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Effect of gender diversification in the management of banks on the risk-taking behavior of banks

Abstract

Motivated by the gender diversification discussion, regulation of the European Banking Authority, and the recent publication of the European Banking Authority, this thesis investigates the effect of gender diversification of the bank board on the bank risk. This thesis has three contributions to the existing literature. First, adding empirical evidence to the literature by investigating the effect of gender diversification in the management board of banks on the risk-taking of banks. Second, it obtains the information from the banks in the European Union after the financial crisis. Third, using four different risk measures. The main risk measure that is used is the Z-Score. The dataset consists of 137 banks from 27 countries of the European Union. A fixed-effects model is regressed and to control for the dynamic endogeneity problem, a lagged fixed effects model and an Arellano-Bond estimation are regressed. The expectation was that the percentage female on the bank board negatively affected the bank risk. Based on the fixed-effects and lagged fixed-effects model, the conclusion is that gender diversification has a negative effect on bank risk. But, based on the Arellano Bond estimation gender diversification has a positive effect on bank risk.

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1. Introduction

Motivated by the gender diversification discussion, relative new regulation of the European Banking Authority, and the recently published European Banking Authority paper, this thesis investigates the effect of gender diversification in the management of banks on the risk-taking behavior of banks.

Nowadays, gender discussion is one of the most investigated subjects of the recent behavioral and economic sciences. In economics, feminists have started the discussion about gender diversification of the top management. They found empirical evidence that gender diversification in the management of firms can improve the financial performance of firms(Francoeur, Claude, Réal Labelle, and Bernard Sinclair-Desgagné,2008). Furthermore, another paper found that gender diversification in the management of a firm can decline the risk-taking behavior of companies(Khaw, K. L. H., Liao, J., Tripe, D., & Wongchoti, U,2016). Based on these two findings, the feminists argue that more women should be allowed in the management of companies to make the companies better performing and more financially stable.

The European Banking Authority(EBA) followed this gender diversification discussion and in 2013 the EBA decided to implement rules for gender diversity in the management of credit institutions, which includes banks. Since 2013, all the credit institutions in the European Union are required to have a diversity policy. The EBA implemented this rule because they think that if a management board is more diversified, these multiple backgrounds, opinions, and experiences can lead to more consensus and better-advised decisions regarding the policy of the banks(EBA,2020).

Recently, the European Banking Authority published a report about gender diversity in the European banking world. The EBA wanted to know whether their implemented regulations of 2013 have led to significant differences in the management top and what the significant effects on the decision-making of the banks were. The report found that there is an indication that a more gender diversified management team of a bank performs better. Thus, diversified management teams could potentially lead to different policies and performances of the banks.

1.1 Contribution

The contribution of this paper to the existing literature is split into three sections: first, it gives empirical evidence of gender diversification in the management board of banks affects the risk-taking of banks. Second, it obtains the information from the banks in the European Union after the financial crisis, the years 2012 until 2019, to investigate the effect of gender diversity in the management of banks. This thesis focuses on the effect of gender diversification on bank risk-taking in European Union countries in these specific years because several papers have focused on banking profitability (EBA,2020; Pathan, S. & Faff, ,2013; Feng, G., & Wang, C,2018). Furthermore, other papers looked at the effect on bank risk but only focused on one country or the whole world. F. Berger, A. N., Kick, T. and Schaeck, K(2014) obtained data from German banks and Liao R. C., Loureiro, G. and Taboada, A. G(2019) obtained data from 39 countries across the world with different regulations. Finally, Gulamhussen M. A. and Santa, S. F, (2015) used data of 461 banks of 37 OECD countries.

The final contribution is that this thesis will compare different bank risk measurements with each other. In the literature, papers chose to investigate only one or two risk measurements. The paper of Liao, R.C. et al(2019) used the Z-score(Return on Assets + equity/assets) and leverage as important risk measures. Also, the paper of Berger. et al(2014) used the ratio of return to risk-weighted assets as bank risk measurement. Finally, Skała, D. and Weill, L(2018) used the capital adequacy ratio as a bank risk measurement. By comparing multiple bank risk measurements with the same dataset, this thesis can show if gender diversification affects all the bank risk measures in contrast to the aforementioned papers.

This thesis focuses on the banking sector because the banking sector is very important for the economies of the countries in the European Union. The financial crisis of 2008 has shown that excessive risk-taking in banks can lead to a worldwide crisis and a lot of costs for the working class (Tikka, N,2019). Therefore, banks in the world must be financially stable. Regulators such as the European Banking Authority try to maintain financial stability, by creating new rules, such as holding a minimum amount of capital, for banks (Blundell-Wignall, A., & Atkinson, P,2010). By investigating the effect of gender diversity in the management board of banks on the risk-taking, the regulators can gain information about whether their new regulations are good for the financial stability of the European Union economies.

In addition, the banks of the European Union are used because the banks all have the same regulator, thus the same rules apply to all the different institutions. Furthermore, if the women's quota would increase bank risk the regulators of the European Banking Authority can easily change the policy for all the banks of the European Union.

The relationship between the gender diversification and the risk-taking of banks is investigated with a fixed-effects model, lagged fixed effects model, and an Arellano Bond model. The data consists of 137 banks that are located in 27 countries that are members of the European Union. The bank risk is measured by the natural logarithm of the Z-Score, leverage, risk-weighted assets, and capital buffer. Gender diversification is measured by the percentage of females on the bank board. The expectation was that the percentage female on the bank board would negatively affect bank risk because women tend to monitor more, have different networks, and tend to be more conservative than men. This would mean that the Z-Score and capital buffer would be positively affected and the percentage risk-weighted assets and leverage would be negatively affected. The results indicate that in the basic fixed effects and lagged fixed effects model, the percentage female in the bank board has a positive effect on the risk-weighted assets. However, in the Arellano Bond model, the percentage female on the bank board has a positive significant effect on the Z-Score. Therefore, based on the fixed-effects and lagged fixed-effects, the conclusion is that gender diversification increases the risk-taking of banks. But, based on the Arellano Bond estimation, the conclusion is that gender diversification increases the risk-taking of banks.

2. Theoretical Framework

2.1 Boards matter for risk-taking behavior

The board of a firm has been an important part of the risk-taking discussion(Jensen & Meckling,1967). The construction, size, and differences of the board of a firm matter for the amount of risk that a firm takes(Wang, C. J,2012; Nakano, M., & Nguyen, P,2012; Mathew, S., Ibrahim, S., & Archbold, S,2018). In the literature is stated that if a firm has a large-sized board and a lot of different backgrounds, the risk-taking behavior of the firm and the variance of the firm's performance declines(Cheng,2008; Wang, C.J,2012). There are a few explanations for the decline in risk-taking behavior when a firm has a large board size.

First, Cheng(2008) explains that a larger and more diversified board will lead to more consensus and less extreme decisions. The chance that every member of a large board will agree to a decision is smaller. To still come to an acceptable decision on which everyone agrees, the extreme opinions on both sides will need to be compromised in a consensus. This consensus is a less risky outcome.

Second, Adams and Ferreira (2009) state that if the board of firms is more diversified and larger, the ability of the board to monitor increases. When the board of a firm is better able to monitor, the risk-taking behavior of the firm can be decreased efficiently. This argument is based on the agency theory, which assumes that the role of the board is to monitor the managers of the firm, to control that the managers execute the will of the shareholders of the firm(Bathala, C. T., & Rao, R. P,1995).

Third, when there are more people on the board of a firm, there is more expertise, skill, and experience among the board concerning the different firm decision problems, which leads to less risk-seeking decisions(Shakir, R,2008).

2.2 Women are less risk-taking than men

In the literature, empirical evidence is found that women have a different risk attitude than men(Fellner, G., & Maciejovsky, B,2007; Johnson, J.E.V., Powell, P.L,1994; Jianakoplos, N.A., Bernasek, A,1998; Sarin, R., & Wieland, A,2016). Jianakoplos et al (1998) studied the investing behavior of men and women and found that women hold a smaller percentage of risky assets. This led to the conclusion that women are more risk-averse than men. In addition, Eckel and Grossman (2008) studied the risk aversion difference in a sample gamble option game. The same result of a difference in risk aversion of gender was found. Finally, a laboratory experiment found that in individual investment decisions women tend to invest a lower amount of money and tend to invest more financially risk-averse(Charness, G., & Gneezy, U,2007). In the literature, there are a few explanations for the difference in risk aversion between men and women.

First, Niederle and Vesterlund (2007) state that men are overconfident in comparison to women. This confidence gives men the feeling that they can possess a competitive position at the top of the management. Women do not have this overconfidence and are driven away from competitive positions. Men are thus drawn by competitive positions. The overconfidence of the men results in risk-taking behavior when the men are in the top positions on the board of a firm. They are confident that their risky decisions will lead to positive and profit-making outcomes for the firm. Because women do not have this overconfidence, they are more skeptical about risky decisions and the outcomes. Therefore, women are more risk-averse and take less risk than men in the board positions of firms.

Second, Meier-Pesti & Penz (2008) explained the difference in risk aversion by looking into social norms. The paper states that the environment an individual grows up in influences their risk attitude for the rest of their lives. The reason for this is that an individual is taught, how his/her gender is supposed to behave, and what decisions to make in social situations. This means that the social gender rules that an individual faces in his life can explain the gender difference in risk-taking when the types of gender are in a top management position of a firm.

Finally, Eriksson, K., & Simpson, B (2010) added emotional reactions as an explanation for the difference in risk-aversion among genders. The paper found evidence that in response to a losing outcome of an investment or gamble, women react more emotionally than men. The emotional reaction of women leads to a higher risk aversion for the gamble or investment in the future because women are afraid of their emotional reaction.

However, not everyone in the literature agrees that women are less risk-taking than men. The paper of Nelson (2018) specifically criticized the paper of Charness et al (2007) and indirectly captured major flaws that exist among more papers that find a difference in risk-taking among gender. The first flaw is that they tend to have a confirmation bias. Before writing the paper, their focus lies on finding a difference in risk-taking. This affects the way the researchers look at their final results. They present their results in a way that there is a risk difference. Furthermore, the papers tend to forget to include individual social differences. For example, the background of the individual is forgotten about, despite this being a valid factor in the risk-taking behavior of individuals(Eeckhoudt, L., Gollier, C., &

Schlesinger, H, 1996). Finally, the researchers tend to misinterpret the information, by looking at the total numbers but not at the scientific significance. Following these three major flaws, Nelson(2018) conducted a similar research structure as the paper of Charness and Gneezy(2007) to investigate the difference in risk-taking. In contrast to the original paper which found a difference in risk-taking, the paper concluded that there is no difference in risk-taking between women and men.

2.3 Women in the management board

Boards of firms can affect risk-taking and potential differences of genders could influence risk-taking. But, what happens when the women enter the boards of firms and diversify the management of the firm? Firms that have more diversified management tend to spend less on capital expenditures, R&D, and acquisitions(Harjoto, M. A., Laksmana, I., & Yang, Y. W,2018). Moreover, they state that the diversified boards have lower variance of stock returns and a lower variance return on assets. The lower variance shows that the board's decisions are more predictable and thus more financially stable. Finally, the paper indicates that more diversified boards often pay more dividends to their shareholders. These conclusions are based on a dataset of 21,680 firms.

However, the literature also found that gender diversification of the board can lead to sharpened discussions(Erhardt, N. L., Werbel, J. D., & Shrader, C. B,2003). These discussions can effectively intervene in the ongoing decision-making process of the board, making it harder for management to come to a consensus. So, gender diversification can slow the decision-making process down and can even lead to extreme decisions. This can lead to precisely the opposite outcomes in contrast to the previous paper, thus a high-risk policy with a high variance/volatility(Bernile, G., Bhagwat, V., & Yonker, S,2018).

Finally, the papers of Adam and Ferreira(2009) and Ahern and Dittmar(2012) found that when women are in management positions they monitor more. The women that monitor are more confident and therefore are more risk-taking in their decisions.

2.4 Diversified management board effect on banks risk-taking

So on the one hand, women in the boardrooms decline risk-taking because they monitor more and have a different network than the men that already are positioned in the boardroom. The higher amount of monitoring indicates a lower risk-taking behavior of banks. However, on the other hand, more monitoring costs money, and the different backgrounds can lead to discussion among the management. This can lead to inefficient decision making and can increase the risk-taking behavior of banks(Gulamhussen, M. A.et al,2015).

In the literature about the relationship between gender diversification and bank risk, they find that a larger proportion of women in the management of banks leads to a better performance of the banks(EBA,2020; Liao, R.et al,2019; Chandrasekharan, C. V,2016). However, the relationship only holds when the pool of skilled women is big enough in the country. Also, the papers of Berger et al(2014), Gulamhussen et al(2015), and Liao et al(2019) find that a larger proportion of women in the management positions leads to lower bank risk-taking. Berger et al(2014) found this by obtaining data from German banks, Liao et al(2019) obtained data from banks from 39 countries across the world and Gulamhussen et al(2015) used data of 461 large banks of OECD countries.

In line with the literature, the paper of Skała et al(2018) found, when investigating 365 Polish banks, that when women are CEO of a bank that the bank has higher capital ratios and equity to assets ratios, which indicates that a bank has a lower risk. The paper of Gottschalk(2019) found when investigating banks in the US that if the proportion of women in the management team is large in commercial banks, the risk-taking of banks does not change(Gottschalk, S, 2019).

In the papers of Andries, A. M., Mehdian, S. M. and Stoica, O(2017) and Khan, M. H., Fraz, A., Hasan, A., and Abedifar, P.(2018) a credit risk effect was found. The papers indicate that when the banks have a larger proportion of women on the bank board the bank has lower credit losses and takes fewer credit risks.

2.5 Hypothesis

Following the papers of Liao et al(2019), Berger et al(2014), and Gulamhussen et al (2015) the hypothesis is that a larger diversification of the board room decreases the risk-taking of banks. Considering the previous papers, the contribution of this thesis is that four different risk measures are used and that the focus lies on the banks in the European Union. Furthermore, the dynamic endogeneity problem will be dealt with by implementing an Arellano Bond dynamic panel-data estimation. The expectation is that females in the boardroom will monitor more often, will attract different networks than the sitting men in the boardroom, and are more conservative which leads to a decline in the risk-taking of the banks.

3. Methods

To investigate the relationship between the gender diversification of the board and the risk-taking of banks, this paper will use a regression model. Following the papers of Bebeji, A., Mohammed, A. M. and Tank (2017), Loukil, N. and Yousfi, O (2013), and Skała, D. et al (2018) this thesis will start by performing a fixed-effects model or random-effects model. The dataset is a panel data, which includes time-series data and cross-sectional data. Also, a Hausman test is regressed to test whether a fixed-effects or random-effects model is appropriate. The Hausman test is below the 95 percent confidence level: 0,0141<0,05. Therefore, the fixed effects model is used. In total, four fixed effects are used: bank, country, year, and year-country fixed effects. The dataset consists of bank-level data, therefore the best suitable fixed effects model to investigate the relationship between gender diversification and the risk-taking of banks is a model that contains fixed country-year effects. In the fixed country-year effects, the year fixed effects are multiplied with the country-fixed effects. By combining the fixed country and year effects, the model controls for any unobserved variables within a country over time. This leads to the following equation:

(1) $$RISK_{ict} = ß0 + FEMALEß1_{it} + BOARDß2_{it} + SIZEß3_{i} + ASSETß4_{it} + GDPCAPITAß5_{ct} + D_c * D_t + \varepsilon_{ict}$$

$RISK_{ict}$ is the bank risk measure of bank i in country c in year t. $D_t * D_c$ captures the country-year fixed effects. ε_{ict} denotes the error term of the model.

The fixed-effects model is an effective method to measure the relationship between gender diversification and the risk-taking of banks, however, it has a flaw. When discussing the board of a firm or bank, the dynamic endogeneity problem emerges. Endogeneity is a correlation between the explanatory variable and the error term (Duncan, G. J., Magnuson, K. A., & Ludwig, J,2004). The endogeneity problem exists because the previous performance or risk-taking behavior of a bank can influence the current bank board composition(Wintoki, M. B., Linck, J. S., & Netter, J. M,2012). For example, a bank that has performed poorly could have an incentive to hire females on their board.

Following the papers of Goergen, M., Limbach, P., and Scholz, M (2015), Liu, Y., Wei, Z, and Xie, F. (2014), Wintoki et al (2012), and Talavera, O., Yin, S., and Zhang, M (2018) to overcome the dynamic endogeneity and unobserved panel heterogeneity two solutions are presented. The first solution is that the lagged values of the board variables are added as independent variables. The lagged values are added because they could affect the risk-taking of banks now. After all, it takes time for the board to influence the policy of the bank. This leads to the following equation:

(2) $$RISK_{ict} = FEMALEß1_{it} + FEMALE_{t-1}ß2_{it} + BOARDß3_{it} + BOARD_{t-1}ß4_{it} + SIZEß4_{i} + ASSETß6_{it} + GDPCAPITAß7_{ct} + D_c * D_t + \varepsilon_{ict}$$

$RISK_{ict}$ is the bank risk measure of bank i in country c in year t. $D_t * D_c$ captures the country-year fixed effects. ε_{ict} denotes the error term of the model.

The second solution for the dynamic endogeneity problem is regressed in the final model. This regression is an Arellano Bond dynamic panel-data estimation, which is a generalized method of moments estimator. In the Arellano Bond dynamic panel-data estimation, the original model is first differenced. After that, the lagged value of the dependent variable is added to the model as an independent variable. Also, all the lagged values of the dependent variables and the first differenced independent variables are added as instruments.

The advantage of using this model is that it uses a small number of assumptions(Arellano, M., & Bond, S,1991). Furthermore, it gives consistent outcomes even if the panel data has a low amount of time series data(Zhang, Y., & Zhou, Q,2020). However, the model also has some limitations. First, it depends on the values of the past, which are implemented as instruments, which means that if the number of lags increases, weak instruments become even weaker(Kruiniger, H,2009). Second, if there is a low amount of cross-section data the results of the model can be imprecise (Moral-Benito, E., Allison, P., & Williams, R,2019). The model leads to the following equation:

$$\textbf{(3)}\ \Delta RISK_{ict}=\Delta RISK_{ict,t-1}+\Delta FEMALE\beta 1_{it}+\Delta BOARD\beta 2_{i}+\Delta SIZE\beta 3_{i}+\Delta ASSET\beta 4_{it}+\Delta GDPCAPITA\beta 5_{ct}+\varepsilon_{ict}$$

Δ denotes the first difference. $RISK_{ict}$ is the bank risk measure of bank i in country c in year t. ε_{ict} denotes the error term of the model.

3.1 Comparison to the paper of Liao et al, 2019

The paper of Liao et al (2019) uses the gender quota laws to investigate the effect of gender diversification on bank risk and bank performance. The paper looks specifically at countries were gender diversification is low and the gender quota law is introduced. The paper finds a relation between the gender quota law and bank risk. Based on this relationship the paper states that more females in the board management of a bank decrease the bank risk. This thesis does not investigate the effect of gender quota laws, but the effect of the percentage of female directors in the bank board on bank risk. In addition, this thesis looks at the banks in the European Union and not at banks across the world with low female representation in the bank board. This thesis uses the GMM method to overcome the endogeneity problem in contrast to Liao et al(2019), who used a difference in difference estimator and who used the gender quota law as a kind of solution for the endogeneity problem. However, there are a few similarities. The bank risk measures: the Z-score and leverage are also used in this thesis. Also, two control variables measures are similar: the size of the bank and economic size.

3.2 Data

The data for the research is obtained from BoardEx and this data is combined with specific financial bank data from Orbis Bank Focus. The OECD database is used to obtain the GDP per capita data. Banks with the consolidation code ”C2” in the database of Orbis Bank Focus are dropped to avoid double counting banks.”C2” denotes: ”*statement of a mother bank integrating the statements of its controlled subsidiaries or branches with an unconsolidated companion’’*(Duprey, T. et al, 2016).

The dataset is an unbalanced panel dataset with 1,088 observations. The data is obtained from 137 banks from 27 different countries of the European Union. The only country that is not an official member is Switzerland, which left the European Union in 2016(EU,2020). The earliest bank data information on the database of BoardEx was 2012, therefore the data is selected from 2012 until 2019.

3.3 Dependent Variable: Bank Risk measures

The main bank risk measure that is used as a dependent variable is the Z-score, as used in the papers of Liao et al (2019), Pathan, S(2009), Boyd, J. H., Graham, S. L, and Hewitt, R. S (1993). The Z-score measures the insolvency risk of a bank. Insolvency risk is the risk that a bank will not be able to pay his debts(Hannan, T. H., & Hanweck, G. A,1988). A higher Z- Score indicates that a bank has a lower risk of insolvency. Therefore, the expectation is that the percentage female on the bank board has a positive effect on the Z-score. The Z-Score is used as the main dependent variable because it is a popular and common bank risk measure in the literature(Li, X., Tripe, D. W., & Malone, C. B, 2017). Another advantage of using the Z-Score as a bank risk measure is that it is easy to access because only a small amount of bank-level data information is needed to calculate the Z-score(Lepetit, L., & Strobel, F,2015). However, the Z-score has a downside. The assumption is made that the return on assets is normally distributed. Despite this, empirical evidence showed that the returns on assets are in reality often skewed(Lapteacru, I,2016). Following the paper of Laeven and Levine (2009) to overcome this problem, the natural logarithm of the Z-Score is used. The formula of the variable Z-score is:

(4) Z-Score= Logarithm((Return on Assets+ Equity/Assets)/ Return on Assetsσ)

”σ’’ denotes the standard deviation

In line with the papers of De Cabo, R. M., Gimeno, R, and Nieto, M. J(2012) and Liao et al(2019) the second bank risk measure that is used as a dependent variable is leverage. Leverage is measured by dividing the equity by the total assets. The ratio represents the percentage of the bank that is owned by investors. A high equity to asset ratio means that the bank has a high-risk position. The expectation is that a high percentage of females on the board decreases the leverage ratio of the bank, thus makes it less risky.

Following the papers of Berger et al(2012), Adams, R., H. Almeida, and D. Ferreira(2005), and Cheng(2008) the third bank risk measure that is used as a dependent variable is the percentage of the risk-weighted assets. Every individual asset of a bank has a certain risk, which is weighted according to the Basel iii regulations. The weighting depends on the type of credit risk, market risk, and operational risk of the individual type of asset. For example, normal obligations have a higher weighted risk than government obligations, which sometimes have a risk weighting of zero percent. The weighted risk is multiplied with the asset. By summing all the assets of the bank and their risk weighting the total risk-weighted assets are calculated. The percentage of risk-weighted assets is calculated by taking the risk-weighted assets and divide it by the total assets. This percentage shows whether the board has increased the total riskiness of the banks' assets or not. A higher ratio means that a bank has riskier assets thus take more bank risk(Basel Committee on Banking Supervision, 2010; Berger, A. N,1995). Therefore, the expectation is that the percentage female in the board has a negative effect on the percentage of risk-weighted assets because this decreases the risk of the bank.

The final bank risk measurement that is used, is the capital buffer of a bank. Following the paper of Skała, D et al (2018), the bank risk over capital is measured by the capital adequacy ratio. The formula is:

(5) Capital adequacy ratio= (Tier 1 capital +Tier capital 2)/ Risk-weighted assets

The capital adequacy ratio is used because it tends to have an inverse relationship with bank risk(Berger et al,2014). This means that when the capital adequacy ratio grows, the bank risk decreases. In this way, bank risk is measured. The expectation is this that the percentage of female on the board will have a positive effect on the capital adequacy ratio, which means that the capital buffer grows if the female percentage in a board is higher.

3.4 Independent Variables

The main independent variable of this paper is gender diversification in the management board of the bank. Following the papers of Khan, M. H, et al (2018), Sila, V., Gonzalez, A., and Hagendorff, J(2016), and Berger et al (2014) the gender diversification of the board is measured by the female directors in the board divided by the total directors of the board.

3.5 Bank-level Control variables

The first control variable is the size of the bank board. In line with the papers of Pathan (2009) and Farag et al (2017), the bank board size is measured by the total number of directors on the bank board. The expectation is that larger board sizes reduce the bank risk because a larger board can lead to more consensus thus less risky decisions(Sah and Stiglitz,1991).

Following the papers of Farag et al(2017) and Liao et al (2019), the second control variable is the size of the bank. The size of the bank is calculated by taking the natural logarithm of the total assets of the bank. The natural logarithm is used to compare the banks on a relative basis and not in absolute numbers. The expectation is that larger banks take more risks because large banks are better able to absorb risk(Berger et al,2014).

The third bank-level control variable is the growth strategy of a bank. Following the papers of Berger et al(2014) and De Cabo et al(2012), the growth strategy of a bank is measured by the mean of the total asset growth. The mean asset growth per year is calculated by summing up the previous and current asset growth percentage and dividing this by two. The growth strategy is used as a control variable because banks tend to take more risk in times of high growth(Berger et al,2014).

3.6 Country-level control variables

The fourth control variable is economic size. In line with the papers of Berger et al (2014) and Liao et al (2019) economic size is measured by the GDP per capita. GDP per capita is the Gross Domestic Product of a country divided by the inhabitants of the country. The expectation is that economic size increases the risk that a bank takes because, in times of high conjuncture and economic growth, people are more confident in the economy and will take more risks(Dell 'Ariccia, G. and R. Marquez,2006).

3.7 Summary statistics

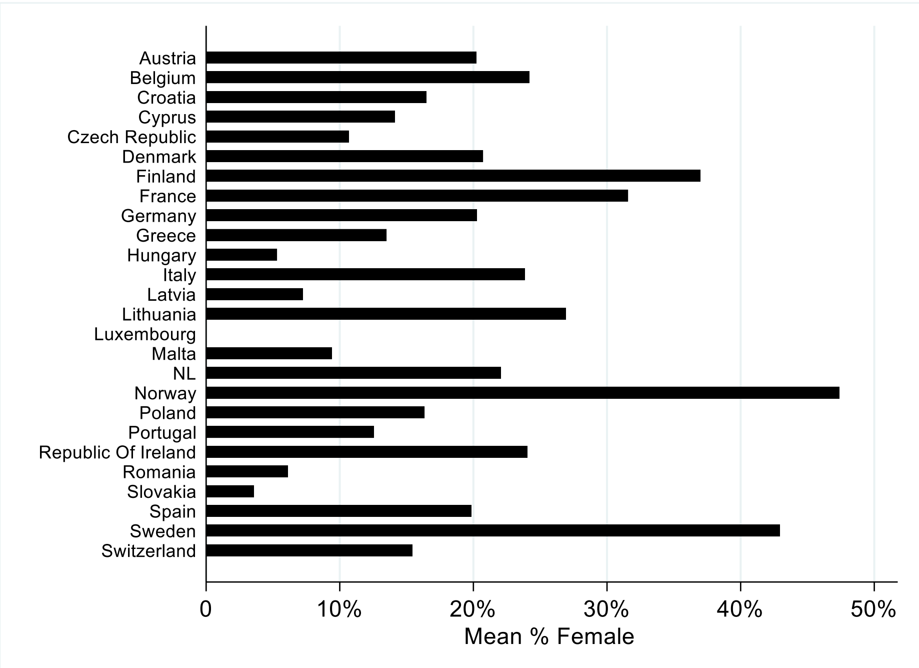
The summary statistics are presented in table 1. The main dependent variable, the natural logarithm of the Z-Score, values range between -1.69335 and 5.173 and has a mean 3.275, which is in line with the paper of Liao et al(2019). The main independent variable, the percentage female on the bank board, has a mean of 0.228. The average percentage female in the board of banks in the dataset is thus 22.8 percent, which is in line with the literature of Bebeji, A. et al(2017) and Sila, V. et al(2016). The maximum percentage female on a bank board is 60 percent. So, there is not one bank in the dataset that has a full women board. However, the minimum percentage female on the board is zero percent. So there are banks in the dataset with a full men bank board. In table 2, the mean of the percentage of females in the bank board per country is presented. It is noticeable that in the Scandinavian countries such as Finland, Norway, and Sweden the banks have a high mean percentage female in the board in comparison to the other countries in the dataset. Luxembourg is the only country in the dataset that has an average percentage of females on the board of zero percent. The mean of leverage is 0.094. So, on average banks have 9,4% equity compared to their total assets. The mean percentage of risk-weighted assets is 0.49. The minimum required capital buffer of a bank is 8.00, under the Basel iii regulations of the European Banking Authority(Repullo, R., & Saurina Salas, J,2011). The mean of the banks in the dataset is 18.10, which is above this number. So, on average the banks in the dataset have a capital buffer that is above the minimum. The average bank board consists of 13.7 people. The mean of bank size can be measured by solving Ln(17.22)= 30,098,924.55 USD[1]. The total assets are denominated in thousand dollars. The mean asset growth is 27.82 percent. The large difference between the minimum and maximum of GDP per Capita can be explained. The Gross Domestic Product is divided by the population. In a country with a small population, such as Luxembourg, and a high Gross Domestic Product the GDP per capita is high. In contrast, in a country like France with a large population and also a high Gross Domestic Product, the GDP per Capita is lower.

Table 1. Summary statistics

Variables	Obs.	Mean	Std. dev.	Min	Max
Dependent variables:					
Z-Score	1,025	3.275	1.028	-1.69335	5.173
Leverage	1,035	0.095	0.0706	-0.0331	0.929
Risk-weighted assets	793	0.490	0.191	0.000675	0.984
Capital Buffer	980	18.10	6.939	0.90	98.96
Independent variables:					
Female	879	0.228	0.145	0	0.60
Board	879	13.74	5.607	3	32
Bank Size	1,035	17.22	2.112	7.6	21.7
Mean Asset growth	1,046	27.82	340.2	-101.5	7,577
GDP per Capita	952	41,060	21,487	8,535	118,824

Z-Score is calculated by taking the natural logarithm of (ROA+ Equity/Assets)/standard deviation of ROA. Leverage is the equity on assets ratio. Risk-weighted assets are the percentage of risk-weighted assets of the total assets. Capital Buffer is measured by the capital adequacy ratio. Female is the percentage female on the board of a bank. Boar is the total number of directors on the bank board. Bank Size is the natural logarithm of the total assets. Mean asset growth is the mean of the total asset growth of the banks. GDP per Capita is the GDP per Capita in a country where the bank is located.

Table 2. Average percentage female in the bank board per country



[1] USD refers to United States Dollars

4. Results

The result section starts with a fixed-effects model which is presented in table 3. This regression can be seen as the benchmark model. The fixed-effects model is used because the outcome of the Hausman test was lower than the 95 percent significance level 0,0141<0,05. The standard errors are clustered on the country-level. In the first column of Table 3, the bank-level fixed-effects are regressed, in the second column the year fixed-effects, in the third column the country fixed-effects, and in the fourth column, the year-country fixed are regressed. As stated before, for this paper with bank-level data the focus lies on the country-year fixed effects model. The year fixed-effects controls for unobserved variation which changes over time but is constant across the banks. By adding the country fixed-effects the model also controls for unobserved variation which changes over countries but is constant across the banks.

When regressing the bank-level fixed effects model, the percentage female on the board has a positive significant effect on the Z-Score with a coefficient of 0.506 and a significance level of 99 percent. Also, size has a negative significant effect on the Z-Score with a coefficient -0.541 and a significance level of 99 percent. Finally, the asset growth also shows a significant effect on the Z-Score with a small coefficient of 0.000364 and a significance level of 99 percent. However, in the other three models, the significant effects are dropped. In the model with country-year fixed effects, the only variable that has a significant positive effect on the Z-Score is the mean asset growth.

As stated before, dynamic endogeneity is a problem when regressing a basic fixed effects model with this dataset because a board composition can affect the bank risk and performance but the previous bank risk and performance can also affect the board composition. If this is the case there is a correlation between the dependent variable and the error term in the regression. To overcome this endogeneity problem a first solution is a lagged fixed-effects model. Therefore, in the final four columns of Table 3, lagged variables of the board variables are added as independent variables.

In the lagged model with bank-level fixed effects, again a significant effect of lagged females on Z-Score is shown, which is in line with the first column of Table 3. However, again in the models with year fixed effects, country fixed effects, and country-year fixed effects this significant effect is dropped. So, the significant results are not consistent over the models and when focusing on the country-year fixed effects model no significant effect on the Z-Score is found.

Table 3. Z-Score fixed effects model

Variables	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score
Female	**0.506*** **	**1.122**	**0.375**	**0.323**	**0.298**	**0.731**	**0.731**	**0.838**
	(0.180)	(0.670)	(0.667)	(0.977)	(0.242)	(0.495)	(0.475)	(0.684)
Lagged Female					0.288*	0.690	-0.222	-0.365
					(0.151)	(0.646)	(0.696)	(0.994)
Board	0.00803	0.0198	0.0132	0.0131	0.0282**	0.0640**	0.0227	0.0177
	(0.0102)	(0.0134)	(0.0172)	(0.0202)	(0.0126)	(0.0275)	(0.0203)	(0.0223)
Lagged Board					0.0310***	-0.0433**	-0.0113	-0.00566
					(0.0107)	(0.0193)	(0.0114)	(0.0132)
Size	-0.541***	-0.00488	-0.0143	-0.0185	-0.516***	-0.00691	-0.0282	-0.0325
	(0.136)	(0.0442)	(0.0355)	(0.0441)	(0.140)	(0.0455)	(0.0392)	(0.0493)
Mean	0.000364***	7.21e-05***	0.000117***	0.000116***	-0.000512	0.00118	0.000109	0.000874
	(8.67e-05)	(2.36e-05)	(2.11e-05)	(3.42e-05)	(0.000747)	(0.00377)	(0.00349)	(0.00521)
GDP per Capita	2.85e-06	1.29e-05**	1.87e-06		2.75e-06	1.39e-05**	-3.37e-06	
	(3.37e-06)	(5.80e-06)	(2.39e-06)		(2.74e-06)	(6.08e-06)	(3.75e-06)	
Constant	12.43***	2.349***	3.215***	3.375***	12.19***	2.279***	3.664***	3.597***
	(2.217)	(0.766)	(0.533)	(0.611)	(2.297)	(0.768)	(0.542)	(0.650)
Observations	715	715	715	715	590	590	590	590
R-squared	0.963	0.117	0.397	0.433	0.966	0.148	0.416	0.449
Bank FE	YES				YES			
Year FE		YES		YES		YES		YES
Country FE			YES	YES			YES	YES

Z-Score is calculated by taking the natural logarithm of (ROA+ Equity/Assets)/standard deviation of ROA. Leverage is the equity on assets ratio. Risk-weighted assets are the percentage of risk-weighted assets of the total assets. Capital Buffer is measured by the capital adequacy ratio. Female is the percentage female on the board of a bank. Boar is the total number of directors on the bank board. Bank Size is the natural logarithm of the total assets. Mean asset growth is the mean of the total asset growth of the banks. GDP per Capita is the GDP per Capita in a country where the bank is located

4.1 Robustness checks

Robustness checks are used to investigate whether the variables of the benchmark model show a similar effect when the variables of the model are measured in a different situation. If the results of the robustness checks are in line with the benchmark fixed-effects model, then the results can be seen as more valid(Lu, X., & White, H., 2014). In the upcoming robustness checks the same model is regressed, however, the bank risk measure Z-Score is replaced by three other risk measurements. The first bank risk measure that is used as a robustness check is leverage.

The robustness check with leverage as a dependent variable is presented in table 4. The percentage female in the bank board has no significant effect on the leverage across all the fixed effects and lagged fixed-effects models. The board size has a significant positive effect on leverage with very small coefficients, in the year fixed effects, country fixed effects, and country-year fixed effects models, but the significant effect is lost in the lagged fixed-effects models. The bank size has a negative significant effect on the leverage across all the fixed effects and lagged fixed-effects models. Furthermore, the mean asset growth is negatively significant in three of the four fixed effects models. Finally, the joint significance test also shows no significant effect: 0.6428>0.10. When focusing on the year-country fixed effects model, the board shows a positive significant effect on leverage, and the mean asset growth and bank size have a negative significant effect on leverage.

Table 4. Leverage Fixed effects model

Variables	Leverage	Leverage	Leverage	Leverage	Leverage	Leverage	Leverage	Leverage
Female	**0.0198**	**-0.0175**	**0.00639**	**-0.0187**	**-0.00494**	**0.00316**	**0.0189**	**0.0293**
	(0.0166)	(0.0254)	(0.0265)	(0.0421)	(0.0130)	(0.0236)	(0.0228)	(0.0311)
Lagged Female					0.0338	-0.0158	-0.00575	-0.0371
					(0.0167)	(0.0279)	(0.0270)	(0.0523)
Board	-0.000939	0.000885***	0.00154***	0.00195***	0.000718	-0.000698	-0.000789	-0.000570
	(0.00110)	(0.000283)	(0.000510)	(0.000552)	(0.000764)	(0.00136)	(0.00151)	(0.00171)
Lagged Board					-0.000979	0.00147	0.00235*	0.00238
					(0.000806)	(0.00128)	(0.00129)	(0.00152)
Size	-0.0430***	-0.0142***	-0.0166***	-0.0165***	-0.0375***	-0.0139***	-0.0164***	-0.0161***
	(0.00995)	(0.00174)	(0.00178)	(0.00200)	(0.00910)	(0.00167)	(0.00166)	(0.00181)
Mean	2.70e-05***	-2.86e-06***	-1.10e-06	-4.82e-06***	-0.000158	-0.000260*	-0.000291**	-0.000276
	(6.46e-06)	(8.50e-07)	(6.47e-07)	(9.47e-07)	(9.26e-05)	(0.000129)	(0.000114)	(0.000170)
GDP per Capita	1.12e-07	-1.75e-07	-9.62e-08		2.48e-07	-2.75e-07	1.14e-07	
	(3.12e-07)	(2.07e-07)	(3.70e-07)		(2.76e-07)	(2.05e-07)	(2.81e-07)	
Constant	0.846***	0.336***	0.359***	0.355***	0.736***	0.337***	0.348***	0.349***
	(0.167)	(0.0293)	(0.0335)	(0.0324)	(0.151)	(0.0278)	(0.0290)	(0.0291)
Observations	722	722	722	722	592	592	592	592
R-squared	0.912	0.267	0.329	0.408	0.930	0.291	0.377	0.432
Bank FE	YES				YES			
Year FE		YES		YES		YES		YES
Country FE			YES	YES			YES	YES

Leverage is the equity on assets ratio. Female is the percentage female on the board. Lagged represents the lagged value t-1 of the variable. Board is the number of directors on the board. Size is the natural logarithm of the total assets. Mean asset growth is the mean of the total asset growth of the banks. A 90 percent significance level is represented by *, 95 percent is represented by **, and 99 percent by ***.

The second bank risk measurement that is used as a robustness check is the percentage of risk-weighted assets. The percentage female in the bank board has a positive significant effect when the country fixed-effects and year-country fixed effects are added to the model. In the final model, the variable shows a positive significant effect with a coefficient of 0.367 and a significance level of 95 percent. Also, in the same model with country-year fixed effects, the lagged percentage female in the bank board shows a significant positive effect on the risk-weighted assets. This can mean that the effect of women on the board is extended for a period because the direct impact of boards is hard to measure, as decisions take time to adapt to an organization. In addition, the joint significance test of female and lagged female in the country-year fixed effects model of column eight shows a significant effect of 0.1128<0.15. In line with the previous models, bank size has a small negative effect on the percentage of risk-weighted assets across all the fixed effects models of table 5. The mean asset growth has a small positive effect on the first models, but this significant effect is dropped in the lagged fixed-effects model. When focusing on the year-country fixed effects model, Table 5 shows that the percentage female on the bank board has a positive significant effect on the risk-weighted assets.

Table 5. Risk-Weighted Assets fixed effects model

Variables	RWA	RWA	RWA	RWA	RWA	RWA	RWA	RWA
Female	**-0.103**	**0.132**	**0.230*** **	**0.367** **	**-0.0577**	**-0.0840**	**0.108* **	**0.118**
	(0.0769)	(0.114)	(0.0792)	(0.161)	(0.0688)	(0.0783)	(0.0615)	(0.0948)
Lagged Female					-0.0800*	0.192	0.125	0.267**
					(0.0437)	(0.122)	(0.0738)	(0.122)
Board	0.00354	0.00478	0.00434	0.00304	0.00292	0.00466	0.00232	-0.000676
	(0.00220)	(0.00309)	(0.00453)	(0.00488)	(0.00270)	(0.00453)	(0.00461)	(0.00504)
Lagged Board					0.000743	-0.000228	0.000865	0.00250
					(0.00162)	(0.00390)	(0.00325)	(0.00511)
Size	-0.153**	-0.0460***	-0.0365**	-0.0365**	-0.126**	-0.0496***	-0.0380**	-0.0378**
	(0.0586)	(0.0136)	(0.0150)	(0.0161)	(0.0607)	(0.0118)	(0.0139)	(0.0154)
Mean	8.44e-05**	1.85e-05***	2.21e-05***	3.31e-05***	-0.000530**	-0.000920	-0.000827	-0.000679
	(3.59e-05)	(3.86e-06)	(3.04e-06)	(3.42e-06)	(0.000219)	(0.000548)	(0.000523)	(0.000531)
GDP per Capita	2.96e-06**	-1.86e-06*	1.90e-06		2.83e-06**	-2.11e-06*	2.23e-06**	
	(1.24e-06)	(1.06e-06)	(1.27e-06)		(1.24e-06)	(1.07e-06)	(8.53e-07)	
Constant	2.997***	1.263***	0.930***	0.992***	2.571**	1.354***	0.965***	1.035***
	(0.983)	(0.245)	(0.290)	(0.293)	(1.029)	(0.211)	(0.254)	(0.271)
Observations	562	562	562	562	496	496	496	496
R-squared	0.927	0.211	0.430	0.509	0.938	0.249	0.462	0.542
Bank FE	YES				YES			
Year FE		YES		YES		YES		YES
Country FE			YES	YES			YES	YES

RWA is the percentage of risk-weighted assets of the total assets. Female is the percentage female on the board. Lagged represents the lagged value t-1 of the variable. Board is the number of directors on the board. Size is the natural logarithm of the total assets. Mean is the mean of the total asset growth of the banks. A 90 percent significance level is represented by *, 95 percent is represented by **, and 99 percent by ***.

The final bank risk measurement that is used as a robustness check is capital buffer. The percentage female in the board has a positive significant capital buffer with a coefficient of 6.212 and a significance level of 99 percent in the bank-level fixed-effects model. However, this effect is not consistent across the other fixed-effects models. The effect even changes from a positive to a negative coefficient. The bank size significantly negatively affects capital buffer in the year-country fixed-effects model. The mean asset growth negatively affects the capital buffer in the three of the four models with a very low coefficient and a confidence level of 99 percent

Table 6. Capital Buffer Fixed effects model

Variables	Capital Buffer	Capital Buffer	Capital Buffer	Capital Buffer	Capital Buffer	Capital Buffer	Capital Buffer	Capital Buffer
Female	**6.212*** **	**-7.940***	**-1.521**	**-9.663**	**0.951**	**-2.640**	**-4.108**	**-3.505**
	(1.769)	(4.035)	(4.415)	(7.520)	(1.853)	(3.477)	(4.484)	(5.014)
Lagged Female					8.203***	-5.070	1.496	-9.261
					(2.156)	(3.930)	(2.909)	(6.518)
Board	-0.0637	-0.0779	0.0258	0.0618	0.224*	-0.120	-0.0375	0.106
	(0.121)	(0.0785)	(0.0980)	(0.0943)	(0.117)	(0.188)	(0.242)	(0.205)
Lagged Board					-0.290**	0.0128	0.0615	-0.0468
					(0.109)	(0.163)	(0.202)	(0.169)
Size	-1.269	-0.464	-1.012**	-0.880*	-0.0993	-0.360	-0.941**	-0.783
	(1.915)	(0.363)	(0.452)	(0.491)	(2.072)	(0.353)	(0.436)	(0.464)
Mean	0.00128	-0.000786***	-0.000457***	-0.00142***	-0.00773	-0.00697	-0.0104	-0.0135
	(0.00109)	(0.000153)	(0.000133)	(0.000116)	(0.00911)	(0.0127)	(0.0164)	(0.0162)
GDP per Capita	-0.000104*	9.20e-05**	-0.000131**		-0.000101**	9.42e-05**	-0.000119**	
	(5.06e-05)	(3.55e-05)	(5.67e-05)		(4.61e-05)	(3.39e-05)	(4.65e-05)	
Constant	43.71	25.13***	40.81***	34.56***	22.73	23.79***	39.63***	33.81***
	(33.08)	(6.039)	(8.149)	(8.506)	(35.05)	(6.053)	(8.381)	(8.529)
Observations	697	697	697	697	572	572	572	572
R-squared	0.792	0.165	0.264	0.383	0.823	0.151	0.262	0.385
Bank FE	YES				YES			
Year FE		YES		YES		YES		YES
Country FE			YES	YES			YES	YES

Capital Buffer is measured by the capital adequacy ratio. Female is the percentage female on the board. Lagged represents the lagged value t-1 of the variable. Board is the number of directors on the board. Size is the natural logarithm of the total assets. Mean is the mean of the total asset growth of the banks. A 90 percent significance level is represented by *, 95 percent is represented by **, and 99 percent by ***.

4.2 GMM model

The second solution for the dynamic endogeneity problem is regressed in the final regression. This regression is an Arellano Bond dynamic panel-data estimation, which is a generalized method of moments estimator. The dependent variables that are presented as robustness checks in the previous tables are also included in table 7.

When controlling for the dynamic endogeneity, table 7 shows that the percentage female in the bank board has a positive significant effect on the Z-score with a coefficient of 0,646 and a confidence level of 99 percent. However, the percentage female in the bank board does not significantly affect the other bank risk measures. The size of the board of a bank has a positive significant effect on the Z-Score with a coefficient of 0.0282 and a significance level of 99 percent. In line with the benchmark model, the mean asset growth has a significant negative effect.

Table 7. Arellano-Bond dynamic panel-data estimation(GMM)

Variables	Z-Score	Leverage	RWA	Capital Buffer
Lagged Z-Score	0.121			
	(0.108)			
Female	**0.646*** **	**0.00255**	**-0.0607**	**5.522**
	(0.156)	(0.0100)	(0.0417)	(3.396)
Board	0.0282***	8.82e-05	-1.54e-05	0.0813
	(0.00864)	(0.000535)	(0.00205)	(0.178)
Size	-0.293***	-0.0427***	-0.0287	0.982
	(0.0826)	(0.00558)	(0.0316)	(1.583)
Mean	-0.00162**	-5.33e-05	-0.000871***	0.000965
	(0.000639)	(4.27e-05)	(0.000181)	(0.0119)
GDP per Capita	-7.14e-07	2.94e-07	1.53e-06*	-0.000137**
	(2.81e-06)	(1.93e-07)	(8.08e-07)	(6.15e-05)
Lagged Leverage		-0.175		
		(0.132)		
Lagged RWA			0.731***	
			(0.204)	
Lagged Capital Buffer				0.400**
				(0.172)
Constant	7.559***	0.838***	0.598	-3.146
	(1.605)	(0.102)	(0.616)	(26.56)
Observations	502	510	348	481
Number of ID	123	123	107	117
AR2 p-value	0.5158	0.1504	0.3855	0.2825

The Z-Score is calculated by taking the natural logarithm of (ROA+ Equity/Assets)/ standard deviation of ROA. Leverage is equity on assets ratio. RWA is the percentage of risk-weighted assets on total assets. Capital Buffer is measured by the capital adequacy ratio. Female is the percentage female on the board. Board is the total number of directors on the board. Mean is the mean of the total asset growth of the banks. AR2 is a second-order serial correlation test in the first differenced residuals with H0 representing no serial correlation. A 90 percent significance level is represented by *, 95 percent is represented by **, and 99 percent by ***

5. Conclusion & Discussion

Motivated by the gender diversification discussion, regulation of the EBA, and the recent publication of the EBA, this thesis examined the relationship between the percentage female in the bank's board and the risk-taking behavior of banks. The bank risk is measured by the natural logarithm of the Z-score. Furthermore, three other bank risk measures are used as a robustness check: leverage, percentage risk-weighted assets, and capital buffer. The expectation was that if the percentage of females in a bank board is higher, the bank takes less risk. For the data, this would indicate a higher Z-score and capital buffer, but a lower percentage risk-weighted assets and leverage. The dataset consists of 137 banks from 27 countries of the European Union. The relationship is tested by performing a basic fixed-effects model. To overcome the dynamic endogeneity problem, a fixed-effects model with lags and an Arellano-Bond dynamic panel-data estimation are regressed.

The thesis has shown mixed results concerning the effect of the percentage female in the bank board on the risk-taking behavior of banks. When investigating the fixed effects model and lagged fixed effects model, the percentage female on the bank board increases the risk-taking behavior of banks by positively affecting the risk-weighted assets when controlling for the year-country fixed effects. Therefore, based on the fixed effects and lagged fixed effects model, the conclusion is that gender diversification of a bank board has a negative effect on bank risk-taking. However, when controlling for the dynamic endogeneity in the Arellano Bond estimation the percentage female on the bank board decreases the risk-taking behavior of banks by positively affecting the Z-Score. Therefore, based on the Arellano Bond estimation, the conclusion is that gender diversification in the bank board decreases the risk-taking behavior of banks. But, this model has limitations. Often the model uses weak instruments and when the amount of cross-sectional data is low, the results are imprecise. Hence, the relationship between gender diversification and bank risk-taking should be investigated further.

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Appendix

Table 8. Hausman test

Variables	Z-Score
Chi-squared	**12.48**
Prob> Chi-squared	0,0141