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WOMEN IN LEADING CORPORATE POSITIONS AND CREDIT RISK: EVIDENCE FROM ITALIAN FIRMS

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Abstract

The present paper aims to analyse whether the presence of women in leading positions can affect the risk profile of a firm. We provide new and more robust empirical evidence that there is a negative relationship between female participation in the top management and credit risk. We focus on a large and representative sample of Italian manufacturing firms, and we extract data on directors and top managers as well as rating classes and credit score indicators. We provide evidence of a significant credit risk reduction associated with the inclusion of women among the top managers of the firm, using a fixed effects model. Our results are robust to different model specifications and estimation strategies. We also find different magnitudes for the impact, with a greater impact associated with smaller firms.

Key-words: rating; insolvency risk; female representation; top managers.

JEL: J16, G32, B54, M14

1. Introduction

Gender issues, female participation and the most suitable mechanism for rebalancing female participation remain hot topics in empirical studies at an international level, and they are also on the political agenda of most European countries. The European Commission presents statistics on the role of women in industrial organizations, and the empirical evidence confirms that the managerial make-up of firms has changed and improved over time. European countries (EU36) show, on average, increases in the

percentages of female executives and CEOs in the largest listed companies from 2013 to 2018 (i.e., executives: from 12% to 19%; CEOs: from 3% to 7%). This trend is confirmed for all European countries, although the slopes are different. In detail, in Italy the average percentage of female executives increased by 89% (from 5% in 2013 to 10% in 2019); on the other hand, the percentage of female CEOs changed from 0% to 3%. Of course, these changes in corporate governance are not a spontaneous outcome: most national policy makers have enforced increases in female participation by introducing quota laws. This is also the case in Italy, with the so-called Golfo–Mosca law (120/2011). This law introduced a quota for the number of each gender on the executive body of a listed company: this number was to be no less than one fifth (to be increased to one third by the end of 2013) of the total number of members. The law came into force in 2012 and has recently been renewed to increase the share of the under-represented gender (law 157/2019, i.e. Tax Decree 2020). In Italy, as in most European countries, quota laws are not applied to the plethora of small or medium firms that represent the majority of economic actors, but only to listed or very large firms. However, the increasing attention being paid to equality of opportunities for reaching managerial positions within firms may have affected the economy as a whole, and may also have questioned the cultural model of a predominantly male leadership for smaller firms (Almond and Verba, 2015; La Valle, 2006). Indeed, the general involvement of women in top positions, both in politics and in the economy, has increased over time and is still growing (EIGE, 2019). Moreover, the law had a spill-over effect for financial institutions, by increasing the number of women on the board for unlisted banks too (Bongiovanni et al., 2019).

Following this stream of research, the present paper investigates whether and to what extent the presence of women among the managers of Italian manufacturing firms affects corporate financial risk. We do this by using a large sample that is representative of Italian manufacturing firms. We decided to change the usual perspective of the empirical literature, which is too frequently performance oriented: the effect of female participation in management has been extensively investigated with a clear focus on economic performance, but this is only one of the aspects that might be influenced by a change in leadership. Moreover, the emerging empirical evidence is inexorably linked to the main cultural perception of women in the reference country, and those differences may partially explain the inconclusive empirical evidence. Indeed, when looking at the effect on performance of female participation in leading positions, some contributions find modest positive effects (Dezso and Ross, 2012; Green and Homroy, 2018), other studies show no effects (Comi et al., 2019 Ferrari et al., 2016; Gregory-Smith et al., 2013), while yet other studies argue that there is a negative impact (Adams and Ferreira, 2009; Ahern and Dittmar, 2012; Matsa and Miller, 2013). Within these works, we observe a significant prevalence of contributions focused on large, very large or listed firms, while small and medium firms (SMEs) are often under-represented, despite their importance in many economies, especially in southern European countries.

Also with a specific focus on Italy, the empirical evidence fails to converge towards a clear conclusion on a prevailing positive or negative effect of female leadership on performance, even if the recent literature reports on an increasing number of studies (see, for instance, Devicienti et al., 2019; Ferrari et al., 2018; Flabbi et al., 2019; Maida and Weber, 2018; Manello et al., 2019).

However, as anticipated, the recent literature on gender diversity underlines that, in general, firms with a woman as a director have other differences that go beyond a pure or direct effect on performance. Numerous existing studies converge on the idea that female leaders show generally higher risk aversion, a fact that might partially reshape corporate strategy and the corporate risk profile. This aspect, as highlighted by Sila et al. (2016), has already been thoroughly investigated in the financial and banking sector, where the focus on risk is more traditional and is motivated by the characteristics of the sector. Also, in more general contexts, authors have reached a consensus that there is a lower risk profile associated with female leadership (see, for instance, Adams and Ragunathan, 2017; Berger et al., 2014; Faccio et al., 2016; Huang and Kisgen, 2013; Sapienza et al., 2009) or in general to board diversity (Bernile et al., 2018). Only a few studies (e.g.., Faccio et al., 2016; Bernile et al., 2018) investigate the relationship that exists outside the banking sector between the presence of women in the boardroom and financial aspects, and our work aims to fill part of this gap by explicitly considering credit risk, following an early work by Wilson and Altanlar (2009). We aim to add new and more robust empirical evidence of a negative relationship between female participation in the boardroom or in the top management and credit risk, by focusing on a large and representative sample of Italian manufacturing firms. Our data on directors and senior managers are extracted from the AIDA database (provided by Bureau van Dijk), and we also use rating scores and credit score indicators. We provide evidence of a lower credit risk associated with the appointment of at least one woman among the top managers of the firm, using a model that takes into account individual fixed effects at firm level. As a robustness check, we also consider different subsamples (according to geographical regions and size classes) as well as a different kind of estimate (ordered probit, focusing on rating classes). Our main findings remain substantially unchanged for all our extensions and specifications, and we conclude in favour of a decrease in the credit risk when a woman becomes a top manager.

The remainder of the paper is as follows: the next section presents the main theoretical findings on corporate governance and economic–financial performance; section 3 describes the methodologies and data used in the analysis; section 4 sets out and discusses the results; and the final paragraph contains our conclusions and final remarks on the topic.

2. Theoretical background and literature

The literature on gender diversity and firm management is quite rich and has grown strongly in the last decade. Great attention has been given to the volatility of firms' performance and returns, while much less interest has been paid to the risk dimension. We therefore aim to contribute to filling this gap by investigating the relationship between female participation in the board of directors or top management and the firm's credit risk, a measure of risk that is very rarely investigated.

In general, we find a strong consensus for the idea that women are more risk-averse than men. This gender-specific risk behaviour may be due to a natural attitude (i.e. a different general level of testosterone), as argued by Sapienza et al. (2009), or to different opportunity sets (Schubert et al., 1999). The main emerging consequence is that women seem to be more cautious in their financial decisions and show lower risk tolerance than men (Fisher and Yao, 2017) . Watson and Robinson (2003) suggested that women are more risk-averse, while others have found that they are simply less self-confident than men, especially in financial and investment decisions (Barber and Odean, 2001; Byrnes et al., 1999; Croson and Gneezy, 2009), and are more concerned about the risk of losing control of their business (Constantinidis et al., 2006; Verheul and Thurik, 2001). Moro et al. (2017) investigated the effect of being a female entrepreneur in accessing credit. They found that firms run by women are less likely to apply for a loan, compared to firms run by men. The fear of being rejected, due to lack of self-confidence, generates a priori self-exclusion, and potentially leads to the firm missing out on lending opportunities that would be beneficial to its growth. Huang and Kisgen (2013) also proved that this caution exists with respect to debt funding. In their analysis of American listed companies, they showed that firms with female executives are less likely to issue debt to make acquisitions, and therefore that they grow more slowly. These results are consistent with the relative over-confidence of male executives compared with female executives.

Consequently, female entrepreneurs are less prone to borrow, have a lower growth-orientation o invest less (Carter and Shaw, 2006; Pelger, 2011; Charness and Gneezy, 2012), and prefer to operate in low capital-intensive sectors, relying less on external finance.

However, a prudent attitude among women towards making financial decisions can turn into more responsible and accurate behaviour. Beck et al. (2009), using a data set from a commercial lender in Albania, argued that female loan officers are better at screening and monitoring their borrowers, obtaining lower default rates than their male colleagues. Adams and Ferreira (2009), analysing a sample of US firms, observed that women, when appointed to boards of directors, do their job with a higher sense of duty and responsibility than male directors. In fact, they have better attendance records and are

more likely to join monitoring committees. More recently, Bernile et al., (2018) analyse firms from different industries in US and find that higher board diversity, measured by demographic aspects including gender, is associated with lower risk, measured through stock return volatility

In this vein, several studies have concentrated their attention on the role of women on boards of directors and their impact on the firm risk profile. Regardless of the type of firm (listed versus non-listed firms, or large corporations versus SMEs), sector (private versus public, financial versus non-financial) and geographical location, the evidence is quite clear-cut: when women sit at the decision-making table, they make companies less risky and more stable.

Faccio et al. (2016), using a large sample of listed European companies, found that firms run by female CEOs have lower leverage, have more stable profitability and are more likely to survive than otherwise similar firms run by male CEOs. Additionally, the risk-taking of a given firm tends to decrease (increase) when a woman substitutes a man on the board of directors (or vice versa). Skala and Weill (2018) looked at the banking sector, and found that banks headed by female CEOs are less risky and have more capital. Interestingly, the bigger capital cushions are not required to absorb riskier assets, but are due to the higher risk aversion of the female CEOs. More recently, Suzuki and Avallaneda (2018) examined the relationship between gender and risk-taking behaviour in public finance. They targeted all city-level municipalities in Japan and found that the presence of women on local councils is positively correlated with risk-averse financial decisions.

Another stream of studies has considered the relationship between female participation and firm performance. Indeed, if women are more risk-averse than men, we would also expect that firms perform differently when women are in positions of power. The main evidence from the recent empirical literature is still uncertain, and the real effect of female leadership remains an unsolved problem, as argued by Gagliarducci and Paserman (2015) and Pletzer et al. (2015). In fact, the literature describes potentially controversial results on female leadership, which remain strongly dependent on the specific context, the measure of performance and the econometrical technique employed. For example, Adams and Ferreira (2009), analysing a sample of US firms, concluded that the presence of women leaders negatively affects firms' profitability when measured as Return on Assets (ROA) or Tobin's q. Similar conclusions have been found by Ahern and Dittmar (2012) and Matsa and Miller (2013) for Norway, the first country in Europe to introduce gender quotas. Comi et al. (2019) analysed a European sample where the ROA index was used as measure of firm performance, but found no statistically significant effect except in Italy and Spain, where a positive effect was found when considering total factor productivity. Similarly, an absence of effects was found in Italy by Ferrari et al. (2016) and in the UK by Gregory-Smith et al. (2013), even though in both works firm performance was evaluated through market value or other accounting

measures. A positive effect was found by Green and Homroy (2018), who studied the effect on the ROA index of a large European sample when women were on the board of directors and also when they were on board committees. If, of the one hand, researchers have suggested many measures of performances then, on the other, female participation in business management has also been represented in different ways. For example, Christiansen et al. (2016) considered a very large sample of non-listed and listed European companies. They found that the presence of women in senior positions positively affects firms' profitability, with a strong impact in innovative sectors.

Following the suggestions from the literature, we used the proportion of women in top/senior positions as the independent variable in our study to evaluate the effect of this on the credit risk of Italian manufacturing firms. To our knowledge, few works have addressed our specific research question using a credit score measurement as the dependent variable and measuring the effect of women in corporate leadership (considering seats on the board of directors and top management positions) on the credit classification. Wilson and Altanlar (2009) analysed the characteristics of the directors and owners of over 900,000 private limited UK firms in 2007-2008 in order to discover whether there was a relationship between financial performance and the management traits. Out of this sample, 17,000 companies failed in 2008, and the researchers estimated their insolvency risk and predicted failures using, respectively, the z-score approach (Altman, 1968) and a logit/conditional mixed process technique (Probit-IV regression). The results, even if they are dated, suggest a possibly negative relationship between the ratio of female directors and insolvency, arguing the possibility, which is actually well documented, of strong risk-awareness among women in conducting business.

3. Methodology and data

3.1 Methodology and empirical strategy

A simple way to evaluate the impact of female top managers on a firm's credit risk is to estimate the difference for firms that have at least one female top manager between the risk indicator before and after the year in which a female manager was first appointed to the firm. Clearly, the most recent economic literature on female participation highlights the presence of potential endogeneity problems in relation to the arrival of a female manager at a firm and the unobservable characteristics of the firm. These characteristics depend strongly on the quality and ability of managers (or of owners in the case of small firms without managers), so that the identification of the causal effect crucially depends on the possibility of separating these unobservable factors, as well as other observable factors, from the presence of female top managers. Our partial solution to this issue is, on the one hand, the inclusion of all the available controls for observable factors, reflecting differences among firms in relation to financial/economic

aspects (i.e. size, past profitability, and past physical capital intensity) and, on the other hand, the use of a fixed effects estimator. In fact, it is more difficult to deal with unobservable factors, such as specific features like firm tradition, culture, or firm "quality" (which substantially coincides with the ability or qualities of the main decision maker), which potentially creates endogeneity problems. These unobservable factors undoubtedly influence the probability of there being female managers among the leaders of the firm. If we are willing to assume that firm culture or the ability/quality/capacity of managers are stable over time, any potential endogeneity problem can be solved through the inclusion of firm fixed effects in the following regression model:

$$CR_{it} = \alpha + \beta Female_{it-1} + \delta Z_{it-1} + \eta D_t + \omega_i + \varepsilon_{it} \qquad (1)$$

where CR_{it} represents the measure of credit risk and $Female_{it}$ is our variable of interest, included in the form of either a dummy variable identifying the firm-year observation in which at least one top manager is a female or, alternatively, the proportion of top managers who are female. The female dummy (as well as the proportion of women) changes over time and becomes active when a female manager arrives at the firm. Z_{it} is a vector of firm-level time-variant controls, observed one year before the credit risk indicator to reduce simultaneity issues (i.e. firm size, capital intensity and profitability). D_t is a vector of year fixed effects (i.e. dummies for the specific year of analysis) together with other aspects such as geographical macro area, region or industrial activity (on the basis of Ateco 2-digit codes, that follow NACE classification of economic activities), to catch macroeconomic trends. The last part of the equation, $\omega_i + \varepsilon_{it}$, indicates the error term: the first component ω_i is the firm-specific fixed effect and might be correlated with the presence of female managers, while the second component, ε_{it}, is a purely white noise error term**.** The estimated coefficient of the variable $Female_t$ represents the difference in the level of credit risk due to the presence of a female manager (in either the female dummy or the female share specification).

Our empirical strategy consists of the estimation of equation (1) for the whole sample, using different model specifications in order to test the robustness of the results and then repeating the estimates for different subsamples. All the estimates take into account the panel structure of the database and include firm fixed effects as well as year-specific fixed effects.

The second empirical approach is based on a different model, where the dependent variable assumes a discrete form, with the aim of focusing only on relevant changes in the credit score indicator. In fact, our data sources allow us to group firms according to different categories of default risk, or rating classes, exactly as in the case of the labels used by the large rating companies (Moody's; Standard and Poor's; Fitch Ratings). There are seven identified categories, and the next subsection provides all the relevant technical details. As regards the estimation strategy, the shift to a categorical variable as the dependent

variable leads to a radical change in the estimation model, since it can no longer be based on a simple OLS. In this case we opt for an ordered probit model estimated though maximum likelihood:

$$RC_{it} = \alpha + \beta Female_{it-1} + \delta Z_{it-1} + \eta D_t + \varepsilon_{it} \qquad (2)$$

where RC_{it} represents the classification of the firm during a specific year into a rating class from 1 to 7. $Female_{it}$ is our variable of interest, included only in the form of a dummy variable identifying the firm-year observation in which at least one top manager is female. In this case the model does not include firm-specific fixed effects, but we compensate by using the richer specification in term of interactions among year, geographical location and industrial activity (i.e. our baseline specification, defined in table 3).

3.2 Data and descriptive statistics

Our empirical analysis is essentially based on administrative, financial and economic information on Italian manufacturing firms drawn from the AIDA database provided by Bureau van Dijk. We combine and process information from three specific modules of this data source: the "rating and creditworthiness section" available from 2015 onwards, the "main representative" section, which gives information on the managers and owners of each firm, and, finally, the standard financial section.

The creditworthiness section provides us with two different indicators: the credit score and the rating class. As is known, a credit score measures how likely it is that the borrower will pay back its loans on time, so it can be used to assess the likelihood of obtaining finance from external sources. In the AIDA database the credit score indicator, recorded as a continuous variable ranging from zero to 1,000, is provided not directly by Bureau van Dijk but by KF Economics, a leader in the definition of financial tools for credit scoring in Italy (http://kfeconomics.com/wordpress/la-societa/). The indicator is calculated according to a mixture of financial and economic information drawn from the balance sheet, with a strong weight assigned to the current sustainability of the financial sources. The precise methodology adopted, and the exhaustive list of the aspects considered, is not available, but we can assume that the indicator is obtained in the same way for all the firms involved.

A rating score provides a synthetic evaluation of the financial situation of a firm. Before the entry into force of Basel II (in detail, the first pillar of this) in 2007, rating scores could only be assigned by the ECAI (External Credit Assessment Institution), but since the European Directive came into force, all banks and financial institutions can create an internal rating system in order to evaluate the creditworthiness of borrowers. Following the approaches suggested by the European Commission and the examples of big international rating agencies (i.e., Moody's, Standard and Poor's, and Fitch Ratings), all the interested subjects have created internal rating systems. These scores have become a useful and

synthetic indicator for, on the one hand, credit institutions, and, on the other hand, firms, who can use this evaluation as a key variable for strategic financing decisions (Ruiz et al., 2019; . Indeed, the recent literature focuses on the relevance of credit scores or financial ratings as fundamental information in the microfinance field, because they play a crucial role in investment decisions for both financial regulators and loan customers (Shi et al., 2019). However, it is clear that the precise assignment of credit scores or ratings depend crucially on the criteria adopted by those who develop them, so they differ from one another. Scholars have developed and validated many models that use different variables but have the same aim of distinguishing between firms or individuals who are likely or unlikely to be able to fulfil their financial commitments.

As mentioned above, the credit score indicator used in the present study varies between 0 (for failed firms) and 1,000 (for extremely healthy firms), and, based on these scores, the AIDA database provides a classification of the firms according to seven standard rating classes using the specific thresholds that are reported in table 1. Moving from the KR7 class (extremely healthy firms) to KR1 (failed firms), Bureau van Dijk also provides an average probability of default (PD), with an inverse relationship to the credit score indicators.

Table 1: Rating classes, descriptions, average default probabilities and credit score thresholds

Rating Class	**Description**	**Average PD**	**Credit score**
KR7	Good solvency but possible weakness due to short-term events	0.002	771-1000
KR6	Sufficient solvency but in adverse economic conditions would have difficulty in repaying debts	0.006	646-770
KR5	Sufficient solvency but possible default condition in adverse economic conditions	0.021	541-645
KR4	High financial vulnerability but able in the short term to repay debts	0.061	476-540
KR3	Low financial solvency	0.151	411-475
KR2	Possible default situation	0.343	356-410
KR1	High default risk	0.899	0-355

Since the concept of rating is usually associated with classes or groups to which the market refers to assess the reliability of a firm, we use both the credit score and the rating class as dependent variables to test whether there is a difference in results according to the indicator used.

The second fundamental piece of information is retrieved from the composition of the board of directors or, in the case of a unique decision maker, personal information on this subject. In particular, we use information on the gender of each director/unique decision maker in order to build an indicator of the gender composition of the governing body of each firm. In particular, the AIDA database reports some

limited personal information on the unique executive, CEO, or president, or the members of the board of directors in the case of firms with a more complex corporate governance structure. As we underline above, in many cases of smaller firms or those with a very simple corporate governance structure, these positions collapse into a single person who in some case coincides with the single owner/single executive. The challenge of considering larger, medium and small firms all together, as well as firms with different degrees of complexity of corporate governance structure, requires the top management to be defined in a sufficiently flexible way so that it is suitable for different categories of firm. We decided to accommodate the presence of women among the top managerial figures in as flexible a way as possible, by assuming a definition of top managers that includes all the members of the board of directors, the CEO, the executives and the president/vice president of the board, as well as single executives or a single final owner in the absence of any other information. We use two substantially different indicators for the female presence among top managers: a dummy that indicates whether at least one person among the decision makers is a woman, and the proportion of women among those decision makers.

Table 2 reports the average proportion of women at the level of the area or region, the distribution for female participation across the group of firms characterized by a simple corporate governance model (i.e. those having a single CEO or administrative or senior manager) and those with multiple senior managers, and the respective proportions of women. In small firms, that is, those led by a single executive, around 80 per cent of the firms in the sample are managed only by men, with no woman being counted among their governing bodies or top positions. This percentage, as expected, drops to 54 per cent when we observe larger manufacturing companies that have more complex corporate governance structures. However, despite the fact that 46 per cent of larger firms have one or more female leaders, the average proportion of women among the board members or top managers in our sample is 20%, in line with the general evidence from Italy.

Table 2 shows the distribution of the sample between single executive firms and firms with multiple board members, and according to the geographical area of the firm. The average percentage of women among the directors is around 20%, in line with the results in other studies in Italy,[1] and the situation is very similar for smaller firms (around 40,000 of them) with a simple model of corporate governance and a sole director (i.e. an *amministratore unico* in Italian) and larger firms (around 68,000) with more complex models of corporate governance based on a board of directors.

[1] For non-listed firms, the proportion of women among the directors is around 17% in Italy (https://know.cerved.com/wp-content/uploads/2018/01/CERVED_LE-DONNE-AL-VERTICE.pdf), while the OECD reports a percentage of around 27% https://www.oecd.org/italy/Gender2017-ITA-en.pdf

Table 2: Shares of women among directors across regions, macro areas and sizes of firm, using the last year (2017) as reference

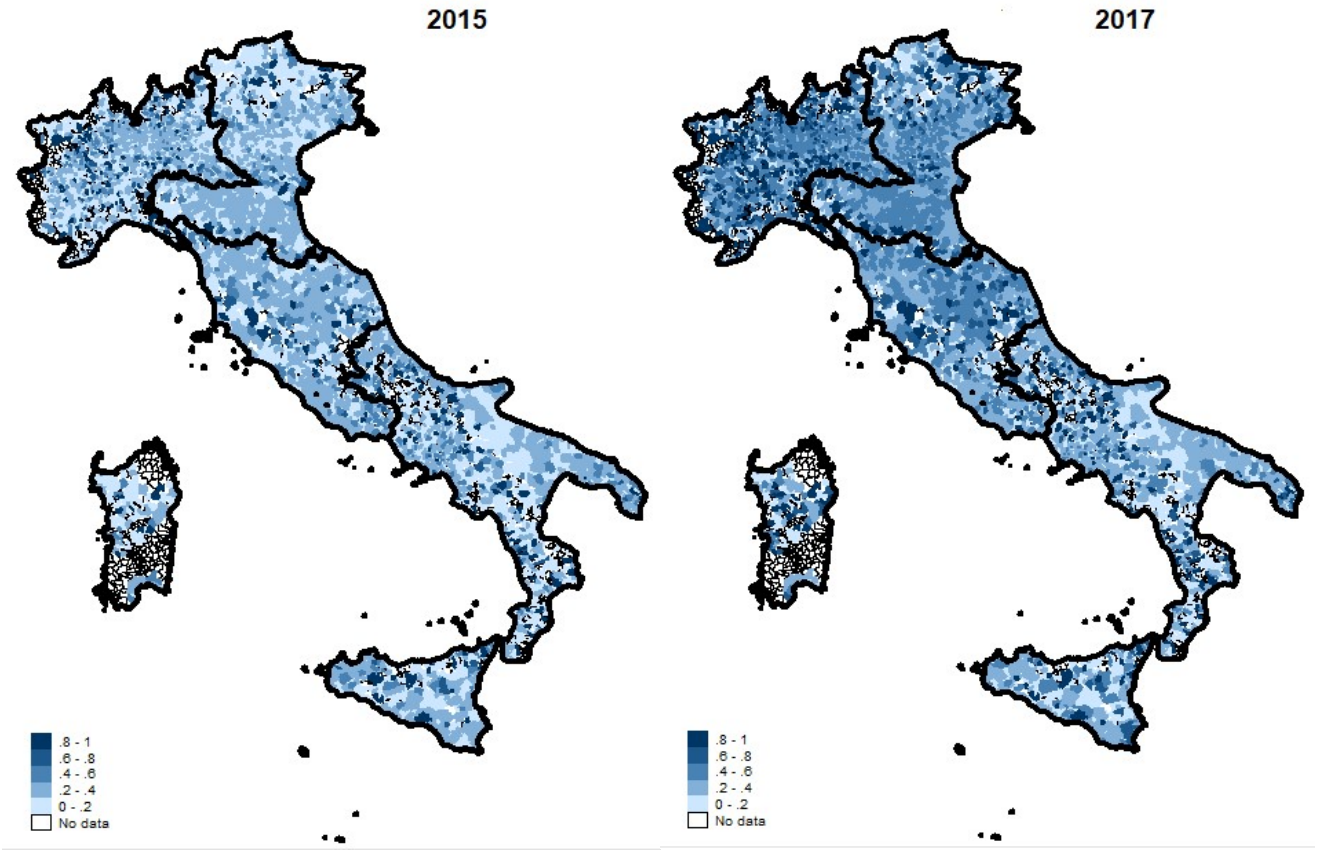
Region/Macro area	Total sample		Single director		Board of directors	
	Share	N of firm	Share	N of firm	Share	N of firm
Valle d'Aosta	0.136	117	0.147	34	0.132	83
Piemonte	0.203	7728	0.183	2201	0.211	5527
Liguria	0.203	1408	0.190	483	0.210	925
Lombardia	0.204	28117	0.199	8267	0.206	19850
North-West	**0.203**	**37370**	**0.195**	**10985**	**0.207**	**26385**
Trentino-Alto Adige	0.132	1535	0.102	420	0.144	1115
Veneto	0.190	14888	0.168	4101	0.199	10787
Friuli-Venezia Giulia	0.171	2507	0.142	678	0.182	1829
Emilia-Romagna	0.197	11944	0.184	3158	0.202	8786
North-East	**0.189**	**30874**	**0.169**	**8357**	**0.196**	**22517**
Toscana	0.222	9062	0.234	3048	0.216	6014
Umbria	0.249	1584	0.278	528	0.234	1056
Lazio	0.245	5543	0.253	3464	0.231	2079
Marche	0.212	4648	0.215	1704	0.211	2944
Centre	**0.228**	**20837**	**0.240**	**8744**	**0.219**	**12093**
Abruzzo	0.223	2153	0.229	1205	0.215	948
Basilicata	0.183	540	0.183	317	0.183	223
Calabria	0.219	1083	0.203	715	0.251	368
Campania	0.213	6454	0.219	4370	0.201	2084
Molise	0.226	313	0.245	184	0.199	129
Puglia	0.211	4302	0.216	2722	0.204	1580
Sardegna	0.205	1117	0.218	564	0.191	553
Sicilia	0.223	3158	0.221	1852	0.227	1306
South & Islands	**0.215**	**19120**	**0.218**	**11929**	**0.209**	**7191**
Total Italy	0.206	108201	0.206	40015	0.206	68186

If we investigate in more detail the geographical picture of female leaders, we observe that females are surprisingly more common in the south, especially in smaller firms with a unique decision maker, while they are under-represented in the north east in both categories of firms. Regions in the north west are in line with the Italian situation, while some marginal regions like Valle d'Aosta and Trentino-Alto Adige show regional averages far below the national average, with a lower proportion of female directors. The central regions show the best situation in terms of female representation, with an average percentage of women decision makers of around 23% and a positive performance in both Umbria and Lazio in both groups.

A graphical representation of the picture, as shown in figure 1, shows the main trends during the period under investigation: it compares the number of firms with at least one female director at municipality level in Italy for the two years 2015 and 2017. Darker zones represent municipalities with a higher

percentage of firms in which there is at least one woman on the board. Looking at these maps, the results suggest that, over the period under consideration, the number of municipalities with women involved in making decisions for firms has grown, with a larger increase in the north and centre of Italy. A lower increase or a similar distribution can be observed for both the south of Italy and the islands.

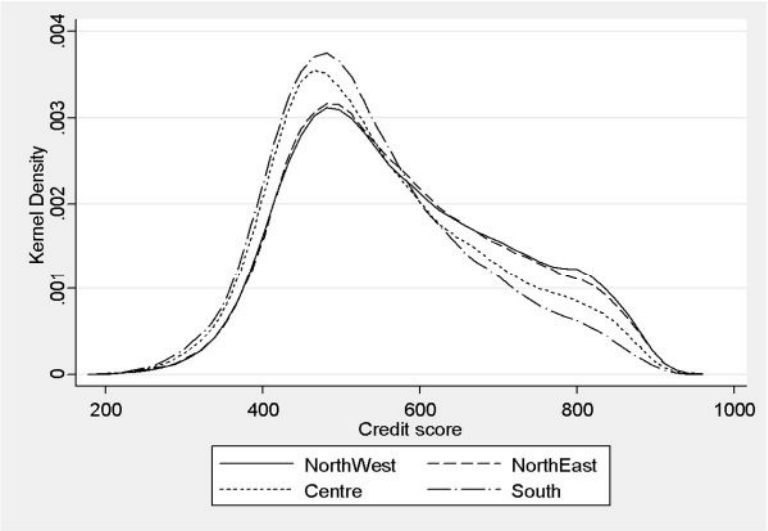
Figure 1: Firms with at least one woman director at municipality level (2015 vs 2017)



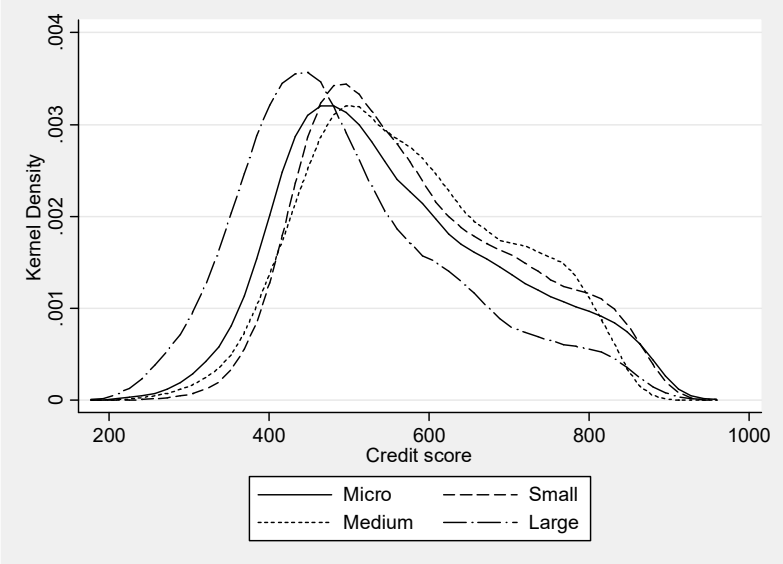
On the credit score side, figure 2 illustrates the kernel density graph of the credit scores according to different subsampling strategies: the geographical location of the firm, the size class and the year. First, panel (a) of figure 2 shows that the credit scores are not uniformly distributed across the macro regions of Italy, and that the shapes of the credit score distribution are not exactly the same for the south/centre region and the north. We observe a larger right-tail distribution of the credit score indicator for the subsample of firms located in the north west and the north east, suggesting that the average credit scores may be structurally lower for firms located in the south and centre of Italy. In particular, a higher proportion of firms in the north show higher credit scores (i.e. we observe a partial second mode at around a value of 800), which translates into a larger proportion of firms belonging to the higher rating class KR7, mainly at the threshold of that class (771-1000). Second, panel (b) of figure 2 shows another unexpected piece of evidence from our data focused on manufacturing firms: large firms show the worst

performance in terms of credit score indicators, with a surprisingly more positive performance by micro firms. The better profile in terms of credit score is for the two intermediate classes, medium and small firms, which show a larger average and a fatter right tail of the distribution. Third, looking at annual trends and the annual shape of the credit score distributions, we can observe very similar profiles in term of distribution, with a weak tendency for a slight improvement, but the effects on the global distribution are negligible, as suggested by the graphic reported in panel (c) of figure 2. For each of the three years considered, we observe a main mode of around 500 and a second partial mode at around the level of 800, with a distribution characterized by a fatter right tail in all the years.

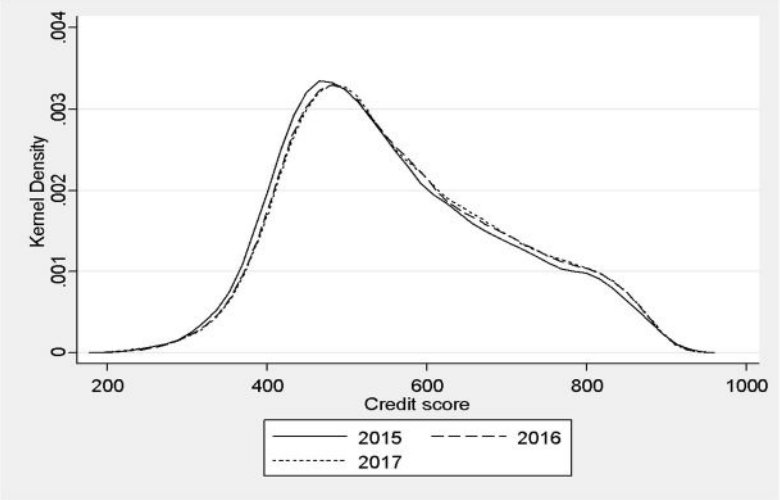
Figure 2. Distribution of credit score indicators across macro regions, by size class of the firm (2007), and during the analysed period.



(a)



(b)



(c)

4. Results

In this section we present our results and discuss the main implications of our analysis, with a focus on female participation in the government of a firm and the firm's credit risk. As anticipated, we concentrate our attention on two different measures of female participation, tailored to the specific features of our data: the *female_dummy*, which is equal to one if there is at least a woman on the board or among the top managers, and the *female_share*, which is the percentage of women on the board or among the top managers. We use as a baseline the specification with the *female_dummy*, while all the analyses are replicated using the proportion of women among the top managers as a robustness check; this second set of results gives very similar findings. All the dependent variables, and then also our variables of interest, are lagged in order to reduce contemporaneity and endogeneity issues. Table 3 reports our main results and represents the baseline for all the additional analyses proposed in robustness checks or as extensions of the main findings.

4.1 Baseline model, whole Italian manufacturing sector

Starting with standard OLS estimates for all the figures over the years, the first column of table 3 reports a very strong and statistically significant impact of the female dummy on the credit score indicator, even if many unobservable factors may affect the credibility of the coefficient and suggest an over-estimation of the real effects. In fact, columns 2-5 of table 3 collect estimates from four regression models that include firm-level fixed effects, and show more reliable results both for the gender issue and other control factors. The female dummy, indicating the presence of at least one female director, shows a positive and stable coefficient across the four model specifications. The magnitude of the effect is small but not negligible, and shows an increase in the credit score indicator (which ranges from 0 to 1,000) of around 2.2 points, considering that at the mean value of the indicator in the whole sample (which is around 500)

the magnitude is around half a percentage point. The coefficient from the OLS model overestimates the real effect, highlighting the role of endogenous factors that give a positive bias in the effect; however, the effect is persistent, and it is always significant and positive.

Other regressors include standard firm-level controls such as an indicator of profitability (the return on assets), firm size (computed as the natural log of revenues), mechanization (using the capital to labour ratio, computed as fixed assets over labour costs), and financial equilibrium (using the leverage index, computed as capital over external debt). Moreover, in the different specifications we include as alternatives different sets of dummies and interactions for capturing different sectoral, geographical and temporal specificities. The other firm-level controls have substantially their expected role in influencing credit scores, with a very strong and positive connection with past profitability (lagged ROA) and past financial independence (lagged Leverage), and a positive relationship with firm size. These main findings are stable and confirmed across all the models reported in table 3 and therefore they appear robust to the different sets of industry and geographical interactions with year dummies.

Table 3: Female dummy (i.e. at least one woman among top managers/directors)

					(baseline)
	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS		Fixed effect		
Female_dummy (lagged)	11.40***	2.266**	2.264**	2.293**	2.264**
	(0)	(0.0373)	(0.0375)	(0.0352)	(0.0376)
Return_on_Assets (lagged)	350.9***	206.7***	206.5***	206.5***	206.4***
	(0)	(0)	(0)	(0)	(0)
Firm_size (lagged)	4.999***	23.87***	23.84***	23.83***	23.85***
	(0)	(0)	(0)	(0)	(0)
Capital_to_Labour_ratio (lagged)	9.84e-05***	8.85e-06	1.31e-05	1.06e-05	9.31e-06
	(0.00107)	(0.935)	(0.904)	(0.922)	(0.932)
Leverage (lagged)	2.677***	0.259***	0.259***	0.259***	0.259***
	(0.00104)	(0)	(0)	(0)	(0)
Firm-level fixed effects	No	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Macro areas interacted with years	---	---	Yes	---	---
Regions interacted with years	Yes	---	---	Yes	Yes
2-digit Ateco codes interacted with years	Yes	---	---	---	Yes
Constant	471.1***	295.7***	296.0***	297.7***	299.0***
	(0)	(0)	(0)	(0)	(0)
Observations	177,354	177,354	177,354	177,354	177,354
R-squared	0.219	0.248	0.248	0.249	0.249
Number of firms		100,317	100,317	100,317	100,317

Robust p value in parentheses; *** p<0.01, ** p<0.05, * p<0.1

If the presence of at least one woman among the top managers gives a first insight into a female presence, the intensity of this presence represents another important aspect that should be considered. We measure

this intensity through the proportion of women among the top managers.[2] The results of the regressions in which the variable *female_share* is included instead of the female dummy are collected in table 4, with the same model specification as reported in table 3. In this case, too, our estimates confirm a positive and significant impact of increasing the presence of women among the top managers, with the coefficient remaining more stable throughout the passage from the simple OLS to the model with firm-level fixed effects. The magnitude of the coefficient is comparable with the one estimated for the dummy, and with an increase of 100% in terms of female share, the baseline model (column 5) shows an increase of 3.6% in terms of the credit score indicator.

The other controls substantially confirm their expected impact on credit scores, with positive large and significant impacts of past profitability, past size and past financial independence. In the case when the proportion of women is used as an indicator of female participation in decision making, too, our main findings are robust to all specifications and confirm that female participation reduces the credit score indicator. On the other side of the coin, given the structure of the credit score indicator and its negative relationship with default probability as shown in table 1, our results say that an increase in female participation substantially contributes to a reduction in default probability. Therefore, a female presence seems consistent with a change in financial corporate strategy to demonstrate more prudence and a more balanced apportionment of capital between debt and the firm's own capital.

Table 4: Share of women among the top managers for the whole sample

	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS	Fixed Effects			
Female_share (lagged)	3.408***	3.703**	3.661**	3.665**	3.670**
	(0.000108)	(0.0334)	(0.0354)	(0.0353)	(0.0350)
Return_on_Assets (lagged)	350.7***	206.7***	206.5***	206.5***	206.4***
	(0)	(0)	(0)	(0)	(0)
Firm_size (lagged)	5.179***	23.88***	23.85***	23.83***	23.85***
	(0)	(0)	(0)	(0)	(0)
Capital_to_Labour_ratio (lagged)	9.62e-05***	8.81e-06	1.30e-05	1.06e-05	9.28e-06
	(0.00150)	(0.935)	(0.904)	(0.922)	(0.932)
Leverage (lagged)	2.686***	0.259***	0.259***	0.259***	0.259***
	(0.00103)	(0)	(0)	(0)	(0)
Constant	488.5***	381.3***	381.5***	381.9***	382.8***
	(0)	(0)	(0)	(0)	(0)
Firm-level fixed effects	No	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Macro areas interacted with years	---	---	Yes	---	---
Regions interacted with years	Yes	---	---	Yes	Yes
2-digit Ateco codes interacted with years	Yes	---	---	---	Yes
Observations	177,354	177,354	177,354	177,354	177,354

[2] A caveat on the nature of the data has to be highlighted. Our firms mainly consist of micro firms with monistic corporate governance bodies (i.e. a unique executive who often coincides with the owner). The ratio will then be either zero or one depending on the gender of the owner.

R-squared	0.217	0.248	0.248	0.249	0.249
Number of firms		100,317	100,317	100,317	100,317

Robust p value in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.2 Extensions and other evidence

The Italian context is characterized by a generally low rate of participation of women in leading positions, as highlighted by Devicienti et al. (2019) or Bruno et al. (2018), with substantial differences between geographical areas. Together with traditional and cultural differences, the preliminary evidence on macro areas motivates an extension of our analysis to regional differences and features, to give a deeper understanding of our main findings.

From the point of view of the empirical strategy adopted, we rely on subsampling according to the geographical locations of firms, so as to be able to estimate the relationship using firm fixed effects. In particular, we use as a reference our baseline specification in column 5 of table 3 and we split the sample into the four main macro areas, the north west, the north east, the centre and the south. This is done in order to capture the geographical differences that are very pronounced in Italy. The results are displayed in table 5. We expect that the northern regions, where there are more women in the labour market, would also benefit more from having women among the firm managers, but our results only partially support this evidence. In fact, table 5 shows that in two of the subsamples the female dummy plays a positive and significant role: the north west (+3 points in the credit score indicator) and the central region (+4.5 points). These areas drive the globally positive effect, while in the north east the effect is still positive but not significant. Southern Italy registers a dynamic that is further from the general trend, with a negative coefficient for the female dummy, even if this is not significant. We interpret these results by looking at the general evidence on the proportion of women among top managers in table 2. In the north eastern regions, female participation is lower than the national level, and the small coefficient confirms the weaker influence of female managers on corporate strategies, which is probably affected by the difficulties in reaching a critical mass of women as well as by the predominantly male-oriented leadership. In the north western and central regions, the presence of women is stronger and this greater integration of women among managers can influence the strategies and, as a consequence, the financial structure of a firm, with a positive effect on the credit score indicator. The less intuitive evidence comes from the southern regions, where the share of women among managers is high, as is confirmed by other sources (ManagerItalia, 2019). However, to interpret our unexpected results we have to understand the framework and the picture of public incentives in the south during recent years. Since 2014, the Italian Ministry for Equal Opportunities has made it possible for ‘female firms’ to access specific financial sources under favourable conditions and with a public guarantee. ‘Female firms’ are generally defined

as new firms founded by women, but they also include previously existing firms where most of the executives or owners are women; this second case may be of potential interest in our analysis. In fact, this kind of instrument to incentivize women to participate as entrepreneurs or managers, together with other incentives on regional bases, have been particularly used in the south to sustain economic activities, with a potentially positive effect on the amount of debt because of the favourable conditions. This mechanism might partially inflate the size of debt in female firms, and could be one of the possible explanations for the negative sign we find in our econometric model.

Table 5: Geographical differences according to Italian macro areas, subsamples, and baseline specification

	(1)	(2)	(3)	(4)
VARIABLES	North west	North east	Centre	South
Female dummy (lagged)	3.134*	1.039	4.654*	-2.061
	(0.0644)	(0.581)	(0.0841)	(0.505)
Return_on_Assets (lagged)	222.0***	284.9***	150.9***	172.8***
	(0)	(0)	(0)	(0)
Firm_size (lagged)	25.45***	20.16***	28.67***	22.16***
	(0)	(0)	(0)	(0)
Capital_to_Labour_ratio (lagged)	0.00106***	0.000109	-8.74e-05	-0.000160
	(0.00152)	(0.763)	(0.528)	(0.561)
Leverage (lagged)	0.0577**	5.362***	2.708***	0.560***
	(0.0333)	(0)	(0)	(0)
Firm-level fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Regions interacted with years	Yes	Yes	Yes	Yes
2-digit Ateco codes interacted with years	Yes	Yes	Yes	Yes
Constant	377.5***	404.4***	342.4***	382.6***
	(0)	(0)	(0)	(0)
Observations	63,087	51,656	33,861	28,750
R-squared	0.252	0.338	0.231	0.221
Number of firms	34,666	28,394	19,470	17,787

Robust p value in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The last angle of our analysis is based on the expected differences for the different sizes of firm; in this case, too, our estimation strategy is still based on subsampling to show the individual fixed effect. Table 6 collects the results from the estimation of our baseline econometric model (i.e. column 5 of table 3) after separating the firms according to the European classification into dimensional classes, using only revenues as the reference. We divide our sample into micro firms (having less than 2 million Euros in terms of revenue), small firms (from 2 to 10 million), medium firms (from 10 to 50 million) and large firms (more than 250 million Euros), and we run separate regressions as we did for geographical area.

Table 6: Size class according to European classification, subsamples, baseline specification

VARIABLES	(1) Micro	(2) Small	(3) Medium	(4) Large
Female dummy (lagged)	3.378*	1.587	1.884	-24.65***
	(0.0551)	(0.220)	(0.657)	(0.00420)
Return_on_Assets (lagged)	180.5***	366.8***	253.5***	283.2***
	(0)	(0)	(0)	(2.52e-10)
Firm_size (lagged)	26.01***	11.67***	2.629	15.89**
	(0)	(0)	(0.569)	(0.0285)
Capital_to_Labour_ratio (lagged)	2.79e-05	-0.0204	-2.185	-2.228
	(0.814)	(0.326)	(0.100)	(0.352)
Leverage (lagged)	0.168***	3.212***	12.95***	42.27***
	(1.59e-09)	(0)	(0)	(0)
Firm-level fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Regions interacted with years	Yes	Yes	Yes	Yes
2-digit Ateco codes interacted with years	Yes	Yes	Yes	Yes
Constant	383.7***	460.7***	525.5***	570.4**
	(0)	(0)	(0)	(0.0199)
Observations	104,731	66,774	3,923	1,926
R-squared	0.246	0.330	0.274	0.587
Number of firms	61,621	35,016	2,032	1,648

Robust p values in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The results, in this case too, confirm our main results in the most numerous group, the micro firms, which represent more than 60% of the sample. As is partially expected, in very small firms when a woman joins the board of directors or becomes an executive (i.e. the information given by the female dummy), her influence on the firm's strategy is not negligible. As a consequence, according to our prior discussion on risk aversion, she might be able to adjust the corporate strategy and influence the financial or debt structure, with a predicted influence of 3.3 points on the credit score indicator. For other firms characterized by a small size (i.e. small and medium firms), the results are more uncertain and only marginally or barely significant, but they still remain positive. By contrast, the effect of a new female among the top managers in a large firm seems to be negative and significant and the magnitude of the coefficient is very large. However, we must be cautious because of the small number of large firms, which represent only 16% our sample.

4.3 The influence of female participation on rating classes

The credit score dependent variable is a continuous indicator in all the previous regressions, but most financial evaluations are based on the concept of rating, which is usually structured as a class variable.

Therefore, it is not all changes in credit score values that are relevant for a firm, but only those that influence its classification into a specific rating class, which is the real information that is relevant for the market. Is the presence of women on the board able to improve the credit rating of a firm, by upgrading it to a higher class? To test this question, we carry out an ordered probit analysis to take into account the ascending order of the credit score, on the basis of equation (2), using the baseline specification in table 3 as reference, excluding firm-level fixed effects.[3] We present the results in table 7 in terms of the marginal effect regarding our variable of interest, where the coefficients for the same controls of the baseline specification are omitted but are in line with the previous findings. As is well known, coefficients from Maximum Likelihood estimates of an ordered probit model are not equivalent to the marginal effects. We compute the marginal effects according to the standard transformation – dP(n)/dF, with P as the probability of being in the nth class rate and F the female dummy, relative to the dummy variable of having only women on the board.

Our findings are coherent with the previous results, showing a positive effect of the presence of at least one woman, but, of course, in this case the marginal effect should be split for each rating class. Table 7 provides four negative coefficients for the female dummy when estimated for the four worst classes in term of rating, with the clear message that the presence of a woman among the managers reduces the probability of having a low rating judgment. On the other side of the coin, we find a positive and significant coefficient for the female dummy for the best rating classes, with a stronger effect in terms of magnitude for the two best rating groups. In fact, the presence of at least one woman among the top managers increases, by 1.6 and 1.4 per cent, respectively, the probability of being in the KR7 or KR6 class. This last model confirms the relevance of a female presence in increasing the financial sustainability of a firm, but also confirms that this effect is not negligible and does indeed contribute to improving the final rating judgment: that is, a female presence is a determinant in improving discontinuous creditworthiness indicators.

Table 7: Marginal effects estimated for the female dummy (i.e. the presence of at least one woman among the top managers) on the probability of being in a certain credit class (one to seven); ordered probit model.

Rating Class	Marginal Effect	Std. Err.	Z	P>z	[95% Conf.	Interval]
1	-.0039021	.0002344	-16.65	0.000	-.0043616	-.0034427
2	-.0090878	.0005324	-17.07	0.000	-.0101312	-.0080443
3	-.0158472	.0009207	-17.21	0.000	-.0176517	-.0140426
4	-.006395	.0003739	-17.10	0.000	-.0071279	-.0056621
5	.005045	.0002978	16.94	0.000	.0044614	.0056287
6	.0140216	.0008146	17.21	0.000	.0124249	.0156183

[3] In the context of ordered probit models, the inclusion of individual fixed effects is still questioned in terms of the relative advantage in comparison to the estimation difficulties.

7	.0161654	.0009414	17.17	0.000	.0143203	.0180105

5. Conclusions and final remarks

Our analysis offers important insights into the influence of women on the financial structure of a firm, measured according to credit scores and rating classes. Our paper offers new results on female representation among top managerial positions, suggesting that women still remain under-represented despite their presence having increased over time, with some differences in terms of geographical area and the average size of the firm. Focusing on the Italian manufacturing industry, the proportion of women on the management board is around 20%. Our empirical analysis, mainly based on standard regression models, employs lagged explanatory variables in combination with firm-level fixed effects to reduce contemporaneity and endogeneity issues, which are both potential sources of bias. All our estimates confirm that the presence of women among the top managers reduces the firm-level financial risk, measured as a continuous credit score indicator or as the rating class in which the firm is categorized. In particular, the presence of at least one woman among the top managers contributes to an improvement in the firm credit score of around half a percentage point at the mean, and the results are confirmed if the female share is used instead of the simple dummy. Geographical specificities play a crucial role, with most of the global results being driven by firms located in the north west and the centre of Italy, in contrast with a neutral situation in the north east and the south. Another fundamental aspect is the size of the business, with the positive effect being mainly driven by smaller firms, where one woman can really make a difference in influencing corporate strategy. Moreover, our main finding on the reduction in credit risk associated with female participation is confirmed when the attention is focused on the rating class. Our evidence is confirmed by an ordered probit model estimating the probability of being in a certain rating class in the light of female participation. In this case, too, our results show that the presence of at least one woman on the board increases the probability of having a better rating judgment, confirming that the positive effect of women is determinant and effective.

In conclusion, our study confirms that promoting women's participation in managing and leading firms is important and has to be further sustained. Some initiatives have already been taken, and their effects are coming to light. For example, the quota rule for boards of directors of listed companies has increased the number of seats held by women, and, looking at small and medium enterprises, subsidized loans for female entrepreneurship have encouraged the growth of new business opportunities. Despite these positive effects, the data recording the inclusion of women in top management positions reveal that the female share is still low, especially in those countries like Italy where both the general and the workplace

culture is male-oriented. Policy makers should educate the market to ensure a more gender-balanced representation, assisting – and in certain cases forcing – individuals and firms to experience the positive contribution of women to the financial soundness of the firm.

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