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Does Board Gender Diversity Enhance Firm Performance in Estonia?

Master's Thesis

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I have written this Research paper/Master's Thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced.

Abstract

In recent years, board gender diversity has gradually become an important issue in the field of corporate governance. This study examines the impact of board gender diversity on company performance based on panel data from 1998 to 2020 in Estonia. It also explores how this relationship may vary under different governance structures. This paper adopts a two-way fixed effects model and combines it with a two-stage least squares method (2SLS) to address endogeneity issues. In addition, an event study design and propensity score matching (PSM) are used to assess the short-term causal impact of appointing female board members. The findings reveal that there is a significant negative correlation between the number of women on the board and labour productivity. The result remains robust across various tests. The study's conclusions align with the symbolic representation theory, which argues that female directors may be appointed for appearance rather than substantive impact, and critical mass theory, which suggests that a minimum proportion of female members (typically 30%) is required for them to influence board decisions meaningfully.

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Introduction

Since Norway introduced gender quota laws for corporate boards in 2003, board gender diversity has gradually become a popular topic in corporate governance. It has widely attracted attention from both academic researchers and policymakers. Even though women's roles in the workplace have generally improved, such as in education, research, and middle management, women remain underrepresented in senior leadership, particularly on corporate boards (Matsa and Miller, 2013). The gender gap in top-level positions is not only common in developing countries but also in many developed ones. Estonia, in particular, has not properly addressed the issue of board gender equity (Banerjee and Wahl, 2022).

To tackle this imbalance, numerous European countries have adopted mandatory gender quota policies for boards, aiming to increase women's influence in corporate decision-making. These policies have helped boost the number of female directors (Comi et al., 2020), encouraged companies to pursue gender equity, and also triggered a large amount of academic research discussing how board gender diversity affects corporate performance (Arvanitis et al., 2022; Ben Slama et al., 2019; Brahma et al., 2021; Mohsni et al., 2021). However, Estonia has not enforced such quotas, making it a relevant context to study the impact of gender diversity in the absence of legal mandates. As a result, appointing female directors on the board typically depends on the companies' governance arrangements or social values, rather than regulations. Before such policies are introduced or refined, the related research is essential. So, this thesis aims to evaluate the impact of board gender diversity on firm performance in Estonia between 1998 and 2020. More specifically, it addresses the following questions:

- RQ1: Does board gender diversity influence firm performance in Estonia?
- RQ2: Are the impacts of gender diversity nonlinear or subject to threshold effects?
- RQ3: Does appointing a new female director produce changes in firm performance in the short term?
- RQ4: Do these effects vary depending on labour productivity, firm size, or regional location?

Based on the resource dependence theory and the agency theory, promoting gender diversity on the board is seen not just as a social or moral good, but as potentially advantageous for business. Previous studies conclude that female directors often have unique thinking patterns,

risk preferences, and communication styles (Bin Khidmat et al., 2020; Chijoke-Mgbame et al., 2020; Hazaea et al., 2023). Women can broaden the board's perspective, strengthen collective problem-solving, refine decision-making, foster innovation, and improve relationships with external stakeholders (Arora, 2022; Marinova et al., 2016; Song et al., 2020). Also, gender diversity can enhance the board's oversight function, support better strategic choices, and boost the company's long-term stability. Furthermore, it enhances the company's reputation and public trust by showcasing social responsibility.

However, on no account can one ignore the potentially adverse impacts triggered by board gender diversity. Some scholars have noted that an increasing share of female directors on the board may also lead to organisational challenges, such as communication barriers and increased costs due to different viewpoints and group integration. In some cases, this may even have a negative influence on firm performance. In addition, factors such as firm size, industry type, and geological location may cause variations or heterogeneity in how gender diversity impacts governance (Ali et al., 2011; Joecks et al., 2013).

Overall, it cannot be denied that the introduction of the board gender diversity policy does generate substantial benefits. Using data from the Estonian Business Registry Database, this article constructs a balanced panel dataset covering 1,014 enterprises from 1998 to 2020. The firm performance is measured by labour productivity (Log of Labor Productivity), while the board gender diversity is analysed through several metrics: the number of female directors (Number of Female Board Members), the proportion of female directors (Female Board Ratio (%)), whether there is at least one female director on the board (Board Includes Females), and whether the proportion of the female directors is at least 30% on the board (Female Board Share ≥ 30%)

In terms of empirical methods, this article applies a two-way fixed effects model, controlling both firm fixed effects and year fixed effects, which could effectively eliminate the interference of firm-level time-invariant and macro environmental changes on the estimation results. Additionally, this study constructs an instrumental variable (IV) - the average proportion of female directors at the industry level and uses two-stage least squares (2SLS) to mitigate endogeneity issues. Additionally, this article introduces the Propensity Score Matching (PSM) method to identify the short-term performance changes in companies after the first addition of female directors. It allows us to estimate the causal effects of gender

diversity from a dynamic perspective. Finally, we adopt subsample regressions to examine the differences in outcomes by firm performance, size, and geographic region.

To illustrate how the research questions, hypotheses, methodologies, empirical results and preliminary conclusions of the thesis are connected, Table 1 provides an overview of the empirical framework.

Table1
Overview of Research Questions, Hypotheses, Methodology, and Key Findings on the Impact of Board Gender Diversity on Firm Performance in Estonia (1998–2020)

Research Question	Hypothesis	Methodology	Empirical Result	Preliminary Conclusion
RQ1: Does board gender diversity affect labor productivity in Estonia?	H1a: Diversity improves performance H1b: Alternatively, may reduce it	Two-way fixed effects regression and 2SLS	Significant negative correlation between the number of female board directors and labour productivity	Might suggest symbolic appointments or lack of critical mass
RQ2: Are the effects non-linear or subject to thresholds?	H1c: U-shaped relationship H1d: Positive impact after critical mass (≥30%)	Two-way fixed effects regression	No U-shape detected; critical mass dummy positive but insignificant	Weak evidence for threshold effects
RQ3: Does the appointment of a female director affect productivity?	H2a: Event of adding a female director leads to short-term performance change	Event study and PSM	ATT estimates negative from t+1 to t+4, but statistically insignificant	Directionally consistent with baseline results
RQ4: Are effects heterogeneous across firm characteristics (size, performance, region)?	H3a: Effect differs by labour productivity, firm size and region	Subsample regressions	More pronounced negative effects in low-productivity, larger-size and non-Tallinn firms	Institutional and structural factors moderate the impact of board gender diversity

Note: 2SLS: Two-Stage Least Squares, PSM: Propensity Score Matching, ATT: Average Treatment Effect on the Treated.
Source: Author's own work

The structure of the rest of this thesis is as follows. Chapter 1 is about the overview of theoretical and empirical research on the relationship between board gender diversity and corporate performance. Chapter 2 details data sources, variable construction, and descriptive statistics. Chapter 3 describes the empirical models and methodological choices. Chapter 4 demonstrates the regression results, robustness testing, and heterogeneity analysis by firm characteristics. Chapter 5 discusses implications for policymakers and corporate management. Chapter 6 summarises research findings, contributions, limitations and suggestions for future research.

CERCS code: S180 Economics, econometrics, economic theory, economic systems, economic policy

1. Literature Review

1.1. Key Concepts and Importance of Gender Diversity

Board gender diversity refers to the representation of women on corporate management boards. In this thesis, it is measured using the following several indicators: (1) the number of

female directors, (2) the proportion of female directors to total board size, (3) a dummy variable indicating whether the board includes at least one woman, and (4) a dummy variable for whether women comprise at least 30% of the board.

Corporate performance, firm performance and financial performance are used interchangeably in this thesis. They refer to a company's operational and financial outcomes, particularly measured by the log of labour productivity.

Board gender diversity has been widely seen as a critical factor for enhancing corporate performance. It is not just about increasing the number of women on the board. There are diverse viewpoints, skill sets, values, and problem-solving capabilities brought by female directors to the table (Arora, 2022). The higher proportion of women sparks diverse perspectives and reduces groupthinking. So, a more diverse board could make decision-making and problem-solving more strategic and efficient, leading to a better understanding of the market conditions (Marinova et al., 2016).

In addition, women on boards contribute to healthy debates. It allows the same situation to be tackled in different ways by leveraging diverse skills, competencies, and life experiences (Arora, 2022). In other words, increasing board gender diversity is an important channel for improving broader cognitive diversity, which might improve the board's productivity and problem-solving skills, ultimately enhancing company performance.

Besides, a gender-diverse board can satisfy a wider range of stakeholders, including employees, customers, and the community, especially when firms operate in multiple global markets (Song et al., 2020). Women are often more sensitive to the interests and perspectives of various stakeholders (Nielsen and Huse, 2010). This sensitivity can make effective monitoring and better decision-making, contributing to board oversight of firm strategies. Also, board gender diversity could benefit the corporate public image and help attract or retain more talented female employees (Li and Chen, 2018; Song et al., 2020).

However, while women may bring specific advantages to the strategic decision-making, their impact on everyday operational control tasks, such as administrative monitoring, may not differ significantly from that of men (Nielsen and Huse, 2010). This finding suggests that simply adding women to boards is not enough, while firms and policymakers should ensure that female directors are empowered to participate actively in strategy and governance.

1.2. Theoretical Frameworks

A number of theoretical perspectives reveal how board gender diversity affects corporate performance. One perspective views gender diversity as a strategic resource, which enhances firm performance through different forms of human capital, such as skills, experiences, and perspectives. The resource dependence theory (RDT) is one of the most important theories in this regard, explaining the relationship between gender diversity and financial performance (Hazaea et al., 2023). It emphasises that the board provides essential resources for the firm, and gender diversity strengthens this role by bringing in diverse perspectives and skills (Bin Khidmat et al., 2020; Chijoke-Mgbame et al., 2020; Marquez-Cardenas et al., 2022). Song et al. (2020) found that the benefits of diversity (creativity, innovation, and effective problem-solving) outweigh the potential costs (communication problems and lack of cohesion). So, women's unique skills, external networks, and valuable experience could improve firms' efficiency and profits (Hazaea et al., 2023; Martinez-Jimenez et al., 2020). Increased diversity has also been linked to higher productivity, creativity, and innovation, outcomes that are critical for firm performance (Simionescu et al., 2021; Wu et al., 2022).

Agency theory offers another lens commonly used in finance and economics to understand the relationship between board characteristics and firm value (Carter et al., 2003). In firms, the separation of "ownership" and "control" can cause agency problems (Fama and Jensen, 1983). The agency problem refers to investors' difficulties in ensuring that their funds are used for profitable projects, since there are differences in interests between the investor as the principal and the manager as the agent (Hindasah and Harsono, 2021). Given that an information asymmetry exists between managers and investors, managers can filter the information they share with the investors (Reddy and Jadhav, 2019). So, the board's main function is to monitor top management actions on behalf of investors (Fama and Jensen, 1983). Within this framework, the agency theory framework suggests that women on boards reduce agency conflicts, increase legitimacy, and enhance effective monitoring, leading to positive effects on firm performance (Chijoke-Mgbame et al., 2020). There is evidence that this effect is especially valuable in the challenging times: Papangkorn et al. (2021) find that during a period of crisis, when firms face more uncertainty and agency conflicts may become more severe, more diverse boards provide stronger monitoring and more diverse advice.

Thus, this study, based on the theoretical supports regarding benefits from gender diversity, hypothesises that benefits (valuable resources and effective monitoring) from board gender diversity exceed costs, thereby positively affecting firm performance as follows:

Hypothesis 1a: Board gender diversity is positively related to firm performance in Estonia.

Hypothesis 2a: The Event of adding a female director leads to a short-term firm performance change in Estonia.

While the above theories expect positive outcomes from the increased female board representation, other frameworks caution that the impact of board gender diversity may be neutral or even negative under certain conditions. An increasing number of countries have introduced gender quota policies to promote gender equality, but gender quotas may lead to symbolic or token representation rather than substantive impact. It could be the case that the only reason for including a female director on the board is that it provides a signal that the organisation respects the accomplishments of its women, rather than that they are the best, most qualified individuals (Guldiken et al., 2019; Rixom et al., 2023). Even though they are not overqualified, solo women on a male-dominated board often feel isolated or marginalised, limiting their ability to contribute (Konrad and Kramer, 2006). Empirical evidence from India by Hindasah and Harsono (2021) supports the tokenism concern: they find that the minority members are often included symbolically instead of being integrated into core decision-making, especially in a complete ownership scenario. Since board diversity is desirable, but the perception of tokenism is not, it is reasonable to ask at what point the minority member is no longer a token (Rixom et al., 2023). At the critical mass, the research shows that women tend to be regarded by other board members, not as “female directors” but simply as directors, and they don’t report being isolated or ignored (Konrad and Kramer, 2006).

According to the critical mass theory, a certain threshold of female representation on boards is necessary to realise the benefits of gender diversity on firm outcomes. Studies have found a U-shaped relationship between gender diversity and firm performance, where the positive effects become significant only after a critical mass of about 30% of women (Joecks et al., 2013). Reaching this critical mass can minimise the conflict with male directors and persuade them to accept the opinions of female directors (Martinez-Jimenez et al., 2020). However, some studies suggest that beyond a certain point (e.g., 33%), the positive effects may diminish (Ali et al., 2011). When the proportion of female directors on board is beyond 33%, the costs of gender diversity predicted by social identity theory (e.g., miscommunication, disagreements, conflicts and loss of trust) outweigh the potential benefits of diversity predicted by agency and resource dependence theories (e.g., greater monitoring, improved decision-making, a plethora of views, opinions and skills, stronger connections with female

clients and workers and better corporate image) (Arvanitis et al., 2022). Also, it says that both male-only and female-only boards should be more effective. So, we make the following predictions:

Hypothesis 1b: Board gender diversity is negatively related to firm performance in Estonia.

Hypothesis 1c: There is a U-shaped relationship between board gender diversity and firm performance in Estonia.

Hypothesis 1d: If the proportion of female directors is at least 30%, board gender diversity will have a positive impact on the firm performance in Estonia.

The existence of these different theoretical views underlines the importance of careful policy design regarding gender diversity. To challenge the male-dominated board and address gender inequity, some countries have implemented legislative gender quota policies that set the minimum proportion/number of female directors on the board. In 2003, the first gender quota policy was introduced in Norway, followed by several EU countries, like France, Germany and Italy. However, there is always debate surrounding gender quota legislation in various countries, highlighting the challenges of implementing such policies. While some countries support mandatory quotas, others argue that more organic and voluntary measures may be more effective in promoting gender diversity without unintended consequences (Singh and Dwesar, 2022). Importantly, the level at which the quota is set also matters. The minimum threshold may ensure the basic compliance, but might be insufficient to overcome tokenism or reach the critical mass needed for substantive impact. For example, Rixom et al. (2023) suggest that if the legal quota is three women, boards may be anticipated to exceed the minimum quota mandate (e.g., four women). Only once they exceed these quota-based expectations will they overcome tokenism and attain the benefits suggested by resource dependence theory.

1.3. Empirical Findings

A large body of empirical research has demonstrated the positive impact of gender diversity on firm performance (Arora, 2022; Duppati et al., 2020; Jiang et al., 2021; Ozdemir, 2020; Saleh et al., 2021; Ullah et al., 2019). Arvanitis et al. (2022) found that the positive impact of gender diversity on board operation (like increased legitimacy, effective monitoring, better decision-making and easier access to limited external resources) can improve financial performance. The finding aligns with agency theory and resource dependence theory

perspectives – female directors bring valuable knowledge and skills that can help firms operate more efficiently. For example, Brahma et al. (2021) shows that the positive relationship between female directors' education, age, and firm performance further supports the resource dependence theory, that women bring valuable human capital to the board. Some research also points to the importance of having more than one token woman. Brahma et al. (2021) and Chijoke-Mgbame et al. (2020) find that gender diversity has a positive and highly significant effect on financial performance, particularly when three or more women are appointed to the board, by using firm fixed effects and system GMM methods to address potential endogeneity concerns. Similarly, Đặng et al. (2020) suggest that firms should have a more efficient view regarding having WOCB (Women on Corporate Boards), since ROA is increased by up to 3 percentage points by a greater proportion of WOCB, which is a substantial improvement. These support the critical mass theory by indicating that a higher proportion of female directors meaningfully enhances firm performance.

The positive impact of gender diversity is not limited to traditional financial metrics. Studies also highlight broader organisational benefits. Martinez-Jimenez et al. (2020) find that gender diversity enhances board effectiveness, which is measured by strategic control, organisational innovation, and decision-making. Gender diversity is particularly beneficial in dynamic environments, as firms require innovation and adaptability to drive success. Wu et al. (2022) show that high levels of gender diversity in top management teams (TMT) and boards of directors (BOD) achieve greater innovation outcomes, thereby enhancing firm performance. This shows that board gender diversity can foster an innovative culture and long-term value beyond just short-term financial gains.

Despite the extensive evidence of positive findings, other studies report no significant relationship or a negative relationship between gender diversity and firm performance (Singh and Dwesar, 2022). For example, Marinova et al. (2016) find no relation between the share of women on boards and firm performance in the Netherlands and Denmark. Similarly, Fernández-Temprano and Tejerina-Gaite (2020) report that there is no evidence of a significant influence of gender diversity on performance.

These divergent results the impact of board gender diversity might depend on additional factors. Differences in empirical findings can be traced to variations in specifications and methodologies in terms of performance measures, statistical models, time horizons, omitted variables, etc (Conyon and He, 2017). More importantly, these contradicting results suggest that the impact of gender diversity may depend on contextual factors, such as industry

characteristics, firm size, and cultural norms (Li and Chen, 2018; Post and Byron, 2015). For instance, gender diversity might yield more benefits in companies which value egalitarian leadership.

One reason for null or negative findings could be the underrepresentation of women on boards, which limits their ability to influence firm performance (Matsa and Miller, 2013). This connects to the critical mass theory. In regions where boardrooms remain male-dominated (like in parts of Latin America), the lack of gender diversity may hinder firms from realising the full benefits of board gender diversity to their performance (Marquez-Cardenas et al., 2022). In such cases, female directors might be unable to significantly contribute to a firm's reputation, maintain relationships with stakeholders, monitor, or bring new ideas. Rahman et al. (2023) predict that the actions and contributions of directors in minority or women directors are enormously affected and constrained in a male-dominated boardroom. Interestingly, Rahman et al. (2023) also find that firms even with a single female director perform better than those with no female directors in the later empirical experience, which suggests that some female representation is still better than none at all.

There is no consensus on the impact of gender diversity on the board of directors on corporate performance. Some studies have found that diverse backgrounds can enrich strategic perspectives and optimise decision-making quality, thereby improving corporate performance. Conversely, some studies have also pointed out that it brings negative effects. More specifically, management complexity and communication barriers would, in turn, suppress performance. There are also other studies finding no significant relationship between gender diversity and performance. These research differences may stem from variations in research methods and handling of situational variables, like industry sector, ownership structure, and external economic conditions, especially when organisational characteristics such as performance levels and firm size are overlooked.

From a research methodology perspective, most empirical studies rely on conditional mean regression (such as OLS), which assumes that the effect of gender diversity on performance is uniform across the sample as a whole. However, this method fails to reveal the differential impact of diversity in enterprises with different performance levels.

Conyon and He (2017) use quantile regression and find that the gender diversity effect has significant directional differences in different percentiles of the distribution of corporate performance. In lower performance percentiles (such as the 25th percentile), the proportion of

female directors has a significant positive association with corporate performance, while in higher performance percentiles (such as the 75th percentile), a stronger significant positive relationship is observed. In other words, gender diversity appears to benefit all firms to some extent, but the benefit is greater for companies already performing well. This result indicates that the effect of gender diversity on firm performance is not linear or consistent, but is significantly moderated by the level of performance at which the firm operates. Therefore, incorporating the level of corporate performance as a key moderating variable into the analysis framework can help enhance research interpretability and reveal the true impact of gender diversity in different contexts.

Notably, the differences in sample structure may further exacerbate the inconsistency of research results. If the proportion of companies with poor performance in the sample is too high, the estimated results are more likely to show weaker positive, insignificant or even negative effects. If the proportion of high-performance enterprises is higher, the positive impact of gender diversity is more likely to be expected Conyon and He (2017).

The threat-rigidity theory offers a possible theoretical explanation. When facing economic adversity, organisations may exhibit rigidity or be unable to take action and/or do new things (Staw et al., 1981). Low performance poses a threat to firms and consequently changes the informational and decision-making processes of the board in a negative way. Shimizu (2007) points out in his study that when losses reach a certain "threat point", organisations are more likely to choose more conservative, low-risk response strategies (such as divestment) due to the threat rigidity effect, rather than continuing to bear potentially greater losses. In such situations, ideas that challenge the status quo, like those introduced by female directors, may be seen as more uncertain or risky and therefore receive more pushback. This theory emphasises that under heavy external or internal pressure, even if there is a possibility of higher returns, organisations have a tendency to avoid changing behaviour due to fear and resource constraints. In contrast, when a firm has shown good performance, there is less pressure to suppress ideas from female sides, which would result in better and more positive utilisation of women’s knowledge, expertise, and unique perspectives, giving rise to higher-quality board decisions (Conyon and He, 2017).

In addition to firms’ performance heterogeneity, differences in firm size are also one of the core organisational characteristics that influence gender diversity effects. According to Contingency Theory, firm size, a key organisational structural variable, affects resource

allocation, communication mechanisms, and governance efficiency (Child, 1975). Li and Chen (2018) find that in small and medium-sized enterprises, the organisational structure is relatively flat, and companies have fewer management levels, which gives more flexible communication channels. In these settings, the diverse knowledge and creativity of female directors are more easily adopted and put into practice by the organisation. Those enterprises have stronger responsiveness and project flexibility in dealing with external environmental changes, which makes it easier to unleash the potential value brought by gender diversity. However, in larger organisations, the hierarchy is more complex, and resource competition is fiercer. Decision-making processes could be slower and more formal, and entrenched institutional norms might make it harder for minority voices to influence outcomes. As a result, the opinions of female directors are more likely to be marginalised by institutional inertia or power structures, thereby weakening their positive role.

Li and Chen (2018) find that when the size of a company is below a certain critical value, there is a significant positive relationship between board gender diversity and performance. However, after exceeding a certain scale, the positive relationship gradually disappears and even turns negative. This indicates that the size of the enterprise regulates the direction of the impact of gender diversity on performance, and may explain the phenomenon of "ineffective diversity" or even "reverse effect" found in some studies.

Beyond performance and size, other characteristics of the enterprise, such as geographical location, governance structure, decision-making mechanism, and degree of resource redundancy, may form complex contextual frameworks, affecting the actual operational path of gender diversity. For example, when companies have more centralised governance mechanisms or uneven distribution of board power, female directors may have nominal diversity but may not necessarily have substantial influence. In such enterprises, the marginal effect of gender diversity on performance may be low or invisible (Li and Chen, 2018). All these nuances underscore that the impact of board gender diversity is not one-size-fits-all.

In summary, the impact of gender diversity on corporate performance may not be uniform, whether from the perspective of corporate performance level, corporate size or position. It might be highly dependent on the specific structure and development context of the organisation. Therefore, we systematically incorporate performance level, firm size and geographical place as moderating factors into the empirical research framework. This could not only help clarify the complex relationship between diversity and performance but also

provide theoretical and empirical support for understanding when, where, and how firms release diversity effects. So, based on these, we propose the following hypothesis:
Hypothesis 3a: The impact of board gender diversity varies by labour productivity, firm size, and geographical location.

1.4. Research Gaps

Compared to studies in Western Europe and North America, the empirical research on board gender diversity and a firm's performance in Estonia is largely missing. So, this thesis aims to fill this gap from Estonia's unique institutional context. It could offer specific insights for Estonian policymakers and business leaders regarding how to promote board diversity.

Earlier research often uses the relatively short panel datasets, which may prevent capturing the dynamic changes. There is a small amount of paper utilising the event study framework and propensity score matching (PSM) to compensate for the static character of the two-way-fixed effects model, which is widely used in the research field (Bin Khidmat et al., 2020; Lafuente and Vaillant, 2019; Song et al., 2020). Besides, most of the studies assume a uniform association between the board's gender diversity and corporate performance (Jiang et al., 2021; Saleh et al., 2021; Sanad and Al Lawati, 2023). Few empirical works have simultaneously addressed multiple moderating factors, like a firm's performance, firm's size and firm's location.

Therefore, we construct a balanced panel dataset of companies in Estonia from 1998 to 2020, providing a long-term view. We employ a combination of econometric approaches to strengthen causal inference. We use a two-way fixed effects model to account for time-invariant differences across firms and a two-stage least squares (2SLS) instrumental variable approach to mitigate potential endogeneity bias. Also, we complement an event study framework and propensity score matching (PSM) to examine the causal impact of the "event", adding one female director, on firm performance in the short term. Furthermore, we adopt a systematic approach to examine heterogeneity by testing whether the association between the board gender diversity and firm performance is different by corporate performance, firm size and geographic location. Overall, this thesis brings a rigorous methodological design, with long-span panel data and multiple identification strategies to obtain more reliable results.

2. Data and Variables

This section provides information on data sources, data processing, and the construction of variables. It also presents the descriptive statistics of the variables and the multicollinearity diagnostic.

2.1. Data Description

We construct a balanced panel dataset from the Estonian Business Registry, covering the period from 1995 to 2020. This database includes all companies registered in Estonia, having national representativeness and completeness. Its annual data has financial information at the enterprise level, such as balance sheets, income statements, and cash flow statements. Companies' background information is also contained, like five-digit industry classification codes (NACE), ownership types, and the number of employees. The annual coverage of enterprises ranges from approximately 20,000 to 50,000, ensuring the breadth and systematicity of the sample.

The database also provides detailed board structure data, allowing us to identify and measure the gender diversity on the board. The original data records distinguish between two types of board members - members of the Management Board and members of the Supervisory Council. In this study, we only retain information on members of the Management Board. Estonia implements a dual-layer corporate governance structure, which broadly follows the German model (Postma and Hermes, 2003.). The management committee is responsible for the day-to-day operation and strategic execution of the company, serving as the core body of the company's substantive decision-making. The supervisory board is appointed by shareholders and mainly exercises supervisory responsibilities, with less direct involvement in the company's operations. Therefore, we focus solely on the members of the management committee, making sure that the impact of gender diversity of the board on corporate performance can be more accurately captured.

We merge company-level data with board-level data using company registration code and year as key variables, obtaining a balanced panel data covering 1,014 companies for 23 consecutive years (with a total of 23,322 firm-year observations). It is longitudinal panel data covering a long time span from 1998 to 2020. Companies without complete data on key financial or board composition indicators are excluded. To maintain a balanced panel

structure, firms that fail to provide continuous reports throughout the full observation period are also omitted.

2.2. Variable Definition

Table 2
Overview of Variables used in the Estonian Panel Dataset (1998–2020)

Variable	Measure
Log of Labor Productivity	Labor productivity is calculated as real turnover divided by the number of employees. Real turnover is obtained by deflating nominal turnover using the deflator for value added. We use the natural logarithm of labor productivity in this analysis. This indicator reflects the firm's performance.
Number of Female Board Members	The number of female directors on the board, used to capture the board gender diversity.
Female Board Ratio (%)	The ratio of female directors on board to the total number of directors on board, whether they are independent or executive members. It is used as an alternative to capture the board gender diversity.
Board Includes Female (dummy)	The dummy variable equals 1 if there is at least 1 female director on board and 0 otherwise, used as an alternative of the board gender diversity.
Female Board Share ≥ 30% (dummy)	The dummy variable equal to 1 if the proportion of female board members is at least 30%.
Log of Total Assets	Firm size, measured by the natural logarithm of total assets.
Tallinn	Geographic location. A dummy variable equal to 1 if the firm is headquartered in Tallinn, the capital of Estonia, and 0 otherwise.
Capital intensity	Capital intensity, defined as the ratio of fixed assets to total assets, representing the extent of capital investment in the firm.
Return on Assets	Return on assets, calculated as net income divided by total assets.
Log of Asset Turnover	Asset turnover, defined as the natural logarithm of total sales scaled by total assets.
Employee Costs per Employee	It is measured by the total employee costs divided by the number of employees.
industry_1-industry_19	Dummy variables for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025). These control for systematic industry-level differences.
year	Dummy variables for each year from 1998 to 2020. One year is omitted to serve as a reference category to avoid the dummy variable trap.

Source: Authors' calculations based on Estonian Business Registry data.

The dependent variable, Log of Labour Productivity, is constructed based on the method used by Ali et al. (2011), Bae and Skaggs (2019). Since one of the main functions of management is to improve employee productivity, we expect organisational management performance to be closely related to employee productivity (Bae and Skaggs, 2019). Specific calculation for labour productivity: In order to eliminate the impact of price changes on a firm's turnover, the deflator for value added is utilised to calculate the actual turnover by adjusting the nominal turnover through price adjustments. Next, we divide the actual revenue by the number of people employed by the company to obtain the company's labour productivity index. In this paper, this variable is treated by Winsorization at the 1% and 99% quantiles. We use the natural logarithm of labour productivity in this analysis.

Gender diversity is commonly measured by the proportion of women on boards, the number of female directors, and diversity indices like the Blau and Shannon (Arvanitis et al., 2022; Đặng et al., 2020; Marquez-Cardenas et al., 2022; Mohsni et al., 2021; Simionescu et al., 2021). These metrics capture different dimensions of gender diversity, and the choice of metric should align with the research objectives. There are also dummy variables to reflect different levels of gender diversity (uniform, skewed, tilted, and balanced boards) (Arora, 2022; Joecks et al., 2013; Papangkorn et al., 2021; Ullah et al., 2019). Blau and Shannon indices provide a non-directional measure of board diversity by assessing the distributional balance across gender categories. However, they cannot distinguish whether women or men dominate the board. Since this study focuses specifically on female representation and its impact on firm performance, we prefer directional measures - the proportion of women on boards, the number of female directors and a dummy variable that shows if the board contains at least one female.

In this study, we adopt several proxies to quantify board gender diversity. The primary metric is the Number of Female Board Members. It is represented by the number of female directors on the board (Simionescu et al., 2021). In the later robustness test, we also use the proportion of female board members to total board members (Female Board Ratio (%)) and the dummy variable (Board Includes Females) as alternative indicators of board gender diversity (Arora, 2022; Marquez-Cardenas et al., 2022; Mohsni et al., 2021). Board Includes Females takes the value of 1 when at least one of the board members is a woman during this time period. These indicators effectively capture female presence, but they fall short in reflecting true gender

balance. For example, if all board members are female, these measures might not present the genuine diversity in a strict sense.

We refer to existing research and select control variables at the firm level and the industry level. Firm-level control variables include company size (Log of Total Assets), geographical location (Tallinn), capital intensity (Capital Intensity), return on assets (Return on Assets), asset turnover (Log of Asset Turnover), and average employee costs (Empcosts Costs per Employee). The control variables at the industry level are industry type.

Regarding company size (measured as the log of the total assets), due to economies of scale and their greater influence in the market, large companies are more likely to generate more revenue per given amount of assets than small companies (Ali et al., 2011; Sanad and Al Lawati, 2023). The size of a company is represented by the natural logarithm of its total assets (Arvanitis et al., 2022; Bin Khidmat et al., 2020; Jiang et al., 2021; Ozdemir, 2020; Saleh et al., 2021).

Geographic location (Tallinn): We use a dichotomy to control geographic location. Tallinn is a dummy variable, 1="Business headquarters located in Tallinn", 0="Other". Given that Tallinn is the main urban centre of Estonia, companies headquartered here may have the potential to expand their productivity (Bae and Skaggs, 2019). In our sample, approximately 23.75% of companies are headquartered in Tallinn.

Capital intensity (Capital Intensity): Capital intensity is the ratio of fixed assets to total assets. Fixed assets investment may help the company improve its financial performance, because it helps improve the company's production level (Ozdemir, 2020).

We also include return on assets (Return on Assets), asset turnover (Log of Asset Turnover), and average employee costs (Empcosts Costs per Employee) as control variables (Carter et al., 2003; Ullah et al., 2019).

Finally, two sets of dummy variables, namely industry dummies and year dummies, are used to control for industry-specific effects and time-specific effects (Saleh et al., 2021). The industry classification in this article is based on the Classification of Economic Activities in Estonia (EMTAK 2025). According to the first two digits of the industry code to which the company belongs (division level), the sample companies are divided into 19 different

industry categories. They reflect the main economic activity areas where the company engages and shares a high degree of generalisation. In regression analysis, this article introduces industry fixed effects (industry_1 to industry_19) to control for possible systematic differences in technology structure, capital investment intensity, labour characteristics, and market environment among different industries, to reduce the interference of industry-level heterogeneity on labour productivity estimation results.

We also construct an instrumental variable at the industry level - the average proportion of female directors in the industry (Kalia, 2025). More specifically, companies are grouped by industry (the same category criteria as the industry dummies in the control variable part) and year, and then the average percentage of female directors in each group is calculated.

2.3. Descriptive Statistics and Correlation Analysis

Table 3
Descriptive Statistics of Key Variables: Estonian Firm-Level Panel Data (1998–2020)

Variable Name	Obs	Mean	SD	Min	Median	Max
Log of Labor Productivity	23322	10.862	0.976	8.298	10.831	13.579
Number of Female Board Members	23322	0.437	0.696	0.000	0.000	6.000
Number of Female Board Members (Squared)	23322	0.675	1.681	0.000	0.000	36.000
Female Board Ratio (%)	23322	22.113	34.597	0.000	0.000	100.000
Board Includes Females	23322	0.343	0.475	0.000	0.000	1.000
Female Board Share ≥ 30%	23322	0.326	0.469	0.000	0.000	1.000
Tallinn	23322	0.237	0.426	0.000	0.000	1.000
Capital Intensity	23322	0.429	0.289	0.000	0.411	1.004
Log of Total Assets	23322	14.007	2.033	7.493	14.038	21.059
Log of Asset Turnover	23322	-1.105	1.571	-23.837	-1.342	2.983
Employee Costs per Employee	23322	70365.334	91119.503	0.000	30833.917	2.47e+06
Return on Assets	23322	0.075	0.194	-6.225	0.061	1.878

Source: Authors' calculations based on Estonian Business Registry data.

In Table 3, the descriptive statistical results of the main variables in this article are presented. Winsorization is applied to the Log of Labour Productivity. The mean is 10.862, the median is 10.831, the standard deviation is 0.976, the minimum value is 8.298, and the maximum value is 13.579. After controlling for the impact of extreme values, the variable still exhibits a right-skewed distribution, reflecting significant differences in production efficiency among the sample enterprises. However, this processed variable is considered suitable for subsequent empirical analysis.

The average number of female members (Number of Female Board Members) on the board of directors is 0.437, with a median of 0 and a maximum of 6, indicating that the majority of corporate boards are still highly male-dominated. Furthermore, the average of the board female ratio (Female Board Ratio (%)) is only 22.1%, indicating that board gender diversity

is generally low. This may show that the appointment of female directors by companies is primarily a symbolic gesture rather than a genuine effort to enhance gender diversity.

As for the average percentage of women (Female Board Ratio (%)), the standard deviation is 34.6%, and the median is 0%, meaning that over half of the corporate boards have no female members. The maximum value is 100%, indicating that in some firms, all board members are women. However, this situation is rare and typically occurs in very small firms. 92% of boards with a full female composition consist of only two members. The minimum value is 0%. There are around 65.8% of firms that have no female representation on their board.

Board Includes Females is a dummy variable which takes a value of 1 if there is at least one female member on the board. The mean value is 0.343, showing that approximately 34.3% of the firms in the sample have women on their boards.

Tallinn is a geographical dummy variable with a mean of 0.237, indicating that approximately 23.7% of companies are headquartered in Tallinn, the capital of Estonia. The average of Capital Intensity is 0.429, with a maximum value slightly higher than 1 (1.004), reflecting that there are some differences in capital investment among sample companies. The mean of the log of total assets is 14.007, with a standard deviation of 2.033. The minimum value is 7.493, and the maximum value is 21.059, demonstrating a dispersed distribution of enterprise size. The mean of Employee Costs per Employee is 70,365.334 euros, with a maximum value of 2,470,000 euros, which is driven by outliers, and a minimum value of 0, which is caused by a very small portion of company data missing. The average return on assets is 7.5%, with a minimum value of -6.225 and a maximum value of 1.878, as the sample includes both profitable and loss-making companies.

Table 4
Distribution of Female Directors by Board Size in Estonian Firms (1998–2020)

Board Size	Number of Female Directors in Boardroom (Persons)							Total
	0	1	2	3	4	5	6	
1	9100	1892	0	0	0	0	0	10992
2	4161	2762	647	0	0	0	0	7570
3	1538	1222	484	169	0	0	0	3413
4	377	251	140	56	43	0	0	867
5	123	80	75	31	15	5	0	329
6	26	22	7	7	3	2	1	68
7	2	10	10	27	1	1	0	51
8	5	0	0	5	1	1	0	12
9	1	0	6	3	1	0	0	11

Board Size	Number of Female Directors in Boardroom (Persons)							Total
10	1	0	4	0	0	0	0	5
11	0	0	2	0	0	0	0	2
13	0	0	0	0	1	0	0	1
14	0	0	0	0	0	1	0	1
Total	15334	6239	1375	298	65	10	1	23322
Percentage	0.66	0.27	0.06	0.01	0	0	0	1

Note: The table presents the distribution of firm-year observations according to total board size (rows) and the number of female board members (columns), using 23,322 observations from Estonian firms spanning 1998 to 2020. Each observation corresponds to a firm-year, meaning the same firm may appear multiple times across different years.
Source: Authors' calculations based on Estonian Business Registry data.

Based on Table 4, within the entire sample of 23,322 firm-year observations, 65.75% of the firms did not have any female directors on their boards in that year, indicating that women are still underrepresented on boards in general.

When it comes to board size, the absence of female directors is most prevalent in smaller boards. Specifically, among companies with just one director, only 17.2% have female directors; among two-person boards, the percentage of companies with female directors is 45.0%, but only 8.6% of companies have two female directors. As the size of the board increases, the number of female directors rises slightly. Some medium-sized boards (e.g., 3-5 persons) begin to have multiple female directors. On three-person boards, the percentage of enterprises with two or more female directors is 19.2%, and on five-person boards, the percentage of enterprises with three or more female directors is only 15.5%.

Overall, only 5.9% of companies have two female directors, 1.3% have three, 0.28% have four, and less than 0.05% have five or more, which is almost negligible.

Before conducting the regression analysis, this study tests the pairwise correlations. Table 5 shows the correlation between the performance indicator and the board diversity attribute. The diversity attribute is negatively correlated with the performance indicator, while control variables (other than capital intensity) are positively correlated with the performance indicator. Looking at the correlation coefficients of the independent variables, the critical value is much smaller than 0.8 (Bin Khidmat et al., 2020), indicating the absence of multicollinearity.

Table 5
Correlation Matrix of Key Variables for Estonian Firms (1998–2020)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Log of Labor Productivity	1.000							
(2) Number of Female Board Members	-0.147*	1.000						
(3) Tallinn	0.154*	-0.046*	1.000					
(4) Capital Intensity	-0.199*	-0.021*	-0.144*	1.000				
(5) Log of Total Assets	0.430*	-0.138*	0.183*	0.151*	1.000			
(6) Log of Asset Turnover	0.187*	0.055*	-0.158*	-0.280*	-0.544*	1.000		
(7) Employee Costs per Employee	0.288*	-0.048*	0.335*	-0.081*	0.530*	-0.435*	1.000	
(8) Return on Assets	0.199*	-0.008	0.076*	-0.145*	0.152*	-0.044*	0.130*	1.000

*Note: The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

3. Empirical Methodology

3.1. Fixed Effect Model

The research sample consists of panel data. Panel data may have unobservable heterogeneity. To control for unobservable heterogeneity related to the independent variable, we employed the Hausman test (Simionescu et al., 2021) to select a more appropriate estimation method between fixed effects and random effects models. The test results support the use of a fixed effects model (chi square=319.67, Prob>chi square=0.0000). Therefore, this article adopts a two-way fixed effects regression model to estimate the direct impact of board gender diversity on firm performance (Joecks et al., 2013). This model can simultaneously control for unobserved heterogeneity at both the company and year levels, thereby improving the reliability and interpretability of the results (Ozdemir, 2020).

The study regression equation is modelled as follows:

$$
\begin{aligned}
&Log\ of\ Labor\ Productivity_{it} \\
&\quad = \beta_0 + \beta_1 Board\ Gender\ Diversity_{it} + \beta_2 Tallinn_{it} \\
&\quad + \beta_3 Capital\ Intensity_{it} + \beta_4 Log\ of\ Total\ Assets_{it} \\
&\quad + \beta_5 Employee\ Costs\ per\ Employee_{it} + \beta_6 Return\ on\ Assets_{it} \\
&\quad + \beta_7 Log\ of\ Asset\ Turnover_{it} + \alpha_i + \gamma_j + \delta_t + \epsilon_{it}
\end{aligned}
$$

where $Log\ of\ Labor\ Productivity_{it}$ denotes the labor productivity of firm i in year t; $Board\ Gender\ Diversity_{it}$ is the key independent variable, represented by the number of female board members, female board ratio (%), and board includes females (dummy), of firm i in year t; $Tallinn_{it}$ controls for geographic location, taking the value 1 if the firm is

headquartered in Tallinn, the capital of Estonia, and 0 otherwise; $Capital\ Intsnsity_{it}$, $Log\ of\ Total\ Assets_{it}$, $Employee\ Costs\ per\ Employee_{it}$, $Return\ on\ Assets_{it}$, and $Log\ of\ Asset\ Turnover_{it}$ are firm-level control variables, accounting for capital structure, firm size, average labor costs, return on assets, and asset turnover, respectively; α_i captures firm fixed effects, controlling for time-invariant unobservable firm characteristics; γ_j represents industry fixed effects (industry dummies, j=1,...,19), which control for structural differences across industries; δ_t denotes year fixed effects (year dummies), controlling for macroeconomic changes over time; ϵ_{it} is the error term.

3.2. Endogeneity Issues

The empirical literature has identified potential endogeneity in the board structure-firm performance relationship caused by time-invariant heterogeneity (Saleh et al., 2021; Sanad and Al Lawati, 2023; Simionescu et al., 2021). In order to address the possible endogeneity of unobserved time-invariant heterogeneity and/or simultaneity, most of the early studies on corporate governance relationships used fixed-effects methods and/or instrumental variable (IV) methods (Arvanitis et al., 2022). So, two-stage least squares (2SLS) estimators with instrumental variables and fixed effects are used. Previous studies have argued that it is difficult to obtain valid instruments regarding instrumental variables in the context of corporate governance structure. Firm-specific characteristics related to board diversity are inevitably correlated with firm performance (and the error term) and are already included as control variables in the model (e.g., firm size, ROA, and location) (Song et al., 2020). However, given the importance of causality issues that may affect valid estimation, and with reference to previous literature, this study employs an instrumental variable, namely the industry average proportion of females (Kalia, 2025).

3.3. Treatment Effect Estimation Methods

Although traditional fixed effects panel regression models can control unobservable individual heterogeneity, their essence still belongs to static settings, mainly relying on linear changes in cross-sections and time series for estimation. However, such models have certain limitations in dealing with "event-based" shocks with clear time nodes, making it difficult to accurately identify the causal effects brought about by the events themselves (Papangkorn et al., 2021).

If we intend to include the typical "event" variable of adding female directors to a company, fixed effects models may be difficult to capture the trend differences between the treatment group and the control group before and after the event. In addition, the estimated "average effect" of the model may also mask heterogeneous reactions between different enterprises, thereby affecting the explanatory power of the conclusions.

Therefore, this article introduces the event study framework and Propensity Score Matching methods as supplements and robustness tests to the main model results (Papangkorn et al., 2021), in order to more comprehensively and dynamically identify the potential impact of new female directors on corporate performance.

This article refers to the approach of Masso and Vahter (2024) on the impact of innovation at the enterprise level on the gender wage gap in the setting of the treatment group and control group. Specifically, the treatment variable is defined at the company level: when a company adds at least one female director in a certain year compared to the previous year, it is considered to have "entered the treatment group" for that year. This article constructs an event window from t-1 to t+4, where t is the year when the first female director was added, t-1 is the covariate observation period, and t and t+4 are the investigation periods for the outcome variables. In the sample, the treatment group retains data within the event window. To ensure the effectiveness of causal identification, the control group enterprises are required not to enter a treatment state during the entire event window (t-1 to t+4), in order to avoid the counterfactual results of future "potential treatments" in the control group interfering with the estimation.

The propensity score is estimated by the Logit model, and all covariates used are from the year before treatment (t-1), including Log of Total Assets, Capital Intensity, Return on Assets, Log of Asset Turnover, and Employee Costs per Employee, while controlling for industry fixed effects and year fixed effects. Based on the estimated propensity score, the inverse probability weight in ATT is calculated using the following formula:

$$IPW_i = D_i + (1 - D_i) \times \frac{p_i}{1 - p_i}$$

Where D_i indicates whether or not to enter the treatment group, and p_i is the estimated propensity score for the firm i.

After constructing the weights, this article uses weighted OLS regression to compare the differences in labour productivity changes between the treatment group and the weighted control group in order to estimate the average treatment effect (ATT):

$$ATT_{IPW} = \mathbb{E}[\Delta Y_i | D_i = 1] - \mathbb{E}_w[\Delta Y_i | D_i = 0]$$

Where $\Delta Y_i = Y_{i,t+\tau} - Y_{i,t-1}$, $\tau \epsilon \{0, 1, 2, 3, 4\}$, denotes the cumulative change in the log of the labour productivity from the pre-treatment baseline (t-1) to each post-treatment year (t+τ), and the second term is the weighted average change value for the control group over the same period.

To ensure that the treatment and control groups are comparable on covariates, this thesis also tests for balance after weighting by Standardised Mean Difference (SMD).

4. Empirical Results

4.1. Benchmark Regression Results

Table 6
Stepwise Fixed Effects Regression Results on the Impact of Board Gender Diversity on Firm Performance in Estonia (1998–2020)

VARIABLES	(1) Log of Labour Productivity	(2) Log of Labour Productivity	(3) Log of Labour Productivity
Number of Female Board Members	-0.100***	-0.078***	-0.071***
	(-3.64)	(-3.45)	(-3.35)
Tallinn		0.057**	0.065**
		(2.19)	(2.55)
Capital Intensity		-0.064	-0.063
		(-1.33)	(-1.38)
Log of Total Assets		0.359***	0.362***
		(17.25)	(17.52)
Log of Asset Turnover		0.324***	0.328***
		(8.17)	(8.10)
Employee Costs per Employee		0.000***	0.000***
		(12.88)	(12.98)
Return on Assets		0.345***	0.345***
		(8.50)	(8.85)
Constant	10.765***	6.141***	6.110***
	(440.58)	(25.18)	(24.52)
Industry dummies	NO	NO	YES
Company FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	23,322	23,322	23,322

VARIABLES	(1) Log of Labour Productivity	(2) Log of Labour Productivity	(3) Log of Labour Productivity
R-squared	0.024	0.392	0.409
Number of firms	1,014	1,014	1,014

*Note: This table reports multiple regression results using the fixed effects model. Log of Labour Productivity: firm performance, Number of Female Board Members: board gender diversity, Tallinn: geographical location, Capital Intensity: capital intensity, Log of Total Assets: board size, Employee Costs per Employee: the average employee costs, Return on Assets: return on assets, Log of Asset Turnover: asset turnover, industry dummies: for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

Table 6 presents the results of three stepwise fixed effects regression models, which are used to analyse the impact of board gender diversity on firm labour productivity. All models have controlled for firm fixed effects and year fixed effects, and use robust standard errors clustered at the firm level.

Model (1) only includes the core explanatory variable, Number of Female Board Members, and fixed effects. The regression coefficient is -0.100, which is significant at the 1% significance level, indicating that for each additional woman on the board, the company's performance declines by 10%, ceteris paribus. Although the model does not control for enterprise and industry characteristics, preliminary results suggest a statistically negative correlation between the two.

Model (2) introduces control variables at the enterprise level, including company size (Log of Total Assets), geographical location (Tallinn), capital intensity (Capital Intensity), return on assets (Return on Assets), asset turnover (Log of Asset Turnover), and average employee costs (Employee Costs per Employee). After controlling for these variables, the regression coefficient of Number of Female Board Members remains negative and significant at the 1% level (-0.078). In other words, every additional female board member is associated with a 7.8% decrease in labour productivity, ceteris paribus. It indicates that the relationship has a certain degree of robustness.

In Model (3), after adding a set of industry dummy variables (i.e. industry fixed effects), it shows a slight decrease in the coefficient of Number of Female Board Members, still

significant at the 1% level. The coefficient -0.071 implies that for each additional female board member, the firm's labour productivity decreases by around 7.1%, ceteris paribus. It indicates that the negative correlation between the number of female directors and the log of labour productivity still exists after controlling for more comprehensive enterprise and industry characteristics. The results support Hypothesis 1b, because board gender diversity has a negative association with employee productivity. There is no support for competing Hypothesis 1a. This finding is also in line with the findings of many previous studies (Matsa and Miller, 2013; Rahman et al., 2023) that confirm the negative relationship between gender diversity and financial performance, while it contrasts with the findings of some other empirical studies (Arora, 2022; Duppati et al., 2020) that support the positive of gender diversity on firm performance.

It is important to note that this negative correlation does not mean that female directors themselves have poor performance. Instead, more attention should be put on how effectively gender diversity is implemented within the organisation. As pointed out by Carter et al. (2003), the negative or insignificant effects of gender diversity may stem from female directors being appointed merely for symbolic reasons or operating within a corporate culture that does not support their meaningful engagement on the board.

In our samples, the average proportion of female directors on the board is only 22.11%, far below the "critical mass" threshold needed to exert meaningful influence. According to Joecks et al. (2013), an insufficient number of female representatives not only limits their ability to contribute effectively but may also hinder internal communication and reduce decision-making efficiency. This is due to marginalisation and weak voice, which in turn affect company performance. Gender diversity only truly has a positive impact on corporate performance when the proportion of women reaches around 30% (or with at least three female directors). Brahma et al. (2021) and Martinez-Jimenez et al. (2020) also point out that diversity can only form a "collective voice" when there are three or more women on the board, enabling them to meaningfully shape decision-making and ultimately enhance company performance.

Adams and Ferreira (2009) further emphasise that having female directors does not automatically mean they can meaningfully engage in discussions, and that gender diversity can only be transformed into actual governance advantages when they are truly involved in and able to influence decision-making.

In addition, Lafuente and Vaillant (2019) criticise the practice of "symbolic appointments" and point out that introducing only a few female directors does not truly improve performance. They contend that merely reaching a minimum threshold is not enough; instead, boards should achieve genuine gender balance to realise meaningful economic benefits. This provides an important perspective for us to understand the findings of this thesis: the current proportion of female directors is not yet sufficient to reflect "substantive representation", and even though the bottom number line is crossed, the true board gender balance may not be achieved, both of which might prevent gender diversity from delivering its intended governance and collaborative advantages.

In summary, the negative correlation results found in this article are more likely due to the fact that board gender diversity has not yet reached the "critical point". In addition, female directors lack substantial participation and influence in organisational structures. This conclusion also puts forward higher requirements for companies to promote gender diversity strategies in the future. Diversity should not be treated merely as a numerical goal but must also translate into real influence and active participation at the board level.

The regression coefficient of Tallinn (whether located in the capital city of Tallinn or not) is 0.064, which is significant at the 5% level. It indicates that if the headquarters of a company is located in Tallinn, its labour productivity is approximately 6.4% higher than those located elsewhere. This may be because of the comprehensive advantages of the capital in infrastructure, talent resources, and commercial networks.

The regression coefficient of the Log of Total Assets is 0.362, which is significant at the 1% level. It shows that a 1% increase in the size of the enterprise is associated with a 0.362% increase in labour productivity, which is in line with the theory of economies of scale. This result is also consistent with the research findings of Carter et al. (2003) and Conyon and He (2017), which suggest a positive correlation between firm size and firm performance.

The coefficient of Return on Assets is 0.345, which is highly significant at the 1% level, indicating that the stronger the profitability of a company, the higher its labour productivity. A 1% growth in return on assets is associated with a 0.345% increase in labour productivity. This reflects the consistency between financial performance and operational efficiency, and is consistent with the conclusion of Carter et al. (2003) that ROA is positively correlated with corporate performance.

The regression coefficient of the Log of Asset Turnover is 0.328, which is also significant at the 1% significance level. This suggests that a 1% increase in asset turnover is associated with a 0.328% increase in labour productivity, holding other factors constant. The result indicates that companies with effective asset usage often have higher per capita output.

Although the coefficient of Capital Intensity is negative (-0.063), it is not significant ($p>0.1$). The coefficient of Employee Costs per Employee is positive (0.000) and significant at the 1% level, indicating that higher average employee expenses are associated with higher labour productivity. This is consistent with the notion that investment in human capital can enhance firm performance.

In summary, the comparison results of the three models show that the gradual introduction of control variables does not change the sign or significance of the core explanatory variables, and their impact has a certain degree of stability. This indicates that the negative correlation between the number of female directors and labour productivity is not driven by omitted firm-specific or industry-level factors.

4.2. Robustness Checks

After running the benchmark fixed effects model, we use the variance inflation factor (VIF) to test for multicollinearity diagnosis. Table 7 presents the results of the VIF test. It is clearly seen that all values of VIF are between 1 and 10, showing the stability of the coefficient estimates of the regression results.

Table 7
Variance Inflation Factor (VIF) Test for Multicollinearity among Independent Variables in the Benchmark Regression (Estonia, 1998–2020)

Variable	VIF	1/VIF
Number of Female Board Members	1.120	0.893
Tallinn	1.330	0.751
Capital Intensity	1.490	0.673
Log of Total Assets	2.110	0.474
Log of Asset Turnover	3.430	0.292
Employee Costs per Employee	2.220	0.450
Return on Assets	1.110	0.904
Mean	VIF	2.550

Note: VIF statistics for year and industry fixed effects are omitted from the table for clarity, but these variables are included in the estimation.
Source: Authors' calculations based on Estonian Business Registry data.

To ensure that our results are not affected by the way we measure board gender diversity, we reestimate our baseline regression using the percentage of women on the board and a dummy variable, whether there is at least one female on the board.

Based on Table 8, after replacing board gender diversity with the proportion of women (Female Board Ratio (%)), the regression coefficient of the variable is -0.001, which is significant at the 5% significance level (p=0.05). This result indicates that when the proportion of female directors on the board increases by 10%, the average labour productivity of the enterprise decreases by about 1%.

Although the statistical significance of this indicator is relatively weak (slightly above the 5% significance level), its coefficient direction is highly consistent with the benchmark model, providing strong evidence for the preliminary conclusion.

Further setting the gender diversity indicator as a dummy variable (Board Includes Females), the regression coefficient is -0.083, with statistical significance at the 1% level (p=0.006). This means that when at least one woman appears on the board, and other conditions remain unchanged, the average labour productivity of the company decreases by about 8.3%. Its negative significance is consistent with the benchmark model, enhancing the reliability of the original conclusions and eliminating the possibility of opposite relationships arising from different measurement methods.

Table 8
Robustness Check Using Alternative Measures of Board Gender Diversity and Their Association with Firm Performance: Evidence from Estonian Firms (1998–2020)

VARIABLES	(1) Log of Labour Productivity	(2) Log of Labour Productivity
Female Board Ratio (%)	-0.001**	
	(-1.96)	
Board Includes Females		-0.083***
		(-2.74)
Constant	6.099***	6.101***
	(24.46)	(24.47)
Control Variables	YES	YES
Industry dummies	YES	YES
Company FE	YES	YES
Year FE	YES	YES
Observations	23,322	23,322
R-squared	0.407	0.408

VARIABLES	(1) Log of Labour Productivity	(2) Log of Labour Productivity
Number of firms	1,014	1,014

*Note: This table reports multiple regression results using the fixed effects model. Log of Labour Productivity: firm performance, Female Board Ratio (%): the ratio of female directors on board to the total number of directors on board (alternative board gender diversity), and Board Includes Females: the dummy variable equals 1 if there is at least 1 female director on board and 0 otherwise (alternative board gender diversity). Control variables: Tallinn (geographical location), Capital Intensity (capital intensity), Log of Total Assets (board size), Employee Costs per Employee (the average employee costs), Return on Assets (return on assets), and Log of Asset Turnover (asset turnover). Industry dummies: for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

Furthermore, to test whether there is a non-linear relationship between the number of female directors and corporate performance, this paper introduces a quadratic term for the number of female directors. The second column of Table 9 reports the regression results. It can be seen that the linear coefficient of female directors is still significantly negative ($p<0.1$), and their square coefficient is negative (-0.002), but not statistically significant. Although it has not yet reached the traditional level of significance, its coefficient shows that there is no strong evidence of "U-shaped relationships", which is supported by Bae and Skaggs (2019) and Joecks et al. (2013). So, the regression results do not support Hypothesis 1c.

In order to test the critical mass theory, whether the positive effects become significant only after a critical mass of about 30% of women (Joecks et al., 2013), this paper sets a dummy variable (Female Board Share $\geqslant$ 30%). If the ratio of females on the board is at least 30%, the variable is 1, otherwise, it is 0. The third column of Table 9 shows the results. The coefficient of the dummy variable is 0.021, indicating that firms meeting the critical mass threshold have about 2.1% higher labour productivity than those that do not, holding other factors constant. However, it is statistically insignificant. It is possible that some boards may theoretically achieve the threshold (30%) for critical mass, but female directors might still be excluded from meaningful involvement in strategic decision-making. So, this result does not provide strong empirical support for Hypothesis 1d.

However, the positive sign of the coefficient supports the theories of symbolism and critical mass. The latter points out that only when female directors reach a certain critical proportion on the board, their opinions and participation will be taken seriously and can substantially affect the company's decision-making and operational performance.

Table 9
Robustness Checks for Non-Linear and Threshold Effects of Board Gender Diversity on Firm Performance in Estonian Firms (1998–2020)

VARIABLES	(1) Log of Labour Productivity	(2) Log of Labour Productivity	(3) Log of Labour Productivity
Number of Female Board Members	-0.071***	-0.066*	-0.083***
	(-3.35)	(-1.80)	(-3.06)
Number of Female Board Members (Squared)		-0.002	
		(-0.20)	
Female Board Share ⩾ 30%			0.021
			(0.59)
Tallinn	0.065**	0.065**	0.064**
	(2.55)	(2.55)	(2.54)
Capital Intensity	-0.063	-0.063	-0.063
	(-1.38)	(-1.38)	(-1.39)
Log of Total Assets	0.362***	0.362***	0.362***
	(17.52)	(17.51)	(17.52)
Log of Asset Turnover	0.328***	0.328***	0.328***
	(8.10)	(8.11)	(8.11)
Employee Costs per Employee	0.000***	0.000***	0.000***
	(12.98)	(12.97)	(12.99)
Return on Assets	0.345***	0.345***	0.345***
	(8.85)	(8.85)	(8.85)
Constant	6.110***	6.110***	6.109***
	(24.52)	(24.52)	(24.52)
Industry dummies	YES	YES	YES
Company FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	23,322	23,322	23,322
R-squared	0.409	0.409	0.409
Number of firms	1,014	1,014	1,014

Note: This table reports multiple regression results using the fixed effects model. Log of Labour Productivity: firm performance, Number of Female Board Members: board gender diversity, Number of Female Board Members (Squared): the squared term of the Number of Female Board Members, Female Board Share ⩾ 30%: the dummy variable equals 1 if the proportion of female directors on the board is at least 30% and 0 otherwise, Tallinn: geographical location, Capital Intensity: capital intensity, Log of Total Assets: board size, Employee Costs per Employee: the average employee costs, Return on Assets: return on assets, Log of Asset Turnover: asset turnover, industry dummies: for 19 industries, classified

*based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

Overall, this section of the analysis serves as a theoretical extension of the benchmark model, testing the potential nonlinear and threshold effects. The insignificant coefficient of the Number of Female Board Members (Squared) suggests that the linearity of the baseline model assumption is stable and appropriate. While the coefficient of the dummy variable, whether the proportion of females on the board is at least 30%, is insignificant, it indicates that there might be a positive sign to the threshold effect. It provides a further supplementary perspective for understanding the impact mechanism of female directors on corporate performance.

4.3. Instrumental Variable Models

In benchmark regression, this study finds a significant negative correlation between the number of female members on the board and labour productivity. However, this estimation result may be affected by endogeneity issues, leading to bias. On the one hand, some companies with lower productivity may proactively introduce female members to their board of directors as a symbolic improvement or formal diversity response due to reputation management, compliance pressure, or public image considerations. This motivation makes the increase of female directors not necessarily due to the company's expectations of their management performance, but more of a strategic display behaviour. If not identified, reverse causality may arise in the regression model, leading to misjudgment of the direction of causal relationships. On the other hand, unobserved factors such as corporate governance preferences, industry norms, or regional culture may simultaneously affect the gender composition of the board and the labour productivity of the company. If not controlled, such omitted variables may also lead to biased estimation results. Therefore, in order to identify whether the negative correlation is causal, this paper adopts the two-stage least squares method (2SLS) (Carter et al., 2003).

This article draws on the methods of Kalia (2025) to construct instrumental variables based on the industry and the year. Specifically, this article uses the average proportion of female directors of their respective industries for each year as the instrumental variable (Industry Avg. Female Ratio).

The gender diversity atmosphere (such as talent availability, industry norms, and sector-specific governance practices) in an industry where a company belongs might significantly affect a firm's board composition. Companies operating within the same industry face a similar pool of board candidates and regulatory expectations, so their board gender diversity should be relevant (Kalia, 2025).

As a variable constructed at the industry level, Industry Avg. Female Ratio reflects the external environment, such as gender composition trends and industry culture, but has no direct causal relationship with the labour productivity of a specific company. As long as the board structure of other companies within the same industry does not directly affect the production efficiency of the company through any channel, it can be considered as meeting the exogenous conditions of instrumental variables. In addition, the regression model has controlled for year, industry fixed effects, and a series of firm-level variables.

Looking at Table 10, in the first stage, the regression coefficient of Number of Female Board Members for Industry Avg. Female Ratio was 0.011, with a significance level of 1%, indicating a significant positive correlation between the instrumental variable and the dependent variable, which meets the strength requirements of the instrumental variable.

In the second stage, the estimated coefficient of the instrumental variable method for Number of Female Board Members was -0.342, with a significance level of 1% ($p<0.01$). This is consistent with the baseline regression results, confirming that an increase in the number of female directors is associated with a 34.2% decrease in labour productivity after controlling for endogeneity bias.

Table 10
Two-Stage Least Squares Estimation of the Causal Effect of Board Gender Diversity on Firm Performance in Estonian Firms (1998–2020)

VARIABLES	(1) First stage Number of Female Board Members	(2) Second stage Log of Labour Productivity
Industry Avg. Female Ratio	0.011*** (13.09)	
Number of Female Board Members		-0.342*** (-3.09)
Tallinn	-0.044*** (-5.12)	0.051*** (3.95)
Capital Intensity	-0.020 (-1.46)	-0.067** (-2.39)

VARIABLES	(1) First stage Number of Female Board Members	(2) Second stage Log of Labour Productivity
Log of Total Assets	-0.004	0.360***
	(-0.88)	(26.13)
Log of Asset Turnover	-0.003	0.327***
	(-0.75)	(9.76)
Employee Costs per Employee	-0.000	0.000***
	(-1.34)	(17.31)
Return on Assets	-0.012	0.342***
	(-1.10)	(9.93)
Industry dummies	YES	YES
Company FE	YES	YES
Year FE	YES	YES
Observations	23,322	23,322
R-squared		0.380
Number of firms	1,014	1,014

*Note: This table reports multiple regression results using the fixed effects model. Labour Productivity: firm performance, Industry Avg. Female Ratio: instrumental variables, Number of Female Board Members: board gender diversity, Tallinn: geographical location, Capital Intensity: capital intensity, Log of Total Assets: board size, Employee Costs per Employee: the average employee costs, Return on Assets: return on assets, Log of Asset Turnover: asset turnover, industry dummies: for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

This section constructs exogenous instrumental variables with industrial representativeness and uses 2SLS for endogeneity correction. The estimation results show that the coefficient for the Number of Female Board Members becomes increasingly negative, from -0.071 in the fixed effects model to -0.342 in the 2SLS model. It further confirms the causal explanatory power of the negative correlation between female directors and company labour productivity. Although this result does not negate the potential value of women's governance, it may reflect institutional barriers that limit female directors' empowerment, actual influence, and broader involvement in effective corporate governance.

4.4. Propensity Score Matching

To further identify the causal effects of the addition of female directors on a company's labour productivity, this paper further combines the event study and PSM method. After constructing covariates in the previous year (t-1) and estimating propensity scores through a

Logit model, weighted OLS regression analysis is conducted on the treatment effects using inverse probability weights in the form of ATT.

To ensure the effectiveness of ATT estimation, this article reports the results of the covariate balance test weighted by IPW. In Table 11, the SMD of all variables is significantly lower than 0.1, indicating that the weighted treatment group and the control group have achieved a good balance in the covariate dimension, meeting the key prerequisite of comparability in ATT estimation.

The result in Table 12 shows the average changes from the year t to year t+4 in labour productivity in the treatment group (i.e. companies with newly added female directors) after controlling for covariate bias. The year t-1 is taken as the baseline. The number of treated firm-year observations in each regression ranges from 226 to 260. More specifically, there are 260 observations to year t, 257 to year t+1, 248 to year t+2, 236 to year t+3, and 226 to year t+4. None of the estimated treatment effects is statistically significant. But the average treatment effects are negative between year t+1 and year t+4, showing a consistent negative direction of effects. For example, the ATT at t+2 is -0.699, which corresponds to an estimated 69.9% decrease in labour productivity compared to the baseline. The results offer weak empirical support for Hypothesis 2a.

Although the ATT estimates are not statistically significant, their negative directions align with the baseline regression results, indicating that the observed relationship may not be caused by model specification. Instead, it may reflect heterogeneity in how the addition of female directors operates across different types of firms, which may have an offsetting effect on the average.

Table 11
Covariate Balance After Inverse Probability Weighting (IPW): Treated vs. Control Firms in Estonia (t−1, 1998–2020)

Variable	Weighted Mean (Treated)	Weighted Mean (Control)	SMD
Lagged Capital Intensity	0.414	0.414	0.002
Lagged Log of Total Assets	14.33	14.328	0.001
Lagged Empcosts Costs per Employee	80418.938	80458.338	0.0
Lagged Return on Assets	0.078	0.078	0.0
Lagged year	2006.6	2006.603	0.0
Tallinn	0.252	0.252	0.0

Note: The table compares the weighted mean of covariates between the treated group (firms that appoint a female director in year t) and the control group (firms whose board composition remains unchanged from t−1 to t+4). All variables (except for Tallinn) are

measured with a one-year lag prior to treatment (t−1). Weighted Mean (Treated) and Weighted Mean (Control) respectively represent the average values of the weighted treatment group and control group on each covariate. SMD (Standardised Mean Difference) is used to measure the degree of balance between the treatment group and the control group on covariates. It is generally believed that SMD less than 0.1 indicates that the variable has reached an acceptable balance between the groups. Industry fixed effects (industry_1 to industry_18) are excluded from this table for conciseness, but all corresponding SMD values are below 0.1, suggesting adequate balance.
Source: Authors' calculations based on Estonian Business Registry data.

Table 12
Estimated Average Treatment Effects on Labour Productivity from Year t to t+4 (Estonian Firms, 1998–2020)

	(1) diff_t0	(2) diff_t1	(3) diff_t2	(4) diff_t3	(5) diff_t4
(mean) treatment	0.219	-0.269	-0.699	-0.511	-0.103
	(0.280)	(0.352)	(0.603)	(0.655)	(0.758)
Observations	260.000	257.000	248.000	236.000	226.000
R-squared	0.003	0.002	0.012	0.004	0.000

Note: This table reports the ATT (Average Treatment Effect on the Treated) estimates from year t through t+4, where t marks the year a firm appoints at least one female director. The dependent variable is the change in the log of labour productivity relative to t-1. Robust standard errors are shown in parentheses. None of the reported estimates are statistically significant.
Source: Author's own work

Therefore, the next section will further explore heterogeneity topics to examine whether there are significant differences in the board gender diversity in different types, sizes, or regions of companies, to reveal the structural mechanisms behind the average effect.

4.5 Heterogeneity Analysis

To examine the heterogeneity of gender diversity effects across different corporate characteristics, this article conducts a heterogeneity analysis from three aspects. We use subsample regressions based on firm performance, firm size and geographic location (Tallinn and non-Tallinn).

For firm performance heterogeneity, the existing research on the relationship between board gender diversity and firm performance is inconsistent, and one of the core reasons is the neglect of the moderating role of corporate performance itself. From a theoretical perspective, firm performance is viewed as an important contingency factor in the study of board gender

diversity (Conyon and He, 2017). To investigate further, this study adopts the approach proposed by Conyon and He (2017). We divide the sample into two groups based on the median labour productivity: high-performance and low-performance companies. Then, we conduct fixed effects regressions separately. This method is similar to quantile regression and can reveal how the influence of gender diversity may vary across firms with different performance levels.

Although some literature (Conyon and He, 2017) uses ROA or Tobin's Q to classify company performance levels, this study uses labour productivity as the measure of firm performance. Therefore, the heterogeneity test is also based on the median division of labour productivity, which is more theoretically consistent and logically consistent.

Table 13
Heterogeneity Test by Firm Performance

VARIABLES	(1) High Performance Log of Labour Productivity	(2) Low Performance Log of Labour Productivity
Number of Female Board Members	-0.029	-0.040*
	(-1.32)	(-1.87)
Tallinn	0.039	0.002
	(1.46)	(0.08)
Capital Intensity	-0.109**	0.085**
	(-2.16)	(2.14)
Log of Total Assets	0.311***	0.259***
	(16.40)	(10.42)
Log of Asset Turnover	0.375***	0.241***
	(15.66)	(5.77)
Employee Costs per Employee	0.000***	0.000***
	(13.05)	(4.77)
Return on Assets	0.279***	0.257***
	(5.90)	(8.66)
Constant	7.649***	6.752***
	(28.91)	(24.77)
Industry dummies	YES	YES
Company FE	YES	YES
Year FE	YES	YES
Observations	11,661	11,661
R-squared	0.344	0.371
Number of firms	825	802

Note: This table reports the results of fixed effects regression, estimating the heterogeneity of the impact of female directors on labour productivity in firms with different performance levels. The sample is divided into high performance group and low low-performance group according to the median of labour productivity (Log of Labour Productivity), and regression

*analysis is performed separately. Log of Labour Productivity: firm performance, Number of Female Board Members: board gender diversity, Tallinn: geographical location, Capital Intensity: capital intensity, Log of Total Assets: board size, Employee Costs per Employee: the average employee costs, Return on Assets: return on assets, Log of Asset Turnover: asset turnover, industry dummies: for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

According to Table 13, model (1) only includes firms with the log of labour productivity above the median. The results show that the coefficient of Number of Female Board Members is negative, but not statistically significant, suggesting that board gender diversity is not strongly associated with productivity changes in high-performing firms.

First, from the perspective of the Threat Rigidity Theory, high-performance enterprises face less external pressure, and the board is more likely to maintain an open and inclusive governance atmosphere (Conyon and He, 2017). They are generally better equipped to adopt diverse opinions and innovative perspectives from female directors, which can help mitigate the potential identity tension and communication challenges. Second, according to the Critical Mass Theory, if the number of female directors does not reach a certain threshold, which is required for genuine influence (usually considered to be 3 or 30%), women may still be in a symbolic position, making it difficult to truly influence the decision-making. This means that even in high-performance companies, women may not have a sufficient voice. In addition, the theory of tokenism also suggests that when women are underrepresented, they are more likely to be marginalised and even subject to role stereotypes and extra scrutiny. Therefore, although high-performance companies may ease some negative mechanisms, their positive potential is still not fully released until a critical level of representation is reached, resulting in statistically insignificant negative regression results in the thesis.

In contrast, Model (2) focuses on low-productivity enterprises below the median. The regression results indicate that the coefficient of Number of Female Board Members remains negative (-0.04) and is significant at the 10% level. It shows that each additional female director is associated with a 4% decrease in labour productivity, controlling for other factors.

This discovery is consistent with the conclusions of existing literature. Conyon and He (2017) find that there is a negative correlation between the proportion of female directors and

performance at the 25th percentile of the performance distribution, measured using ROA. The effect is not significant around the median but shows a significant positive relationship at the 75th percentile. On the one hand, it can be explained through the Threat Rigidity Theory. When companies face external threats, such as declining performance, board members tend to simplify decision-making, tighten power structures, and avoid expressing non-traditional opinions (Staw et al., 1981). Within this defensive group mindset and institutional framework, although female directors are introduced into the board, it is difficult to break the existing male-dominated structure. The potential value brought by them is difficult to adopt and integrate. Instead, it may increase internal tensions due to communication barriers, identity tension, and role ambiguity, ultimately having a negative impact on corporate performance. This suggests that low-performance environments can suppress the positive effects of gender diversity (Conyon and He, 2017). On the other hand, low-performing firms are less likely to attract highly qualified female directors and are also less effective in leveraging human capital and social capital (Conyon and He, 2017).

Based on the results of this study, it can be inferred that the effect of gender diversity on the board has heterogeneity across firms with different productivity levels. In high-performing companies, the board is more likely to provide an inclusive and diverse governance environment, allowing the positive contributions of female directors to be more effectively realised. Conversely, in underperforming companies, introducing female directors may increase governance complexity, expose existing structural contradictions, and result in a short-term decline in productivity.

The findings suggest that the impact of board gender diversity may not be uniform among all firms, and could vary depending on firm characteristics like labour productivity (Conyon and He, 2017). This heterogeneity analysis suggests that there may be differences in the direction and significance of female directors' impact between high-performance and low-performance firms.

As for firm size, we divide the sample into two groups based on the median total assets (Log of Total Assets) of companies. Smaller-size enterprises are those whose total assets fall below the sample median; larger-size enterprises are those with values at or above the median. We conduct two-way fixed effects regression analysis to control for company fixed effects and year fixed effects, while retaining all original control variables (including the Log of Total Assets themselves).

Table 14
Heterogeneity Test by Firm Size

VARIABLES	(1) Smaller-size Log of Labour Productivity	(2) Bigger-size Log of Labour Productivity
Number of Female Board Members	-0.066**	-0.081***
	(0.027)	(0.030)
Tallinn	-0.002	0.153***
	(0.029)	(0.040)
Capital Intensity	-0.116**	0.047
	(0.051)	(0.072)
Log of Total Assets	0.347***	0.342***
	(0.027)	(0.032)
Log of Asset Turnover	0.278***	0.379***
	(0.050)	(0.060)
Employee Costs per Employee	0.000***	0.000***
	(0.000)	(0.000)
Return on Assets	0.278***	0.504***
	(0.042)	(0.060)
Industry dummies	YES	YES
Firm FE	YES	YES
Year FE	YES	YES
Observations	11661.000	11661.000
R-squared	0.392	0.451
Number of firms	832	869

*Note: This table reports the results of fixed effects regression, estimating the heterogeneity of the impact of female directors on labour productivity in firms with different performance levels. The sample is divided into smaller-sized group and larger-sized group according to the median of company size (Log of Total Assets), and regression analysis is performed separately. Log of Labour Productivity: firm performance, Number of Female Board Members: board gender diversity, Tallinn: geographical location, Capital Intensity: capital intensity, Log of Total Assets: board size, Employee Costs per Employee: the average employee costs, Return on Assets: return on assets, Log of Asset Turnover: asset turnover, industry dummies: for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

In Table 14, the regression results show that there is a significant negative correlation between the number of female directors and the log of the labour productivity in a large-scale

enterprise sample (coefficient=-0.081, $p<0.01$). It indicates that each additional female director is associated with an 8.1% decrease in labour productivity, holding other factors constant. This result is consistent with the study by Li and Chen (2018), which suggests that the positive impact of female directors may gradually weaken or even turn negative as the size (natural logarithm of the book value of year-end total assets) of the company increases. Large firms often have more complex organisational structures and slower decision-making processes. With numerous issues competing for attention, boards may struggle to fully integrate the diverse insights and governance contributions of female directors. Meanwhile, according to the Symbolism theory (Tokenism), if the proportion of female directors is not sufficient to reach a "critical mass", their opinions may be marginalised. This can lead to internal friction or governance efficiency decline, ultimately inhibiting firm performance.

In the sample of small-scale enterprises, the regression coefficient for female directors is significantly negative (-0.066). This corresponds to a 6.6% reduction in productivity per additional female director. Li and Chen (2018) find that the marginal effects of board gender diversity are significantly positive at the 10^{th} and 25^{th} percentiles of firm size, while at the 50^{th} percentile the marginal effect turns negative. Although this result is not entirely consistent with the significant positive relationship found by Li and Chen (2018) in small firms, it is still reasonable. On the one hand, the governance structure of small businesses is flatter, the communication chain is shorter, and the cultural adaptation costs are lower. This makes it theoretically easier to achieve governance benefits of gender diversity (Li and Chen, 2018). However, on the other hand, in the sample of this study, the overall proportion of female directors is relatively low, failing to reach the "critical mass" required for substantive change. As a result, the negative effects of diversity (such as communication barriers and marginalisation of opinions) are not entirely eliminated. Therefore, the potential negative impact of board diversity may not be offset by the positive effect of small businesses.

Furthermore, the coefficients of control variables also highlight how firm size contributes to varying outcomes. For example, in large enterprises, being located in Tallinn is significantly and positively associated with productivity (coefficient = 0.153, $p < 0.01$), while this variable is not significant in small enterprises. Return on Assets and the Log of Asset Turnover show significant positive influence in both groups, but their coefficients are higher in large enterprises. This indicates that financial performance and asset turnover have a stronger driving effect on labour productivity in large firms.

In summary, firm size serves as a key moderating factor in the relationship between gender diversity and firm performance. In large companies, if the number or influence of female directors is insufficient, gender diversity may lead to higher governance friction and coordination costs, thereby suppressing labour productivity. In small firms, more flexible organisational structures can help alleviate these challenges, allowing them to better absorb the effects of diversity and reduce its potential drawbacks. This finding emphasises the importance of organisational size and governance structure in shaping and assessing gender diversity policies.

Regarding geographic region, there is currently a lack of direct theoretical literature in the academic field on how regional context influences the relationship between board gender diversity and firm performance. Given the fact that Tallinn's unique position in the Estonian economic system, this study introduces regional division as an exploratory heterogeneity test within the empirical framework. As the Estonian economic and administrative centre, Tallinn attracts many large enterprises and foreign-invested firms, leading to more intense market competition and more standardised governance practices. In contrast, firms located outside Tallinn may operate under different governance logics, employment standards, and networking culture. These regional differences may indirectly shape how female directors influence firm performance. This section aims to preliminarily reveal the empirical evidence of this mechanism and provide theoretical insights for further in-depth research.

Like the subsample regression method used in the earlier heterogeneity tests, this article uses the geographical location (Tallinn or non-Tallinn) as the criterion to group observations.

Table 15
Heterogeneity Test by Region

VARIABLES	(1) Tallinn Log of Labour Productivity	(2) non-Tallinn Log of Labour Productivity
Number of Female Board Members	-0.020	-0.074***
	(-0.68)	(-2.84)
Capital Intensity	0.024	-0.066
	(0.37)	(-1.23)
Log of Total Assets	0.393***	0.360***
	(14.25)	(15.18)
Log of Asset Turnover	0.477***	0.294***
	(16.56)	(6.68)
Employee Costs per Employee	0.000***	0.000***

VARIABLES	(1) Tallinn Log of Labour Productivity	(2) non-Tallinn Log of Labour Productivity
	(11.11)	(7.80)
Return on Assets	0.316***	0.319***
	(7.20)	(6.96)
Constant	6.039***	6.037***
	(15.22)	(21.19)
Industry dummies	YES	YES
Company FE	YES	YES
Year FE	YES	YES
Observations	5,538	17,784
R-squared	0.498	0.391
Number of firms	389	1,014

*Note: This table reports the results of fixed effects regression, estimating the heterogeneity of the impact of female directors on labour productivity in firms located in different regions. The sample is divided into the Tallinn group and the non-Tallinn group according to the dummy variable (Tallinn), and regression analysis is performed separately. Log of Labour Productivity: firm performance, Number of Female Board Members: board gender diversity, Tallinn: geographical location, Capital Intensity: capital intensity, Log of Total Assets: board size, Employee Costs per Employee: the average employee costs, Return on Assets: return on assets, Log of Asset Turnover: asset turnover, industry dummies: for 19 industries, classified based on the first two digits (division level) of the Estonian Classification of Economic Activities (EMTAK 2025), and year dummies: for each year from 1998 to 2020. The significance levels are represented by * for p<0.1, * * for p<0.05, and * * * for p<0.01, respectively.*
Source: Authors' calculations based on Estonian Business Registry data.

In Table 15, for firms in the Tallinn region, the negative coefficient is statistically insignificant, suggesting that gender diversity does not significantly affect labour productivity. Firms in Tallinn may have more formalised governance systems and specialised management approaches, which may reduce the marginal effect of individual board members. In addition, there may be some adjustment costs, but these costs may be absorbed by the higher institutional capacity and organisational flexibility of companies in Tallinn.

At the same time, for the companies headquartered in non-Tallinn region, the regression results show that the coefficient for the Number of Female Board Members is -0.074 and statistically significant ($p<0.01$), indicating that in the non-Tallinn region, each additional female director is linked to a 7.4% reduction in labour productivity, assuming other factors constant.

These non-Tallinn-based enterprises are typically smaller in scale and share limited resources. Although they may be more deeply rooted in local organisational structures,

appointing female directors may not effectively leverage potential advantages within local social networks. Various structural barriers in corporate governance and cultural environment may make it difficult to realise the benefits of gender diversity, and even lead to adverse outcomes.

First, the governance structure of non-Tallinn firms is often not standardised enough, and they have strong family or relational characteristics. Female directors are usually taken as a symbol and lack real decision-making power. Second, in more traditional organisational cultures, women on the board are often subjected to gender role expectations, and this stereotype can increase their identity pressure and weaken their actual role. Besides, although female directors may have access to certain social resources, the local economy has limited resources. Social capital is difficult to effectively transform into tangible performance gains. In addition, small firms often maintain conservative approaches to human resources structures and communication systems, so introducing female board members may actually lead to internal friction, communication barriers, and increased management coordination costs. Therefore, the three heterogeneity tests support Hypothesis 3a - The impact of board gender diversity varies by labour productivity, firm size, and geographical location.

5. Discussion

The empirical research in this study reveals the complex mechanism of how board gender diversity influences company performance in Estonia. The baseline regression results show a significant negative correlation between the number of female directors and labour productivity, a finding partially supported in the PSM results. Although the presence of a critical mass (30%) of female directors shows a positive relationship with performance, this impact is not statistically significant. After addressing endogeneity concerns, this negative relationship remains robust, indicating that gender diversity has not yet shown governance benefits in the current context. However, the heterogeneity analysis results further indicate that there are significant differences in how female directors affect productivity based on firm characteristics. In underperforming firms, the negative impact is statistically significant, whereas in high-performing firms, although still negative, the effect is not significant. When analysing by firm size, the adverse influence of female directors is stronger and more significant in large enterprises than in smaller ones. In addition, it is found that in the non-Tallinn region, the impact of female directors on firm performance is more negative and

statistically significant. These findings imply that performance levels, company size, and location all moderate the relationship between board gender diversity and firm outcomes.

From a theoretical perspective, this research aligns with several frameworks. First, starting with the Critical Mass Theory, if the proportion of women in the board of directors is below a certain threshold (usually considered to be 30%), they tend to be marginalised, limiting their impact on group decision-making. This makes it difficult for them to have a substantial impact on collective decision-making. In most companies in Estonia, the proportion of female directors is generally low, far from reaching the critical point, which may explain the overall negative effects found in this article.

Second, Symbolism Theory emphasises that female directors are often appointed for appearances, external perceptions, or compliance reasons, rather than genuine governance contributions. As a result, their voices and influence may be minimal. This type of symbolic inclusion can even heighten gender barriers and reduce team cohesion.

Third, this article finds that the role of gender diversity in low-performing enterprises is weakest, and may even have a negative effect, which can be explained by the Threat Rigidity Theory. This theory suggests that when a company is under pressure or facing uncertainty, the organisation tends to be conservative, suppressing diversity as a perceived risk. Consequently, female board members may be viewed as liabilities in times of crisis, undermining their ability to contribute meaningfully.

In addition, the subsample analysis results of this article indirectly support the Contingency Perspective Theory. It states that the governance effect of gender diversity is not universally consistent. In small and medium-sized enterprises, high-performance enterprises, or enterprises located in Tallinn areas, female directors are more likely to integrate into the board culture and play a coordinating role.

These insights have significant implications for policy-making in Estonia and other countries that have not yet implemented gender quota policies. Firstly, policymakers could establish target thresholds, like the 30% benchmark, to ensure that women are able to have a real influence on decision-making. Secondly, tailored support should be offered to low-performing firms to help them embrace diverse perspectives effectively.

From a managerial standpoint, the research highlights the need to move beyond superficial compliance with gender diversity norms. Firstly, companies should prioritise appointing women with professional competence, industry background, and strategic awareness to the board. Secondly, firms must be cautious not to sideline gender diversity and should instead encourage inclusive governance practices. Thirdly, build an internal reserve team of female talents, starting from the junior management level, and systematically construct their growth path.

In summary, the research argues that gender diversity cannot be achieved overnight. True progress occurs only when female board participation evolves from tokenism to a meaningful and strategic governance presence.

Conclusion

This article takes Estonian companies as research samples to systematically analyse how board gender diversity influences firm labour productivity. The study is based on balanced panel data from 1998 to 2020. It integrates a two-way fixed effects model, instrumental variable method (2SLS), event study and Propensity Score Matching (PSM) to explore the impact of gender diversity on firm performance from different perspectives.

The benchmark regression results show a significant negative relationship between the number of female directors and labour productivity. Although some studies often highlight the positive contributions of gender diversity, this study finds that in Estonia, where no mandatory gender quotas currently exist, female directors on the board have not significantly improved overall firm labour productivity. However, when examining firms where female representation meets or exceeds the 30% “critical mass,” the results suggest a potential, though statistically insignificant, positive influence.

To control for potential endogeneity issues, this study further uses the industrial average proportion of female directors as an instrumental variable and performs a two-stage least squares estimation (2SLS). The results indicate that after controlling for possible reverse causality and omitted variable bias, the negative relationship remains statistically significant.

In addition, this article estimates the average treatment effect (ATT) of adding female directors through event studies and PSM methods. Although the estimation results do not

pass the traditional significance test, their direction aligns with the main regression findings, offering preliminary support for deeper investigations into underlying mechanisms and dynamic effects.

In the heterogeneity analysis section, the paper segments firms by performance level, size, and geographic location to assess variation in the impact of gender diversity. The results show that the negative impact of female directors is more significant in companies with poor performance, larger asset sizes, and non-Tallinn regions. These findings underscore the role that firm structure and environmental context play in moderating the relationship between gender diversity and productivity.

In summary, this article finds that board gender diversity in Estonian companies has not yet significantly transformed into corporate governance advantages. However, this does not mean that female directors lack the ability, but rather points to structural challenges such as symbolic appointments, insufficient critical mass, and inadequate support for meaningful participation. Achieving the benefits of gender diversity requires broader institutional, cultural, and organisational reform.

This study offers several contributions at the academic and practical levels. Firstly, in terms of research subjects, this article focuses on Estonia, a former middle-income transition economy without mandatory gender quotas. It fills the academic gap in corporate governance in Central and Eastern Europe. Compared to studies from developed nations, these findings offer insights into how gender diversity functions in a more organic setting. Secondly, in terms of methodological innovation, this article combines a two-way fixed effects model, instrumental variable method, event study method, and PSM method, improving the robustness and causal explanatory power of the results. Thirdly, in terms of theoretical application, this article organically integrates various theoretical frameworks such as resource dependence theory, agency theory, symbolism theory, critical mass theory, and threat rigidity theory. It provides a multidimensional understanding of how gender diversity influences firm outcomes. Finally, in terms of policy implications, the findings inform policy debates in Estonia and similar countries on promoting gender-balanced governance.

Although this article has been as rigorous as possible in terms of data selection, model construction, and method application, there are still inevitably several limitations. This study mainly uses the number and proportion of women on the board as indicators, and fails to

further capture the actual role played by female directors, such as meeting participation rate, educational background, and professional experience. While IV and event study methods reduce endogeneity concerns, they cannot eliminate all potential unobserved biases. This study focuses on Estonian firms. Its culture, system, and economic background are specific. The applicability of research conclusions to other countries still needs to be approached with caution. The short event window (t-1 to t+4) may also underestimate the long-term influence of female leadership on strategy.

Based on these findings and limitations, this article proposes suggestions and future research directions. At the policy level, the government should tailor diversity policies to firm characteristics and promote both gender balance and board effectiveness. At the firm level, companies should avoid treating gender diversity as symbolism and ensure women are empowered with real authority, supported through training and feedback systems. In future research, there should be conducted comparative studies across multiple countries to identify differences within different institutional environments. Moreover, the machine learning and nonlinear models should be applied to explore the complex interactions between gender composition and firm performance. Expanding research on gender diversity not only supports equality but also enhances strategic resilience and corporate responsibility.

References

Adams, R.B., Ferreira, D., n.d. Women in the boardroom and their impact on governance and performance.

Ali, M., Kulik, C.T., Metz, I., 2011. The gender diversity–performance relationship in services and manufacturing organizations. Int. J. Hum. Resour. Manag. 22, 1464–1485. https://doi.org/10.1080/09585192.2011.561961

Arora, A., 2022. Gender diversity in boardroom and its impact on firm performance. J. Manag. Gov. 26, 735–755. https://doi.org/10.1007/s10997-021-09573-x

Arvanitis, S.E., Varouchas, E.G., Agiomirgianakis, G.M., 2022. Does Board Gender Diversity Really Improve Firm Performance? Evidence from Greek Listed Firms. J. Risk Financ. Manag. 15, 306. https://doi.org/10.3390/jrfm15070306

Bae, K.B., Skaggs, S., 2019. The impact of gender diversity on performance: The moderating role of industry, alliance network, and family-friendly policies – Evidence from Korea. J. Manag. Organ. 25, 896–913. https://doi.org/10.1017/jmo.2017.45

Banerjee, S., Wahl, M.F., 2022. Corporate governance in Estonia: equilibrium on board, in: Economic Growth in the Conditions of Globalization Conference Proceedings Vol I. Presented at the Economic growth in the conditions of globalization. International Scientific-Practical Conference, XVIth edition, National Institute for Economic Research, pp. 65–79. https://doi.org/10.36004/nier.cecg.I.2022.16.6

Ben Slama, R., Ajina, A., Lakhal, F., 2019. Board gender diversity and firm financial performance in France: Empirical evidence using quantile difference-in-differences and dose-response models. Cogent Econ. Finance 7, 1626526. https://doi.org/10.1080/23322039.2019.1626526

Bin Khidmat, W., Ayub Khan, M., Ullah, H., 2020. The Effect of Board Diversity on Firm Performance: Evidence from Chinese L isted Companies. Indian J. Corp. Gov. 13, 9–33. https://doi.org/10.1177/0974686220923793

Brahma, S., Nwafor, C., Boateng, A., 2021. Board gender diversity and firm performance: The UK evidence. Int. J. Finance Econ. 26, 5704–5719. https://doi.org/10.1002/ijfe.2089

Carter, D.A., Simkins, B.J., Simpson, W.G., 2003. Corporate Governance, Board Diversity, and Firm Value. Financ. Rev. 38, 33–53. https://doi.org/10.1111/1540-6288.00034

Chijoke-Mgbame, A.M., Boateng, A., Mgbame, C.O., 2020. Board gender diversity, audit committee and financial performance: evidence from Nigeria. Account. Forum 44, 262–286. https://doi.org/10.1080/01559982.2020.1766280

Child, J., 1975. MANAGERIAL AND ORGANIZATIONAL FACTORS ASSOCIATED WITH COMPANY PERFORMANCE-PART II. A CONTINGENCY ANALYSIS. J. Manag. Stud. 12, 12–27. https://doi.org/10.1111/j.1467-6486.1975.tb00884.x

Comi, S., Grasseni, M., Origo, F., Pagani, L., 2020. Where Women Make a Difference: Gender Quotas and Firms' Performance in Three European Countries. ILR Rev. 73, 768–793. https://doi.org/10.1177/0019793919846450

Conyon, M.J., He, L., 2017. Firm performance and boardroom gender diversity: A quantile regression approach. J. Bus. Res. 79, 198–211. https://doi.org/10.1016/j.jbusres.2017.02.006

Đặng, R., Houanti, L., Reddy, K., Simioni, M., 2020. Does board gender diversity influence firm profitability? A control function approach. Econ. Model. 90, 168–181. https://doi.org/10.1016/j.econmod.2020.05.009

Duppati, G., Rao, N.V., Matlani, N., Scrimgeour, F., Patnaik, D., 2020. Gender diversity and firm performance: evidence from India and Singapore. Appl. Econ. 52, 1553–1565. https://doi.org/10.1080/00036846.2019.1676872

Fama, E.F., Jensen, M.C., n.d. Separation of Ownership and Control.
Fama, E.F., Jensen, M.C., n.d. Agency Problems and Residual Claims.
Fernández-Temprano, M.A., Tejerina-Gaite, F., 2020. Types of director, board diversity and firm performance. Corp. Gov. Int. J. Bus. Soc. 20, 324–342. https://doi.org/10.1108/CG-03-2019-0096
Guldiken, O., Mallon, M.R., Fainshmidt, S., Judge, W.Q., Clark, C.E., 2019. Beyond tokenism: How strategic leaders influence more meaningful gender diversity on boards of directors. Strateg. Manag. J. 40, 2024–2046. https://doi.org/10.1002/smj.3049
Hazaea, S.A., Al-Matari, E.M., Farhan, N.H.S., Zhu, J., 2023. The impact of board gender diversity on financial performance: a systematic review and agenda for future research. Corp. Gov. Int. J. Bus. Soc. 23, 1716–1747. https://doi.org/10.1108/CG-07-2022-0302
Hindasah, L., Harsono, M., 2021. Gender Diversity on the Board of Director and Firm Performance: Agency Theory Perspective. J. Manaj. Bisnis 12. https://doi.org/10.18196/mb.v12i2.10804
Jiang, L., Cherian, J., Sial, M.S., Wan, P., Filipe, J.A., Mata, M.N., Chen, X., 2021. The moderating role of CSR in board gender diversity and firm financial performance: empirical evidence from an emerging economy. Econ. Res.-Ekon. Istraživanja 34, 2354–2373. https://doi.org/10.1080/1331677X.2020.1863829
Joecks, J., Pull, K., Vetter, K., 2013. Gender Diversity in the Boardroom and Firm Performance: What Exactly Constitutes a "Critical Mass?" J. Bus. Ethics 118, 61–72. https://doi.org/10.1007/s10551-012-1553-6
Kalia, A., 2025. Decade of mandate: does board gender diversity enhance Indian corporate performance? Gend. Manag. Int. J. https://doi.org/10.1108/GM-06-2024-0306
Lafuente, E., Vaillant, Y., 2019. Balance rather than critical mass or tokenism: Gender diversity, leadership and performance in financial firms. Int. J. Manpow. 40, 894–916. https://doi.org/10.1108/IJM-10-2017-0268
Li, H., Chen, P., 2018. Board gender diversity and firm performance: The moderating role of firm size. Bus. Ethics Eur. Rev. 27, 294–308. https://doi.org/10.1111/beer.12188
Marinova, J., Plantenga, J., Remery, C., 2016. Gender diversity and firm performance: evidence from Dutch and Danish boardrooms. Int. J. Hum. Resour. Manag. 27, 1777–1790. https://doi.org/10.1080/09585192.2015.1079229
Marquez-Cardenas, V., Gonzalez-Ruiz, J.D., Duque-Grisales, E., 2022. Board gender diversity and firm performance: evidence from Latin America. J. Sustain. Finance Invest. 12, 785–808. https://doi.org/10.1080/20430795.2021.2017256
Martinez-Jimenez, R., Hernández-Ortiz, M.J., Cabrera Fernández, A.I., 2020. Gender diversity influence on board effectiveness and business performance. Corp. Gov. Int. J. Bus. Soc. 20, 307–323. https://doi.org/10.1108/CG-07-2019-0206
Masso, J., Vahter, P., 2024. Innovation as a firm-level factor of the gender wage gap. Int. J. Manpow. 45, 449–465. https://doi.org/10.1108/IJM-02-2023-0083
Matsa, D.A., Miller, A.R., 2013. A Female Style in Corporate Leadership? Evidence from Quotas. Am. Econ. J. Appl. Econ. 5, 136–169. https://doi.org/10.1257/app.5.3.136
Mohsni, S., Otchere, I., Shahriar, S., 2021. Board gender diversity, firm performance and risk-taking in developing countries: The moderating effect of culture. J. Int. Financ. Mark. Inst. Money 73, 101360. https://doi.org/10.1016/j.intfin.2021.101360
Nielsen, S., Huse, M., 2010. The Contribution of Women on Boards of Directors: Going beyond the Surface. Corp. Gov. Int. Rev. 18, 136–148. https://doi.org/10.1111/j.1467-8683.2010.00784.x

Ozdemir, O., 2020. Board diversity and firm performance in the U.S. tourism sector: The effect of institutional ownership. Int. J. Hosp. Manag. 91, 102693. https://doi.org/10.1016/j.ijhm.2020.102693

Papangkorn, S., Chatjuthamard, P., Jiraporn, P., Chueykamhang, S., 2021. Female directors and firm performance: Evidence from the Great Recession. Int. Rev. Finance 21, 598–610. https://doi.org/10.1111/irfi.12275

Post, C., Byron, K., 2015. Women on Boards and Firm Financial Performance: A Meta-Analysis. Acad. Manage. J. 58, 1546–1571. https://doi.org/10.5465/amj.2013.0319

Postma, T., Hermes, N., n.d. Institutions, Corporate Governance and Corporate Governance Institutions: The Case of Estonia. Corp. Gov.

Rahman, H.U., Zahid, M., Al-Faryan, M.A.S., 2023. Boardroom gender diversity and firm performance: from the lens of voluntary regulations, "tokenism" and "critical mass." Total Qual. Manag. Bus. Excell. 34, 345–363. https://doi.org/10.1080/14783363.2022.2056439

Reddy, S., Jadhav, A.M., 2019. Gender diversity in boardrooms – A literature review. Cogent Econ. Finance 7, 1644703. https://doi.org/10.1080/23322039.2019.1644703

retrieve-2, n.d.

Rixom, J.M., Jackson, M., Rixom, B.A., 2023. Mandating Diversity on the Board of Directors: Do Investors Feel That Gender Quotas Result in Tokenism or Added Value for Firms? J. Bus. Ethics 182, 679–697. https://doi.org/10.1007/s10551-021-05030-9

Saleh, M.W.A., Zaid, M.A.A., Shurafa, R., Maigoshi, Z.S., Mansour, M., Zaid, A., 2021. Does board gender enhance Palestinian firm performance? The moderating role of corporate social responsibility. Corp. Gov. Int. J. Bus. Soc. 21, 685–701. https://doi.org/10.1108/CG-08-2020-0325

Sanad, Z., Al Lawati, H., 2023. Board gender diversity and firm performance: the moderating role of financial technology. Compet. Rev. Int. Bus. J. https://doi.org/10.1108/CR-05-2023-0103

Shimizu, K., 2007. Prospect Theory, Behavioral Theory, and the Threat-Rigidity Thesis: Combinative Effects on Organizational Decisions to Divest Formerly Acquired Units. Acad. Manage. J. 50, 1495–1514. https://doi.org/10.5465/amj.2007.28226158

Simionescu, L.N., Gherghina, Ș.C., Tawil, H., Sheikha, Z., 2021. Does board gender diversity affect firm performance? Empirical evidence from Standard & Poor's 500 Information Technology Sector. Financ. Innov. 7, 52. https://doi.org/10.1186/s40854-021-00265-x

Singh, G., Dwesar, R., 2022. BOARD GENDER DIVERSITY, FIRM PERFORMANCE AND FIRM RISK: A LITERATURE SURVEY. Copernic. J. Finance Account. 11, 69–84. https://doi.org/10.12775/CJFA.2022.014

Song, H.J., Yoon, Y.N., Kang, K.H., 2020. The relationship between board diversity and firm performance in the lodging industry: The moderating role of internationalization. Int. J. Hosp. Manag. 86, 102461. https://doi.org/10.1016/j.ijhm.2020.102461

Staw, B.M., Sandelands, L.E., Dutton, J.E., 1981. Threat Rigidity Effects in Organizational Behavior: A Multilevel Analysis. Adm. Sci. Q. 26, 501. https://doi.org/10.2307/2392337

Ullah, I., Fang, H., Jebran, K., 2019. Do gender diversity and CEO gender enhance firm's value? Evidence from an emerging economy. Corp. Gov. Int. J. Bus. Soc. 20, 44–66. https://doi.org/10.1108/CG-03-2019-0085

Wu, J., Richard, O.C., Triana, M.D.C., Zhang, X., 2022. The performance impact of gender diversity in the top management team and board of directors: A multiteam systems approach. Hum. Resour. Manage. 61, 157–180. https://doi.org/10.1002/hrm.22086

Kas juhatuse liikmete sooline mitmekesisus suurendab ettevõtte tulemuslikkust Eestis?

Käesolevas väitekirjas hinnatakse soolise mitmekesisuse mõju Eesti ettevõtete tegevusedukusele aastatel 1998-2020. Erinevalt paljudest teistest Euroopa riikidest ei ole Eestis kehtestatud kohustuslikke sookvoote ettevõtete juhatustele, mistõttu on see asjakohane kontekst soolise mitmekesisuse mõju uurimiseks vastavate regulatsioonide puudumisel.

Naised võivad laiendada juhatuse liikmete silmaringi, tugevdada kollektiivset probleemide lahendamist, täiustada otsuste tegemist, soodustada innovatsiooni ja parandada suhteid väliste sidusrühmadega, kuid naiste osakaalu suurenemine juhatuses võib tekitada organisatsioonilisi probleeme, näiteks kommunikatsioonilõhed ja suurenenud kulud, mis tulenevad erinevatest seisukohtadest ja meeskondade integreerimisest. Kasutades Eesti Äriregistri andmebaasi andmeid, konstrueeritakse käesolevas artiklis tasakaalustatud paneelandmestik, mis hõlmab 1014 ettevõtet aastatel 1998-2020. Analüüsis kasutatakse kahesuunalist fikseeritud efektide mudelit, kontrollides nii ettevõtte fikseeritud efekte kui ka aastate fikseeritud efekte. Lisaks sellele konstrueeritakse käesolevas uuringus instrumentmuutuja (IV) - keskmine naisjuhtide osakaal tööstusharu tasandil ja kasutatakse kaheastmelisi vähimruutude meetodit (2SLS), et arvestada endogeensuse probleemidega (s.t. võimalusega, et ettevõtte tegevusedukus mõjutab juhatuse soolist mitmekesisust). Lisaks kasutatakse käesolevas artiklis tõenäosusliku sobitamise (*propensity score matching*, PSM) meetodit, et teha kindlaks lühiajalised muutused ettevõtete tulemuslikkuses pärast naisjuhtide esmakordset lisandumist ettevõtte juhatusse. Lõpuks kasutatakse alamvalimi regressioone, et uurida tulemuste erinevusi ettevõtte tulemuslikkuse, suuruse ja geograafilise piirkonna järgi.

Põhiregressioonianalüüs näitab statistiliselt olulist negatiivset seost naisjuhtide osakaalu ja ettevõtte tööviljakuse (tootlikkuse) vahel. See seos jääb püsima ka instrumentmuutujate meetodi kasutamisel. Kui aga uuritakse ettevõtteid, kus naiste esindatus vastab või ületab 30 % tase (nö. kriitilise massi), näitavad tulemused võimalikku, kuigi statistiliselt ebaolulist, positiivset mõju. Tõenäosusliku sobitamise meetodil saadud tulemused on kvalitatiivselt kooskõlas põhimudeliga, kuigi statistiliselt mitteolulised. Heterogeensuse testid näitavad, et negatiivne mõju on eriti tugevalt väljendunud suuremates ettevõtetes, madalama tulemuslikkusega ettevõtetes ja väljaspool Tallinna asuvates ettevõtetes.

Kokkuvõttes leitakse käesolevas magistritöös, et Eesti ettevõtete juhatuse sooline mitmekesisus ei ole veel märkimisväärselt muutunud ettevõtte juhtimise eeliseks. See ei tähenda siiski, et naissoost juhatuse liikmetel puuduvad ettevõtte juhtimiseks vajalikud

võimed, vaid see viitab pigem struktuurilistele probleemidele, nagu sümboolsed ametissenimetamised, ebapiisav kriitiline mass ja ebapiisav toetus naiste sisuliseks osalemiseks ettevõtte juhtimises. Soolise mitmekesisuse eeliste saavutamine eeldab laiemat institutsionaalset, kultuurilist ja organisatsioonilist reformi.

Käesolev uurimus annab mitmeid panuseid akadeemilisel ja praktilisel tasandil. See keskendub Eestile, keskmise sissetulekute tasemega endisele üleminekumajandusele, kus puuduvad kohustuslikud sookvoodid. Teiseks, see täidab uurimislüngalünga Kesk- ja Ida-Euroopa ettevõtete juhtimise alases kirjanduses. Metodoloogilise uuenduslikkuse osas ühendab artikkel kahesuunalise fikseeritud efektide mudeli, instrumentmuutujate meetodi, sündmusuuringu (*event study*) meetodi ja tõenäosusliku sobitamise meetodi. Tulemused annavad teavet Eesti ja sarnaste riikide poliitilistele aruteludele sooliselt tasakaalustatud juhtimise edendamise kohta.

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