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Women on Boards and Firm Performance: A Microeconometric Search for a Connection

Marek Gruszczyński

Institute of Econometrics, SGH Warsaw School of Economics, 02-554 Warszawa, Poland;
marek.gruszczynski@sgh.waw.pl

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Abstract: This paper discusses questions of the gender diversity of corporate boards vis-à-vis firm performance. Typically, researchers have asked if a female presence is associated with improved performance and more transparent governance. The paper's first part reports on several econometric attempts in the quest to prove the existence of such an association. The primary outcome is that the results vary over geographical, cultural, and time settings. The study presented in the second part examines European firms' annual reports from 2015. Binomial models, multiple regression, and quantile regression are applied resulting in the finding that female presence on a board is not significantly related to firm performance for this sample. Together with the picture that emerged from the paper's first part, this result leads to the possibility that the search for an association between women on boards and company performance is not fundamental. Nevertheless, modern business societies worldwide may need to boost the female presence on managerial bodies. Current econometric evidence indicates that this is not harmful to corporate results.

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1. Introduction: Corporate Boards Vis-à-Vis Gender Diversity

Topics in corporate finance and corporate governance research include the examination of such aspects of corporate board structure as the presence of independent directors, the formation of committees, and recently the presence of women. This paper discusses research attempts concerning the possible relationship between gender structure and the financial results of companies.

Research in empirical corporate finance is developing in many directions. Some studies have a sound theoretical setting, while some still need to be properly rooted in theory. Specific theories have proved to be unstable over time and space—as shown by empirics—and there is, perhaps, no need to strive for a unified theory of corporate finance. Instead, there is a growing demand for more "operational" results based on statistical data on companies (Gruszczyński 2020). This paper contemplates an area that is in the developmental phase, apparently without solid theory, and, perhaps, that is an advantage.

Empirical studies on women and the corporation have emerged in recent decades in vast numbers, along with changes in societies' views on gender issues. The new subject of the corporate presence of women has naturally become a topic for research in corporate governance, corporate finance, corporate law, and other areas. Researchers have concentrated on various aspects of women's presence in corporations, including the relationship between women on boards of directors (BoDs) and financial results.

The presence of women on corporate boards is no longer questioned, with major efforts being constantly directed towards increasing the proportion of women on boards. This has become a political issue since the "natural" process of board evolution into bodies reflecting the gender structure of

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their respective societies seems to be rather lengthy. The result is that, in some countries, gender board quotas have been imposed, such as 40% in Norway, Spain, Iceland, and France, 33% in Belgium, and 30% in the Netherlands and Italy (Ahern and Dittmar 2012).

The European Commission in 2012 adopted a proposal for a directive "setting a minimum objective of having 40% of the under-represented sex in non-executive board-member positions in listed companies in Europe by 2020, or 2018 for listed public undertakings" (European Commission 2012). While the European Parliament voted in 2013 to back this law, until now, EU countries have not adopted the directive. In 2019, the Commission reported on "data confirming the positive impact of gender diversity in management on business performance, but also data indicating that the EU still scores low when it comes to equality in decision-making, and that the gap between Member States is widening" (European Commission 2019).

In Section 2, we propose an overview of this paper's subject, beginning with a brief account of theories regarding the female presence in organizational leadership, theories rooted in political science, sociology, psychology, economics, and finance. Furthermore, we comment on two meta-analyses summing up research devoted specifically to the association between women's presence on boards and company performance.

Section 3 presents a short survey of microeconometric methodologies applied in exploring gender vs. performance. The examples include studies that rely on techniques of multiple linear regression, panel data linear modelling, quantile regression, the diff-in-diff technique, and other methods. In Section 4, we show how econometric approaches may compete in discussing the direction of association between firm performance and women on BoDs for a sample of companies in Norway.

The study presented in Section 5 examines European firms' financial reports from the year 2015 and the association between women's presence on boards and their respective companies' performance. Applying binomial models, multiple regression, and quantile regression, we find that, for this sample, female presence on BoDs is not significantly related to firm performance.

Section 6 concludes.

2. Women on Boards and Financial Results—Theoretical Underpinnings and Meta-Analyses

There are multiple theories directed towards showing the necessity of female participation in all corporate structures, reflective of their presence in greater society. Aluchna and Krejner-Nowecka (2016) propose a list of such theories, including:

- the non-discrimination approach: "women represent 50% of the society and should be given rights to have the respective participation in corporate boards";
- the social/gender/feminist theory: "women's presence can help to change stereotypes embedded in others' expectations";
- the resource dependency theory: "women having adequate experience and education improve the board work quality";
- the diversity management perspective: "women enrich corporate boards contributing to communication, leadership style, different risk attitude and term orientation";
- the stakeholder theory: "women reveal stronger stakeholder representation and largest social and environmental concerns".

None of these theories tackle the question of the "impact" of female presence on corporate financial results. It seems that this issue is not theoretically solid and remains a "political" or "sociological" question rather than an economic or financial one. Eckbo et al. (2019) point out that "in principle, restricting shareholders' free choice of directors can reduce board effectiveness". There are studies pointing out that new female directors may lead to a reduction in firm value, that new and less experienced female directors may be "overly focused on monitoring and exhibit excessive risk aversion". On the other hand, "it is in principle possible for shareholders to benefit from the

diversity and broader skill set resulting from adding female directors". As can be seen from this paper, the evidence in each direction of reasoning is mixed.

Editors of the book "Women in corporate boards. An international perspective" (Aluchna and Aras 2018) state that "Female presence and involvement on boards improves firm performance, transforms corporate governance and leads to the transition towards more responsible business". This general observation should be limited, at least in regard to the aspect that can be statistically/econometrically examined—i.e., relating women's presence on boards and firm performance. As in many instances of research in corporate finance and corporate governance, this relationship may differ across countries, regions, time spans, samples, etc. Explaining those differences without a unified theory is a task outside the scope of economics and finance.

To this end, we reference the comprehensive meta-analysis provided by Halliday et al. (2020) that addresses gender diversity questions in the framework of psychology. They "integrate psychological theory related to implicit biases and agency theory, with institutional theory, to propose that the national context for gender equality moderates the extent to which characteristics of organizational leadership relate to female board representation". This comprehensive analysis begins with 1604 studies published in or before 2018. The final set examined in the authors' paper consists of 158 studies, mostly journal articles, from the period 2004–2018. The "sample" contains 60,648 organizations from 36 countries. Their final conclusion stresses the "importance of the national context for gender equality as a boundary condition for understanding the relationship between organizational leadership characteristics and female board representation". The national context is important, but this observation is, in fact, the only solid result from so comprehensive a meta-analysis.

There are attempts, however, to place the question of gender into the theoretical framework of economics/finance. For example, Taghizadeh-Hesary et al. (2019) show the disparity in the lending behavior of banks to small and medium-sized enterprises (SMEs) based on their owners' gender. They use the production function approach, distinguishing the capital of male- and female-owned companies. The major assumption is that "the loan default risk of female-owned companies is greater than the default risk of male-owned companies", placed in the context of Asia, where customarily female entrepreneurs face greater credit constraints than their male counterparts. Along with this assumption, it is shown that, indeed, there is gender-based inequity in bank lending. To mitigate this issue, the authors propose a governmental credit guarantee for female-owned enterprises and, subsequently, demonstrate that this would increase GDP growth. The elegant mathematical structure is then followed by a statistical–econometric analysis on a sample of 1492 Iranian SMEs in which it is shown that, actually, "female-owned SMEs perform lower relative to male counterparts as they have a higher default ratio and lower profitability, liquidity, and coverage". To sum up, what we really have here is a theoretical dispute, but it has no relevance to the empirical exercise that is the substance of this paper.

What remains as a major research possibility in examining gender edge vis-à-vis corporate categories is the application of a statistical–econometric methodology. Such research attempts typically use microdata on large numbers of companies and may be placed under the label of "financial microeconometrics" (Gruszczyński 2020).

There are at least two meta-analyses in this direction. Post and Byron (2015) use results from 140 studies (92 published, 48 unpublished) and examine "whether results vary by firms' legal/regulatory and socio-cultural contexts". The conclusion is mixed. On one side "female board representation is positively related to accounting returns" ($r = 0.047$; significantly higher than zero), and on the other "the relationship between female board representation and market performance is near-zero" ($r = 0.014$; not significantly different from zero). The authors indicate that much depends on the countries in

question: the relationships are stronger in countries with greater gender parity. In a sense, this appears to be a similar conclusion to the analysis by Halliday et al. (2020)[1].

Pletzer et al. (2015) present a meta-analysis of 20 studies from peer-reviewed journals that examine the possible relationship of female presence on corporate boards and firm financial performance. The primary conclusion is that the "mere representation of females on corporate boards is not related to firm performance". The authors explain that their analysis, unlike that of Post and Byron (2015), follows "a more rigorous and controlled methodological approach by investigating the relationship between percentage of females on corporate boards and firm financial performance, operationalized as return on assets, return on equity, and Tobin's Q". The primary hypothesis here is "that female representation on corporate boards is either positively or negatively related to firm financial performance, but that the magnitude of such a relationship is likely to be small".

Thus, the empirical research, as evidenced in three meta-analyses, does not convey the message of a significant relationship between women's presence on boards and firm performance. The primary outcome is that the mere representation of females in the governing bodies substantially relates to the "national context". A similar conclusion may also be attributed to research by Carrasco et al. (2015). The authors use Hofstede cultural dimensions methodology and apply it to a comprehensive data set from 32 countries from 2010. It turns out that two of the four Hofstede dimensions are related to the level of female representation on BoDs. These are power distance and masculinity. Companies in the countries where unequal distribution of power in institutions is accepted have relatively fewer women on BoDs. It is also the case in countries where values associated with the masculine role dominate. Thus, the national context seems to be an important determinant of female presence on boards.

Before embarking on specific issues of methodology, we point to the paper by Ferreira (2015) who clearly subscribes to the view of this paper. He states that research does not show a clear "business case for gender quotas", nor does it support the contrary: that female participation on BoDs reduces firm profitability.

However, there is always the question of the methodological quality of the research. This is discussed in the next section.

3. Financial Microeconometrics: Selected Empirical Studies on Gender vs. Performance

3.1. Methodological Considerations

In this section, we concentrate on specific studies, as well as on financial microeconometrics methodologies. Indications remain that the inconclusive outcomes might be embedded in the research question itself, as shown in Section 2, and may also be the result of an improper methodological setup.

Our argument, in some way, coincides with the line taken by Adams (2016) in her important paper published in the special issue of *The Leadership Quarterly* on strategic questions of female participation on boards vis-a-vis challenges faced by the research[2]. She argues that "more research needs to be done to understand the benefits of board diversity". The principal problems are data limitations, selection, and causal inference. This is in line with the reasoning presented by the same author in the paper Adams (2017) on possible flaws in corporate governance research. Gruszczyński (2018) indicates similar questions in the paper on good practices in corporate governance and accounting research.

For example, a significant correlation between the measure of female presence on boards and the measure of firm performance should not be interpreted as a causal relationship if the endogeneity problem is not taken into account. This is a situation in which the gender variable, being exogenous in the linear regression model explaining the performance variable, is also correlated with an error term. It

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[1]　These authors present another meta-analysis on how the female presence on boards relates to corporate social performance (Byron and Post 2016). Based on 87 studies from more than 20 countries, the authors find that this relationship is positive and is stronger in countries with higher stakeholder protection and gender parity.

[2]　I thank an anonymous reviewer for referring this paper to me.

means the gender variable is correlated with another explanatory variable that has not been included in the model. Such a variable may be, for example, firm size: it is more likely that women are appointed to the boards of larger companies. Company size may also be a determinant of its performance. There are various types of remedies for endogeneity. One group includes techniques that aim at the source of the variability of the exogenous variable: the instrumental variables approach, or such methods as diff-in-diff or regression discontinuity design. An example of diff-in-diff is given later in this section. The second group comprises techniques that use panel data or matching estimation (Roberts and Whited 2013).

The techniques mentioned above belong to what are referred to as new microeconometrics or 'metrics' and are presented in the seminal books of Angrist and Pischke (2009, 2015), among other sources. The primary issue is how to "prove" causality between the variables. Thi appears to offer a way of solving the primary question here: what is the impact of female directors on firm performance? However, most techniques advocate the use of experiments or natural experiments. Adams (2016) points out that an experiment is impossible: "To experimentally identify the causal effect of gender diversity on firm performance, one would have to randomly assign female directors to firms and then measure subsequent firm performance". The same view is held by Ferreira (2015): "Causal effects will always be too hard to estimate, unless governments unintentionally help us with badly designed policies that randomly assign quotas to some firms and not to others".

The question is whether regression analyses may suffice without searching for causality. Obviously, regression tools are valuable, as evidenced in corporate finance and corporate governance research. Regression outcomes may even be close to ascertaining causality, especially when we use panel techniques (Gruszczyński 2018). On the other hand, to properly design and execute research with endogeneity in mind is sometimes hard, as pointed out in the survey paper of Atanasov and Black (2016).

Another concern should be raised here: the question of the statistical significance of the explanatory variables in the regression-type model. It is often the case in empirical corporate finance that some insignificant variables are not removed from the model due to their merit in research. Such practice is admissible and correct. Putting too much weight on statistical significance may not be correct (for more, see Gruszczyński 2020, section 2.8). Today, this is the subject of worldwide discussion among researchers who, in their hundreds, recently endorsed the call to "retire statistical significance" (Amrhein et al. 2019).

3.2. Selected Empirical Studies

From the plethora of studies on the topic, we choose a few, one of which specifically represents the "new microeconometrics" methodology. All belong methodologically to financial microeconometrics (Gruszczyński 2020).

Ionascu et al. (2018) examine Romanian companies listed on the Bucharest Stock Exchange 2012–2016 (343 firm-year observations). Their results indicate that, on average, the diversity of BoDs has no significant impact on firm performance. In the authors' words: "although firm performance seems to be positively correlated with gender diversity of the boards, the association is not robust and ceases to be significant after endogeneity is controlled for". The method employed is panel data linear regression with a dependent variable representing performance. There are three such variables attempted: return on assets (ROA), Market-To-Book ratio, and Tobin's Q. Such a setup is typical for most studies. The gender diversity variable is one of the explanatory variables in the regression. The authors consider three such variables: the proportion of female members on a board, a dummy variable indicating a woman as president of the board, and an interaction variable being the product of the first two variables. A major problem is always the selection of other predictors (explanatory variables, controls). The authors also try to perform the same analysis for profitable companies with a

marginally better result: for profitable companies, the relationship between female presence and firm performance is then marginally positive[3].

Gordini and Rancati (2017) use panel data analysis to establish the relationship between female presence (gender diversity) on boards and firm performance for 918 listed companies in Italy between 2011 and 2014. The authors use Tobin's *Q* as the measure of firm performance. The "female" variables are four (sequentially): a dummy representing at least one woman on the BoD, the percentage of female directors, the Blau index, and the Shannon index. The last two indices measure the gender diversity of the BoD with limits of zero (no diversity) and 0.5 or 0.69—perfect diversity or 50:50, respectively. According to Italian law from 2011, it is mandatory that there be at least one woman on a BoD. Nevertheless, only 73% of boards in the sample fulfilled this law. This variable specifically turns out to be insignificant in the models explaining Tobin's *Q* with other typical control variables. Other "female" variables are significantly positively related to Tobin's *Q*. Strangely enough, the authors placed ROA as one of the performance measures among the controls. The authors maintain that their study shows a "positive and significant effect" on Tobin's *Q* of the three variables measuring the presence of women on BoDs in Italy.

Examples of studies using the simple methodologies are as follows:

- Rossi et al. (2017) use a cross-section of Italian listed companies from 2016. The result is a significantly positive relationship between financial performance and the composition of the BoD. The methodology used is linear regression where price/book value is related to the percentage of women on the BoD.
- Kompa and Witkowska (2017) consider listed companies in Poland in 2010–2015. They study the correlation between changes in the feminization ratio of BoDs and changes in ROE as a measure of company performance. No significant correlation was observed.

Another study referenced here uses the more sophisticated approach of quantile regression. Conyon and He (2017) investigate 3000 US companies for the period 2007–2014 (over 18,000 firm-year observations). With two dependent variables, ROA and Tobin's *Q*, and a number of typical controls, the authors examine the association between the percentage of women on BoDs and firm performance. Firstly, they report OLS and fixed-effects OLS estimation results. The OLS gives a mixed message: a significant and positive association between women on boards and Tobin's Q, and a significant and negative association between women on boards and ROA. After controlling for firm-level fixed effects, the board gender diversity variable becomes insignificant in both cases. Now, the authors claim that the assumption (in OLS regressions) that "the board gender effect is constant across the performance distribution is not valid". Alongside such reasoning, a quantile regression is employed, which provides very promising results supporting the authors' main hypothesis: "Board gender diversity has a significantly larger positive impact on firm performance in high-performing firms than in low-performing firms". The paper shows that searching for a relationship between female presence on BoDs and performance requires sometimes more than simple techniques of multiple regression.

The new microeconometrics (as coined in Section 3.1) are represented in this survey by Sila et al. (2016), who investigate 1960 US firms with 13,581 firm-year observations for the period 1996–2010. The authors examine the gender diversity of corporate boards and its possible effect on company risk. The methodology employed applies linear regression, binomial probit, and diff-in-diff with matching. In stage (1), the authors use the binomial probit to explain the probability that at least one female director is appointed in a company in a given year. The major predictor is the risk variable defined (in one variant) as the variability of daily stock returns in the preceding year. The number of firm years with the appointment of at least one director is 7101. It is shown that risk may well predict a female appointment.

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[3]   Interestingly, an earlier study examining companies listed on the Bucharest Stock Exchange (2007–2011) by Vintilă et al. (2014) showed a mostly significant relationship between female representation on BoDs and firm value.

In stage (2), the authors estimate linear regression, with risk being explained by the proportion of women on the board and other control variables. The method used for estimation is GMM for a dynamic panel system. In effect, the authors find no evidence of a relationship between equity risk and a female appointment. In stage (3), an alternative strategy for identifying this relationship is applied with the use of diff-in-diff and matching. This amounts, here, to estimating the following model:

$$Risk_{it} = \alpha_0 + \alpha_1 Female\ Appointment_{it} * Post\ Period_{it} + \alpha_2 Female\ Appointment_{it}$$
$$+ \alpha_3 Post\ Period_{it} + CONTROL'_{it}\gamma + \varepsilon_{it}$$

The variable *Female Appointment$_{it}$* = 1 for firms in treatment group, =0 otherwise. Firms comprising the treatment group appoint exactly one female director in year *t* to replace a departing male director (must be older than 60). The variable *Post Period$_{it}$* = 1 in the post-treatment period, =0 in the before-treatment period.

The firms from the treatment group are matched to similar control firms that represent a group with a male director appointed to replace another male director (there are 153 matches possible). Matching is made with the propensity score and nearest-neighbor techniques. The model is estimated for both sets of data: for propensity score and for nearest-neighbor. The authors find that the *Female Appointment$_{it}$ * Post Period$_{it}$* variable is not significant in either version of the model. In other words, this is the causal evidence that appointments of female directors and male directors do not result in different risks. The final conclusion is that a board with a higher proportion of female directors is no more or less risk-taking than a more male-dominated board.

The research by Sila et al. (2016) is an example of how to use techniques of identifying the causal relationship between the gender structure of the board and the firm performance (in this case: equity risk).

Examples presented in this subsection are intended to show the diversity of possible methodological approaches that are available in the microeconometric toolbox and that may be used in regard to corporate governance questions like the one considered in this paper. The major hypothesis here remains as before: there is no solid evidence for a significant association between female presence on BoDs and firm performance across countries, regions, time spans, and samples.

4. The Case of Norway: Competing Econometric Studies

One interesting case concerns Norway, where gender quotas were imposed on listed companies a relatively long time ago—a 40% quota was imposed in 2003, becoming compulsory from 2008. A number of studies of Norway's gender balancing of corporate boards conclude that the gender quota law imposed large costs on the shareholders of firms. Eckbo et al. (2019) especially identify one paper by Ahern and Dittmar (2012) (AD), who state that their research reveals a causal effect of the imposition of the quota on (1) stock prices and on (2) companies' financial performance. Effect (1) occurred immediately after the announcement of the new law, while effect (2) was reflected in a significant decline in Tobin's *Q* in the following years. AD also maintain that the quota led to "younger and less experienced boards, increases in leverage and acquisitions, and deterioration in operating performance".

The AD study is strongly rooted in good econometric methodology, applied to a panel of 248 publicly listed companies in Norway for the period 2001–2009. The tools used include the event study on the stock price reaction to the initial announcement of the quota, the instrumental variable approach to investigate the "impact of the quota on Tobin's *Q*", the "effect of the quota on board characteristics", and the "effect of quota on firm policies", as well as the binomial logit for explaining companies' decisions to delist any time during the period 2003–2009. The AD paper appeared in the *Quarterly Journal of Economics* and has been widely cited and followed by other research in the area.

In the study by Eckbo et al. (2019), the authors use the AD data and perform a comprehensive new econometric analysis. In effect, the authors state that AD's results are not sustained when "simple

econometric adjustments" are applied. Eckbo et al. (2019) use the same methodology as AD with refinements that (the authors claim) are necessary. For example, the event study has been repeated but with the use of a portfolio approach—which yielded insignificant abnormal returns to major quota-related news events—and also with adjustment for cross-correlation, resulting in insignificant abnormal returns as well. In addition, the instrumental variable approach to panel Tobin's *Q* regression resulted in an insignificant effect of the quota on *Q*. Finally, by using the diff-in-diff regression, the authors prove that, unlike AD, there is no significant change in CEO experience following the quota.

The discussion reported here is an example of results that differ even when using the same sample. Such a message is not very encouraging. Perhaps, wider use of good practices and extending the reasoning foundation into areas outside economics and finance may be an appropriate solution when conducting such research in the future.

5. European Data: Microeconometric Exercise

The final part of this paper presents another study within the search for a relationship between female presence on BoDs and firm performance, this time for European companies in 2015. The data used in this study were collected by Olesiejuk[4] (2017) from the Amadeus (Orbis) database. There are 1194 observations selected on an availability basis (non-random sample), representing the same number of European companies and their financial statements for the year 2015.

The companies represent 18 countries, primarily Italy (49% of observations) and Spain (23%), followed by the UK (7%), Sweden (7%), and Norway (4%). The average number of BoD members is 3.57 and all the BoD members are male in 57% of the cases. Due to the large proportion of Italian companies in the full sample, we also consider a "no Italy" (limited) sample with 614 observations (companies).

In line with the research results presented in this paper, our search starts with finding predictors/correlates of the dummy variable *WomaninBoD* (=1 when there is at least one woman on the board, =0 otherwise). For the full sample, the *WomaninBoD* variable has the mean 0.4263—i.e., in 509 cases out of 1194, *WomaninBoD* = 1. In the limited sample, the *WomaninBoD* variable has the mean 0.4495—i.e., in 276 cases out of 614, *WomaninBoD* = 1.

The list of potential predictors for the variable *WomaninBoD* in the dataset includes more than 50 variables[5]; however, *WomaninBoD* is significantly correlated with only a few.

Tables 1 and 2 present the linear correlation coefficients of *WomaninBoD* with other variables that are significantly different than zero. Most correlations are low. Our plan now is:

(1) First, we try to find how the relationship between *WomaninBoD* and the other variables holds in the binomial regression model where *WomaninBoD* is the dependent variable. This is because we have here a cross-section situation and the attempted binomial model is just representing how in a given year (2015) the presence of women on the boards is associated with selected company characteristics/financials for that year. The novel approach is showing the connection in reverse: from the predictors to the dummy variable representing women on the BoD. When the performance variable appears as a predictor, this is the reverse causality setup—e.g., the better-performing companies may choose to appoint more (or fewer) female directors (Adams 2016). This interpretation is possible for our limited sample where the predictors include *ROCE* or *ROA*.

(2) Secondly, we attempt to repeat the typical linear regressions where, on the left-hand side, the "performance" variable is explained by *WomaninBoD* and other selected predictors.

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[4] The Olesiejuk (2017) study is not used here.
[5] Since not all companies in the sample are listed, no market-based variables are available for the sample.

Table 1. Correlation of *WomaninBoD* with selected explanatory variables. Full sample.

Full Sample n = 1194	WomaninBoD	ROCE	Logassets	BoDsize	Gearing
WomaninBoD	1				
ROCE	−0.0693 *	1			
logassets	0.2174 *	−0.1430 *	1		
BoDsize	0.3468 *	−0.0874 *	0.5309 *	1	
gearing	−0.0738 *	−0.0713 *	−0.0231	−0.0620 *	1
solvency	0.1058 *	−0.1019 *	0.1636 *	0.1081 *	−0.6000 *

Table 2. Correlation of *WomaninBoD* with selected explanatory variables. Limited sample.

Limited Sample n = 614	WomaninBoD	ROCE	ROA	Logassets	BoDsize	Solvency
WomaninBoD	1					
ROCE	−0.0996 *	1				
ROA	−0.0792 *	0.7518 *	1			
logassets	0.2755 *	−0.1410 *	−0.1620 *	1		
BoDsize	0.4948 *	−0.0798 *	−0.0710	0.5736 *	1	
solvency	0.1011 *	−0.0595	0.1476 *	0.1094 *	0.0730	1
net_assets_ turnover	−0.0851 *	0.2065 *	0.0044	−0.1707 *	−0.0654	−0.3666 *

* indicates $p < 0.05$; Explanation of terms: gearing ratio = (non-current liabilities + current loans)/(shareholder funds) × 100; solvency ratio = (shareholder funds)/(total assets); *ROCE* = return on capital employed = (P/L before tax + extr. items + interest paid)/(shareholder funds + non-current liabilities); ROA = return on total assets = P/L before tax + extr. items/total assets; net assets turnover = (operating revenue)/(shareholder funds + non-current liabilities); non-current liabilities = long term debt + other non-current liabilities.

Tables 3 and 4 present the results of the first stage: estimating the logistic regression of *WomaninBoD* against some variables, but not more than two at a time. This is because of the high multicollinearity among the prospective correlates of *WomaninBoD*.

Table 3. Estimation results of binomial logit (logistic regression) for *WomaninBoD* as the outcome variable. Full sample ($n = 1194$) with *WomaninBoD* = 1 for 509 observations.

WomaninBoD	Coeff.	Std. Err.	z	P > |z|
solvency ratio	0.0048353	0.0029843	1.62	0.105
logBoD	1.418742	0.101768	13.94	0.000
constant	−1.773889	0.1514283	−11.71	0.000
LR chi2(2) = 264.85	Prob > chi2 = 0.0000		Pseudo R2 = 0.1626	
Count R2 (Cramer) = 0.701	Area under ROC = 0.757			

Table 4. Estimation results of binomial logit (logistic regression) for *WomaninBoD* as the outcome variable. Limited sample ($n = 614$) with *WomaninBoD* = 1 for 276 observations.

WomaninBoD	Coeff.	Std. Err.	z	P > |z|
ROCE	−0.005823	0.003341	−1.74	0.081
logBoD	1.598067	0.1472888	10.85	0.000
constant	−1.793394	0.1870708	−9.59	0.000
LR chi2(2) = 170.86	Prob > chi2 = 0.0000		Pseudo R2 = 0.2022	
Count R2 (Cramer) = 0.700	Area under ROC = 0.789			

The classification tables for logistic regressions are formed on the basis of Cramer's rule (Cramer 1999). This possibility is often neglected. When samples are unbalanced, Cramer (1999) advocates the use of a cut-off point α equal to the proportion of ones in the sample. In effect, the success rates for $y_i = 1$ and $y_i = 0$ are better spread than for the typical cut-off point of 0.5 (Gruszczyński 2019).

The interpretation effect of logistic regressions lies in showing that—despite poor correlation with prospective covariates—the variable *WomaninBoD* may formally be "explained" with such models.

Classification results are rather weak but sensible—the fit measure of around 0.7 is common in microeconometric applications in corporate finance.

Now we place *WomaninBoD* among the regressors in the typical model considered in previous sections of this paper where the outcome variable is firm performance. After the correlation check, one should expect that *WomaninBoD* is insignificant in any model attempted in the classical way—i.e., as multiple regression, and, in fact, that is the case here. As an example, Tables 5 and 6 present the estimation results of two regressions: one for the full sample and one for the limited sample.

Table 5. Estimation results of multiple regressions with *WomaninBoD* as the predictor variable and *ROCE* as the dependent variable. Full sample (*n* = 1194).

ROCE	Model I	Model II	Model III
WomaninBoD	−2.330915 (1.704436)	−2.656997 (1.704133)	−3.00803 * (1.6794)
logassets	−2.429104 ** (0.5311289)	−2.439499 ** (0.5297278)	−1.875371 ** (0.5293145)
gearing	——	−0.0122183 ** (0.0045002)	——
solvency × *gearing*	——	——	−0.0027405 ** (0.000425)
constant	52.8078 ** (7.753808)	54.85445 (7.769805)	51.90963 (7.626242)
Adjusted R2	0.0203	0.0256	0.0526

Standard errors in brackets; * indicates *p* < 0.1; ** indicates *p* < 0.05.

Table 6. Estimation results of multiple regressions with *WomaninBoD* as the predictor variable and *ROA* as the dependent variable. Limited sample (*n* = 614).

ROA	Model I	Model II
WomaninBoD	−0.7753716 (0.8596029)	−1.047199 (0.8498533)
logassets	−0.8995534 ** (0.2461068)	−0.9889818 ** (0.2435302)
solvency	——	0.0805369 ** (0.0186925)
constant	19.54126 ** (3.615013)	17.76706 ** (3.587858)
Adjusted R2	0.0244	0.0516

Standard errors in brackets; ** indicates *p* < 0.05.

As shown in Tables 5 and 6 multiple regressions for performance against *WomaninBoD* reveal no significance of this variable, even in a typical setup for controlling the endogeneity—i.e., with the control variable being the size of the company, here represented by the *logassets* variable (see Adams 2016, Table 1).

The next step would be searching for relationships between *WomaninBoD* and firm performance along the distribution of the performance variable. In other words, we may try to employ quantile regressions as in the paper of Conyon and He (2017), mentioned in Section 3. Tables 7 and 8 present the results of the quantile regressions estimation for the full sample and for the limited sample. We used the setup from the multiple regression:

(1)   the full sample performance variable is *ROCE* and the regressors are *WomaninBoD*, *logassets*, and the interaction variable *solvency* × *gearing*.

(2)   the limited sample performance variable is *ROA* and the regressors are *WomaninBoD*, *logassets*, and *solvency.*

Table 7. Estimation results of quantile regressions with *WomaninBoD* as the predictor variable and *ROCE* as the dependent variables. Full sample (*n* = 1194).

Quantile	**25**	**50**	**75**
WomaninBoD	−0.7275284 (0.7895722)	−0.2503224 (1.07899)	−2.570621 (2.047829)
logassets	−0.2003255 (0.2488579)	−1.055661 ** (0.3400768)	−2.281304 ** (0.6454362)
solvency × gearing	−0.0003952 ** (0.0001998)	−0.0014783 ** (0.000273)	−0.0032773 ** (0.0005182)
constant	8.399047 ** (3.585488)	31.20172 ** (4.899749)	68.13485 ** (9.299297)
Pseudo R2	0.0041	0.0331	0.0727

Standard errors in brackets; ** indicates $p < 0.05$.

Table 8. Estimation results of quantile regressions with *WomaninBoD* as the predictor variable and *ROA* as the dependent variables. Limited sample (*n* = 614).

Quantile	**25**	**50**	**75**
WomaninBoD	−0.5104711 (0.5368787)	−0.5208956 (0.7291287)	−1.315783 (1.300562)
logassets	−0.03384130 (0.1538456)	−0.2523032 (0.2089359)	−1.294657 ** (0.3726834)
solvency	0.0177385 (0.0118086)	0.0572204 ** (0.0160371)	0.0822441 ** (0.0286058)
constant	0.9480991 (2.266561)	5.532674 * (3.078191)	27.01107 ** (5.490634)
Pseudo R2	0.0052	0.0162	0.0422

Standard errors in brackets; * indicates $p < 0.1$; ** indicates $p < 0.05$.

Quantile regressions were performed for centiles 25, 50, and 75. Tables 7 and 8 show that, along the full distribution of the performance variables, we do not see any connection between female presence on the boards and firm performance. This evidence is, to some extent, stronger than that resulting from multiple regressions.

Again, for this particular dataset, the association of women on boards and performance of companies seems not to be present.

The study presented in this section may be the starting point for a more thorough investigation. Firstly, the dataset could be improved by taking into consideration the time dimension and applying panel econometric techniques. Secondly, the differences between countries could be better examined—e.g., by considering further controls. Those may be governance-specific variables like country shareholder protection strength (Byron and Post 2016) and Hofstede dimension variables (Carrasco et al. 2015).

6. Conclusions

The results of research on the association of female presence on boards and firm performance worldwide are not consistent. This might be due to a lack of solid theories on this particular issue. The general reasoning points in all three possible directions: female presence and performance are (1) related negatively, (2) related positively, and (3) not related. Outcome (3) is advocated in this paper. We present examples of research showing all three types of associations. On the basis of selected works,

we also show the variety of microeconometric methodologies that might be applied in the search for the relationship between female presence on boards and firm performance.

In the empirical part of the paper, we present a study of this association for a sample of European companies in 2015. With the use of binomial modelling, multiple regression, and quantile regression, we find that female presence on BoDs is not significantly related to firm performance for the sample of European companies.

This, together with the picture emerging from the paper's first part, leads to us stating that, perhaps, searching for an association between women on boards and performance is not fundamental. However, modern business societies worldwide may need to boost the female presence within managerial bodies. Current econometric research provides evidence that this is not harmful to corporate results.

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