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Financial Stability in the European Union: a case for gender diversity

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Abstract

This work project investigates whether a higher share of women on the boards of directors of European Union banks leads to greater financial stability. Employing a fixed effects model and using yearly panel data (2015-2021), this study finds evidence that, on average, an increase in the share of women on the board of directors is associated with an increase in the *z-score* and a decrease in the *NPL ratio*, which implies greater financial stability at bank and systemic levels, respectively. It also briefly explores other measures of board gender diversity and the impact of gender quotas on financial stability.

Keywords: Gender Diversity, Financial Stability, Board of Directors, Banking, European Union

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1. Introduction

Women's role in society has dramatically changed in the last century and gender equality is, nowadays, on the top of institutional agendas, being the 5th SDG[1]. There has been meaningful progress in the last decades. According to UNICEF, an increasing number of girls have access to primary education and laws are being implemented aiming at furthering gender equality in diverse societal scopes and infrastructures, from health systems to the labour market. Although these accomplishments are non-negligible, women are still underrepresented in different areas, such as finance. Consequently, it is relevant to acknowledge the problems that arise in the financial sector as a consequence of gender bias.

This relationship can be analysed from different perspectives, having women as the users or providers of financial services. This study takes the provider's perspective and analyses the impact of gender diverse boards and female representation on financial stability. Hence, it tests the hypothesis that a higher share of women on the boards of directors of European Union (EU) banks leads to greater financial stability, at bank and systemic levels.

To empirically study such relationship, this paper uses panel data on European banks (2015-2021). Employing a year and country-fixed effects regression, and controlling for observable variables, it tests for the impact of greater female representation on two financial stability indicators (*z-score* and the ratio of non-performing loans to gross loans). Using other identification strategies, it briefly attempts to explore the impact of gender quotas on financial stability.

This research question tackles the lack of studies on the topic, since most, to the best of my knowledge, focus on governance and gender diversity in the non-financial sector, with very few investigating such relationship in the financial sector, namely in financial stability. Considering most studies analyse data from U.S. firms/banks, or take an international perspective, focusing on banks in the European Union, that are generally subject to similar regulations and governance backgrounds, allows to understand how financial stability in the EU can be fostered and inform policymakers. Analysing the EU banking context and comparing it with the U.S., one can spot considerable differences in how financial standards are adopted at the international

[1] The Sustainable Development Goals are 17 international goals to achieve a "better and more sustainable future". These were established by the United Nations General Assembly in 2015 to be fulfilled by 2030.

level and in the banking supervision systems in place[2]. Therefore, conclusions retrieved from analysing the U.S. context, in this topic, may not be directly applicable to the EU. Hence the need to directly target the European banking paradigm.

Evidence shows that increasing women's labour force participation helps promote growth and contributes to financial sector stability (Kochhar et al., 2017). By reinforcing such evidence, this study offers an important contribution to the existing literature and exploits the dynamics between corporate governance and financial stability.

This paper is organised as follows: *Section 2* summarizes the existing literature on the topic; followed by *Section 3* describing the methodology employed and data sample; *Sections 4* and *5* detail the results arising from the empirical strategy and discuss possible limitations associated with it, respectively; and finally, *Section 6* provides an overview of the paper, reinforcing important results, literature contributions, and policy implications.

2. Literature Review

Governance and board composition are important lenses to analyse firm dynamics and performance. Different theoretical frameworks can help understand the benefits and the impact of board diversity. Firstly, agency theory states that a higher share of independent non-executive directors can improve board monitoring (Carter et al., 2010). Hillman and Dalziel (2003) conclude that boards should be composed of a balanced mix of experiences and backgrounds to better perform their monitoring function. Gender can be considered a factor to achieve such diversity. In fact, female representation on the board has the potential to improve its monitoring role and, consequently, contribute to lower agency costs (Farag & Mallin, 2016).

Focusing on the resource dependence theory, the presence of women on the board brings diverse resources and benefits to the firm. Accordingly, female individuals carry distinct perspectives that otherwise would be dismissed in too homogeneous boards, which can potentially lead to greater financial performance and convey a positive signal to the labour market (Carter et al., 2010 & Mateos de Cabo et al., 2012). Besides, board gender diversity is thought to improve transparency (Jain & Jamali, 2016) and bring ethical/societal perspectives

[2] The implementation of the Basel Standards in both geographies differs, with the EU adopting a stricter relationship with the standards in terms of financial regulation, and the U.S. maintaining some independence. In terms of supervision, both diverge in the weight they attribute to supervision and in the oversight method: while the U.S. has progressed into a federal approach, with supervisory bodies responsible for systemic coordination and decentralised agencies engaging in a more operational role; the EU works as a multilevel centralised structure, through the Single Supervisory Mechanism (SSM) (Pugliese, 2016).

into decision-making (Abou-El-Sood, 2021). Likewise, human capital theory supports the idea that the more diverse a board is, the wider range of perspectives and skills it will have, which results in more efficient resource allocation and better management and financial performance (Terjesen et al., 2009).

Moreover, to understand the role of women on boards of directors, it is important to study the extent to which they can influence decision-making. Different studies focus on the critical mass theory and on the social psychological concept of minorities (social impact theory). Evidence suggests that majority groups have a greater influence in decision-making (Carter et al., 2010). Consequently, as a minority group on boards, women may have limited power and influence in the decision-making process (Westphal & Milton, 2000). This comes in consonance with the notion that only a sufficient number of adopters of a new idea in a social system can be self-sustainable and foster further growth (critical mass theory). Evidence suggests that above a critical mass of 18% and 21% female representation on the board of directors and the supervisory boards respectively, banks' exposure to financial crisis decreases significantly (Farag & Mallin, 2017). Additionally, a one standard deviation increase in board gender diversity leads to a 39.80%, 50.97% and 38.61% increase in the distances to default, insolvency, and capital, respectively. The same authors found that three or more women on the board considerably decrease bank-specific credit risks when compared to boards with lower female representation (Kinateder et al., 2021).

Despite the above-mentioned evidence, Sahay and Čihák (2018) pointed out that women amounted to less than 2% of financial institutions' Chief Executive Officers (CEOs) and under 20% of executive board members. And, contrarily to general perception, several low- and middle-income countries have higher female representation on bank boards than advanced economies. That same study states that, while evidence suggests that larger inclusion of women as users of financial services has beneficial macroeconomic impacts, women still account for the majority of the financially excluded, with some regional idiosyncrasy. In the same IMF Working Paper, evidence is found that banks with higher shares of women on the board present larger capital buffers, a lower percentage of non-performing loans, and superior stress resistance. Likewise, Cardillo et al. (2020) concluded that banks with a higher share of women on the board demanded less public funding during the financial crisis when compared to banks with little board gender diversity. Besides, narrowing the gender gap is expected to foster greater banking stability and economic growth, which ultimately can contribute to more effective fiscal and monetary policies (Sahay & Čihák, 2018). Theoretical studies suggest that inequality can hamper economic development (Lagerlöf, 2003). Accordingly, evidence shows that increasing women's labour force participation not only helps promote growth, but also diversifies economies, diminishes inequality, mitigates demographic shifts, and contributes to financial stability (Kochhar et al., 2017).

Different hypotheses for such phenomena arise in the existing literature, with a lack of consensus among specialists. Some argue this relationship can be explained by a higher risk-aversion of female leaders when compared to their male peers (Jianakoplos & Bernasek, 1998). Others did not find empirical evidence establishing such connection. Farag and Mallin (2017) found female directors on the management board were not risk averse. Analysing a sample of U.S. commercial banks (2002–2018), Abou-El-Sood (2021) found that, in well-capitalised banks with large capital ratios, when female directors identify the positive returns arising from risky investments and when power moves away due to CEO equity ownership, banks tend to pursue risker investment strategies. The contrary happens when women on the board of directors perceive the drawbacks of risky investments during financial crises.

Nonetheless, this study focuses on the impact of bank board gender diversity on financial stability, regardless of the risk profile of female directors. Hence, it is important to understand the concept of financial stability and the existing literature on how to measure it. According to the World Bank, financial stability "is about the absence of system-wide episodes in which the financial system fails to function (crises)" and "about resilience of financial systems to stress". A stable financial system allows for a more efficient resource allocation, assessment and management of risk and contributes to keeping employment levels close to the natural rate by eliminating real price movements that disturb monetary stability and employment levels (World Bank, 2015). Consequently, a financial system can be considered stable when it is capable of dissipating financial imbalances that occur endogenously or that result from unforeseen events, by absorbing the shocks. Thus, financial stability is pivotal to economic growth, as most transactions depend on the financial system.

To understand the relationship between governance and finance, with a diversity lens, it is important to analyse the current European policy context on the topic and what is being made to address the subject. Looking at data from the European Institute for Gender Equality (EIGE), in the EU, women represent 60% of new university graduates. Nonetheless, in economic decision-making positions, as of June 2022, only 31,5% of board members of EU publicly listed companies are women and they constitute only 8% of board chairs.

In an attempt to foster gender equality, governments and organisations have been developing diverse programs and strategies. One of the most common ones is the implementation of gender quotas. According to Reuters, in March 2022, the European Union gave initial approval to board quotas for women. And, on 17 October 2022, the European Council adopted the final EU law to promote gender representation on the boards of listed companies. Even though it is still to be transposed into national law, the directive enforces that a minimum of 40% of non-executive directors of listed companies should be individuals of the underrepresented sex by 2026. Additionally, if Member States decide to also apply the rule to executive directors, the benchmark quota is 33% of all director positions. This rule comes with the expectation that women's involvement in economic decision-making at the top level will have a positive spillover effect on female employment, which, according to existing literature, boosts economic growth, improves competitiveness, and tackles the demographic challenge Europe is facing.

The literature around such policy implementation points in different directions, and it tends to focus on its impacts on firm performance, rather than financial stability. A study on the impact of a gender quota on selection found that a stricter quota leads to an increase in competence, especially among male individuals (Besley et al., 2017). Simultaneously, despite the positive impacts on female representation and diversity in firms, there are mixed performance effects and evidence suggests that such policy implementation cannot be justified through economic efficiency (Smith, 2018). The same author points out that the short-term performance impacts are insignificant or negative, and more time is needed to retrieve conclusions and establish long-term effects.

In Europe, the first country to enact national quotas for female board representation was Norway (2016). Matsa and Miller (2013) used such implementation to study its effects on corporate decision-making. The authors found evidence that gender quotas influence corporate strategy: short-run profitability decreased in affected firms due to increased labour costs caused by fewer lay-offs and higher relative employment. Mixed evidence was found on the quota effects on labour market outcomes for young women. Analysing the same law, Bertrand et al. (2017) found limited impact on women in business beyond the ones directly appointed as board members. They observed that the appointed women after the quota implementation had a higher qualification level than their female predecessors and that the gender gap in board earnings decreased. Contrarily, Ahern and Dittmar (2011) found that the same quota implementation led to younger and less experienced boards, and that companies experienced a stock price drop at the announcement of the law.

A study by the IZA World of Labour analyses the effects of introducing a gender quota law on the boards of listed companies in Italy. They found that such implementation was associated with a greater share of women directors, higher educational levels among all board members and lower demographics in terms of age. Thus, the authors reject the hypothesis that gender quotas lead to a decrease in economic performance, and state that there was a positive stock market reaction upon board election (Ferrari et al., 2016). Finally, in terms of perception, Radojevic (2022) examines how quotas affect party elites' perceptions of quota beneficiaries. The author finds that, contrary to initial expectations, being perceived as a "quota woman" only has a negative impact among radical right elites. Nevertheless, literature on the subject is limited given the recent implementation of gender quotas.

Overall, the literature suggests that greater board gender diversity can positively impact firm performance, through better resource allocation, transparency, and governance, which can ultimately impact capital buffers, risk strategies and financial stability. Besides, increasing female labour force participation, namely in decision-making positions, can foster economic and financial development in different spheres. Accordingly, this paper empirically tests the initial hypothesis and investigates the impact of female representation on financial stability, as detailed in the following sections, contributing to the literature by focusing on financial stability and the EU banking sector.

3. Data & Methodology

3.1. Data and Sample Selection

To test the hypothesis that a higher share of women on the board of directors is associated with greater financial stability, it was used a data set consisting of information on the board composition and financial data of banks in European Union from 2015-2021. Additionally, Switzerland was included due to its close link to the EU and impact in the European banking system. Concentrating the analysis on EU banks is expected to improve the within-sample comparability of banks from different countries, due to their regulatory and accounting similarities[3].

The dataset is composed of panel annual data for the 7 years above mentioned. This time frame was selected due to data availability constraints and to analyse banks after the implementation of the Single Supervisory Mechanism[4] (SSM) in 2014, since it establishes a

[3] Despite not belonging to the Euro Area, and therefore not being under SSM supervision, Denmark, Poland, and the Czech Republic are part of the European Union and follow similar accounting and regulatory standards, being included in the sample.
[4] System of banking supervision in Europe, composed of the European Central Bank (ECB) and the national supervisory authorities (NCAs) of the participating countries.

common approach to banking supervision activities and ensures the consistent application of regulations and supervisory policies. Additionally, it intends to isolate the results from possible effects arising from the Great Financial Crisis.

The data collection steps were, as follows: (1) there were selected all entities belonging to the banking sector, located in the European Union and Switzerland, with board composition data available on BoardEx, from 2015-2021; (2) annual bank-level financial data was retrieved from BankFocus at the highest consolidation level available (C2)[5]; (3) some banks were excluded due to their business models, namely, central banks, multilateral development banks, non-bank holding companies and specialised governmental credit institutions, as their operational specifications influence financial ratios, capital buffers, board composition, and therefore possible results; besides, these banks have an idiosyncratic contribution to financial stability, because of their mission as government institutions and social/development purpose; (4) country-level data and gender statistics were collected from AMECO (Annual macro-economic database) and World Bank Data, respectively. All figures collected represent end-of-the-year data and variables denominated in percentage terms follow a scale from 0 to 1.

Merging all data, the final sample consists of 93 banks, spread across 20 countries, and therefore, given the 7-year time frame, 651 observations. In the regressions detailed in *Section 4.*, some of these observations are dropped from the initial sample, according to each regression's specifications and data availability.

3.2. Empirical methodology and variables description

To analyse the relationship between board gender diversity and financial stability in the banking sector, this paper builds on the work by Sahay and other IMF staff members (2017), but rather focuses on the European Union scope. It tests for such hypothesis by running a fixed effects regression on panel data, to control for bank heterogeneity and other unobservable changes in company characteristics that might affect the results. The estimated regressions took the following equation as a baseline:

$$Y_{itc} = \beta_1 X_{itc} + \beta_2 controls_{itc} + \partial_t + \lambda_c + \varepsilon_{itc} \quad \text{(I)}$$

[5] When data was not available at such consolidation level (C2), the subsequent level was used, according to the following order: C2, C*, C1, U*, U1.

where we aim to estimate the effect on Y of a change in X, for bank i located in country c at time t, controlling for observable characteristics and employing country (λ_c) and year (∂_t) fixed effects.

A first regression uses the *z-score* as the dependent variable (Y). Literature on financial stability focuses on analysing the *z-score*, using it as a firm-level standard measure (see, for example, Čihák & Hesse (2008); Demirgüç-Kunt & Huizinga (2012); Sahay et al. (2017); Sahay & Čihák (2018)). This indicator explicitly compares buffers (capitalisation and returns) with risk (volatility of returns) to measure the solvency risk of banks. Theoretically, it is defined as follows:

$$z = \frac{k + \mu}{\sigma} \quad \text{(II)}$$

where k is total capital as a percentage of total assets, μ is the return on assets, and σ is the standard deviation of the return on assets as a proxy for return's volatility. As in Sahay et. al (2017), it is calculated as the sum of the book values of capital (total capital/total assets) and profit (return on assets) averaged by volatility of returns (standard deviation of the return on assets over the previous three years). According to the World Bank, the common use of the *z-score* as a financial stability measure is related to the fact that it has a (direct) negative relationship to the probability of insolvency. Therefore, a higher *z-score* indicates a lower probability of insolvency. The *z-score* is frequently measured in terms of standard deviations from the mean (Čihák & Hesse, 2008). In the empirical model, the variable is transformed into its natural logarithmic form[6], due to its highly (right) skewed distribution[7] and to interpret results in relative terms (%).

Secondly, another regression was run using the ratio of non-performing loans to total gross loans (*NPL ratio*) as the dependent variable (Y), to capture financial soundness at systemic-level and to understand if credit risk is lower with higher female board representation. The World Bank also suggests the ratio of non-performing loans as a financial soundness measure, capturing the distribution of systemic loss and complementing the bank-level perspective provided by the analysis of the *z-score*. Additionally, an ECB Working Paper shows that an increase in the NPL ratio change is likely to decrease bank lending volumes, widen bank lending spreads, and ultimately lead to a decrease in real GDP growth. Besides, it provides evidence

[6] See, for example, Chiaramonte et al. (2016) and Bitar et al. (2021)

[7] Graphical representation in Appendix I.

that reducing banks' NPL ratios can potentially produce significant benefits for Euro Area countries, by improving macroeconomic and financial conditions (Huljak et al., 2020).

The independent variable of interest (X) is the share of women on the board of directors of banks as a percentage of total board members (*share of women*). Other independent variables were added to account for board characteristics, country data and bank-level controls (Table I). Besides, country and year-fixed effects were implemented to control for global cyclical characteristics, which can affect stability in several banks and the global (and European) economy.

This study also analyses the impact of female representation by using two alternative measures of board gender diversity, while testing for robustness, as it is further detailed in *Section 4.2*. Furthermore, it attempts to compare the results of banks located in countries where gender quotas with the potential of affecting board composition were implemented through a difference-in-differences (DiD) methodology.

Table I | Descriptive statistics[8].

Description		**Obs**	**Mean**	**Median**	**Std. Dev.**	**Min.**	**Max.**
Key dependent variables							
Z-Score	Sum of total capital to total assets ratio and the return on assets (ROA) divided by the standard deviation of ROA over the 3 last years.	584	112.3415	53.6266	211.9006	1.4514	2680.4140
ln (Z-Score)	Natural logarithm of the sum of total capital to total assets ratio and the return on assets (ROA) divided by the standard deviation of ROA over the 3 last years.	584	3.9671	3.9820	1.2365	0.3725	7.8937
NPL ratio	Nonperforming loans to total gross loans.	625	0.0625	0.0346	0.0929	0.0003	1.0000
Key explanatory variable							
Share of women	Share of female directors on the board of directors (%)	650	0.2815	0.2835	0.1215	0.0000	0.5710
Controls							
Bank-level | Board Composition							
Board size	Total number of directors on the board of directors	650	13.9123	13.0000	5.3121	2.0000	32.0000
Board experience	Mean of the average time each director sits on the Board of Quoted Companies	642	2.7171	2.6000	1.6791	0.0000	9.3000
Board qualification	Average number of qualifications at undergraduate level and above for all the directors at the annual report date selected	651	1.9661	2.0667	0.6699	0.0000	3.7500
Gender quota	Dummy variable that takes the value of 1 if and when the bank is legally binded to adopt a gender quota	651	0.3011	0.0000	0.4591	0.0000	1.0000
Bank-level | Financial data							
Bank size	Natural logarithm of Total Assets (th EUR)	640	17.8443	17.6102	1.9413	11.8410	21.6919
Quoted	Dummy variable that takes the value of 1 if the banks is publicly listed	651	0.7742	1.0000	0.4184	0.0000	1.0000
ROE	Return on Equity of the bank calculated as Net Income divided by Equity	640	0.0684	0.0703	0.1040	-0.5590	0.6419
CAR	Capital Adequacy Ratio has reported by banks	612	0.1869	0.1805	0.0413	0.0572	0.4168
Country-level							
GDP growth	Natural logarithm of GDP per capital at constant prices at country and year level	651	3.6006	3.6402	0.4467	2.4069	4.4308
Female to male	Ratio of female to male labor force participation rate (%) (modeled ILO estimate)	651	0.8189	0.8407	0.0628	0.6416	0.9065
Female Employment	Employment to population ratio, 15+, female (%) (modeled ILO estimate)	651	0.4921	0.5146	0.0730	0.3177	0.6001
Alternative Measures of Board Gender Diversity							
Critical Mass	Dummy variable that takes the value of 1 if the board of directors is composed of at least 20% of female directors and at least 3 women	651	0.6667	1.0000	0.4718	0.0000	1.0000
Woman	Dummy variable that takes the value of 1 if the board of directors is composed of at least 1 woman	651	0.9585	1.0000	0.1995	0.0000	1.0000

Note: The variables *NPL ratio, Share of women, ROE, CAR, Female to male* and *Female Employment* are represented in percentage terms in a scale from 0 to 1.

[8] Appendix II reports the data sources for each variable described in Table I.

3.3. Summary statistics

In this section, one can find general descriptive statistics, with a special focus on the distribution of the sample, the main explanatory variable (*share of women*) and the main dependent variables (*z-score* and the *NPL ratio)*. The statistics associated with the *z-score* are below detailed in its accounting measure, without the natural logarithm transformation.

Table I reports the summary statistics for the variables used in the empirical analysis, complemented with brief variable descriptions. One can observe that the two main dependent variables, *z-score* and *NPL ratio*, have a median value of 53.6266 and 0.03446 (3.446%) and a mean of 112.3415 and 0.0625 (6.25%), respectively. Table II provides an overview of the composition of the sample by country and Table III reports the sample distribution per business model. Overall, the sample is composed of 20 countries, distributed among 8 different business models. Tables II and III show that, among the 20 countries in the sample, France (12.90%), Italy (12.90%) and Switzerland (11.83%) have the largest representation and that the sample is mostly composed of commercial banks (67.74%).

Analysing the *share of women*'s distribution per year, Figure I shows that the average percentage of female individuals on the board of directors has been increasing. In the studied period (2015-2021), the average *share of women* grew from approximately 22.6% to 33% (10.4 pp increase). Nonetheless, in 2021, there are still banks in the sample with no female board representation, as the minimum *share of women* remained constant and equal to 0% in the period.

Among the countries in the study, Sweden shows the highest average female board representation (41.4%), followed by Finland (37.4%) and France (36.9%). On the other hand, Malta shows the lowest average *share of women*, with an average of 7.5% women on the board of directors, being the only country with a representation below 10%. Cyprus (19%) and Greece (19,6%) follow Malta as the countries with the lowest average board gender diversity (Figure II).

Looking at the evolution per country from 2015 to 2021 (Figure III), Latvia (25 pp) and the Republic of Ireland (20.3 pp) show the largest absolute increase in the average *share of women*, followed by the Czech Republic (20 pp) and Spain (19.9 pp). On the opposite trend, only two countries show decreases in the average variable, with Poland experiencing the largest decrease (-8.3 pp), followed by Finland (-6.6 pp). In 2021, Italy has the highest average female board representation (43.6%), with Ireland (40.8%), Sweden (40.5%) and France (40.5%) immediately after.

Figure IV shows the evolution of the average values of both dependent variables in study, the *z-score* and the *NPL ratio*. The *z-score* has been varying throughout the period, without a clear trend, going from an average of 88.92 (2015) to its minimum average value of 52.57 (2021), with its maximum yearly average being reached in 2019 (162.61). The *NPL ratio*, on the other hand, shows a clearer average decreasing trend, from 8.5% in 2015 to 3.5% in 2021.

Overall, these summary statistics suggest that there has been an average increase in board gender diversity in the sample, with some country idiosyncrasy. Additionally, looking at financial stability at bank-level, the banks in the sample show an average decrease in the *z-score*, and therefore an increase in the probability of insolvency. On the other hand, at systemic-level, banks show a decrease in the average *NPL ratio*, which suggests an increase in the credit quality of the sample. More details on the distribution of these variables can be found in Appendix III.

Table II | Sample composition and country representativeness

Country name	**Banks**	**Sample %**
Austria (AT)	8	8.60
Belgium (BE)	2	2.15
Cyprus (CY)	3	3.23
Czech Republic (CZ)	1	1.08
Denmark (DK)	6	6.45
Finland (FI)	3	3.23
France (FR)	12	12.90
Germany (DE)	5	5.38
Greece (GR)	2	2.15
Italy (IT)	12	12.90
Latvia (LV)	1	1.08
Lithuania (LT)	1	1.08
Malta (MT)	2	2.15
Netherlands (NL)	6	6.45
Poland (PL)	3	3.23
Portugal (PT)	2	2.15
Republic of Ireland (IE)	3	3.23
Spain (ES)	6	6.45
Sweden (SE)	4	4.30
Switzerland (CH)	11	11.83
Total	93	100.00

Table III | Sample composition and Business Model distribution

Business Model / Specialisation	**Banks**	**Sample %**
Bank holding company	8	8.60
Commercial bank	63	67.74
Cooperative bank	11	11.83
Investment & trust corporation	1	1.08
Investment bank	2	2.15
Private banking	2	2.15
Real estate & mortgage finance institution	4	4.30
Savings bank	2	2.15
Total	93	100.00

Figure I | Distribution of share of women per year: mean, maximum and minimum values

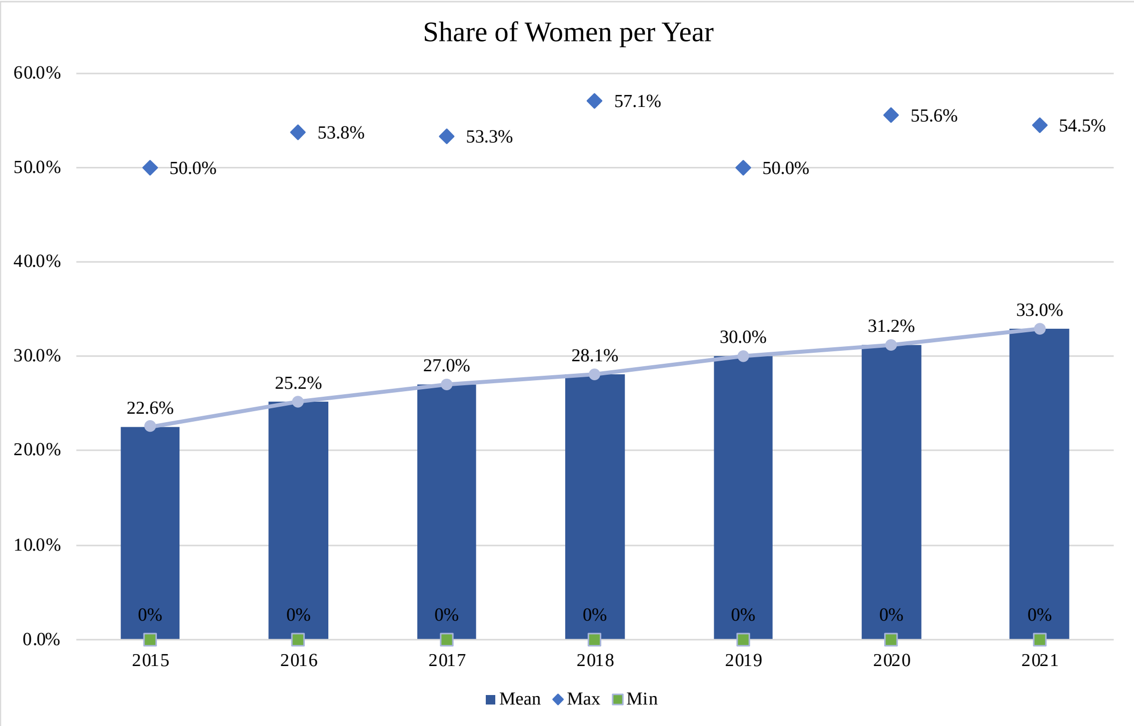


Figure II | Distribution of share of women per country: mean, maximum and minimum values

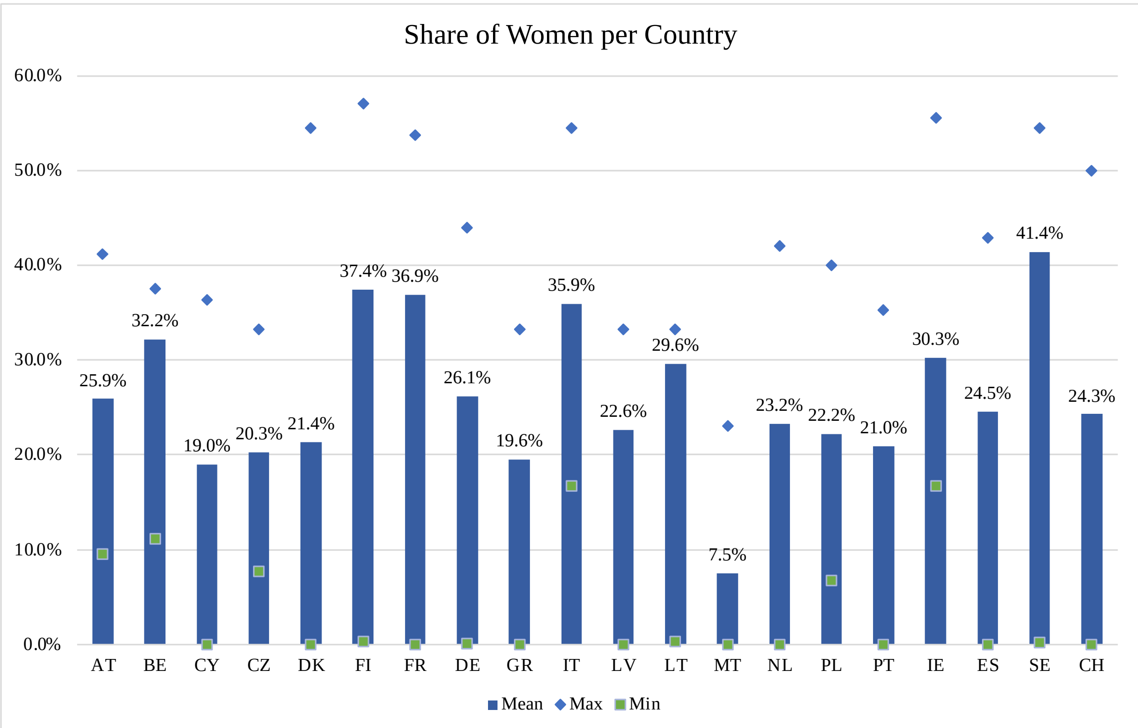


Figure III | Distribution of the average share of women per country: 2015 vs 2021 and absolute change in the period

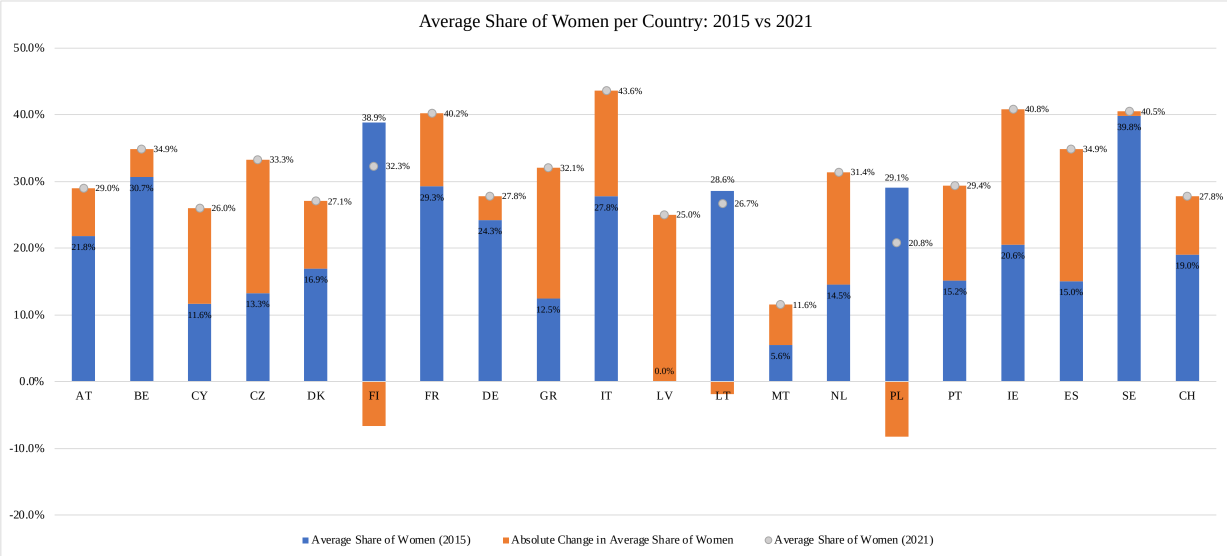
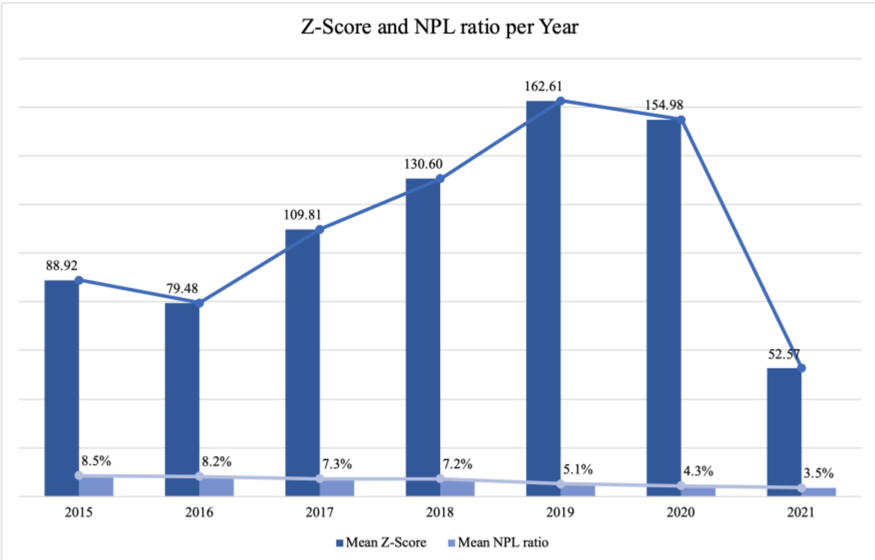


Figure IV | Distribution of the z-score and NPL ratio per year: mean values



4. Empirical Analysis

4.1. Regression Results and Analysis

Table IV presents the results for the fixed-effects regressions with the *z-score* (in natural logarithmic terms, i.e., *ln (Z-Score)*) and *NPL ratio* as the main dependent variables. Relevant entity, country, and time-variant controls were included to increase the estimators' accuracy in each specification, keeping the year and country fixed effects constant. In columns (1) to (3) and (4) to (6), the different specifications vary in the number of controls employed, with (1) and (4) using one control at board, bank, and country level, and (3) and (6) using the full set of controls, accounting for other additional characteristics such as *board experience*, return on equity (*ROE*) and *female-to-male* labour force participation.

Table IV | Female board representation and financial stability: empirical results

Variables	(1) ln (Z-Score)	(2) ln (Z-Score)	(3) ln (Z-Score)	(4) NPL ratio	(5) NPL ratio	(6) NPL ratio
Share of women	2.267***	1.897***	1.899***	-0.069**	-0.075**	-0.066**
	(0.502)	(0.521)	(0.519)	(0.029)	(0.033)	(0.032)
Board size	-0.027*	-0.040***	-0.036**	0.001	0.001	0.000
	(0.015)	(0.015)	(0.015)	(0.001)	(0.001)	(0.001)
Bank size	-0.006	0.051	0.051	-0.001	-0.002	-0.004*
	(0.033)	(0.035)	(0.036)	(0.002)	(0.002)	(0.002)
GDP growth	-1.350	-0.997	-0.426	0.020	0.003	0.114
	(1.288)	(1.280)	(1.394)	(0.076)	(0.082)	(0.086)
Board experience		0.008	0.029		-0.005**	-0.006***
		(0.032)	(0.033)		(0.002)	(0.002)
Board qualification		-0.341***	-0.338***		0.014**	0.016**
		(0.102)	(0.102)		(0.007)	(0.006)
Quoted		0.468***	0.427***		-0.023**	-0.013
		(0.150)	(0.155)		(0.010)	(0.010)
Gender quota		0.096	0.083		0.018	0.006
		(0.182)	(0.184)		(0.012)	(0.011)
Female to male		-8.027	-2.554		1.122***	1.455***
		(5.840)	(6.660)		(0.372)	(0.406)
NPL ratio		-3.207***	-2.840***			
		(0.674)	(0.706)			
Z-Score					-0.000	-0.000
					(0.000)	(0.000)
Female Employment			-10.113			-1.294***
			(6.792)			(0.415)
ROE			1.108**			-0.215***
			(0.518)			(0.031)
CAR			2.275*			0.022
			(1.340)			(0.083)
Observations	583	569	564	624	569	564
R-squared	0.311	0.390	0.405	0.548	0.532	0.579
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.275	0.352	0.363	0.525	0.502	0.550
F-test (p-value)	0.000	0.000	0.000	0.143	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

All specifications using the *z-score* as the main dependent variable provide strong support to the hypothesis that a higher *share of women* on the board of directors contributes to a higher *z-score*[9]. Looking at specification (3), controlling for more variables, findings suggest that the estimated coefficient on the *share of women* was positive and statistically significant at a 1% level of significance. These results imply that, on average, *ceteris paribus*, a 1 pp increase in the *share of women* on the board of directors leads to, approximately, a 1.899 percentage increase in the *z-score*, therefore reducing the probability of insolvency and increasing financial stability at bank-level. Additionally, evidence suggests that, on average, increases in *board size* and *board qualification* decrease the *z-score*. Both coefficients were found to be statistically significant, at a 5% and 1% significance level, respectively.

Looking at regressions (4) to (6), using the *NPL ratio* as the main dependent variable, evidence provides strong support to the hypothesis that a higher *share of women* on the board

[9] Considering the specifications using the ln(z-score) as dependent variable are log-linear models, coefficients are interpreted as percentages. When independent variables are detailed in percentage terms (between 0 and 1), the coefficient is divided by 100 before applying the percentual interpretation.

of directors contributes to a lower *NPL ratio*. Specification (6) suggests that, on average, a 1 pp increase in the share of women on the board leads to a 0.066 pp decrease in the *NPL ratio*. Such coefficient is statistically significant at a 5% significance level. Considering the mean value of the *NPL ratio* (6.25%), this coefficient shows considerable impact, given the financial nature of the variable, and that reductions in non-performing loans in banks' balance sheets can be substantially beneficial to the economy, at micro and macroprudential levels (ECB, 2017).

Further analysing the results on *board qualification*, the opposite signs of the coefficient, being negative on the *z-score* and positive on the *NPL ratio*, suggest that an increase in *board qualification*, on average, deteriorates financial stability. Such results might be related to: (1) the fact that the variable is measured as the average number of qualifications at undergraduate level and above for all the directors, that is, one would have to further investigate the marginal impacts for board governance associated with further education above undergraduate level, and/or (2) other board dynamics, as changes in composition, that despite increasing the educational level, might lead to periods of transitional instability. Nonetheless, further investigation would have to be done on the topic to retrieve meaningful evidence and test for such hypothesis. Also, the results on *board experience* were inconclusive in regressions (2) to (3), considering that despite the positive coefficient (0.008 and 0.029, respectively) the variable is not statistically significant. On the other hand, the variable was found to be statistically significant in specifications (5) and (6), with a 5% and 1% significance level, respectively, suggesting a small but negative average impact on the *NPL ratio*. Despite inconclusive, the results are aligned with the literature, showing that board composition is a complex and cognitive dynamic process (Nordberg & Booth, 2019) and needs to be further investigated beyond gender lenses.

Analysing regression (3), one understands that, on average, an increase in the *NPL ratio* negatively contributes to financial stability at bank-level (-2.840), with a 5% statistical significance. This finding is aligned with the idea that systemic risk has the potential to affect individual-level stability and severely compromise the real economy (Caruana, 2010). On the contrary, the *z-score* was not found statistically significant in regression (6). This might be explained by the ability of systemic risk (*NPL ratio*) to compromise bank-level stability, while individual instability might have limited impact in the overall financial system.

Looking at macroeconomic variables such as the *female-to-male labour force participation rate* and *female employment-to-population ratio*, no statistical significance was found in regression (3). Yet, both were found to be statistically significant at a 1% significance level in specification (6). However, the two variables show coefficients with opposite signs, suggesting that, on average, a 1 pp increase in the *female-to-male labour force participation rate* leads to a 1.455 pp increase in the *NPL ratio*, deteriorating financial stability, and a 1 pp increase in *female employment-to-population ratio* leads to a 1.294 pp decrease in the *NPL ratio*, improving financial stability. Concluding, no clear hypothesis can be drawn from such evidence. On one side, the significance of such variables when testing for system-level financial stability (*NPL ratio*), rather than for bank-level stability (*z-score*), might be explained by their macroeconomic nature, being in consonance with the literature on the potential effects of macroeconomic trends in systemic-risk and its connection to the real economy (Giglio et al., 2016). Nonetheless, it does not explain the different signs of the coefficients. One hypothesis that might support such discrepancies may be the fact that increasing *female-to-male labour force participation* does not necessarily imply an increase in the representation of women in positions within economic decision-making power, and therefore, with limited impact on financial stability. Besides this ratio explores the female labour force participation compared to the male, so more information on the drivers of changes in the variable would be necessary to test for such hypothesis.

Finally, there is evidence supporting that an increase in the return on equity (*ROE*) improves financial stability, both at bank and systemic levels. In specifications (3) and (6), such variable is statistically significant at a 5% and 1% significance level, respectively. This suggests that, on average, a 1 pp increase in *ROE* leads to a 1.180 percent increase in the *z-score* and a 0.215 pp decrease in the *NPL ratio*. According to the ECB, bank's profitability is an important driver of capital and financial intermediation resilience and, ultimately, financial stability. Therefore, the evidence above-mentioned is aligned with financial theory.

4.2. Alternative measures for board gender diversity and female representation

To test for the robustness of the results, different specifications were run using the baseline model, namely regressions (3) and (6), replacing the explanatory variable, *share of women*, with two alternative measures of board gender diversity (Table V).

The first variable, *woman*, is a dummy variable that accounts for the presence of at least one woman on the board, taking the value of 1 in that case and 0 otherwise. The second specification draws from the literature on the critical mass theory which argues that, as a minority group in boards (as it is the case in the studied sample), women may have limited power and influence in the decision-making process (Westphal & Milton, 2000). Therefore, this dummy variable (*critical mass*) builds on the findings by Farag and Mallin (2017) and Kinateder et al. (2021)

and takes the value of 1 if the board of directors is composed of at least 20% of female directors and at least 3 women.

Table V | Alternative measures of board gender diversity: empirical results and robustness check

Variables	(7) ln (Z-Score)	(8) ln (Z-score)	(9) NPL ratio	(10) NPL ratio
Woman	0.212		-0.042**	
	(0.271)		(0.016)	
Critical Mass		0.256**		-0.015*
		(0.125)		(0.008)
Observations	564	564	564	564
R-squared	0.390	0.394	0.581	0.578
Controls	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Adjusted R2	0.347	0.352	0.551	0.548
F-test (p-value)	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The complete empirical results including the controls' coefficients can be found in Appendix IV

Looking at regression (9), results provide strong support to the hypothesis that there is an average difference of -0.042 pp in the *NPL ratio*, between banks with at least one woman on the board of directors compared with banks with no female board-level representation. Such coefficient associated with the variable *woman* was found to be statistically significant at a 5% significance level. This provides empirical evidence that female representation is associated with greater financial stability at systemic-level and further supports the main findings above detailed. Nonetheless, no statistical significance was found for such variable in regression (7). Comparing the magnitudes of the *share of women* coefficients in (6) and (9), one can understand that simply having at least one woman on the board does not contribute to systemic financial stability as much as experiencing a 1 pp increase in *share of women*. That is, a 1 pp increase in *share of women* leads to, on average, a larger decrease in the *NPL ratio* by 0.024 pp.

Now analysing specifications (8) and (10), the coefficient associated with the variable *critical mass* is positive for the *z-score* (0.256), and statistically significant at a 5% significance level, and negative for the *NPL ratio* (-0.015), with a 10% significance level. Thus, evidence suggests that a banks with a board of directors composed of at least 20% female directors and 3 women have, on average, a lower *NPL ratio* and a higher *z-score* than those that do not fulfil such criteria. Therefore, evidence supports the critical mass theory detailed in the literature.

Overall, the above-mentioned results strengthen the initial hypothesis that higher board gender diversity is associated with greater financial stability and provide robustness to the initial findings.

4.3. Difference-in-differences (DiD) analysis

Despite the mixed and limited literature on the effects of gender quotas, different countries in the European Union have been implementing such policy, mainly triggered by the directive of the European Parliament and the Council (2012) to improve gender balance among board directors of listed companies. According to different sources[10], up until 2021, Austria, Belgium, Germany, France, Greece, Italy, the Netherlands, and Portugal have implemented gender quotas, joined by Switzerland[11]. More details on the countries implementing gender quotas and respective quota thresholds can be found in Table VI.

Table VI | Gender Quotas: countries, implementation year and quota minimum

Country name	Quota Implementation	Year of Implementation	Quota Threshold (Minimum)	Banks with gender quota
Austria (AT)	Yes	2018	30.0%	5
Belgium (BE)	Yes	2011	33.3%	1
Cyprus (CY)	No	-	-	-
Czech Republic (CZ)	No	-	-	-
Denmark (DK)	No	-	-	-
Finland (FI)	No	-	-	-
France (FR)	Yes	2017	40.0%	8
Germany (DE)	Yes	2015	30.0%	4
Greece (GR)	Yes	2021	25.0%	2
Italy (IT)	Yes	2011	33.3%	12
Latvia (LV)	No	-	-	-
Lithuania (LT)	No	-	-	-
Malta (MT)	No	-	-	-
Netherlands (NL)	Yes	2021	33.0%	3
Poland (PL)	No	-	-	-
Portugal (PT)	Yes	2018	33.3%	1
Republic of Ireland (IE)	No	-	-	-
Spain (ES)	No	-	-	-
Sweden (SE)	No	-	-	-
Switzerland (CH)	Yes	2021	30.0%	8
Total				44

Given the general lack of literature on the effects of such policy implementation, namely on financial stability, this paper briefly analyses the impact of gender quotas on the two main variables in study (*z-score* and *NPL ratio*). Taking advantage of the policy shock, it attempts to use a quasi-experimental approach to observe the potential effects of imposing gender quotas, through a difference-in-differences methodology. This method allows to compare changes over time in a group unaffected by the policy, *control group*, to the changes over time in a group affected by the intervention, *treatment group*, attributing the difference-in-differences effect to the policy implementation.

Firstly, non-listed banks were excluded from the analysis, given that gender quotas were only applied to listed companies in the countries in study. This allows to strengthen the assumption of no spillover effects and increases comparability across both groups.

[10] Namely, data and information from the International Labour Organisation (ILO), OECD and Delloite.

[11] Despite being outside the European Union, Switzerland is economically related to it and has adopted several provisions of European Union law.

To identify the treatment and control groups, a dummy variable was created (*treated*), that takes the value of 1 for banks located in countries that have enacted mandatory gender quotas and 0 otherwise. The *control* and *treatment* groups are composed of 28 and 44 banks, respectively.

Additionally, the variable *post-treatment* captures if the bank is in the pre- or post-treatment period, taking the value of 0 or 1, respectively. This variable accounts for the multiple times of implementation across the sample (Table VI), becoming 1 once the policy is enacted in the given country where the bank is located. For the *control* group, where no policy was implemented, this variable takes the value of 1 in 2018. Even though, in empirical terms, the control group is never in post-intervention, this method enables the comparison between the outcomes before and after the policy implementation[12]. For the control group, the chosen implementation year does not influence the results, given that year-fixed effects will be added to the difference-in-differences regression to ensure comparability across all years[13].

Afterwards, a propensity score method (PSM) was applied to further ensure comparability across both groups, minimize selection bias and possible endogeneity issues, and address the concern that the *treatment* and *control* groups may differ in characteristics that could potentially affect their trends over time. To adjust for pre-treatment observable differences, a propensity score matching (calliper at 0.05) was employed across both groups, relying on radius matching where the dependent variable identifies the treatment group (*treated)* and then matching the two groups based on their *z-score* and *NPL ratio*. This PSM contains the control variables employed in the baseline model (Table I)[14]. Common support is found for most of the observations (Appendix V), ensuring an overlap in the range of propensity scores across comparison groups. Therefore, *off-support* observations were dropped, restricting the estimation of the treatment effect to the region of common support. This methodology is aligned with different studies on the subject (see, for example, Ivashina et al. (2008); Cardillo et al. (2020); Farag & Mallin (2017); Matsa & Miller (2013)) and with methodologies proposed in literature on impact evaluation and difference-in-differences methodologies (see, for example, Stuart et al. (2014); Caliendo & Kopeining (2005); Fredriksson & Oliveira (2019)).

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[12] This artificial implementation time allows to create 4 distinct groups to be compared: control group pre-intervention, treated group pre-intervention, control group post-intervention, and treated group post-intervention.

[13] In this case, 2018 was chosen as the implementation year given it represents the median year of the studied period and considering that most of the countries implementing such policy between 2015 and 2021 did so in 2018 (Table VI).

[14] The variable *Quota* was excluded given we limit the study to listed companies.

Finally, the DiD model is estimated to examine whether changes in financial stability indicators are caused by the quota implementation. The model uses as independent variables *treated* and *post*, as above described. The main independent variable is an interaction term between *treated* and *post* (*treated · post*) and is expected to capture the estimated difference between the comparison groups in the *post-treatment* period. This regression includes controls for observable characteristics, as in the baseline model detailed in *Sections 3* and *4*, incorporating the propensity score as an additional control (propensity score adjustment) (see, for example, Austin, P.C. (2011)). The estimated regression took the following equation as a baseline:

$$Y_{itc} = \beta_1\, treated + \beta_2\, post\ treatment + \beta_3\, treated \cdot post + \beta_4 controls_{itc} + \partial_t + \lambda_c + \varepsilon_{itc} \qquad \text{(III)}$$

where we follow the baseline model in equation (I), but include the three dummy variables above described, with β_3 capturing the treatment effect.

Results suggest that the interaction variables' estimated coefficients are statistically significant at a 1% and 10% significance levels, for the *z-score* and *NPL ratio* respectively (Table VII). These findings corroborate the initial hypothesis and preliminarily suggest that the mandatory gender quota implementation had an estimated treatment effect of approximately 90.9 percent in the *z-score* and -0.023 pp in the *NPL ratio*. Nonetheless, these results must be analysed with further caution, given the limitations and shortcomings below detailed.

Table VII | Difference-in-differences analysis: estimated results

Variables	(11) ln (Z-Score)	(12) NPL ratio
Treated x Post	0.909***	-0.023*
	(0.259)	(0.013)
Controls	Yes	Yes
Propensity Score Adjustment	Yes	Yes
Observations	436	436
R-squared	0.434	0.711
Country FEs	Yes	Yes
Year FEs	Yes	Yes
Adjusted R2	0.383	0.685
F-test (p-value)	436	436

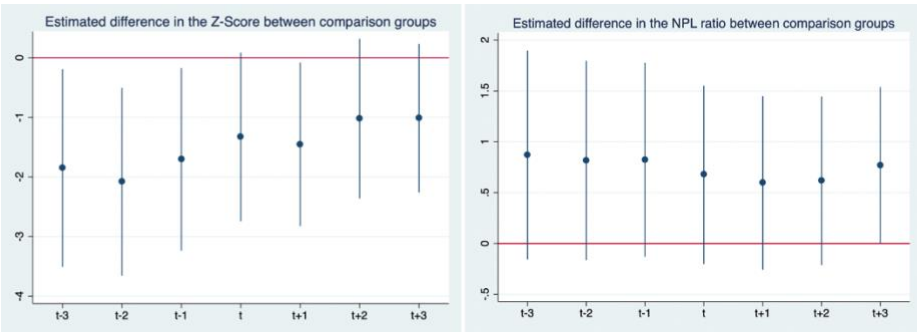
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3.1. Robustness Checks: testing for pre-existing trends and DiD shortcomings

To arrive at causal inference using a DiD method, one relies on the assumption of parallel counterfactual trends (Ahlfeldt, 2018). In the analysis above detailed, it is assumed that in the absence of treatment, and controlling for observable differences in the comparison groups, the difference between the *treatment* and *control* group would be constant over time.

Given we cannot empirically observe the counterfactual trends, one visually inspects the pre-implementation trends of the *z-score* and *NPL ratio* to assess if there is a parallel trend in that period. Using a country and year-fixed effects model specification on the common support region above determined, with the controls used in the baseline model, we obtain the estimated differences in the *z-score* and *NPL ratio* between the two groups, from *t-i* to *t+i*, with *t* being the implementation year of each bank and $i = \{1,2,3\}$. Plotting such coefficients from *t-3* to *t+3,* one can visualise the estimated differences between comparison groups for the two dependent variables in study (Figure V). In the pre-implementation period, the estimated difference in *z-score* between the two groups was negative and close to -2 with some variation. Nonetheless, the average difference decreases from *t* onwards, reaching -1 at *t-2*, and displaying a change in trend. For the *NPL ratio*, the estimated difference was constant around 0.8 from *t-3* to *t-1*, with an observable decrease in value in *t*, and considerable variation until *t+3*.

Figure V | Plot with the estimated differences between comparison groups (t-3 to t+3): z-score and NPL ratio



While for the *NPL ratio*, one fails to reject the hypothesis of pre-implementation parallel trends, since the estimated difference between the two groups is constant and approximately 1 in the period, such empirical evidence is not so clear for the *z-score*. This lack of clear evidence might be related to different points as, for instance: (1) omitted unobservable characteristics that might affect financial stability; (2) other observable characteristics that affect the variables in study and were not controlled for; (3) the different and multiple implementation periods, which do not allow to analyse a common pre- and post-intervention period for all banks; and (4) the time lag between the policy announcement and implementation, since usually gender quota policies are announced before becoming binding and allow for an adjustment period. Regarding the latter, in the sample in study, from the 27 banks located in countries that implemented mandatory gender quotas between 2016[15] and 2021, 10 were already fulfilling

[15] 2015 was not included in this analysis since there is no data available in the sample for the previous year (2014).

such threshold the year prior to the time of implementation.[16] In fact, banks may have changed their corporate strategy in anticipation of the policy implementation becoming binding (Matsa & Miller, 2013), which can ultimately influence financial stability, namely at bank-level (*z-score*). Thus, an analysis excluding such set of banks could allow to isolate the policy effect and be valuable for further research. From the remaining 17 banks, most were considerably far from fulfilling the quota at *t-1*, with only 3 banks being less than 5 pp below the threshold (Appendix VI). This time lag also opens the discussion around the exogeneity of the policy shock. While a quota implementation tends to be external and unpredictable, one can discuss such exogeneity, given there is a time buffer between announcement and implementation and banks already expect to have to comply with the quota threshold when it becomes binding.

Nonetheless, recent literature points out that matching methods can help increase the hypothesis of parallel trends, since matching on covariates is likely to reduce the bias associated with such covariates (Ham & Miratrix, 2022). The authors also showcase evidence that a decision to match on all available pre-treatment outcomes reduced bias and allowed for a more credible causal estimate. Additionally, Roth (2018) illustrates that the properties of a traditional DiD estimator do not hold conditional on having passed the standard pre-implementation test, suggesting other approaches to address such shortcomings. Bilinski and Hatfield (2019) also suggest that when rejecting parallel trends, not much can be understood on the magnitude of the violation and to what extent that influences results, since trivial differences in pre-trends can potentially lead to rejecting the strong assumption. Therefore, confidence in the estimated treatment effects relies on the reliability of the counterfactual extrapolation. A recent paper by Rambachan and Roth (2022) shows that the causal parameter of interest allows for (partial) identification conditional to a certain set of restrictions that impose that the post-implementation violation of parallel trends should be similar to the pre-trends. Overall, these authors point out that pre-implementation trends tend to be an intuitive method to test the parallel trends assumption, yet recent studies have shown that they might suffer from low power. Thus, they suggest that researchers should carefully reflect on the nature of the violations and robustness implications, rather than simply assuming the assumption holds or abandoning the DiD estimation upon the rejection of parallel trends.

To address such shortcomings, different methods were employed: (1) restricting the sample to ensure no spillover effects and increasing comparability across comparison groups; (2)

[16] No conclusions can be retrieved on this matter for the 17 banks with an implementation year before 2016 (Table VI).

controlling for observable characteristics; (3) adding year and country fixed effects to adjust for year idiosyncrasies and for all time-constant factors that vary across geographies; (4) using a PSM method, to create a more balanced sample and diminish self-selection bias, and including it as a control in the DiD model.

Nonetheless, given this study finds partial support to the pre-test on the parallel trends' assumption, the estimated treatment effect should be taken into account, but considered with caution, leaving space for further investigation.

5. Discussion, limitations, and further research

This paper finds empirical support for the hypothesis that a higher share of women on the board is associated with greater financial stability at individual and systemic levels. Nonetheless, some limitations should be considered, complementing the ones already outlined throughout the paper.

Firstly, one must bear in mind the shortcomings of the *z-score* as a financial stability measure, namely that it is calculated through accounting data, being as good as the underlying accounting and auditing frameworks. Even if reporting issues are disregarded, the *z-score* can potentially provide an over-optimistic view of financial stability since, by being a bank-level estimate, it might overlook default risk at systemic level. To address such limitations, this paper analysis also the non-performing loans ratio as a systemic-level measure that, despite being better known, still lags soundness indicators (Schaeck & Čihák, 2010).

Finally, this study might suffer from a certain degree of reverse causality, since one could argue that banks that appoint female directors are associated with prior greater financial stability. Accordingly, studies on corporate governance dynamics can potentially suffer from endogeneity problems (Coles et al., 2012).

Further research might be needed to address such limitations and focus on different dimensions of financial stability and board gender diversity. Firstly, one of this study's limitations lies in its data availability, especially regarding board characteristics. Increasing data disclosure and further expanding the sample in study and country representation would be important to enhance the current understanding of the topic.

Moreover, financial stability is highly influenced by financial inclusion in different dimensions besides board representation, so one could potentially explore the links between female economic participation and financial stability. It is also important to investigate the impact of female representation on corporate governance and board dynamics and how including women in decision-making might affect diverse financial inclusion scopes, considering the limitations of bank-stability measures and the importance of studying banks' contribution to society. Other aspects of financial inclusion and representation should not be disregarded, in order to understand the impact of different dimensions of diversity (socioeconomic, ethnical, etc.) on financial and economic outcomes.

Finally, further investigation is needed to understand the impact of policies that aim at fostering gender equality and what role can supervisory authorities play, namely the SSM.

6. Conclusion

Prior literature mostly focuses on firm performance in the corporate sector, disregarding financial stability indicators, and addresses the international or U.S. scope. After the Great Financial Crisis, it became clear that financial stability was crucial to build a safe and sound Banking Union and European Project. This paper extends the evidence on gender equality and financial inclusion, going beyond standard financial performance indicators and testing not only for the impact of a higher share of women on the *z-score* and *NPL ratio*, but also for the presence of at least one woman on the board and the existence of a critical mass of female representation.

Exploring panel data on banks located within the European Union, including Switzerland, and using a year and country-fixed effects model, results show that, on average, a 1 pp increase in the *share of women* on the board of directors leads to a 1.899 percent increase in the *z-score*, therefore reducing the probability of insolvency and increasing financial stability at bank-level. Besides, it provides strong support to the hypothesis that a higher *share of women* significantly contributes to a lower *NPL ratio*, showing that, on average, a 1 pp increase in the *share of women* on the board of directors leads to a 0.066 pp decrease in the *NPL ratio*.

Additionally, it employs a DiD methodology to study the effects of implementing gender quotas on financial stability. Despite results suggesting a positive impact arising from the policy, they should be cautiously analysed according to the limitations extensively outlined. Nonetheless, it provides an initial step towards the study of such policy implementation on financial stability.

The results found throughout this paper provide an important insight to policymakers, specifically in the European scope, and foster the conversation around human rights and financial inclusion. Gender diversity should not be a business case, but rather a matter of equality and inclusion. This study provides an empirical analysis on financial inclusion with a gender lens and further contributes to the discussion on how policies designed to ensure a levelled playing field are not only a matter of equity, human rights, and social justice, but pivotal to stimulate economic growth, benefiting the overall economy (Bertay et al., 2020).

References

Abou-El-Sood, H. (2021). *Board gender diversity, power, and bank risk taking.* International Review of Financial Analysis, 75, 101733.

Ahern, K. R., & Dittmar, A. (2011). *The Changing of the Boards: The Impact on Firm Valuation of Mandated Female Board Representation*. Quarterly Journal of Economics, 2012, vol. 127(1): 137-197. http://dx.doi.org/10.2139/ssrn.1364470

Ahlfeldt, G. (2018). *Weights to Address Non-parallel Trends in Panel Difference-in-differences Models.* CESifo Economic Studies, 64(2), 216–240. https://doi.org/10.1093/cesifo/ify013

Austin, P.C. (2011). *An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies*. Multivariate Behavioral Research. May 4. 6(3):399-424. doi: 10.1080/00273171.2011.568786.

Baczynska, G. (2022, March 14). *EU gives initial agreement to board quotas for women, more talks needed.* Reuters. https://www.reuters.com/business/eu-gives-initial-agreement-board-quotas-women-more-talks-needed-2022-03-14/

Bertay, A., Dordevic, L., & Sever, C. (2020). *Gender Inequality and Economic Growth: Evidence from Industry-Level Data.* IMF Working Paper 20/119. Washington: International Monetary Fund.

Bertrand, M., Black, S. E., Jensen, S., & Lleras-Muney, A. (2014). *Breaking the Glass Ceiling? The Effect of Board Quotas on Female Labor Market Outcomes in Norway*. National Bureau of Economic Research, Working Paper Series, WP 20256. http://www.nber.org/papers/w20256

Besley, T., Folke, O., Persson, T., & Rickne, J. (2017). *Gender Quotas and the Crisis of the Mediocre Man: Theory and Evidence from Sweden.* American Economic Review 107 (8): 2204–42.

Bilinski, A., & Hatfield, L. A. (2018). *Nothing to see here? Non-inferiority approaches to parallel trends and other model assumptions*. arXiv:1805.03273. https://doi.org/10.48550/arXiv.1805.03273

Bitar, M., Naceur, S.B., Ayadi, R., & Walker, T. (2021). *Basel Compliance and Financial Stability: Evidence from Islamic Banks*. Journal of Financial Services Research Vol. 60, 81–134 https://doi.org/10.1007/s10693-020-00337-6

Cardillo, G., Onali, E., & Torluccio, G. (2020). *Does gender diversity on banks' boards matter? Evidence from public bailouts*. Journal of Corporate Finance 101560.

Carter, D., D'Souza, F., Simkins, B., & Simpson, G. (2010). *The gender and ethnic diversity of US boards and board committees and firm financial performance*. Corporate Governance: An International Review, 18(5), 396–414.

Caruana, J. (2010). *Systemic risk: how to deal with it.* BIS Other Publications. 12 February. Bank of International Settlements. https://www.bis.org/publ/othp08.htm

Chiaramonte, L., Liu, F. H., Poli, F, & Zhou, M. (2016). *How Accurately Can Z-Score Predict Bank Failure?* Financial Markets, Institutions & Instruments, Vol. 25, Issue 5, pp. 333-360, 2016, Available at SSRN: https://ssrn.com/abstract=2870125 or http://dx.doi.org/10.1111/fmii.12077

Čihák, M., & Hesse, H. (2008). *Islamic Banks and Financial Stability: An Empirical Analysis*. IMF Working Paper 08/16. Washington: International Monetary Fund.

Coles, J.L., Lemmon, M.L., & Meschke, J.F. (2012). *Structural models and endogeneity in corporate finance: the link between managerial ownership and corporate performance*. J. Financ. Econ. 103 (1), 149–168.

Council of the European Union. (2022). *Gender balance on corporate boards*. Policy Brief. European Council

Delloite. (2022). *Progress at a snail's pace. Women in the boardroom: A global perspective Seventh Edition.* Deloitte Global Boardroom Program.

Demirgüç-Kunt, A., & Huizinga, H. (2012). *Do We Need Big Banks? Evidence on Performance, Strategy and Market Discipline.* Bank of International Settlements. http://www.bis.org/bcbs/events/bhbibe/demirguc.pdf

European Central Bank. (2017). *Guidance to banks on non-performing loans*. ECB Banking Supervision https://www.bankingsupervision.europa.eu/ecb/pub/pdf/guidance_on_npl.en.pdf

Farag, H., & Mallin, C. (2016). *The influence of CEO demographic characteristics on corporate risk-taking: Evidence from Chinese IPOs*. The European Journal of Finance, 1-30. http://dx.doi.org/10.1080/1351847X.2016.1151454.

Farag, H., & Mallin, C. (2017). *Board diversity and financial fragility: Evidence from European banks*. International Review of Financial Analysis, 49, 98–112

Ferrari, G., Ferraro, V., Profeta, P., & Prozanto, C. (2016). *Gender Quotas: Challenging the Boards, Performance, and the Stock Market.* IZA DP No. 10239. IZA World of Labor. https://docs.iza.org/dp10239.pdf

Fredriksson, A. & Oliveira, G.M.d. (2019). *Impact evaluation using Difference-in-Differences*. RAUSP Management Journal, Vol. 54 No. 4, pp. 519-532. https://doi.org/10.1108/RAUSP-05-2019-0112

Giglio, S., Kelly, B., & Pruitt, S. (2016*). Systemic risk and the macroeconomy: An empirical evaluation.* Journal of Financial Economics, Volume 119, Issue 3, 2016, Pages 457-471, ISSN 0304-405X. https://doi.org/10.1016/j.jfineco.2016.01.010.

Ham, D.W., & Miratrix, L. (2022). *Benefits and costs of matching prior to a Difference in Differences analysis when parallel trends does not hold.* arXiv:2205.08644. https://doi.org/10.48550/arXiv.2205.08644

Hillman, A. J., & Dalziel, T. (2003). *Boards of directors and firm performance: Integrating agency and resource dependence perspectives*. Academy of Management Review, 28, 383–396.

Huljak, I., Martin, R., Moccero, D., & Pancaro, C. (2020). *Do non-performing loans matter for bank lending and the business cycle in euro area countries?.* Working Paper Series 2411, European Central Bank.

ILO. (2020). *Improving gender diversity in company boards.* Women in Business and Management. International Labour Organization (ILO)

Ivashina, V., Nair, V.B., Saunders, A., Massoud, N., & Stover, R. (2008). *Bank debt and corporate governance*. Rev. Financ. Stud. 22 (1), 41–77.

Jain, T., & Jamali, D. (2016). *Looking inside the black box: The effect of corporate governance on corporate social responsibility*. Corporate Governance: An International Review, 24, 253–273.

Jianakoplos, N.A., & Bernasek, A. (1998). *Are women more risk averse?*. Economic Inquiry 36, 620–630.

Kinateder, H., Choudhury, T., Zaman, R., Scagnelli, S. D., & Sohel, N. (2021). *Does boardroom gender diversity decrease credit risk in the financial sector? Worldwide evidence*. Journal of International Financial Markets, Institutions & Money, 73, 101347.

Kochhar, K., Jain-Chandra, S., & Newiak, M. (2017). *Women, Work, and Economic Growth: Leveling the Playing Field*. Washington: International Monetary Fund.

Lagerlöf, N. P. (2003). *Gender Equality and Long-Run Growth*. Journal of Economic Growth, 8(4), 403–26.

Mateos de Cabo, R. M., Gimeno, R., & Nieto, M. J. (2012). *Gender diversity on European Banks' board of directors*. Journal of Business Ethics, 109, 145–162.

Matsa, D. A., & Miller, A. R. (2013). *A Female Style in Corporate Leadership? Evidence from Quotas.* American Economic Journal: Applied Economics, 5 (3): 136-69.

Nordberg, D. & Booth, R. (2019). *Evaluating the effectiveness of corporate boards.* Corporate Governance 19, 372–387.

Pugliese, S. (2016). *Divergences between EU and US in the Financial Regulation: What Effects on the TTIP Negotiations?.* European Journal of Risk Regulation, 7(2), 285-289.

Radojevic, M. (2022). *The Subjective Effects of Gender Quotas: Party Elites Do Not Consider "Quota Women" to Be Less Competent*. Politics & Gender, 1-24. doi:10.1017/S1743923X22000137

Rambachan, A., & Roth, J. (2022). *A More Credible Approach to Parallel Trends*. Working Paper

Roth, J. (2018). *Should We Adjust for the Test for Pre-trends in Difference-in-Difference Designs?* arXiv:1804.01208. https://arxiv.org/pdf/1804.01208.pdf

Sahay, R., Čihák, M. & other IMF Staff. (2018). *Women in Finance: A Case for Closing Gaps*. IMF Staff Discussion Note 18/05. Washington: International Monetary Fund.

Sahay, R., Čihák, M., N'Diaye, P., Barajas, A., Kyobe, A., Mitra, S., Mooi, Y. N., & Yousefi, S. R. (2017). *Banking on Women Leaders: A Case for More?*. IMF Working Paper 17/119. Washington: International Monetary Fund.

Schaeck, K., & Čihák, M. (2010). *Competition, Efficiency, and Soundness in Banking: An Industrial Organization Perspective*. European Banking Center Discussion Paper No. 2010-20S. CentER Discussion Paper Series No. 2010-68S

Smith, N. (2018). *Gender quotas on boards of directors.* IZA World of Labor https://wol.iza.org/uploads/articles/461/pdfs/gender-quotas-on-boards-of-directors.pdf

Terjesen, S., Sealy, R., & Singh, V. (2009). *Women directors on corporate boards: A review and research agenda*. Corporate Governance: An International Review, 17(3), 320–337.

Turan, G. (2015). *Why quotas work for gender equality.* OECD Forum 2015 Issues. Organisation for Economic Co-operation and Development (OECD). https://www.oecd.org/gender/quotas-gender-equality.htm

UNICEF. (2020). *Global annual results report 2019: Gender equality*. June. https://www.unicef.org/media/71421/file/Global-annual-results-report-2019-gender-equality.pdf

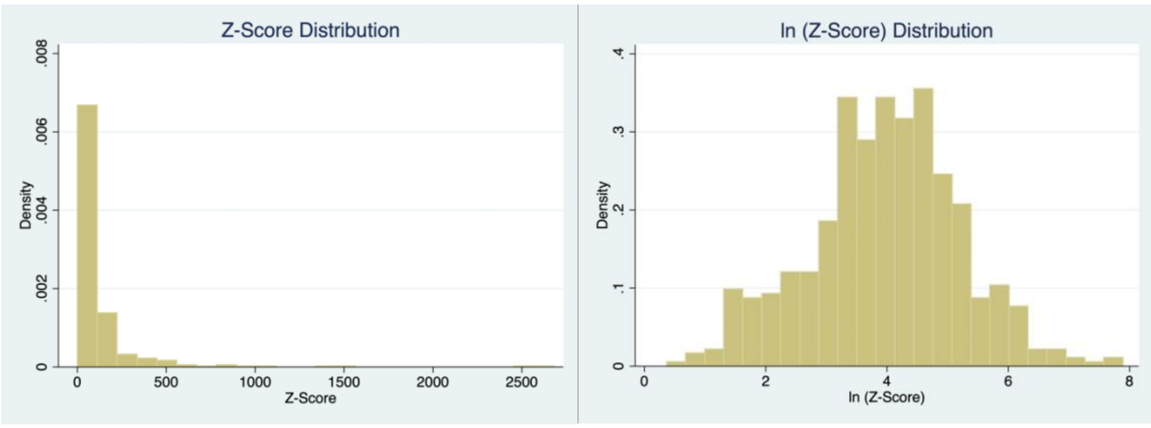
United Nations. (2015). *Transforming our World: The 2030 Agenda for Sustainable Development*. A/RES/70/1. https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

Westphal, J. D., & Milton, L. P. (2000). *How experience and network ties affect the influence of demographic minorities on corporate boards*. Administrative Science Quarterly, 45, 366–398.

World Bank. (2015). *Global Financial Development Report 2015/2016: Long-Term Finance.* Global Financial Development Report. Washington, DC. World Bank. https://openknowledge.worldbank.org/handle/10986/22543 License: CC BY 3.0 IGO.

Appendix

Appendix I | Histogram: Z-Score distribution pre and post natural logarithm transformation



Appendix II | Descriptive statistics, variables description and sources

Description		Obs	Mean	Median	Std. Dev.	Min.	Max.	Source
Key dependent variables								
Z-Score	Sum of total capital to total assets ratio and the return on assets (ROA) divided by the standard deviation of ROA over the 3 last years.	584	112.3415	53.6266	211.9006	1.4514	2680.4140	Own estimate (BankFocus)
ln (Z-Score)	Natural logarithm of the sum of total capital to total assets ratio and the return on assets (ROA) divided by the standard deviation of ROA over the 3 last years.	584	3.9671	3.9820	1.2365	0.3725	7.8937	Own estimate (BankFocus)
NPL ratio	Nonperforming loans to total gross loans.	625	0.0625	0.0346	0.0929	0.0003	1.0000	BankFocus
Key explanatory variable								
Share of women	Share of female directors on the board of directors (%)	650	0.2815	0.2835	0.1215	0.0000	0.5710	BoardEx
Controls								
Bank-level | Board Composition								
Board size	Total number of directors on the board of directors	650	13.9123	13.0000	5.3121	2.0000	32.0000	BoardEx
Board experience	Mean of the average time each director sits on the Board of Quoted Companies	642	2.7171	2.6000	1.6791	0.0000	9.3000	BoardEx
Board qualification	Average number of qualifications at undergraduate level and above for all the directors at the annual report date selected	651	1.9661	2.0667	0.6699	0.0000	3.7500	BoardEx
Gender quota	Dummy variable that takes the value of 1 if and when the bank is legally binded to adopt a gender quota	651	0.3011	0.0000	0.4591	0.0000	1.0000	ILO, OECD and Delloite
Bank-level | Financial data								
Bank size	Natural logarithm of Total Assets (th EUR)	640	17.8443	17.6102	1.9413	11.8410	21.6919	BankFocus
Quoted	Dummy variable that takes the value of 1 if the banks is publicly listed	651	0.7742	1.0000	0.4184	0.0000	1.0000	BankFocus
ROE	Return on Equity of the bank calculated as Net Income divided by Equity	640	0.0684	0.0703	0.1040	-0.5590	0.6419	Own estimate (BankFocus Data)
CAR	Capital Adequacy Ratio has reported by banks	612	0.1869	0.1805	0.0413	0.0572	0.4168	BankFocus
Country-level								
GDP growth	Natural logarithm of GDP per capital at constant prices at country and year level	651	3.6006	3.6402	0.4467	2.4069	4.4308	AMECO
Female to male	Ratio of female to male labor force participation rate (%) (modeled ILO estimate)	651	0.8189	0.8407	0.0628	0.6416	0.9065	World Bank Data
Female Employment	Employment to population ratio, 15+, female (%) (modeled ILO estimate)	651	0.4921	0.5146	0.0730	0.3177	0.6001	World Bank Data
Alternative Measures of Board Gender Diversity								
Critical Mass	Dummy variable that takes the value of 1 if the board of directors is composed of at least 20% of female directors and at least 3 women	651	0.6667	1.0000	0.4718	0.0000	1.0000	Own estimate
Woman	Dummy variable that takes the value of 1 if the board of directors is composed of at least 1 woman	651	0.9585	1.0000	0.1995	0.0000	1.0000	Own estimate

Note: The variables *NPL ratio, Share of women, ROE, CAR, Female to male* and *Female Employment* are represented in percentage terms in a scale from 0 to 1.

Appendix III | Descriptive statistics per year and country: share of women, z-score and NPL ratio

Board composition and financial stability: summary statistics

Panel A	Share of women			Z-Score			NPL ratio		
Year	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
2015	0.226	0.000	0.500	88.922	2.715	814.382	0.085	0.001	0.575
2016	0.252	0.000	0.538	79.478	1.451	657.683	0.082	0.002	0.575
2017	0.270	0.000	0.533	109.806	2.446	1347.092	0.073	0.001	0.533
2018	0.281	0.000	0.571	130.601	3.806	1100.896	0.072	0.002	1.000
2019	0.300	0.000	0.500	162.611	3.829	2680.414	0.051	0.001	0.327
2020	0.312	0.000	0.556	154.982	2.842	2462.690	0.043	0.001	0.273
2021	0.330	0.000	0.545	52.575	2.708	348.689	0.035	0.000	0.246

Panel B	Share of women			Z-Score			NPL ratio		
Country	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Austria (AT)	0.259	0.095	0.412	119.403	8.311	549.293	0.034	0.008	0.119
Belgium (BE)	0.322	0.111	0.375	78.713	20.135	221.444	0.053	0.025	0.091
Cyprus (CY)	0.190	0.000	0.364	12.299	2.715	49.284	0.264	0.071	0.575
Czech Republic (CZ)	0.203	0.077	0.333	150.084	22.812	319.243	0.030	0.021	0.043
Denmark (DK)	0.214	0.000	0.545	64.429	3.599	191.207	0.070	0.001	1.000
Finland (FI)	0.374	0.003	0.571	160.626	26.177	1347.092	0.011	0.005	0.020
France (FR)	0.369	0.000	0.538	105.569	11.466	494.722	0.028	0.008	0.059
Germany (DE)	0.261	0.001	0.440	218.090	12.955	2680.414	0.024	0.006	0.052
Greece (GR)	0.196	0.000	0.333	60.103	3.806	349.630	0.302	0.068	0.452
Italy (IT)	0.359	0.167	0.545	50.627	1.451	398.993	0.109	0.001	0.386
Latvia (LV)	0.226	0.000	0.333	45.786	26.262	99.702	0.274	0.236	0.345
Lithuania (LT)	0.296	0.003	0.333	28.949	13.269	49.692	0.054	0.034	0.071
Malta (MT)	0.075	0.000	0.231	64.397	3.899	218.181	0.050	0.038	0.082
Netherlands (NL)	0.232	0.000	0.421	122.030	3.969	479.416	0.037	0.018	0.107
Poland (PL)	0.222	0.067	0.400	102.437	13.167	501.777	0.075	0.043	0.145
Portugal (PT)	0.210	0.000	0.353	34.179	7.460	115.195	0.068	0.041	0.113
Republic of Ireland (IE)	0.303	0.167	0.556	85.270	4.813	520.586	0.099	0.040	0.274
Spain (ES)	0.245	0.000	0.429	107.410	5.191	990.803	0.043	0.017	0.082
Sweden (SE)	0.414	0.002	0.545	97.718	8.833	339.887	0.004	0.000	0.009
Switzerland (CH)	0.243	0.000	0.500	248.097	12.726	1543.147	0.013	0.001	0.061

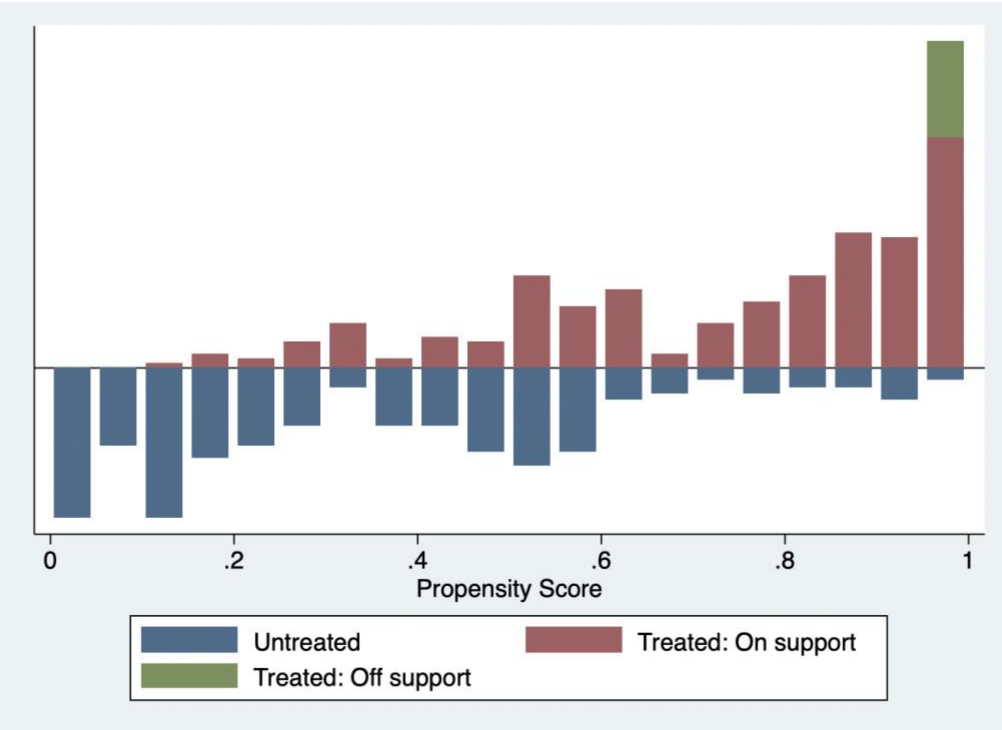
Note: The statistics associated with the z-score are measured in terms of standard deviations from the mean, without any transformation to the variable.

Appendix IV | Alternative measures of board gender diversity: empirical results, including the estimated coefficients on the control variables

Variables	(7) ln(Z-Score)	(8) ln(Z-Score)	(9) NPL ratio	(10) NPL ratio
Woman	0.212		-0.042**	
	(0.271)		(0.016)	
Critical Mass		0.256**		-0.015*
		(0.125)		(0.008)
Board size	-0.041***	-0.043***	0.001	0.000
	(0.015)	(0.015)	(0.001)	(0.001)
Bank size	0.076**	0.062*	-0.004**	-0.004*
	(0.036)	(0.037)	(0.002)	(0.002)
GDP growth	-0.530	-0.531	0.123	0.119
	(1.412)	(1.406)	(0.086)	(0.086)
Board experience	0.017	0.027	-0.005***	-0.006***
	(0.033)	(0.034)	(0.002)	(0.002)
Board qualification	-0.277***	-0.293***	0.015**	0.015**
	(0.102)	(0.102)	(0.006)	(0.006)
Quoted	0.524***	0.545***	-0.008	-0.016*
	(0.164)	(0.151)	(0.010)	(0.009)
Gender quota	0.071	0.041	0.003	0.008
	(0.188)	(0.186)	(0.011)	(0.011)
Female to male	-0.235	-1.967	1.353***	1.474***
	(6.713)	(6.737)	(0.404)	(0.407)
NPL ratio	-3.015***	-2.956***		
	(0.716)	(0.712)		
Z-Score			-0.000	-0.000
			(0.000)	(0.000)
Female Employment	-11.096	-10.087	-1.215***	-1.314***
	(6.877)	(6.858)	(0.415)	(0.416)
ROE	1.048**	1.153**	-0.201***	-0.218***
	(0.531)	(0.523)	(0.031)	(0.031)
CAR	2.502*	2.176	-0.007	0.031
	(1.366)	(1.354)	(0.083)	(0.083)
Observations	564	564	564	564
R-squared	0.390	0.394	0.581	0.578
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Adjusted R2	0.347	0.352	0.551	0.548
F-test (p-value)	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix V | Propensity Score Matching results: common support region and "off support" observations



Appendix VI | Share of women of banks not fulfilling the quota threshold at the year before the implementation time (t-1)

LEICode	Company Name	Quota Threshold (Minimum)	Share of Women (at t-1)	Distance to quota fulfillment (pp)
506700PR1R98BSF81139	EFG INTERNATIONAL	30.0%	14.3%	15.7
5299003ATVTQVPTW4735	BANK FUR TIROL UND VORARLBERG AG	30.0%	18.2%	11.8
724500D8WOYCL1BUCB80	VAN LANSCHOT KEMPEN N.V.	33.0%	25.0%	8.0
969500TJ5KRTCJQWXH05	CREDIT AGRICOLE SA	40.0%	33.3%	6.7
JEUVK5RWVJEN8W0C9M24	EUROBANK ERGASIAS SERVICES AND HOLDINGS SA	25.0%	23.1%	1.9
969500FF9M4SBM5VHR15	CAISSE REGIONALE DE CREDIT AGRICOLE MUTUEL NORD DE FRANCE SC	40.0%	33.3%	6.7
9ZHRYM6F437SQJ6OUG95	RAIFFEISEN BANK INTERNATIONAL AG	30.0%	20.8%	9.2
RRUN0TCQ1K2JDV7MXO75	OBERBANK AG	30.0%	22.7%	7.3
549300NYKK9MWM7GGW15	ING GROEP NV	33.0%	27.3%	5.7
969500B5DNR7Q1ACGD23	CAISSE REGIONALE DE CREDIT AGRICOLE MUTUEL ATLANTIQUE VENDEE SC	40.0%	22.2%	17.8
969500PI25OKPKTD9364	CAISSE REGIONALE DE CREDIT AGRICOLE MUTUEL DE PARIS ET D'ILE-DE-FRANCE SC	40.0%	28.6%	11.4
JU1U6S0DG9YLT7N8ZV32	BANCO COMERCIAL PORTUGUES, SA	33.3%	20.0%	13.3
529900HVPKKKCF0Q2854	BANK LINTH LLB AG	30.0%	20.0%	10.0
549300506SI9CRFV9Z86	CREDIT SUISSE GROUP AG	30.0%	23.1%	6.9
549300ZDHOETLAIVTE82	CEMBRA MONEY BANK AG	30.0%	28.6%	1.4
PQOH26KWDF7CG10L6792	ERSTE GROUP BANK AG	30.0%	26.1%	3.9
969500FYEXW795NPJO79	CAISSE REGIONALE DE CREDIT AGRICOLE MUTUEL BRIE PICARDIE SC	40.0%	28.6%	11.4
Total				**17**