2. GENDER DIVERSITY ON BOARDS AND BANK EFFICIENCY ACROSS EMERGING EUROPE

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Abstract

This paper aims to contribute to the intense policy debate on gender diversity by providing new insights regarding the link between gender diversity across boards and efficiency in emerging banking markets. We employ an original dataset specific to a large sample of financial institutions from Central and Eastern Europe (CEE) and find robust evidence that the absence of females on supervisory and managing boards results in lower cost efficiency (minimum production cost with limited resources), as well as lower technical efficiency (maximum output production with limited resources). In turn, greater gender diversity among the members of the bank boards increases efficiency, especially for smaller banks. Our results also indicate that encouraging females' presence in supervisory boards that have more domestic or less independent members leads to higher bank efficiency. When banks have less restrictive governance mechanisms, greater gender diversity across managing boards also enhances bank efficiency.

Keywords: gender diversity, bank efficiency, corporate governance, managing boards, supervisory boards

JEL classification: G21, G32, G34

1. Introduction

The positions held by women within the bank boards are significantly lower compared to those held by men, despite the regulatory and legislative initiatives on gender diversity adopted in recent years. The board of directors is the main instrument providing support to shareholders (Jensen and Meckling, 1976). This mechanism has several functions, for instance, controlling the insiders' behavior, providing information and counsel, controlling the fulfillment of laws, creating

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connections with the environment, as well as hiring and firing the CEOs (Martín and Mínguez, 2014).

Recent studies have pointed out that the gender of managers can influence firm performance (see Hussain et al., 2024, for a review). These works exploit Agency Theory and sociology and psychology perspectives. According to these theories, female managers are more efficient in monitoring communicating, and avoiding risks. However, some studies (e.g., Adams and Funk, 2011, Tabassum and Nayak, 2021) advocate for gender neutrality concerning risk attitude. Ahern and Dittmar (2012) show that after Norwegian firms introduced board quotas in 2003, Tobin's Q largely declined, as the quota increased the share of less experienced members on the boards, which increased firms' risk. Another example is the introduction of gender quotas in California in 2018, which caused a reduction in valuation, more pronounced in firms that did not turn over their least-supported male directors (Gertsberg, Mollerstrom, and Pagel, 2022). Naaraayanan and Nielsen (2022) also highlight the significance of the board structure. Analyzing the introduction of gender quotas in India, they show that the transition to gender-diverse boards is inhibited by strong patriarchal views among current directors.

For the banking industry, the structure of the boards is extremely important, and the governance mechanisms of financial intermediaries might differ considerably from those of non-financial corporations. Specifically, the implementation of internal governance mechanisms by banks is different due to stricter regulation and higher leverage of financial institutions (Adams and Mehran, 2003). Gulamhussen and Guerreiro (2009) highlight a clear conflict of interests between shareholders and depositors, as bank executives are more prone to take on risky projects that maximize shareholders' value at the expense of deponents' gains. To avoid bank runs and contagion spillovers, small deposits are insured, and the overall banking activity is intensely regulated (John et al., 2000). Financial institutions are more strictly regulated than other firms also because the credit and payment systems depend on the banks' financial health (De Andres and Vallelado, 2008). The existence of a safety net can lead to moral hazard incentives by banks (Kahn and Santos, 2005) and the development of systemic vulnerabilities (European Central Bank, 2005).

An expanding body of the literature focuses on the effects of board composition on bank efficiency. Hillman and Dalziel (2003), for example, highlight that the board needs members who contribute with different skills to enhance its efficiency. However, regulation could shape the influence of the board composition on performance (Booth et al., 2002). Also, regulatory constraints might lead to a sub-optimal behavior of banks' boards (Hermalin and Weisbach, 2003), while the complexity of the banking activities can diminish stakeholders' capacity to monitor managerial decisions and increase information asymmetry (De Andres and Vallelado, 2008).

The share of women on boards of directors in the financial services sector has been growing slowly around the world, from 15 percent in 2016 to 25 percent at the end of 2023, thus it is still low (Delloite, 2024). Regarding the European banking sector, women's presence on bank boards has gradually improved, however, at the end of 2021, only 18 percent of the executive directors and 28 percent of non-executive directors are represented by women (EBA, 2023). The misrepresentation of women in bank boards is an even bigger issue for the banking industry in CEE countries where the efforts towards gender diversity policies and practices have been less significant and much slower.

Considering the specific frictions of the financial sector and the institutional background of emerging European countries, we aim to investigate how female directors among bank boards influence bank efficiency across CEE countries. This is a relevant research question with economic, political, and social implications, intensely debated by regulators and policymakers. The relationship between gender diversity and bank efficiency has also been addressed in prior studies, yet, most of them focus on advanced economics (Hillman and Dalziel 2003; Ramly et al., 2015).

Building on the previous findings, we take a further step and investigate the relationship between gender diversity among bank boards and efficiency by focusing on a sample of emerging countries from the CEE area. These banks provide an excellent laboratory for our research design from several perspectives. Compared to developed economies, emerging European countries have a less developed financial market and weaker institutions, present high levels of public debt (Vives, 2016), and are more exposed to inflationary policies or banking crises (Ard and Berg, 2010). Regulators are also less independent in these countries and more politically connected (Vives, 2016). In addition, several particularities of these countries make them unique. The banking sector in the CEE area has more concentrated ownership, which in most cases is represented by foreign shareholders. This circumstance increases the competing interests between shareholders and other stakeholders (Bebchuck and Weisbach, 2010). Besides, in emerging countries, independent directors have a close relationship with top executives, and directors are usually less experienced (Berger et al., 2010). Nevertheless, banks from these countries went through an extensive privatization process, leading to some of them being held by an individual or family group, which increases the agency conflicts between large and small shareholders (Love and Rachinsky, 2015).

To investigate our empirical question, we employ a unique, hand-collected dataset on gender variables for a large sample consisting of 128 commercial banks from the CEE area, observable from 2005 to 2012. We focus on two proxies that reflect the efficiency of banks, i.e. cost efficiency, and technical efficiency, which are computed using the Data Envelopment Analysis (DEA) and an approach oriented toward outputs and variable returns to scale. We use both cost and technical efficiency as dependent variables due to their complementary. Cost efficiency assesses the efficiency of a bank from an "input" (cost-minimizing) perspective, while technical efficiency considers an "output" approach[5] (we estimate technical efficiency as output-oriented). Xiang *et al.* (2015) consider that the advantages of cost efficiency over technical efficiency consist of including price information that is better related to the classical measurements of performance ROA and ROE and in the ability to capture better banks' behavior during crisis periods. Also, technical efficiency presents the benefit of being very informative on how well a bank undertakes operations.

Our main regressors are represented by the presence of females among managing and supervisory boards. The variables are hand-collected from banks' reports, and their websites due to limited availability in governance databases like RiskMetrics or BoardEx. Based on the variables that reflect the share of board members within each of the two categories, females and men, we further construct the Blau index of heterogeneity among boards adapting the form proposed by Blau (1977) and the Shannon diversity index among boards following Shannon (1948). We also employ a no-female dummy variable and variables indicating the number of women among boards on the critical mass theory. We differentiate among the supervisory and managing boards in our empirical setting, as they have different objectives, sizes, and responsibilities, which can lead to different dynamics of gender diversity among them.

To account for possible reverse causality, we consider an endogenous framework and employ a set of instruments consisting of the initial Blau index of gender diversity times year fixed effects and the female participation ratio in the labor force. These variables are likely to affect the gender diversity indices but are not correlated with bank efficiency. The empirical setting accounts for heterogeneity among banking institutions, and controls for types of banks, board characteristics, as well as macroeconomic conditions, and financial crises.

[5] *Technical efficiency can be determined using input or output approaches. The former defines technical efficiency as the maximum possible reduction in inputs when the output is given, while the output-oriented approach focuses on determining the maximum possible increase in outputs when the input is given. We estimate technical efficiency using the output–oriented approach.*

Our results indicate a positive and significant impact of gender diversity among banks' boards on bank efficiency. The economic effect is also large. Banks with no females on supervisory and managing boards have 0.44 units lower cost efficiency scores and 0.20 units lower technical efficiency than financial institutions with females participating in the boardroom.[6] Increasing the female representation in boards by one standard deviation boosts the cost efficiency by about 50 percent of its standard deviation, a result that is linked to a semi-elasticity of 125 percent. The effect on technical efficiency is also economically meaningful, corresponding to an increase of 43 percent of its standard deviation and a semi-elasticity of 53 percent. For small banks, the percentage of females on the boards increases in both types of efficiency measures. Regarding the females' representation in supervisory boards, the evidence shows a positive moderating effect for less independent boards and those with high percentages of domestic directors. Also, greater gender diversity among financial institutions' managing boards with less restrictive internal governance practices can lead to higher efficiency scores.

Our framework presents several contributions to the literature. First, we differentiate from prior research by investigating the influence of gender diversity on bank efficiency using a large sample of commercial banks from CEE countries. Commercial banks are the most important financial intermediaries within the emerging European banking system. Also, these types of banks are interesting from the governance point of view because they went through a difficult transition from the socialist system to the market economy with the adaptation of their old governance structures. Another particularity of this region is that many banks are foreign-owned, and assessing the females' representation across boards with both domestic and foreign representation provides new insights into the multifaced dimensions of gender diversity. Second, we use an original dataset consisting of variables on gender diversity among banks' boards from Emerging Europe, hand-collected from banks' financial reports and websites. Third, we analyze the substitution effect between females' presence on the supervisory and managing boards and other characteristics that can influence the bank efficiency like board independence, the share of foreign directors, and the risk management structure. These corporate governance attributes are also hand-collected from banks' annual reports. Finally, in contrast to the findings of Ramly *et al.* (2015), which indicate that the appointment of either female or independent directors alone does not significantly improve bank efficiency, our research demonstrates that female directors are more effective on boards when they are also appointed as independent directors.

Given the particularities of the banking industry in the CEE region, as well as the lack of legislative initiatives that encourage a greater gender balance across boards, we think our study can provide relevant policy implications. One limitation of our framework is the dataset spanning from 2005 to 2012. However, gender diversity across banks' boards changes slowly with time, especially in emerging Europe where there are no specific legislative initiatives to encourage gender balance across boards in the banking industry.[7] Moreover, a report of the European Parliament (2020) shows that the share of female executive directors in banks from the Eurozone is still at a low level (i.e., 27.4% in case of management positions, and 31.7% in case of supervisory boards).

The rest of this work is organized as follows. In section 2 we review the literature. In section 3 we describe the methodology and the data used. In section 4 we discuss the results of our empirical tests. Finally, in section 5 we offer possible policy recommendations.

[6] *The efficiency indicators range from 0 to 1. Higher values of the indicators are associated with greater efficiency.*

[7] *At the European Union level, a new directive tackling gender imbalances among corporate boards of listed companies has been adopted. By 2026, listed companies must have 33% of all board members, or 40% of non-executive directors, who are members of underrepresented sex (European Commission, 2022). In European countries that are not members of EU, no such legislative proposal has been initiated.*

2. Literature review

A large strand of literature investigates the link between board structure and bank performance. Most of these studies consider an extended set of proxies for the banks' corporate governance mechanisms, like gender diversity, board size, board independence, foreign diversity, or expertise of the board members.

Gender diversity and performance

In recent times, a growing body of research on gender diversity within the realm of corporate governance has been emerging. A comprehensive review by Terjesen *et al.* (2009) encompasses over 400 studies spanning various research domains, utilizing a range of theoretical frameworks based on the analytical level – whether it be individual, board, corporate, or industry/ environmental. These frameworks often intersect, resulting in studies that, while they may primarily explore economic dimensions, integrate multiple theories or methodologies. For instance, studies by Carter *et al.* (2010) and Mateos de Cabo *et al.* (2012) leverage the same quartet of theoretical perspectives: resource dependence, human capital, agency, and social psychology. Our investigation similarly embraces this multidisciplinary approach, drawing on insights from these diverse theories, which we will outline briefly below.

Agency Theory

According to Jensen and Meckling (1976), the agency relationship is defined as a contract in which one or several individuals (the principal(s)) employ another individual (the agent) to perform a service on their behalf, which entails a delegation of authority. Under these circumstances, it is common for agents to pursue their own goals. Due to the incomplete alignment of interests between principals and agents, agency conflicts arise, leading to related agency costs. The likelihood of opportunistic actions by the agent, and therefore, the agency costs, increases with the asymmetry of information between the principal and the agent.

On the other hand, Fama (1980) argues that a board of directors is only effective if it provides impartial and high-quality advice, which is achieved to a greater extent with the independence of its members. Following this logic, Carter *et al.* (2003) suggest that greater diversity on the board can contribute to its independence. Therefore, increasing gender diversity on the board could be a strategy for improving oversight and management control. Although Agency Theory has been the subject of criticism in recent times (Fontrodona and Sison 2006; Stout 2012), it remains the predominant approach in most corporate governance research, as evidenced by Terjesen *et al.* (2009).

Social Psychology

There are several theories focused on social groups, such as Social Identity Theory and Social Categorization Theory. These explore the tendency of individuals to associate with others who share similar demographic characteristics, viewpoints, and values. This affinity is strengthened through communication within the same group. According to these theories, individuals belonging to a majority group often have a significant influence on decision-making, leading to the perception that diversity may negatively affect outcomes in organizations (Westphal and Milton, 2000). These theories also suggest that individuals classify members of organizations into two categories: those who are part of their group (in-groups), i.e., people they consider similar to themselves, and those who are part of an external group (out-groups), i.e., people they see as different. Generally, the former group is perceived positively and the latter negatively (Nielsen and Huse 2010). In heterogeneous groups, communication and coordination problems are more common, which can reduce the effectiveness of leveraging knowledge and skills. This situation can lead to lower cohesion and interaction among group members (Milliken and Martins 1996; Forbes and Milliken 1999).

Focusing on gender diversity within boards, it is observed that women often constitute a unique presence or form a small minority. This minority status, especially when notably small, can lead to marginalization and being considered merely symbolic (Kanter 1977). In this context of tokenism, stereotypes can act as a barrier preventing these minority members from influencing group decisions, often subject to negative perceptions and a lack of trust. This phenomenon can result in adverse effects such as isolation. Therefore, studies like Torchia *et al.* (2011) do not limit their analysis to the proportion of women on boards but also consider the absolute size of the minority. They propose that reaching a critical size within this minority group could change the dynamics from tokenism to one of significant critical mass. According to this, it is argued that diversity could negatively impact board performance unless the minority group reaches a substantial size.

Human Capital Theory

This theory is based on how an individual's education, experience, and skills can be valuable to an organization (Becker, 1964). Currently, in developed nations, women possess qualifications as high as men, albeit with different backgrounds, perspectives, experiences, and working methods. This fact could translate into superior performance by women in certain specific tasks.

Various studies highlight these gender differences. For example, Loden (1985) proposes that roles on a board can be divided into strategic and financial control functions. Strategic functions tend to be more qualitative and long-term oriented, while financial control functions are more quantitative and focused on the short term. Loden (1985) indicates that, on average, women tend to lean more toward qualitative approaches, in contrast to a more quantitative orientation in men. This circumstance suggests that women could be more efficient, on average, in areas such as corporate social responsibility and strategic control. Further research, such as that of Hillman *et al.* (2002) and Daily and Dalton (2003), suggests that the female presence can enrich board deliberations and that their communication style tends to be more participatory and focused on the decision-making process. Therefore, from the perspective of Human Capital Theory, the evidence shows that diversity improves board performance (Terjesen et al., 2009; Carter et al., 2010).

Resource Dependence Theory

Resource Dependence Theory suggests that corporations operate within an interactive system, requiring the exchange of resources and thus generating an interdependence between the company and external entities. In this context, boards of directors act as bridges between the company and other organizations, facilitating the management of these environmental dependencies (Pfeffer and Salancik, 1978). From the perspective of this theory, diversity within work groups is generally associated with positive impacts on organizational outcomes. For example, greater diversity can lead to a broader understanding of the market, and more effective identification with customers and employees, thus enhancing the company's ability to expand into new markets (Robinson and Dechant, 1997).

Having outlined these theories we find most pertinent to our study, we introduce two additional concepts that could influence the decision-making process in boards with gender diversity. The first concept involves the differing levels of risk aversion between men and women. Numerous studies offer insights and evidence suggesting that women generally favor a more conservative approach to risk (Chaganti, 1986; and others). The second concept addresses the debate over the impact of female board members on corporate performance. Some scholars suggest that the influence of women on the board, whether positive or negative, may be negligible. They argue that female executives often eschew traditional gender stereotypes and values, leading to behaviors and decision-making patterns that closely mirror those of their male counterparts (Powell, 1990; Adams et al., 2002).

According to the majority of the theoretical contributions, we propose the following hypothesis to test empirically.

H 1: The presence of females on the bank boards of directors enhances bank efficiency.

Board independence and bank performance

There are different theoretical arguments about the impact of board independence on bank performance. First of all, independent directors are less likely to have conflicts of interest with management, making them more effective in monitoring and controlling managerial actions. This heightened oversight can lead to a reduction in agency costs, contributing to improved bank performance (Jensen and Meckling, 1976). Besides, independent board members can provide unbiased oversight of the bank's risk management policies and practices. Their external perspective can contribute to more prudent risk-taking, which is crucial for the stability and performance of banks (Pathan, 2009).

On the other hand, boards with a higher proportion of independent directors are better positioned to contribute to strategic decision-making. Their independence from management allows them to offer objective perspectives that can lead to better strategic choices and, consequently, improved bank performance (Adams and Mehran, 2012). In addition, independent directors play a crucial role in ensuring that banks comply with regulatory requirements and uphold high ethical standards. Their commitment to governance best practices can protect banks from reputational damage and legal penalties, thereby enhancing performance (Erkens *et al.* (2012).

The presence of independent directors on bank boards can enhance the confidence of investors, regulators, and customers. This increased confidence can lead to better access to capital, more favorable terms of credit, and a stronger customer base, all of which contribute to better bank performance (Macey and O'Hara, 2003) and often bring diverse experiences and viewpoints to the boardroom. This diversity can foster innovation and creativity in problem-solving, leading to more effective strategies and products that improve bank performance (Anderson et al., 2011).

However, independent directors can also present negative issues. In this way, independent directors may not always have the same level of industry-specific knowledge as insider directors. This can lead to decisions that are not fully informed about the complexities of banking operations and the financial market's volatility (Macey and O'Hara, 2003).

With a focus on governance and risk management, independent directors might push for overly conservative strategies that limit banks' ability to pursue profitable opportunities. This could hinder banks' performance, especially in dynamic financial markets (Adams and Mehran, 2003). Although independent directors are intended to act in the best interest of shareholders, their lack of financial stake in the company might lead to a misalignment of interests. This could result in decisions that do not optimally benefit long-term shareholder value (Pathan, 2009). Besides, the appointment of independent directors often comes with significant costs, including high remuneration and the expenses associated with maintaining an elaborate governance structure. These costs can detract from a bank's profitability, especially if the benefits of having independent directors do not proportionately exceed these costs (Erkens et al, 2012).

Finally, while independent directors are supposed to be free from conflicts of interest, in reality, they may have their own networks and relationships that could influence their decisions in ways that do not align with the bank's best interests (Cornett et al, 2009).

The previous empirical evidence on the linkage between board independence and performance is inconclusive, too. Some research studies find that independent directors tend to enhance earnings quality and limit management compensation (Mishra and Nielsen, 2000; Pathan and Faff, 2013), and are linked with lower conflicts of interests (Liang et al., 2013). Pathan and Faff (2013) show that more independence of directors reduces bank performance, while Subrahmanyam *et al.* (1997) document a negative effect of more independent directors on banks's abnormal returns.

Besides, Liang *et al.* (2013) document that more independent directors have significantly positive effects on both banks' asset quality and performance. Cornett *et al.* (2009) demonstrate the same effect of board independence on bank performance for the largest publicly traded bank-holding companies in the United States. De Andres and Vallelado (2008) obtain an inverted U-shaped

connection between board composition (executive versus non-executive/outsiders) and bank value.

On the other hand, Terjesen *et al.* (2005) propose that while boards with a greater share of independent directors are generally viewed more favorably, the gender composition of these boards could significantly influence perceptions of their independence. Specifically, they suggest that boards predominantly comprised of men, regardless of their independence, might be perceived as less independent from management compared to more gender-diverse boards. This perception could, in turn, impact various stakeholders' confidence in the board's efficacy in monitoring executive actions and thereby affect firm performance.

This argument posits that gender-diverse boards are likely to enhance the effectiveness and perceived independence of non-executive directors, improving firm performance. The logic behind this hypothesis rests on the notion that a gender-imbalanced board, particularly one lacking female directors, may signal to stakeholders that the board's selection is biased or that the firm is not fully committed to diversity and inclusiveness. This could raise doubts about the board's independence and its ability to oversee management effectively. In contrast, a board that reflects gender diversity is seen as more likely to be selected based on a wide range of skills and perspectives, thereby enhancing its independence and the firm's ethical standing.

According to these theoretical arguments, we formulate the following hypothesis:

H2: Increasing the presence of females on boards with fewer independent members enhances bank efficiency.

Foreign board membership and bank performance

The participation of foreign members on the boards of banks can significantly impact bank performance, influencing governance practices, strategic decision-making, and international market operations. Theoretical arguments suggest that the inclusion of foreign directors can offer both benefits and challenges to bank performance.

Foreign board membership is often associated with the introduction of global perspectives and practices into the bank's governance and operational strategies. These directors can bring diverse viewpoints, experiences, and knowledge of international markets, potentially enhancing strategic decision-making and innovation. Moreover, their presence is theorized to enhance the credibility of the bank in international markets, facilitating access to global capital and partnerships (Pucheta-Martínez and Bel-Oms, 2016). This global perspective is crucial for banks aiming to expand or maintain a presence in competitive international markets.

Furthermore, foreign directors may contribute to improving governance standards. They often bring experience from markets with stringent regulatory requirements and corporate governance standards, which can help in adopting best practices (Aggarwal et al., 2011). Such improvements in governance can lead to better risk management and compliance practices, ultimately enhancing bank performance and stability.

At the same time, the objectives established by foreign executives fit better with those of the parent banks. This can increase the likelihood of banks from host markets generating more revenues from non-traditional banking activities (Gulamhussen and Guerreiro, 2009).

However, the theoretical framework also identifies potential challenges associated with foreign board membership. Language barriers, cultural differences, and the physical distance from the bank's home country operations can hinder effective communication and decision-making processes (Nielsen and Nielsen, 2013). These issues may lead to misunderstandings or delays in critical governance activities, potentially affecting the bank's agility and performance in fast-moving financial markets.

Moreover, the alignment of interests between foreign directors and the bank's local stakeholders might not always be straightforward. Differences in market priorities, regulatory environments, and business cultures can lead to conflicts in strategic direction, potentially impacting the bank's

performance negatively (Ringe, 2015). Analyzing the Korean banking market, Choi and Hasan (2005) demonstrate a positive effect of foreign directors on bank performance. On the other hand, García-Meca *et al.* (2015) show that the national diversity of boards inhibits bank performance.

Considering the specificities of the CEE banking system that switched from socialism to a market economy, we expect that foreign directors can help local banks diversify the sources of profitability, and therefore make an important contribution to bank efficiency. Therefore, we formulate the subsequent hypothesis:

H3: Increasing the presence of females on boards with more domestic directors increases bank efficiency.

Risk management structure and bank performance

The emergence of the Chief Risk Officer (CRO) role within banks marks a significant development in the evolution of risk management practices. Theoretically, the presence of a CRO is argued to have a profound impact on bank performance by enhancing the institution's ability to manage and mitigate risks more effectively. This enhancement comes through strategic risk management, governance, and cultural shifts toward risk-aware decision-making. One of the primary theoretical arguments supporting the positive impact of a CRO on bank performance is that the CRO provides focused leadership and oversight for risk management activities. This role ensures that risk management is not just an operational concern but a strategic priority at the executive level. The CRO's presence in the C-suite underscores the importance of risk management to the bank's overall strategy and decision-making processes. According to Trottier (2013), the inclusion of a CRO at the executive level leads to better integration of risk management with business strategies, resulting in enhanced performance and competitiveness.

Furthermore, the CRO plays a crucial role in developing and implementing a comprehensive risk management framework that spans across all levels of the organization. This framework is designed to identify, assess, monitor, and proactively mitigate risks. By adopting a holistic approach to risk management, banks can navigate the complexities of the financial markets more effectively, avoiding pitfalls that could lead to significant financial losses. Liebenberg and Hoyt (2003) suggest that the CRO's expertise in crafting and executing risk management strategies is pivotal in enhancing a bank's ability to withstand financial shocks, thereby supporting sustained performance.

Another critical aspect of the CRO's impact on bank performance is related to regulatory compliance and reporting. In the aftermath of the global financial crisis, regulatory bodies have placed increased emphasis on risk management practices within financial institutions. The CRO is responsible for ensuring that the bank's risk management activities comply with regulatory requirements, thereby avoiding potential fines and sanctions that could impact the bank's reputation and financial performance. Pagach and Warr (2011) highlight the role of the CRO in navigating the complex regulatory landscape, indicating that effective compliance can lead to improved performance metrics by fostering trust among stakeholders.

Moreover, the presence of a CRO can lead to a cultural shift within the organization, where risk awareness becomes embedded in the decision-making processes at all levels. This shift is instrumental in creating a risk-aware culture that prioritizes long-term stability over short-term gains. According to Power (2007), the CRO's influence extends beyond the executive team, shaping the attitudes and behaviors of employees towards risk, which is essential for fostering an environment where risks are managed proactively rather than reactively. Besides, strong risk management practices may reduce banks' moral hazard incentives (Keys et al., 2009), while weak ones may result in financial vulnerability (Sabato, 2010). Aebi *et al.* (2012) document greater stock returns and a higher return on equity for banks that have a committee in charge of risk practices and where the CRO reports to the board of directors. Andrieș and Brown (2017) also highlight the importance of dedicated risk committees and CRO's visibility (i.e., who report to the board instead of the CEO) for credit growth.

In banks, where risk management is a cornerstone of operational integrity, the absence of a CRO or a dedicated risk management committee on the board presents unique challenges and opportunities. Increasing the number of female directors under these circumstances is posited to significantly enhance bank efficiency, supported by a confluence of theoretical frameworks and empirical research.

From the perspective of organizational behavior and diversity theory, the inclusion of female directors enriches the board's cognitive diversity, introducing a breadth of perspectives, problem-solving approaches, and decision-making styles (Carter et al., 2003; Adams and Ferreira, 2009). This diversity is crucial in environments lacking a CRO or risk management committee, as it compensates for potential oversight gaps through a collective, nuanced understanding of risk factors and innovative mitigation strategies. Moreover, empirical studies suggest that female directors often exhibit a more conservative risk appetite, advocating for robust due diligence and risk assessment protocols, thereby fortifying the bank's resilience against unforeseen contingencies (Adams and Ferreira, 2009).

According to the Agency theory, in the absence of a formal risk management framework led by a CRO or committee, the vigilant oversight practices promoted by female directors can serve as a deterrent against managerial opportunism and reckless risk-taking, thus safeguarding the bank's assets and ensuring sustainable efficiency (Adams and Ferreira, 2007)

Human capital theory emphasizes the intrinsic value of the diverse expertise, experiences, and skill sets that female directors bring to the board (Becker, 1964). In scenarios where risk oversight is not centralized through a CRO or committee, the broad spectrum of knowledge possessed by female directors, including but not limited to financial acumen, legal insight, and strategic foresight, becomes instrumental in navigating the complex risk landscape inherent to banking operations.

According to these arguments, we propose the following hypotheses:

H4: Increasing female directors in banks without the CRO as a member of the board of directors increases bank efficiency.

H5: Increasing female directors in banks without a risk management committee increases bank efficiency.

In what follows, all these hypotheses will be examined to provide new facets of the link between gender diversity and efficiency across emerging banking markets.

3. Methodology and data

3.1. Sample

Our sample consists of 128 banks from 17 CEE countries. The analyzed period consists of the 2005-2012 period. We initially included a large sample of active commercial banks with data available in Orbis but ended up with a sample of the institutions with information available for a minimum of five years and non-missing values for the inputs or outputs needed to compute the efficiency scores (Table 1 available online in Supplemental Appendix). The sample comprises public banks in a proportion of 33 percent, but also banks that are non-listed institutions. The minimum size of the financial institutions is 40 million euros, while the largest size is 47 billion euros. Among them, 75 percent are foreign-owned and 6 percent are state-owned.

These types of banks running a commercial business model are the most important financial intermediaries in the CEE banking system. The number of sample banks within a country is from 3 to 11 (Table 2). Another particularity of this region is that most banks are foreign-owned.

According to ECB statistics, more than 78% of CEE countries have foreign ownership.[8] Some studies highlight the significant differences in business models and risk profiles among foreign-owned and domestic-owned banks in the CEE region, which became more pronounced during the global financial crisis (Choi et al., 2016).

Table 2. Distribution of banks and country statistics

Country	Number of banks	Cost efficiency (mean)[a]	Technical efficiency (mean)[a]	Banks with no females in boards (mean)[b]	Females among members of the bank's boards (mean)[b]	Females among members of the bank's supervisory boards (mean)[b]	Females among members of the bank's managing board (mean)[b]
Albania	4	0.69	0.85	0.23	0.13	0.11	0.12
Bosnia and Herzegovina	6	0.51	0.75	0.21	0.12	0.11	0.14
Bulgaria	9	0.59	0.86	0.17	0.21	0.09	0.37
Croatia	10	0.62	0.83	0.17	0.14	0.07	0.25
Czech Republic	10	0.93	0.98	0.17	0.14	0.14	-
Estonia	3	0.93	0.99	0.13	0.14	0.11	0.23
Hungary	8	0.85	0.96	0.13	0.13	0.13	0.13
Latvia	10	0.68	0.87	0.28	0.19	0.20	0.20
Lithuania	5	0.65	0.84	0.05	0.21	0.23	0.15
Macedonia	6	0.50	0.74	0.15	0.14	0.15	0.04
Montenegro	2	0.57	0.75	0.31	0.19	0.13	0.40
Poland	11	0.87	0.98	0.20	0.10	0.09	0.10
Romania	11	0.59	0.77	0.24	0.11	0.12	0.10
Serbia	4	0.45	0.85	0.00	0.18	0.04	0.39
Slovakia	9	0.65	0.89	0.10	0.14	0.12	0.19
Slovenia	11	0.80	0.93	0.50	0.07	0.07	0.10
Ukraine	9	0.65	0.84	0.10	0.17	0.11	0.21
Total	***128***	***0.70***	***0.88***	***0.19***	***0.14***	***0.12***	***0.19***

Note: a Calculations determined using data from Bankscope. b Calculations determined using data from banks' reports. Definitions of variables are provided in Table 1.

3.2. Empirical strategy

We assess the impact of gender diversity on bank efficiency using an instrumental variable approach:

$$Efficiency_{ij,t} = \alpha_0 + \alpha_1 \times Gender\ diversity_{ij,t-1} + \Omega \times Bank\ variables_{ij,t-1} + \Psi \times Macro\ variables_{j,t-1} + \\ + GFC_t + SDC_t + \nu_i + \varepsilon_{ij,t} \quad (1)$$

Estimations are run using the IV 2SLS method with bank-level clustered standard errors. $Efficiency_{,t}$ is represented by the bank i's cost efficiency score, and respectively by its technical efficiency score. The main regressors are represented by banks' gender diversity indices (*Gender diversity*$_{,t-1}$) that reflect the share of females among members of bank i's boards *(Females among boards)*, considering both supervisory boards and managing boards *(Females among supervisory board, Females among managing board)*, and the presence of females among banks' boards *(No female in boards dummy* taking the value of 1 for banks with no females in boards at time t and 0 otherwise).

To control for cross-banking differences we employ a set of control variables *(Bank variables*$_{ij,t-1}$*)* that consist of (1) bank size defined by the natural logarithm of *Total assets*; (2) capitalization

[8] *This percent corresponds to CEE countries excluding Russia.*

represented by the *Equity to Total assets ratio*; (3) lending activity represented by the *Net loans share in Total assets*; (3) funding risk represented by the share of *Deposits and short-term borrowings* in *Total loans*; (5) the *Credit growth ratio*; (6) *Foreign ownership dummy* taking the value of 1 if the financial institution is a foreign bank; and (7) *State ownership dummy* taking the value of 1 if the state owns more than 50% of banks' shares, and 0 otherwise. We consider banks to be foreign-owned if more than 50% of their shares are owned by foreigners, and, respectively domestic if less than 50% of their shares are owned by domestic private shareholders, or governments as in Claessens and van Horen (2014).

In addition, we include characteristics of the managing board that could affect bank efficiency: *CRO present* (a dummy variable taking the value of 1 if the CRO responsible for bank-wide risk management is present within the bank), *CRO executive* (a dummy variable taking the value of 1 if the CRO is an executive officer of the bank), *risk committee* (a dummy variable taking the value of 1 if the bank has a committee responsible for supervising the bank's risk management practices), and *reports to board* (dummy variable taking the value of 1 if the CRO responsible for bank-wide risk management is present within the bank if the key management-level risk committee reports directly to the bank's board of directors instead of to the CEO). We also control for the supervisory board dimensions: *board size* (the natural logarithm of the number of directors on a bank's supervisory board), *board expertise* (the share of expert members on the supervisory board), *board independence* (the share of independent outside directors on the supervisory board), and *board foreign* (the share of foreign members on the supervisory board).[9] Finally, we add the share of interlocks on a bank's boards (i.e., the proportion of shared directors) to capture the concentration of power within a bank. Prior research argues that the interlocked network can reduce bank competition (Barone et al., 2022) and thus hinder bank efficiency.

We also control for differences in regulatory and macroeconomic conditions across countries *(Macro variables$_{j,t-1}$)*, considering: the stringency of capital regulation across CEE countries expressed by the *Capital regulatory index* and the activity restrictions of banks reflected by the *Banking restrictions index,* both from the World Bank survey of bank regulations (Barth *et al.* 2013); the *Regulatory quality index* from the World Governance Indicators database of the World Bank; the *banking sector concentration* represented by the assets of the five largest commercial banks as a share in total banking sector assets from the Global Financial Development Database of World Bank; *inflation* measured by the consumer price index and annual percentage of the growth rate of PDG *(GDP growth)* from World Development Indicators of World Bank. The empirical models include a dummy that accounts for the 2008-2009 global financial crisis period *(GFC$_t$),* the 2010-2011 European sovereign debt crisis period *(SDC$_t$)*, and bank fixed effects *(v_i)* to control for unobserved heterogeneity among banks.[10] $\boldsymbol{\varepsilon}_{ij,t}$ is the error term. All explanatory variables are lagged one period. Their definitions are given in Table 1.

A possible issue of our empirical framework is that banks' efficiency could also affect boards' gender structure, as financial institutions operating at high-efficiency levels might appoint more females to the supervisory boards and managing committee structures. To address reverse causality concerns the gender indices are considered endogenous and instrumented with variables that are correlated with the share of females among members of the boards (as well as with the gender diversity indices), but uncorrelated with bank efficiency. The first exogenous instrument we employ in the first stage regression is the initial Blau index of gender diversity times year fixed effects, obtained from the 2005 financial reports. Banks with a previously higher degree

[9] *Other possible controls could be the average age of board members and the average board tenure. We did not include them in the regressions as such information is not available for our sample banks.*

[10] *Prior studies also include time-fixed effects (Owen and Temesvary, 2018; Arnaboldi et al., 2021; Karavitis et al., 2021). We do not include them in our models as some year dummies are eliminated due to multicollinearity reasons. We address this issue by including two dummy variables reflecting the GFC and SVG. Also, to better control for the changes in banking regulations, we added in our empirical models the capital regulatory index and the banking restrictions index k, and the Regulatory quality index. To control for economic cycles, we added inflation and GDP growth.*

of gender equality across the board of directors face smaller constraints to appoint more females on boards than the banks with a lower initial Blau index of gender diversity. This agrees with the literature and aims to address the multi-faced nature of gender-based disparities. In a study related to the implementation of a new gender law in Norway requiring that 40% of firms' directors should be females, Ahern and Dittmar (2012) proposed the pre-quota cross-sectional variation of female presence in the board as an instrument for changes to corporate boards following the quota.[11] Analyzing the link between gender diversity and banking performance, Owen and Temesvary (2018) employ the initial Blau index times years fixed effects to instrument the share of female directors in US bank boards. The second exogenous instrument we employ is the share of females in the total labor force. This variable is likely to affect boardroom gender diversity (Adams and Kirchmaier, 2013), but it is not correlated with bank efficiency.

In robustness checks, we also used as an alternative instrument the initial share of females among members of bank's boards (the 2005 values) times year fixed effects. Unreported results confirm that the findings remain unchanged.[12] The validity of the instrumental variables set is verified using a test of under-identification and a test of weak identification. For underidentification, we report the values of the Kleibergen-Paap rk LM test, to assess if the excluded instruments are correlated with the endogenous regressors. To validate if the equation is weakly identified we employ the Kleibergen-Paap rk Wald F test.

3.3. Efficiency measures

The empirical literature embarks on different bank performance measures to effects of board composition. This could explain the inconclusive results of this relationship in the literature. The most widely used proxies of bank performance are the return on assets (ROA), expressed by the bank's net income as a share in total assets; return on equity (ROE), calculated as net income to equity; Tobin's Q ratio, representing the ratio of the firm's market value to its book value of assets; non-performing loans ratio, expressed through the non-performing loans to gross loans ratio (Liang et al., 2013; Del Prete and Stefani, 2015; García-Meca et al., 2015). In addition, multiple studies use stochastic frontier analysis in measuring bank performance (e.g., Choi and Hasan, 2005).

In this paper, we focus on banks' efficiency determined using the *Data Envelopment Analysi*s methodology *(DEA)*. Employing this approach, we can determine non-parametrically the efficiency frontier for the analyzed units. Each decision unit included in the dataset is assessed in connection with the efficient frontier. The units that are on the efficiency frontier (i.e., they are considered to have the best performance) receive a relative efficiency score corresponding to their performance, while the others receive an inefficiency score (not being on the efficiency frontier they are considered inefficient).

Different types of DEA methods have been embarked on in the literature based on input or output models (Charnes et al., 1978; Berger and Humphrey, 1992; Berger and Mester, 1997; Humphrey and Pulley, 1997). The input-oriented DEA models identify the maximum drop in inputs for each decision unit, considering constant the outputs. In contrast, the output DEA approach identifies the maximum increase in outputs for each decision unit, considering constant the inputs. These two approaches generate equal scores only if the production process implies a proportional link between the size of inputs and the outputs, otherwise, the efficiency scores are different.

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[11] *In 2013, when the law was implemented, Norvegian firms had a share if only 9% of women among firms' directors.*

[12] *Previous literature has also used the board size (Ferris et al., 2003), the share of independent members in boards (Adams and Mehran, 2012), or the number of interlocks (Pfeffer and Salancik, 1978) as instruments for gender diversity in analyzing its impact on bank performance. However, for our sample of banks from CEE these variables are correlated with bank efficiency, thus we do not use them as instruments.*

We focus on a model oriented toward outputs, namely the *Variable Returns to Scale model (VRS)* developed by Banker *et al.* (1984). We implement this approach as a large strand of the literature showed empirically that banks' returns to scale are not constant due to regulation, imperfect competition, or financing constraints (McAllister and McManus, 1993; Wheelock and Wilson, 1999). Using constant returns to scale can bias the efficiency scores.

To implement the VRS model we assume that the inputs are transformed into outputs and banks experience common best practice frontiers (by pooling yearly subsamples). Firstly, we determine the *Cost efficiency score* as the ratio between the lowest potential production cost and the observed production cost for bank j (j =1…n). This procedure involves solving the next linear system of equations:

$$min \sum_{i=1}^{m} p_i^o \tilde{x}_{io}$$

subject to:

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \tilde{x}_{io}, i = 1,2, \dots, m; \qquad (2)$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \leq y_{ro}, r = 1,2, \dots, m;$$

$$\lambda_j, \tilde{x}_{io} \geq 0;$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

where y_j is a vector of outputs of bank j of dimension (1 x m), x_{ij} is a vector of inputs of bank j of dimension (1 x m), p_i^o represents the input price i of bank j, and n is the total number of banks.

Next, the cost efficiency index of bank j is computed using eq. (3):

$$\frac{\sum_{i=1}^{m} p_i^o \tilde{x}_{io}^*}{\sum_{i=1}^{m} p_i^o x_{io}} \qquad (3)$$

Secondly, we determine the *Technical efficiency score* that implies finding the solution for the following linear system of equations:

$$min\theta_j - \epsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$$

subject to:

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{io}, i = 1,2, \dots, m; \qquad (4)$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{ro}, r = 1,2, \dots, m;$$

$$\lambda_j \geq 0, j = 1,2, \dots, T;$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

where $\theta_j \leq 1$ represents the technical efficiency index of bank j, and s_i^-, s_r^+ are the input and output slack. To account for the VRS hypothesis, we impose an additional constraint: $\sum_{j=1}^{n} \lambda_j = 1$.

In line with Andrieș and Căpraru (2014), we include in the empirical models the following output variables: *Loans* (i.e., commercial)*, Loans and advances to banks*, *Other securities,* and *Off-balance sheet items*. As inputs, we consider *Fixed assets*, *Labor,* and *Total borrowed funds*. The

input prices are represented by physical capital, labor, and funds costs. Table 1 provides their definitions.

The statistics from Table 3 (available online in Supplemental Appendix) indicate that the average cost efficiency score for the sample banks during 2005-2012 is 0.71 (standard deviation 0.19), while de mean technical efficiency is 0.88 (standard deviation 0.12). A higher score is associated with greater efficiency. Analyzing the country-level data (Table 2) the output indicates that the lowest level of cost efficiency was obtained by banks from Serbia (an average score of 0.45), while the greatest level is registered by the Czech Republic and Estonia (an average score of 0.93). Technical efficiency varies from an average value of 0.74 (Macedonia) to 0.99 (Estonia).

3.4. Gender diversity data

We employ an original dataset to determine the representation of females on CEE banks' boards of directors. As information regarding the gender of members from these boards and their attributes has limited availability in governance databases (i.e., RiskMetrics or BoardEx) we hand-collect different variables from the financial institutions' reports.

Our main regressors account for the proportion of females in supervisory boards *(Females among supervisory board)* and managing boards *(Females among managing board)*, but also for the total share of females among all boards *(Females among boards)*. Nonetheless, we consider a dummy variable taking the value 1 if a bank has no female in boards and 0 otherwise (*No female in boards dummy)* to distinguish boards occupied by men and boards including at least one female.

In Figure 1 (Panel B) we show the evolution of the average share of females among board members for our sample of CEE banks during 2005-2012. Overall, managing boards include more females than supervisory boards. Also, the inclusion of females on boards has become more common after the 2008 financial crisis, especially in the case of supervisory boards.

The average values of the gender diversity indices by sample countries are provided in Table 2. On average about 19% of the banks have no females on boards, the percentage of banks with no females' representation in boards varying from 50% in Slovenia to 0% in Serbia (where females are present in all banks from our sample in this country). The mean value of the percentage of females among members of banks' boards is 14% (standard deviation 0.11). On average, the representation of females on supervisory boards is about 12% (standard deviation 0.13), the highest value being attained by Lithuania (23%). Regarding the managing boards, the average share of females among the members is 19% (standard deviation 0.20), the values ranging between 4% (Macedonia) to about 35%-40% in Bulgaria, Serbia, and Montenegro.

In addition, we use two alternatives for gender diversity built on the previous variables to control for the heterogeneity among board members, namely the Blau index of heterogeneity and the Shannon diversity index. The Blau index of heterogeneity among boards is adapted from the form proposed by Blau (1977):

$$Blau\ index\ = 1 - \Sigma_{i=1}^{n}(\text{Share of board members}_i)^2 \quad (5)$$

Share of board members is the proportion of board members in one of the two categories, men and females, and n represents the number of board members within the bank (Blau, 1977). The index takes values from 0 (presence of all board members in only one category) to 0.5 (an equal number of females and men among banks' boards).

Next, we compute the Shannon diversity index among boards, adapted from Shannon (1948):

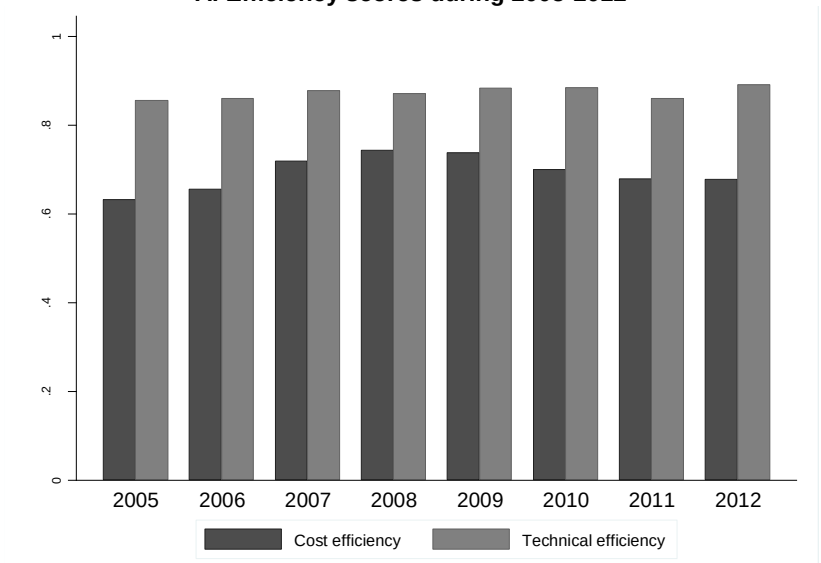
$$Shannon\ index = -\Sigma_{i=1}^{n} Share\ of\ board\ members_i \times log(Share\ of\ board\ members_i) \quad (6)$$

The Shannon index ranges from 0 (no diversity) to 0.69 (an equal number of females and men among banks' boards) and it presents the advantage of better capturing small differences across the gender structure of banks as it is based on the logarithm of the proportion of men and females among boards. The maximum level of Blau and Shannon indices are reached by two institutions

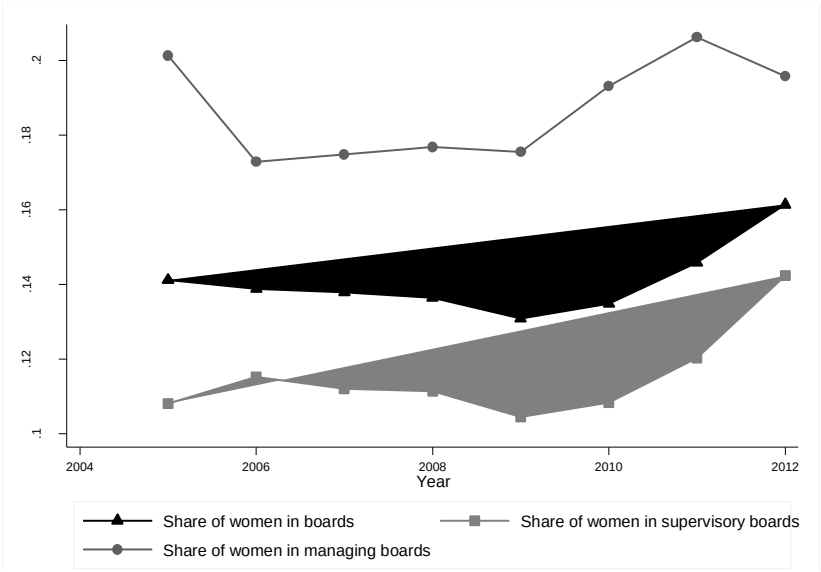
from Bulgaria, Raiffeisen Bank Bulgaria and Societe Generale Expressbank, and, two institutions from Latvia, Norvik Banka and Mortgage and Land Bank.

Figure 1. CEE banks' efficiency and females' presence on boards

A. Efficiency scores during 2005-2012



B. The share of females among board members during 2005-2012



Note: This figure summarizes the average efficiency scores (Panel A) and the average percentage of females among board members (Panel B) for a sample of 128 banks from the CEE banking system during 2005-2012. Cost and technical efficiency scores are computed using the DEA method. The variables

range between 0 and 1, with higher scores being associated with greater efficiency. In Table 1 we provide the definitions of variables

Finally, to add another layer of robustness, we employ several variables constructed following the critical mass theory (Torchia et al., 2011). These are dummy variables indicating if a bank has one female on board, two females, and a minimum of three females (critical mass). In addition to the instruments previously introduced, for the empirical models including these dummy variables, we use as additional instruments the gender inequality index from the World Health Organization and its lagged value. This measure reflects inequality in achievements between women and men in three dimensions: reproductive health, empowerment, and the labor market, and is unlikely to be correlated with bank efficiency.

3.5. The role of size and corporate governance

To explore different channels that might shape the relationship between the representation of females in boards and bank efficiency, we introduce first in the empirical estimations the interaction between gender diversity and size. Second, we assess the interplay between the internal governance structure of supervisory and managing boards, the presence of females in these boards, and efficiency.

Size, gender diversity, and efficiency

We investigate the impact of banks' size by interacting the gender diversity index with a Dummy variable taking the value one for large banks (if the logarithm of Total assets is above the median of the sample). The following regression is estimated via the IV 2SLS method with bank-level clustered standard errors:

$$Efficiency_{ij,t} = \alpha 0 + \alpha 1 \times Gender\ diversity_{ij,t-1} + \alpha 2 \times Gender\ diversity_{ij,t-1} \times Size_{ij,t-1} + \alpha 3 \times Size_{ij,t-1} + \Omega \times Bank\ variables_{ij,t-1} + \Psi \times Macro\ variables_{j,t-1} + GFC_t + SDC_t + v_i + \varepsilon_{ij,t} \quad (7)$$

We alternatively include the interaction between the gender indices ($Gender\ diversity_{ij,t-1}$) and the bank size dummy ($Size_{ij,t-1}$). The gender variety variables are considered endogenous and instrumented with the initial Blau index of gender diversity times year fixed effects.

Corporate governance, gender diversity, and efficiency.

To explore the impact of internal governance structure on the relationship between females' presence on boards and efficiency in the first step we consider the role of supervisory boards, while in the second step the influence of managing boards. Bank-year data regarding various aspects of the structure and attributes of these boards are hand-collected from the banks' financial reports.[13] The link between bank efficiency, gender diversity, and supervisory boards is explored using the next regression estimated via the IV 2SLS method:

$$Efficiency_{ij,t} = \alpha_0 + \alpha_1 \times Gender\ diversity_{ij,t-1} + \alpha_2 \times Gender\ diversity_{ij,t-1} \times Supervisory\ board\ governance_{t-1} + \alpha_3 \times Supervisory\ board\ governance_{t-1} + \Omega \times Bank\ variables_{ij,t-1} + \Psi \times Macro\ variables_{j,t-1} + GFC_t + SDC_t + v_i + \varepsilon_{ij,t} \quad (8)$$

Supervisory board governance accounts for the attributes and composition of banks' supervisory boards considering alternatively the following variables: the share of independent outside directors *(Board independence),* and the percent of foreign members *(Board foreign)* within the supervisory board. Higher values of the indices indicate a prudent supervisory structure, while lower values point out less rigid mechanisms. Descriptive statistics of these indices provided in Table 3 show that on average about 19% of the members are independent outside directors (standard deviation 0.22) and 59% of the members are foreigners (standard deviation 0.34).

[13] *Data regarding corporate governance attributes for banks from CEE countries have limited availability in databases like RiskMetrics and BoardEx for example.*

The influence of managing boards on the relationship between females' presence in boards and bank efficiency is exploited using the next empirical form estimated via the IV 2SLS method:

$$Efficiency_{ij,t} = \alpha_0 + \alpha_1 \times Gender\ diversity_{ij,t-1} + \alpha_2 \times Gender\ diversity_{ij,t-1} \times Managing\ board\ governance_{t-1} + \alpha_3 \times Managing\ board\ governance_{t-1} + \Omega \times Bank\ variables_{ij,t-1} + \Psi \times Macro\ variables_{j,t-1} + GFC_t + SDC_t + \nu_i + \varepsilon_{ij,t} \quad (9)$$

Similar to Andrieș and Brown (2017), the features of the banks' risk practices are captured by two dummy variables accounting if the CRO has also an executive officer role *(CRO Executive),* and whether the bank has a committee responsible for supervising risk-management practices *(Risk committee)*. Higher values of the indices indicate a rigorous management structure, while lower values point out less rigid governance. We summarize the descriptive statistics of these variables in Table 3. During 2005-2010, 41% of banks from our sample had a CRO that was a member of the managing board (standard deviation 0.49) and 47% of banks had a committee dedicated to monitoring the bank's risk strategies (standard deviation 0.50). The gender diversity variables are considered endogenous and instrumented with the initial Blau index of gender diversity times year fixed effects.

4. Empirical results

4.1. Main findings

Table 4 reports the empirical results for the IV 2SLS estimation technique corresponding to equation (1). Panel A exhibits the coefficient estimates for the impact of gender diversity across all boards on cost efficiency. We start by including in Column (1) the share of females among members of the bank's boards, bank-level characteristics, macroeconomic controls, and bank fixed effects. The output corresponding to the 2nd stage estimates shows that increasing the female representation in boards by one standard deviation boosts the cost efficiency by 50 percent of its standard deviation on average, a result that is linked to a semi-elasticity of 125 percent (Column (1)). This outcome continues to hold after adding proxies for board characteristics in Column (2), thus validating H1.

In Columns (3)-(6), we employ alternatively the Blau and Shannon indices of diversity among members of the bank's board. The corresponding coefficient estimates point to a positive impact of gender diversity in board rooms on efficiency that is statistically and economically significant. An increase of the gender diversity index among boards by one standard deviation produces an average increase in banks' cost efficiency by about 77 percent of its standard deviation, the associated semi-elasticity being about 95 percent (Column (3)). Replacing the Blau diversity index with the values of the Shannon index we obtain similar results.

Next, we consider the variable reflecting the absence of females in boards (No female in boards dummy), in Columns (7) –(8). The findings show that the absence of females in the boardroom has a negative and significant impact on banks' cost efficiency.[14] Our results are also economically meaningful. Banks with no females on supervisory and managing boards have 0.44 units lower cost efficiency scores than financial institutions with females participating in boardrooms (Column (7)). As the average bank from our sample has a 0.71 cost efficiency score this implies a semi-elasticity of -62 percent.[15]

Finally, we test H1 using the variables developed based on the critical mass theory. The output in Columns (9)-(10) indicates that a minority presence of one or two females in bank boards is symbolic, while a critical mass of a minimum of three females could enhance bank cost efficiency.

[14] *The extended output of the 1st stage estimates, not reported for brevity, is available upon request.*

[15] *We compute the semi-elasticity for the model corresponding to Column (1) which includes bank controls, bank fixed effects, and macroeconomic controls.*

Table 4. Cost efficiency and boards' gender diversity

Dependent variable	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A. All boards										
Females on boards	0.877***	0.828***								
	(0.332)	(0.307)								
Blau diversity index			0.664***	0.620***						
			(0.243)	(0.224)						
Shannon diversity index					0.493***	0.455***				
					(0.174)	(0.159)				
No female in boards dummy							-0.443***	-0.395***		
							(0.136)	(0.122)		
One woman in board									0.356	0.370
									(0.262)	(0.271)
Two women in board									-0.112	-0.089
									(0.228)	(0.226)
Critical mass (at least three women in board)									0.274*	0.240*
									(0.161)	(0.143)
Size	0.013	0.022	0.015	0.024	0.013	0.023	-0.002	0.013	0.056	0.081*
	(0.033)	(0.034)	(0.032)	(0.033)	(0.032)	(0.033)	(0.037)	(0.036)	(0.048)	(0.049)
Equity to Total assets	0.442	0.515	0.419	0.492	0.412	0.480	0.346	0.384	0.288	0.232
	(0.351)	(0.335)	(0.351)	(0.334)	(0.354)	(0.335)	(0.387)	(0.353)	(0.552)	(0.549)
Net loans share	0.122	0.141	0.138	0.157	0.139	0.158	0.126	0.151	-0.201	-0.075
	(0.139)	(0.137)	(0.138)	(0.137)	(0.140)	(0.138)	(0.169)	(0.160)	(0.269)	(0.249)
Funding risk	0.063	0.064	0.066	0.067	0.067	0.067	0.075	0.073	0.051	0.064
	(0.045)	(0.045)	(0.046)	(0.046)	(0.046)	(0.046)	(0.054)	(0.052)	(0.068)	(0.065)
Credit growth	0.021	0.014	0.025	0.018	0.026	0.019	0.039	0.026	-0.023	-0.030
	(0.024)	(0.025)	(0.024)	(0.024)	(0.024)	(0.024)	(0.027)	(0.027)	(0.042)	(0.041)
Foreign bank dummy	0.163**	0.111*	0.164**	0.113*	0.166**	0.114*	0.178**	0.118	0.143	0.121
	(0.068)	(0.058)	(0.067)	(0.058)	(0.067)	(0.059)	(0.086)	(0.079)	(0.187)	(0.172)
State ownership dummy	-0.089	-0.077	-0.081	-0.070	-0.076	-0.064	-0.041	-0.030	0.046	0.016
	(0.099)	(0.103)	(0.098)	(0.103)	(0.096)	(0.101)	(0.085)	(0.090)	(0.145)	(0.136)
CRO present		0.004		-0.007		-0.013		-0.056		-0.132
		(0.037)		(0.036)		(0.037)		(0.048)		(0.113)
CRO executive		-0.038*		-0.038**		-0.040**		-0.057**		-0.057*

Dependent variable	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		(0.019)		(0.019)		(0.019)		(0.023)		(0.033)
Risk committee		-0.017		-0.012		-0.009		0.015		0.021
		(0.022)		(0.021)		(0.021)		(0.028)		(0.046)
Reports to board		0.016		0.015		0.011		-0.017		-0.012
		(0.031)		(0.031)		(0.031)		(0.037)		(0.058)
Board size		0.002		0.002		0.001		-0.003		0.003
		(0.006)		(0.006)		(0.006)		(0.008)		(0.011)
Board expertise		-0.015		-0.017		-0.013		-0.014		0.107
		(0.085)		(0.081)		(0.081)		(0.099)		(0.173)
Board independence		0.079		0.076		0.072		0.033		-0.130
		(0.078)		(0.078)		(0.078)		(0.082)		(0.168)
Board foreign		0.176**		0.163**		0.165**		0.196**		0.037
		(0.083)		(0.078)		(0.077)		(0.082)		(0.103)
Interlocks share		0.025		0.027		0.026		0.013		0.057
		(0.025)		(0.025)		(0.026)		(0.036)		(0.043)
Capital regulatory index	-0.006	-0.005	-0.005	-0.005	-0.005	-0.005	-0.006	-0.005	-0.008	-0.009
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.008)	(0.008)
Banking restrictions index	0.002	0.002	0.002	0.002	0.002	0.002	0.005	0.005	0.018*	0.017*
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.011)	(0.011)
Regulatory quality index	0.048	0.018	0.040	0.012	0.041	0.012	0.068	0.032	0.372**	0.375**
	(0.084)	(0.084)	(0.083)	(0.084)	(0.084)	(0.085)	(0.101)	(0.096)	(0.169)	(0.160)
Concentration	-0.004	-0.028	0.007	-0.015	0.025	0.004	0.190	0.159	0.145	0.234
	(0.138)	(0.131)	(0.134)	(0.129)	(0.137)	(0.131)	(0.191)	(0.176)	(0.294)	(0.288)
Inflation	0.325*	0.423**	0.360**	0.447**	0.366**	0.457**	0.372*	0.487**	0.667**	0.660**
	(0.184)	(0.191)	(0.181)	(0.189)	(0.183)	(0.191)	(0.222)	(0.223)	(0.321)	(0.312)
GDP growth	-0.024	-0.036	-0.021	-0.031	-0.024	-0.034	-0.074	-0.075	-0.177*	-0.150
	(0.052)	(0.053)	(0.052)	(0.052)	(0.053)	(0.053)	(0.074)	(0.069)	(0.104)	(0.097)
GFC dummy	0.031*	0.025	0.031*	0.025	0.032*	0.025	0.038*	0.027	0.013	-0.004
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.020)	(0.019)	(0.027)	(0.027)
SDC dummy	-0.005	-0.008	-0.002	-0.006	-0.002	-0.006	-0.005	-0.010	-0.016	-0.020
	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.023)	(0.021)	(0.034)	(0.033)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV 1st stage										
Blau diversity index among boards (initial) * Year FE	-0.050***	-0.052***	-0.067***	-0.070***	-0.095***	-0.099***	0.137***	0.147***	-0.005	0.030
	(0.009)	(0.009)	(0.011)	(0.011)	(0.016)	(0.015)	(0.028)	(0.029)	(0.042)	(0.044)
Female in labor force (%)	0.016**	0.015**	0.020**	0.020**	0.026*	0.026**	-0.004	-0.009	-0.111**	0.058
	(0.007)	(0.006)	(0.009)	(0.009)	(0.013)	(0.013)	(0.031)	(0.030)	(0.048)	(0.043)

Dependent variable	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gender inequality index									-0.054	-2.900**
									(1.451)	(1.181)
Gender inequality index lagged									1.328	2.465*
									(1.667)	(1.289)
LM statistic	28.56	33.05	32.11	36.26	32.50	36.41	22.44	24.01	5.19	4.84
LM statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.09
F statistic	18.35	21.02	20.35	22.99	20.08	22.55	11.68	12.59	1.32	1.16
R squared	0.12	0.12	0.12	0.11	0.12	0.12	0.15	0.14	0.19	0.18
No. obs.	738	737	738	737	738	737	738	737	627	627
No. banks	128	128	128	128	128	128	128	128	110	110
Panel B. Supervisory board										
Females on boards	0.699***	0.681***								
	(0.270)	(0.257)								
Blau diversity index			0.586***	0.554***						
			(0.212)	(0.198)						
Shannon diversity index					0.435***	0.404***				
					(0.151)	(0.140)				
No female in boards dummy							-0.332***	-0.296***		
							(0.107)	(0.097)		
One woman in board									-0.167	-1.846
									(0.994)	(5.647)
Two women in board									0.336	0.652
									(0.296)	(1.318)
Critical mass (at least three women in board)									0.271**	0.030
									(0.130)	(0.574)
Panel C. Managing board										
Females on boards	1.978**	1.749**								
	(0.878)	(0.684)								

Dependent variable	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff	Cost Eff
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Blau diversity index			1.316***	1.231***						
			(0.487)	(0.426)						
Shannon diversity index					0.898***	0.843***				
					(0.329)	(0.287)				
No female in boards dummy							-0.500***	-0.476***		
							(0.179)	(0.154)		
One woman in board									2.942	2.709
									(2.711)	(4.411)
Two women in board									0.411	1.255
									(1.178)	(1.444)
Critical mass (at least three women in board)									0.160	-0.685
									(1.543)	(1.374)

*Note: This table shows the output of the next equation: Efficiencyij,t = α0 + α1×Genderij,t-1 + Ω×Bank variablesij,t-1 + Ψ×Macro variablesj,t-1 + GFCt + SDCt + vi + εij,t. Estimations are run using IV 2SLS with bank-fixed effects and bank-level clustered standard errors. In Panel A we report results for all boards, in Panel B we report the coefficient estimates for the supervisory board, while in Panel C for the managing board. The instruments used for the gender variables are the initial Blau index of gender diversity times year fixed effects and the share of females in labor force (%). In columns (9) and (10) we also add as instruments the gender inequality index and its lagged value. LM statistic and F statistic report the validity of the instrumental variables. Variables are winsorized at 1st and 99th levels, and the regressors are lagged by one period. Bank-level clustered standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.*

As the female presence in boardrooms and gender diversity proxies are considered endogenous and instrumented with external variables it is important to assess the validity of the instruments. The first stage results corresponding to the coefficients associated with the instrumental variables are presented in each column of Table (4). As expected, the initial Blau index times year fixed and the female representation in the labor force are strong predictors of the variation in gender diversity among boards across most of the models. Table 4 also reports the Kleibergen-Paap rk LM statistic, which permits us to assess if the excluded instruments are relevant. (i.e., correlated with the endogenous regressors). Under its null hypothesis, the equation is underidentified. The corresponding p-value confirms that the models are identified and the instruments are valid in the IV 2SLS first-stage estimations. We also employ the Kleibergen-Paap rk Wald F test to assess the weak identification restrictions (i.e., the excluded instruments are correlated with the endogenous regressors, but only weakly). Because we applied heteroskedastic corrections to the standard errors the the rk Wald F statistic's values are compared with the Stock and Yogo's critical values (2005). According to Baum, Schaffer, and Stillmann (2007), they can yield robust evidence when non-i.i.d. errors are present. The large values of the F statistic reject the null hypothesis of weak instruments, supporting the choice of our instrumental variables.[16] In robustness checks, we also use alternative instruments, i.e. we replace the initial Blau index with the initial share of females among members of the bank's boards (the 2005 values) times year fixed effects. Unreported results validate our main findings.[17]

Panel B depicts results linked with the supervisory board, and Panel C shows the results associated with the managing board. Overall, our findings strongly support H1, indicating that increasing the gender diversity among the supervisory and managing boards of banks could improve cost efficiency.

Following the same strategy, we assess the impact of gender diversity on technical efficiency in Table (5).[18] The output indicates that by strengthening the female representation in boards by one standard deviation the technical efficiency is enhanced by about 43 percent of its standard deviation on average, a result that corresponds to a semi-elasticity of 53 percent (Column (1)). Including alternatively the Blau and Shannon diversity indices (Columns (3)-(6)), the findings highlight a positive effect of greater gender diversity in the boardroom on technical efficiency. Results also depict a significantly lower technical efficiency score by 0.20 units for banks with no females among the boards in comparison with banks where at least one female participates in the board meetings (Column (7)). Considering that the average technical efficiency score for our sample is 0.88, the associated semi-elasticity is -23 percent. Moreover, a critical mass of a minimum of three females significantly enhances bank technical efficiency. Finally, when distinguishing among supervisory and managing boards in Panels B and C, the results continue to hold, thus confirming the importance of greater gender diversity across both types of bank boards from CEE in enhancing technical efficiency. The diagnosis tests uphold the robustness of our results. The Kleibergen-Paap rk LM statistic confirms that the instruments are not correlated with the endogenous regressors (underidentification), and, the Kleibergen-Paap rk Wald F validates the condition of weak instruments.

In Table 6 (available online in Supplemental Appendix), we use two alternative definitions for the dependent variables. In Panel A we employ the cost-to-income ratio, while in Panel B we use the performance expressed by the average return on assets (ROAA). The output indicates a

[16] *Staiger and Stock (1997) suggest as "rule of thumb" to compare the F statistic with 10. If the values associated with F statistic are at least 10, weak identification should not to be considered a problem.*

[17] *The results are available upon request.*

[18] *We estimate the effects of female presence in boards and gender diversity using all empirical models presented in Table (4), but due to reasons of parsimony we report the output associated with the benchmark models that include bank controls, bank fixed effects, board characteristics, and macroecnomic controls (i.e., models (2), (4), (6) from Table 4).*

significant and negative impact of a greater presence of females among board members and greater gender diversity on banks'cost-to income-ratio, and a positive impact on banks' performance, validating H1.

Table 7 (available online in Supplemental Appendix) provides supplementary robustness checks using restricted samples to estimate our models. Within our dataset, some banks did not have any females present among members of managing or supervisory boards in some of the years. To alleviate this sample bias concern, first, we run the empirical specifications for a restricted sample of banks with females represented on the boards for at least 4 years (109 banks had females sitting on boards for at least 4 years). In Panel B the sample is restricted to banks with females present in the boards for the whole period 2005-2008 (73 banks were represented by females in boards during the whole period of 8 years; Panel A). Similar to the case of our initial output, the positive and significant coefficients associated with the female variables suggest that banks with greater gender diversity across boards are more efficient. The diagnosis tests for endogeneity uphold our results.

Overall, the empirical findings show that the presence of females on boards boosts the efficiency of the banks from Emerging European countries. Our results are similar to the strand of literature considering that gender diversity could have a positive impact on bank performance (De Cabo et al., 2012; García-Meca et al., 2015), and they support hypothesis H1.

4.2. Size, gender diversity, and efficiency

To investigate the relationship between gender diversity and efficiency across different types of banks we explore the effects of size. In Table 8, Panel A exhibits the output for cost efficiency, while the results associated with technical efficiency are shown in Panel B. Results show that for smaller banks, strengthening females' participation in the boardroom increases efficiency. The coefficient associated with the interaction term *Females among boards* × *Size dummy* is negative and strongly significant for the cost efficiency score (i.e., -1.06***, Column (1)).[19] Replacing the dummy variable for size with the logarithm of total assets yields analogous results for both cost and technical efficiency (Columns (2) and (8)). We also report the coefficients corresponding to the interaction between size and the Blau and Shannon indices of gender diversity among boards. The findings point to higher levels of cost efficiency (Columns (3)-(6)) and technical efficiency (Columns (9)-(12)) for smaller banks.[20]

Our findings highlight that small financial institutions increase their efficiency level if they appoint more females on boards, thus policymakers can incentivize these organizations to enhance gender diversity in the boardroom. The diagnosis tests for underidentification restrictions (Kleibergen-Paap rk LM statistic) and weak identification restrictions (Kleibergen-Paap rk Wald F statistic) validate our results.

[19] *We report the estimates for a model similar with that corresponding to Column (2) Table (4) which includes bank controls, bank fixed effects, board characteristics, and macroecnomic controls. Running specifications analogous to Column (1) yields to comparable results.*

[20] *Unreported results confirm a similar effect when using the Shannon index of diversity among boards' members.*

Table 5. Technical efficiency and boards' gender diversity

Dependent variable	Tech Eff	Tech Eff	Tech Eff	Tech Eff	Tech Eff	Tech Eff	Tech Eff	Tech Eff	Tech Eff	Tech Eff
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A. All boards										
Females on boards	0.468**	0.428**								
	(0.187)	(0.177)								
Blau diversity index			0.353**	0.321**						
			(0.137)	(0.131)						
Shannon diversity index					0.256***	0.232**				
					(0.098)	(0.093)				
No female in boards dummy							-0.200***	-0.180**		
							(0.076)	(0.070)		
One woman in board									0.203	0.211
									(0.131)	(0.140)
Two women in board									0.050	0.042
									(0.121)	(0.123)
Critical mass (at least three women in board)									0.193**	0.163**
									(0.078)	(0.071)
Size	0.016	0.022	0.017	0.023	0.016	0.023	0.011	0.020	0.028	0.043*
	(0.019)	(0.019)	(0.018)	(0.018)	(0.019)	(0.018)	(0.020)	(0.020)	(0.024)	(0.025)
Equity to Total assets	0.333	0.390*	0.320	0.378*	0.316	0.371*	0.281	0.326	0.567*	0.521
	(0.223)	(0.211)	(0.224)	(0.213)	(0.227)	(0.214)	(0.240)	(0.225)	(0.315)	(0.319)
Net loans share	0.149*	0.171**	0.158**	0.179**	0.158**	0.179**	0.149*	0.174**	0.023	0.071
	(0.077)	(0.076)	(0.077)	(0.076)	(0.077)	(0.076)	(0.086)	(0.084)	(0.137)	(0.131)
Funding risk	0.059**	0.060**	0.060**	0.061**	0.061**	0.061**	0.062**	0.062**	0.067*	0.069**
	(0.025)	(0.024)	(0.025)	(0.024)	(0.025)	(0.024)	(0.028)	(0.027)	(0.034)	(0.034)
Credit growth	-0.013	-0.019	-0.011	-0.017	-0.010	-0.016	-0.004	-0.013	-0.021	-0.028
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.024)	(0.024)
Foreign bank dummy	0.107*	0.082*	0.107*	0.083*	0.107**	0.083**	0.106**	0.082*	0.062	0.059
	(0.058)	(0.044)	(0.055)	(0.043)	(0.054)	(0.042)	(0.054)	(0.043)	(0.084)	(0.076)
State ownership dummy	-0.091	-0.070	-0.086	-0.066	-0.083	-0.063	-0.064	-0.046	-0.028	-0.024
	(0.074)	(0.076)	(0.074)	(0.076)	(0.074)	(0.076)	(0.072)	(0.074)	(0.085)	(0.081)
CRO present		-0.002		-0.008		-0.011		-0.031		-0.061
		(0.020)		(0.019)		(0.020)		(0.024)		(0.057)

CRO executive		-0.022**		-0.022**		-0.023**		-0.030**		-0.032**
		(0.010)		(0.010)		(0.010)		(0.012)		(0.015)
Risk committee		-0.007		-0.004		-0.003		0.008		0.009
		(0.012)		(0.012)		(0.012)		(0.015)		(0.022)
Reports to board		0.001		0.000		-0.002		-0.014		-0.016
		(0.019)		(0.019)		(0.019)		(0.022)		(0.028)
Board size		-0.005		-0.006		-0.006		-0.008*		-0.007
		(0.004)		(0.004)		(0.004)		(0.004)		(0.006)
Board expertise		0.050		0.049		0.051		0.050		0.055
		(0.047)		(0.046)		(0.046)		(0.052)		(0.083)
Board independence		0.028		0.026		0.024		0.005		-0.055
		(0.049)		(0.049)		(0.049)		(0.048)		(0.086)
Board foreign		0.079*		0.073*		0.073*		0.080*		0.012
		(0.045)		(0.043)		(0.042)		(0.043)		(0.054)
Interlocks share		0.035**		0.036**		0.035**		0.031*		0.028
		(0.014)		(0.014)		(0.015)		(0.018)		(0.023)
Capital regulatory index	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.004	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Banking restrictions index	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.000	-0.000	0.005	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Regulatory quality index	0.145***	0.124***	0.141***	0.120**	0.141***	0.121**	0.152***	0.130**	0.175**	0.182**
	(0.049)	(0.048)	(0.049)	(0.048)	(0.050)	(0.048)	(0.056)	(0.053)	(0.082)	(0.081)
Concentration	0.054	0.049	0.060	0.056	0.070	0.066	0.145	0.137	0.066	0.116
	(0.081)	(0.078)	(0.080)	(0.078)	(0.081)	(0.079)	(0.102)	(0.097)	(0.149)	(0.152)
Inflation	0.053	0.131	0.071	0.144	0.074	0.148	0.075	0.156	0.255	0.271*
	(0.121)	(0.122)	(0.120)	(0.121)	(0.121)	(0.122)	(0.131)	(0.132)	(0.160)	(0.160)
GDP growth	0.006	0.008	0.008	0.010	0.006	0.009	-0.015	-0.009	-0.048	-0.034
	(0.035)	(0.036)	(0.035)	(0.036)	(0.036)	(0.036)	(0.043)	(0.042)	(0.054)	(0.051)
GFC dummy	-0.010	-0.016*	-0.010	-0.016*	-0.010	-0.016*	-0.008	-0.016	-0.013	-0.023*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.013)	(0.013)
SDC dummy	-0.023**	-0.023**	-0.021**	-0.022**	-0.021**	-0.022**	-0.023*	-0.024**	-0.020	-0.022
	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.013)	(0.012)	(0.016)	(0.016)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV 1st stage										
Blau diversity index among boards (initial) * Year FE	-0.050***	-0.052***	-0.067***	-0.070***	-0.095***	-0.099***	0.137***	0.147***	-0.005	0.030
	(0.009)	(0.009)	(0.011)	(0.011)	(0.016)	(0.015)	(0.028)	(0.029)	(0.042)	(0.044)
Female in labor force (%)	0.016**	0.015**	0.020**	0.020**	0.026*	0.026**	-0.004	-0.009	-0.111**	0.058
	(0.007)	(0.006)	(0.009)	(0.009)	(0.013)	(0.013)	(0.031)	(0.030)	(0.048)	(0.043)

Gender inequality index									-0.054	-2.900**
									(1.451)	(1.181)
Gender inequality index lagged									1.328	2.465*
									(1.667)	(1.289)
LM statistic	28.56	33.05	32.11	36.26	32.50	36.41	22.44	24.01	5.19	4.84
LM statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.09
F statistic	18.35	21.02	20.35	22.99	20.08	22.55	11.68	12.59	1.32	1.16
R squared	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09
No. obs.	738	737	738	737	738	737	738	737	627	627
No. banks	128	128	128	128	128	128	128	128	110	110
Panel B. Supervisory board										
Females on boards	0.390**	0.364**								
	(0.155)	(0.152)								
Blau diversity index			0.314***	0.287**						
			(0.120)	(0.116)						
Shannon diversity index					0.226***	0.205**				
					(0.085)	(0.082)				
No female in boards dummy							-0.156***	-0.140**		
							(0.058)	(0.055)		
One woman in board									-0.076	-0.689
									(0.564)	(2.180)
Two women in board									0.201	0.311
									(0.177)	(0.511)
Critical mass (at least three women in board)									0.172**	0.068
									(0.072)	(0.226)
Panel C. Managing board										
Females on boards	1.107**	0.913**								
	(0.477)	(0.366)								
Blau diversity index			0.756***	0.647***						
			(0.269)	(0.236)						

Table 8. Efficiency, boards' gender diversity, and banks' size

Dependent variable	A. Cost efficiency						B. Technical efficiency					
Females	*Females among boards*		*Blau index of diversity among boards*		*Shannon index of diversity among boards*		*Females among boards*		*Blau index of diversity among boards*		*Shannon index of diversity among boards*	
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Females × Size dummy	-1.057***		-0.719**		-0.464**		-0.515**		-0.369**		-0.246**	
	(0.389)		(0.282)		(0.193)		(0.228)		(0.167)		(0.115)	
Females × Size		-1.016		-0.983*		-0.642*		-0.821		-0.609*		-0.393*
		(0.882)		(0.555)		(0.337)		(0.635)		(0.362)		(0.219)
Females	1.112***	14.795	0.778**	14.470*	0.528**	9.468*	0.580**	12.044	0.419**	8.987*	0.287**	5.808*
	(0.425)	(12.952)	(0.304)	(8.209)	(0.207)	(4.984)	(0.253)	(9.334)	(0.183)	(5.358)	(0.126)	(3.235)
Size dummy	0.165**		0.165**		0.166**		0.080**		0.084**		0.088**	
	(0.067)		(0.071)		(0.075)		(0.038)		(0.041)		(0.044)	
Size	0.002	0.144	0.013	0.235	0.016	0.344	0.012	-0.131	0.017	-0.058	0.018	0.015
	(0.037)	(0.443)	(0.034)	(0.576)	(0.034)	(0.540)	(0.020)	(0.406)	(0.019)	(0.416)	(0.019)	(0.389)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Board controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV 1st stage												
Blau diversity index among	-0.038***	-0.001	-0.050***	-0.002**	-0.073***	-0.003**	-0.038***	-0.001	-0.050***	-0.002**	-0.073***	-0.003**
boards (initial) * Year FE	(0.008)	(0.001)	(0.009)	(0.001)	(0.013)	(0.001)	(0.008)	(0.001)	(0.009)	(0.001)	(0.013)	(0.001)
Female in labor force (%)	0.013**	0.001	0.019**	0.001	0.027**	0.002	0.013**	0.001	0.019**	0.001	0.027**	0.002
	(0.005)	(0.001)	(0.007)	(0.001)	(0.011)	(0.001)	(0.005)	(0.001)	(0.007)	(0.001)	(0.011)	(0.001)
LM statistic	22.18	4.20	25.46	6.74	26.93	8.38	22.18	4.20	25.46	6.74	26.93	8.38
LM statistic p-value	0.00	0.12	0.00	0.03	0.00	0.02	0.00	0.12	0.00	0.03	0.00	0.02
F statistic	13.26	2.01	15.44	3.26	16.29	4.11	13.26	2.01	15.44	3.26	16.29	4.11

R squared	0.12	0.13	0.11	0.14	0.11	0.14	0.07	0.09	0.07	0.09	0.07	0.09
No. obs.	737	737	737	737	737	737	737	737	737	737	737	737
No. banks	128	128	128	128	128	128	128	128	128	128	128	128

*Note: This table shows the output of the next equation: Efficiencyij,t = α0 + α1×Genderij,t-1 + α2×Genderij,t-1×Sizet-1 + α3×Sizet-1 + Ω×Bank variablesij,t-1 + Ψ×Macro variablesj,t-1 + GFCt + SDCt + vi + εij,t. Estimations are run using IV 2SLS with bank-fixed effects, and include a dummy variable for the crisis period. Females variable is represented alternatively by Females among boards, Blau diversity index among boards, and the Shannon diversity index among boards. The instruments used for the gender variables are the initial Blau index of gender diversity times year fixed effects and the share of females in labor force (%). LM statistic and F statistic report the validity of the instrumental variables. Variables are winsorized at 1st and 99th levels, and the regressors are lagged by one period. Bank-level clustered standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.*

4.3. Supervisory board, gender diversity, and efficiency

We further distinguish between the presence of females in supervisory boards versus managing boards and assess their separate effects on efficiency across different governance characteristics of banks.

In Table 9 we investigate the impact of supervisory board structure on the relationship between the gender diversity among supervisory board and efficiency. The empirical output shows that more independent directors increase bank efficiency. Therefore, in the case of less independent boards, a higher share of females among members of the supervisory boards of CEE banks has a positive effect on cost efficiency and technical efficiency (Columns (1) and (7) of Table 8). This result supports the hypothesis H2. This finding might reflect that adding females to boards that already have a high share of independent outside members would not make a difference in boosting efficiency.

A similar result is obtained for banks with more domestically appointed directors. Results indicate a positive effect of the presence of foreign directors on bank efficiency. About the interaction terms *Females* × *Board foreign*, which are negative and significant, hypothesis H3 is confirmed (Columns (2) and (8)). This finding can be linked to García-Meca *et al.* (2015), who demonstrate that national diversity within banks' boards inhibits their performance. This result indicates that for supervisory boards with more domestic members, which is the case of many banks from the CEE region, gender diversity can enhance the efficiency of the banks.

As a robustness check, we use the Blau diversity index among members of the supervisory board. The coefficient estimates presented in Columns (3)-(4) for cost efficiency, and (9)-(10) for technical efficiency, confirm a statistically significant and negative impact of gender diversity across banks with more independent supervisory boards, and a negative effect for banks with a large share of foreign members in supervisory boards. Replacing the Blau index with the Shannon diversity index among supervisory boards in Columns (5)-(6) and (11)-(12), the results remain qualitatively similar.

4.4. Managing board, gender diversity, and efficiency

Finally, in Table 10 we assess the mitigating role of corporate governance on the link between females' presence in managing boards and banks' efficiency. Previous literature indicates that banks with strong governance practices are more efficient (Adams and Ferreira, 2009; Terjesen, Sealy, and Singh, 2009), and performant (Sabato, 2010; Aebi et al., 2012; Andrieș and Brown, 2017).

In our framework, corporate governance is represented through two proxies that reflect the risk management practices within banks. First, we account if the chief risk officer responsible for bank-wide risk management has also an executive role within the bank *(CRO Executive)*. Second, we consider whether the bank has a committee responsible for supervising the bank's risk management practices *(Risk committee).* Both variables have a positive and significant influence on a bank's efficiency. Higher values of these indices indicate tighter risk management practices. Furthermore, the coefficient estimates of the interaction between these variables and the percentage of females presence on the board, which are negative and significant, indicate that a higher representation of females among members of managing boards boosts the efficiency of financial institutions with less rigid corporate governance structures (Columns (1)-(2) for cost efficiency, and respectively Columns (7)-(8) for technical efficiency).

These results support the hypotheses H4 and H5. Using robustness exercises the Blau and Shannon indices of gender diversity, the results remain similar (Columns (3)-(6) for cost efficiency and (9)-(12) for technical efficiency).

Table 9. Gender diversity among supervisory boards, governance, and efficiency

Dependent variable	A. Cost efficiency						B. Technical efficiency					
Females	*Females among supervisory board*		*Blau index of diversity among supervisory board*		*Shannon index of diversity among supervisory board*		*Females among supervisory board*		*Blau index of diversity among supervisory board*		*Shannon index of diversity among supervisory board*	
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Females × Board independence	-1.695**		-1.341**		-0.942**		-0.813*		-0.641*		-0.456*	
	(0.736)		(0.589)		(0.421)		(0.445)		(0.369)		(0.263)	
Females × Board foreign		-3.142***		-2.299***		-1.569***		-1.270**		-0.932**		-0.639**
		(1.147)		(0.781)		(0.537)		(0.560)		(0.395)		(0.271)
Females	0.666**	2.626***	0.544**	1.925***	0.398**	1.312***	0.394**	1.099**	0.315**	0.807**	0.227**	0.551**
	(0.317)	(0.985)	(0.250)	(0.663)	(0.179)	(0.454)	(0.194)	(0.476)	(0.155)	(0.332)	(0.111)	(0.227)
Board independence	0.247**	0.309**	0.272**	0.263**	0.293**	0.246*	0.116	0.122*	0.125	0.102	0.135	0.095
	(0.114)	(0.145)	(0.123)	(0.130)	(0.132)	(0.126)	(0.075)	(0.073)	(0.082)	(0.067)	(0.088)	(0.066)
Board foreign	0.167*	0.497**	0.165**	0.480***	0.170**	0.491***	0.083	0.201**	0.080	0.194**	0.081*	0.199**
	(0.088)	(0.213)	(0.084)	(0.184)	(0.085)	(0.185)	(0.050)	(0.097)	(0.049)	(0.088)	(0.049)	(0.089)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Board controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV 1st stage												
Blau diversity index among boards (initial) * Year FE	-0.042***	-0.025***	-0.053***	-0.034***	-0.076***	-0.049***	-0.042***	-0.025***	-0.053***	-0.034***	-0.076***	-0.049***
	(0.010)	(0.007)	(0.012)	(0.009)	(0.018)	(0.013)	(0.010)	(0.007)	(0.012)	(0.009)	(0.018)	(0.013)
Female in labor force (%)	0.022***	-0.001	0.027***	-0.001	0.036***	-0.001	0.022***	-0.001	0.027***	-0.001	0.036***	-0.001
	(0.007)	(0.004)	(0.009)	(0.005)	(0.013)	(0.008)	(0.007)	(0.004)	(0.009)	(0.005)	(0.013)	(0.008)
LM statistic	23.75	13.26	23.47	15.44	22.40	14.92	23.75	13.26	23.47	15.44	22.40	14.92
LM statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F statistic	13.29	6.82	13.03	8.00	12.31	7.66	13.29	6.82	13.03	8.00	12.31	7.66
R squared	0.11	0.15	0.11	0.14	0.11	0.14	0.07	0.08	0.07	0.08	0.07	0.08

No. obs.	737	737	737	737	737	737	737	737	737	737	737	737
No. banks	128	128	128	128	128	128	128	128	128	128	128	128

*Note: This table shows the output of the next equation: Efficiencyij,t = α0 + α1×Femalesij,t-1 + α2×Femalesj,t-1×Supervisory board governancet-1 + α3×Supervisory board governancet-1 + Ω×Bank variablesij,t-1 + Ψ×Macro variablesj,t-1 + GFCt + SDCt + vi + εij,t. Estimations are run using IV 2SLS with bank-fixed effects, and include a dummy variable for the crisis period. Females variable is represented alternatively by Females among supervisory board, Blau diversity index among supervisory board, and the Shannon diversity index among the supervisory board. The instruments used for the gender variables are the initial Blau index of gender diversity times year fixed effects and the share of females in labor force (%). LM statistic and F statistic report the validity of the instrumental variables. Variables are winsorized at 1st and 99th levels, and the regressors are lagged by one period. Bank-level clustered standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.*

Table 10. Gender diversity among managing boards, governance, and efficiency

Dependent variable	A. Cost efficiency						B. Technical efficiency					
Females	*Females among managing board*		*Blau index of diversity among managing board*		*Shannon index of diversity among managing board*		*Females among managing board*		*Blau index of diversity among managing board*		*Shannon index of diversity among managing board*	
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Females × *CRO executive*	-0.802***		-0.505***		-0.353***		-0.425***		-0.268**		-0.188**	
	(0.298)		(0.193)		(0.134)		(0.170)		(0.113)		(0.078)	
Females × *Risk committee*		-1.041***		-0.676***		-0.475***		-0.550***		-0.333***		-0.231***
		(0.318)		(0.217)		(0.150)		(0.172)		(0.121)		(0.084)
Females	1.362***	1.323***	0.807***	1.053***	0.561***	0.721***	0.716***	0.688***	0.428***	0.559***	0.297***	0.384***
	(0.471)	(0.421)	(0.271)	(0.319)	(0.187)	(0.216)	(0.266)	(0.234)	(0.165)	(0.180)	(0.113)	(0.122)
CRO executive	0.102**	-0.044	0.085**	-0.031	0.089**	-0.030	0.050***	-0.027	0.041*	-0.020	0.043*	-0.019
	(0.046)	(0.034)	(0.040)	(0.031)	(0.041)	(0.031)	(0.024)	(0.018)	(0.022)	(0.016)	(0.023)	(0.016)
Risk committee	-0.068	0.160**	-0.031	0.129**	-0.028	0.136**	-0.032	0.090**	-0.013	0.065*	-0.011	0.068*
	(0.057)	(0.069)	(0.042)	(0.064)	(0.042)	(0.065)	(0.032)	(0.036)	(0.024)	(0.035)	(0.024)	(0.035)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Board controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV 1st stage												
Blau diversity index among	-0.045***	-0.054***	-0.056***	-0.065***	-0.082***	-0.096***	-0.045***	-0.054***	-0.056***	-0.065***	-0.082***	-0.096***
boards (initial) * Year FE	(0.011)	(0.011)	(0.011)	(0.012)	(0.016)	(0.017)	(0.011)	(0.011)	(0.011)	(0.012)	(0.016)	(0.017)
Female in labor force (%)	0.012	-0.007	0.034**	0.004	0.049**	0.004	0.012	-0.007	0.034**	0.004	0.049**	0.004
	(0.013)	(0.013)	(0.014)	(0.015)	(0.019)	(0.021)	(0.013)	(0.013)	(0.014)	(0.015)	(0.019)	(0.021)
LM statistic	18.46	19.34	29.32	24.25	29.80	25.54	18.46	19.34	29.32	24.25	29.80	25.54
LM statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

F statistic	9.57	11.59	16.23	14.45	16.43	15.21	9.57	11.59	16.23	14.45	16.43	15.21
R squared	0.16	0.15	0.13	0.15	0.13	0.15	0.09	0.08	0.07	0.08	0.07	0.08
No. obs.	427	427	427	427	427	427	427	427	427	427	427	427
No. banks	75	75	75	75	75	75	75	75	75	75	75	75

*Note: This table shows the output of the next equation: Efficiencyij,t = α0 + α1×Femalesij,t-1 + α2×Femalesj,t-1×Managing board governancet-1 + α3×Managing board governancet-1 + Ω×Bank variablesij,t-1 + Ψ×Macro variablesj,t-1 + GFCt + SDCt + εij,t. Estimations are run using IV 2SLS with bank fixed effects, and include a dummy variable for the crisis period. Females variable is represented alternatively by Females among managing board, Blau diversity index among managing board, and Shannon diversity index among managing board. The instruments used for the gender variables are the initial Blau index of gender diversity times year fixed effects and the share of females in labor force (%). LM statistic and F statistic report the validity of the instrumental variables. Variables are winsorized at 1st and 99th levels, and the regressors are lagged by one period. Bank-level clustered standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.*

In sum, our findings highlight the idea that gender diversity among the managing board of directors can enhance efficiency for CEE banks with less restrictive corporate governance practices.

5. Conclusions

We explore an original hand-collected dataset on different proxies for gender diversity of banks' supervisory and managing boards from CEE countries within an instrumental variable framework. We provide empirical evidence that the representation of females on boards strongly boosts the cost efficiency and technical efficiency of banks from emerging Europe. Taking into account the dimension of banks, we found that the effect is more pronounced in the case of small banks. Also, our results show that the presence of females in supervisory boards has a positive effect on less independent boards and those with more domestic directors. Nonetheless, greater gender diversity within banks' managing boards with less restrictive governance mechanisms boosts bank efficiency.

Our results underline the idea that board gender diversity is a relevant matter for bank efficiency in the context of emerging economies. We conjecture that any policy formulation aiming to refine the governance of CEE banks should consider the boards' structure and gender diversity. In the same direction, the regulators should pay more attention when fixing the requirements of being a bank's board member and account for the moderating role of risk management and supervisory practices within banks.

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