copy the strategies of peers because it is less risky than taking a different decision. This effect can especially be observed with younger managers, who have career progression ambitions.
- In addition, the "consumption on the job" phenomenon predicts that there is the danger that managers use the firm's resources for their own benefit (Mustaghni, 2012).

Several authors use the agency theory to argue for a positive impact of increasing gender diversity in the boardroom. For example, Handschumacher & Ceschinski (2020) argue that women are more independent because they are not part of networks like the "old boys club". Moreover, they argue that women are more likely to scrutinise the management. Hence, female directors increase the monitoring quality of the board and therefore help to avoid agency losses.

#### *4.1.1.4 Stakeholder theory*

The stakeholder theory extends the view of the shareholder theory, which states that a firm is mainly responsible for creating shareholder value (Edward Freeman, Phillips, & Sisodia, 2020; Schaltegger, Hörisch, & Freeman, 2019). Following Donaldson & Preston (1995), the stakeholder theory is a morally acceptable alternative, which considers a wider business responsibility compared to the narrowed view of the shareholder theory.

According to Freeman's (1984) stakeholder theory, a firm should take into account the interests of its stakeholders in the process of the strategy development. Stakeholders in this sense are individuals and groups who have influence on or are influenced by the firm's purpose. Post, Preston, & Sachs (2002) define stakeholders as the following.

> "The stakeholders in a firm are individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities, and who are therefore its potential beneficiaries and/or risk bearers." (p. 8)

Consequently, the firm must pay attention to the interests of the stakeholders because individuals or organisations may be impacted by its activities. Thus, the firm has a responsibility not to harm its stakeholders. This moral obligation is described as the normative approach of this theory. It highlights the necessity of managing principles and norms that relate to ethical and moral behaviours (Donaldson & Preston, 1995). Another reason for considering the stakeholder's interests is that the firm's value creation ability depends on the favour of others and the firm's environment. Hence, the firm may benefit, if it meets the stakeholder's claims and expectations (Schaltegger et al., 2019). Donaldson & Preston (1995) and Jones (1995) describe this aspect as the instrumental approach of the stakeholder theory.

Apart from that, the stakeholder theory carries additional managerial implications. For example, it highlights the importance of considering that the firm has

to conduct ethical, responsible, and sustainable business practises (E. R. Freeman, Harrison, Wicks, Parmar, & Colle, 2010).

Consequently, the question of what is of value for each stakeholder should be the starting point of the managerial activities. By following this approach, the concept of the stakeholder theory can be understood as a guideline for value creation and effective management (Freeman et al., 2010).

Accordingly, Berman, Wicks, Kotha, & Jones (1999) suggest to use the stakeholder theory as basis for a "strategic stakeholder management model" to improve the firm's financial performance and/or the "intrinsic stakeholder commitment model" to enhance the contribution to its stakeholders interests. A third model, that additionally covers the legal obligation to consider the stakeholder interests in the decision-making process, complements the financial and moral perspectives (Fifka, 2013). Hence, the firm's leaders act as the agents of the firm's stakeholders. These stakeholders, in turn, have different stakes in the firm and a differing influence on the firm's management.

Figure 8 illustrates the different stakeholders of a company. According to Donaldson & Preston (1995), the stakeholders can be governments, investors, political groups, suppliers, customers, trade associations, employees, and communities.

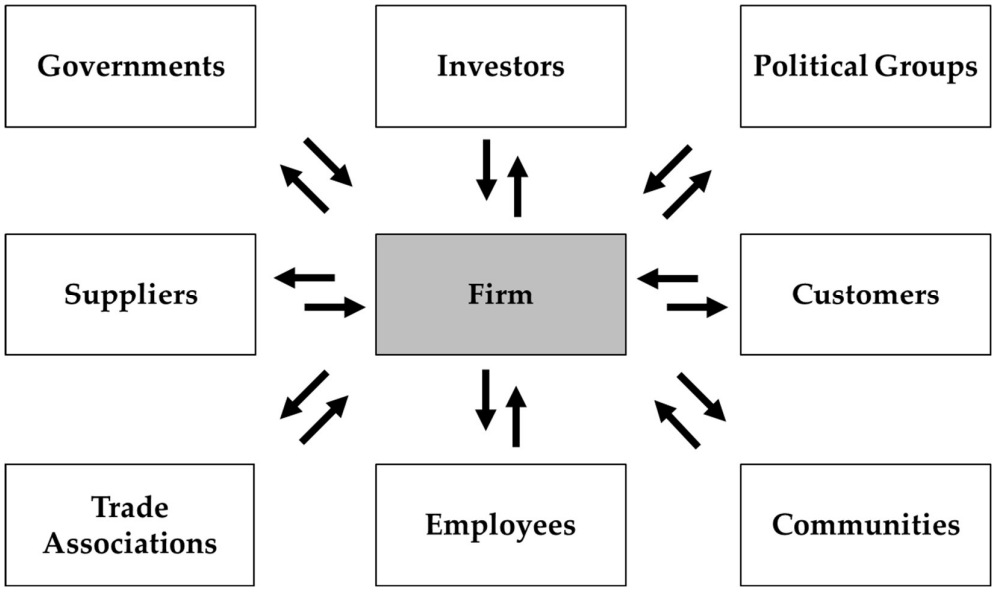



**Figure 8: Stakeholder model**

**Source: Donaldson & Preston (1995)**

A lot of journal articles focusing on the concept of gender diversity in the context of organisations also refer to the stakeholder theory as theoretical framework (Cabrera-Fernández et al., 2016). For example, Reguera-Alvarado et al. (2017) use the stakeholder theory to link board gender diversity and firm performance. They argue that board gender diversity has a positive impact on the financial performance because female directors better understand the needs of the diverse stakeholders and also act as a signal that the firm is stakeholder oriented.

#### *4.1.1.5 Resource dependence theory*

Another stream of research studying the effects of the board composition applies the resource dependence theory as theoretical basis. This theory assumes that firms are dependent on other organisations and their environment, and that the firms' boards help to secure critical resources (Pfeffer & Salancik, 1978).

The resource dependencies are driven by the domain (industry) that the company is active on. Accordingly, the company's individual task environment includes organisations with which the company interacts directly to get access to the necessary resources. Moreover, these organisations have suppliers, buyers, and

other partners that interact with the company and that have influence on its success. The more complex the company becomes, the more increases the complexity of its task environment, and the higher the number of interdependencies to other organisations becomes (Thompson, 1967).

Thus, the company is dependent on resources of the environment that it operates in. Therefore, the power of an organisation increases based on its capability to provide another organisation with critical resources (Pfeffer & Salancik, 1978). This increased power in one certain context may be reversed in a different context and hence the organisations may be mutually dependent. In case of an increased mutual dependence, the risk that negative experiences of one organisation impacts the other organisation increases in parallel (Piskorski, 2005).

In that sense, bad performance is an indication for a firm's lack to access critical resources from its business partners (Pfeffer & Salancik, 1978). Following this body of thought, firm interdependence with external partners increases dependency and therefore uncertainty (Eisenhardt, 1989). In addition, uncertainty negatively impacts the firm's control of resources (Rivas, 2012) and at the same time reduces shareholder value (Combs, Ketchen, Perryman, & Donahue, 2007). To mitigate this development, the board of directors as well as the executives link the company with its external partners, such as customers, suppliers, financiers and regulators, thereby reducing uncertainty (Rivas, 2012), and enhancing the firm's long-term viability (Hillman & Dalziel, 2003).

Hence, firms create links with the external environment to receive resources. In this respect, the management of the firm may act as the connecting intermediary (Hillman, Withers, & Collins, 2009). The described three main linkages to the external environment are advice and counsel, legitimacy, and networks or channels for communicating information. These linkages, in turn, are categorized in the dimensions human capital and relational capital (Hillman & Dalziel, 2003). The sum of human capital (i.e. experience, know-how, and/or reputation) and relational capital (i.e. connections to other companies or stakeholders) results in the so-called board capital.

The focus of the studies using the resource dependence theory as theoretical basis is on analysing how board capital results in the provision of resources for the firm (Hillman & Dalziel, 2003). Accordingly, members of the board are selected

based on their human and relational capital, and consequently based on their potential to help the firm to get access to critical resources. Therefore, diversity of the board members expands the pool of expertise and external linkages of the firm (Geiger & Marlin, 2012).

Summarising, the resource dependence theory proposes that a company depends on resources originating from the external environment. The board of directors as well as the executives help to link the firm with the outside world and eventually to secure critical resources to enable long-term prosperity for the firm's shareholders. Directors and executives under this view, create an interface to the firm's external environment, manage the firm's public affairs and relationships with its stakeholders to get the support of the external environment (Carter et al., 2010). Accordingly, this approach defines directors and executives as

> "insiders, business experts, support specialists, and community influentials" (Carter et al., 2010, p. 378).

Several authors, such as Handschumacher & Ceschinski (2020), use the resource dependency theory to argue that female directors reduce the firm's dependency on external resources because they have complementary networks of customer, suppliers, and investors, and thereby improve the firm's ability to get access to critical resources.

#### *4.1.1.6 Signalling theory and legitimacy theory*

Signalling theory is concerned with reducing information asymmetries between two or more parties (Spence, 2002). The parties and items within the scope of the signalling theory are the "signaller", the "receiver", and the "signal". The signallers can be organisations (e.g. Ross 1977) that have an informational advantage compared to the outside world (information asymmetry). The signaller decides whether or not to communicate the positive or negative information to his stakeholders. Still, the primary focus of the signalling theory is the communication of positive signals with the ambition to communicate positive organisational characteristics. The two criteria for effective signals are (1) signal observability and (2) signal cost. The first point refers to the question, if the stakeholders are able to observe the signal appropriately, whereby the ladder refers to the costs attached to achieve the underlying quality to get to the position to be able to send the signal (Connelly, Certo, Ireland, & Reutzel, 2011).

The second party of the signalling theory, the receiver, receives the signal send by the signaller. Receivers are outsiders and stakeholders that have an information deficit regarding the organisation of interest, but want to close this information gap (Connelly et al., 2011). According to the empirical literature, receivers are considered as existing shareholders and/or potential investors (Kang, 2008; Park & Mezias, 2005), or further stakeholders such as consumers, competitors, and employees (Basdeo, Smith, Grimm, Rindova, & Derfus, 2006; Carter, 2006).

The third major component of this theory is the signal. In most of the cases, the signaller's objective is to signal some sort of quality. Quality can be interpreted as an unobservable capability that the signaller possesses and that is helpful for the receiver (Connelly et al., 2011). Also, the terms reputation (Kreps & Wilson, 1982) and prestige (Certo, 2003) are applied as equivalents or as manifestations of quality (Connelly et al., 2011).

Signaller and receiver have partially competing interests. For example, a successful signalling of a signal without the underlying quality would benefit the signaller at the cost of the receiver (Bird & Smith, 2005). Hence, there is a moral hazard for inferior signallers to intentionally convey misleading signals to achieve an advantage (Johnstone & Grafen, 1993). Therefore, the term "credibility" is introduced in this respect to describe the appropriateness of the signaller sending a signal to the receiver (Davila, Foster, & Gupta, 2003).

There are several studies that apply the signalling theory to organisational contexts. Some studies also analyse the mechanisms of receivers closing the loop by sending feedback to the signallers, or by sending a countersignal (e.g. Gupta, Govindarajan, & Malhotra, 1999). Assuming that the information asymmetry exists on both sides (receiver looks for information of the signaller and signaller seeks for information of the receivers), sending signals and countersignals may improve the signalling process and finally decrease the information asymmetry of both parties (Gulati & Higgins, 2003).

Moreover, some management researchers argue that signalling effectiveness partly depends on the characteristics of the receiver. Hence, the signalling process may not be successful, if the receiver is not motivated to look for the signal or if the receiver is not aware of what to look for. Consequently, the receiver's attention likely impacts the signalling process (Connelly et al., 2011). In addition, the receivers' interpretation of the signal may differ (Perkins & Hendry, 2005; Srivastava,

2001). Thus, the information processing of the signal and its translation into understanding is an additional factor that likely impacts the signalling effectiveness (Connelly et al., 2011).

According to Branzei, Ursacki-Bryant, Vertinsky, & Zhang (2004) receivers may "calibrate" signals, attach varying importance or even different meanings to it. Based on their prior knowledge and opinion about the signal, receivers may draw conclusions about the importance of the signal or even may cognitively distort them (Branzei et al., 2004; Ehrhart & Ziegert, 2005).

In addition, the signalling environment is of importance for the signalling success of reducing information asymmetry (Lester, Certo, Dalton, Dalton, & Cannella, 2006; Rynes, Bretz, & Gerhart, 2006). Potential distortions are the media coverage following a press release (Carter, 2006), or the influence of receivers among each other (Branzei et al., 2004). Particularly, receivers, who are unsure about the interpretation of the signal, may follow the interpretation of others and act accordingly (Sliwka, 2007). This may lead to an imitation effect and hence few receivers can influence the interpretation of the signal of many receivers, regardless of the fact that the interpretation is biased (Mcnamara, Haleblian, & Dykes, 2008).

Figure 9 illustrates the respective signalling timeline, which starts with a signaller having an underlying quality. The next steps are the signal is sent to the receiver, who, in turn, observes and interprets the signal afterwards. Finally, the receiver might send a feedback to the signaller.

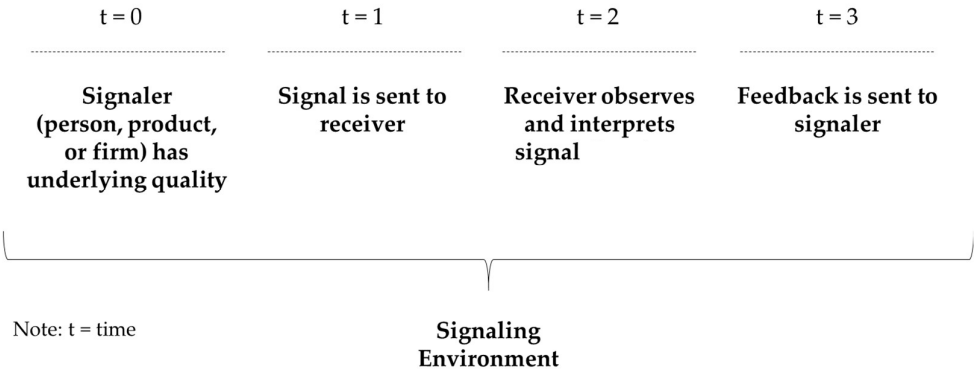



**Figure 9: Signalling timeline**

**Source: Adapted from Connelly et al. (2011)**

Furthermore, the literature often refers to a combination of the reasoning of the signalling theory and the views of the legitimacy theory as theoretical basis.

According to the legitimacy theory, firms seek legitimacy to survive (Certo, 2003). One strategy for gaining legitimacy is to signal unobservable quality via reputable directors, supervisory board members (Certo, Daily, & Dalton, 2001), or top managers (Lester et al., 2006). In that sense, the appointment of a female supervisory board member might serve as a signal for the commitment to gender diversity and thereby has a positive effect on the legitimacy of the firm (E-vahdati et al., 2018; Meyer & Rowan, 1977). The beneficial effects of this signal will particularly appear among stakeholders that value gender diversity, such as female employees, the general public, and investors (Bilimoria, 2006). Focusing on signalling towards female talents, supervisory board gender diversity acts as a positive signal (Good & Good, 1974; Kirsch, 2018; Kurtulus & Tomaskovic-Devey, 2012) and increases the likelihood that women prefer those companies (Gould, Kulik, & Sardeshmukh, 2018).

#### *4.1.1.7 Human capital theory and resource-based view of competitive advantage*

The main assumption of the human capital theory is that people's learning capacities are similarly important like other resources in the production of goods and services (Lucas, 1988, 1990). Consequently, if this resource is effectively used the results will be beneficial for the individual, the organisation, and finally the society (Schultz, 1961).

Several economic scholars developed a definition for human capital. Schultz (1961) for example, describes human capital as the knowledge and skills that people acquire through education and training. He interprets it as a form of capital that brings returns following an investment. Many of the scholars follow this view and describe the human capital as an investment in education and training. Apart from that, Fitzenz (2000) describes human capital as traits that an individual brings to the job.

Eventually, the human capital theory tries to ratify an increase of education and training as an investment in human resources (Aliaga, 2001). Moreover, it suggests that people are a form of capital that can be developed (Aliaga, 2001; Becker, 1993; Benhabib & Spiegel, 1994; Engelbrecht, 2003; Hendricks, 2002). Education and people development are interpreted as dedicated investments in the improvement of the labour force, which subsequently may lead to an increase of productivity of each individual and hence of the organisation. This may result in growth, higher

profitability, and an improved firm performance (Nafukho, Hairston, & Brooks, 2004).

Accordingly, another main assumption of human capital theory is that the performance at a particular task positively correlates with the amount of human capital (Becker, 1975). However, this relationship may not be consistent at the organisational level and in the context of organisations with distinct human capital. At this level, it is the combined tacit knowledge of the organisation that impacts the firm's performance (Spender, 1996). Therefore, it is necessary to consider to what extent individual tacit knowledge sums up into a collective one. This process of collectivisation of knowledge is driven by the ongoing interaction among the individuals of the organisation (Nonaka, 1994) while fulfilling a particular task (Spender, 1996).

Individuals bring knowledge and experience from multiple domains to the firm. The extent to which the individual's expertise in a particular domain contributes to the collective of the firm's tacit knowledge may not be uniformly in different contexts. Hence, the positive effect may be dependent on the already existing knowledge and experience of the collective in this domain. Eventually, it is the shared knowledge and experience of the collective that is combined to the firm-level tacit knowledge and that enables the firm to stand out from its competition (Dimov & Shepherd, 2005).

Human capital can be distinguished between general and specific human capital. The ladder refers to knowledge and experience with regards to a particular task or context. On the other hand, general human capital refers to the overall knowledge and experience of the individual that is not attached to a specific area or activity (Becker, 1975; Gimeno, Folta, Cooper, & Woo, 1997).

Combining the human capital theory with the resource-based view of the firm helps to understand the relationship of human capital and performance in this context. The resource-based view of the firm explains superior performance as a consequence of the possession of resources that are valuable, rare, inimitable, and non-substitutional (Barney, 1991).

Resources like knowledge and experience meet these conditions and are heterogeneously distributed across firms. Therefore, they are critical for understand-

ing differences in performance. Even though not all knowledge results in an advantage for the firm, the tacit component of it, embedded in the respective context, may lead to a long lasting advantage (Spender, 1996). Thereby, personal knowledge is typically tacit in nature. It reflects an individual's unique social environment and experience (Polanyi, 1967).

Tacit knowledge likely belongs to an individual or a firm exclusively and leads to actions and decisions that are hardly imitable. On the other hand, explicit knowledge is easier to replicate because it is typically visible and not unique to an individual or organisation. Human capital stands for the knowledge, traits, and skills that individuals bring to an organisation. It contributes to the firm through education and personal experience and thus to explicit as well as tacit knowledge (Dimov & Shepherd, 2005).

Hence, these theories help to explain the positive impact of female directors. They predict that firms with gender diverse boards are more successful because female directors add unique human capital to the boards that can be leveraged for the benefit of the firm (Bennouri et al., 2018; Dienes & Velte, 2016).

#### *4.1.1.8 Critical mass theory*

The critical mass theory is a popular and often used theory in the context of justifying measures to promote the female representation for public and political offices (Grey, 2006). Despite the fact that is it applied by several scholars in the field of legislative and political research, it has its roots in social psychology research.

Since decades, social psychology research analyses the influence of minorities and majorities on group decision-making. The prevailing opinion in the literature is that the majority exerts more influence in a group than the minority. Reason being is the advantage of their greater number (Asch, 1951, 1955; Tanford & Penrod, 1984). That is why minorities are easily marginalised, if they are under-represented and seen as a symbol or token (Kanter, 1977a, 1977b).

Kanter (1977a, 1977b) studies the critical mass theory in the business context of women and men working together. More specifically, Kanter (1977a, 1977b) analyses how the number of women in a male-dominated group influences the group processes. Kanter (1977a, 1977b) labels the members of the majority as "dominants" and the members of the minority as "tokens". Kanter (1977a, 1977b) argues

that the tokens may be perceived as barriers to exerting influence on group decisions, if they behave according to their stereotype. In addition, tokens may not be appreciated, but perceived in a negative way (Maass & Clark, 1984; Nemeth & Wachtler, 1983). They tend to be not taken seriously or trusted and the labelling as token often results in uneasiness, isolation, and self-doubt of the tokens (Kanter, 1977 (a); Kanter, 1977 (b)). This situation likely impacts their performance (Powell, 1993).

Furthermore, because of the visibility of the tokens within the group they face additional performance pressures and expectations. They often are in the spotlight because of being different and not because of their particular efforts or contributions. This likely applies, if the token is a minority or a woman in a larger group (Torchia, Calabrò, & Huse, 2011).

However, the above described situation, perception, and relationship likely changes, if the size of the minority increases and exceeds the status of a token minority (Bear et al., 2010; Etzkowitz, Kemelgor, Neuschatz, Uzzi, & Alonzo, 1994). According to Kanter (1977 a, b), an increase of the size of the minority group likely leads to an increase of trust and appreciation towards the minority. Eventually, the likelihood increases that the majority accepts the contributions of the minority members and makes use of their distinct resources. Hence, the number of the members of the minority, its strength, and its directness affect the assertiveness and influence of a minority (Latané, 1981).

The critical mass theory (Granovetter, 1978; Kanter, 1977a, 1977b, 1987) predicts that the interaction of subgroups within a group is affected by their size and that a qualitative change in the nature of the group's interaction takes place, if the minority achieves a critical mass. More specifically, it predicts that the level of influence of the minority increases, if this subgroup reaches a certain threshold. However, it does not specify the number that a critical mass must represent.

In this context, for example Torchia et al. (2011) refer to Asch's (1951, 1955) experiments to derive a threshold of a critical mass. According to Asch's (1951, 1955) results, individuals, who are confronted with the unanimous opinion of three people, tend to follow their opinion. More specifically, the results show that group pressure increases significantly when a group of people reaches three members. The additional increase in pressure becomes weaker once the threshold of three is achieved. Other studies also support the view that the threshold for a critical mass

in a group setting is at three members (Bond, 2005; Nemeth, 1986; Tanford & Penrod, 1984). Table 4 discusses the potential consequences of the critical mass theory in this context in more detail.

| | One woman | Two women | Three or more women |
|---|---|---|---|
| **Summary** | Possible impact, but real risk of tokenism | Situation often improves, but tokenism can still exist | Critical mass |
| **Potential consequences** | Hypervisibility: being in the spotlight | Increased feelings of inclusion and comfort | Normalisation – gender is no longer a barrier to acceptance and communication |
| | Invisibility: being ignored, dismissed, not taken seriously, or otherwise excluded | Validation, reinforcement, and having a strategy partner | Women more comfortable being themselves and associating with one another |
| | Being stereotyped and also viewed as representing all women, not seen as individuals | Decrease in stereotyping | More supportive atmosphere |
| | Needing to work very hard to be heard, included, and have an impact | Larger impact on the board | Women not seen as representing all women |
| | | Woman may still be stereotyped | Women freer to raise issues, be more active |
| | | Woman still having to work to be heard | Women more likely to be heard |
| | | Women keeping their distance from each other – concerned being seen as conspirators | Noticeable impact on content and dynamics in the boardroom; increased collaboration and inclusiveness |

**Table 4: Critical mass theory**

**Source: Konrad et al. (2008)**

### 4.1.2 Empirical foundation

#### *4.1.2.1 Identification of relevant literature*

Because of the globally increasing attention for this topic there is a relatively large literature basis examining the impact of women on boards already. To ensure that the existing findings on the effects of board gender diversity are incorporated in this dissertation, a review of recent literature is conducted. The identification strategy includes two iterations. Firstly, the literature is identified based on a review of several meta-analyses and literature reviews. Secondly, a database and a manual research complement the literature sample. In the following, the two steps for identifying the literature is described in more detail

This dissertation analyses the literature used in the meta-analyses of Post & Byron (2015), Byron & Post (2016), and Hoobler, Masterson, Nkomo, & Michel (2018), as well as the literature reviews of Cabrera-Fernández, Martínez-Jiménez, & Hernández-Ortiz (2016), Velte (2017), and Kirsch (2018). The key aspects and findings of these studies are summarised in table 5.

Post & Byron (2015) review a total of 140 studies, consisting of 92 journal articles, 8 theses or dissertations (doctoral, master's, or bachelor's), 35 conference or working papers, 4 technical reports, and 1 book chapter completed until May 2014. Their focus is on studies analysing the relationship between female board representation and firm financial performance. In addition, they extend the scope to studies analysing the relationship between female board representation and the fulfilment of the board's duties (in this case "monitoring" and "strategy involvement"). Their search strategy includes several steps, starting with the search in two databases, ABI Inform Global and JSTOR. The applied search criteria are "gender", "female", "women", "diversity", "heterogeneity", or "composition" combined with the terms "board", "directors", or "governance". Then they review the references of 20 review articles that cover the theme "board governance". After that, they contact 12 experts and request published as well as unpublished studies on this topic. Finally, they screen the references of the selected studies to identify additional literature. Apart from that, they conduct further activities to increase the included number of studies analysing the relationship between female board rep-

resentation and the fulfilment of the board's duties. In summary, the selected studies span over 35 countries in 5 continents and consist of a combined sample size of 90,070 firms.

Byron & Post (2016) review a total of 84 studies (n = 26,710 firms), consisting of 70 journal articles, 4 working papers, 4 conference papers, 4 theses or dissertations, 1 book chapter, and 1 technical report. Their search strategy covers five different steps. They start by the searching in the databases ABI Inform Global and JSTOR with the keywords "gender", "female", "women", "diversity", "heterogeneity", or "composition" combined with the terms "board", "directors", or "governance". They then screen the reference lists of various review articles focusing on board composition or corporate social performance. They explicitly mention Dalton, Daily, Certo & Roengpitya (1998), Deutsch (2005), Joecks, Pull & Vetter (2013), Rao & Tilt (2016), and Terjesen, Sealy & Singh (2009). As a third step, they manually analysed the tables of contents of the journals *Academy of Management Journal, Corporate Governance, Corporate Governance: An International Review, Journal of Business Ethics, Journal of Management, Journal of Management Studies,* and *Strategic Management Journal* to identify relevant studies in the timeframe between January 1989 and July 2015. Step four is to screen the reference lists of the selected studies to identify additional literature. Finally, they also look for unpublished studies and e-mailed to 12 prominent authors in this field and to four listservs for divisions of the Academy of Management (i.e., GDO, BPS, SIM, and OB). They also analysed the SSRN website until July 2015.

Hoobler et al (2018) review a total of 78 studies (n = 117,639 organisations). To identify their sample of articles they conduct several activities. Firstly, they conduct a keyword search in the databases PsycINFO, ABI Inform, Business Source Premier, Google Scholar, and ProQuest Dissertations and Theses. The applied search criteria are "gender," "women," "female," "diversity," "CEO/Chief Executive," "leader," "board of directors," "TMT/top management team," "upper echelon," and "heterogeneity" combined with "performance". Secondly, they search in conference proceedings of pertinent annual management and psychology conferences in the period 2008-2014 and contacted the first authors of the studies to get a copy of the work. Thirdly, they twice send requests to pertinent listservs of the Academy of Management in 2013. Fourthly, the sample is complemented by a manual search for relevant review articles like Nielsen (2010) and Terjesen, Sealy, &

Singh (2009). To be considered in the meta-analysis the studies need to include an indicator for female representation in leadership as independent variable and an indicator for organisational financial performance as dependent variable reported as a simple bivariate correlation. Thereby, female representation is measured by the presence (yes, no), the proportion, the number of female members on the top management team or board of directors, the reported gender of the CEO, as well as by a standardised measure for gender heterogeneity (e.g., Blau's index of heterogeneity). Financial performance includes accounting and market-based measurers. Accounting based measures are return on assets, return on equity, return on capital, return on invest, profitability, leverage, sales, and accounting composite scores, whereas market-based measures are Tobin's Q, stock returns, and market capitalisation.

Cabrera et al (2016) review a total of 76 journal articles focusing on women's participation on boards of directors, whereof 24 articles are classified as "empirical". Their focus is on journals covering gender and business management. Their sources are the ISI-Web of Knowledge, the databases ABI/Inform, Business Source Premier, Scopus, JSTOR, and ScienceDirect. The applied search criteria are "board of directors", "gender diversity" and "performance" in the title, abstract or keywords.

Velte (2017) reviews a total of 200 studies, whereas 105 studies examine the relationship between women on the board of directors and financial performance. Velte (2017) does not focus on specific countries or governance forms because of the internationality of the topic. His research strategy is a targeted search in the international databases Web of Science, Google scholar, SSRN, EBSCO, science direct, and in libraries. The applied research criteria are "gender diversity", "women on boards", "women on boards of directors" in combination with "financial reporting", "CSR reporting", "internal audit(s)", "external audit(s)", "firm performance", "financial performance", "CSR performance" or technically associated terms (e.g., "financial accounting' or "earnings equality"). In addition, he either expanded the search by complementing the wider keyword "corporate governance" or specified the search by complementing specific variables (e.g. "CEO gender", "CFO gender", "blau index"). The included studies have a temporal limitation and are restricted to those that cover the period after the commencement of the Sarbanes-Oxley Act rules for corporate governance. Consequently, the samples of the included studies

analyse an observation period of 2004 or later. Also, studies which use multivariate statistics are considered only. To ensure a high quality of the studies only articles published in international journals with double blind review have been included.

Kirsch (2018) reviews a total of 310 articles published in 135 journals. The search strategy includes a keyword search in the databases Social Sciences Citation Index, Business Source Premier, and Scopus. The applied combinations of the keywords are "women", "gender", "female", "corporate board", "board of directors", "supervisory board", "women directors", "female director", "board composition", "board diversity", "regulation" and "quota". The search is limited to English articles published in academic journals since 1981 and before January 1, 2017. In addition, cross-referencing and manual research is conducted to identify further relevant articles. Recommendations from experts are considered as well. For quality reasons, articles with questionable methodological quality or with focus on state-owned or non-profit organisations were excluded. As the article does not include an overview of the included articles, the reference list is the basis for identifying additional journal articles.

Based on this strategy, it was possible to identify 510 studies published between 1990 and 2016. To further expand the empiric basis to the latest articles, an additional literature research was conducted. The research strategy included a keyword search in the international database Web of Science for the period 01.01.2017-01.06.2019 (several word combinations of the keywords "diversity", "gender diversity", "gender quota", and "board"). In addition, a manual research primarily via Google Scholar and EBSCO Discovery Service, and via a review of the references of other papers published after 2017 supplemented the already identified sample of literature. Another 388 journal articles are identified by this strategy. Focusing on journal articles of journals indexed in Scopus for quality reasons, 615 journal articles across 227 different journals remain as literature sample.

| Author (Year) | Title | Journal | Methodology | Sample | Evidence |
|---|---|---|---|---|---|
| Hoobler, Masterson, Nkomo, & Michel (2018) | The Business Case for Women Leaders: Meta-Analysis, Research Critique, and Path Forward | Journal of Management | Meta-analysis | 78 studies (n = 117,639 firms) | Financial performance: tendency of positive significance |
| Kirsch (2018) | The Gender Composition of Corporate Boards: A Review and Research Agenda | Leadership Quarterly | Literature review | 310 studies | Financial performance: mixed results<br>CSR performance: tendency of positive significance<br>Gender diversity below board level: tendency of positive significance |
| Velte (2017) | Do Women on Board of Directors Have an Impact on Corporate Governance Quality and Firm Performance? A Literature Review | International Journal of Sustainable Strategic Management | Literature review | 200 studies | Financial reporting: tendency of positive significance<br>CSR reporting: mixed results<br>Audit: mixed results<br>Corporate philanthropy: mixed results<br>Financial performance: mixed results<br>CSR performance: tendency of positive significance |

| Author (Year) | Title | Journal | Methodology | Sample | Evidence |
|---|---|---|---|---|---|
| Byron & Post (2016) | Women on Boards of Directors and Corporate Social Performance: A Meta-Analysis | Corporate Governance: An International Review | Meta-analysis | 84 studies (n = 26,710 firms) | CSR performance: tendency of positive significance |
| Cabrera-Fernández, Martínez-Jiménez, & Hernández-Ortiz (2016) | Women's Participation on Boards of Directors: A Review of the Literature | International Journal of Gender and Entrepreneurship | Literature review | 76 studies | Financial performance: mixed results |
| Post & Byron (2015) | Women on Boards and Firm Financial Performance: A Meta-Analysis | Academy of Management Journal | Meta-analysis | 140 studies | Financial performance: tendency of positive significance |

**Table 5: Overview of selected meta-analyses and literature reviews**

#### *4.1.2.2 Characteristics of the literature sample*

In the following, the literature sample (n = 615) is characterised based on different dimensions to better understand the development of academic interest for board gender diversity. Looking at the historical development of relevant journal articles published per year, figure 10 shows a continuous and increasing popularity, especially since 2008/2009. The number of published journal articles more than doubled from 2016 to 2017 and tends to stay on this high level (2019 covers the period until June 1st only). Since more than half of the articles were published in the period 2016-2019, the academic interest is at its all-time peak. This might be a reflection of the increasing attention of society and policy makers on gender diversity in the boardroom.

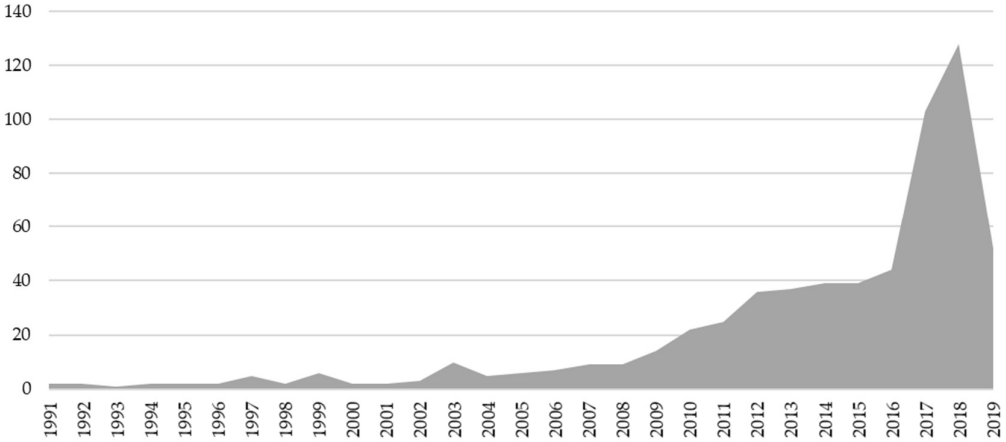



**Figure 10: Relevant articles by year of publishing (1990- June 2019)**

Another dimension for characterising the literature sample is to look at the respective research disciplines that are represented. In doing so, the literature sample was aggregated based on the Scopus Subject Areas and All Science Journal Classification Codes of each journal article. The analysis is summarised in figure 11 and shows that three research disciplines dominate the literature sample, namely "Business, Management and Accounting", "Economics, Econometrics and Finance", and "Social Sciences". Hence, the interest is spread over several disciplines again demonstrating the importance of this topic.

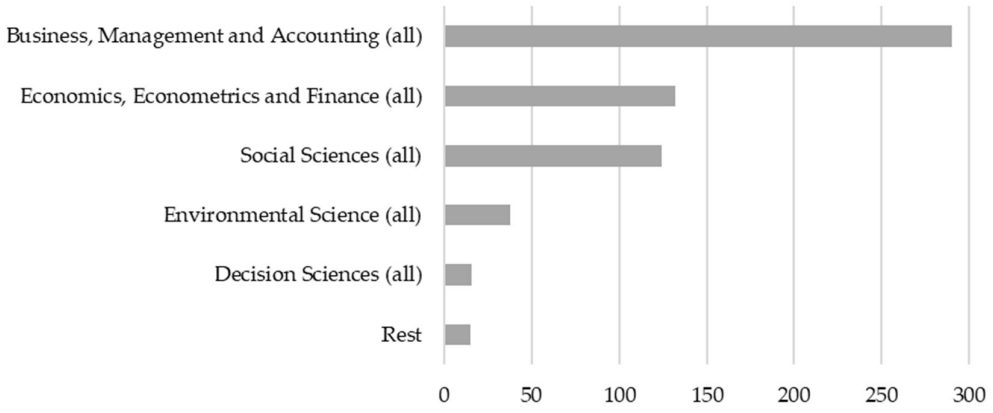



**Figure 11: Relevant articles by field of research (1990- June 2019)**

The third dimension used to characterise the literature sample is the thematic emphasis over time. In doing so, this study also makes use of the findings of Kirsch's (2018) literature review as it is also representative for this sample. In the 1990s, the focus of research regarding board gender diversity was on female director's characteristics and on exploring national institutional factors that might influence women's access to the boardroom. In parallel, the first journal articles focusing on the effects of board gender diversity on the boards themselves, on social and ethical behaviour of the firm, and on diversity within the firm were published (this interest slowed down, but the topic became popular again later in the 2010s). Later in the late 1990s and in the beginning of the 2000s, the research interest changed to the effects of board gender diversity on financial performance and firm strategy. As of today, the interest, particularly regarding the effects on financial performance, has still not slowed down. Moreover, the scope of research expanded to additional aspects of the institutional context influencing board gender diversity and its effects on the firm. Around the 2010s, researchers started to focus on the antecedents and effects of legislation on gender quotas. At present, scholars still are interested in the effects of the board gender composition. However, the regional focus moves from the US to Europe, Asia, and Africa. Prior to the 2010s, the focus was almost exclusively on the Anglo-Saxon countries. While the main focus remains on the effects of board gender diversity on the financial performance (Kirsch, 2018; Velte, 2017), Byron & Post (2016), Jain & Jamali (2016), and Rao & Tilt (2016) also highlight the increasing research activities regarding the effects on corporate social responsibility (CSR) as dependent variable, which has been outside the scope

for some years. Moreover, the interest regarding the effects of gender quota legislation on firm outcomes are at the forefront of academic discussions because of the introduction of policies in more and more countries.

The fourth dimension is to look at the applied methodologies. Methodologically, the international empirical literature is dominated by quantitative studies exploring the impact of board gender diversity on the firm based on single country studies. By the majority, the data collection is based on the synthesis of firm data (i.e. financial performance or CSR performance indicators) and board characteristics (i.e. demographic variables) sourced from different databases (Velte, 2018).

#### *4.1.2.3 Overview and results of selected journal articles*

To identify and select the journal articles most impactful and relevant for the research questions of this dissertation, the list of journal articles is further prioritised. The main prioritisation criteria are the number of citations in the years 2017-2019, the thematic focus of the article, and the topicality according to the Web of Science Citation report in June 2019.

Table 6 summarises the used methodologies, the theoretical focus, samples, and results of the top 20 journal articles according to the selection process sorted by the number of citations in the years 2017-2019 in a descending order. Combining the findings of the selected meta-analyses and literature reviews of table 5 and the results of the journal articles of table 6, there is no consensus about the impact of board gender diversity on firm performance. The evidence is mixed and ambiguous. Some studies report a positive impact, whereas others report a negative, or even a non-significant relationship with indicators like the ROA, the ROE, or the Tobin's Q. Thus, it appears as if the relationship is also depending on the context and is not universally valid.

Furthermore, the theorised positive impact of gender diversity on CSR related issues appears to be more of a general nature compared to financial performance indicators. Similarly, the effect on corporate governance related outcomes tends to be less ambiguous. To conclude, the empirical evidence tends to support the view that female presence on the board matters.

From a theoretical perspective, only the minority of the studies rely on one theoretical framework, such as the agency theory (i.e. Adams & Ferreira, 2009;

Campbell & Mínguez-Vera, 2008). Interestingly, most the studies rely on a mix of theories to explain the hypothesised relationships (i.e. Bear et al., 2010; Carter et al., 2010), which corresponds to the multi-theoretical approach of this dissertation.

It is also noteworthy that the considered samples are not homogenous and that some of the studies are addressing endogeneity problems, whereas others are conspicuously at risk to suffer from endogeneity bias. In particular, the studies relying on one- or two-year observation periods using simple OLS estimation are at risk to suffer from endogeneity bias, i.e. through reverse causality. Consequently, there is the concern that the heterogenous research designs and statistical techniques are drivers for the inconclusive results.

For example, Adams & Ferreira (2009) find a negative relationship between the percentage of female directors and the financial performance (return on assets, Tobin's Q). They argue that board gender diversity increases the monitoring efforts also referring to the agency theory. Furthermore, they use a large panel data set of almost 2,000 US firms over the observation period 1996-2003 and pay special attention to address endogeneity problems. In contrast, Campbell & Minguez-Vera (2008) report a positive relationship between the percentage of female directors and the financial performance (Tobin's Q) based on a relatively small sample of less than 70 Spanish firms. On the other hand, there are studies that are paying less attention to endogeneity problems, such as Bear, Rahman, & Post (2010). They report a positive relationship of the number of female directors on CSR ratings using a data set of 51 international firms over the observation period 2007-2008. They do not address endogeneity concerns, such as reverse causality, and rely on OLS estimation. Eventually, these examples show how heterogenous the studies in this field are designed.

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Adams & Ferreira (2009) | Women in the boardroom and their impact on governance and performance (386) | Journal of Financial Economics | OLS, fixed effects, instrumental variables with fixed effects, Arellano-Bond one step (agency theory) | n = 1,939; US firms; period 1996-2003 | Negative; percentage of women directors on the BoD → ROA, Tobin's Q<br>Positive; percentage of women directors on the BoD → attendance behaviour on board meeting<br>Positive; percentage of women directors on the BoD → CEO turnover<br>Negative; gender quotas in the BoD → stock performance |
| Campbell & Minguez-Vera (2008) | Gender Diversity in the Boardroom and Firm Financial Performance (187) | Journal of Business Ethics | Fixed effects, random effects, two-stage least squares (agency theory) | n = 68; Spanish firms; period 1995-2000 | Positive; percentage of women on the BoD, Blau's and Shannon's index → Tobin's Q |

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Bear, Rahman, & Post (2010) | The Impact of Board Diversity and Gender Composition on Corporate Social Responsibility and Firm Reputation (186) | Journal of Business Ethics | OLS, mediation model (resource dependence, agency, signalling theory) | n = 51; international firms; one-year period 2007/2008 | Positive; number of women directors on the BoD → CSR ratings |
| Carter, D'Souza, Simkins, & Simpson (2010) | The Gender and Ethnic Diversity of US Boards and Board Committees and Firm Financial Performance (158) | Corporate Governance-An International Review | Fixed effects, three stage least squares with fixed effects (agency, resource dependence, human capital theory) | n = 641; US firms; period 1998-2002 | No significance; number of women directors on the BoD → ROA, Tobin's Q |
| Terjesen, Sealy, & Singh (2009) | Women Directors on Corporate Boards: A Review and Research Agenda (141) | Corporate Governance-An International Review | Literature review | n > 400 studies | Positive; gender diversity on the BoD → corporate governance, firm level outcomes |

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Dezsö & Ross (2012) | Does female representation in top management improve firm performance? A panel data investigation (138) | Strategic Management Journal | Fixed effects, Arellano Bond (upper echelons theory, gender-based differences) | S&P 1,500 firms (US firms); period 1992-2006 | Positive only if firm focuses on innovation; dummy variable to indicate presence of women executives in top management → Tobin's Q, ROA, ROE |
| Miller & Triana (2009) | Demographic Diversity in the Boardroom: Mediators of the Board Diversity-Firm Performance Relationship (119) | Journal of Management Studies | OLS; mediation model (behavioural, signalling theory) | n = 326; US firms; period 2003 | No significance; percentage of women on the BoD, Blau's index → ROI, ROS (in 2005)<br>Positive; percentage of women on the BoD, Blau's index → R&D expenditures (innovation) |
| Gul, Srinidhi, & Ng (2011) | Does board gender diversity improve the informativeness of stock prices? (113) | Journal of Accounting and Economics | Several regression models (gender-based differences in leadership and teams) | n = 5,021 firm years; US firms; period 2001-2006 | Positive; several gender diversity variables on the BoD → Stock price informativeness |

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Rose (2007) | Does female board representation influence firm performance? The Danish evidence (107) | Corporate Governance-An International Review | Fixed effects (gender-based differences) | n > 100; Danish firms; 1998-2001 | No significance; percentage of women directors on the supervisory board → Tobin's Q |
| Nielsen & Huse (2010) | The Contribution of Women on Boards of Directors: Going beyond the Surface (104) | Corporate Governance-An International Review | OLS; mediation model (gender-based differences in leadership and teams) | n = 201; Norwegian firms (survey); 2003 | Positive; percentage of women directors on the BoD → board strategic control |
| Srinidhi, Gul, & Tsui (2011) | Female Directors and Earnings Quality (102) | Contemporary Accounting Research | Probit and logistic models (build on existing empiric literature) | n = 2,480 firm years; US firms; period 2001-2007 | Positive; dummy variable to indicate presence of women executives on the BoD → earnings quality |
| Farrell & Hersch (2005) | Additions to corporate boards: the effect of gender (90) | Journal of Corporate Finance | Event study (build on existing empiric literature) | n = 111 announcements; US firms; period 1990-1999 | No significance; announcement of adding women director on the BoD → abnormal returns |

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Post, Rahman, & Rubow (2011) | Green Governance: Boards of Directors' Composition and Environmental Corporate Social Responsibility (87) | Business & Society | Regression models (group diversity, gender-based differences, critical mass theory) | n = 78; US firms; one-year period 2006/2007 | No significance; critical mass of three or more women directors on the BoD → environmental corporate social responsibility |
| Liao, Luo, & Tang (2015) | Gender diversity, board independence, environmental committee and greenhouse gas disclosure (85) | British Accounting Review | Probit model (stakeholder, legitimacy theory, gender-based differences) | n = 329; UK firms; one-year period 2010/2011 | Positive; percentage of women directors on the BoD → greenhouse gas disclosure |
| Faccio, Marchica, & Mura (2016) | CEO gender, corporate risk-taking, and the efficiency of capital allocation (84) | Journal of Corporate Finance | Fixed effects, probit model (gender-based differences) | n = 338,397 firm years; European firms; period 1999-2009 | Positive; dummy variable to indicate presence of female CEO → risk avoidance |

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Francoeur, Labelle, & Sinclair-Desgagné, (2008) | Gender diversity in corporate governance and top management (79) | Journal of Business Ethics | Fama and French three-factor model (agency, stakeholder theory) | n = 230; Canadian firms; period 2002-2004 | Positive; indicator of female officers → ROE |
| Liu, Wei, & Xie (2014) | Do women directors improve firm performance in China? (77) | Journal of Corporate Finance | Fixed effects (with and without lagged variables), two-stage least squares, Arellano-Bond one step (resource dependence, agency, critical mass theory) | n > 2,000; Chinese firms; period 1999-2011 | Positive; Percentage and number of women directors on the BoD → ROA, ROS |
| Adams & Funk (2012) | Beyond the Glass Ceiling: Does Gender Matter? (76) | Management Science | Schwartz's 40 question Portrait Values Questionnaire, two questions were added | n = 628; Swedish directors and CEO's; 2005 | Female directors and CEO's are more benevolent, universally concerned, and risk loving and less power, tradition, and security oriented than their male peers |

| Author (Year) | Title (number of citations 2017-June 2019) | Journal | Methodology (theoretical focus) | Sample | Evidence |
|---|---|---|---|---|---|
| Hafsi & Turgut (2013) | Boardroom Diversity and its Effect on Social Performance: Conceptualization and Empirical Evidence (72) | Journal of Business Ethics | OLS (upper echelons theory, gender- based-differences) | n = 95; US firms; 2005 | Positive; percentage of women directors on the BoD → corporate social performance |
| Joecks, Pull, Vetter (2013) | Gender Diversity in the Boardroom and Firm Performance: What Exactly Constitutes a Critical Mass? (70) | Journal of Business Ethics | OLS and random effects with lagged variables (critical mass theory) | n = 151; German firms; period 2000-2005 | No significance; percentage of women directors on the supervisory board → ROE<br>Critical mass at 30 percent/three women on the board |

**Table 6: Summary of selected journal articles sorted by the number of citations in a descending order in the years 2017-2019**

Table 7 summarises the existing but inconclusive evidence about the trickle-down effects of board gender diversity comparing US-based studies (one-tier system) with studies based on Australia (one-tier system) and European countries, such as Norway (one-tier system), Italy (choice between three different board structures, traditional, one-tier, or two-tier system), and Germany (mainly two-tier system). It is noteworthy that there are relatively few studies researching this topic (Kirsch, 2018).

US- and Australia-based studies support the concept of trickle-down effects. They argue that "women help women" and that there are demand-side barriers ("glass ceiling") as a consequence of male directors tacitly discriminating against or stereotyping by gender (Bilimoria, 2006; Cook & Glass, 2015; Gould et al., 2018; Matsa & Miller, 2011; Skaggs, Stainback, & Duncan, 2012). However, studies based on the Norwegian and Italian setting do not find similar relationships (Bertrand, Black, Jensen, & Lleras-Muney, 2019; Maida & Weber, 2019). Interestingly, the report of Kirsch & Wrohlich (2020a) implies that the relationship in Germany is positive.

Again, it needs to be mentioned that the different research designs of the studies are potentially causing the mixed evidence because the samples and methodologies of the studies are very heterogenous. In particular, the German study is exposed to endogeneity problems like omitting important variables because it relies on a simple bivariate regression analysis. Also, the US-based studies relying on samples based on one- or two-year observation periods are threatened to suffer from endogeneity bias. Compared to that the Norwegian and Italian based studies are more rigorous with regards to minimising the risk of endogeneity problems by using a natural experiment design with difference-in-differences estimation or instrumental variable methods.

| Author (Year) | Title | Journal | Main Methodology (mechanism explaining the top down impact) | Main Sample | Evidence |
|---|---|---|---|---|---|
| Bilimoria (2006) | The Relationship Between Women Corporate Directors and Women Corporate Officers | Journal of Managerial Issues | Several linear and logistic regressions with one-year lagged variable (institutional, signalling theory) | n = 444; US firms; 1999/2000 | Positive relationship between the presence of women corporate directors and the representation of women executives |
| Matsa & Miller (2011) | Chipping away at the Glass Ceiling: Gender Spillovers in Corporate Leadership | American Economic Review | Fixed effects with and without lagged variables (gender-based differences) | n = 13,491 firm years; US firms; period 1997-2009 | Positive spill-over effect of women corporate directors on the representation of women executives |
| Skaggs, Stainback, & Duncan (2012) | Shaking things up or business as usual? The influence of female corporate executives and board of directors on women's managerial representation | Social Science Research | Hierarchical linear model (critical mass, signalling theory) | n = 81; US firms; 2005 | Positive impact of women corporate directors, but not in executive positions, on female managerial representation |
| Cook & Glass (2015) | Diversity begets diversity? The effects of board composition on the appointment and success of women CEOs | Social Science Research | Cox hazard model with lagged variables (critical mass theory) | n = 500; US firms; 2001-2010 | Positive relationship between board gender diversity and the likelihood of a woman being appointed CEO |

| Author (Year) | Title | Journal | Main Methodology (mechanism explaining the top down impact) | Main Sample | Evidence |
|---|---|---|---|---|---|
| Gould, Kulik, & Sardeshmukh (2018) | Trickle-down effect: The impact of female board members on executive gender diversity | Human Resource Management | Mixed effects Poisson regression with lagged variables, two-stage least squares with fixed effects (similarity attraction theory, homophily principle) | n = 1,387; Australian firms; period 2003-2012 | Positive trickle-down effect of female board representation on female executive representation |
| Bertrand, Black, Jensen, Lleras-Muney, & Ucla (2019) | Breaking the Glass Ceiling? The Effect of Board Quotas on Female Labour Market Outcomes in Norway | Review of Economic Studies | Fixed effects with instrumental variable (build on existing empiric literature) | Several samples; Norwegian firms; period 2003-2014 | No spill-over effects of female board representation on female executive representation |
| Maida & Weber (2019) | Female leadership and gender gap within firms: Evidence from an Italian board reform | IZA Discussion paper | Difference-in-differences | n = 316; Italian firms; period 2008-2016 | No spill-over effects of female board representation on female executive representation |
| Kirsch & Wrohlich (2020a) | More women on supervisory boards: increasing indications that the effect of the gender quota extends to executive boards | DIW article | Bivariate regression | n = 161; German firms; period 2014-2019 | Positive relationship between the average proportion of women on the supervisory board in the years 2014 to 2018 and the proportion of women on executive board in 2019 |

**Table 7: Selected journal articles regarding the effects on the diversity in the management layers below**

Table 8 gives an overview about studies focusing on the impact of quota legislation in this context. Most of the studies analysing the effects of gender quotas only focus on the Norwegian case and on the effects on the financial performance (Ahern & Dittmar, 2012; Dale-Olsen et al., 2013; Matsa & Miller, 2013; Nygaard, 2011). Hence, there is only little knowledge about the effects of this regulation on the firm and its performance in other countries (Kirsch, 2018).

According to Ferreira (2015), the studies of Ahern & Dittmar (2012) and Matsa & Miller (2013), which focus on the case of Norway, are the best known and most influential ones in the literature of gender quota legislation in this respect. Methodologically, both studies use the introduction of the gender quota in Norway as exogenous impact for conducting a "natural experiment". Matsa & Miller (2013) use the difference-in-differences approach and report a negative effect of the gender quota on the ROA. Ahern & Dittmar (2012) conduct an event study identifying a negative stock price reaction because of the quota announcement for firms that are forced to hire female board directors to comply with the law. In addition, they use an instrumental variable – pre-quota variation in female directors – for further analysing the effects on the Tobin's Q. They again identify a negative effect. Another event study regarding the stock market reaction, which is using a different announcement date of the quota legislation, finds the opposite result (Nygaard, 2011). Dale-Olsen et al. (2013) criticise the applied methodologies of the three before mentioned studies and report a negligible impact on the ROA also using difference-in-differences estimations.

Furthermore, Bozhinov (2018) performed an event study similar to Ahern & Dittmar (2012) and Nygaard (2011), but uses Germany as laboratory of the "natural experiment". Analysing the effects of the announcement of a gender quota in Germany on the stock price returns, he reports a negative impact on the cumulative abnormal stock returns for the total of the German firms. Further regression analysis of the results reveals that a higher share of women on the supervisory board of firms, which did not fall under the mandatory quota, is penalised by the stock market, whereas it was rewarded for firms which were within the scope of the law. Thus, this might serve as supporting evidence for a gender bias of investors because gender diversity on the supervisory board is valued negatively when not explicitly enforced by legislation (Bozhinov, 2018).

In summary, there is no consensus about the effect of quotas on firm performance. Also, there is criticism about the provided empirical evidence. Still, it is plausible that new regulation, which forces firms to take actions, likely leads to some costs (at least opportunity costs) – particularly if firms are forced to hire new or additional female directors. At the same time, experts question that newly hired female directors have the same level of qualifications as the incumbents do. Further arguments for explaining the negative impact of quota legislation on the profitability are that managerial talent might not be in excess supply and that firms are not willing to sacrifice profits just to discriminate women (Ferreira, 2015b).

| Author (Year) | Title | Journal | Main Methodology (mechanism explaining the effect of the quota) | Main Sample | Evidence |
|---|---|---|---|---|---|
| Nygaard (2011) | Forced Board Changes: Evidence from Norway | Discussion Paper | Event study | Norwegian firms; period 2004–2008 | Firms with low information asymmetry experience positive and significant cumulative abnormal returns |
| Ahern, Dittmar (2012) | The Changing of the Boards: The Impact on Firm Valuation of Mandated Female Board Representation | The Quarterly Journal of Economics | Event study<br><br>Difference-in-difference→ triple difference identification strategy<br>(firms choose boards to maximise value, appointed women are younger and less experienced than current directors) | n = 248; Norwegian firms; period 2001-2009<br>n = 130; Norwegian firms; period 2001-2009 | Negative stock price reaction of quota announcement for firms forced to change<br>Negative effect on Tobins' Q for firms forced to change |
| Matsa, Miller (2013) | A Female Style in Corporate Leadership? Evidence from Quotas | American Economic Journal: Applied Economics | Difference-in-difference → triple difference identification strategy (gender based-differences) | n = 104; Norwegian firms; period 2006-2009 | Negative effect on ROA, due to fewer workforce reductions for firms forced to change<br>Impact on corporate strategy by selecting like-minded executives |

| Author (Year) | Title | Journal | Main Methodology (mechanism explaining the effect of the quota) | Main Sample | Evidence |
|---|---|---|---|---|---|
| Dale-Olsen, Schøne, Verner (2013) | Diversity among Norwegian Boards of Directors: Does a Quota for Women Improve Firm Performance? | Feminist Economics | Difference-in-differences | Norwegian firms; period 2003-2007 | Short-run impact of the reform on ROA is negligible |
| Eckbo, Nygaard, Thorburn (2016) | Does gender-balancing the board reduce firm value? | SSRN Electronic Journal | Event study (firms choose boards to maximise value, appointed women are less experienced than current directors) | n = 402; Norwegian firms, period 1998-2013 | Value-neutral effect (insignificant abnormal stock and accounting performance) |
| Bozhinov (2018) | Stock price reactions to policies promoting women on boards: Evidence from Germany | SSRN Electronic Journal | Event study (investors regard the status-quo as optimal, hence, the policy may have a negative impact on the fundamental value of a firm) | n = 108, German firms; period 2009-2016 | Negative cumulative abnormal stock returns for firms not affected by the mandatory board gender quota |

**Table 8: Selected journal articles regarding the effects of gender quotas**

#### *4.1.2.4 Review of methodologies and research design*

Following, for example, Ferreira's (2011) argumentation, the mentioned endogeneity problems may be an explanation for the inconclusive and mixed results presented in the respective literature. As also presented in table 6, a substantial share of the studies rely on simple ordinary least square (OLS) estimations, such as Hafsi & Turgut (2013), Post, Rahman, & Rubow (2011), Bear, Rahman, & Post (2010), Nielsen & Huse (2010), and Miller & Triana (2009), and thus report biased estimates as a consequence of endogeneity issues (Bennouri et al., 2018). Adams & Ferreira (2009) show the importance of addressing endogeneity problems properly. They demonstrate that the results are depending on the used methodology and model formulation and illustrate that the conclusions can easily change in case that endogeneity concerns are ignored.

An effective method to solve endogeneity issues is performing an experiment. In this case, the variable of interest is randomly assigned and hence it cannot be correlated with the error term. Accordingly, the impact will be causal. However, in the context of this study applying an experimental research design is neither possible nor credible because it is not possible to randomly assign, for example, a female supervisory board member to a firm and then observe the organisational outcomes (Adams, 2016). Even if this was feasible, selection bias is a concern and the results would not be generalisable (Levitt & List, 2007).

However, economics and financial literature identified several tools to address endogeneity problems. Although, these tools are not able to eliminate endogeneity problems completely, they allow for interpreting the coefficient effect sizes and for proposing the direction of causality, if applied properly and combined with solid theoretical arguments (Adams, 2016).

To cope with endogeneity concerns several studies apply fixed effects regressions with panel data. Tables 6 and 7 present examples for this approach, such as Faccio, Marchica, & Mura (2016), Matsa & Miller (2011), and Rose (2007). In doing so, the omitted variable bias can be addressed. Fixed effects regression models control for unobserved heterogeneity on firm level because of time invariant variables that cannot be included in the model because of measurement issues (i.e. corporate culture or workplace practice). Hence, fixed effects estimations subtract the mean values from variables and thereby eliminate fixed differences across firms or years.

In other words, the time invariant omitted variable bias for variables that do not change over time is eliminated (firm fixed effects). Also, time trends can be controlled for, if year fixed effects are included (Adams, 2016). This is a popular approach in the field of econometrics (Roberts & Whited, 2013; Wintoki et al., 2012).

However, estimates of fixed effects models are consistent only, if there are no dynamic endogeneity or reverse causalities like a correlation between past performance of the firm and current board composition. According to the argumentation in the literature, this assumption might not be realistic because theory and empirical results indicate that those relationships need to be considered (Roberts & Whited, 2013).

To address reverse causality concerns it is a typical approach to apply instrumental variable (IV) techniques. Table 6 also presents examples for this approach, such as Carter, D'Souza, Simkins, & Simpson (2010) and Campbell & Minguez-Vera (2008). These methods adjust the endogenous variable, i.e. share of female board members, for its correlation with the error term. To do that, the techniques use a variable, the instrument, that is not included in the regression equation, but correlated with the endogenous variable. Starting with predicting the values of the endogenous variable based on the instrument and the control variables, one then uses these values instead of the endogenous values of the original model. Because of substituting the original variable, the standard errors need to be adjusted in a second step. Typically, these two steps are performed by pre-programmed IV commands. The advantage of this method is a straightforward handling, but the main challenge is the identification of instruments outside the model (Adams, 2016). Furthermore, the problem of dynamic endogeneity needs to be controlled for because theoretical arguments and empirical results indicate that past performance influences the composition of the supervisory board (Bennouri et al., 2018).

In the econometrics literature, the system generalized method-of-moments (GMM) method, as suggested by Arellano & Bover (1995) and Blundell & Bond (1998), has long been the most popular method for estimating dynamic panel models to eventually mitigate dynamic endogeneity and also reverse causality concerns. Examples for this approach in connection with analysing the impact of board gender diversity are Liu, Wei, & Xie (2014), Dezsö & Ross (2012), and Adams & Ferreira (2009). These are also included in table 6. This method relies on lagged variables as instruments (Allison, Williams, & Moral-Benito, 2017; Williams,

Allison, & Moral-Benito, 2018). On the other hand, sociologists addressed the same problems with a different approach using structural equations models (Allison, 2009; Bollen & Brand, 2010), which will also be described in this chapter.

With the system GMM method one can estimate the relationship of board composition and firm performance in levels and first differences simultaneously. The level equation defines performance as a function of its lagged values (past values), observable firm characteristics, e.g. firm size and other explanatory variables, and the error term including a fixed effects element. On the other hand, the difference equation considers year-to-year differences in the level equation. Thus, the difference equation defines the variation in year-to-year performance as a function of the year-to-year lagged variation in performance, year-to-year variation of the explanatory variables, and the difference in error terms. Because the fixed effects error term is time invariant by definition it finally disappears in the difference equation. The system GMM method allows for estimating both equations at the same time and thereby controls for heterogeneous endogeneity due to time-invariant variables while accounting for the dynamic structure of the relationship between the board composition and firm outcomes. However, the system GMM method relies on the assumption of orthogonality of internal instruments and therefore misspecification of the model is a concern. Moreover, the system GMM method holds the issue of the proliferation of instruments especially because each (additional) explanatory variable brings several lagged values and differences instruments (Bennouri et al., 2018). Consequently, the potential issue of weak instruments increases with the number of variables (Roodman, 2009a).

Generally, the GMM approach computes consistent estimators of the coefficients, but these estimators tend to be not fully efficient because the estimators do not apply all the moment restrictions implied by the model. Furthermore, they suffer from small-sample bias and they do not perform well when the autoregressive parameter is close to 1.0. Moreover, uncertainty about the selection of instruments also remains an issue (Allison et al., 2017; Williams et al., 2018).

Recently, Allison et al. (2017) and Williams et al. (2018) showed that the maximum likelihood structural equation modelling (ML-SEM) can cope with the same problems like the system GMM and hence can be an alternative approach to system GMM. Allison et al. (2017) build on Moral-Benito's (2013) work, who, in essence, showed that maximum likelihood estimation can be used in dynamic panel models

in a way that avoids the incidental parameter problem (endogeneity problems) without the necessity for special assumptions about the initial conditions. They also showed that the ML-SEM method outperforms the GMM method regarding bias and efficiency under most conditions. In addition, Allison et al. (2017) describe the advantages of ML-SEM over GMM as follows:

- "Error variances can easily be allowed to vary with time.
- The unobserved, time-invariant factor can have different effects at different times.
- Missing values on predictors can easily be handled by full information maximum likelihood (FIML).
- Many goodness-of-fit measures are available to assess the over-identifying restrictions of the model.
- There is no need to choose among many possible instrumental variables.
- Latent variables with multiple indicators can be incorporated into the model.
- Time-invariant variables can be included in the model." (Allison et al., 2017, p. 2).

Still, ML-SEM also has some downsides. It is not suitable, if the time dimension T of the data is large relative to the sample size N, because ML-SEM operates on the full covariance matrix for all variables at all points in time. Taking the example of a covariance matrix of 101 x 101 (i.e. T = 11; predictors = nine time-varying variables) this means that N must be > 101, or the matrix will not have full rank. If the matrix has no full rank, the maximisation algorithm will break down. Moreover, ML-SEM's iterative algorithm will sometimes fail to converge, especially in the case of small sample sizes and extreme parameter values. Even if it converges, the computation time tends be longer compared to GMM (Allison et al., 2017).

An additional important limitation of ML estimation is the strong assumption of multivariate normality. This distributional assumption is often violated in practise, which can be a serious problem because it potentially leads to biased results. However, the literature agrees that ML estimation is quite robust against the violation of the multivariate normality assumption (Boomsma & Hoogland, 2001; Chou & Bentler, 1995; Curran, West, & Finch, 1996; Muthén & Muthén, 2002; West, Finch, & Curran, 1995). Furthermore, there are corrections available to address non-normal data with scaled statistics and robust standard errors coming with the Satorra-Bentler scaled test statistic (Satorra & Bentler, 1988, 1994). Simulations have shown that robust ML estimators based on the Satorra-Bentler scaled $\chi^2$ statistic

possess good statistical properties in relation to least squares estimators (Boomsma & Hoogland, 2001).

Also, robustness studies demonstrate that using the scaled $\chi^2$ statistic brings better results than using the standard ML estimator (Chou & Bentler, 1995; Chou, Bentler, & Satorra, 1991; Curran et al., 1996). The models using robust standard errors have the least biased standard errors, particularly in cases where the distributions of the observed variables are extremely non-normal (Chou & Bentler, 1995). However, the challenge in this respect is the need for relatively large samples with, for example, $n \geq 400$ (Boomsma & Hoogland, 2001) because it is not proved that it is beneficial to use the scaled $\chi^2$ statistic version for smaller samples (Schermelleh-Engel, Moosbrugger, & Müller, 2003).

Another major downside of the ML method is that it is extremely sensitive to the hypotheses made a priori (e.g. fixed vs. random effects). Therefore, this method is rather exposed to misspecification and thus biased estimation. Due to the severe consequences of misspecification this estimation method is not widely used in the context of dynamic panel models (Croissant & Millo, 2019).

More details on the ML estimation via SEM like the econometric specification, the resulting equations, and its comparison to GMM can be found in Allison et al. (2017), Moral-Benito (2017), or Williams et al., (2018).

An additional alternative for determining causality is to use exogenous changes in the environment that force firms to modify the composition of their boards (Ferreira, 2011). Such natural experiments in combination with difference-in-differences estimators are an option to address reverse causality. A natural experiment can be described as any type of exogenous impact that creates variation in the variable of interest. What makes the experiment natural is the fact that it is not taking place in a laboratory. For example, board diversity policies may serve as an exogenous impact and therefore can be used as natural or quasi-natural experiment. Measures like the implementation of board quotas may interrupt the issue of the reverse relationship and thus the interpretation of correlations between board diversity and organisational outcomes following this exogenous impact is more straightforward. The application of difference-in-differences analysis allows for addressing cross-sectional heterogeneity as well as time trends by comparing the impact on "treated groups" and on "control groups" before and after the exogenous impact. In the context of this study, this means that firms subject to the quota can

be defined as "treated group" and firms that are not affected by the quota may serve as "control group". Moreover, the "treatment" can be defined as the introduction of quota legislation (Adams, 2016). Even though, natural experiments, like for example the one of Ahern & Dittmar (2012), who used the introduction of gender quotas in Norway to conduct their study, are a promising way of ascertaining causality, they still have limitations as highlighted by Ferreira (2014). The major issue remains the selection bias problem in trying to randomly chose a control group of firms that are not subject to the legislation (Ferreira, 2011).

### 4.1.3 Synopsis

Based on the literature review, the following preliminary findings regarding the formulated research questions are derived.

*RQ1: How does supervisory board gender diversity affect the financial performance in the German set-up, and is this effect dependent on the statistical methodology used?*

**Theoretical implications –** There are several theories that are relevant for research question 1. However, the theoretical implications are mixed. There are theories that explain the benefits of gender diversity, but there are also theoretical considerations that predict negative consequences of supervisory board gender diversity. Despite the conflicting implications, the majority in the literature emphasises the benefits and argues based on the business case of board gender diversity.

**Empirical results** – Germany has hardly been within the scope because most of the studies and samples focus on the US environment and on countries with the one-tier corporate governance system in place. Thus, the majority of the studies examines the topic based on the Anglo-Saxon common law governance principles and the one-tier corporate governance structure. The results of the studies analysing the relationship between gender diversity in the boardroom and firm performance are inconclusive. Some find no significant evidence for a direct relationship, some find a negative, and some a positive impact of gender diversity measures on financial performance indicators. The mixed evidence indicates that the relationship is not uniformly across different contexts and therefore it is likely that the context matters. According to Adams and Ferreira (2009), the impact of board gender diversity on firm performance depends on the circumstances and therefore is likely to be heterogeneous. For example, Post & Byron (2015) follow that body of thought

and argue that country factors, namely the "degree of shareholder protection" and the "extent of gender parity", are likely moderating the board gender diversity and firm performance relationship. However, the assumed positive impact is still in the focus of most of the studies in this field of research.

**Methodologies and research design** – Experts raise concerns about the robustness of the methodologies and research designs used in a lot of the studies in this field. Hence, they articulate the concern that the results might be biased because of endogeneity problems. In particular, the "business case" argument of board gender diversity is an example of a regression that is threatened by several sources of endogeneity problems. Consequently, endogeneity problems may be an explanation for the inconclusive and mixed results presented in the literature.

*RQ2: How does supervisory board gender diversity affect the gender diversity on the management board in the German set-up, and is this effect dependent on the statistical methodology used?*

**Theoretical implications –** It is not clear whether female leaders have the aspiration and the competence to support other women's progression. One stream in the literature reasons that women tend to support other women and demonstrate solidarity. Another stream argues based on the "queen bee" phenomenon and the assumption that women tend to be disloyal and therefore stop other women from progressing. Still, most of the studies argue based on a trickle-down effect of female presence in the boardroom.

**Empirical results** – Whilst academic research largely focuses on the "business case" of gender diversity on the board of directors, only a few studies to-date have examined the impact of female presence in the boardroom on recruiting decisions. Despite the attention, there is only little and ambiguous research on whether female presence in the boardroom affects the female presence in the management. Particularly, the impact of female presence on the supervisory board on the female presence on the management board in the two-tier system, which is the corporate governance structure in Germany, is not in the focus of the empirical literature.

**Methodologies and research design –** Similar concerns regarding the robustness of the methodologies and research designs like in studies examining the "business case" argument can be mentioned here as well because the same threats to validity exist. Not consistently addressing these concerns adversely impacts the

credibility of the empirical results. There are reservations about the validity of most studies on leadership and management because of endogeneity problems.

*RQ3: How has the quota impacted the firm's financial performance in Germany?*

**Empirical results** – Following the increasing attention of policy makers for board gender diversity, several European countries, such as Italy, Belgium, the Netherlands, and Germany followed the pioneer Norway and implemented gender quotas for the supervisory board or the board of directors. Accordingly, the academic interest regarding the effects of gender quotas has been increasing. However, Kirsch (2018) emphasises that the research on the effects of gender quota legislation is almost exclusively focused on the case of Norway, whereas nowadays there are several additional countries that introduced policies in this respect. In addition, the studies focus on the impact on financial performance or stock performance and mostly assume a negative relationship.

*RQ4: How has the quota impacted the female representation on the management boards in Germany?*

**Empirical results** – As mentioned above, the effects of gender quotas on aspects beyond financial topics has not been extensively researched. In particular, the effects of gender quotas on the female presence on the management layers below is not clear yet.

**Methodologies and research design** – Studies analysing the effects of gender quota legislation mainly rely on an event study or a difference-in-differences approach.

## 4.3 HYPOTHESIS DEVELOPMENT

### 4.3.1 Hypotheses development

#### *4.3.1.1 Supervisory board diversity and firm performance*

The theory to explain the relationship between supervisory board gender diversity and firm performance involves multiple disciplines (Carter et al., 2010; Kiel & Nicholson, 2003). Thus, the hypotheses of this study are developed based on theories coming from multiple disciplines because there is no single theoretical framework that completely explains the relationships under investigation of this study. This dissertation refers to the theories identified in the literature to develop its hypotheses with the belief that they complement each other and that each of them explains certain elements that are relevant for understanding the effects of supervisory board gender diversity. The most prominent theories used for the purpose of hypotheses development are introduced in chapter 4.1.1 and they are the basis for the following explanations.

**Women are different than men** – This dissertation builds on the belief that gender-typical characteristics matter and influence the behaviours (Eagly & Johannesen-Schmidt, 2001). This is in line with the approach of Bennouri et al. (2018), Faccio, et al. (2016), Hafsi & Turgut (2013), Matsa & Miller (2013), Dezsö & Ross (2012), Gul, et al. (2011), Matsa & Miller (2011), Nielsen & Huse (2010), Post, et al. (2011), and Rose (2007). The different gender-typical attributes of men and women indicate that female leaders think and act differently (Eagly, Karau, & Makhijani, 1995) and have a different leadership style than their male peers (Eagly & Karau, 2002). Therefore, the female-typical attributes likely influence board decisions and eventually firm behaviour. Also, women likely have different experiences, values, and knowledge than their male counterparts (Post & Byron, 2015), which leads to increasing creativity and perspectives. Individuals with different life experiences and backgrounds likely tackle the same problems differently. Empirical evidence supports the argument that diverse groups enhance creativity and generate a greater range of perspectives and problem-solving alternatives (e.g. Watson et al., 1993; Wiersema & Bantel, 1992). So, the risk of groupthink is lower

in diverse groups. Also, differing group members likely add to the groups creativity due to gathering information from different and therefore more diverse sources of knowledge (Granovetter, 1973).

Empirical research regarding the performance of diverse groups shows that diverse groups likely outperform homogeneous groups because of their tendency to discuss issues more extensively based on a broader pool of knowledge and perspectives (Loyd, Wang, Phillips, & Lount, 2013; van Ginkel & van Knippenberg, 2008).

Furthermore, female leaders tend to appreciate interdependence, benevolence, and tolerance more than their male peers (Adams & Funk, 2012). This may lead to the consideration of additional perspectives and opinions, which, in turn, might improve the debates of the boards. Moreover, according to Bart & McQueen (2013) female directors have the tendency to be more cooperative in decision-making and hence strive for fair decisions by taking into account the competing interests. On the other hand, male directors show the tendency of

> "using rules, regulations and traditional ways of doing business or getting along." (Bart & McQueen, 2013, p. 97)

Amongst others, Carter et al. (2010) Hillman, Cannella, & Harris (2002), Hillman, Cannella, & Paetzold (2000) report that women are more likely to have advanced university degrees. Groysberg & Bell (2013) find out that women are more likely to have strengths in marketing and sales and have a more diverse set of hobbies and non-work activities. Moreover, Hillman, Canella, & Harris (2002) and Singh, Terjesen, & Vinnicombe (2008) report that women have different career paths. Because of these differences in preferences and social networks of female directors, gender diversity leads to complementary insights.

Different decision-making approaches of gender diverse boards compared to homogeneous boards – due to the difference in what is discussed and how it is discussed – may lead to an improved ability of the firm to generate profits from its assets and investments (Miller & Triana, 2009). In addition, there is evidence for gender diverse boards to have a broader understanding of the firm's marketplace and different stakeholders (Carter et al., 2003).

**Women take different decisions** – According to the upper echelons theory (Hambrick & Mason, 1984) firm performance and strategic decisions are partially

predicted by the managers' and directors' backgrounds and characteristics. These cognitive frames are difficult to capture and therefore the empirical literature referring to upper echelons theory uses demographic characteristics, such as the gender, of the upper echelons to identify different cognitive frames (Dezsö & Ross, 2012; Krishnan & Park, 2005).

Accordingly, the upper echelons theory can be interlinked with the theory of gender-based differences because women and men likely have different cognitive frames as a result of different traits, preferences, experience, career paths, values and knowledge. In addition, the different cognitive frames of women likely influence the decision-making processes on the board. This is also based on the circumstance that female board directors affect what information are relevant and how the decision-making takes place (Post & Byron, 2015). For example, Bennouri et al. (2018), Hafsi & Turgut (2013), and Dezso & Ross (2012) also argue based on belief.

**Women improve monitoring** – In general, the agency literature predominantly suggests enhancing the monitoring of the management practices and activities (Combs et al., 2007). It also suggests incentivising the management for maximising shareholder value instead their own well-being to eventually avoid an agency loss (Eisenhardt, 1989) and thus to reduce the moral hazard in decision making (Gomez-Mejia & Wiseman, 2007).

Combining the idea that women are different than men with the agency theory also helps to explain why board gender diversity can improve the firm's financial performance. A more gender diverse board can lead to increased independence and better monitoring, which, in turn, may result in a better performance due to a decrease of the probability of negative behaviour and moral hazard of the boards. Accordingly, Handschumacher & Ceschinski (2020), Reddy, Jadhav, & Pai (2019), Adams & Ferreira (2009), and Campbell & Minguez-Vera (2008) also use this argumentation to explain the effects of board gender diversity. In particular, the gender-based differences regarding the aspects, such as ethical behaviour, risk aversion, and legitimacy concerns likely influence the level of monitoring of the board (Post & Byron, 2015).

The view that women are more focused on ethical behaviour is supported by meta-analytic evidence that suggests that women are more likely to apply stricter ethical standards than men (Pan & Sparks, 2012) and that they are more likely to

classify questionable business practices unethical (Franke et al., 1997). Further research indicates that women may be more risk-averse and that their increased risk awareness likely leads to an intensified desire to fulfil their monitoring responsibilities to avoid the risk of reputational damage because of not being compliant with legal or ethical provisions (Law Chapple, Kent, & Routledge, 2012). In addition, women's latent disadvantage regarding their legitimacy may result in an increased discipline in preparing for meetings (Carli, 1999; Foschi, 2000; Singh, Kumra, & Vinnicombe, 2002). Thus, female directors tend to be better prepared for board meetings than their male counterparts (Huse & Grethe Solberg, 2006) and are more diligent in executing their fiduciary responsibility, which likely positively influences the monitoring quality (Post & Byron, 2015). In line with this argumentation, female directors are relatively often members of the audit and monitoring committees (Adams & Ferreira, 2009; Zhu, Small, & Flaherty, 2010).

Carter et al. (2003) also argue that

> "diversity increases board independence because people with different gender, ethnicity, or cultural background might ask questions that would not come from directors with more traditional backgrounds." (p. 37)

Consequently, board gender diversity might impact the performance by reducing agency problems through increasing the monitoring quality, through a better information processing, and through an increasing need for discussion in the board's meetings (Carter et al., 2010).

**Women improve stakeholder management** – Also, the signalling theory and the stakeholder theory help to explain the relationship within in the scope because board gender diversity may serve as a signal that the firm acts socially and ethically responsible to customers and investors. It may also influence the perception of further stakeholders, like the society, because of the public awareness of the topic. For example, Skaggs, et al. (2012), Bear, et al. (2010) and Miller & Triana (2009) also argue that female directors act as signal. Additionally, Velte (2017) argues that female directors better understand the needs of the diverse stakeholders and that female directors are a sign of considering stakeholder expectations. Therefore, it may positively affect the reputation of the firm (Bear et al., 2010). Research in that field also suggests that institutional investors claim for female board representation and prefer firms that take that into account (Byoun, Chang, & Kim, 2016). Hence, this

signal might attract investors and customers who seek for socially responsible investments and business partners for sustainability reasons. In addition, women likely have access to a different network of contacts. This may improve the firm's ability to manage its diverse stakeholders, such as investors, customers, or the female population, which in turn, may impact the firm's perception and favour by these stakeholders.

Moreover, a gender diverse board might be better representing the target market of the firm (Oakley, 2000) and consequently might lead to a competitive advantage (Berman et al., 1999). Accordingly, considering the stakeholder's interests with regards to gender equality might influence the firm's ability to create value and to be successful.

**Women add human and social capital –** The theories of human and social capital propose that diverse board members provide more valuable services and resources to the firm, which, in turn, may result in better overall firm performance. Therefore, complementary human and social capital form critical resources for entrepreneurial success (Bruederl, Preisendoerfer, & Ziegler, 1992; Davidsson & Honig, 2003). By combining the human capital perspective with the idea of gender-based differences, these theories predict that female board members bring additional experiences, values, and skills to the board. This additional human capital enriches the pool of know-how of the board and can be used to the benefit of an organisation (Terjesen et al., 2009). This argumentation is also referred to by Bennouri et al. (2018) and Carter, D'Souza, Simkins, Simpson (2010).

Also, the social capital perspective considers relationships and reputation as critical resources that can positively impact the firm performance. Diverse board members have diverse backgrounds and contacts, and therefore the firm likely gets access to different resources and networks (Hillman, Shropshire, & Cannella, 2007). Hence, women may have access to a wider network of customer, suppliers, and investors. This, in turn, reduces potential conflicts, creates additional opportunities, and eventually increases the likelihood for the firms to be successful (Adams & Funk, 2012).

Consensus of these theories is that they predict that the firm performance will be positively affected by supervisory board gender diversity. Consequently, this study examines the effect of supervisory board diversity based on the following hypothesis.

*H1: The share of female supervisory board members is positively related to the firm's financial performance.*

**Critical mass of female supervisory board members –** Supervisory boards are dominated by men. Consequently, female supervisory board members are numeric minorities. As outlined in the chapter describing the critical mass theory (chapter 4.1.1.8), theory and empiric research indicate that minority leaders tend to have relatively weak structural positions in leadership teams, a lower status compared the majority members (Collins, 1997; Kanter, 1977a; Ridgeway, 1997), and consequently less impact on the firm's behaviour and results (Ashfrod, Rothbard, Piderit, & Dutton, 1998; Maume, 2011; Penner, Toro-Tulla, & Huffman, 2012).

Applying these findings in the context of women on supervisory boards, several studies, such as Liu, et al. (2014) Joecks, et al. (2013), Skaggs, et al. (2012), and Cook & Glass (2015), argue that once a critical mass of three women on the board is reached, the boards and its members behave differently. In other words, they argue that the probability that female directors have an impact on the board increases, if there are three or more women on the board (Erkut, Kramer, & Konrad, 2008; Konrad, Kramer, & Erkut, 2008; Torchia et al., 2011).

Also taking this view into account, this dissertation formulates the following additional hypothesis.

*H2: A critical mass of three or more women on the supervisory board is positively related to the firm's financial performance.*

**Potential threats of supervisory board gender diversity** – Diversity does not always lead to positive consequences. Therefore, this study also mentions the potential negative aspects of gender diversity on the supervisory board in order to show a complete picture of the literature. For example, Ferreira (2011) highlights the potential costs of diversity. Potential disadvantages of group heterogeneity are conflict, lack of cooperation, and insufficient communication. Moreover, management researchers argue that demographic diversity may lead to splitting a group into subgroups because of their heterogeneous demographic characteristics. In this context, they also refer to the concept of group faultlines. Faultlines are defined as

> "hypothetical dividing lines that may split a group into subgroups based on one or more attributes." (Lau & Murnighan, 1998, p. 328)

Hence, demographic disparity could reduce interpersonal attraction and group cohesiveness and therefore result in conflict and a lack of communication. Focusing on the boardroom, there might be the hazard of inhibiting the functioning of the board, if the members are too diverse (Ferreira, 2011). In addition, the flow of information from the management board to the supervisory board may be affected because of the reluctance of executives to share information with supervisory board members who are demographically dissimilar and therefore assumed to have opposing values and views. This might also negatively impact the effectiveness of the supervisory board because it depends on the management board to get access to the necessary information (Adams & Ferreira, 2007).

Another potential disadvantage of fostering board diversity may be the subsequent costs of selecting board members who have little experience, inadequate qualifications, or are overused. Selecting board members focusing on their demographic characteristics may result in the neglect of other important characteristics. Consequently, the chosen board member might not be the right fit when considering the experience and expertise (Ferreira, 2011). This is especially relevant when it comes to legal provisions regarding quotas combined with the hypothesis that boards are selected to maximise (shareholder) value. Thus, legal constraints regarding the selection of board members may lead to a decline in value for shareholders (Demsetz & Lehn, 1985).

Furthermore, board diversity may lead to conflicts of interests and self-serving agenda pushing of the board members. A more diverse board may represent more diverse interests and hence there is a hazard that they prioritise their own agendas at the expense of the company's profits. Reason being can be an insufficient alignment with the shareholders' interests due to an increased risk of the board being influenced by board members with individual personal and professional interests (Ferreira, 2011).

#### *4.3.1.2 Supervisory board diversity and management board diversity*

Appointing the management board is one of the core tasks of the supervisory board in the two-tier corporate governance system. This dissertation also explores whether gender diversity on the supervisory board impacts its recruiting decisions with respect to increasing the presence of female management board members. Similarly, theories from different disciplines are relevant for explaining the

"trickle-down" or the "spill-over" effect of supervisory board gender diversity.

In accordance with the literature, the main theories applied are the upper echelons theory (Hambrick, 2007; Hambrick & Mason, 1984), theories on gender-based differences (Eagly & Johannesen-Schmidt, 2001; Eagly et al., 2003; Eagly & Johnson, 1990), the similarity-attraction theory (Berscheid & Walster, 1978; Byrne, 1961, 1971), and the signalling theory (Spence, 1973).

**Women support other women –** The UET supports the idea of a relationship between board gender diversity and strategic decisions like the appointment of management board members because women likely have a different cognitive frames, e.g. diverse experiences, values, and personalities, than the to the incumbent male directors (Ruigrok, Peck, & Tacheva, 2007). The idea of UET is confirmed by research on differences between women and men that argues that female leaders have different preferences and leadership styles than their male peers (Eagly & Johannesen-Schmidt, 2001; Eagly et al., 2003; Eagly & Johnson, 1990). Adams & Ferreira (2009) empirically support this by demonstrating that female directors tend to be more active when it comes to monitoring and to have a better attendance record than male directors.

Combining the suggestions of the UET and the gender-based differences with the argumentation of the similarity-attraction theory (Byrne, 1961), that humans favour to collaborate with those who are socially and professionally similar to them, this dissertation argues that female supervisory board members likely prefer to work with female management board members. This approach is in line with the argumentation of Gould, et al. (2018), who argue that women in senior roles prefer to work with other women. Accordingly, gender diverse supervisory boards tend to support the recruitment of female talents in board discussions (Kirkman, Rosen, Tesluk, & Gibson, 2004; Thomas, 1999). Kanter (1977a) also argues that female upper echelons tend to replicate themselves by appointing candidates who are socially and demographically similar to them. The respective underlying processes might not be limited to homosocial reproduction. Female supervisory board members might also facilitate female advancement via processes, such as mentoring relationships, social networking, political alliances, and stereotype reduction.

There is also empirical evidence indicating that demographic minority leaders, like female directors, tend to increase the representation of other demographic

minorities, e.g. by serving as a role model and mentor, or by fostering their appointment in board meetings (Duguid, Loyd, & Tolbert, 2012; Ibarra, 1995). Eventually, women are assumed to have both the aspiration and the competence to help other women progress (Cook & Glass, 2015).

In addition, a gender diverse supervisory board might influence the corporate culture through visionary statements regarding diversity related issues or by requesting and enforcing policies to promote gender diversity in the layer below (Skaggs et al., 2012), i.e. by defining high gender target quotas for the management board. Accordingly, when the gender diversity on supervisory board increases, female supervisory board members might create opportunities for other women.

**Impact of the German environment** – The German public is clamouring for more female presence on the management board and thereby additionally motivates the female supervisory board members to support and promote the appointment of female management board members.

**Female supervisory board members as a signal –** The second mechanism that explains a positive relationship between women's supervisory board presence and female management board representation is based on the assumption that the presence of women on the supervisory board operates as a signal. This signal, in turn, might improve the opportunities for women and increase the attractiveness of the firm to female talents. Hence, even if female supervisory board members do not actively support other women, their mere presence does. Firms having women in strategically relevant positions, like the supervisory board, signal a commitment to the advancement of women in the organisation (Daily & Dalton, 2003). Having women on the supervisory board also improves the credibility that the firm enhances a leadership culture that supports women's careers and lives (Bilimoria, 2000). Consequently, this signal might also influence the incumbent male supervisory board members and their recruiting decisions because they are less likely to discriminate against female candidates. They might even prefer women in recruiting discussions to satisfy the firms ambition to promote female career opportunities. The idea of signalling is also supported by several studies analysing the perceived employer attractiveness (Iseke & Pull, 2019) and thus, supervisory board gender diversity may also bring a competitive advantage in terms of recruiting and retaining female talents (Bilimoria, 2006; Kanter, 1977a; Morrison, White, & Van

Velsor, 1987). Women might feel more positive about their own career advancements in such an environment (Burke, 1994).

Bilimoria (2006) also argues that

> "the legitimacy signals provided by the presence of women corporate directors are likely to positively influence gender diversity at the highest corporate ranks through institutional approval from organizational stakeholders, self-selection and retention by women executives themselves, and encouragement of male corporate executives to promote and retain women officers." (p. 50)

Furthermore, Skaggs et al. (2012) note that female board representation can be utilised to attract qualified employees across all management layers in the company. At the same time, it signals compliance with gender equality norms.

Consequently, this study predicts a positive association between women's supervisory board presence and female management board representation. Similarly, the prediction of the critical mass theory is tested.

*H3: The share of female supervisory board members is positively related to the share of the female management board members.*

*H4: A critical mass of three or more women on the supervisory board is positively related to the share of female management board members.*

**Reasoning against a positive effect –** Apart from the argumentation for a positive relationship of supervisory board gender diversity and management board gender diversity, there are also theoretically derived concerns that the effects might be negative. Hence, it is not clear whether female leaders actively promote other women's careers (Staines et al., 1974). Not to ignore the conflicting theory, this study also introduces the implications of the "queen bee syndrome". This theory contradicts the assumption that women are natural allies because it assumes that women are more likely to distance themselves from other women to defer to a masculine culture to avoid risking their own position (Kanter, 1977a, 1987; Staines et al., 1974). In other words, queen bee behaviour does worsen the "anti-female bias" (Arvate et al., 2018) because female leaders are less likely to support female talents. In addition, there is empirical evidence for male decision makers becoming less favourable toward female candidates once a women joins the decision making body (Bagues, Sylos-Labini, & Zinovyeva, 2017). Additional support for the queen

bee theory stems from the idea that women in boardroom positions have completely different traits and preferences than the average female population. If so, female supervisory board members might be more like their male colleagues in the same positions (Adams & Funk, 2012). As a consequence, female supervisory board members might be more critical towards potential female management board members and therefore might be less likely to support them (Nieva & Gutek, 1981). Apart from that, there are concerns about a potential supply-side shortage of qualified female talents for board positions because of women having different preferences and career aspirations (Marianne Bertrand, Goldin, & Katz, 2010; A. R. Miller, 2011; Niederle & Vesterlund, 2007).

#### *4.3.1.3 Impact of quota legislation*

This study also focuses on analysing the impact of quota legislation on the financial performance and on the management board gender diversity level. The hypotheses development for the impact of the quota legislation is grounded in theoretical as well as practical considerations, which is in line literature in this area (see table 8).

**Qualified female candidates are short in supply –** Gender quota legislation might also have an impact on the firm performance because of the costs for the firm coming with the implementation. For example, the recruitment of additional female supervisory board members leads to additional recruitment costs. At the same time, there is no indication that the newly recruited supervisory board members are as qualified as the incumbents (Ferreira, 2015b). If firms are forced to hire less qualified supervisory board members, this might negatively impact the overall quality of the board and consequently might translate into an adverse firm performance (Dale-Olsen et al., 2013).

Accordingly, one major reasoning against an introduction of mandatory gender quotas is the concern that the supply of qualified female candidates is not enough. Thus, there is also a threat of "over-boarding" the qualified female supervisory board members (Bennouri, De Amicis, & Falconieri, 2020).

**Firms choose boards to maximise value –** Standard economic theory predicts that firms staff their supervisory boards to maximise profits. Consequently, the supervisory boards already consider the optimal gender balance prior to the intro-

duction of gender quotas. Hence, assuming that the firms are at a point where profits are maximised, a mandated increase of the share of women on the supervisory board might negatively impact the firm performance and value (Demsetz & Lehn, 1985). Mandating an increase of supervisory board gender diversity may change the nature of board member selection and also have direct effects on further dimensions, such as the average competence or the number of members that are new to the board (Matsa & Miller, 2013). This, in turn, might even further shift the board composition away from the point where profits were maximised (Becker, 1957).

**Risk of tokenism –** There is a threat that quotas are seen as a form of tokenism (Nekhili & Gatfaoui, 2013). Consequently, the negative consequences of the tokenism phenomenom, such as a relatively weak position and less influence on decisions and outcomes, might plague the mandated female supervisory board members. In other words, it is questionable that the female supervisory board members, who have been appointed because of the law, have the same influence and authority within the board. Interestingly, Bozhinov, Koch, & Schank (2017, 2019), who analyse the role of women on German supervisory boards, confirm this view and report that women are underrepresented in senior board positions.

To conclude, this study predicts that the gender quota adversely impacted the financial performance of the firms concerned.

*H5: The implementation of the gender quota legislation is negatively related with the firm's financial performance*

**Firms try to escape institutional pressure –** Another frequently debated topic in the context of gender quotas is the question whether there is a positive impact of the reform on the female presence in management layers beyond the regulated boards. The German reform forces firms that fall under the law to achieve a mandatory gender quota of at least 30 percent on the supervisory board. In addition, the affected firms need to define a target gender quota for the management board and also report on the progress of achieving this target. However, there neither are statutory provisions regarding the target gender quota for the management board nor any penalties attached to it. Therefore, these target gender quotas can also be understood as voluntary quotas (Masulis et al., 2012; Sojo, Wood, Wood, & Wheeler, 2016). Despite the objective of the target quota to increase the number of female management board members, it might adversely impact this ambition because of its voluntary character (Bozhinov, 2018). This argument is based on the

prediction of institutional theory, which states that firms tend to develop strategic responses to resist institutional pressure (Oliver, 1991). In addition, there is evidence that supports the view that voluntary quotas are less effective compared to mandatory quotas (Bennouri et al., 2020).

For example, Ahern & Dittmar's (2012) and Bøhren & Staubo's (2014) results support the prediction of institutional theory by demonstrating that companies tended to avoid the pressure and the scope of the quota legislation by changing their organisational form. Accordingly, the affected firms in Germany may aim for a minimum target gender quota for the management board to avoid any additional pressure. Several reports support this theory and show that numerous German companies defined low target quotas for the management board (i.e. Allen & Overy, 2017; Ankersen & Berg, 2019). In 2019, more than 50 of the 160 DAX, MDAX, and SDAX companies reported a target gender quota for the management board of zero percent (Ankersen & Berg, 2019).

**Qualified female candidates are short in supply –** The explanation for that development might also be attached to an alleged scarcity of qualified women. If the supply of qualified female candidates is short, then the firms might focus on recruiting the top female candidates for the supervisory board to comply with the mandatory quota, instead of appointing them to the management board, which would not help to achieve compliance with the law.

Therefore, this study predicts that the additional pressure coming from the gender quota does not promote management board gender diversity.

*H6: The implementation of the gender quota legislation does not increase the number of female management board members*

Table 9 summarises the hypotheses of this dissertation.

| **Summary of hypotheses** | |
|---|---|
| Impact of supervisory board gender diversity on financial performance | |
| H1 | *The share of female supervisory board members is positively related to the firm's financial performance.* |
| H2 | *A critical mass of three or more women on the supervisory board is positively related to the firm's financial performance.* |
| Impact of supervisory board gender diversity on management board | |
| H3 | *The share of female supervisory board members is positively related to the number of the female management board members.* |
| H4 | *A critical mass of three or more women on the supervisory board is positively related to the number of female management board members.* |
| Impact of gender quota legislation | |
| H5 | *The implementation of the gender quota legislation is negatively related with the firm's financial performance.* |
| H6 | *The implementation of the gender quota legislation does not increase the number of female management board members.* |

**Table 9: Overview of hypotheses**

# 5 EMPIRICAL STUDY

## 5.1 DATA AND DESCRIPTIVE STATISTICS

### 5.1.1 Data collection process and data preparation for further analysis

This dissertation was designed as a panel study and tested the hypotheses based on data of listed German companies over the observation period 2011-2018. More specifically, this dissertation focuses on stock companies listed in the regulated market and the DAX Composite Index, which comprises all German companies listed in the Frankfurt stock exchange. These companies adhere to the "General Standard" and the "Prime Standard" (highest levels of reporting transparency).[1]

The data collection process included three iterations to build a database that eventually combines information from different data sources. In the following, the process is described in more detail.

**First iteration** – Initially, a report of the equities listed in the DAX Composite Index (CDAX) was sourced from the Thomson Reuters Eikon database at June 6th, 2019. The report included 412 companies in total. The CDAX includes all German companies in the Prime Standard and General Standard and therefore covers the full spectrum of the German equities market (Group Deutsche Börse, n.d.). As a second step, the list was matched with the companies included in the annual studies "Women-on-Board-Index" of the association FidAR for the years 2011-2018. These studies compiled publicly available data and also used databases to analyse the gender related information of the supervisory boards and the management boards of the 160 DAX, MDAX, SDAX, and TecDAX companies starting in 2011. The DAX indices require the "Prime Standard" (highest level of transparency) and consist of the largest and most important companies in Germany. In total, the "Women-on-Board-Index" studies included more than 160 companies in the given

[1] Companies beyond these segments could not be considered. They lacked reporting transparency regarding the necessary information and therefore offered limited data availability.

timeframe because the companies listed in the indices changed over time. Since 2017, the studies also included 25 and since 2018 26 additional companies that are publicly listed in the regulated market and that are equally co-determined.

**Second iteration** – After that, the information of the CDAX list and the annually produced "Women-on-Board-Index" studies are consolidated into one database. This process led to a sample of 427 companies. Then, foreign-domiciled companies and companies with the one-tier set-up were excluded because of the focus of this dissertation on German listed companies with the two-tier corporate governance set-up. In addition, companies which were insolvent, acquired, merged, or no longer separately managed in the period 2011-2018 were also excluded. After the data cleansing according to the described criteria 350 firms and 2580 firm-years remain.

**Third iteration** – In the next iteration, the database was completed by adding further panel data information on the company and its performance, which were downloaded from Thomson Reuters Datastream. Subsequently, the sample was reviewed to identify missing values. The sourced data from Thomson Reuters Datastream did not contain all panel data information on the companies and their performance for the total sample and for the complete observation period. Consequently, the companies that did not have the complete data for the variables within the scope of the models were excluded for quality reasons. Finally, the sample was reviewed to identify missing values regarding the gender diversity of the supervisory boards and the management boards. When missing values were identified, a manual research in the annual reports of the companies was conducted to complement the gaps in the panel.

**Full sample** – The data collection process resulted in a sample of 2440 firm-year observations covering information about a total of 305 companies over eight years (see figure 12). This sample is the basis for the models with the gender diversity level of the management board as the dependent variable.

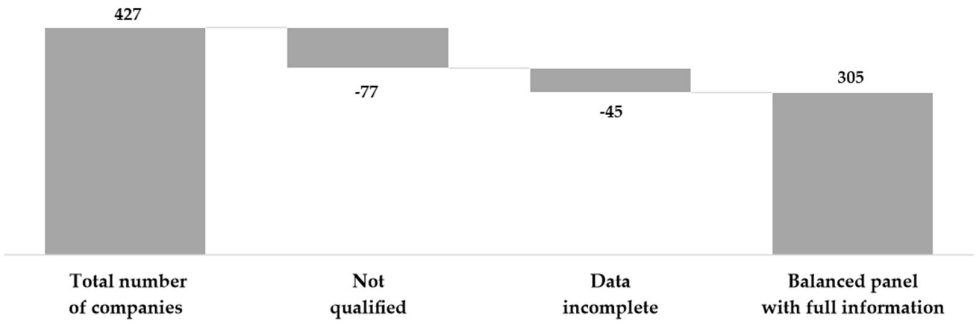



**Figure 12: Sample and data collection process for full sample**

**Representativeness** – In general, samples must represent the characteristics of the population to allow for a generalisation of the results (Hair, Black, Babin, & Anderson, 2010). The aim of this study is to generate and test data that is representative for the population of the German CDAX companies with a two-tier set-up. In order to test the sample for representativeness, it is tested for its industry representativeness because this is a frequently used criterion in business studies (Homburg & Giering, 1996). The information about the industry sector is available for both the sample and the population (see appendix).

To test if the sample represents the industry characteristics of the population a chi-square ($\chi^2$) test for homogeneity of the sample and the population is conducted (Bortz & Schuster, 2010). Figure 13 illustrates the distribution of industry frequencies of the sample and the population of 350 qualified firms.

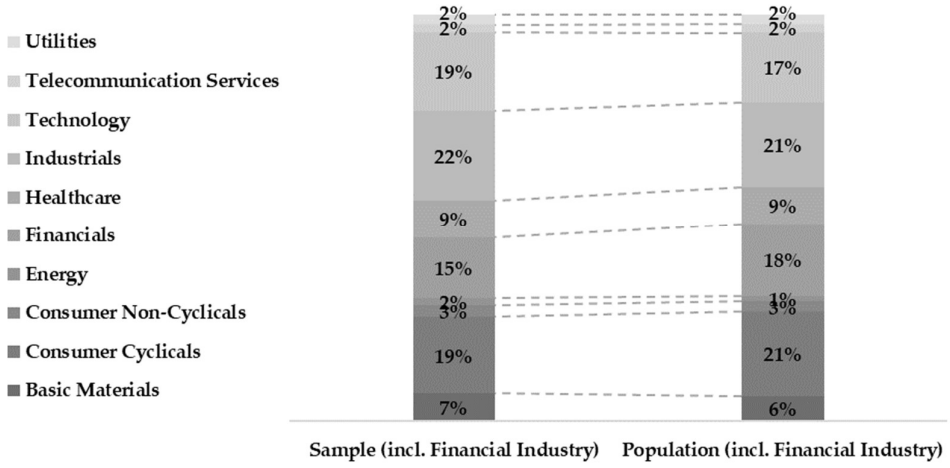



**Figure 13: Distribution of the full sample and population by industry**

Because of two industries having less than five expected frequencies the industries "Energy" and "Telecommunication Services" are added to one group for the $\chi^2$ test. The $\chi^2$ value is 1.64 (see table 10) and therefore the null hypotheses that the sample distribution equals the population distribution can be accepted at the 0.01 significance level, indicating that the sample is representative for the industry characteristics of the population.

| | N | $\chi^2$ | Df | p-value |
|---|---|---|---|---|
| Full Sample | 305 | 1.64 | 8 | 0.99 |

**Table 10: Results of chi-square ($\chi^2$) test for homogeneity**

**Sub-sample** – In line with the guidance of the literature analysing the impact of board gender diversity on the financial performance, companies in the financial industry, such as banking, investment services, insurance, or real estate, are excluded from the sample to avoid that the particular features of these firms are biasing the results (Bennouri et al., 2018; Liu, Wei, & Xie, 2014; Matsa & Miller, 2013; Sila, Gonzalez, & Hagendorff, 2016). Accordingly, an additional sub-sample is created, which excludes companies operating in the financial industry. This sample is the basis for the models with the financial performance as the dependent variable.

**Variable transformation** – After the data collection process and the creation of the samples, the data is transformed in order to proceed with the analyses. In line with the literature (i.e. Matsa & Miller, 2013), financial variables are winsorized at the 1 percent tails. Also, the number of employees is transformed using the natural logarithm. Table 11 summarises the variable transformation.

| **Variable** | **Variable transformation** |
|---|---|
| Employees | X → log(x) |
| Price volatility | Winsorized at the 1% and 99% levels |
| Leverage | Winsorized at the 1% and 99% levels |
| Sales growth | Winsorized at the 1% and 99% levels |
| ROA | Winsorized at the 1% and 99% levels |
| P2B | Winsorized at the 1% and 99% levels |

**Table 11: Variable transformation**

### 5.1.2 Definition of variables

#### *5.1.2.1 Independent variables – female supervisory board representation*

In this study, different models are specified. Nevertheless, the presence of women on the supervisory board is the key independent variable of interest. It is measured following the majority of the empirical literature in this field (Post & Byron, 2015). Hence, female supervisory board representation is measured by the share of female supervisory board members. The share of female supervisory board members is calculated as the number of female supervisory board members divided by the total number of members on the supervisory board.

In addition, this study tests the critical mass assumption for female supervisory board members. To do this, the sample was divided in two groups considering the existence of a critical mass by creating a dummy variable (0/1) to compare firms with a critical mass of at least three female members with those that have less than three female members. The dummy was coded so that it has the value '1' if a case has a critical mass of three or more women, and '0' if not.

In case of new elections and/or appointments of board members only the individuals that served the board in that year for more than six months were included.

#### *5.1.2.2 Dependent variables – firm performance measures and female management board representation*

**Firm performance** – In line with the empirical literature, this study measures firm financial performance based on accounting returns and market performance. The literature states that both dimensions shall be considered due to the multi-dimensionality of firm performance (Combs, Crook, & Shook, 2005; C. C. Miller, Washburn, & Glick, 2013). Accounting returns indicate how a firm utilises its resources and represents past or short-term performance (Combs et al., 2005; Gentry & Shen, 2010). This study relies on the return on assets (ROA) as accounting measure, which is also the dominantly used indicator in the literature (Post & Byron, 2015; Velte, 2017). This also ensures a comparability with other studies.

The ROA is calculated as follows:

(Net Income Bottom Line + ((Interest Expense on Debt-Interest Capitalized) *

(1-Tax Rate))) / Average of Last Year's and Current Year's Total Assets * 100

The interpretation is that a higher ROA is an indicator for higher earnings.

In addition, the capital market performance perspective considers the development of an equity or a security in the marketplace and therefore reflects the expectations and perceptions of the firm's future and long-term development of the capital market. This study uses the Price-to-Book (P2B) value as the measure for the capital market performance (Lindstädt, Wolff, & Fehre, 2011). The P2B value captures the capital market perception of the firm's future development, which is dependent on the board's compositions and decision-making. Hence, gender diverse boards potentially influence this measure because of a different market perception.

The P2B value is calculated as follows:

Market Price-Year End / Book Value Per Share

The interpretation is that a value between zero and one indicates that a company's share price is below the actual valuation of its assets (share is undervalued). A value of one indicates that the share price equals the valuation of the assets. A value higher than one indicates that the share price is higher than the valuation of the assets (share is overvalued). It must be noted, that market based measures can be compromised by stock market distortions (Velte, 2017).

Thus, the financial performance is measured with a past and short-term oriented variable as well as a forward-looking and long-term oriented variable to cover both dimensions of firm performance.

**Female management board representation** – The two-tier corporate governance system is the traditional set-up for stock companies in Germany. Therefore, two boards, the supervisory board (non-executive) and the management board (executive), are relevant. This dissertation also analyses whether there is a trickle-down effect of supervisory board gender diversity on the management board. Female management board representation is measured by the share of female management board members. The share of female management board members is calculated as the number of female management board members divided by the total number of members on the management board.

*5.1.2.3 Control variables*

To address the hazard of spurious correlations caused by omitting important independent variables, it is necessary to include control variables. In this study, control variables at the industry, firm, and board level are included.

**Models analysing the impact on the firm performance** – This study follows the literature and controls for variables that are likely to correlate with firm performance. The included control at the industry level is the industry classification (based on the Thomson Reuters Business Classification). This is necessary because the relationship between gender diversity and firm performance may not be consistent across different industries (Chapple & Humphrey, 2014; Lindstädt et al., 2011). The included control variables at the firm level are the firm size, proxied by the number of employees, the sales growth, the leverage, proxied by the ratio of debt to assets, and the share price volatility (Miller & Triana, 2009; Terjesen, Couto, & Francisco, 2016). This study also controls for the fact that the relationships might be impacted by the firm's exposure regarding public attention and quota legislation. To do this, a dummy variable is created. The dummy was coded so that it has the value 1 if the firm is within the scope of the quota, and 0 if not. The literature also discusses a potential relationship between performance and corporate governance quality (Adams et al., 2010). This study uses the board size, proxied by the number of supervisory board members, to control for this relationship (Bennouri et al., 2018).

**Models analysing the impact on the gender diversity on the management board** – This dissertation addresses the risk that the relationship between supervisory board and management board gender diversity might be impacted by the firm's exposure as regards public attention and quota legislation. To do this, a dummy variable is created. The dummy was coded so that it has the value 1 if the firm is within the scope of the quota, and 0 if not. In addition, this study controls for the impact of the industry sector (Matsa & Miller, 2011) using the Thomson Reuters Business Classification code, and the firm size, proxied by the number of employees, to control for potential supply-side factors at the industry and firm level. Lastly, the supervisory board size is included to control for the effect of larger boards.

Table 12 summarises the variables and their definitions.

| Variable | Measure |
|---|---|
| *Firm performance* | |
| ROA* | Ratio of operating income to total asset |
| P2B* | Market price-year end / book value per share |
| *Management board* | |
| Female executives | Share of female management board members |
| *Supervisory board* | |
| Female directors | Share of female supervisory board members |
| Critical mass dummy | Dummy variable that takes the value of 1 if the company has a critical mass of at least 3 female supervisory board management members and 0 otherwise |
| *Difference-in-differences estimation* | |
| Quota** | Dummy variable that takes the value of 1 if the company is within the scope of the quota and 0 otherwise |
| Time** | Dummy variable that takes the value of 1 if post inception of the gender quota (starting with 2015) and 0 if before 2015 |
| *Control variables* | |
| Firm size | Natural logarithm of the number of employees |
| Sales growth* | Percentage growth in reported sales between year t and year t-1 |
| Leverage* | Ratio of total debt to total assets |
| Price volatility* | Percentage stock's average annual price movement to a high and low from a mean price for each year |
| Industry | Dummy variable that takes the value of 1 if the company belongs to the sector in question and 0 otherwise. The industry classification is based on the Thomson Reuters Industry Classification |
| Quota | Dummy variable that takes the value of 1 if the company is within the scope of the quota and 0 otherwise |
| Board size | Number of supervisory board members |

**Table 12: Definitions of variables**

Note: *Variables are winsorized at the 1% and 99% levels; **for difference-in-difference models only

### 5.1.3 Descriptive statistics

#### 5.1.3.1 *Full sample*

Table 13 shows the descriptive statistics for the panel of 305 firms and 2,440 firm-year observations over the period 2011-2018. The firms' average ROA and P2B are 2.77 and 2.33 respectively. For female board representation the average share of female supervisory board members is 14%. This translates in an average of 1.37 women on the supervisory board. The average share of female management board members is 4%, which translates into 0.15 women per management board.

| | Number of obs. | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|
| *Firm characteristic* | | | | | |
| Employees | 2,440 | 18,025 | 59,880 | 1 | 664,496 |
| Log(employees) | 2,440 | 3.13 | 1.13 | 0 | 5.82 |
| Sales growth | 2,411 | 0.19 | 1.05 | -0.65 | 9.37 |
| Leverage | 2,347 | 21.35 | 20.51 | 0.01 | 112.27 |
| Price volatility | 2,282 | 29.25 | 10.01 | 11.66 | 58.58 |
| ROA | 2,332 | 2.77 | 13.75 | -70.06 | 28.49 |
| P2B | 2,351 | 2.33 | 2.53 | -4.35 | 14.75 |
| *Management board characteristic* | | | | | |
| # female management board members | 2,440 | 0.15 | 0.40 | 0 | 5 |
| % female management board members | 2,440 | 0.04 | 0.11 | 0 | 100 |
| *Supervisory board characteristic* | | | | | |
| Board size | 2,440 | 7.88 | 5.38 | 3 | 21 |
| # female supervisory board members | 2,440 | 1.37 | 1.74 | 0 | 9 |
| % female supervisory board members | 2,440 | 0.14 | 0.14 | 0 | 1 |
| # Critical mass dummy | 2,440 | 0.21 | 0.40 | 0 | 1 |

**Table 13: Descriptive statistics of time varying variables**

To investigate the trend of female boardroom presence, the historical development is analysed in Table 14. Since 2011, the female representation is higher on the supervisory board than on the management board. Comparing 2011 to 2018, the share of female representation more than doubled from 8 percent to 19 percent on the supervisory board and tripled from 2 percent to 6 percent on the management board. This translates into an average increase of the number of female supervisory board members by 1.20, whereas the increase of the average number of female management board members is clearly less than one member with 0.16.

Also, the number of firms with a critical mass of at least three female supervisory board members more than tripled over the observation period. The highest year-on-year growth for the number of female supervisory board occurs from 2015 to 2016 (year of quota implementation).

| Year | n | CM yes | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|---|
| Number/share of female supervisory board members | | | | | | |
| 2011 | 305 | 29 | .78/.08 | 1.21/.12 | 0/0 | 6/.67 |
| 2012 | 305 | 36 | .94/.09 | 1.34/.12 | 0/0 | 8/.67 |
| 2013 | 305 | 48 | 1.11/.11 | 1.48/.14 | 0/0 | 8/1.0 |
| 2014 | 305 | 49 | 1.20/.12 | 1.51/.13 | 0/0 | 7/.67 |
| 2015 | 305 | 61 | 1.36/.14 | 1.64/.13 | 0/0 | 8/.67 |
| 2016 | 305 | 88 | 1.76/.17 | 1.96/.15 | 0/0 | 8/.67 |
| 2017 | 305 | 93 | 1.84/.18 | 2.02/.15 | 0/0 | 9/.67 |
| 2018 | 305 | 97 | 1.98/.19 | 2.13/.16 | 0/0 | 9/.67 |
| Total | 2,440 | 501 | 1.37/.14 | 1.74/.14 | 0/0 | 9/1.0 |
| Number/share of female management board members | | | | | | |
| 2011 | 305 | | .08/.02 | .28/.09 | 0/0 | 2/.50 |
| 2012 | 305 | | .10/.03 | .31/.10 | 0/0 | 2/.50 |
| 2013 | 305 | | .14/.04 | .37/.10 | 0/0 | 2/.50 |
| 2014 | 305 | | .15/.04 | .38/.11 | 0/0 | 2/.50 |
| 2015 | 305 | | .15/.04 | .39/.12 | 0/0 | 2/1.0 |
| 2016 | 305 | | .18/.04 | .42/.11 | 0/0 | 2/.50 |
| 2017 | 305 | | .19/.05 | .44/.12 | 0/0 | 2/1.0 |
| 2018 | 305 | | .24/.06 | .54/.13 | 0/0 | 5/1.0 |
| Total | 2,440 | | .15/.04 | .40/.11 | 0/0 | 5/1.0 |

**Table 14: Development of female boardroom presence**

Furthermore, table 15 analyses the female representation based on the industry. The highest average share of female supervisory board members is 21 percent in the healthcare sector, whereas the highest average share of female management board members is 7 percent in the financial sector. The industry with the lowest female supervisory board representation is the technology sector (8 percent). For the female management board representation, the Energy sector has the lowest share of 0 percent female management board representation.

| Industry Sector | Mean share of female supervisory board members | Mean share of female supervisory board members |
|---|---|---|
| Energy, n = 40 | 12% | 0% |
| Basic Materials, n = 168 | 16% | 3% |
| Industrials, n = 536 | 14% | 4% |
| Consumer Cyclicals, n = 456 | 14% | 2% |
| Consumer Non-Cyclicals, n = 72 | 16% | 5% |
| Financials, n = 368 | 13% | 7% |
| Healthcare, n = 224 | 21% | 6% |
| Technology, n = 472 | 8% | 4% |
| Telecom. Services, n = 48 | 21% | 4% |
| Utilities, n = 56 | 15% | 1% |

**Table 15: Female board representation based on the industry sector**

Table 16 explores the relationship between the number and share of female supervisory board members and the number and share of female management board members. The pattern supports the idea that female supervisory board representation has trickle-down effects on the management board because an increase of the number or share of female supervisory board members is accompanied by an increase of the number or share of female management board members. The increase is especially noticeable, if the number of female supervisory board members exceeds three members, or if the share is higher than 40 percent.

| Mean number of female supervisory board members | Mean share of female management board members |
|---|---|
| 0 (n = 1,057) | 0.09 |
| 1 (n = 584) | 0.11 |
| 2 (n = 297) | 0.14 |
| 3 (n= 167) | 0.19 |
| More than 3 (n = 335) | 0.42 |
| **Mean share of female supervisory board members** | **Mean share of female management board members** |
| Less than 10% (n = 1,174) | 3.1% |
| 10% to 20% (n = 489) | 3.9% |
| 20% to 30% (n = 261) | 4.0% |
| 30% to 40% (n = 432) | 5.6% |
| 40% or greater (n = 84) | 9.1% |

**Table 16: Number/share of female management board members as a function of number/share of female supervisory board members**

Finally, table 17 presents the pair-wise correlation matrix between time-varying variables. Concerning correlations with the dependent variable P2B, the quota (r = -.08****), the board size (r = -.09****), the leverage (r = -.22****), and the critical mass variable (r = -.04*) are slightly negatively related. The share of female supervisory board members (r = .02) is not significantly related with the P2B. Regarding the dependent variable ROA, the sales growth (r = -.05*) and the leverage are slightly negatively related (r = -.06**), whereas the price volatility (r = -.35****) is moderately negatively related. The critical mass (r = .07***), the quota (r = .10****), the board size (r = .11****), and the Log(employees) (r = .29****), are slightly positively related with the ROA. The share of female supervisory board members (r = -.01) is not significantly related with the ROA. Apart from that, the share of female supervisory board members (r = .10****) and the critical mass variable (r = .10****) are positively related with the share of female management board members

Looking at the interrelations of the main explanatory variable share of female supervisory board members, it is moderately positively related to the critical mass (r = .57****), the quota (r = .32****), the board size (r = .38****), and slightly positively with the Log(employees) (r = .29****). This is plausible because bigger firms, in terms of number of employees, typically have larger boards, are within the scope

of the quota legislation, and thus, have a higher degree of gender diversity. Moreover, the share of female supervisory board members is slightly negatively related to the price volatility (r = -.18****).

Looking at the interrelations of the control variables, the board size is strongly positively correlated with the quota (r = 0.85****), the critical mass (r = 0.68****), and the Log(employees) (r = 0.74****). The quota and the critical mass are also strongly correlated (r = 0.60****). To control for the risks as a result of multicollinearity, the variance inflation factors (VIF) are calculated. The VIF value of the board size (VIF = 5.43) exceeds the recommend threshold of < 5 (Daoud, 2017). To avoid the inflation of the coefficients, the board size is excluded in the following regression analyses. After the exclusion of the board size variable, the highest VIF value is at 2.61 (not tabulated) and thus there is no multicollinearity problem left.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | VIF |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1) P2B | | | | | | | | | | | |
| 2) ROA | 0.09**** | | | | | | | | | | |
| 3) % female management board members | 0.02 | -0.09**** | | | | | | | | | |
| 4) % female supervisory board members | 0.02 | -0.01 | 0.10**** | | | | | | | | 1.43 |
| 5) Critical mass | -0.04* | 0.07*** | 0.10**** | 0.57**** | | | | | | | 2.38 |
| 6) Quota | -0.08**** | 0.10**** | 0.03 | 0.32**** | 0.60**** | | | | | | 3.98 |
| 7) Board size | -0.09**** | 0.11**** | 0.08*** | 0.38**** | 0.68**** | 0.85**** | | | | | 5.43 |
| 8) Log(employees) | -0.01 | 0.29**** | -0.03 | 0.29**** | 0.49**** | 0.67**** | 0.74**** | | | | 3.09 |
| 9) Sales growth | -0.02 | -0.05* | 0.01 | -0.03 | -0.04* | -0.08*** | -0.08**** | -0.17**** | | | 1.04 |
| 10) Price volatility | 0.00 | -0.35**** | 0.05* | -0.18**** | -0.28**** | -0.25**** | -0.35**** | -0.47**** | 0.15**** | | 1.38 |
| 11) Leverage | -0.22**** | -0.06** | -0.02 | -0.03 | 0.07*** | -0.01 | 0.04 | -0.01 | -0.03 | 0.09**** | 1.06 |

**Table 17: Pair-wise correlation matrix and VIF values**

Note: **** significant at < 0.0001; *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1

5.1.3.2 *Sub-sample excluding financial sector*

Excluding the firms operating in the financial sector (sub-sample) the average ROA and P2B are 2.86 and 2.46 respectively. The average share of female supervisory board members remains at 14 percent and the average number of women is slightly lower with 1.36 women (not tabulated).

Table 18 compares firm-level characteristics for the sub-sample excluding the financial sector for firm-years in which firms have a at least one female supervisory board member to firm-years with no female supervisory board members. It shows that in years in which firms have at least women on the supervisory board, the firm size and the board size are (significantly) larger, which is in line with the literature (Adams & Ferreira, 2009; Bennouri et al., 2018) and that the price volatility is (significantly) lower. The leverage and the sales growth are (not significantly) different. Interestingly, ROA and P2B are also not statistically different, whereas the number and share of female management board members are (significantly) higher in firms that have at least women on the supervisory board.

| Firm characteristic | Mean for firms with female directors | Mean for firms without female directors | t-test (Welch) |
|---|---|---|---|
| ROA | 3.14 (n = 1.170) | 2.46 (n = 833) | 1,04 |
| P2B | 2.48 (n = 1.176) | 2.43 (n = 843) | 0,45 |
| Price volatility | 27.58 (n = 1.145) | 31.62 (n = 828) | -9,07*** |
| Leverage | 19.58 (n = 1.181) | 19.83 (n = 834) | -0,28 |
| Log(employees) | 3.63 (n = 1.210) | 2.71 (n = 862) | 22,51*** |
| Sales growth | 0.16 (n = 1.202) | 0.17 (n = 852) | -0,38 |
| Board size | 10.49 (n = 1.210) | 4.52 (n = 862) | 32,71*** |
| # Female management board members | 0.17 (n = 1.210) | 0.08 (n = 862) | 5,99*** |
| % Female management board members | 0.039 (n = 1.210) | 0.027 (n = 862) | 2,68*** |

**Table 18: Comparing firms with female supervisory board members to firms without**

Note: **** significant at < 0.0001; *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1

Table 19 explores the relationship between female supervisory board representation and the performance measures ROA and P2B for the sub-sample that excludes all firms operating in the financial sector. The ROA pattern supports the

prediction of the critical mass theory because the increase in the number of female supervisory board members is accompanied by an increase of ROA once three or more women are on the board. If there are only one or two female "tokens" on the board the ROA decreases. However, this pattern in not confirmed when focusing on the P2B. The P2B increases with one female supervisory board member, but it drops when the number of female members increases. The lowest P2B value is at three female members. Conversely, when looking at the share of female supervisory board members the relationship changes for ROA and P2B. The pattern for the ROA becomes ambiguous, but the P2B has the highest values once the share of female members exceeds 20%.

This suggests that the effect of supervisory board gender diversity might not be the same for the ROA and P2B. Also, the effect is not uniformly across different measures of gender diversity on the supervisory board.

| Number of women on the supervisory board | ROA | P2B |
|---|---|---|
| 0 (n = 862) | 2.46 | 2.43 |
| 1 (n = 532) | 1.89 | 2.68 |
| 2 (n = 262) | 2.12 | 2.39 |
| 3 (n= 139) | 3.94 | 2.06 |
| More than 3 (n = 277) | 6.1 | 2.40 |
| Share of women on the supervisory board | | |
| 0 (n = 862) | 2.46 | 2.43 |
| 0%<10% (n = 125) | 5.61 | 2.02 |
| 10%<20% (n = 483) | 3.25 | 2.38 |
| 20%<30% (n = 214) | 5.06 | 2.53 |
| >30% (n = 388) | 1.08 | 2.72 |

**Table 19: Firm performance as a function of female supervisory board representation**

#### 5.1.3.3 *Matched vs. unmatched samples*

Table 20 compares the descriptive statistics of firms within the scope (treatment group) with firms outside the scope (control group) of the quota legislation. Not surprisingly, firms within the scope are generally larger, and consequently have more employees, larger boards, and more female board members. This is no surprise because the gender quota applies for firms that are publicly listed and that have more than 2,000 employees.

To reduce the differences in the observed characteristics between the two groups as much as possible, nearest neighbour propensity score matching with a 1:1 ratio for each firm-year observation using the R package "MatchIt" is performed. Firstly, a logistic regression model is estimated. The binary dependent variable measures whether or not a firm falls under the quota legislation. All governance and control variables available in the respective sample as well as the industry classification are included in the logit equation. Secondly, after each firm's propensity score is calculated, the firms are then matched with a respective control firm using the near neighbour matching procedure. This method matches the firms within the scope of the quota with firms outside the scope based on the smallest absolute difference between their predicted propensity scores (Olmos & Govindasamy, 2015). The results of the matching procedure are also included in table 22. The firms are still different based on the observed criteria, but the differences are smaller after the matching exercise. This suggests that the matched samples better control for heterogeneity between the sub-samples.

| | Unmatched | | Matched | | Matched | | Matched | |
|---|---|---|---|---|---|---|---|---|
| | | | ROA | | P2B | | Number female mgt. board members | |
| In scope of the quota | yes | no | yes | no | yes | no | yes | no |
| ROA | 4.94 | 1.83 | 5.25 | 5.76 | | | | |
| P2B | 2.01 | 2.46 | | | 2.13 | 2.73 | | |
| Price volatility | 25.30 | 30.88 | 25.38 | 27.56 | 25.35 | 27.58 | | |
| Leverage | 20.97 | 21.51 | 21.08 | 19.12 | 21.13 | 19.22 | | |
| Log(employees) | 4.28 | 2.63 | 4.3 | 3.34 | 4.3 | 3.34 | 4.28 | 3.33 |
| Sales growth | 0.06 | 0.24 | 0.06 | 0.15 | 0.06 | 0.15 | | |
| Board Size | 14.86 | 4.86 | 14.6 | 5.71 | 14.59 | 5.68 | 14.86 | 5.99 |
| # Female supervisory board members | 3.12 | 0.61 | 3 | 0.73 | 3 | 0.74 | 3.12 | 0.84 |
| % Female supervisory board members | 0.21 | 0.11 | 0.2 | 0.11 | 0.2 | 0.11 | 0.21 | 0.12 |
| Critical mass | 0.57 | 0.05 | 0.56 | 0.06 | 0.56 | 0.06 | 0.57 | 0.1 |
| # Female management board members | 0.25 | 0.11 | 0.22 | 0.08 | 0.22 | 0.08 | 0.25 | 0.11 |
| % Female management board members | 0.04 | 0.04 | 0.04 | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 |
| # Companies | 92 | 213 | 80 | 95 | 80 | 92 | 92 | 115 |

**Table 20: Descriptive statistics of unmatched and matched samples**

Figure 14 graphically shows the historical development of the average P2B, the average ROA, the average number of female management board members, and the average number of female supervisory board members for the unmatched and matched samples over the observation period 2011-2018, and compares firms within the scope of the quota legislation with firms outside the scope. Focusing on the P2B, there is a similar and close to parallel trend for firms in and outside the scope of the quota for the unmatched sample in the period prior to the quota implementation. Starting from 2015 onwards, the development for firms outside the scope of the quota is more positive. The same applies for the matched sample because the trend after the quota implementation remains positive for firms outside the scope of the quota, whereas there is not a similar positive trend for firms within the scope of the quota. Focusing on the ROA, there is a similar downward trend for both groups for the unmatched sample in the years 2011-2015. After 2015, there is

a strong positive increase for firms outside the scope of the quota, which is not the case for firms within the scope of the quota. For the matched sample, the ROA develops very closely for both groups. Again, the trend is more favourable for firms outside the scope of the quota in the years after the quota implementation. Looking at the trend lines regarding the average number of female management board members, the development in both samples is largely parallel in the period before the quota and then becomes more positive for the firms within the scope of the quota. The same applies for the average number of female supervisory board members with a noteworthy uptick from 2015-2016, indicating the impact of the quota.

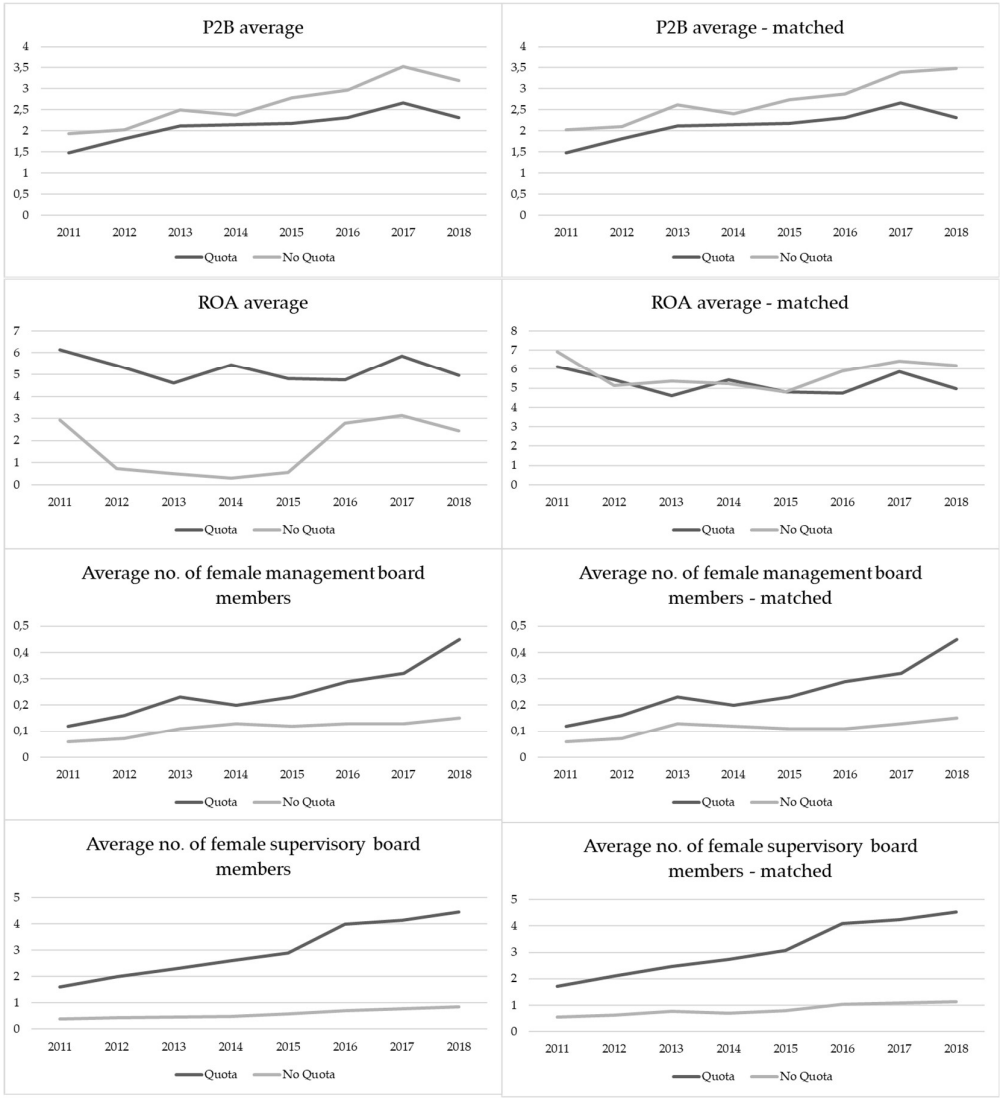



**Figure 14: Trend analysis treatment vs. control group**

## 5.2 CONSIDERATIONS ON RESEARCH METHODOLOGY

### 5.2.1 Research design, causality, and endogeneity problems

To answer the research questions and to test the hypotheses of this dissertation requires quantitative research to be able to assess the strength and significance of the associations between female supervisory board representation or the gender quota implementation and the financial performance or the female representation on the management board respectively. In addition, to understand causality is a particularly important task of this study.

At the same time, addressing concerns regarding causality remains a major challenge for causal inference in this field of research. Despite the fact that the statistical tools have matured, they still have critical assumptions that do not always hold in empirical research. Even though the tools might not be perfect, applying them also influences the thinking. While understanding causality is important in general, it has particular relevance when it comes to the discussion about the impact of board gender diversity. Both negative and positive stereotypes create unrealistic expectations for female directors. Against this background, it is important to identify causal effects using the best methodologies and approaches possible in order to shape the discussion towards realistic relationships and to help solving the problems coming with wrong stereotypes (Adams, 2016).

The best way to produce causal evidence and to avoid threats of endogeneity is to conduct randomised experiments because they eliminate endogeneity by experimental design. Unfortunately, randomisation is not possible in most cases in social sciences research. Therefore, social scientists often apply and argue based on models from correlational data. Such nonexperimental models, in turn, require certain design and estimation conditions to allow for causal interpretation. Consequently, the threat that the assumptions of the methods applied are violated need to be addressed accordingly to be able to generate valid and interpretable results (Antonakis et al., 2010). However, the threat of endogeneity is not addressed consequently in leadership and management studies, despite its importance. That said, reporting parameter estimates that might be inconsistent as a result of endogeneity does not help to explain the phenomenon because they will not reflect the true population parameter. In other words, in the presence of endogeneity the parameter

estimates are inconsistent because the true relation may differ. This means that the true relation might be completely different (lower, higher, zero, or of a different sign) and that the parameter estimates are incorrect. So will be the conclusions about the validity of the theory (Antonakis et al., 2014).

In general, correlational inference is a controversially discussed topic. A famous and often cited saying in this context is: "Correlation does not imply causation."

According to (Kenny, 1979), the terms "correlational" and "inference" can be defined as follows.

> Correlational: "correlational means a statistical relationship between a set of variables, none of which have been experimentally manipulated." (p. 2)

He further states that:

> "Although correlations and covariances can be computed from experimental data, we usually reserve the term correlation for a relationship between unmanipulated variables. Very often, the random assignment of units to treatment conditions, the backbone of experimental inference, is impossible and there is only correlational data. In such a case, causal inference may still be the goal."
>
> Inference: "inference means confirmation or disconfirmation of a scientific hypothesis by the use of data. To interpret data, there must be a set of reasonable assumptions about how the data were generated and additional assumptions about how the data can be summarised. The set of assumptions about how the data were generated is usually called the model, and data are summarised by statistical methods."

Eventually, correlational inference often aims for causal inference. Hence, the focus is on the question on how to measure a causal effect of a variable x on a variable y. Kenny, (1979, p.3) defines three conditions to be complied:

1. time precedence
2. relationship
3. nonspuriousness

The first condition states that the variable x must precede the variable y temporally. Important to note is that simultaneity (x and y simultaneously affect each other) or reverse causality (x is caused by y) need to be addressed. Furthermore, only because x precedes y does not imply causation because x also must be exoge-

neous. The second condition states that x and y need to be correlated on a statistically significant basis. Hence, quantitative data is required in order to perform statistical analysis. The third condition states that the correlation of x and y is not explained or eliminated by other causes. This means that x must be exogeneous. Consequently, a change of x ceteris paribus produces a change of y. Thus, if the relationship of x and y is driven by other (omitted) causes, x turns out to be endogenous – the endogeneity problem occurs. Clearly, this is not the case if x varies randomly and is not correlated with omitted variables. The nonspuriousness condition is seen as the most troublesome, whereas it has to do with analysis and design matters and less theoretical arguments (Antonakis et al., 2010, 2014).

In principle, panel data allows us to comply with these conditions. Hence, this dissertation gathered panel data with the ambition to perform a panel data analysis. A panel data approach has several benefits, such as a potentially larger data set compared to cross-sectional or time series data. This, in turn, leads to more variability and less collinearity between the variables with the benefit that one gets more reliable estimates (Baltagi, 2014). In addition, panel data allows to control for unobserved and time-invariant confounders to model the direction of causal relationships. However, this approach also brings challenges that need to be considered and addressed (see table 9). Hence, the potential of panel data can only be exploited, if appropriate methods are applied that can take advantage of this data (Allison et al., 2017).

Again, focusing on the effects of board gender diversity, there are difficulties in establishing causality between the board composition and organisational outcomes because of endogeneity problems. For example, Adams et al., (2010, p. 97) highlight the endogeneity problem of this relationship.

> "the makeup of boards is interesting because it affects what the board does; and, consequently, their makeup is influenced by a desire to affect what they do. This problem of joint endogeneity is vexing for both theoretical and empirical research on boards."

The most discussed sources of endogeneity in this context are the omitted variable bias, reverse causality and dynamic endogeneity, and measurement error. Potentially, all of these problems apply to regressions that model the impact of board gender diversity on firm outcomes like the financial performance (Adams, 2016; Bennouri et al., 2018; Ferreira, 2011). Therefore, experts in this field stress the

importance of addressing endogeneity problems when assessing the board diversity and firm outcomes relationships (Adams, 2016; Adams & Ferreira, 2009; Ferreira, 2011, 2015).

In other words, endogeneity problems occur when the variable of interest in a regression model correlates with the error term. Thus, the coefficient of the variable of interest does not explain the effect of that variable alone because of confounding factors. It is also possible that these confounding factors are the real drivers for the correlation of the regression model and therefore it is necessary to address this concern (Adams, 2016). See table 21 for an overview of threats to estimator validity.

| Validity Threat | Explanation |
|---|---|
| Omitted variables | (a) Omitting a regressor, that is, failing to include important control variables when testing the predictive validity of dispositional or behavioural variables (e.g., testing predictive validity of "emotional intelligence" without including IQ or personality; not controlling for competing leadership styles)<br>(b) Omitting fixed effects<br>(c) Using random effects without statistical justification (i.e., Hausman test)<br>(d) In all other cases, independent variables not exogenous (if it is not clear what the controls should be) |
| Omitted selection | (a) Comparing a treatment group to other non-equivalent groups (i.e., where the treatment group is not the same as the other groups) |
| Simultaneity | (a) Reverse causality (i.e., an independent variable is potentially caused by the dependent variable) |
| Measurement error | (a) Including imperfectly measured variables as independent variables and not modelling measurement error |
| Dynamic endogeneity | (a) Lagged reverse causality<br>(b) Lagged effect of the dependent variable on itself |
| Inconsistent inference | (a) Using normal standard errors without examining for heteroscedasticity<br>(b) Not using cluster-robust standard errors in panel data (i.e., multilevel hierarchical or longitudinal) |
| Model misspecification | a) Not correlating disturbances of potentially endogenous regressors in mediation models (and not testing for endogeneity using a Hausman test or augmented regression)<br>(b) Using a full information estimator (e.g., maximum likelihood, three-stage least squares) without comparing estimates to a limited information estimator (e.g., two stage-least squares). |

**Table 21: Overview of validity threats**

**Source: Adapted from Antonakis et al. (2010)**

Technically, the omitted variable bias arises when unobserved variables are correlated with variable of interest. For example, Adams & Ferreira (2009) and Adams (2016) demonstrated that firm-specific omitted variables like corporate culture or firm size are sources of error that need to be addressed in order to perform unbiased inference.

Reverse causality is the concern that organisational outcomes and characteristics or individual preferences influence the board composition and not the other way around. Hence, the concern is that the causal link is that successful firms may appoint more diverse boards and not that diverse boards lead to superior performance.

> "This means any correlation between corporate outcomes and board diversity can be interpreted as reflecting the effect of diversity on outcomes as well as the effect of outcomes on diversity. In performance regressions, for example, the coefficient on gender diversity reflects both a causal effect of diversity on performance (which can be positive, zero or even negative) and a causal effect of performance on diversity. Performance can causally affect board diversity if women choose to join the boards of better performing firms or if better performing firms choose to have more female directors." (Adams, 2016, p. 7)

Dynamic endogeneity addresses the problem of lagged reverse causality between outcomes and the makeup of boards. Dynamic endogeneity is a well-known and frequently discussed issue in the econometric literature. Typically, the econometric literature refers to models that try to combine fixed effects models with cross-lagged panel models as "dynamic" because of the issue that the dependent variable affects itself over time (lagged effect). The associated problems again are endogeneity problems because the error terms are correlated with predictors and uncertainties about the treatment of initial assumptions (Allison et al., 2017).

In addition, measurement error is a topic that also needs attention. It is relatively straightforward to generate firm-level outcomes or board-level diversity variables using databases, which is a common practice in the literature to date. Still, the generated data must be evaluated for plausibility and double-checked to identify any obvious errors after the data collection and prior the statistical analyses.

### 5.2.2 Effects of supervisory board gender diversity

#### 5.2.2.1 *Addressing endogeneity problems: generalized method of moments (GMM)*

Past research implies that the supervisory board composition is adapted based on the needs of the firm. For example, the agency problems, the strategic focus, and the firm's environment can be determinants for the board compositions. Consequently, some authors suggest that the board composition is a result of an

endogenous process (Adams et al., 2010; Harris & Raviv, 2005; Hermalin & Weisbach, 2003; Linck, Netter, & Yang, 2008; Pfeffer, 1972).

Accordingly, panel models testing the impact of the supervisory board composition on organisations are exposed to, amongst others, endogeneity bias triggered by reverse causality. Thus, endogeneity must be controlled for to perform unbiased inference (Antonakis et al., 2010, 2014; Arvate et al., 2018; Wintoki et al., 2012).

It is a common approach to use fixed effects panel models to address the omitted variable bias and to control for unobservables (Allison, 2005, 2009; Firebaugh, Warner, & Massoglia, 2013; Halaby, 2004). To use cross-lagged panel models, on the other hand, is a common strategy to model a causal direction. However, there are difficulties to combine both approaches, controlling for unobservables via fixed effects and modelling a causal direction, because of the lagged effect of the dependent variable on itself (Allison et al., 2017).

As already highlighted in the chapters 4.1.2.4 and 4.1.2.5, the econometrics literature identified several tools to cope with these challenges, such as instrumental variable techniques like the system GMM method suggested by Arellano and Bover (1995) and Blundell and Bond (1998). Consequently, this study's strategy is to use system GMM. This dynamic panel design checks for fixed effects and also for the lagged effect of the dependent variable on itself (Allison, Williams, & Moral-Benito, 2017).

> "The system GMM approach allows the relationship between female directorship and performance to be estimated in levels and first differences simultaneously. The level equation presents performance as a function of its past values (lagged values), observable firm characteristics (board structure and explanatory variables), and the error term including a fixed effect component. The difference equation presents year-to-year differences in the level equation. Hence, the difference equation presents the variation in year-to-year performance as a function of the year-to-year lagged variation in performance, year-to-year variation of the explanatory variables, and the difference in error terms. Note that the fixed effect error term disappears in the difference equation, since it is by definition time invariant. By estimating these equations simultaneously, the system GMM approach controls for heterogeneous endogeneity (stemming from time-invariant variables) and includes the dynamic structure of the relationship between performance and board gender diversity. More interestingly, some of the lagged values

(both for level and differences) included in the model act as internal exogenous instruments." (Bennouri et al., 2018, p. 279)

To examine whether the results are robust in terms of the statistical methodology used, three different methods are computed to contrast the respective results. System GMM is deemed as the main and most appropriate method in line with the corporate governance literature (Bennouri et al., 2018; Wintoki et al., 2012).

#### 5.2.2.2 *Introduction to system GMM*

The difference GMM (Arellano & Bond, 1991) and the system GMM (Arellano & Bover, 1995; Blundell & Bond, 1998) are becoming increasingly popular in the field of dynamic panel data analysis. According to Roodman (2009b, p. 86), the GMM estimators are suited for

"1) "small T, large N" panels, meaning few time periods and many individuals; 2) a linear functional relationship; 3) one left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning they are correlated with past and possibly current realizations of the error; 5) fixed individual effects; and 6) heteroskedasticity and autocorrelation within individuals but not across them."

The difference GMM, introduced by Arellano & Bond (1991), generally transforms the regressors by differencing (Hansen, 1982). On the other hand, the system GMM, introduced by Arellano & Bover (1995) and Blundell & Bond (1998), enhances the difference GMM by additionally assuming that first differences of the instrumental variables are uncorrelated with the fixed effects and thus enables the introduction of more instruments to dramatically improve efficiency. Accordingly, the system GMM is based on a system of two equations, namely, the original and the transformed one. Furthermore, GMM models can be estimated using either one-step or the two-step estimators, whereas the two-step approach is seen as more efficient and robust with regard to heteroscedasticity and autocorrelation (Roodman, 2009b).

The main advantage of the GMM over the OLS and the traditional fixed-effects estimators is its ability to address further important sources of endogeneity that come with dynamic panel settings. More specifically, the GMM approach is superior because it uses a combination of historical values of the variables as inter-

nal instruments to address the issue of reverse causality and thus provides an alternative for identifying external instruments outside the panel (Wintoki et al., 2012). This is beneficial because the identification of such external exogenous instruments for female supervisory board members is a challenging, if not impossible task (Bennouri et al., 2018; Pathan & Faff, 2013).

Nevertheless, the GMM approach also has limitations: It is a relatively complicated method that can quickly result in invalid estimates if not performed properly. Since it relies on internal instruments (lags of dependent and predictor variables) this leads to the potential problem of weak instruments. Moreover, this potential problem increases with the number of lags of the instrumental variables, which, in turn, leads to a dilemma: The more the instruments' lag length goes back in time the more exogenous and weaker the instruments might become at the same time. Moreover, the GMM approach is similarly exposed to the threat of misspecification and omitting important time-varying variables like the OLS and traditional fixed-effects estimation. Consequently, the GMM estimation does not solve all endogeneity problems for dynamic panel models. In the absence of natural experiments and strictly exogenous external instruments, it does however provide a promising alternative to the OLS and traditional fixed-effects estimation (Wintoki et al., 2012).

There are also two features of the GMM approach that need to be addressed when it comes to inference. First, it is necessary to correct the variance-covariance matrix of the coefficients in order to avoid standard errors being downward biased, which might be the case, if the classical formula for the variance-covariance matrix is applied. Windmeijer (2005) proposes a solution for addressing this phenomenon and obtaining robust standard errors, which is also available in the PLM package in R and applied in this study. Second, the estimation is consistent only if the crucial assumptions of the GMM estimation are satisfied. In particular these are the assumptions of no error correlation and the moments' validity (Croissant & Millo, 2019).

To test the validity of these assumptions, the literature proposes to perform the Arellano-Bond serial correlation test as well as the Sargan/Hansen test of overidentifying restrictions (Arellano & Bond, 1991). The Arellano-Bond serial correlation test checks with the null hypothesis of no autocorrelation, if enough lags are

included in the model to check for the dynamic aspects of the empirical relationships within the scope of this study. If enough lags are included, the values before those lags are potentially valid instruments because they are exogenous to current innovations of the dependent variable. In practice, this means that in the light of this study the residuals in first differences (AR(1)) should correlate, whereas the second differences (AR(2)) should not correlate serially. The Sargan/Hansen test of overidentifying restrictions checks the moments' validity with the null hypothesis of the validity of instruments (Roodman, 2009b; Wintoki et al., 2012). In effect, this means that the result of the Sargan/Hansen test should not reject the null hypothesis.

However, the Sargan/Hansen test should not be overly relied upon because it is vulnerable to weaknesses, especially if the number of instruments is too high. In this case it might lead to implausibly good p-values (Andersen & Sørensen, 1996; Bowsher, 2002; Roodman, 2009b). This issue, labelled as "problem of instrument proliferation", should be considered and addressed to avoid overfitting the endogenous variables and biasing the Sargan/Hansen test. Hence, caution should be exercised when there are a substantial number of lags and/or predictor variables because each predictor variable generates several instruments (depending on the time dimension of the panel) (Roodman, 2009b). Nevertheless, there is no consensus and little guidance in the literature on how many instruments shall be used (Roodman, 2009a; Ruud, 2000).

The literature highlights two strategies, which can be used separately or in combination, to cope with the risk of overfitting and to test the robustness of the results. The first strategy is to "collapse" the moments condition. This strategy constrains all the yearly moment conditions to be the same. The second strategy is to limit the number of lags included and hence to reduce the number of GMM-style instruments in this way (Croissant & Millo, 2019; Roodman, 2009a, 2009b; Wintoki et al., 2012). Roodman (2009b) also suggests that researchers should not take comfort in a Sargan/Hansen test's p-value below 0.1. He also alerts researchers that higher values, exceeding 0.25 for example, are also potential signs of trouble.

More information on the difference and system GMM estimation, such as the econometric specification, the resulting equations, the theoretical arguments motivating the use of internal instruments, and its practical application can be found in Roodman (2009a, 2009b), in Croissant & Millo (2019), and in Wintoki et al. (2012).

### 5.2.3 Effects of gender quota

#### 5.2.3.1 *Addressing endogeneity problems: difference-in-differences*

The literature suggests that the most appropriate methodology to assess the impact of the quota legislation is a difference-in-differences approach. Difference-in-differences models are a method for potentially inferring causality in non-experimental designs. The difference-in-differences model calculates an average causal effect of the quota (treatment) on the firms within the scope (treatment group) by comparing the firms within the scope at some defined point in time with firms outside the scope (control group) as counterfactual to assess what would have happened to the firms within the scope, if there was no quota implementation at that time (Strumpf, Harper, & Kaufman, 2017).

Difference-in-differences modelling can be used in situations where a treatment and a very similar control group exist. Then their development can be compared before and after a treatment over time. Hence, the idea of this method is to compare two similar groups over time to examine the effect of an exogenous impact (i.e. gender quota) by differencing out possible confounding factors affecting both groups. Nevertheless, this is a non-experimental design because it imitates a controlled experiment, but without random assignment. In a randomized experiment the groups are theoretically interchangeable because the firms in the treatment and control groups are nearly equivalent at the beginning of the experiment. However, in a difference-in-differences model interchangeability is not certain. Therefore, the researcher has to demonstrate and to elaborate on the quality of the counterfactual (Antonakis et al., 2010; Suissa, 1995).

By controlling for all fixed differences between the groups and shared changes over time, the difference-in-differences model focuses on changes of the variable of interest that occur for those firms affected but not others. Provided that the key assumptions of this method are satisfied, the causal effect of the treatment on the dependent variable can be estimated (Strumpf et al., 2017).

#### 5.2.3.2 *Introduction to difference-in-differences*

The basic difference-in-differences regression framework assumes two groups, a treatment and a control group, and two time periods, before and after the treatment. The respective regression model is as follows:

$$y_{it} = \beta_0 + \beta_1 x_i + \beta_2 t + \beta_3 x_i \times t + e_{it}$$

Where i is a firm in a group (x = 0 for control group; x = 1 for treatment group) in a particular time period (t = 0 for pre-intervention; t = 1 for post-intervention), and $e_{it}$ is the error term. The models also include control variables (described in chapter 5.2.2.3), which are omitted in the equation for the sake of simplicity. The treatment effect is defined as the difference between the treated group and a comparable control group across time. Thus, the estimated coefficient of the interaction term $\beta_3$ reveals any change in outcome y from the pre-policy period to the post-policy period that occurs in the treatment group and not in the control group (Antonakis et al., 2010; Strumpf et al., 2017).

| | Pre-intervention | | Post-intervention | |
|---|---|---|---|---|
| | Outcome | Coefficient | Outcome | Coefficient |
| Control Group | $y_{00}$ | $\beta_0$ | $y_{01}$ | $\beta_0 + \beta_2$ |
| Treatment Group | $y_{10}$ | $\beta_0 + \beta_1$ | $y_{11}$ | $\beta_0 + \beta_1 + \beta_2 + \beta_3$ |

**Table 22: Difference-in-differences in potential outcomes and regression coefficients**

**Source: Adapted from Strumpf et al. (2017)**

Another way of calculating the treatment effect is to difference the differences of y across groups and periods. Table 22 shows the potential outcomes for y (group and period) and the respective regression coefficients. The equation capturing this is as follows (Antonakis et al., 2010; Strumpf et al., 2017):

$$(y_{11} - y_{01}) - (y_{10} - y_{00}) = [(\beta_0 + \beta_1 + \beta_2 + \beta_3) + (\beta_0 + \beta_2)] - [(\beta_0 + \beta_1) - \beta_0] = \beta_3$$

Any differences between the groups prior to the treatment are controlled for by the coefficient of x, capturing the fixed effects of group membership. Also, time fixed effects are checked for and captured by the coefficient of t. Besides the importance of the difference between the groups being stable over time and the timing of the treatment being exogenous, it is important to correct the standard errors given that it is panel data (Antonakis et al., 2010).

Under certain conditions, the difference-in-differences method allows for causal inference regarding the treatment effect (Antonakis et al., 2010, 2014). Therefore, the researcher must be able to develop a convincing case for satisfying the

identifying assumptions. In most cases, this is achieved by comparing observable characteristics and indicators between the treatment and the control group in the pre-intervention period. As mentioned before, the difference-in-differences estimation checks for all fixed differences between the two groups. Therefore, differences that can be expected to endure over time are not necessarily a threat to validity. Nevertheless, such differences raise concerns about any unmeasured time-varying differences that affect one group and not the other because they cannot be checked for with the fixed effects. Even though it is unlikely that the two groups are as similar as in a randomized experiment, they should nevertheless be sufficiently matched (Strumpf et al., 2017).

Accordingly, using a matching technique might help to improve the similarity of the groups (i.e. applying a matching algorithm or propensity scores for weighting differences in each firm). The idea of this strategy is to address the concerns that the treatment and the control group may differ in ways that would affect their trends over time and that their compositions may change over time and thus confound the results (Stuart et al., 2014). For example, the work of Matsa & Miller (2013) relies on several difference-in-differences models with matched and unmatched samples. They report similar results for both the matched and the full samples. Also, Stuart et al. (2014) study difference-in-differences models using a propensity score weighting strategy. They also report similar results for the weighted and unweighted models.

The main identifying assumption of the difference-in-differences method is that the control group serves as an adequate counterfactual for the treatment group. Therefore, the selection of the control group is fundamentally important for the validity of the results (Ryan, Burgess, & Dimick, 2015). If the difference between the two groups remains relatively stable over time in the period prior to the treatment, this suggests that the trend of the variable of interest of the control group in the period after the treatment provides an acceptable counterfactual for what would have happened to the treatment group if there was no treatment. Accordingly, a baseline equivalence is not required since time-invariant differences between the two groups are checked for (by subtracting out). Determining if the difference between the two groups remains relatively stable over time in the pre-intervention period, in turn, requires data on more than one time point in the period before the treatment. Therefore, the validity of models using only two time points

will be threatened because in those cases it is not possible to establish parallel pre-intervention period trends (Angrist & Pischke, 2008; Imbens & Wooldridge, 2009).

Usually, the parallel trend assumption of the variable of interest in the treatment and the control group in the pre-intervention period is tested via graphical analysis and less often with statistical tests in regression models (Angrist & Krueger, 1999; Ionescu-Ittu, Glymour, & Kaufman, 2015). Apart from that, the threat of different compositional changes in the two groups must also be examined (Strumpf et al., 2017). However, this is not a concern for this study because the samples are stable over time.

The second assumption of the difference-in-differences method is that the inception of the treatment is exogenous (Angrist & Pischke, 2008; Angrist & Krueger, 1999; Antonakis et al., 2010; Meyer, 1995). Consequently, to rule out reverse causality or confounding, the treatment must not be driven by pre-intervention period outcomes nor by any unmeasured time-varying common causes of the treatment and the outcome. In other words, the method also assumes that no unmeasured changes affect the variable of interest in the two groups differently over the observation period. Eventually, there is no empirical test to proof the satisfaction of the assumption that no unmeasured confounders bias the results. Only empirical indications and an understanding regarding the reasons and the conditions for the treatment (i.e. gender quota legislation) can support the argumentation for a causal inference (Strumpf et al., 2017).

The pendant to the differences-indifferences design in psychology is known as an untreated control group design with pre- and post-test (Shadish, Cook, & Campbell, 2002). Nevertheless, this study presents the economics perspective because of a broader literature basis for this method.

Figure 15 illustrates the key terms and items of the difference-in-differences estimation, such as the treatment and control group, the counterfactual, the time sequence, and the treatment effect.

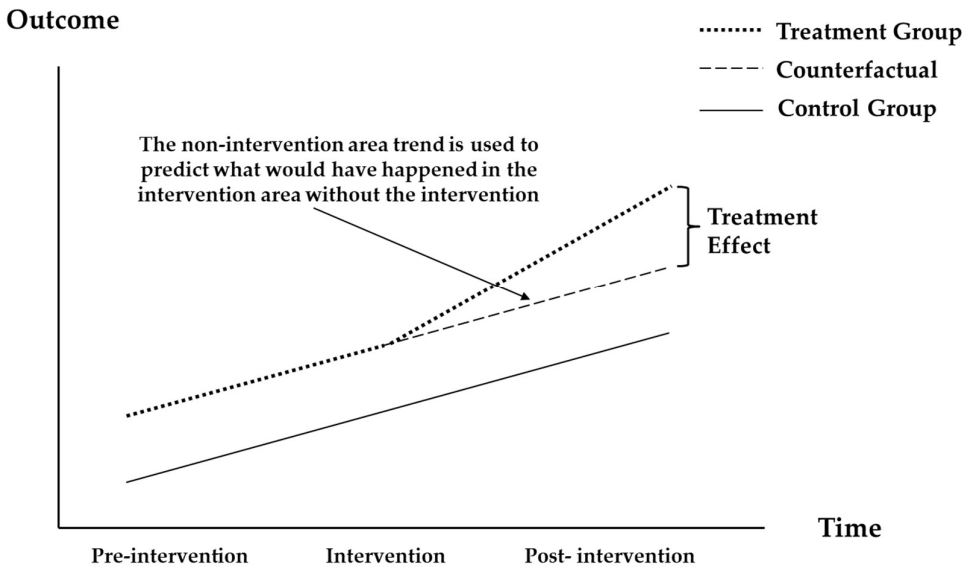



**Figure 15: Estimating causal effects using difference-in-differences**
**Source: Adapted from Antonakis et al. (2010) and Strumpf et al. (2017)**

## 5.3 EVALUATION AND DISCUSSION OF RESULTS

### 5.3.1 Evaluation and discussion of the results of the models analysing the effects of supervisory board gender diversity

#### *5.3.1.1 Evaluation of the models analysing the effects on the firm performance*

This study examines the impact of supervisory board gender diversity on the financial performance. Based on the theoretical foundation and considerations on the research design, the research models are developed. To compute the models of interest this study makes use of a software package called "plm" for the statistic software R (Croissant & Millo, 2019).

Firstly, hypotheses 1 and 2 are tested based on the sub-samples that excluded the financial industry. Tables 24-25 report the results for the ROA and the P2B, respectively. In order to also test the robustness of the results, alternative approaches of estimating the effect of supervisory board gender diversity on the ROA and the P2B are performed:

1. A pooled OLS model with lagged values of the predictor variables including the lagged value of performance as control variable to consider the dynamic feature of firm performance.

2. A fixed effects model with lagged values of the predictor variables including the lagged value of performance as control variable to consider the dynamic feature of firm performance.[2]

3. A system GMM model with lagged values of the predictor variables including the lagged value of performance as control variable to consider the dynamic feature of firm performance.

For all regressions, the predictor variables are the share of female supervisory board members and the dummy variable indicating the presence of a critical mass. The included time-varying control variables putatively affecting the firm performance are the firm riskiness (leverage, price volatility), operational performance (sales growth), and firm size (natural logarithm of the number of employees). All models include year dummies to control for the effects because of time trends on firm performance. The pooled OLS model and the system GMM model additionally include industry dummies to control for industry effects, and a dummy variable indicating the application of the quota legislation as time-invariant control variables.

Starting with the evaluation of the results of the models with the ROA as dependent variable (table 24), the signs of the coefficients of the share of female supervisory board members are negative for the pooled OLS and the system GMM estimators, and positive for the fixed effects estimator. Regarding the coefficients of the dummy variable for a critical mass, the coefficients of the pooled OLS estimator and the system GMM estimator are positive, whereas the fixed effects coefficient is negative. However, all coefficients of the share of female supervisory board members and the dummy variable for a critical mass are not statistically significant. The control variable for firm size, measured by the natural logarithm of the number of employees, is positively and significantly correlated with the ROA for the pooled OLS and the system GMM estimators (at a 1 percent significance level), but negatively for the fixed effects estimator (at a 10 percent significance

[2] Performed Hausman test suggested to use fixed effects instead of random effects.

level). Furthermore, the control variable for sales growth has a positive, but not significant coefficient for the pooled OLS, a positive and, at a 10 percent level, significant coefficient for the fixed effects, and a negative and not significant coefficient for the system GMM estimator. The control variable for price volatility has negative and significant (at a 0.1 percent level) coefficients for the pooled OLS and the system GMM estimators, and a positive and not significant coefficient for the fixed effects estimator. Lastly, the control variable for leverage has a negative coefficient for all models (not significant for pooled OLS and system GMM; significant at a 10 percent level for the fixed effects).

Coming to the evaluation of the models with the P2B as dependent variable (table 25), the signs of the coefficients of the predictor variable share of female supervisory board members are negative for the pooled OLS and the system GMM estimators, and positive for the fixed effects estimator. This pattern is similar to the results of the models focusing the ROA. Regarding the coefficients of the dummy variable for a critical mass, the pooled OLS and the system GMM estimators' coefficients are positive, whereas the fixed effects estimator has a negative coefficient. Similarly, all coefficients of the share of female supervisory board members and the dummy variable for a critical mass are not statistically significant. The control variables for firm size, for sales growth, and for price volatility are positively but not significantly correlated with the P2B across all three estimators. Lastly, the control variable for leverage has a negative coefficient for all three estimators, but the significance level differs between not significant for the fixed effects and system GMM estimators and significant at a 5 percent level for the pooled OLS.

Looking at the economic significance of the models with the ROA as dependent variable, the pooled OLS and fixed effects estimators do not generally lead to less economically significant results than the system GMM estimator. This is not in line with the results of Bennouri et al. (2018), who analyse the relationship based on a French sample and conclude that governance variables correlate only so a small extent with performance measures when using the fixed effects estimator. Furthermore, in the models with P2B as dependent variable, the system GMM estimator is not generally more economically significant than the other estimators. Overall, the results differ between the different estimators. This in line with the ambiguous results reported in the literature (Roberts & Whited, 2013) and thus illustrates the importance of addressing endogeneity concerns (Bennouri et al., 2018).

Compared to the OLS estimator, the fixed effects estimator additionally controls for time-invariant heterogeneity at the firm-level. However, it is biased when the panel data is dynamically endogenous (Sila et al., 2016; Wintoki et al., 2012), like in this study. In this case, the system GMM approach is the most appropriate method with the least biased estimator, especially for panel data with a short time length like in this study (Bennouri et al., 2018; Sila et al., 2016).

> "System GMM reduces the heterogeneity effect (by including the first difference equation in the estimated system of equations), simultaneity and dynamic endogeneity by considering both the first difference equation and the lagged values of the dependent variable in the principal equation." (Bennouri et al., 2018, p. 280)

Consequently, the concluding evaluation of the effects of female supervisory board representation on the firm performance refers to the system GMM results. Nevertheless, the consistency of the results must be examined by analysing whether the crucial assumptions of the system GMM method are satisfied. Following the guidance of the literature, the Arellano-Bond serial correlation test as well as the Sargan/Hansen test of overidentifying restrictions are performed to check the identification of the models. To cope with the risk of overfitting and to address the risk of biasing the Sargan/Hansen p-values, the moments condition were "collapsed" (Croissant & Millo, 2019; Roodman, 2009a, 2009b; Wintoki et al., 2012).

The null hypothesis of no first-order (AR(1)) auto-correlation is rejected, whereas the null hypothesis of no second-order serial correlation (AR(2)) is not rejected for both models. This supports the rationale for using the system GMM estimator because it performs better with only first-order serially correlated processes (Roodman, 2009a). The Sargan/Hansen test of overidentifying restrictions checks the moments' validity with the null hypothesis of the validity of instruments and does not reject the null hypothesis for both models. Hence, the test eventually suggests validity of the instruments. The model with the ROA as dependent variable shows a p-value above the 0.10 significance threshold, but the values does not exceed 0.25 and thus it is within the range suggested by Roodman (2009b). The model with the P2B as dependent variable also shows a p-value above the 0.10 mark, but in this case the value exceeds 0.25, which is a potential sign of trouble (Roodman, 2009b). To address this, the robustness of the estimates is tested. In order to test the robustness, the number of lags used for the GMM-style instruments is limited to

two years, to substantially reduce the instruments count. The results remain qualitatively similar (see tables 26-27).

To summarise, the results suggest that gender diversity on the supervisory board does not positively affect the firm performance in the German environment. The main variables of interest, the share of female supervisory board members and the dummy variable for a critical mass, are both not significantly correlated with the ROA and the P2B. Therefore, the results do not support the view that supervisory board gender diversity positively influences the effectiveness of the supervisory board. Also, the results do not support the idea that supervisory board gender diversity positively influences the investors' perception. Focusing on the control variables, the firm size is positively correlated with the ROA (at a 1 percent significance level), which is line with the findings in the literature (Adams & Ferreira, 2009; Bennouri et al., 2018), and positively, but not significantly, with the P2B. Interestingly, sales growth is negatively correlated with the ROA (at a 5 percent significance level), which contradicts the results of Bennouri et al. (2018), and positively, but not significantly, with the P2B. Moreover, the price volatility as one of the variables measuring the firm risk is negatively correlated with ROA (at a 0.1 percent significance level), and positively, but not significantly, with the P2B. The firms leverage as second indicator for risk is negatively correlated with the ROA (albeit not significantly) and the P2B (significant at a 5 percent level), which is in line with the findings of (Bennouri et al., 2018; Terjesen et al., 2016).

Accordingly, table 23 summarises the results of the hypothesis testing.

| **Hypotheses** | | **Results** |
|---|---|---|
| Impact of supervisory board gender diversity on financial performance | | |
| H1 | *The share of female supervisory board members is positively related to the firm's financial performance.* | - |
| H2 | *A critical mass of three or more women on the supervisory board is positively related to the firm's financial performance.* | - |

**Table 23: Summary of results for hypothesis testing H1 and H2**

Note: - = rejected; / = partly supported; + = supported

| | Pooled OLS | | Fixed Effects | | System GMM (two-step; fd) | |
|---|---|---|---|---|---|---|
| | Coef. | t-test | Coef. | t-test | Coef. | z-test |
| Lag ROA | 0.593*** | 8.244 | 0.043 | 0.693 | 0.336* | 2.303 |
| Lag share of female supervisory board members | -4.440 | -1.561 | 0.268 | 0.055 | -4.400 | -0.666 |
| Lag critical mass | 0.349 | 0.485 | -0.256 | -0.209 | 0.712 | 0.493 |
| Log(employees) | 1.786** | 3.172 | -7.454‘ | -1.654 | 1.912** | 2.591 |
| Sales growth | 0.706 | 0.763 | 2.101‘ | 1.796 | -0.370 | -0.342 |
| Price volatility | -0.173*** | -3.313 | 0.228 | 1.465 | -0.244*** | -3.100 |
| Leverage | -0.026 | -1.135 | -0.083‘ | -1.816 | -0.022 | -0.705 |
| Quota dummy | yes | | no | | yes | |
| Industry dummies | yes | | no | | yes | |
| Year dummies | yes | | yes | | yes | |
| Observations | 1.659 | | 1.659 | | 1.659 | |
| $R^2$ | 0.53 | | 0.05 | | | |
| Arellano-Bond AR(1) p-value | | | | | 0.032 | |
| Arellano-Bond AR(2) p-value | | | | | 0.688 | |
| Sargan/Hansen test p-value | | | | | 0.170 | |

**Table 24: Results for ROA**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1; t- and z-statistics are based on White heteroscedasticity consistent standard errors; 250 firms; moments condition collapsed; Arellano-Bond tests check whether the data process is auto-regressive; the Sargan/Hansen test checks whether the model is overidentified

| | Pooled OLS | | Fixed Effects | | System GMM (two-step; fd) | |
|---|---|---|---|---|---|---|
| | Coef. | t-test | Coef. | t-test | Coef. | z-test |
| Lag P2B | 0.799*** | 14.879 | 0.345*** | 3.962 | 0.804*** | 8.458 |
| Lag share of female supervisory board members | -0.123 | -0.353 | 0.216 | 0.401 | -0.288 | -0.608 |
| Lag critical mass | 0.166 | 1.366 | -0.131 | -0.868 | 0.059 | 0.328 |
| Log(employees) | 0.030 | 0.463 | 0.851 | 1.383 | 0.072 | 0.969 |
| Sales growth | 0.063 | 0.785 | 0.046 | 0.594 | 0.089 | 0.474 |
| Price volatility | 0.005 | 0.733 | 0.016 | 0.730 | 0.002 | 0.2661 |
| Leverage | -0.010* | -2.403 | -0.005 | -0.622 | -0.007 | -1.532 |
| Quota dummy | yes | | no | | yes | |
| Industry dummies | yes | | no | | yes | |
| Year dummies | yes | | yes | | yes | |
| Observations | 1.674 | | 1.674 | | 1.674 | |
| $R^2$ | 0.61 | | 0.13 | | | |
| Arellano-Bond AR(1) p-value | | | | | 0.015 | |
| Arellano-Bond AR(2) p-value | | | | | 0.153 | |
| Sargan/Hansen test p-value | | | | | 0.735 | |

**Table 25: Results for P2B**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1; t- and z-statistics are based on White heteroscedasticity consistent standard errors; 250 firms; moments condition collapsed; Arellano-Bond tests check whether the data process is auto-regressive; the Sargan/Hansen test checks whether the model is overidentified

| | System GMM (two-step; fd) | |
|---|---|---|
| | Coef. | z-test |
| Lag ROA | 0.383** | 3.181 |
| Lag share of female supervisory board members | -4.832 | -0.824 |
| Lag critical mass | 0.345 | 0.250 |
| Log(employees) | 1.706* | 2.279 |
| Sales growth | -0.679 | -1.602 |
| Price volatility | -0.243*** | -3.373 |
| Leverage | -0.001 | -0.034 |
| Quota dummy | yes | |
| Industry dummies | yes | |
| Year dummies | yes | |
| Observations | 1.659 | |
| Arellano-Bond AR(1) p-value | 0.023 | |
| Arellano-Bond AR(2) p-value | 0.722 | |
| Sargan/Hansen test p-value | 0.499 | |

**Table 26: Robustness test ROA – system GMM instruments limited to two years**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1; t- and z-statistics are based on White heteroscedasticity consistent standard errors; 250 firms; moments condition collapsed; Arellano-Bond tests check whether the data process is auto-regressive; the Sargan/Hansen test checks whether the model is overidentified

| | System GMM (two-step; fd) | |
|---|---|---|
| | Coef. | z-test |
| Lag P2B | 0.739*** | 7.218 |
| Lag share of female supervisory board members | -0.060 | -0.109 |
| Lag critical mass | 0.054 | 0.270 |
| Log(employees) | 0.074 | 0.897 |
| Sales growth | 0.093 | 0.442 |
| Price volatility | 0.005 | 0.515 |
| Leverage | -0.010‘ | -1.900 |
| Quota dummy | yes | |
| Industry dummies | yes | |
| Year dummies | yes | |
| Observations | 1. 674 | |
| Arellano-Bond AR(1) p-value | 0.011 | |
| Arellano-Bond AR(2) p-value | 0.149 | |
| Sargan/Hansen test p-value | 0.619 | |

**Table 27: Robustness test P2B – system GMM instruments limited to two years**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1; t- and z-statistics are based on White heteroscedasticity consistent standard errors; 250 firms; moments condition collapsed; Arellano-Bond tests check whether the data process is auto-regressive; the Sargan/Hansen test checks whether the model is overidentified

#### *5.3.1.2 Evaluation of the models analysing the effects on the management board gender diversity*

This dissertation also analyses the impact of gender diversity on the supervisory board on the female presence on the management board. Hypothesis 3 and 4 are tested based on the full sample. Table 28 shows the results for the share of female management board members as dependent variable. In line with the approach in the prior chapter, three different estimation models are computed to check the robustness of the results.

1. A pooled OLS model with lagged values of the predictor variables including the lagged value of management board gender diversity as control variable to consider the dynamic feature of management board gender diversity.

2. A fixed effects model with lagged values of the predictor variables including the lagged value of management board gender diversity as control variable to consider the dynamic feature of management board gender diversity.[3]

3. A system GMM model with lagged values of the predictor variables including the lagged value of management board gender diversity as control variable to consider the dynamic feature of management board gender diversity.

Again, the predictor variables are the share of female supervisory board members and also the dummy variable indicating the presence of a critical mass for all regressions. The included time-varying control variable putatively affecting the management board gender diversity is the firm size (natural logarithm of the number of employees). All models include year dummies to control for effects because of time trends. The pooled OLS model and the system GMM model additionally include industry dummies to control for industry effects, and a dummy variable indicating the application of the quota legislation as time-invariant control variables.

Coming to the evaluation of the results, the signs of the coefficients of the share of female supervisory board members are positive for the pooled OLS estimator, and negative for the system GMM and the fixed effects estimators. Regarding the coefficients of the dummy variable for a critical mass, the pooled OLS and system GMM estimators are positive, whereas the fixed effects estimator has a negative coefficient. It is noteworthy that all coefficients of the share of female supervisory board members and the dummy variable for a critical mass are not significant except for the coefficient of the dummy variable for a critical mass in the system GMM model. This coefficient is significant at 10%. Furthermore, the control variable for the firm size has a negative, but not significant coefficient for all three estimators. Again, the results differ between the different models. The pooled OLS and fixed effects estimators tend to show less economically significant results compared to the system GMM estimator (except for the fixed effects estimator of firm size).

Also in this case, the null hypothesis of no first-order (AR(1)) auto-correlation is rejected, whereas the null hypothesis of no second-order serial correlation

[3] Performed Hausman test suggested fixed effects instead of random effects.

(AR(2)) is not rejected. The Sargan/Hansen test does not reject the null hypothesis and therefore suggests validity of the instruments. The p-value is above the 0.10 significance threshold, but it also exceeds the value of 0.25. The p-value of 0.996 is close to an implausibly good value of 1.00, which again might be a potential sign of trouble according to Roodman (2009b). To address this, the robustness of the estimates is tested. Accordingly, the robustness is tested by limiting the number of lags used for the GMM-style instruments to two years. The results again remain qualitatively similar. However, the Sargan/Hansen test changes only marginally to 0.991 (see table 29).

This study argued that the share of female supervisory board members and the existence of a critical mass of more than three women have a positive impact on the share of female management board members in the German setting. To summarise, the results do not support the concept of a positive effect of the share of female supervisory board members. Also, the empirical evidence for a positive impact of a critical mass is limited (coef. = 0.018; $p < 10\%$). The control variable for the firm size is negatively, but not significantly correlated with the share of female management board members.

To further address the validity concern of the system GMM results because of the high p-value of the Sargan/Hansen test and to further test the robustness of the respective result, the model is again analysed based on a ML-SEM approach following the guidance of Allison et al. (2017) in the following chapter.

| | Pooled OLS | | Fixed Effects | | System GMM (two-step; fd) | |
|---|---|---|---|---|---|---|
| | Coef. | t-test | Coef. | t-test | Coef. | z-test |
| Lag share of female management board members | 0.785*** | 16.573 | 0.408*** | 5.493 | 0.688*** | 8.565 |
| Lag share of female supervisory board members | 0.001 | 0.052 | -0.005 | -0.237 | -0.017 | -0.837 |
| Lag critical mass | 0.009 | 1.600 | -0.004 | -0.501 | 0.018‘ | 1.900 |
| Log(employees) | -0.001 | -0.476 | -0.025 | -1.175 | -0.002 | -0.508 |
| Quota dummy | yes | | no | | yes | |
| Industry dummies | yes | | no | | yes | |
| Year dummies | yes | | yes | | yes | |
| Observations | 2.135 | | 2.135 | | 2.135 | |
| $R^2$ | 0.57 | | 0.15 | | | |
| Arellano-Bond AR(1) p-value | | | | | 0.002 | |
| Arellano-Bond AR(2) p-value | | | | | 0.854 | |
| Sargan/Hansen test p-value | | | | | 0.996 | |

**Table 28: Results management board gender diversity**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ‘ significant at < 0.1; t- and z-statistics are based on White heteroscedasticity consistent standard errors; 305 firms; moments condition collapsed; Arellano-Bond tests check whether the data process is auto-regressive; the Sargan/Hansen test checks whether the model is overidentified

| | System GMM (two-step; fd) | |
|---|---|---|
| | Coef. | z-test |
| Lag share of female management board members | 0.708*** | 7.501 |
| Lag share of female supervisory board members | -0.017 | -0.811 |
| Lag critical mass | 0.017' | 1.799 |
| Log(employees) | -0.002 | -0.431 |
| Quota dummy | yes | |
| Industry dummies | yes | |
| Year dummies | yes | |
| Observations | 2.135 | |
| Arellano-Bond AR(1) p-value | 0.002 | |
| Arellano-Bond AR(2) p-value | 0.863 | |
| Sargan/Hansen test p-value | 0.991 | |

**Table 29: Robustness test – system GMM instruments limited to two years**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ' significant at < 0.1; t- and z-statistics are based on White heteroscedasticity consistent standard errors; 305 firms; moments condition collapsed; Arellano-Bond tests check whether the data process is auto-regressive; the Sargan/Hansen test checks whether the model is overidentified

#### *5.3.1.3 Supplementary robustness analysis via ML-SEM*

To further analyse the robustness of the system GMM result regarding a positive impact of a critical mass on the share of female management board members, the model is again calculated based on the ML-SEM approach, which is the system GMM's methodological pendant in social sciences. This dissertation uses the SEM function of the "lavaan" package in R to compute the model.

Also using ML-SEM brings some benefits in comparison with system GMM method. The following benefits are especially helpful for the robustness analysis (Allison et al., 2017, p. 2):

- "Many goodness-of-fit measures are available to assess the over-identifying restrictions of the model
- There is no need to choose among many possible instrumental variables"

Allison et al. (2017) demonstrate that ML-SEM is an effective alternative to GMM and has the following properties (p. 11):

> "Instead of relying on difference scores to eliminate the fixed effects, maximum likelihood estimation of this model is accomplished by allowing the fixed effects to have unrestricted correlations with the time-varying predictors. The initial observations of the dependent variable are treated just like any other exogenous variables. Cross-lagged causation is accommodated by allowing the error term in each equation to correlate with future values of the time-dependent predictors."

In general, the ML-SEM method requires multivariate normally distributed data. Accordingly, the first step is to check the raw data for skewness and kurtosis. The test based on Mardia's test for multivariate normal distribution rejects multivariate normality because both p-values of skewness and kurtosis statistics are smaller than 0.05 (cut off value > 0.05) (R Package MVN). Nevertheless, there are alternative strategies for handling non-normal data, which also have been implemented in the "lavaan" package (Rosseel, 2012). This dissertation addresses non-normal data with robust standard errors and scaled statistics using the Satorra-Bentler scaled test statistic (Satorra & Bentler, 1988, 1994).

Figure 16 illustrates a simplified path diagram of how the model is computed in alignment with the principles of a cross-lagged panel model with fixed effects worked out by Allison et al. (2017).

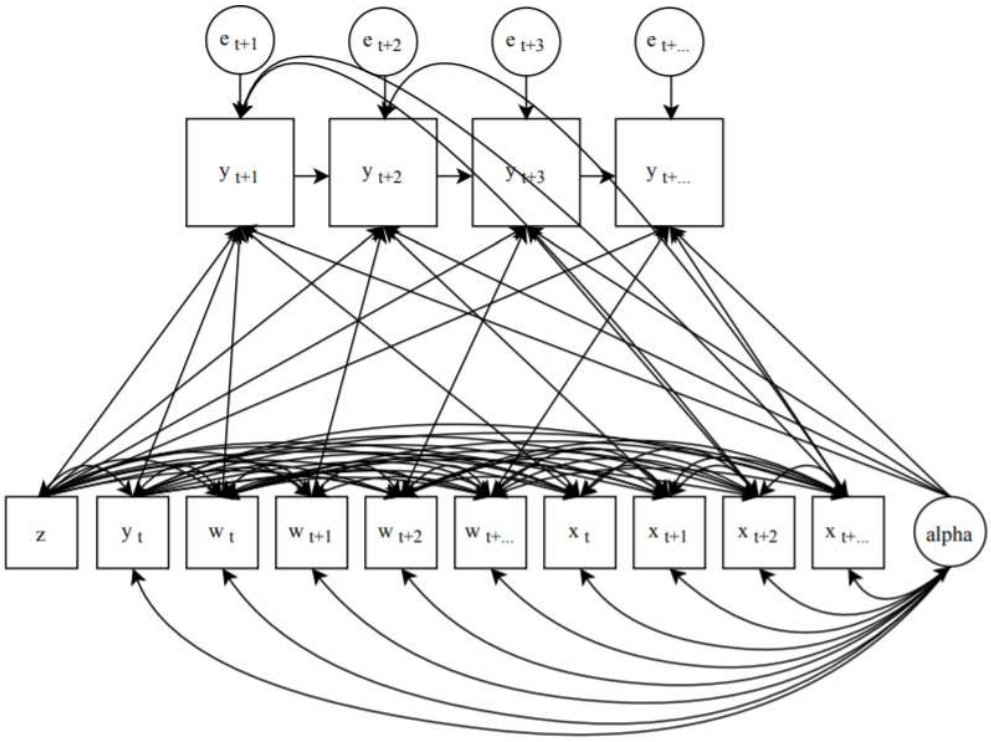



**Figure 16: Simplified path diagram of the research model for a cross-lagged panel with fixed effects**

**Source: Adapted from Allison et al., 2017)**

Note: z = time-invariant control variable, y = dependent variable, w = time-varying control variable, x = independent variable, alpha = fixed effects variable, e = error term, squares represent observed variables, circles indicate latent variables, one-headed arrows indicate an expected directional relationship between two variables, two-headed arrows indicate covariation between two variables

Each arrow represents a computed path and unidirectional arrows between two variables symbolise a direct effect of one variable on the other, whereas bidirectional arrows characterise covariances between exogenous variables. In this simplified example, the model covers a timespan of five years. The model includes a time-invariant control variable z, a time-varying control variable w, a latent variable alpha, and a predetermined variable x. The predetermination of x is defined by the bidirectional arrows between $x_{t+2}$ and $x_{t+...}$ and the error terms $e_{t+1}$ and $e_{t+2}$. This allows for a covariation of x at time t with the error term for y at any prior

point in time (allowing for reverse causation). Figure 16 also shows that all x variables can covary with each other and with $y_t$. The covariation with $y_t$ specifies that this variable is treated like an exogenous variable. Moreover, the latent exogenous variable alpha, which represents the fixed effects variable, can covary with all the exogenous variables except for z, which does not vary over time. At the same time, alpha affects $y_{t+1}$, $y_{t+2}$, $y_{t+3}$, and $y_{t+...}$ (each with a coefficient of 1.0, not shown) (Allison et al., 2017). By allowing alpha to have unrestricted correlations with the time-varying predictors, it behaves as a set of fixed effects (Allison & Bollen, 1997; Allison et al., 2017; Bollen & Brand, 2010; Teachman, Duncan, Yeung, & Lvy, 2001).

The difference between a random effects model and a fixed effects model is that the first-mentioned assumes that the unobserved variables are not correlated with the observed variables, whereas the latter does not restrict any associations between the unobserved variables and the observed variables. Accordingly, the fixed effects model treats the unobserved variables as fixed parameters (Allison, 2009).

Consequently, unobservable heterogeneity because of time-invariant heterogeneity (e.g. differing corporate cultures) is controlled for in this design. In addition, this empirical design allows for addressing and controlling endogeneity concerns caused by simultaneity, reverse causality, and dynamic endogeneity because the cross-lagged panel model estimates a causal direction and allows the error term in each equation to correlate with future values of the time-dependent predictors (Allison et al., 2017).

| Variable definition | Variable | Variable description |
|---|---|---|
| Dependent variable | y | Share female management board members |
| Independent variable | Lag(x1) | Lagged share female supervisory board members |
| | Lag(x2) | Lagged dummy for a critical mass |
| Time-varying control variables | Lag(w1) | Log(employees) |
| | Lag(y) | Lagged share female management board members |
| Time-invariant control variables | z1 | Quota dummy variable |
| | z2-z11 | Industry dummies |
| Observation period: | | 2011-2018 |

**Table 30: ML-SEM model description**

*5.3.1.4 Results of robustness analysis via ML-SEM*

A very important step in SEM is to analyse the model fit (Yuan, 2005). As highlighted before, an advantage in this respect is that there are a number of different measures to analyse whether the model agrees with the data (Allison et al., 2017). Nevertheless, there are no definite guidelines for assessing the model fit in the literature (which indices to report and which cut-off values to consider). This study reports a number of different fit indices to address several aspects of the model fit. This strategy follows the suggested procedure of Kline (2005). The considered indices are the model chi-square ($\chi^2$), the robust RMSEA (following Brosseau-Liard et al. (2012)), and the SRMR. These indices indicate the absolute fit of the model. Furthermore, the robust CFI (following Brosseau-Liard and Savalei (2014)), which is an incremental model fit index, is reported.

Table 31 shows the indices, the cut off values suggested by Hu and Bentler (1999), and the results of the research model. Overall, the model fit indices indicate a good model fit for the tested research model, which allows for proceeding with the interpretation of the ML-SEM estimates in table 32.

| Index | Cut-off value | Model |
|---|---|---|
| Df | Positive | 199 |
| p-value ($\chi^2$) | ≥0.05 | 0.19 |
| Robust CFI | ≥0.95 | 0.99 |
| Robust RMSEA | ≤0.06 | 0.03 |
| SRMR | ≤0.08 | 0.03 |
| Total Result | good | good |

**Table 31: Summary of model fit**

Note: Df, degrees of freedom; CFI, Comparative Fit Index; RMSEA, root mean square error of approximation SRMR, standardised root mean square residual; Satorra-Bentler scaled test statistic and robust standard errors

Comparing the results of ML-SEM with the results of the system GMM estimator in table 28 leads to the following conclusions. Firstly, the signs of the coefficients of the lagged share of female supervisory board members are negative for both the ML-SEM and the system GMM estimator. Secondly, the coefficients of the dummy variable for a critical mass again have the same signs (positive) for the ML-SEM and system GMM coefficients. However, it is noteworthy that the ML-SEM coefficient is not statistically significant. The control variable for the firm size is positive in the ML-SEM model, but negative in the system GMM model. Nevertheless, both coefficients are not significant.

| | ML-SEM | | |
|---|---|---|---|
| | Unstd. Coef. | Std. Coef | z-test |
| Lag share of female management board members | 0.744*** (0.106) | 0.632*** | 7.011 |
| Lag share of female supervisory board members | -0.021 (0.019) | -0.024 | -1.122 |
| Lag critical mass | 0.004 (0.008) | 0.010 | 0.426 |
| Log(employees) | 0.009 (0.014) | 0.096 | 0.615 |
| Quota dummy | yes | | |
| Industry dummies | yes | | |
| Observations | 305 | | |

**Table 32: Results of the cross-lagged panel models with fixed effects analysing the impact of the lagged number of female supervisory board members on the number of female management board members**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ' significant at < 0.1; standard errors in parentheses; Satorra-Bentler scaled test statistic and robust standard errors

To summarise, the ML-SEM results confirm the system GMM results regarding the negative, but not significant coefficient for the lagged share of female supervisory board members. However, they do not confirm the statistically significant impact of a critical mass. Despite the coefficient being positive like in the system GMM model, the statistical significance is different. Consequently, the reported effect of a critical mass is non-robust to a different modelling approach like ML-SEM.

Accordingly, table 33 summarises the results of the hypothesis testing.

| **Hypotheses** | | **Results** |
|---|---|---|
| Impact of supervisory board gender diversity on management board | | |
| H3 | *The share of female supervisory board members is positively related to the share of the female management board members.* | - |
| H4 | *A critical mass of three or more women on the supervisory board is positively related to the share of female management board members.* | / |

**Table 33: Summary of results for hypothesis testing H3 and H4**

Note: - = rejected; / = partly supported; + = supported

*5.3.1.5 Discussion of results*

This study tested the relationship of supervisory board gender diversity and firm performance in the German two-tier corporate governance framework. As described in the course this dissertation, Germany has hardly been within the scope because most of the studies and samples focus on countries with the one-tier corporate governance system in place. In addition, the results of the studies analysing the relationship between gender diversity in the boardroom and firm performance have been inconclusive. The literature review also revealed that the theoretical implications are ambiguous because there are theories that argue that gender diversity is beneficial, but there are also theoretical considerations that predict negative consequences of supervisory board gender diversity.

Furthermore, this study also explored whether gender diversity on the supervisory board affects gender diversity on the management board. This is a topic with little focus in the literature. Again, there no consensus in the literature whether there is a positive effect (see table 7). Similarly, the theoretical implications are ambiguous. There are arguments for both a positive and a negative effect.

This situation indicates that the relationships are not uniformly across different contexts. As outlined in chapter 2, the German corporate governance and legal environment has several particularities that might be relevant in this context.

Moreover, the literature analysis revealed that the robustness of the methodologies and research designs used in a lot of the studies in this field are questioned. Consequently, endogeneity problems are referred to as a potential explanation for the inconclusive and mixed results presented in the literature. This dissertation's strategy to address the endogeneity and validity concerns highlighted in the literature is to estimate three different models, including pooled OLS, fixed effects, and system GMM estimation. In addition, several robustness tests are performed.

As described, the previous literature has already concluded that regressing performance measures on diversity characteristics is a difficult exercise because firm performance is influenced by several internal and external factors (Carter et al., 2003; Erhardt, Werbel, & Shrader, 2003; Smith, Smith, & Verner, 2006). Focusing on board gender diversity, the results of previous studies on the relationship between gender diversity in the boardroom and firm performance are mixed and in-

conclusive (see table 6), despite the popular and frequently discussed positive theoretical implications. If supervisory board gender diversity benefits the effectiveness and decision-making competence of the board, an accounting-based measure like the ROA might be positively impacted by such a performance boost. In addition, a market-based performance measure, such as the P2B, might also be enhanced, if the investors' majority view is that increased board gender diversity positively influences the boards task performance and the firm's success (Bennouri et al., 2018).

However, the empirical results of this study do not support the hypothesis of a positive impact of supervisory board gender diversity on the firm performance. This study measured supervisory board gender diversity by the share of female supervisory board members and by a dummy variable indicating if a critical mass of three or more women is represented on the supervisory board. For both the ROA, as accounting-based measure, and the P2B, as market-based measure, the modeled estimators of the system GMM estimations are negative and non-significant. This result is in line with several other studies analysing the effects of board gender diversity (i.e. Joecks et al., 2013; Carter et al., 2010; Rose, 2007).

Consequently, the results suggest that higher gender diversity on the supervisory board does neither improve the board's performance, nor the investors perception of the boards' capabilities in the German environment. In order to explain these results, this study offers potential explanations based on three categories. The first category of explanations assumes that female board members are different than their male peers, whereas the second category argues based on the opposite assumption. The third category refers to the unique setting of the German environment.

**Is gender diversity always beneficial?** Firstly, as much as there is a theoretical basis for the "business case" argument of board gender diversity, there are also theoretically and empirically motivated arguments that board gender diversity potentially negatively impacts the firm performance. The work of Adams & Funk (2012), for example, suggests that female board members are more risk-loving than their male peers, which can turn out to be good in one case, but also result in worse results in another. The same potentially applies for increased stakeholder orientation if gender diverse boards are generally more stakeholder oriented. This might

positively impact the firm performance in certain circumstances, but also potentially negatively in other situations (Adams, 2016). In addition, the selection of female board members might play a role in this context because the appointment of a female board member does not only affect the gender diversity but might also influence other diversity dimensions such as the qualification and the experience. Accordingly, if qualified and experienced female board members are short in supply, then the "golden skirt" phenomenon (women who accumulate several board memberships in bulk) might be impacting the independence and replicate the negative consequences of the "old boys" network (Huse, 2011). On the other hand, Adams & Ferreira (2009) suggest that changes in board gender diversity increase the independence of the board, which might result in too much monitoring and eventually decreasing shareholder value. Also, because of the short supply, it might be the case that less qualified or less experienced female candidates are appointed to the board and hence negatively impact the current board set-up, which might have been composed to optimally support the firm's strategic ambitions already. Another phenomenon, defined as the "glass cliff" (M. K. Ryan & Haslam, 2005, 2007) might also provide an explanation for the results because the "glass cliff" phenomenon suggests that female candidates are more likely than their male peers to be appointed to a board position that is risky and precarious. Therefore, women might face different preconditions which make it more difficult to be successful. Lastly, it is not clear how individual diversity is aggregating to the whole board. For example, if one additional woman enters the board, how do her views affect the opinions of the collective? Do views of one individual matter at all in board discussions? There is no uniform answer. This might depend on the context, the team dynamics, the respective decision-making process, the board structure, etc. (Adams, 2016; van Dijk, van Engen, & van Knippenberg, 2012).

**Are women on the board different than men?** The above-mentioned rationales are part of the first category, which are based on the assumption that female board members are different or are perceived as different compared to their male peers. However, this is not necessarily the case because it could also be that female board members differ compared to the average female population as regards traits and preferences because they might assimilate the attitude and behaviour of their male peers in the same positions (Adams & Funk, 2012). In other words, if German female supervisory board members need to be like their male counterparts to get

access to the boardroom, the anticipated differences among supervisory board members vanish. Consequently, the hypothesised positive effects of board gender diversity do not materialise, if this is true. This might also explain, why the prediction of the critical mass theory is not supported because even if the critical number of three women on the board is exceeded, it makes no difference, if the female board members are not different. According to the work of Adams & Funk (2012), who analyse this topic based on a Swedish sample of board directors, this is not the case. Nevertheless, it is also possible that gender differences of supervisory board members in Germany are completely different to those in Sweden and thus their results do not necessarily apply in general to the German setting.

**What is the role of German corporate governance particularities?** Thirdly, there is the opportunity that the unique German environment might be relevant for explaining why the results do not support the hypotheses. The relationship in scope could be affected by context-dependent forces, such as corporate governance set-ups, legislation, and culture. Especially, the following Germany-specific factors could be relevant in this context. The two-tier corporate governance system is the traditional set-up for stock companies in Germany. Hence, there are supervisory boards and management boards. Secondly, German companies have to implement the provisions of the co-determination rules, and thus, the Co-Determination Act (for companies with more than 2000 employees) or the One-Third Employee Participation Act (for companies with more than 500 but less than 2000 employees) affect the appointment of supervisory board members. Thus, depending on the number of employees a firm has and consequently which co-determination laws apply, one half or one third of the supervisory board members are elected by the employees. Therefore, it is possible that the female supervisory board members come predominantly from the employee representative side. The recently published study of Handschumacher & Ceschinski (2020), which also focuses on German firms listed in the HDAX and SDAX, indicates that female employee representatives are not affecting the supervisory board's monitoring effectiveness in the same way that the female shareholder representatives do. Also, they might focus their supervisory board work on making sure that the interests of the employees are considered instead of leveraging their complementary views and perspectives to maximise shareholder value. In addition, it might be that female employee representatives have a relatively weak structural position and also a lower status than

the shareholder representing members.[4]

Apart from the business case hypothesis, this study also tested potential trickle-down effects of gender diversity reasoning that the share of female supervisory board members and a critical mass of at least three women on the supervisory board have a positive impact on the share of female management board members. Again, the empiric results of this study offer no robust support for the tested hypothesis of a trickle-down effect. This result is in line with the findings of similar studies based on the Norwegian and Italian setting (M. Bertrand et al., 2019; Maida & Weber, 2019), but contradicts the results of studies based on the US and Australian environment that report a positive effect on the gender diversity level at the management layer below (Bilimoria, 2006; Cook & Glass, 2015; Gould et al., 2018; Matsa & Miller, 2011; Skaggs et al., 2012).

The result also contradicts the findings reported by Kirsch & Wrohlich (2020a) in the "Women Executives Barometer" report. They analyse a sample of n = 161 of the top German companies and find a positive correlation between the proportion of women on executive boards in 2019 and the average proportion of women on supervisory boards from 2014 to 2018. A potential explanation for the inconsistent results is the different methodological approach. This study's research design is more rigorous with regards to addressing potential endogeneity problems and understanding causality, whereas Kirsch & Wrohlich (2020a) rely on a simple bivariate regression.

**Reasoning based on individual preferences** – To explain this unexpected result, this dissertation presents explanations based on three different levels. Starting with the individual level, it might be the case that female talents have different preferences and career priorities than men, which might reduce the attractiveness of top management careers for women. Consequently, there might be less willing female candidates (Matsa & Miller, 2011). Such gender-based differences might lead to a potential supply shortage of qualified and willing female candidates. Apart from supply-sided arguments, the implications of the queen bee syndrome

[4] The chair of the supervisory board usually is a shareholder representative, who has two votes in the event of a tie. Consequently, employee representatives might have less influence on organisational practices and outcomes.

(Staines et al., 1974) might be relevant for this relationship. The queen bee syndrome suggests that woman in a position of authority treat other subordinate women especially critical. This means that, queen bee behaviour would worsen the "anti-female bias" (Arvate et al., 2018) because female leaders are less likely to support female talents because female supervisory board members might be against the recruitment of a female management board member to further enhance their own status and legitimisation (Derks, Ellemers, van Laar, & de Groot, 2011; Derks, Van Laar, Ellemers, & de Groot, 2011).

**Reasoning based on the board-level** – Even if female supervisory board members have the aspiration, they nevertheless might not have the ability to help other women into management positions. One reason for that is that they might not be able to materially influence and drive recruitment decisions, for example because of a relatively weak structural position (Ashfrod et al., 1998; Maume, 2011; Penner et al., 2012). Historically, supervisory boards are dominated by men. Hence, female supervisory board members are underrepresented, and therefore the likelihood of female supervisory board members having an impact on the board's decisions is relatively low. This view is supported by the work of Bozhinov et al. (2017, 2019). Their findings indicate that female supervisory board members in Germany have limited influence on board decision-making, despite the recent increase of the number of women on boards. Nevertheless, the impact of increased gender diversity on the supervisory board as a consequence of the gender quota might eventually emerge in the long run.

**Reasoning based on the German environment** – Looking at the macro-level, the unique German set-up might be relevant for the relationship. Consequently, the results might be context-sensitive and affected by factors like culture, legislation, and corporate governance set-ups. In particular, the two-tier set-up and the co-determination legislation are specialties that might be influencing the relationship in scope. In addition, cultural aspects could also be crucial for trickle-down effects. This idea is supported by the opposing results when comparing continental European with Anglo-Saxon studies. Bertrand et al. (2019) and Maida & Weber (2019) studied the relationships based on the cases of Norway and Italy, and also find no trickle-down effect of board gender diversity, whereas studies conducted in the US and Australia support the concept of a positive relationship (Bilimoria, 2006; Cook & Glass, 2015; Gould et al., 2018; Matsa & Miller, 2011; Skaggs et al., 2012). Also,

the impact of the German gender quota possibly negatively affects the opportunities of female candidates to enter management boards.

### 5.3.2 Evaluation and discussion of the results of the models analysing the effects of the gender quota

#### *5.3.2.1 Evaluation of the models analysing the effects on the firm performance*

This study also considers the implications of the gender quota legislation and argues that the reform can be treated as a natural experiment, which allows for escaping the endogeneity problems highlighted in the literature (Dale-Olsen et al., 2013).

In this section, hypothesis 5 regarding the impact of the quota on the ROA and the P2B is tested based on the sub-samples that exclude the financial industry. This study relies on the difference-in-differences approach to assess the impact of the quota legislation on the dependent variables. In order to also test the robustness of the results, unmatched and matched samples are considered. In addition, placebo tests are performed to examine potential pre-existing trends.

The following difference-in-differences regression is computed:

$$y_{it} = \beta_0 + \beta_1 x_i + \beta_2 t + \beta_3 x_i \times t + \beta_4 No.fem.SB + \beta_5 CM + \beta_6 Firm\ Size + \beta_7 SalesGrowth + \beta_8 PriceVolatility + \beta_9 Leverage + Industry\&Year\ FE + e_{it}$$

Where i is a firm in a group (x = 0 for control group, 1 for treatment group) in a particular time period (t = 0 for pre-intervention, 1 for post-intervention), and $e_{it}$ is the error term. The included control variables are the number of female supervisory board members, a critical mass dummy variable, the firm size, the sales growth, the price volatility, and the leverage. Also, industry and year dummies are included to control for industry and time effects. The treatment effect is defined as the difference between the treated group and a comparable control group across time. Thus, the estimated coefficient of the interaction term $\beta_3$ reveals any change in outcome y from the pre-policy period to the post-policy period, that occurs in the treatment group and not in the control group. The sample period is from 2011 to 2018, and standard errors are adjusted for clustering at the firm level.

To ensure comparability of the control and treatment groups, only German publicly listed firms with the two-tier corporate governance set-up are included. In addition, this study's empirical strategy also included the analyses of matched samples to further reduce the differences in observed characteristics between the two groups in order to address the concern that the treatment and the control group may differ in ways that would affect their trends over time. Chapter 5.2.3.3 describes the matching procedure in more detail.

The main assumption of the difference-in-differences method is that the outcome variables of the treatment and the control group would have evolved in the same way, if there was no quota implemented. This common trend assumption is unobservable and thus, cannot be fully or formally tested. However, comparing for common trends of the outcome variables in the pre-reform period of the two groups is possible and may serve as an indicator for how likely this assumption is (Dale-Olsen et al., 2013; Maida & Weber, 2019). The patterns of the matched samples shown in figure 14 are promisingly close for the ROA, and reassuringly parallel for the P2B. To also test the common trend assumption and to check the robustness, two placebo tests are performed, where the variable $t$ is substituted with another dummy variable with a time lag of one year and a time lag of two years before the introduction of the law in 2015. Hence, in placebo test 1 the dummy variable is equal to 1 starting in 2014, and in placebo test 2 the dummy variable is equal to 1 starting in 2013. Consequently, the results of the placebo tests should show a reduced and/or not significant difference-in-differences coefficient. This is the case (see table 36).

Table 35 reports the results for the total as well as the matched samples for all outcome variables. Focusing on the difference-in-differences estimator for the ROA models, the coefficient is positive for the total and negative for the matched sample. However, both are not statistically significant, and hence the results suggest that the effect of the quota on the ROA is not statistically significant. In turn, the effect of the quota on the P2B is negative and statistically significant for both the total (significant at a 5 percent level) and the matched sample (significant at a 10 percent level). This suggests that investors penalise firms that are within the scope of the gender quota legislation and thus might assume that the board effectiveness is adversely impacted by mandating women to the board.

*5.3.2.2 Evaluation of the models analysing the effects on gender diversity below*

In this section, hypothesis 6 is tested based on the full sample of firms. Again, the difference-in-differences approach is applied. Consistent with the approach in the prior chapter, unmatched and matched samples are considered. Also, placebo tests are performed to examine potential pre-existing trends.

The following difference-in-differences regression is computed:

$$y_{it} = \beta_0 + \beta_1 x_i + \beta_2 t + \beta_3 x_i \times t + \beta_4 No.fem.SB + \beta_5 CM + \beta_6 Firm\ Size + Industry\&Year\ FE + e_{it}$$

Where i is a firm in a group (x = 0 for control group, 1 for treatment group) in a particular time period (t = 0 for pre-intervention, 1 for post-intervention), and $e_{it}$ is the error term. The included control variables are the number of female supervisory board members, a dummy for a critical mass, and the firm size. Also, industry and year dummies are included to control for industry and time effects. The treatment effect is defined as the difference between the treated group and a comparable control group across time. Thus, the estimated coefficient of the interaction term $\beta_3$ reveals any change in outcome y from the pre-policy period to the post-policy period that occurs in the treatment group and not in the control group. Again, the sample period is from 2011 to 2018, and the standard errors are adjusted for clustering at the firm level.

The patterns shown in figure 14 are again reassuringly parallel for the average number of female management board members and thus do not reject the common trend assumption. Again, two placebo tests are performed, where the variable $t$ is substituted with another dummy variable with a time lag of one year and a time lag of two years before the introduction of the law in 2015. Hence, in placebo test 1 the dummy variable is equal to 1 starting in 2014, and in placebo test 2 the dummy variable is equal to 1 starting in 2013. Consequently, the results of the placebo tests should show a reduced or not significant difference-in-differences coefficient. This is again the case (see table 36).

Referring to table 35, the difference-in-differences estimator for the total as well as the matched sample is positive, but very small and statistically insignificant. Consequently, the results suggest that the effect of the quota on the number of female management board members is negligible.

Accordingly, table 34 summarises the results of the hypothesis testing.

| Hypotheses | | Results |
|---|---|---|
| Impact of gender quota legislation | | |
| H5 | *The implementation of the gender quota legislation is negatively related with the firm's financial performance* | + |
| H6 | *The implementation of the gender quota legislation does not increase the number of female management board members* | + |

**Table 34: Summary of results of hypothesis testing H5 and H6**
Note: - = rejected; / = partly supported; + = supported

| | ROA | | P2B | | Number female management board members | |
|---|---|---|---|---|---|---|
| | Total Sample | Matched Sample | Total Sample | Matched Sample | Total Sample | Matched Sample |
| Quota*post inception | 0.123<br>(1.271) | -0.821<br>(0.684) | -0.608*<br>(0.259) | -0.470′<br>(0.262) | 0.011<br>(0.034) | 0.032<br>(0.044) |
| Quota | -1.461<br>(1.123) | 0.257<br>(0.584) | -0.309<br>(0.229) | -0.369′<br>(0.223) | -0.051′<br>(0.030) | -0.133***<br>(0.036) |
| Post inception | 0.799<br>(1.168) | 0.143<br>(0.719) | 0.770**<br>(0.239) | 0.814**<br>(0.276) | 0.029<br>(0.030) | 0.042<br>(0.046) |
| Intercept | -5.308*<br>(2.560) | 8.897***<br>(1.654) | 1.811***<br>(0.522) | 2.686***<br>(0.628) | -0.166**<br>(0.060) | -0.626***<br>(0.096) |
| Control variables | yes | yes | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes | yes | yes |
| Observations | 1,923 | 1,224 | 1,929 | 1,232 | 2,440 | 1,472 |
| $R^2$ | 0.26 | 0.13 | 0.11 | 0.10 | 0.13 | 0.19 |

**Table 35: Summary of results for the difference-in-differences estimation**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ′ significant at < 0.1; standard errors, adjusted for clustering at the firm level, are reported in parentheses

| | ROA | | | P2B | | | Number female management board members | | |
|---|---|---|---|---|---|---|---|---|---|
| | Matched | Placebo 1 | Placebo 2 | Matched | Placebo 1 | Placebo 2 | Matched | Placebo 1 | Placebo 2 |
| Quota*post inception | -0.821<br>(0.684) | -0.464<br>(0.706) | -0.642<br>(0.781) | -0.470'<br>(0.262) | -0.331<br>(0.270) | -0.329<br>(0.300) | 0.032<br>(0.044) | 0.004<br>(0.045) | 0.006<br>(0.050) |
| Quota | 0.257<br>(0.584) | 0.169<br>(0.145) | 0.353<br>(0.740) | -0.369'<br>(0.223) | -0.384<br>(0.245) | -0.341<br>(0.284) | -0.133***<br>(0.036) | -0.121**<br>(0.040) | -0.123**<br>(0.047) |
| Post inception | 0.143<br>(0.719) | 0.145<br>(0.740) | -0.350<br>(0.757) | 0.814**<br>(0.276) | 0.677*<br>(0.283) | 1.071***<br>(0.290) | 0.042<br>(0.046) | 0.027<br>(0.047) | 0.069<br>(0.048) |
| Intercept | 8.897***<br>(1.654) | 8.774***<br>(1.669) | 9.260***<br>(1.688) | 2.686***<br>(0.628) | 2.768***<br>(0.634) | 2.353***<br>(0.641) | -0.626***<br>(0.096) | -0.604***<br>(0.097) | -0.646***<br>(0.097) |
| Control variables | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Observations | 1,224 | 1,224 | 1,224 | 1,232 | 1,232 | 1,232 | 1,472 | 1,472 | 1,472 |
| $R^2$ | 0.13 | 0.13 | 0.13 | 0.10 | 0.10 | 0.10 | 0.19 | 0.19 | 0.19 |

**Table 36: Summary of placebo tests**

Note: *** significant at < 0.001; ** significant at < 0.01; * significant at < 0.05; ' significant at < 0.1; standard errors, adjusted for clustering at the firm level, are reported in parentheses

*5.3.2.3 Discussion of results*

This study analysed the impact of gender quota legislation on the firm performance as well as on the gender diversity on the management board focusing in the German case. In 2015, Germany followed its European peers and also introduced gender quota legislation. As described in the course this dissertation, the law for "equal participation of women and men in leadership positions in the private sector and in public service" has two features that are relevant for this dissertation. Firstly, the law stipulates the necessity of a gender quota of at least 30 percent on the supervisory board for the companies within the scope of the law. Secondly, it stipulates the provision of a formulation of a target percentage of female representation on the management board. The gender quota of 30 percent on the supervisory board and the provision to articulate a target figure for the management board apply for companies that are publicly listed and that fall under the German co-determination act (> 2.000 employees). This applies for approx. 100 of the largest German companies.

The research design relies on the introduction of the gender quota in Germany as exogenous impact for conducting a "natural experiment" with a difference-in-differences approach to address the endogeneity and validity concerns highlighted in the literature.

This study predicted that the introduction of the quota would have detrimental effects on the financial performance of the affected firms. The argumentation for that hypothesis is based on assumptions that qualified female candidates are short in supply, that firms choose boards to maximise value, and that mandating women to the board brings the risk of tokenism. Thus, this study argues that forced board changes are costly and do not necessarily improve the quality or perceived of the board. This approach is in line with the empirical studies summarised in table 8.

The results support the hypothesis of a negative impact on the financial performance and show a negative effect of the gender quota on the P2B. This indicates that investors disparage the statutory interference regarding the supervisory board's composition. However, the results also expose that the effect of the quota on the ROA is not statistically significant. These findings are in line with other studies in the sense that the effect of the gender quota implementation on the ROA is

negligible (Dale-Olsen et al., 2013; Eckbo, Nygaard, & Thorburn, 2016), and that the effect is negative regarding the firm or market value (Adams & Ferreira, 2009; Ahern & Dittmar, 2012).

Moreover, this study predicted that the quota is not successful in increasing the number of female management board members. As carved-out in the course this dissertation, the effects of gender quotas on aspects beyond financial consequences have not been extensively researched. In particular, the impact of gender quotas on the presence of women on the management board is not in the focus. The respective hypothesis is derived from the argumentation that firms might try to escape institutional pressure. This argumentation is in line with the prediction of institutional theory. Hence, firms might avoid additional pressure coming with voluntarily increasing the target gender quotas for the management board while also bearing in mind that qualified female candidates might be short in supply. If the number of qualified female candidates is short, then the firms might seek to comply with the mandatory quota for the supervisory board and consequently appoint the rare number of qualified female candidates to the supervisory board and not to the management board. In this sense, firms aim for compliance with the law to avoid any pressure or conflicts rather than leveraging the potential benefits of an overall increased gender diversity in the firm's leadership.

The results of this study support this argumentation and indicate that there is no statistically significant and hence no relevant effect of the quota on the number of female management board members. This result is in line with the results reported by Bennouri et al. (2020), who show that the quota does not promote the appointments of female executives in the French, Italian, and UK set-up.

Summarising, the results of this study show that quota legislation can have negative and unintended consequences for the companies in scope of the law. In this case, the quota is value reducing and does not support the representation of women on the management board. The findings also highlight the need for alternatives to discernibly increase the female representation in the top management.

# 6 CONCLUSIONS

## 6.1 CONCLUSIONS AND IMPLICATIONS

This dissertation researches the impact of supervisory board gender diversity and quota legislation on the financial performance and management board gender diversity for German companies listed in the CDAX. Hence, this study focuses on the German environment, which is special in this context because of local particularities such as the two-tier corporate goverance structure, the employee representation, and the implemented quota legislation.

The literature review exposed that the theoretical implications and empirical findings do not uniformly indicate what the effects gender diversity on the supervisory board are. There are also concerns that methodological shortcomings are a potential driver for the mixed-results of the tested board gender diversity relationships (Adams, 2016; Arvate et al., 2018; Ferreira, 2011) because most studies on leadership and management are liable to suffer from endogeneity problems (Antonakis et al., 2010, 2014; Wintoki et al., 2012).

Against this background, one of the dissertation's main purposes is to create transparency about what the German society can really expect from women in the boardroom. Therefore, this study stresses the importance of addressing potential endogeneity problems as they might seriously compromise correlational inference based on non-experimental research designs. Accordingly, this study's research design focuses in particular on the methodological shortcomings criticised by experts, who also question the validity of the empirical evidence presented in the literature. To avoid a one-sided approach, the threats and negative theoretical implications of gender diversity on the supervisory board are also discussed. Moreover, this dissertation aims to uncover the effects of the German mandatory gender quota on the supervisory board and the ogligation to define a target gender quota for the management board. This dissertaion therefore also aims to add to the political discussion about legislating women to the boardroom by analysing the consequences of such political reforms.

The study applies an interdisciplinary approach and combines theories and empirical strategies from economics, management science, psychology, and political science. The hypotheses are tested based on panel data from samples of up to 305 German firms over the observation period 2011-2018 (= 2,440 firm years).

The first research question focuses on the business case argument of supervisory board gender diversity.

RQ1: *How does supervisory board gender diversity affect the financial performance in the German set-up, and is this effect dependent on the statistical methodology used?*

This dissertation uses OLS, fixed effects, and system GMM estimation to test if endogeneity problems might be biasing the estimates and if the models are sensitive to the statistical methodologies used. In principle, the system GMM estimator is seen as superior compared to the OLS and fixed effects estimators because it additionally addresses sources of endogeneity that come with dynamic panel settings.

The main findings in this respect are that there is no evidence for the business case of supervisory board gender diversity in Germany. An accounting-based (ROA) and market-based (P2B) measures are both not statistically significantly related with the share of female supervisory board members or the critical mass of three or more women on the supervisory board. Interestingly, the different estimators come to inconsistent results, which tend to differ in direction and/or economic significance. This seems to indicate that endogeneity problems might bias the parameter estimates as well as the conclusions about the business case argumentation of supervisory board gender diversity.

To conclude, this dissertation complements the discussion about what the German society can expect from an increase of female representation on the supervisory board. The results indicate that merely increasing the presence of women on the supervisory board will not increase the financial performance and that this expectation is not realistic. Therefore, this argument should not be at the centre of the debate. In any case, to expect female supervisory board members to be "superheroes" is neither fair nor desirable because it puts additional pressure on newly appointed women, who already are in the spotlight. Hence, there is no scientific evidence that supervisory board gender diversity is the silver bullet to successful corporate governance in the German environment. Indeed, if there is a relationship

between women on the supervisory board and the company's financial performance it is potentially heterogenous, much more complex, and affected by various contextual factors.

Nonetheless, it is noteworthy that there also is no evidence of a negative impact. Consequently, this study does not support the view that female supervisory board members are less qualified or that they negatively impact the efficacy of the board.

The second research question follows the same methodological approach as described above, but focuses on the effect of supervisory board gender diversity on the gender diversity of the management board. By focusing on the effects on the management board gender diversity, this study links the supervisory board composition to an outcome that is more subject to the control of the board than the financial performance.

*RQ2: How does supervisory board gender diversity affect the gender diversity on the management board in the German set-up, and is this effect dependent on the statistical methodology used?*

Again, this dissertation uses OLS, fixed effects, and system GMM estimation to test if endogeneity problems might be biasing the estimates and if the models are sensitive to the statistical methodologies used. In addition, an ML-SEM model is calculated to further test the robustness of the result of the system GMM estimation, which is in doubt because of an almost implausibly good Sargan/Hansen test result.

The main finding of the analysis is, that there is no robust scientific evidence for supervisory board gender diversity impacting the management board gender diversity. Again, the different estimators come to inconsistent results because they differ in direction and/or economic significance. Interestingly, the result of system GMM model is not confirmed by the ML-SEM model, which further indicates that the method used is critical for the resulting parameter estimates.

To conclude, this dissertation provides novel insights for the debate regarding the relationship between supervisory board gender diversity and management board gender diversity. Consequently, the results contradict the findings reported by Kirsch & Wrohlich (2020a), who conducted first correlational analysis between the average proportion of women on a company's supervisory board and the later

proportion of women on its executive board in Germany and found a positive relationship. A possible reason for this mixed evidence is the different methodological approach. Whereas Kirsch & Wrohlich (2020a) rely on a simple bivariate regression, this study's research design is more rigorous with regards to addressing potential endogeneity problems and understanding causality. Hence, this dissertation does not find any evidence of female supervisory board members helping to promote other women into management board positions. However, hidden effects may emerge in the long run as "lazy boards" might adapt their behaviour and recruitment decisions over time.

The third and the fourth research questions focus on the second main topic of this dissertation, which is the analysis of the impact of the German quota legislation. This dissertation uses the introduction of the gender quota in Germany in 2015 as exogenous impact for conducting a "natural experiment" with a difference-in-differences approach to escape from the endogeneity concerns. Both, matched and unmatched samples of listed German firms inside and outside the scope of the quota are considered.

The third research question addresses the impact of the gender quota implementation on the financial performance of the firm.

*RQ3: How has the quota impacted the firm's financial performance in Germany?*

The results indicate that forced changes can have negative and unintended consequences for the companies affected by such a reform. Indeed, the results show that the quota reduced the value of companies impacted by the quota and that shareholders are not in favour of the forced increase of gender diversity. More specifically, the ROA as accounting-based measure is not impacted, which indicates that the accounting-based performance is not affected. However, the P2B is reduced for firms in scope of the quota. This suggests that the stock market anticipates a negative impact of the reform on the firm, which eventually leads to a decline in market value.

Consequently, this dissertation shows that the quota was costly for German firms affected by the law and that the shareholders do not appreciate a state intervention, which can have a negative impact on the quality of the company's corporate governance. This also documents that shareholders tend not to believe that female supervisory board members are "superheroes". The opposite appears to be

the case for mandated gender diversity.

Comparing these results with the results of RQ1, there is an interesting contrast. Both results correspond to the finding that there is no significant impact of gender diversity on the supervisory board on the ROA. However, they show that the shareholders seem to differentiate between mandated and voluntary gender diversity on the supervisory board. The negative effect of the quota on the P2B indicates that shareholders tend to see forced gender diversity on the supervisory board as a risk, and not gender diversity as such.

The fourth research question focuses on the impact of the gender quota legislation on the management board gender diversity.

*RQ4: How has the quota impacted the female representation on the management board?*

The primary objective of the gender quota reform was to increase the representation of women in top positions. Consequently, the quota legislation is not limited to the mandatory quota of 30 percent for the supervisory board, but also includes regulations regarding the formulation of a target gender quota for the management board and the levels below. The mandatory gender quota for supervisory boards has effectively increased women's representation on the supervisory boards of German companies subject to the quota. For 2019, Kirsch & Wrohlich (2020b) report that quota companies have a gender diversity level of about 35 percent on their supervisory boards. However, this dissertation finds no relevant impact of the "voluntary quota" on the number of female management board members based on the performed difference-in-differences analyses.

To conclude, this finding suggests that gender quotas can lead to opportunistic firm behaviour. As an initial response to the reform, the firms tend to focus on achieving compliance with the mandatory quota instead of truly enhancing gender equality by also substantially increasing the number of female management board members. Thus, it appears as if the role and perception of gender diversity as such has not changed beyond the "mechanical effect" of the mandatory quota for the supervisory board.

Table 37 summarises the main results per research question and hypothesis.

| Research questions and hypotheses | | Results |
|---|---|---|
| RQ1 | *How does supervisory board gender diversity affect the financial performance in the German set-up, and is this effect dependent on the statistical methodology used?* | No effect identified; statistical methodology relevant |
| H1 | *The share of female supervisory board members is positively related to the firm's financial performance.* | - |
| H2 | *A critical mass of three or more women on the supervisory board is positively related to the firm's financial performance.* | - |
| | | |
| RQ2 | *How does supervisory board gender diversity affect the gender diversity on the management board in the German set-up, and is this effect dependent on the statistical methodology used?* | No robust effect identified; statistical methodology relevant |
| H3 | *The share of female supervisory board members is positively related to the share of the female management board members.* | - |
| H4 | *A critical mass of three or more women on the supervisory board is positively related to the share of female management board members.* | / |
| | | |
| RQ3 | *How has the quota impacted the firm's financial performance in Germany?* | Negative effect of the quota on the P2B for the firms in scope |
| H5 | *The implementation of the gender quota legislation is negatively related with the firm's financial performance.* | + |
| | | |
| RQ4 | *How has the quota impacted the female representation on the management board?* | No effect identified |
| H6 | *The implementation of the gender quota legislation does not increase the number of female management board members.* | + |

**Table 37: Summary of results per research question and hypothesis**
Note: - = rejected; / = partly supported; + = supported

## 6.2 LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

While this dissertation provides insight into the relationships examined within the scope of this study, it also has limitations. These respective limitations and suggestions for future research are discussed below. Starting with the research design, this dissertation uses a panel design and addresses endogeneity concerns following the "best practise" discussed in the literature, e. g. by also using system GMM and difference-in-differences estimation. Still, non-experimental designs cannot eliminate those concerns because the applied statistical methods rely on critical assumptions. For example, the system GMM estimation relies on the assumption of the validity of the internal instruments and thus, their orthogonality to the errors, which is addressed by statistical tests such as the Sargan/Hansen test of overidentifying restrictions. However, the risk of potential misspecification, e. g. by omitting relevant variables, cannot be avoided completely and therefore remains a threat to the validity of the results.

In addition, the validity of the difference-in-differences estimation relies on the assumption that the control group serves as an adequate counterfactual for the treatment group. Accordingly, the pre-intervention trends are analysed to check how likely it is that the common trend assumption is valid. Also, only publicly listed firms are considered to limit the unobserved differences, and propensity score matching is performed to reduce the differences in observed characteristics between the two groups in order to ensure the greatest possible comparability. Even so, this assumption cannot be formally tested and therefore remains a threat to the validity of the results. Another potential problem arises with the second assumption of the difference-in-differences method, which is exogeneity of the treatment. This method assumes that there are no confounders also impacting the dependent variables, which is an assumption that should not be taken for granted. Moreover, the "event date" of the quota is not perfectly defined and might therefore not operate as a "shock" because some firms might have already anticipated the quota legislation. Furthermore, there is no fixed deadline for compliance because the law stipulates that the gender quota of at least 30 percent must be considered in new elections and thus, the timing of compliance varied based on the tenure of the incumbent supervisory board members.

Moreover, data availability is a problem. The fact that the boardrooms, especially the management boards, are currently and historically dominated by men is a challenge for the literature and research in this field.

> "One cannot study boardroom gender diversity if there are no women on boards. Due to data limitations there is much we still do not know—especially about career progression and team dynamics." (Adams, 2016, p. 5)

However, in the case of Germany there is a growing number of female boardroom members and therefore the data limitations in this respect might become less of a concern for future studies. Nevertheless, a recommendation for future research is to further consider qualitative research methods. Interviewing experts, for example board members, analysing minutes of board meetings, or even observing board meetings might help to better understand what is happening in the boardroom, how the decision-making process takes place, and how individuals influence the board dynamics. This might then help to identify mediating and/or moderating processes on individual and team level, that impact the influence of female supervisory board members on the firm. In turn, these additional aspects can then be tested based on quantitative research to further validate any potential influence factor. Potential influence factors are variables that influence the motivation and/or the ability of boards and firms to leverage the value of diversity and translate that added value into positive results. For example, research on social psychology of groups suggests that the ability of groups to digest and benefit from singular knowledge and opinions of individuals is not consistent (Stasser & Birchmeier, 2003; Stasser & Titus, 2003). Furthermore, research on social psychology of minority voice indicates that groups tend to react to disagreement or differently minded opinions either by pressuring towards consistency, or by increasing efforts at information processing (Stasser & Birchmeier, 2003; Wood, Lundgren, Ouellette, Busceme, & Blackstone, 1994). The probability that groups prioritize the ladder increases if there is a motivation to do so (van Knippenberg, De Dreu, & Homan, 2004). This probably also applies for the boardroom (Westphal & Milton, 2000).

In addition, researchers could make more use of the available transparency about some aspects of the way the boards operate and how they are structured. For example, the corporate governance report of the annual report of the companies gives insights into the organisation of the boards. Eventually, information about the board members such as their demographic characteristics or their experience,

their role in the committees, and their presence in board and committee meetings is generally transparent to researchers. For example, Post & Byron (2015) suggest and analyse "monitoring" and "strategy involvement" as two of the boards' primary responsibilities (American Law Institute, 1994; Zahra & Pearce, 1989) as potential mediators. They argue that female board representation may be linked to an increase in board monitoring activities and strategy involvement and therefore partially mediate the board gender diversity and firm performance relationship. Further board activities, such as appointing the management board, eventually, might also determine the direction and the extent of the impact of the board diversity on the firm's performance (Post & Byron, 2015). The majority of the studies argue based on a direct impact of board diversity on the firm. Only a few studies consider contextual factors that potentially moderate and/or mediate the relationships. Hence, more research is needed to further create transparency.

This dissertation makes use of Germany as a "laboratory" and focuses on the German CDAX and registered market companies because they are required to adhere to the highest levels of reporting transparency. Accordingly, it is not guaranteed that the results can be extended to smaller or not publicly listed German companies. Because the German environment is quite unique (two-tier corporate governance set-up, employee representation, quota legislation, etc.), this population might also not be representative for firms in other countries or contexts. Moreover, this dissertation does no separately analyse shareholder and employee representatives on the supervisory board, whereas the work of Handschumacher & Ceschinski (2020) indicates that a distinction might be relevant. More research in this respect in recommended. In addition, future research should increase the focus on countries with the two-tier corporate governance set-up (such as Austria or Poland) to balance the current literature, which predominantly focuses on countries with the one-tier set-up. Moreover, future research should look for ways to overcome the data limitations inherent in smaller and/or not publicly listed firms to also analyse the effects of supervisory board gender diversity for this population. Another limitation of this dissertation is the observation period because only a rather short timeframe of three years after the quota implementation is covered. Therefore, longer-term effects of the quota that emerge after 2018 are not included in the scope of the analyses. Accordingly, future studies should also study the long-term

effects of the quota legislation and question if it is successful in positively influencing the opportunities for women beyond the mechanical effect of the mandatory quota. Against this background, it is recommended to also analyse if quota legislation has negative or unintended consequences, and if there are alternatives to enhance gender diversity in the management of firms. For example, Ferreira (2015b) mentions that quotas might also impact career aspirations of women and therefore might negatively impact the gender diversity in business sectors, where female representation is relatively well-balanced (e.g. politics, public sector, education, medicine, and law).

Eventually, there are several additional research questions to be addressed by future research. For example, how can research in the context of board gender diversity and firm outcome relationships be disentangled from endogeneity problems? How is the relationship of board gender diversity and firm outcomes in smaller firms or start-ups? What are the long-term effects of board gender diversity and quota legislation? Are quotas influencing women's career decisions? What are the drivers for female management board recruitments? What are effective alternatives to quotas to increase gender diversity in management positions? How can policy makers and societies further support women in leadership? What are the success factors of successful women in board positions?

## 6.3 OUTLOOK

Management scholars argue that firms choose directors and executives for their characteristics and skills in order to maximise shareholder value. Hence, if women are underrepresented due to selection bias, it is unfair and unethical (Singh et al., 2001) and at the same time the failure to select the most talented candidates negatively affects the performance of the company (Burke, 2000). However, it is important to consider the positive as well as the negative aspects of diversity in order to maximise firm value (Ferreira, 2011). In this context, there are competing theories, that predict different results regarding the effects of gender diversity on supervisory boards and boards of directors. In general, conflict-theory based arguments indicate that diversity has negative consequences, while resource-oriented considerations lead to the opposite. To conclude, the composition of the board

needs to be balanced and in accordance with the needs of the company to ensure that the benefits of diversity overweigh the costs of it. On the other hand,

Boards are teams or groups of people. Therefore, group processes such as conflict or teamwork are important drivers for board effectiveness. Consequently, the board effectiveness largely depends on the level of interaction between the board members and their commitment to their duties (Finkelstein & Mooney, 2003, p.102). Also, the fact that boards might act "as groups of individuals who have different biases and prejudices and whose behaviour is affected by social constraints and power relations" (Ferreira, 2011, p. 225) needs to be considered in this respect. In addition, from an investor's perspective board diversity has become an important aspect in evaluating a board's openness and inclusiveness. Investors demand for a robust nomination process, that ensures that the best candidates with regards to qualification and experience are considered. In this sense, a lack of board diversity and a lack of board renewal might indicate that the nomination process is not in line with the demanded quality criteria. Ultimately, investors seek companies with the right boards. Therefore, reviewing and improving the board composition regarding diversity aspects might result in a better overall skillset of the board (Papadopoulos, Kalb, Valderrama, & Balog, 2018).

Gender diversity is the most discussed and examined variable of diversity in research and recent regulation initiatives. Adams (2016) describes the current era as "the age of the female director". But only time will tell whether the overall increase in gender diversity in management positions will further continue. The chances for an ongoing positive trend are good, especially if the debate continues to be in the centre of the social and political agenda, which appears to be case. The Federal Minister for Family Affairs, Senior Citizens, Women and Youth, Franziska Giffey, and the Federal Minister of Justice and Consumer Protection, Christine Lambrecht, claim that the quota legislation needs to be enhanced (both are members of the SPD). They also demand for a mandatory minimum female management board representation and propose that management boards of firms in scope of the quota with four or more members should at least have one woman on the board. It remains to be seen if the coalition partner CDU/CSU will agree to such an enhancement of the coalition contract (Giffey, 2020).

Still, there is the question whether legislation is the only answer. For instance, Kirsch & Wrohlich (2020a) present an alternative and argue that the expectation as regards executive positions should be reconsidered. Whilst these jobs require to largely sacrifice family life, they can only be occupied by people who do not have non-work responsibilities. Hence, new forms of work organization are needed to sustainably increase female boardroom representation.

Supporters of the mandatory quota policy argue that it is an effective instrument to achieve an increase of female representation in the boardroom. However, this argumentation is based on a relatively small number of supervisory boards of only slightly more than 100 public limited companies. It is still not clear if it is successful in solving the management board "problem" and if it is successful on a broader basis of firms. Of course, expanding the scope of the mandatory quota legislation will also "mechanically" increase the representation of women on the management boards in Germany. This might also act as a signal for female talents that there is a fixed minimum of opportunities for management board careers. However, there is no evidence that quotas also change the role and perception of women in the boardroom.

In Terjesen & Sealy's (2016) literature review regarding the theoretical arguments for and against quotas, they highlight that quotas create ethical tensions. They also argue that researchers do not agree on a consistent definition of a successful quota outcome. In addition, the implementation of mandatory quotas is controversially discussed by corporate governance experts. Quotas can be interpreted as a form of tokenism. Therefore, imposing a gender quota to increase gender diversity in the boardroom is deemed to be contrary to best practise (Nekhili & Gatfaoui, 2013). Policy makers could alternatively focus on measures, that also change the perception and role of women in top management positions. This might be a way of avoiding the threat of tokenism, which seems to remain an important issue in this respect. Furthermore, the women's difficulty in obtaining a committee membership in German supervisory boards has even increased since the implementation of the quota compared to the situation in 2009 (Bozhinov et al., 2017).

To conclude, the discussion about board gender diversity is here to stay. Both present and forthcoming female supervisory board members will remain on the boards for several years and will thus influence strategies and decision-making in

the future. Only time will tell if there are more state interventions to come that aim to increase board gender diversity or if there are more effective alternatives for increasing gender equality in Germany. Either way, only credible research combined with realistic expectations add value to the political and public discussion regarding the effects of board gender diversity.

## LITERATURE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## APPENDIX 1: DEFINITION OF FINANCIAL VARIABLES

| Variable | Calculation; Thomson Reuters Data Definitions Guide (Issue 14.3) |
|---|---|
| ROA | (Net Income Bottom Line + ((Interest Expense on Debt-Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's Total Assets * 100 |
| Price/Book Value Ratio | Market Price-Year End / Book Value Per Share |
| Price Volatility | A measure of a stock's average annual price movement to a high and low from a mean price for each year. For example, a stock's price volatility of 20% indicates that the stock's annual high and low price has shown a historical variation of +20% to -20% from its annual average price |
| Net Sales or Revenues | Net Sales or Revenues represent gross sales and other operating revenue less discounts, returns and allowances. |
| Total Debt % Total Assets | All Industries:<br>(Short Term Debt & Current Portion of Long Term Debt + Long Term Debt) / Total Assets * 100 |

## APPENDIX 2: POPULATION (GERMAN CDAX FIRMS WITH TWO-TIER SET-UP)

All company data based on financial years 2018/2019; sourced from Thomson Reuters Eikon DAX Composite Index Constituents Analysis as of 06-Jun-2019 and from manual research of corporate websites accessed in December 2019; Thomson Reuters Business Classification (TRBC)

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| 1&1 DRILLISCH AG | 58 | Telecommunication Services | Wireless Telecoms Service Providers | 5.485.051.945 | 3.662.460.000 | 4.910.731.019 |
| 11 88 0 Solutions AG | 52 | Industrials | Call Center Services | 35.908.149 | 42.921.000 | 29.287.522 |
| 3U HOLDING AG | 52 | Industrials | Building Contractors | 46.353.732 | 50.157.000 | 51.204.399 |
| 4SC AG | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 98.683.157 | 4.173.000 | 62.925.232 |
| 7C SOLARPARKEN AG | 59 | Utilities | Renewable Utilities | 181.504.540 | 40.322.000 | 340.647.071 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Aap Implantate AG | 56 | Healthcare | Medical Equipment, Supplies & Distribution (NEC) | 33.553.471 | 10.781.000 | 23.381.661 |
| Aareal Bank AG | 55 | Financials | Banks (NEC) | 1.722.020.613 | 887.000.000 | 6.511.549.141 |
| Accentro Real Estate AG | 55 | Financials | Residential Real Estate Rental & Development | 283.856.942 | 205.609.000 | 470.761.885 |
| Adesso AG | 57 | Technology | IT Services & Consulting (NEC) | 344.367.333 | 375.470.000 | 306.791.822 |
| Adidas AG | 53 | Consumer Cyclicals | Sports & Outdoor Footwear | 58.040.668.170 | 21.915.000.000 | 50.382.126.276 |
| Adler Modemaerkte AG | 53 | Consumer Cyclicals | Apparel & Accessories Retailers (NEC) | 66.641.914 | 507.093.000 | 282.487.000 |
| Adler Real Estate AG | 55 | Financials | Residential Real Estate Rental & Development | 1.079.374.554 | 424.663.000 | 4.968.575.897 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| ADVA Optical Networking SE | 57 | Technology | Communications & Networking (NEC) | 395.005.585 | 501.981.000 | 378.250.914 |
| a a a AG allgemeine anlageverwaltung | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 49.752.691 | 5.074.580 | 91.450.069 |
| Ahlers AG | 53 | Consumer Cyclicals | Apparel & Accessories (NEC) | 46.047.636 | 223.067.000 | 71.706.560 |
| Aixtron SE | 57 | Technology | Semiconductor Equipment & Testing (NEC) | 1.069.290.765 | 268.811.000 | 687.748.325 |
| Akasol AG | 52 | Industrials | Electrical Components & Equipment (NEC) | 324.641.201 | 21.587.000 | 263.964.346 |
| Albis Leasing AG | 55 | Financials | Commercial Leasing | 57.842.464 | 25.047.810 | 185.197.370 |
| All for One Group AG | 57 | Technology | IT Services & Consulting (NEC) | 267.167.330 | 332.357.000 | 230.929.600 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Allgeier SE | 57 | Technology | IT Services & Consulting (NEC) | 277.300.612 | 687.291.000 | 432.908.901 |
| Allianz SE | 55 | Financials | Multiline Insurance & Brokers (NEC) | 96.610.287.261 | 96.027.000.000 | 102.692.189.420 |
| alstria office REIT AG | 55 | Financials | Office REITs | 2.811.331.384 | 232.353.000 | 3.780.114.448 |
| Amadeus Fire AG | 52 | Industrials | Employment Services (NEC) | 677.260.432 | 205.836.000 | 563.806.845 |
| Artnet AG | 53 | Consumer Cyclicals | Digital Publishing | 22.427.715 | 21.610.103 | 21.595.574 |
| AS Creation Tapeten AG | 53 | Consumer Cyclicals | Wallpaper | 46.916.664 | 134.485.230 | 45.067.940 |
| Atoss Software AG | 57 | Technology | Enterprise Software | 595.046.797 | 62.610.820 | 495.540.594 |
| Audi AG | 53 | Consumer Cyclicals | Automobiles & Multi Utility Vehicles | 38.606.676.343 | 59.248.000.000 | 19.304.000.000 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Aurubis AG | 51 | Basic Materials | Nonferrous Metal Processing | 2.007.046.240 | 10.423.748.000 | 1.610.618.769 |
| Aves One AG | 55 | Financials | Commercial Leasing | 168.397.193 | 77.676.000 | 994.666.110 |
| Axel Springer SE | 53 | Consumer Cyclicals | Consumer Publishing (NEC) | 6.725.172.117 | 3.180.700.000 | 7.687.300.229 |
| B+S Banksysteme AG | 57 | Technology | IT Services & Consulting (NEC) | 16.859.862 | 9.833.000 | 16.591.038 |
| BASF SE | 51 | Basic Materials | Diversified Chemicals | 63.098.197.653 | 62.675.000.000 | 75.425.309.056 |
| Basler AG | 57 | Technology | Security & Surveillance | 597.765.552 | 150.284.000 | 529.225.000 |
| Bastei Luebbe AG | 53 | Consumer Cyclicals | Book Publishing | 34.318.730 | 107.034.000 | 61.866.000 |
| Bauer AG | 51 | Basic Materials | Mining Machinery & Equipment Manufacturing | 468.360.279 | 1.589.091.000 | 944.840.300 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Bayer AG | 56 | Healthcare | Pharmaceuticals (NEC) | 56.636.575.890 | 39.586.000.000 | 86.174.155.017 |
| Bayerische Motoren Werke AG | 53 | Consumer Cyclicals | Auto & Truck Manufacturers (NEC) | 46.081.124.973 | 97.480.000.000 | 127.429.364.687 |
| BayWa AG | 54 | Consumer Non-Cyclicals | Fishing & Farming Wholesale | 1.058.465.571 | 16.625.700.000 | 4.414.263.287 |
| Bechtle AG | 57 | Technology | IT Services & Consulting (NEC) | 4.848.280.285 | 4.323.318.000 | 4.451.790.000 |
| Beiersdorf AG | 54 | Consumer Non-Cyclicals | Personal Products (NEC) | 29.656.732.035 | 7.233.000.000 | 24.526.200.000 |
| Berentzen Gruppe AG | 54 | Consumer Non-Cyclicals | Distilleries | 68.262.058 | 162.167.000 | 53.099.000 |
| Maschinenfabrik Berthold Hermle AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 354.518.427 | 452.922.000 | 180.910.000 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Bertrandt AG | 52 | Industrials | Business Support Services (NEC) | 758.908.496 | 1.019.914.000 | 804.269.460 |
| bet-at-home.com AG | 53 | Consumer Cyclicals | Casinos & Gaming (NEC) | 462.171.538 | 143.350.880 | 333.657.890 |
| BHS Tabletop AG | 53 | Consumer Cyclicals | Tools & Housewares | 69.115.334 | 118.698.000 | 60.161.400 |
| Bijou Brigitte modische Accessoires AG | 53 | Consumer Cyclicals | Apparel & Accessories Retailers (NEC) | 391.872.279 | 321.614.560 | 214.074.240 |
| Bilfinger SE | 52 | Industrials | Construction & Engineering (NEC) | 1.313.125.087 | 4.152.600.000 | 1.061.318.709 |
| Biofrontera AG | 56 | Healthcare | Biopharmaceuticals | 369.038.882 | 21.107.000 | 322.324.807 |
| Biotest AG | 56 | Healthcare | Biopharmaceuticals | 1.017.323.925 | 400.300.000 | 1.125.607.678 |
| Borussia Dortmund GmbH & Co KGaA | 53 | Consumer Cyclicals | Professional Sports Venues | 892.803.052 | 536.043.000 | 745.031.000 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Hugo Boss AG | 53 | Consumer Cyclicals | Apparel & Accessories (NEC) | 4.221.734.679 | 2.795.963.000 | 3.746.687.000 |
| BRAIN Biotechnology Research and Information Network AG | 51 | Basic Materials | Industrial Biotechnology Chemicals | 203.782.091 | 29.051.000 | 188.521.167 |
| Bremer Straßenbahn AG (BSAG) | 52 | Industrials | -- | -- | -- | -- |
| BREMER LAGERHAUS-GESELLSCHAFT–Aktiengesellschaft von 1877 | 52 | Industrials | -- | -- | -- | -- |
| Brenntag AG | 51 | Basic Materials | Diversified Chemicals | 7.411.701.352 | 12.550.000.000 | 8.343.720.000 |
| Cancom SE | 57 | Technology | IT Services & Consulting (NEC) | 1.668.575.691 | 1.378.904.000 | 1.355.974.760 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Capsensixx AG | 55 | Financials | Investment Management & Fund Operators (NEC) | 40.134.562 | 115.700.180 | 27.515.050 |
| Carl Zeiss Meditec AG | 56 | Healthcare | Advanced Medical Equipment & Technology (NEC) | 8.639.048.767 | 1.280.860.000 | 7.718.359.935 |
| Ceconomy AG | 53 | Consumer Cyclicals | Computer & Electronics Retailers (NEC) | 2.104.183.782 | 21.418.000.000 | 600.219.587 |
| CENIT AG | 57 | Technology | IT Services & Consulting (NEC) | 128.038.061 | 169.990.000 | 97.040.509 |
| Centrotec Sustainable AG | 52 | Industrials | Heating, Ventilation & Air Conditioning Systems | 258.307.804 | 614.739.000 | 246.871.559 |
| Centrotherm photovoltaics | 50 | Energy | -- | -- | -- | -- |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Cewe Stiftung & Co KGaA | 52 | Industrials | Specialized Printing Services | 703.526.839 | 653.291.000 | 598.616.690 |
| Co.don AG | 56 | Healthcare | Biopharmaceuticals | 93.580.530 | 5.654.000 | 82.678.005 |
| Comdirect Bank AG | 55 | Financials | Banks (NEC) | 1.536.442.300 | 132.098.000 | -22.181.033.719 |
| Commerzbank AG | 55 | Financials | Banks (NEC) | 8.944.505.868 | 8.670.000.000 | -32.782.314.694 |
| Compugroup Medical SE | 57 | Technology | Enterprise Software | 3.808.182.469 | 717.023.000 | 3.695.232.660 |
| Continental AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 27.903.311.047 | 44.404.400.000 | 27.294.641.892 |
| Creditshelf AG | 55 | Financials | Commercial Loans | 100.351.875 | 2.379.000 | 77.061.750 |
| CropEnergies AG | 50 | Energy | Ethanol Fuels | 588.989.773 | 778.612.000 | 520.687.000 |
| Cts Eventim AG & Co KgaA | 53 | Consumer Cyclicals | Sales Promotions & Events Management | 4.350.626.118 | 1.241.689.000 | 2.989.594.000 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Daimler AG | 53 | Consumer Cyclicals | Auto & Truck Manufacturers (NEC) | 57.836.533.487 | 167.362.000.000 | 172.894.689.328 |
| Data Modul AG Produktion und Vertrieb von Elektronischen Systemen | 57 | Technology | Display Screens | 281.678.786 | 241.417.000 | 229.949.922 |
| Delticom AG | 57 | Technology | E-commerce & Auction Services | 82.732.702 | 693.539.000 | 85.558.653 |
| Demire Deutsche Mittelstand Real Estate AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 597.813.039 | 88.810.000 | 1.088.656.207 |
| Dermapharm Holding SE | 56 | Healthcare | Pharmaceuticals (NEC) | 1.883.894.196 | 572.424.000 | 1.768.754.000 |
| Deutsche Bank AG | 55 | Financials | Banks (NEC) | 14.272.851.878 | 24.793.000.000 | 55.018.853.478 |
| Deutsche Beteiligungs AG | 55 | Financials | Private Equity | 562.789.348 | 62.669.000 | 404.055.801 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Deutsche Boerse AG | 55 | Financials | Financial & Commodity Market Operators & Service Providers (NEC) | 26.774.563.743 | 3.132.400.000 | 24.193.600.000 |
| Deutsche Cannabis AG | 55 | Financials | Investment Management & Fund Operators (NEC) | 8.733.893 | 0 | 7.467.896 |
| Deutsche Euroshop AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 1.852.086.870 | 225.047.000 | 3.056.915.632 |
| Deutsche Industrie REIT-AG | 55 | Financials | Industrial REITs | 366.019.009 | 10.260.000 | 430.477.844 |
| Deutsche Konsum REIT AG | 55 | Financials | Retail REITs | 519.102.100 | 28.601.300 | 692.890.638 |
| Deutsche Lufthansa AG | 52 | Industrials | Airlines (NEC) | 9.369.908.108 | 35.844.000.000 | 11.927.068.026 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Deutsche Pfandbrief-bank AG | 55 | Financials | Retail & Mortgage Banks | 1.850.376.365 | 1.834.000.000 | 19.971.633.017 |
| Deutsche Post AG | 52 | Industrials | Courier, Postal, Air Freight & Land-based Logistics (NEC) | 37.666.565.970 | 61.550.000.000 | 46.225.420.500 |
| Deutsche Real Estate AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 178.955.573 | 260.307.000 | 352.709.050 |
| Deutsche Telekom AG | 58 | Telecommunication Services | Integrated Telecommunications Services (NEC) | 81.942.451.913 | 75.656.000.000 | 141.259.270.684 |
| Deutsche Wohnen SE | 55 | Financials | Residential Real Estate Rental & Development | 17.043.665.746 | 1.438.500.000 | 24.370.980.551 |
| DEUTZ AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 1.028.020.701 | 1.778.800.000 | 820.215.079 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| DF Deutsche Forfait AG | 55 | Financials | International Trade Financing | 7.021.668 | 3.232.540 | 2.687.339 |
| DFV Deutsche Familienversicherung AG | 55 | Financials | Health Insurance | 167.111.243 | -- | 290.499.712 |
| DIC Asset AG | 55 | Financials | Office Real Estate Rental & Development | 802.870.377 | 154.266.000 | 1.909.469.510 |
| Dierig Holding AG | 53 | Consumer Cyclicals | Textiles & Leather Goods (NEC) | 79.859.588 | 59.848.650 | 98.707.920 |
| DMG Mori AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 3.839.762.312 | 2.655.128.000 | 3.225.572.140 |
| Dr Hoenle AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 342.644.665 | 126.492.000 | 300.639.322 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Draegerwerk AG & Co KGaA | 56 | Healthcare | Advanced Medical Equipment & Technology (NEC) | 866.794.928 | 2.595.010.000 | 813.416.000 |
| Duerr AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 2.440.108.895 | 3.869.816.000 | 2.103.049.187 |
| DWS Group GmbH & Co KgaA | 55 | Financials | Investment Management & Fund Operators (NEC) | 6.892.915.241 | 2.180.000.000 | 3.968.000.000 |
| E.ON SE | 59 | Utilities | Multiline Utilities | 23.756.643.948 | 29.565.000.000 | 29.063.142.707 |
| Easy Software AG | 57 | Technology | Enterprise Software | 43.342.664 | 42.744.000 | 42.006.393 |
| Eckert & Ziegler Strahlen und Medizintechnik AG | 56 | Healthcare | Pharmaceuticals (NEC) | 559.375.104 | 168.709.000 | 445.692.999 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Ecotel Communication AG | 58 | Telecommunication Services | Integrated Telecommunications Services (NEC) | 30.802.984 | 98.856.990 | 28.183.680 |
| Einhell Germany AG | 53 | Consumer Cyclicals | Appliances, Tools & Housewares (NEC) | 131.933.709 | 577.903.000 | 150.756.000 |
| Eisen und Huettenwerke AG | 55 | Financials | Private Equity | 345.543.277 | 300.000 | 307.999.000 |
| Elanix Biotechnologies AG | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 15.276.064 | 328.150 | 13.404.090 |
| Elmos Semiconductor AG | 57 | Technology | Semiconductors (NEC) | 469.333.035 | 277.588.000 | 420.710.895 |
| Elringklinger AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 388.114.148 | 1.699.000.000 | 1.106.436.545 |
| Enbw Energie Baden Wuerttemberg AG | 59 | Utilities | Multiline Utilities | 9.930.274.895 | 20.617.500.000 | 15.129.150.528 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Energiekontor AG | 59 | Utilities | Renewable IPPs | 295.210.398 | 110.186.000 | 409.257.788 |
| Epigenomics AG | 56 | Healthcare | Bio Diagnostics & Testing | 80.016.435 | 1.533.000 | 54.206.649 |
| ERWE Immobilien AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 62.063.342 | 0 | 54.479.099 |
| euromicron AG | 52 | Industrials | Electrical Components | 23.576.560 | 318.012.000 | 113.654.082 |
| Evonik Industries AG | 51 | Basic Materials | Diversified Chemicals | 12.615.224.098 | 15.024.000.000 | 14.192.580.000 |
| Evotec SE | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 3.670.424.033 | 375.405.000 | 3.227.771.585 |
| Eyemaxx Real Estate AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 57.100.839 | 5.459.000 | 187.908.833 |
| Fair Value Reit AG | 55 | Financials | Commercial REITs (NEC) | 131.407.181 | 28.174.000 | 283.472.791 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Fielmann AG | 53 | Consumer Cyclicals | Optical Goods Stores | 5.878.421.710 | 1.427.999.000 | 4.999.312.000 |
| First Sensor AG | 57 | Technology | Electronic Components | 323.822.580 | 155.148.000 | 308.586.747 |
| Foris AG | 55 | Financials | Corporate Financial Services (NEC) | 15.194.592 | 20.252.200 | 7.661.796 |
| Fortec Elektronik AG | 57 | Technology | Integrated Circuits | 77.308.850 | 79.570.740 | 67.456.113 |
| Francotyp Postalia Holding AG | 52 | Industrials | Business Support Services (NEC) | 63.825.865 | 204.206.000 | 65.105.067 |
| Fraport AG Frankfurt Airport Services Worldwide | 52 | Industrials | Airport Operators | 7.634.200.222 | 3.478.300.000 | 10.767.053.500 |
| freenet AG | 58 | Telecommunication Services | Integrated Telecommunications Services (NEC) | 2.519.984.215 | 2.897.466.000 | 3.821.602.170 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Fresenius Medical Care AG & Co KGaA | 56 | Healthcare | Healthcare Facilities & Services (NEC) | 22.991.463.194 | 16.546.873.000 | 26.997.888.401 |
| Fresenius SE & Co KGaA | 56 | Healthcare | Hospitals, Clinics & Primary Care Services | 29.232.804.678 | 33.530.000.000 | 52.314.409.126 |
| Friwo AG | 52 | Industrials | Electrical Components & Equipment (NEC) | 235.640.913 | 120.527.000 | 220.040.000 |
| Fuchs Petrolub SE | 51 | Basic Materials | Commodity Chemicals (NEC) | 5.262.485.796 | 2.567.000.000 | 4.487.350.000 |
| Gateway Real Estate AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 783.639.995 | 18.568.000 | 1.205.531.510 |
| GEA Group AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 5.153.960.155 | 4.828.210.000 | 4.480.970.325 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Gelsenwasser AG | 59 | Utilities | Natural Gas Distribution | 3.364.751.747 | 1.763.800.000 | 2.916.225.000 |
| Geratherm Medical AG | 56 | Healthcare | Medical Equipment, Supplies & Distribution (NEC) | 54.578.583 | 21.521.920 | 43.874.400 |
| Gerresheimer AG | 56 | Healthcare | Medical Equipment, Supplies & Distribution (NEC) | 2.253.935.037 | 1.367.730.000 | 2.905.286.000 |
| Gerry Weber International AG | 53 | Consumer Cyclicals | Women's Clothing | 20.039.730 | 880.885.200 | 210.327.912 |
| Gesco AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 289.426.237 | 547.193.000 | 356.459.076 |
| GFT Technologies SE | 57 | Technology | Mobile Application Software | 213.259.089 | 412.825.260 | 248.152.441 |
| Gigaset AG | 57 | Technology | Phones & Smart Phones | 51.267.498 | 280.331.000 | 25.355.284 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| GK Software SE | 57 | Technology | Enterprise Software | 148.441.523 | 106.151.000 | 156.034.310 |
| Godewind Immobilien AG | 55 | Financials | Office Real Estate Rental & Development | 443.535.458 | 712.000 | 338.654.750 |
| Grammer AG | 53 | Consumer Cyclicals | Automotive Accessories | 460.279.561 | 1.861.292.000 | 665.760.076 |
| Grenke AG | 55 | Financials | Commercial Leasing | 4.506.000.737 | 551.512.000 | 8.425.177.515 |
| GSW Immobilien AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 6.376.723.934 | 243.602.000 | 7.792.992.000 |
| H&R GmbH & Co KgaA | 51 | Basic Materials | Commodity Chemicals (NEC) | 289.378.230 | 1.114.148.000 | 396.382.265 |
| Hamburger Hafen und Logistik AG | 52 | Industrials | Marine Port Services (NEC) | 1.738.591.238 | 1.291.136.000 | 1.886.664.278 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Hannover Rueck SE | 55 | Financials | Property & Casualty Reinsurance | 18.683.661.696 | 18.868.885.000 | 18.857.431.352 |
| HanseYachts AG | 53 | Consumer Cyclicals | Sailing Yachts & Motorboats | 72.793.926 | 140.266.600 | 80.109.106 |
| Hapag Lloyd AG | 52 | Industrials | Marine Freight & Logistics (NEC) | 5.974.686.574 | 11.515.100.000 | 10.690.536.878 |
| Hawesko Holding AG | 57 | Technology | E-commerce & Auction Services | 376.999.507 | 524.298.000 | 352.245.932 |
| Heidelberg Pharma AG | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 86.865.970 | 3.667.810 | 57.987.633 |
| HeidelbergCement AG | 51 | Basic Materials | Construction Materials (NEC) | 15.126.630.530 | 18.074.600.000 | 23.072.700.482 |
| Heidelberger Beteiligungsholding AG | 55 | Financials | Private Equity | 39.208.380 | 5.296.790 | 31.132.940 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Heidelberger Druckmaschinen AG | 52 | Industrials | Industrial Machinery | 455.960.088 | 2.420.154.000 | 671.213.886 |
| HELLA GmbH & Co KgaA | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 5.444.924.409 | 7.060.342.000 | 5.048.172.372 |
| Henkel AG & Co KGaA | 51 | Basic Materials | Adhesives | 39.314.854.596 | 19.899.000.000 | 37.102.435.914 |
| Hesse Newman Capital AG | 55 | Financials | Investment Management & Fund Operators (NEC) | 3.442.806 | 1.064.000 | 2.372.000 |
| Hochtief AG | 52 | Industrials | Construction & Engineering (NEC) | 8.457.161.401 | 23.882.290.000 | 7.090.420.625 |
| Holidaycheck Group AG | 53 | Consumer Cyclicals | Digital Publishing | 178.601.228 | 138.890.000 | 125.438.204 |
| home24 SE | 53 | Consumer Cyclicals | Home Furnishings Retailers (NEC) | 116.361.519 | 312.700.000 | 23.118.840 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Hornbach Baumarkt AG | 53 | Consumer Cyclicals | Home Improvement Products & Services Retailers (NEC) | 576.155.421 | 4.095.535.000 | 1.031.172.700 |
| Hornbach Holding AG & Co KGaA | 55 | Financials | Home Improvement Products & Services Retailers (NEC) | 815.472.373 | 4.362.393.000 | 1.599.346.000 |
| Hypoport AG | 55 | Financials | Financial Technology & Infrastructure | 1.427.533.073 | 265.958.000 | 1.317.907.670 |
| IFA Hotel & Touristik AG | 53 | Consumer Cyclicals | Hotels & Motels | 399.842.935 | 81.597.000 | 439.383.000 |
| Indus Holding AG | 52 | Industrials | Industrial Conglomerates | 1.078.363.152 | 1.710.788.000 | 1.443.920.953 |
| infas Holding AG | 53 | Consumer Cyclicals | Market Research | 41.111.149 | 29.343.750 | 22.251.080 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Infineon Technologies AG | 57 | Technology | Semiconductors (NEC) | 19.141.829.291 | 7.599.000.000 | 16.002.449.292 |
| init innovation in traffic systems SE | 57 | Technology | Enterprise Software | 172.828.839 | 135.711.000 | 168.961.000 |
| Instone Real Estate Group AG | 55 | Financials | Residential Real Estate Rental & Development | 913.461.792 | 360.836.000 | 994.700.975 |
| Intershop Communications AG | 57 | Technology | IT Services & Consulting (NEC) | 53.664.820 | 31.199.000 | 43.657.137 |
| Intertainment AG | 53 | Consumer Cyclicals | Movie, TV Production & Distribution | 9.415.919 | 420.000 | 18.103.879 |
| InTiCa Systems AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 26.212.094 | 47.923.000 | 47.588.150 |
| InVision AG | 57 | Technology | Enterprise Software | 37.970.432 | 13.066.630 | 33.328.050 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Isra Vision AG | 57 | Technology | Application Software | 837.808.764 | 152.528.000 | 741.689.807 |
| Itn Nanovation AG | 59 | Utilities | Water Supply & Irrigation Systems | 8.819.682 | 4.919.510 | 7.282.634 |
| IVU Traffic Technologies AG | 57 | Technology | Enterprise Software | 177.428.836 | 77.798.000 | 136.853.193 |
| Jenoptik AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 1.825.700.161 | 834.571.000 | 1.592.428.560 |
| JOST Werke AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 512.139.827 | 755.414.000 | 538.616.000 |
| Jungheinrich AG | 52 | Industrials | Heavy Trucks | 1.427.886.725 | 3.796.389.000 | 1.383.636.832 |
| K&S AG | 51 | Basic Materials | Agricultural Chemicals (NEC) | 3.402.436.966 | 4.039.100.000 | 6.044.020.000 |
| Kabel Deutschland Holding AG | 53 | Consumer Cyclicals | -- | -- | -- | -- |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Kap AG | 55 | Financials | Private Equity | 296.859.849 | 389.829.000 | 342.039.002 |
| KHD Humboldt Wedag Industrial Services AG | 52 | Industrials | Industrial Plant Construction | 4.531.902 | 1.672.430 | -5.856.000 |
| KHD Humboldt Wedag International AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 64.309.705 | 151.766.000 | 10.133.109 |
| Kion Group AG | 52 | Industrials | Heavy Machinery & Vehicles (NEC) | 6.658.667.639 | 7.995.700.000 | 9.224.103.400 |
| Klassik Radio AG | 53 | Consumer Cyclicals | Radio Broadcasting | 42.885.994 | 15.584.000 | 36.571.500 |
| Kloeckner & Co SE | 51 | Basic Materials | Metal Service Centers | 535.330.948 | 6.790.492.000 | 784.404.500 |
| Knorr Bremse AG | 52 | Industrials | Heavy Machinery & Vehicles (NEC) | 17.610.647.945 | 6.615.800.000 | 16.149.887.000 |
| Koenig & Bauer AG | 52 | Industrials | Industrial Machinery | 660.017.098 | 1.226.000.000 | 510.529.797 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| KPS AG | 57 | Technology | IT Services & Consulting (NEC) | 281.215.089 | 172.223.000 | 262.777.070 |
| KROMI Logistik AG | 52 | Industrials | Industrial Machinery & Equipment Wholesale | 38.055.580 | 80.384.000 | 41.683.180 |
| Krones AG | 52 | Industrials | Industrial Machinery | 2.530.829.678 | 3.853.980.000 | 2.034.571.726 |
| KSB SE & Co KgaA | 52 | Industrials | Pump & Pumping Equipment | 624.499.211 | 2.245.948.000 | 544.592.144 |
| Kuka AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 2.224.143.359 | 3.242.100.000 | 2.144.140.859 |
| Kws Saat SE | 54 | Consumer Non-Cyclicals | Fishing & Farming Wholesale | 2.287.990.127 | 1.068.012.000 | 2.026.008.000 |
| LANXESS AG | 51 | Basic Materials | Diversified Chemicals | 4.736.732.323 | 7.197.000.000 | 5.553.055.056 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| LEG Immobilien AG | 55 | Financials | Residential Real Estate Rental & Development | 7.752.693.573 | 766.900.000 | 11.281.471.574 |
| Leifheit AG | 53 | Consumer Cyclicals | Household Appliances | 245.271.768 | 234.196.000 | 167.068.000 |
| Leoni AG | 52 | Industrials | Wires & Cables | 510.355.492 | 5.101.123.000 | 1.039.110.065 |
| Lotto24 AG | 53 | Consumer Cyclicals | Lottery Operators | 360.419.630 | 38.289.000 | 313.616.037 |
| LPKF Laser & Electronics AG | 57 | Technology | Semiconductor Machinery Manufacturing | 210.015.279 | 119.960.000 | 203.001.681 |
| LS Telcom AG | 57 | Technology | Communications & Networking (NEC) | 46.008.695 | 27.621.000 | 46.014.850 |
| Ludwig Beck am Rathauseck Textilhaus Feldmeier AG | 53 | Consumer Cyclicals | Apparel & Accessories Retailers (NEC) | 121.874.684 | 139.579.000 | 142.974.000 |
| MAN SE | 52 | Industrials | Heavy Trucks | 10.677.267.388 | 12.104.000.000 | 10.403.062.028 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Manz AG | 57 | Technology | Semiconductor Machinery Manufacturing | 243.089.136 | 296.920.000 | 208.836.055 |
| Masterflex SE | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 65.286.323 | 77.243.000 | 79.657.137 |
| Maternus Kliniken AG | 56 | Healthcare | Healthcare Facilities & Services (NEC) | 45.405.396 | 124.278.000 | 152.197.100 |
| MAX Automation SE | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 177.810.796 | 277.383.000 | 200.046.653 |
| MBB SE | 55 | Financials | Private Equity | 449.213.684 | 506.590.000 | 275.941.617 |
| Mediclin AG | 56 | Healthcare | Hospitals, Clinics & Primary Care Services | 291.260.224 | 654.954.320 | 295.805.460 |
| Medigene AG | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 214.019.252 | 7.754.000 | 164.748.451 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Medion AG | 57 | Technology | Computer Hardware (NEC) | 817.133.021 | 1.285.653.000 | 723.273.000 |
| Medios AG | 56 | Healthcare | Proprietary & Advanced Pharmaceuticals | 266.330.296 | 327.829.820 | 225.824.750 |
| Merck KGaA | 56 | Healthcare | Proprietary & Advanced Pharmaceuticals | 12.892.089.493 | 14.836.000.000 | 18.525.618.062 |
| Metro AG | 54 | Consumer Non-Cyclicals | Food Retail & Distribution (NEC) | 5.874.143.604 | 29.476.000.000 | 7.411.997.576 |
| Mevis Medical Solutions AG | 56 | Healthcare | Medical Software & Technology Services | 61.020.916 | 16.758.000 | 52.378.000 |
| Ming Le Sports AG | 53 | Consumer Cyclicals | Footwear (NEC) | 4.849.572 | 0 | 3.702.378 |
| MLP SE | 55 | Financials | Investment Management | 498.815.441 | 660.965.000 | 1.777.943.152 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Mologen AG | 56 | Healthcare | Bio Therapeutic Drugs | 33.869.790 | 3.047.000 | 22.179.838 |
| MorphoSys AG | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 2.973.283.914 | 76.442.510 | 2.283.792.166 |
| MS Industrie AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 98.951.029 | 282.753.000 | 155.006.000 |
| MTU Aero Engines AG | 52 | Industrials | Aircraft Parts Manufacturing | 11.581.102.823 | 4.567.100.000 | 11.288.800.000 |
| Mueller Die Lila Logistik AG | 52 | Industrials | Ground Freight & Logistics (NEC) | 76.313.078 | 136.116.580 | 90.274.873 |
| Muenchener Rueckversicherungs Gesellschaft AG in Muenchen | 55 | Financials | Property & Casualty Reinsurance | 35.462.045.704 | 56.324.000.000 | 31.319.020.842 |
| Mvv Energie AG | 59 | Utilities | Multiline Utilities | 1.838.962.816 | 3.902.760.000 | 2.277.035.541 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| MyHammer Holding AG | 57 | Technology | Online Services (NEC) | 79.849.565 | 13.505.380 | 69.050.570 |
| Nemetschek SE | 57 | Technology | Enterprise Software | 5.955.997.345 | 461.299.000 | 5.299.516.000 |
| Nexus AG | 57 | Technology | Enterprise Software | 547.842.218 | 136.469.000 | 463.477.161 |
| NFON AG | 58 | Telecommunica-tion Services | VOIP Services | 170.434.857 | 43.028.000 | 109.786.206 |
| NorCom Information Technology AG | 57 | Technology | IT Services & Con-sulting (NEC) | 44.585.869 | 11.762.300 | 37.544.284 |
| Nordex SE | 52 | Industrials | Heavy Electrical Equipment (NEC) | 1.390.124.295 | 2.459.124.000 | 1.270.911.375 |
| NORDWEST Handel AG | 51 | Basic Materials | Metal Merchant Wholesalers | 86.542.681 | 391.839.100 | 70.345.700 |
| Norma Group SE | 52 | Industrials | Industrial Machin-ery & Equipment (NEC) | 1.304.737.309 | 1.084.140.000 | 1.538.194.600 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Odeon Film AG | 53 | Consumer Cyclicals | Entertainment Production (NEC) | 14.880.689 | 38.283.620 | 18.655.342 |
| OHB SE | 52 | Industrials | Satellite Design & Manufacture | 625.155.396 | 976.551.000 | 586.951.262 |
| Oldenburgische Landesbank AG | 55 | Financials | -- | -- | -- | -- |
| ORBIS AG | 57 | Technology | IT Services & Consulting (NEC) | 69.471.892 | 63.199.000 | 54.084.313 |
| OVB Holding AG | 55 | Financials | Investment Management & Fund Operators (NEC) | 275.787.402 | 231.337.000 | 157.557.601 |
| Paion AG | 56 | Healthcare | Biotechnology & Medical Research (NEC) | 154.470.593 | 2.765.900 | 120.068.347 |
| Panamax AG | 55 | Financials | Investment Holding Companies (NEC) | 1.970.403 | 0 | 1.434.064 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| paragon GmbH & Co KgaA | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 132.535.528 | 187.383.000 | 248.830.543 |
| Patrizia AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 1.810.018.690 | 351.456.000 | 1.585.835.712 |
| Pfeiffer Vacuum Technology AG | 52 | Industrials | Air & Gas Compressors | 1.399.975.023 | 659.725.000 | 1.192.751.800 |
| Phicomm AG | 53 | Consumer Cyclicals | Entertainment Production (NEC) | 1.219.125 | 46.540 | 924.080 |
| Pittler Maschinenfabrik AG | 52 | Industrials | Machine Tools | 7.504.184 | 7.149.990 | 5.288.864 |
| PNE AG | 50 | Energy | Wind Systems & Equipment | 214.729.741 | 91.379.000 | 208.490.355 |
| Porsche Automobil Holding SE | 53 | Consumer Cyclicals | Auto & Truck Manufacturers (NEC) | 9.833.794.624 | 103.000.000 | 7.900.352.838 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| ProCredit Holding AG & Co KGaA | 55 | Financials | Corporate Banks | 566.580.154 | 278.381.000 | -314.609.893 |
| Progress Werk Oberkirch AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 80.514.958 | 485.012.000 | 202.411.500 |
| Prosiebensat 1 Media SE | 53 | Consumer Cyclicals | Broadcasting (NEC) | 3.920.427.313 | 4.009.000.000 | 6.104.515.000 |
| PSI Software AG | 57 | Technology | Software (NEC) | 293.174.329 | 199.156.000 | 217.792.276 |
| Puma SE | 53 | Consumer Cyclicals | Footwear (NEC) | 9.112.502.299 | 4.648.300.000 | 7.817.883.168 |
| PVA TePla AG | 57 | Technology | Semiconductor Machinery Manufacturing | 296.097.990 | 96.783.000 | 226.079.855 |
| QSC AG | 58 | Telecommunication Services | Integrated Telecommunications Services (NEC) | 178.544.839 | 366.843.000 | 224.343.438 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| R Stahl AG | 52 | Industrials | Electrical Components & Equipment (NEC) | 191.284.977 | 280.114.000 | 175.521.000 |
| Rational AG | 53 | Consumer Cyclicals | Kitchen Appliances | 7.342.829.176 | 777.859.000 | 6.299.989.000 |
| Readcrest Capital AG | 52 | Industrials | Business Support Services (NEC) | 675.060 | 0 | 99.370 |
| Realtech AG | 57 | Technology | IT Services & Consulting (NEC) | 6.525.500 | 15.596.930 | -1.560.556 |
| Renk Aktiengesellschaft | 52 | Industrials | n/a | n/a | n/a | n/a |
| Rheinmetall AG | 53 | Consumer Cyclicals | Engine & Powertrain Systems | 4.896.884.927 | 6.148.000.000 | 4.534.400.292 |
| Rhoen Klinikum AG | 56 | Healthcare | Healthcare Facilities & Services (NEC) | 1.947.525.174 | 1.232.908.000 | 1.598.151.850 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| RIB Software SE | 57 | Technology | IT Services & Consulting (NEC) | 893.364.335 | 136.874.000 | 610.566.300 |
| Ringmetall AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 99.097.885 | 110.567.000 | 100.508.191 |
| RWE AG | 59 | Utilities | Multiline Utilities | 15.648.530.780 | 13.388.000.000 | 14.195.570.642 |
| Salzgitter AG | 51 | Basic Materials | Iron, Steel Mills & Foundries | 1.599.097.726 | 9.278.200.000 | 1.519.094.050 |
| SAP SE | 57 | Technology | Enterprise Software | 154.749.984.603 | 24.708.000.000 | 140.191.333.815 |
| Sartorius AG | 56 | Healthcare | Medical Diagnostic & Testing Equipment | 13.642.302.828 | 1.566.033.000 | 13.330.170.626 |
| Schaeffler AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 1.253.357.267 | 14.241.000.000 | 3.654.180.000 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Schloss Wachenheim AG | 54 | Consumer Non-Cyclicals | Wineries | 155.047.760 | 324.527.000 | 212.928.000 |
| Schumag AG | 52 | Industrials | Industrial Components | 5.850.519 | 49.181.000 | 3.647.000 |
| Schweizer Electronic AG | 57 | Technology | Integrated Circuits | 59.965.572 | 125.349.000 | 47.976.000 |
| Secunet Security Networks AG | 57 | Technology | Enterprise Software | 859.295.012 | 163.286.560 | 707.571.980 |
| Serviceware SE | 57 | Technology | Software (NEC) | 194.923.549 | 55.177.580 | 123.198.800 |
| SFC Energy AG | 50 | Energy | Stationary Fuel Cells | 156.386.070 | 61.704.240 | 140.836.483 |
| SGL Carbon SE | 51 | Basic Materials | Nonferrous Metal Processing | 950.448.246 | 1.047.500.000 | 1.070.567.906 |
| SHW AG | 53 | Consumer Cyclicals | Engine & Powertrain Systems | 143.692.780 | 420.936.000 | 173.767.559 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Siemens AG | 52 | Industrials | Industrial Conglomerates | 99.917.867.711 | 83.044.000.000 | 103.065.000.000 |
| Simona AG | 51 | Basic Materials | Plastics | 350.030.852 | 417.916.000 | 277.206.000 |
| Singulus Technologies AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 88.283.624 | 125.900.000 | 82.767.368 |
| Sino German United AG | 54 | Consumer Non-Cyclicals | Food Retail & Distribution (NEC) | 992.338 | 1.395.360 | -946.060 |
| Sixt SE | 52 | Industrials | Passenger Car Rental | 4.214.125.144 | 2.929.534.000 | 6.449.587.569 |
| Sixt Leasing SE | 55 | Financials | Consumer Leasing | 279.800.612 | 805.797.000 | 1.268.367.275 |
| SKW Stahl-Metallurgie Holding AG | 52 | Industrials | -- | -- | -- | -- |
| SLEEPZ AG | 53 | Consumer Cyclicals | Soft Furnishing Retailers | 3.245.780 | 11.691.240 | 3.299.246 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| SMA Solar Technology AG | 57 | Technology | Semiconductors (NEC) | 915.120.217 | 760.934.000 | 506.749.000 |
| SMT Scharf AG | 51 | Basic Materials | Mining Machinery & Equipment Manufacturing | 70.749.986 | 70.794.640 | 69.707.860 |
| SNP Schneider Neureither & Partner SE | 57 | Technology | IT Services & Consulting (NEC) | 229.624.566 | 130.983.280 | 205.706.397 |
| Softing AG | 57 | Technology | Electronic Components | 79.906.810 | 83.890.000 | 69.675.972 |
| Software AG | 57 | Technology | IT Services & Consulting (NEC) | 2.462.753.569 | 865.711.000 | 2.029.160.000 |
| Splendid Medien AG | 53 | Consumer Cyclicals | Movie, TV Production & Distribution | 14.058.674 | 51.731.000 | 24.060.199 |
| Spobag AG | 55 | Financials | Private Equity | 6.002.132 | 0 | 5.326.590 |
| Sporttotal AG | 53 | Consumer Cyclicals | Entertainment Production (NEC) | 33.813.920 | 37.641.000 | 21.910.151 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| STADA Arzneimittel Aktiengesellschaft | 56 | Healthcare | -- | -- | -- | -- |
| Stemmer Imaging AG | 57 | Technology | Electronic Equipment & Parts (NEC) | 211.350.007 | 100.634.000 | 135.615.000 |
| Stratec SE | 56 | Healthcare | Advanced Medical Equipment & Technology (NEC) | 833.892.539 | 187.820.000 | 788.198.115 |
| Stroeer SE & Co KGaA | 53 | Consumer Cyclicals | Outdoor Advertising | 3.978.057.196 | 1.582.459.000 | 4.074.729.016 |
| STS Group AG | 53 | Consumer Cyclicals | Auto, Truck & Motorcycle Parts (NEC) | 53.869.781 | 401.228.000 | 77.770.000 |
| Suedzucker AG | 54 | Consumer Non-Cyclicals | Sugar & Artificial Sweeteners | 3.227.658.614 | 6.754.100.000 | 4.865.675.253 |
| SUESS MicroTec SE | 57 | Technology | Semiconductor Machinery Manufacturing | 202.594.894 | 203.931.000 | 151.630.368 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Surteco Group SE | 53 | Consumer Cyclicals | Home Furnishings (NEC) | 467.539.284 | 698.977.000 | 608.931.591 |
| Symrise AG | 51 | Basic Materials | Specialty Chemicals (NEC) | 13.006.171.656 | 3.154.032.000 | 12.977.023.430 |
| Syzygy AG | 52 | Industrials | Industrial Design Services | 149.762.330 | 65.816.000 | 110.705.256 |
| TAG Immobilien AG | 55 | Financials | Residential Real Estate Rental & Development | 3.520.677.783 | 400.362.000 | 5.478.175.620 |
| Takkt AG | 57 | Technology | Office Equipment Wholesale | 925.679.899 | 1.181.089.000 | 973.576.551 |
| Talanx AG | 55 | Financials | Multiline Insurance & Brokers (NEC) | 10.232.724.109 | 34.046.000.000 | 16.289.938.635 |
| TC Unterhaltungselektronik AG | 57 | Technology | Household Electronics (NEC) | 474.235 | 745.730 | 93.315 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| technotrans SE | 52 | Industrials | Industrial Machinery | 168.259.749 | 216.286.000 | 168.371.947 |
| Teles AG Informationstechnologien | 57 | Technology | Communications & Networking (NEC) | 3.146.411 | 7.062.000 | 6.566.561 |
| thyssenkrupp AG | 51 | Basic Materials | Iron & Steel (NEC) | 8.289.356.729 | 34.777.000.000 | 9.605.663.155 |
| TLG Immobilien AG | 55 | Financials | Real Estate Services (NEC) | 3.104.621.086 | 271.443.000 | 4.215.039.005 |
| Tom Tailor Holding AG | 53 | Consumer Cyclicals | Apparel & Accessories Retailers (NEC) | 108.719.324 | 921.775.000 | 214.816.822 |
| Travel24 com AG | 53 | Consumer Cyclicals | Travel Agents | 6.131.803 | 5.175.130 | 5.389.778 |
| TTL Beteiligungs und Grundbesitz AG | 55 | Financials | Real Estate Rental, Development & Operations (NEC) | 79.916.419 | 672.000 | 122.176.500 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Tuff Group AG | 52 | Industrials | Construction & Engineering (NEC) | 58.280.172 | 6.520.090 | 49.823.310 |
| TUI AG | 53 | Consumer Cyclicals | -- | -- | -- | -- |
| Turbon AG | 57 | Technology | Office Equipment (NEC) | 10.898.859 | 89.227.000 | 24.172.015 |
| United Internet AG | 58 | Telecommunication Services | Integrated Telecommunications Services (NEC) | 7.440.622.855 | 5.130.804.000 | 8.644.929.000 |
| United Labels AG | 53 | Consumer Cyclicals | General Department Stores | 16.871.151 | 25.920.910 | 25.097.980 |
| ÜSTRA Hannoversche Verkehrsbetriebe Aktiengesellschaft | 52 | Industrials | -- | -- | -- | -- |
| USU Software AG | 57 | Technology | Enterprise Software | 174.146.640 | 90.487.000 | 150.224.608 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Uzin Utz AG | 52 | Industrials | Building Contractors | 312.144.941 | 345.747.000 | 334.676.545 |
| va Q tec AG | 53 | Consumer Cyclicals | Construction Supplies & Fixtures (NEC) | 123.354.257 | 50.708.000 | 141.812.817 |
| Valens Holding AG | 55 | Financials | Banks (NEC) | 362.688 | 123.320.000 | -70.289.639 |
| Value Management & Research AG | 55 | Financials | Investment Management | 7.712.583 | 1.790.030 | 11.318.371 |
| Vapiano SE | 53 | Consumer Cyclicals | Quick Service Restaurants | 173.686.780 | 324.699.000 | 275.679.711 |
| Varta AG | 52 | Industrials | Batteries & Uninterruptable Power Supplies | 1.900.678.746 | 271.650.000 | 1.554.775.000 |
| Verallia Deutschland AG | 51 | Basic Materials | Glass Containers & Packaging | 572.165.816 | 522.756.000 | 652.473.000 |
| Verbio Vereinigte Bioenergie AG | 50 | Energy | Biodiesel | 533.736.119 | 685.898.000 | 380.718.000 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Villeroy & Boch AG | 53 | Consumer Cyclicals | Plumbing Fixtures & Fittings | 222.805.414 | 853.100.000 | 203.431.680 |
| Viscom AG | 57 | Technology | Semiconductor Testing Equipment & Service | 141.265.737 | 93.557.000 | 123.100.400 |
| Vita 34 AG | 56 | Healthcare | Healthcare Facilities & Services (NEC) | 65.537.881 | 20.409.000 | 58.968.724 |
| Vivanco Gruppe AG | 57 | Technology | Household Electronics (NEC) | 23.799.830 | 77.801.850 | 34.940.797 |
| Volkswagen AG | 53 | Consumer Cyclicals | Auto & Truck Manufacturers (NEC) | 81.415.406.516 | 235.849.000.000 | 205.866.827.465 |
| Voltabox AG | 52 | Industrials | Batteries & Uninterruptable Power Supplies | 230.446.514 | 66.909.000 | 180.896.500 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Vonovia SE | 55 | Financials | Residential Real Estate Rental & Development | 28.619.575.936 | 6.501.700.000 | 45.940.759.010 |
| Vossloh AG | 52 | Industrials | Railway Construction | 609.012.178 | 865.000.000 | 857.896.114 |
| VTG AG | 52 | Industrials | -- | -- | -- | -- |
| Wacker Chemie AG | 51 | Basic Materials | Advanced Polymers | 4.350.304.074 | 4.978.800.000 | 4.236.093.764 |
| Wacker Neuson SE | 52 | Industrials | Heavy Machinery & Vehicles (NEC) | 1.684.035.508 | 1.706.500.000 | 1.705.487.600 |
| Wasgau Produktions & Handels AG | 54 | Consumer Non-Cyclicals | Supermarkets & Convenience Stores | 125.493.638 | 546.492.000 | 153.796.000 |
| WashTec AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 958.089.266 | 435.446.000 | 860.513.867 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Webac Holding AG | 52 | Industrials | Industrial Machinery & Equipment (NEC) | 4.788.048 | 6.568.000 | 5.891.665 |
| Westag & Getalit AG | 53 | Consumer Cyclicals | Construction Supplies & Fixtures (NEC) | 150.363.583 | 233.182.000 | 122.569.580 |
| Westwing Group AG | 53 | Consumer Cyclicals | Home Furnishings Retailers (NEC) | 188.013.392 | 253.900.000 | 74.885.737 |
| Wild Bunch AG | 53 | Consumer Cyclicals | Movie, TV Production & Distribution | 70.577.534 | 109.141.000 | 148.743.018 |
| windeln de SE | 53 | Consumer Cyclicals | Internet & Mail Order Department Stores | 13.227.946 | 211.899.000 | -18.856.869 |
| Wirecard AG | 52 | Industrials | Transaction & Payment Services | 20.686.715.042 | 2.016.200.000 | 17.036.959.197 |
| Wuestenrot & Wuerttembergische AG | 55 | Financials | Life & Health Insurance (NEC) | 1.970.325.232 | 5.419.492.000 | 4.888.910.770 |

| Name | TRBC Code | TRBC Economic Sector | TRBC Sector | Market Cap (USD) | Revenue (USD) | Enterprise Value (USD) |
|---|---|---|---|---|---|---|
| Xing SE | 57 | Technology | Social Media & Networking | 2.168.977.852 | 231.537.000 | 1.882.290.205 |
| Yoc AG | 53 | Consumer Cyclicals | Advertising & Marketing (NEC) | 16.672.181 | 14.486.360 | 20.114.781 |
| Your Family Entertainment AG | 53 | Consumer Cyclicals | Movie, TV Production & Distribution | 14.479.274 | 3.207.680 | 19.822.074 |
| Zooplus AG | 57 | Technology | E-commerce & Auction Services | 808.670.702 | 1.341.701.110 | 709.246.037 |