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# DOES BOARD GENDER DIVERSITY REDUCE INFORMATION ASYMMETRY? EVIDENCE FROM THE USA*

**Gerçek ÖZPARLAK****

**Abstract**

The contributions of women managers to the financial, economic and sustainability areas of firms are obvious. However, women managers can also play a key role in reducing asymmetric information. The purpose of this study is to investigate the effect of gender diversity in corporate management on information asymmetry. The study refers to agency theory and critical mass theory. Gender equality, board diversity and control variables are used in the analyses. In the study, an ordinary least squares (OLS) model is used to analyse the relationship of variables. In addition, fixed effect, quantile regression and lag estimation models are used to analyse endogeneity problems. The annual data of 401 American companies listed in the S&P500 index between 2008 and 2023 were used in the sample. The results of the study contribute to the current debate on the benefits of gender diversity in corporate management with different tests and theories. According to the results of the study, increasing the number of women on the board contributes to the reduction of information asymmetry. According to another result of the study, under the critical mass theory, having three or more women in the company management contributes more to the reduction of information asymmetry.

**Keywords:** *Information asymmetry, Board gender diversity, Gender equality, Corporate finance, Financial modelling.*

# YÖNETİM KURULUNDA CİNSİYET ÇEŞİTLİLİĞİ BİLGİ ASİMETRİĞİNİ AZALTIR MI? ABD'DEN KANITLAR

**Öz**

Kadın yöneticilerin firmaların finansal, ekonomik ve sürdürülebilirlik alanlarına katkıları açıktır. Bununla birlikte, kadın yöneticiler asimetrik bilginin azaltılmasında da kilit bir rol oynayabilir. Bu çalışmanın amacı, şirket yönetiminde kadın çeşitliliğinin bilgi asimetrisi üzerindeki etkisini araştırmaktır. Çalışma, vekalet teorisi ve kritik kütle teorisine atıfta bulunmaktadır. Çalışmanın analizlerinde cinsiyet eşitliği, yönetim kurulu çeşitliliği ve kontrol değişkenleri kullanılmıştır. Bu çalışmada, değişkenler arasındaki ilişkiyi analiz etmek için sıradan en küçük kareler (OLS) modeli kullanılmıştır. Ayrıca, içsellik sorunlarını analiz etmek için sabit etki, kantil regresyon ve gecikme tahmin modelleri kullanılmıştır. Çalışmada S&P500 endeksinde yer alan 401 Amerikan şirketinin 2008-2023 yılları arasındaki yıllık verileri kullanılmıştır. Çalışmanın sonuçları, şirket yönetiminde cinsiyet çeşitliliğinin faydaları konusundaki güncel tartışmalara farklı test ve teorilerle katkı sağlamaktadır. Çalışmanın sonuçlarına göre, şirketlerin yönetim kurullarında kadın sayısının artması asimetrik bilginin azalmasına katkı sağlamaktadır. Çalışmanın bir diğer sonucuna göre, kritik kütle teorisi altında, şirket yönetiminde üç veya daha fazla kadının olması asimetrik bilginin azaltılmasına daha fazla katkı sağlamaktadır.

**Anahtar kelimeler:** *Bilgi asimetrisi, Yönetim kurulunda cinsiyet çeşitliliği, Cinsiyet eşitliği, Kurumsal finans, Finansal modelleme.*

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## 1. INTRODUCTION

The board of directors are the decision-making bodies of companies. Future plans and investment decisions for companies are made by the board of directors. Therefore, optimising the effectiveness and efficiency of the board is very important for the future of companies. For this purpose, board diversity is presented as an option to improve the performance of the board. Board diversity provides different perspectives in solving critical decisions or problems of the company. Thanks to board diversity, the performance and impact of the board can increase (Abdou et al., 2020; Bufarwa et al., 2020). Therefore, board diversity is one of the major important issues that countries, organisations and researchers have recently focused on (Liao et al., 2015).

Board diversity can be explained as the heterogeneity of board members in terms of gender, age, tenure, race, power, expertise and education (Harjoto et al., 2015; Khatib, et al., 2021). However, gender equality has a special importance among the diversity variables of the board. Because gender equality in the board must be ensured as a requirement of human rights rather than economic reasons (Szydło et al., 2015). In this sense, countries and organisations are making more and more efforts to increase gender equality in management. With new laws, incentives and mandatory quotas, companies aim to have at least 40% female directors on their boards. Norway was the first nation to implement mandatory gender quotas in 2003 (Teigen, 2012, Latura et al., 2023).

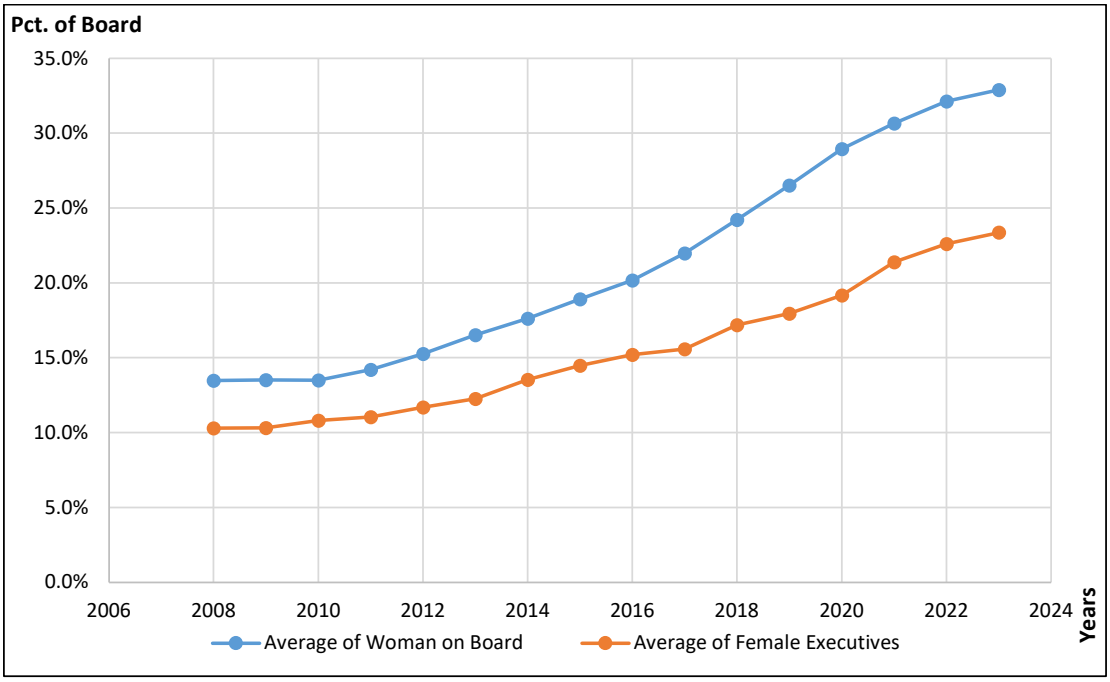


**Figure 1: The Average of Woman on Board Ratio and the Average Female Executives Ratio in S&P500 between 2008 and 2023**

Increasing the proportion of women on boards (WOB) is becoming increasingly important globally (Liao et al., 2015). Figure 1 shows the average ratio of women on boards of 401 pieces S&P500 companies in the sample of the study between 2008 and 2023. As can be seen in the graph, the average of woman on board ratio is 13.5% in 2008 and 32.9% in 2023. In addition, while the average female executive ratio was 10.3% in 2008, it is 23.4% in 2023. It is clear that both ratios are on an upward trend. However, even in the USA, one of the most developed countries in the world, the WOB ratio is still 32.9%. Globally, board gender diversity is still very low, including developed countries (Teigen, 2012).

Women in management provide great benefits to companies. Increasing the proportion of women on the board contributes to the increase in the economic and financial performance of companies (Arena et al., 2015; Brahma et al., 2021). For example, women support the increase in the market value of companies (Francoeur et al., 2008; Ullah et al., 2019). In addition, women in management play a role in reducing company risks (Adams et al., 2004; Jane Lenard et al., 2014). Moreover, women are more sensitive to sustainability efforts and

the environment than men. In this way, they play an important role in increasing the sustainability scores of companies (Ozparlak et al. 2023; Gurol et al., 2023).

Asymmetric information (AI) arises when one party, such as shareholders, managers, investors, etc., is under-informed compared to the others. Especially during periods of economic or political uncertainty, AI has a significant impact on listed companies (Cepoi et al., 2020). The asymmetric information is an important problem that affects the sustainability of the company's economic activities. Therefore, companies spend a lot of effort to reduce asymmetric information. As a solution to the problem, woman managers contribute to the reduction of asymmetric information (Loukil et al., 2020). Because women increase the quantity and quality of firms' disclosure (Brown et al., 2007; Heflin et al., 2005). In this way, the reduction of information risk among market participants helps to reduce asymmetric information (Abad et al., 2017; Seebeck et al., 2022).

The ratio of QBAS is widely used to measure asymmetric information (Leuz et al., 2000; Goh et al., 2016; Abad et al., 2017; Almulhim, 2023). QBAS is measured as the difference between the bid and ask price divided by the sum of the bid and ask price divided by two (MAB).

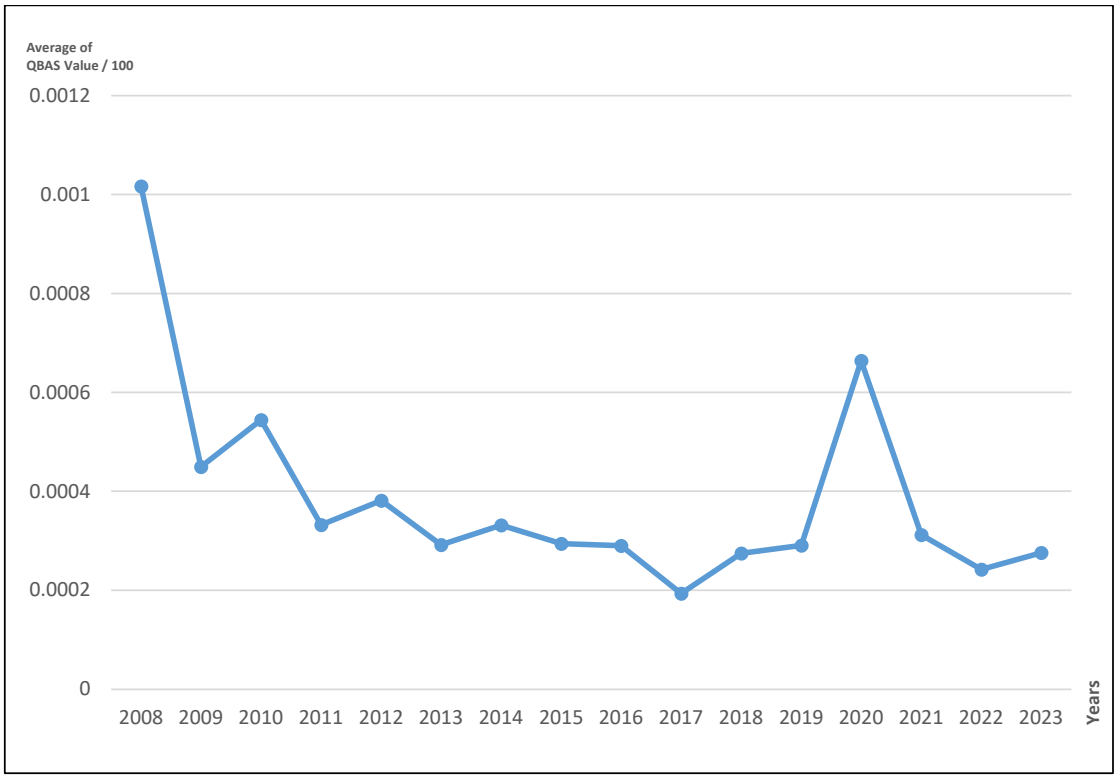


**Figure 2: The The average of level of information asymmetric (QBAS value/100) in S&P500 between 2008 and 2023**

Looking at the sample of this study in Figure 2, it is seen that asymmetric information (AI is shown here using the QBAS ratio) is on a downward trend. However, AI made a sharp peak in 2020. We can explain this with the uncertainties brought by the Covid-19 environment (Cepoi et al., 2020). However, literature studies have mostly focused on economic, financial and sustainability relationships. However, there is little direct evidence on the relationships between gender-diverse boards and information asymmetry among market participants (Liao et al., 2015, Abad et al., 2017). The purpose of this study is to show the contribution of women in management to the reduction of asymmetric information. In this way, it is aimed to support the 40% women in management. The number of companies with regular sustainability data on a global scale is limited (Ozparlak et al., 2023).

Therefore, American companies were selected for the sample of the study due to the regularity and accessibility of the data. In the sample of the study, the companies in the S&P500 and not in the financial sector

were excluded. The study covers the period between 2008 and 2023. The study has limitations. The study covers large-scale firms in the American stock exchanges. In the study, two models were used to represent board gender diversity. In the first model, percentage of women on board (WOB) is used to represent board gender diversity. In the second model, the number of female executives in the management is used to represent gender diversity. These two models were first analysed with Pool Regression test. Fixed Effect, Quantile Regression Q (0.50) and lag estimation models to test the robustness of the study. In addition, two diversity analyses were used in the additional analysis sections of the study. Blau index and Shannon index are frequently used in board diversity studies. In this way, definite results have been obtained that the results obtained from the study are not coincidental. This study makes respective important contributions to the literature. Firstly, it extends the previous literature by making empirical contributions to the benefits of women in management for companies and society. Secondly, gender equality in the board is becoming increasingly important for countries and organisations. With mandatory gender quotas and laws, there is increasing pressure on company managements to ensure gender equality. Consequently, the empirical results obtained from this study support the legal changes and incentives required to ensure gender equality. In addition, this research emphasises the effects of gender equality on corporate governance and company performance. In this way, it creates a debate for improving corporate performance. This study contributes to the analyses of researchers, investors, company owners, company managers, regulators and auditors because of the contribution of increased gender equality to the reduction of asymmetric information.

The study consists of five chapters. The first section is the introduction. In this section, an introduction is made to explain the relationship between board gender diversity and asymmetric information. In the second section, literature studies are included. In addition, the hypotheses of the study are developed in this section. The third section describes the data set and methodology. The fourth section presents the findings. The last section presents the discussion, conclusion, recommendations for policy makers and suggestions for future research.

## 2. LITERATURE FRAME

By sharing different experiences, ideas and opinions in company managements, they can create better corporate governance (Wang, 2020). However, agency problems may arise in corporate governance due to the differences in the power and authority of owners and managers (Jensen et al., 1976). Agency theory also talks about conflicts of interest that may arise since owners and managers are separate individuals (Jensen et al., 1976). Information deficiencies between owners and managers may lead to the formation of asymmetric information. The formation of asymmetric information may fuel conflicts of interest. Because asymmetric information has a great impact on the investment decisions of market participants (Myers et al., 1984). Agency theory suggests that managers will increase disclosure to reduce information asymmetry (Liao et al., 2015). Gender equality in the board of directors and the inclusion of non-executive directors can reduce conflicts of interest between owners and managers (Fama et al., 1983; Adams et al., 2009). Moreover, women contribute to board independence (Fama et al. 1983) and lay the foundations for more effective communication between the board and stakeholders (Eagly et al., 2003; Amin et al., 2022). Diversity on the board can improve the quality of management control and supervision (Bear et al., 2010). In addition, boards with female directors tend to have higher levels of accountability (Buertey et al., 2021). This may contribute to the reduction of conflicts of interest. Female directors are more active and courageous in company management compared to men (Abad et al., 2017). In this way, they make significant contributions to the independence and efficiency of companies (Teserjen et al., 2016). In this way, more independent boards of directors work to promote corporate transparency and improve the quality of financial reporting (Amstron et al., 2010; Dobija et al., 2022). In this way, the presence of women in management contributes positively to the firm's transparency and disclosure quality (Abad et al., 2017). This, in turn, leads to a decrease in asymmetric information and a decrease in asymmetric information between firm owners and investors. In this way, due to the reduction of information risk between the parties, it is expected that there will be a negative correlation between the proportion of women in management and asymmetric information (Abad et al., 2017). In the light of these studies in the literature, the following hypothesis is formulated.

*$H_1$: Board gender diversity is negatively associated with asymmetric information.*

Gender equality in company management improves corporate governance and enhances decision-making processes for companies (Adams et al., 2016). However, according to Critical Mass Theory, if the number of women in the management of companies is two or more, women can have an impact on company decisions. If the number of women is less than two, women may be ineffective in management (Kanter, 1977a). However, recent studies have shown that women can be effective in management if there are three or more women (Torchia et al., 2011; Joecks et al., 2013; Liu et al., 2014). In addition, Schwartz-Ziv (2017) analysed in his study that having at least three directors of the same gender on the board of directors of a company can be at least 79% more effective in company decisions. The presence of women on the board can lead to stronger business strategies and governance systems (Martinez-Jimenez, et al., 2020), which can reduce information risk. In this case, the proportion of female directors above a critical level can have a positive impact on corporate decisions (Bear et al., 2010; Cook et al., 2018), and women may thus cease to be symbols in management (Owen at al., 2018). Accordingly, increasing the number of female managers (one woman, two women and at least three women) may have an impact on reducing asymmetric information. In the light of the studies in the literature, the following hypothesis was developed.

*$H_2$: The number of female directors has a negative impact on asymmetric information.*

## 3. DATA AND METHODOLOGY

### 3.1. Data

Companies listed in the S&P500 index were selected for the sample of the study. However, companies in the financial sector and companies without valid data were excluded from the sample. Between 2008 and 2023, 401 companies were included in the study. As a result, 5225 firms were included in the study. All data were obtained from Bloomberg data terminal.

**Table 1: Number of companies in the sample**

| Sectors | | Number of Company | Percentage |
|---|---|---|---|
| 1. | Consumer, non-cyclical | 104 | 25.94% |
| 2. | Industrial | 58 | 14.46% |
| 3. | Consumer, cyclical | 57 | 14.21% |
| 4. | Technology | 52 | 12.97% |
| 5. | Communications | 33 | 8.23% |
| 6. | Financial | 30 | 7.48% |
| 7. | Utilities | 28 | 6.98% |
| 8. | Energy | 23 | 5.74% |
| 9. | Basic Materials | 16 | 3.99% |
| **Grant Total** | | 401 | |

Table 1 shows the industry sectors in which the companies in the sample of the study are located. Accordingly, there are 9 sectors in the study. The most common sectors are consumer, non-cyclical (104 firms), industrial (58 firms) and consumer, cyclical (57 firms). The least sectors are utilities (28 firms), energy (23 firms), basic materials (16 firms).

**Table 2: Definition of the variables**

| Symbol | Variable Name | Measure | Literature Supports |
|---|---|---|---|
| MAB | The midpoint of quote | The sum of ask and bid prices divided by "2". | Leuz et al., 2000; Goh et al., 2016; Abad et al., 2017; Almulhim, 2023 |
| QBAS | Asymmetric information (AI) | The difference between the ask price and the bid price is divided by MAB. Max-min normalisation of the QBAS variable was performed. | |
| WOB | % Women on Board | Percentage of the board members who are woman. | Aribi et al., 2018; Loukil et al., 2020 |
| F1 | Number of Female Executives | Dummy variable that takes the value of "1" if there is *one female director and "0" otherwise* | Loukil et al., 2020; Sarang et al., 2022; Seebeck et al., 2022; Sarang et al.,2022 |
| F2 | Number of Female Executives | Dummy variable that takes the value of "1" if there are *two female directors and "0" otherwise* | |
| F3 | Number of Female Executives | Dummy variable that takes the value of "1" if there are *three or more female directors and "0" otherwise* | |
| *ln*BAVR | Board Average Age | Natural log of the average age of the board members. | Sarang et al., 2022 |
| PINDR | % Pct Independent Directors | Independent directors as a percentage of the total board membership. | Hamrouni et al., 2022 |
| NBMT | Number of Board Meetings for the Year | Total number of corporate board meeting held in the past year. | Kanagaretnam et al., 2007 |
| BS | Board Size | Number of individuals who serve on the board that oversees the company activities and management. | Loukil et al., 2020; Hamrouni et al., 2022; Sarang et al., 2022 |
| AUC | Size of Audit Committee | Number of board members serving on the company's audit, or equivalent committee. | El Mahdy et al., 2022 |
| CEO | CEO duality | Dummy variable that takes the value of 1 if CEO is also a chairman *and "0" otherwise* | Loukil et al., 2020; Almulhim et al., 2023 |
| ROA | Return on Assets | ROA = Net Income / Average Assets | Hamrouni et al., 2020; Sarang et al., 2022 |
| TQ | Tobin's Q Ratio | Market value of equity divided the book value of equity | Poursoleiman et al. (2020) |
| BLAUW | Blau Diversity Index | The Blue index ranges from "0" to "0.50", where "0" indicates no diversity and "0.50" indicates maximum diversity (Blau, 1977). | Abad et al., 2017; Seebeck et al., 2022; Arora et al., 2024 |
| SHNN | Shannon Diversity Index | The Shannon index ranges from "0" to "1", where "0" indicates no diversity and "1" indicates maximum diversity (Shannon, 1948). | Abad et al., 2017; Shaer et al., 2016; Gordini et al., 2017 |

Table 2 shows the variables used in the models of the study together with their literature support. In this study, bid ask spread is used to define asymmetric information in the light of the studies in the literature (Leuz et al., 2000, Goh et al., 2016; Almulhim, 2023).

$$\mathrm{MAB} = \frac{(\mathrm{A} + \mathrm{B})}{2} \quad (1)$$

Where A is the asking price, B is the bid price, MAB is the midpoint of the sum of ask and bid.

$$\mathrm{QBAS} = \frac{(\mathrm{A}-\mathrm{B})}{\mathrm{MAB}} \quad (2)$$

Where QBAS represents asymmetric information. In addition, A is the asking price, B is the bid price. The variables WOB, F1, F2 and F3 are used to represent board gender diversity in the model. The WOB ratio expresses the percentage of women on the board of directors of the company. F1, F2 and F3 variables are dummy variables. Dummy variable that takes the value of 1 if there is one female director and zero otherwise. In addition, Dummy variable that takes the value of 1 if there are two female directors and zero otherwise. Finally, Dummy variable that takes the value of 1 if there are three or more female directors and zero otherwise. BAVR, PINDR, NBMT, BS, AUC, CEO represent the board structure of the firm. CEO duality is a dummy variable. It takes the value of 1 if CEO is also a chairman and zero otherwise ROA and TQ are control variables. These variables represent the profitability of the firm.

Blau and Shannon diversity indices were used in additional analyses of the study. The Blua Index (BLAUF) assesses the diversity between groups (Blau, 1977). This index takes values between "0" and "0.50". When the index approaches "0", it indicates a decrease in the diversity of the group. On the other hand, when the index approaches "0.50", it indicates an increase in diversity among the groups. This index is frequently used in the literature to assess gender diversity in the board of directors (Campbell et al., 2008; Valls Martínez et al., 2019).

$$Blau\ Diversity\ Index = 1 - \sum_{i=1}^{n} P_i^2 \quad (3)$$

Where Pi is the percentage of male and female executive members in the management of a company and n is the total number of gender groups (male and female). The Shannon Diversity Index (SHNN) is another method used to quantitatively express the diversity of groups (Shannon, 1948). This index is frequently used in board diversity studies (Díaz-García et al., 2013; Al-Shaer et al., 2016).

$$Shannon\ Diversity\ Index\ (H) = -\sum_{n=1}^{n}(pi * \ ln\ p_i) \quad (4)$$

Where $P_i$ is the percentage of male and female executive members in the management of a company and n is the total number of gender groups (male and female).

$$E_H = \frac{H}{ln(n)} \quad (5)$$

The Shannon equality index is simply the Shannon diversity index divided by the maximum diversity. This normalises the Shannon diversity index between the values "0" and "1". An index approaching the value "0" indicates a decrease in the diversity of the group. On the other hand, when the index approaches the value "1.0", it indicates an increase in the diversity between groups.

### 3.2. Methodology

Equation (6) was used to explain the validity of the models analysed in the study.

$$AI_{i,t} = \alpha + \beta_0(gender\ diversity\ effect)_{i,t} + \beta_1(board\ characteristics)_{i,t} + \beta_2(firm\ characteristics)_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where $AI_{it}$ is a proxy for the level of asymmetric information of firm *i* in year *t.* The gender diversity effect captures the gender diversity on the board. It uses the percentage of women on the board (WOB) and the percentage of the number of female directors. Board characteristics represent other board variables other than WOB ratio such as BAVR, PINDR, NBMT, BS, AUC, CEO. Firm characteristics are control variables such as ROA and TQ, which represent the company's financial performance and profitability ratios.

Moreover, Fixed Effect, Quantile Regression (Q-0.50) and lag estimation models are used to test for endogeneity issues. In fixed effect and quantile regression tests, the dependent variable is the QBAS ratio. However, in the Pool OLS test, we take lag (1) QBAS ($QBAS_{t-1}$) as the dependent variable.

## 4. FINDINGS

**Table 3: Descriptive statistics**

| | Mean | Max | Min | Std. Dev. | Skew. | Kurt. | Obs. |
|---|---|---|---|---|---|---|---|
| **QBAS** | 0.099 | 0.411 | 0.001 | 0.016 | 2.755 | 3.327 | 5270 |
| **WOB** | 0.233 | 0.667 | 0.063 | 0.100 | 0.552 | 3.063 | 5270 |
| **F1** | 0.349 | 1.000 | 0.000 | 0.477 | 0.635 | 1.403 | 5270 |
| **F2** | 0.224 | 1.000 | 0.000 | 0.417 | 1.321 | 2.744 | 5270 |
| **F3** | 0.192 | 1.000 | 0.000 | 0.394 | 1.565 | 3.450 | 5270 |
| ***ln*BAVR** | 4.134 | 8.830 | 3.222 | 0.088 | 2.563 | 1.560 | 5270 |
| **PINDR** | 0.843 | 1.000 | 0.286 | 0.092 | -1.703 | 3.558 | 5270 |
| **NBMT** | 7.950 | 43.00 | 2.00 | 3.419 | 2.485 | 1.992 | 5270 |
| **BS** | 10.61 | 18.00 | 3.00 | 2.037 | 0.104 | 3.118 | 5270 |
| **AUC** | 4.303 | 10.000 | 0.000 | 1.077 | 0.768 | 3.752 | 5270 |
| **CEO** | 0.473 | 1.000 | 0.000 | 0.499 | 0.109 | 1.012 | 5270 |
| **ROA** | 7.437 | 59.248 | -61.821 | 7.921 | -0.204 | 2.676 | 5270 |
| **TQ** | 2.640 | 23.563 | 0.627 | 2.086 | 3.396 | 2.112 | 5270 |
| **BLAUW** | 0.663 | 0.880 | 0.500 | 0.099 | 0.308 | 2.054 | 5270 |
| **SHNN** | 0.741 | 1.000 | 0.340 | 0.168 | -0.431 | 2.135 | 5270 |

Table 3 displays the statistics of the variables in the sample of our research. According to this, the QBAS variable takes values between "0.001" and "0.411". Its mean value is "0.099". While the maximum value of the WOB variable is "0.667", the minimum value is "0.063". The mean value is "0.233". F1, F2 and F3 values are dummy variables. Among these three variables, F1 is the value with the highest mean. NBMT has the highest mean value in the sample. ROA has the highest standard deviation (7.921).

**Table 4: Correlation matrix**

| | QBAS | WOB | F1 | F2 | F3 | *ln*BAVR | PINDR | NBMT | BS | AUC | CEO | ROA | TQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **QBAS** | 1 | | | | | | | | | | | | |
| **WOB** | -0.148*** | 1 | | | | | | | | | | | |
| **F1** | -0.004 | -0.015 | 1 | | | | | | | | | | |
| **F2** | -0.042*** | 0.099*** | -0.377*** | 1 | | | | | | | | | |
| **F3** | -0.081*** | 0.261*** | -0.339*** | -0.245*** | 1 | | | | | | | | |
| ***ln*BAVR** | -0.077*** | 0.030** | -0.004 | 0.001 | 0.018 | 1 | | | | | | | |
| **PINDR** | -0.147*** | 0.278*** | 0.018 | 0.073*** | 0.128*** | 0.128*** | 1 | | | | | | |
| **NBMT** | 0.037*** | 0.093*** | 0.010 | 0.009 | 0.065*** | 0.007 | 0.148*** | 1 | | | | | |
| **BS** | -0.028** | 0.012 | -0.009 | 0.010 | 0.064*** | 0.040*** | 0.036*** | 0.007 | 1 | | | | |
| **AUC** | -0.137*** | 0.142*** | -0.031** | 0.067*** | 0.127*** | 0.140*** | 0.329*** | 0.057*** | 0.021 | 1 | | | |
| **CEO** | -0.096*** | 0.011 | -0.010 | -0.027** | 0.072*** | 0.056*** | 0.205*** | -0.011 | 0.051*** | 0.142*** | 1 | | |
| **ROA** | -0.171*** | 0.082*** | -0.024* | 0.057*** | 0.015 | 0.029** | 0.016 | -0.176*** | 0.011 | 0.024* | -0.009 | 1 | |
| **TQ** | 0.002 | 0.076*** | -0.028** | 0.035*** | -0.017 | -0.081*** | -0.078*** | -0.177*** | 0.006 | -0.132*** | -0.077*** | 0.391*** | 1 |

Note: ***, ** and * indicate the significance of the variables in the model at 1%, 5% and 10% levels, respectively.

Table 4 shows the correlation matrix. Accordingly, the highest correlation value is between TQ and ROA (0.391). Accordingly, there is no multi correlation problem among the variables. There is a negative and significant correlation between QBAS and WOB. These results are consistent with some literature studies (Hamrouni et al.,

2022; Sarang et al., 2022). There is a negative and insignificant relationship between QBAS and F1. However, the relationship between QBAS and F2, F3 is negative and significant. These results are in line with studies showing that for women's decisions on the board to be effective, there should be at least two members. (Loukil et al., 2020; Atif et al., 2021; Sarang et al. 2022). However, the relationship between QBAS and *ln*BAVR, PINDR, BS, AUC, CEO and ROA is negative and significant. Moreover, the relationship between QBAS and NBMT is positive and significant. Finally, the relationship between QBAS and TQ is positive and insignificant.

**Table 5: Pool OLS regression result**

| ***Dependent Variable*** | **QBAS** | **QBAS** |
|---|---|---|
| | Model 1 | Model 2 |
| WOB | -0.0178*** | |
| | (-8.160) | |
| F1 | | -0.0027*** |
| | | (-4.332) |
| F2 | | -0.0033*** |
| | | (-4.768) |
| F3 | | -0.0046*** |
| | | (-6.222) |
| *ln*BAVR | -0.0083*** | -0.0086*** |
| | (-3.052) | (-3.168) |
| PINDR | -0.0137*** | -0.0163*** |
| | (-5.078) | (-6.110) |
| NBMT | 0.0002*** | 0.0002*** |
| | (3.161) | (2.958) |
| BS | -0.0002 | -0.0001 |
| | (-1.326) | (-0.905) |
| AUC | -0.0013*** | -0.0012*** |
| | (-5.310) | (-5.107) |
| CEO | -0.0023*** | -0.0022*** |
| | (-4.785) | (-4.434) |
| ROA | -0.0004*** | -0.0004*** |
| | (-12.530) | (-12.599) |
| TQ | 0.0006*** | 0.0005*** |
| | (4.456) | (3.774) |
| Constant | 0.1570*** | 0.1588*** |
| | (14.006) | (14.131) |
| Adjusted R-squared | 0.077 | 0.073 |
| F-statistic | 53.582*** | 41.618*** |

Note: ***, ** and * indicate the significance of the variables in the model at 1%, 5% and 10% levels, respectively. The t-statistics are shown in parentheses.

Table 5 shows the regression results of the two separate models we used to test the two hypotheses of the study. The Adjusted R-Squared result of the first model is 0.077. The adjusted R-square result of the second model is 0.073. Both models are statistically significant.

The focussed variable in Model 1 is the WOB ratio. According to these results, the WOB ratio is negative and highly significant at 1% level. These results are consistent with some results in the literature (Diamond et al., 1991; Easly et al., 1996; Sarang et al. 2022). These results support our hypothesis $H_1$.

In Model 2, the focussed variables are F1, F2 and F3. According to these results, all three variables are negative and highly significant at 1% level. Among these three variables, the variable with the highest weight is F3. On the other hand, the variable with the lowest weight is F1. These results are consistent with some results in the literature (Seebeck et al., 2022; Sarang et al., 2022). These results support our hypothesis $H_2$. In addition, having three or more female executives contributes more to the reduction of asymmetric information (Schwartz-Ziv, 2017).

Furthermore, NBMT, TQ and constant variables are positive and significant at 1% level. On the other hand, *ln*BAVR, PINDR, AUC, CEO and ROA variables are negative and significant at 1% level. Moreover, BS is negative and insignificant.

**Table 6: The results of the robustness tests (Model 1)**

| ***Dependent Variable*** | **QBAS** | **QBAS** | **$(QBAS)_{t-1}$** |
|---|---|---|---|
| | **Fixed Effects** | **Quantile Regression Q (0.50)** | **Pool OLS** |
| WOB | -0.0103*** | -0.0078*** | -0.0204*** |
| | (-3.798) | (-7.838) | (-7.973) |
| *ln*BAVR | -0.0048 | -0.0097*** | -0.0133*** |
| | (-1.551) | (-2.841) | (-4.254) |
| PINDR | -0.0193*** | -0.0076*** | -0.0210*** |
| | (-4.667) | (-4.464) | (-6.520) |
| NBMT | 0.0003*** | 0.0001*** | 0.0001* |
| | (4.119) | (2.768) | (1.684) |
| BS | -0.0002 | -0.0002** | -0.0001 |
| | (-0.985) | (-2.537) | (-0.757) |
| AUC | -0.0006* | -0.0005*** | -0.0011*** |
| | (-1.682) | (-4.491) | (-4.060) |
| CEO | 0.0001 | -0.0016*** | -0.0024*** |
| | (0.131) | (-6.510) | (-4.275) |
| ROA | -0.0005*** | -0.0001*** | -0.0003*** |
| | (-12.229) | (-6.777) | (-9.303) |
| TQ | -0.0003 | 0.0001 | 0.0005*** |
| | (-1.622) | (0.708) | (3.611) |
| Constant | 0.1436*** | 0.1487*** | 0.1846*** |
| | (11.095) | (10.574) | (14.190) |
| Adjusted R-squared | 0.178 | 0.031 | 0.067 |
| F-statistic | 4.222*** | | 43.587*** |

Note: ***, ** and * indicate the significance of the variables in the model at 1%, 5% and 10% levels, respectively.The t-statistics are shown in parentheses.

Three different tests are employed to strengthen the regression results for Model 1 in Table 1. Table 6 displays the result of the robustness tests, which are Fixed Effect, Quantile Regression (Q - 0.50) and lag estimation model test. The WOB variable is negative and highly significant at the 1% level in all columns. Therefore, these results support hypothesis $H_1$.

**Table 7: The results of the robustness tests (Model 2)**

| ***Dependent Variable*** | **QBAS** | **QBAS** | **$(QBAS)_{t-1}$** |
|---|---|---|---|
| | **Fixed Effects** | **Quantile Regression Q (0.50)** | **Pool OLS** |
| F1 | -0.0024 *** | -0.0016 *** | -0.0035 *** |
| | (-3.294) | (-4.604) | (-4.752) |
| F2 | -0.0026 *** | -0.0020 *** | -0.0044 *** |
| | (-2.901) | (-5.439) | (-5.330) |
| F3 | -0.0021 ** | -0.0028 *** | -0.0058 *** |
| | (-2.088) | (-7.685) | (-6.628) |
| *ln*BAVR | -0.0050 | -0.0107 *** | -0.0135 *** |
| | (-1.605) | (-3.241) | (-4.302) |
| PINDR | -0.0224 *** | -0.0083 *** | -0.0234 *** |
| | (-5.597) | (-5.237) | (-7.357) |
| NBMT | 0.0003 *** | 0.0001 *** | 0.0001 |
| | (4.079) | (2.723) | (1.495) |
| BS | -0.0002 | -0.0001 ** | 0.0000 |
| | (-0.996) | (-2.538) | (-0.345) |
| AUC | -0.0006 * | -0.0004 *** | -0.0010 *** |
| | (-1.863) | (-4.083) | (-3.782) |
| CEO | 0.0003 | -0.0015 *** | -0.0023 *** |
| | (0.436) | (-6.536) | (-3.985) |
| ROA | -0.0005 *** | -0.0001 *** | -0.0004 *** |
| | (-12.349) | (-6.977) | (-9.334) |
| TQ | -0.0004 ** | 0.0000 | 0.0004 *** |
| | (-2.250) | (0.399) | (2.982) |
| Constant | 0.1470 *** | 0.1527 *** | 0.1855 *** |
| | (11.374) | (11.317) | (14.231) |
| Adjusted R-squared | 0.177 | 0.031 | 0.067 |
| F-statistic | 4.190 *** | | 34.425 *** |

Note: ***, ** and * indicate the significance of the variables in the model at 1%, 5% and 10% levels, respectively.
The t-statistics are shown in parentheses.

Table 7 shows the results of the Fixed Effect, Quantile Regression - Q (0.50) and lag estimation models. These results prove that the test results obtained from Table 1 and Model 2 are not coincidental. In all results of table, the WOB is negative and highly significant at the 1% level. The results confirm hypothesis $H_2$.

### 4.1. Additional Analyses

**Table 8: The results of the Blau and Shannon diversify indexes.**

| ***Dependent Variable*** | **QBAS** | **QBAS** |
|---|---|---|
| BLAUW | -0.0181 *** | |
| | (9.422) | |
| SHNN | | -0.006 *** |
| | | (-4.286) |
| *ln*BAVR | -0.0079 *** | -0.005 * |
| | (-2.916) | (-1.912) |
| PINDR | -0.0125 *** | -0.016 *** |
| | (-4.633) | (-6.101) |
| NBMT | 0.0002 *** | 0.000 *** |
| | (3.199) | (4.759) |
| BS | -0.0002 | 0.000 ** |
| | (-1.391) | (-2.289) |
| AUC | -0.0012 *** | -0.001 *** |
| | (-5.016) | (-5.425) |
| CEO | -0.0023 *** | -0.001 *** |
| | (-4.831) | (-3.156) |
| ROA | -0.0004 *** | 0.000 *** |
| | (-12.368) | (-7.830) |
| TQ | 0.0006 *** | 0.000 *** |
| | (4.537) | (3.540) |
| Constant | 0.1378 *** | 0.143 *** |
| | (12.091) | (13.673) |
| Adjusted R-squared | 0.080 | 0.048 |
| F-statistic | 56.227 *** | 30.778 *** |

Note: ***, ** and * indicate the significance of the variables in the model at 1%, 5% and 10% levels, respectively.
The t-statistics are shown in parentheses.

Table 8 shows the results of the two diversity indices used to represent the diversity of women on the board. According to these results, BLAUW and SHNN diversity indices are negative and highly significant at 1% level on QBAS. These tests are significant to show the effects of gender diversity on the board.

## 5. CONCLUSION AND RECOMMENDATIONS FOR POLICY DIRECTION

Many literature studies have focussed on the economic, financial and sustainability contributions of women. However, this study focuses on the gender diversity to mitigate the risk of asymmetric information. Asymmetric information is an important problem affecting the sustainability of firms' economic activities. Therefore, companies are committed to reducing asymmetric information. Hence, reducing asymmetric information is crucial for increasing confidence in firms and markets.

To this end, this study analyses the relationship between asymmetric information and gender diversity in corporate boards. For this purpose, a sample of 401 firms listed in the S&P500 index between 2008 and 2023 is used. This study is limited to large-scale firms listed on the stock exchange, as there is no sustainability data available for SMEs. In addition, conducting a study for small and medium-sized enterprises (SMEs) that are not listed on the stock exchange will increase the scientific and social benefit in the future. However, the biggest challenge in this process will be access to the data of SMEs.

The empirical results of the study reveal that, in line with agency theory and critical mass theories, an increase in the number of women on the board (WOB) reduces asymmetric information. In addition, the study also confirms that asymmetric information decreases as the number of female executives (F1, F2, F3) in a company

increases. Increasing the number of female managers may reduce information asymmetry in organisations due to their willingness to provide transparent and reliable information (Doan et al, 2018). As an additional analysis, the diversity indexes (Blau and Shannon Gender Diversity Index) were used to strengthen the results of the study. Additional analyses confirm the impact of board gender diversity on the reduction of asymmetric information.

According to the results of the study, the control variables lnBAVR, CEO, PINDR have a negative and significant role in reducing asymmetric information. Considering that an increase in the BAVR ratio may be parallel to an increase in the work experience of board members, it can be argued that these members will be more successful in managing asymmetric information (Fernandes et al., 2019). Likewise, through CEO duality, a more powerful CEO may be able to manage asymmetric information more effectively (Alduais et al., 2022). Independence of board members will contribute to the increase in transparency of the company and reduce asymmetric information. (Wu et al., 2019, Alhulhim, 2023). In addition, the relationship between the NBMT and information asymmetry is complex (Alsartawi et al., 2019; Elbadry et al., 2015). The result of study indicates that there is a positive relationship between NBMT and AI. Frequent board meetings can divert attention away from management monitoring (Alheres et al., 2018), which can lead to increased AI.

When women can overcome artificial barriers and are appointed to important positions such as board membership, they increase corporate transparency and corporate information quality. As a result, they contribute to the reduction of asymmetric information. In this respect, it is important to ensure equal opportunities for women in business life. However, these equalities should not be limited to the number of women on the board. Women should also be empowered to be effective on the board.

In line with the results obtained from the study, the following recommendations were made to policy makers.

- Women's equality in company management should be ensured. If necessary, necessary legal arrangements should be made for this purpose and their effectiveness should be regularly audited.

- Women's representation in company management should not be a symbol. They should be given the necessary authorisations and responsibilities to be more effective in management. Because this is a requirement of the most basic human rights as well as economic and financial benefits.

- The target of having at least 40% women executives in company managements should be made mandatory and this target should be protected by legal regulations.

- Board Gender Diversity should be extended not only to public companies listed on stock exchanges, but also to SMEs.

- Organise trainings for board members on the benefits of gender equality for the company.

- Suitable environments should be provided for women members to share their views or make suggestions without any difficulty.

- The knowledge level of the board should be increased from time to time with the help of external consultants and experts. This will reduce asymmetric information and increase the benefits of diversity.

- Sanctions should be imposed through market regulatory bodies or judicial authorities against the transactions of companies that cause asymmetric information and cause mistrust in the market.

These recommendations can help gender diversity on boards reduce information asymmetry and thus lead to healthier and more balanced decision-making processes for companies.

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