Do female managers perform better?
Evidence from Italian manufacturing firms

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Abstract: The aim of the paper is to test whether the presence of females at management level influences firm productivity. The analysis is conducted on a sample of Italian manufacturing firms extracted from the AIDA database (2004-2012). Results demonstrate that firm productivity is positively influenced by women managers. We also find the productivity differential due to geographical localisation. In the presence of female managers, firms located in the North-West regions significantly increase the positive firm productivity differential of the geographical area, while firms located in the South and Islands reduce the differential productivity gap. Female and mixed managed firms result more productive than male only managed firms.

Keywords: gender participation, female managers, firm productivity, regional development, Italian manufacturing sector

JEL Codes: M14, J16, J24

Introduction

Among the wide range of factors considered important for firms' performance, the interaction between gender and productivity remains controversial and is yet to be explored. We revisit this issue by investigating whether the presence of females at the management level influences firm productivity in the Italian manufacturing sector. We focus on the case of Italy, which is particularly interesting since Italy is mainly characterised by small and medium size firms, often managed by family members. The productivity of such firms has not experienced substantial growth during the two last decades under investigation for a wide range of reasons delineated in the literature, but mainly due to a lack in technological innovation adoptions (Castiglione and Infante 2014; Hall et al. 2013), the large presence of small firms, and a low rate of female employment and participation in economic activities. The average number of employees of Italian small firms is four, while, in Germany this number is thirteen and in the United Kingdom it is eleven. The Italian firms with more than fifty labour units account for 56.4% of the manufacturing sector, while in France and the United Kingdom this number is around 30%. It is worth noting that the firms that have more than 250 labour units represent only 23% of this sector, which is half of what we find in France and the United Kingdom and a third of that in Germany. Given the small size, these firms present a lack of research and development (R&D) investments due to excessive efforts and costs required (Hall et al. 2009; Pagano and Schivardi 2003).

The prevalence of small and medium size firms often relies on the entrepreneur production function, which depends on coordination and organisation capacities. The manager of a firm often personally takes the decisions regarding production process and excludes the intervention of external forces, assuming entire responsibility for firm performance. Clearly then, the productivity of small firms directly depends on the personal skills and characteristics of the manager, such as the age, level of education, experience, risk awareness, innovation

capacity, and other factors. The analysis of gender differences in the management of firms becomes interesting in such a context since personal characteristics are mostly under the spotlight. In addition, the Italian economy presents a large degree of heterogeneity in terms of business environment across size, industries and geographic areas, which calls for a diversified analysis of firms' productivity.

Therefore, the objective of this paper is to further explore the impact of female management on firms' performance by concentrating on productivity in Italian manufacturing firms. The manufacturing sector in Italy has been experiencing difficult times in the recent two decades. Italy has registered, in the middle of ICTs revolution, a productivity slowdown that has weakened its role in the new global competition context and when the world crisis, that hit the world economy in the second half of the 2000s, arrived in Italy the manufacturing sector was already experiencing great difficulties. As reported by Ciccarone and Saltari (2015), in Italy between 2008 and 2013 national income fell by 9 per cent, per capita incomes by 11 per cent, and industrial production by 25 per cent. They suggest that the causes of this productivity slowdown could be traced back to the nineteen-nineties when globalization, low cost competition from emerging countries and Internet technologies started. The double-dip economic crises that Italy had registered in these years has led to high levels of unemployment, especially in the southern regions, among women and younger workers, increasing economic differentials between northern and southern regions.

Given the phenomena of globalisation and information technologies, Italian manufacturing firms were more involved in management and production reorganisation. In this process, a key role was also played by women whose participation in the manufacturing sector has increased in recent years also as a result of active government policies providing incentives for women entrepreneurs (Italian law n. 215/1992), and gender quotas on boards of directors (BoDs) (Italian law n. 120/2011).

This research adds to previous studies in several aspects. First of all, it offers new evidence on gender differences in firm productivity in the Italian manufacturing sector. Secondly, the analysis covers a large dataset on manufacturing firms, and female participation is considered for each firm present in the dataset individually. In the work closest to our research by Depalo and Lotti (2013), the analysis is concentrated on Italian firms' performance by providing a sectorial approach and analysing financial indicators of female firms. The authors, however, do not find any evidence on gender differences in their analysis. On the other side, in a more recent paper, Flabbi et al. (2016) do find that female executives make a difference on wage/gender gaps and firm performance in the Italian manufacturing sector.

The research is carried out by utilising data extrapolated from AIDA database, carried out by Bureau van Dijk and covers Italian manufacturing limited companies (industries 10-33) relative to the year 2004 (62,618 firms) and the year 2012 (139,321 firms). Our main results show that greater female participation as members of boards of directors and managers of manufacturing firms has a positive impact on firm productivity by a magnitude of about 3.0-4.0% when only the number of female managers is taken into account. This result holds for firms operating in all geographic areas taken into consideration (North-West, North-East, Centre, and South and Islands). A higher impact of female managers on productivity is detected in firms situated in the North-West and, partially, in the South and Islands areas. Interestingly, firms managed only by men, in comparison to those managed by only women or by men and women, are found to be bad performers that lower firm productivity in the South and Islands. In terms of policy implications, our main results indicate that government policies whose aim is to increase female participation in the manufacturing sector are grounded and represent a necessary condition to achieve greater returns in productivity,

especially in the most advanced area of the North-West and in the most economically disadvantaged areas, such as the South and Islands.

Firm productivity and gender differences

Understanding what the determinants of firm productivity are is an important question and theory has outrun theoretical and empirical work here, but it is still an area of active economic research. An empirical and experimental research in this field is dedicated to female participation and its significance for firm performance.

However, before evaluating the empirical literature, we need to introduce the theoretical context in which the present work is rooted.

Let us consider the simplest case in which the firm production function is the following

$$Y=f(K,L,M) \qquad (1)$$

where K is the capital factor, L is the labour factor and M is the additional input in the production set that can be called the management factor.

We can assume that the management one is a composite factor, such as $M = M_1 + M_2$, where M_1 is the number of male managers and M_2 is the number of female managers. In this case, (1) can be rewritten as:

$$Y=f(K,L,M_1+M_2) \qquad (2)$$

Equation (2) shows that the maximum output can be produced using alternative combination of capital, labour and management inputs.

Leaving aside the K and L factors, the firm is in equilibrium when:

$$MP_{M1}/W_{M1}=MP_{M2}/W_{M2}$$

The two management factors are perfect substitutes when an additional female manager would produce the same output and would receive the same wage of a male manager. In this case, there is no gender discrimination and the allocation of managers is efficient.

This result does not hold either if, following Becker (1957), a discriminatory coefficient on M_2 wage is introduced, or M_2 marginal productivity is lower than that of M_1. Since wage discrimination between the same group of managers can be easily detected and denounced, firms can justify their lower hiring of female managers on the base of differences in productivity. According to Arrow (1973), the discrimination can persist in this case if employers have preconceived beliefs that women managers have a lower productivity than male managers.

Therefore, we investigate whether the persistent difference of firms in hiring female managers with respect to male managers reflects differences in manager gender productivity.

In analysing the gender contribution to firm productivity, the economic literature results are often polarised given that positive and negative aspects of female manager participation to firm performance can be figured out. For example, among the negative effects we find Khalife and Chalouhi's (2013) analysis of the financial performance of Lebanese firms which demonstrates that female-owned firms generate lower gross revenues than their counterparts. Positive evidence on the firm performance is provided by Khan and Vieito (2013) who demonstrate that firms with a female CEO are associated with an increase in returns of assets in the United States. The performance of Danish firms (Smith et al. 2005) in the relation to the proportion of women in management demonstrates a variation from none to positive in relation to the characteristics of managers, such as university degree or selection procedure. Indeed, some studies confirm that no gender difference is found. From this perspective, Du Reitz and Henrekson (2000) evaluate gender differences in terms of profitability of Swedish firms and do not find evidence of female underperformance. Similarly, Lam et al. (2013) have not found any CEO gender–return of assets link for Chinese firms. The equality between top-manager genders is indirectly confirmed by Crespo et al. (2014) who, in analysing the existence of a distinct pattern of occupational mobility between genders, found that women

exhibit an unfavourable pattern of occupational mobility when they are at the bottom of the occupational distribution whilst when they occupy top positions the differences between genders do not exist.

Gagliaducci and Peserman (2015), using a data set on German establishments between 1993 and 2012, investigate whether the gender composition of the top layer of management affects a variety of establishment and worker outcomes. They find that there is a strong negative association between the fraction of women in the top layer of management and several establishment outcomes (such as sales, investment, wages, and employment). On the other side, Dale-Olsen et al. (2013), in analysing the Norwegian reform on board gender quotas, conclude that the short-run impact of the reform on economic firm performance was negligible.

Farrell and Hersch (2005), using event study analysis based on a Fortune 500 companies, find that although better performing firms tend to have more women on the board, this does not generate better firm performance.

In light of recent literature on Italy, we signal the work of Depalo and Lotti (2013) that evaluates whether there are systematic differences between male and female firms in terms of performance. The data comes from Firms Registry of the Chambers of Commerce and the related Cerved database for the balance sheet data. Their analysis regards firms operating in different economic sectors, from agriculture to services and considers different indicators of return of investments and productivity. The estimated results also demonstrate that there are no significant differences in performance between firms run by women or men. More recently, Flabbi et al. (2016) published an interesting paper on the effects of female managers in Italian manufacturing firms in which they demonstrate that gender matters. They build a balanced panel data set using three different sources on Italian manufacturing firms (Bank of Italy, INPS and CADS surveys) to test whether female executives make a difference on

gender-specific wage distribution and on firm performance and find that female managers increase the variance of women's wages at firm level and, of interest for our purpose, positively affect firm productivity because females managers are better in interpreting the real productivity of female workers.

However, as remarked by Bloom and Van Reenen (2010), there are some manager characteristics that differentiate firm management and produce differences in firm productivity, that should also be taken into account when studying the role of the gender of managers in firm performance. According to Pekka et al. (2004), there are various theories and arguments on how different characteristics of an individual worker or manager affect firm productivity. For example, attitude to risk, age and education of managers are important control variables in explanatory models of firm productivity, if these characteristics vary across gender.

Since management ability is applied to different level of firm management, one characteristic that is often evaluated is the attitude of managers towards risk. A way to look at managers risk attitude regards their management choices on firm cash holding. Opler et al. (1997) discuss three channels through which managers can use cash for their own objectives: to comply with their risk aversion; to pursue investments in projects without using the capital markets; to keep funds in the firm without paying out excess cash to shareholders. Other studies also discuss whether substantial cash holdings are beneficial or detrimental to firm performance, in particular in the presence of female managers.

A common wisdom asserts that females are more risk-averted than males as they retain more cash. This is a question that has been investigated at different levels and contexts. Rai and Kimmel (2015) ask if women generally exhibit greater financial risk aversion than men. They find that single women exhibit greater behavioural risk aversion compared to single

men. However, this gender difference does not exist when they compare behavioural risk aversion of married women and men in charge of household finances.

Wei (2007) and Schubert et al. (2000) demonstrate that women are more risk averse than men, which can be positive in evaluating financial and investment decisions. Gneezy at al. (2003) and Neiderle and Vestelund (2007) find evidence of women's reluctance to engage in competitive interactions. Zeng and Wang (2015) argue that female managers add value to the company because they are more risk averse and are associated with a lower level of management discretion problems.

In general, the relationship between employee age and productivity is not linear. Productivity should increase up to a certain employee age and then should decrease (Warr 1993) unless experience and learning by doing intervene to counterbalance the diminishing productivity connected to higher ages. In this case, the relationship should become positive. For the purpose of this work, we found that Bandiera et al. (2011) in analysing a sample of Italian firms and managers assume the number of years the CEO has been in control of the firm as proxy for job experience. They find that risk tolerance decreases as managers age, while the number of years the CEO has been in control of the firm is uncorrelated with risk tolerance. Fitjar et al. (2013), in a study on a sample of Norwegian firms, find that manager age has a negative impact on the likelihood of firm product innovation. On the other side, Daveri and Parisi (2015) assume the average age of managers as proxy for experience and find that as it increases the innovativeness and productivity of the Italian manufacturing firms rises too. Flabbi et al. (2016) find that the CEO age tenure has a positive impact on different definitions of firm performance.

Education is another characteristic that varies across managers and gender. According to Castagnetti and Rosti (2009) females outperform male students in academia, and, thereafter, in the labour market. Croson and Gneezy (2009) review the literature on gender

differences in economic experiments and add other factors responsible for female-specific outcomes, such as low confidence in investment decisions, high sensitivity to social cues and high context-dependency among others. Negative features are also noted. Scarce managerial experience and insufficient education are detected in Gottschalk and Niefert's (2011) analysis.

From this summary, we conclude that the literature support for the female contribution in firm performance is mixed and needs further investigation. The purpose of the present study is to analyse whether and how the productivity of Italian manufacturing firms is influenced by the presence of a female manager, by the number of female managers present in a firm and their characteristics, and whether this relationship is influenced by the geographic area of the country (North-West, North-East, Centre, and South and Islands) where firms operate. The period of study covers the two years 2004 and 2012. This gives us the opportunity to analyse the Italian case in very different years, since the year 2004 is one of relative growth of the Italian economy, while 2012 is the year in the middle of the "double-dip" recession that the Italian economy suffered after the 2007-2008 world economic crisis.

Empirical model

As is well-known, firm productivity depends on factors that traditionally include capital, labour, and other factors. Productivity is also influenced by the way these inputs are managed, and management should be considered as a factor of production no different from any other. The impact of the management factor either on labour productivity or on total factor productivity has been studied in several ways (Bloom et al. 2012; Bloom et al. 2016; and Bresnahan et al. 2002), following both the neoclassical and Schumpeterian approaches. Our model is focused on managerial gender differentials in firm productivity. To this end, the determinants of firm productivity can be extended to include management inputs regarding

participation of women as members of the board of directors of firms. Our baseline model takes the following form:

$$Y_{it} = A_{it} K_{it}^{\beta_1} Imm_{it}^{\beta_2} L_{it}^{\beta_3} \quad (3)$$

where *Y* denotes the output of firm *i* in year *t*. A is a Hicks-neutral efficiency term, *K* indicates physical capital, *Imm* defines intangible assets and *L* is labour.

After normalising the above equation on labour to test for labour productivity, we include the management factor in terms of manager gender differences in the BoD, managers characteristics and other effects influencing productivity – such as size, industry and macro-territorial area. Under these assumptions, equation (3) can be written as:

$$y_{it}=\alpha_0+\beta_1 k_{it}+\beta_2 Imm_{it}+\beta_3 Fem_{it}+\beta_4 Women_{it}+\beta_5 Cash\_propensity_{it}+\beta_6 Age\_Fem_{it}$$
$$+\beta_7 Area_i+\beta_8 Size_{it}+\beta_9 Ind_i+\varepsilon_{it} \quad (4)$$

where *y* is labour productivity expressed as the volume of sales per worker; *k* is tangible assets per worker; *Imm* indicates intangible assets per worker; *Fem* represents a dummy variable that is equal to one if there is at least one female manager in the firm and zero otherwise. Although the number of female managers depends on the number of persons that constitutes the BoD of the firm, that in turn is influenced by firm size, to better evaluate the influence of female managers on firm performance we introduce into the productivity equation a new variable (*Women*) that accounts for the number of women on the firm BoD and shows more variation than the dummy *Fem* variable. To control for some manager quality characteristics, we introduce a set of variables such as risk attitude (*Cash_Propensity*), the average age (*Age_Fem*), whilst to control for the effects of firm localisation, industry and firm size on productivity we use a set of dummy variables (*Area*) that indicate geographic area of *North-West, North-East, Centre, and South and Islands*, 23 manufacturing industries (*Ind*) where the sample firms operate, and four firm sizes (*Size*: *micro*, *small*, *medium* and *large*).

The key idea of the empirical model is to check whether the firms with at least one female manager achieve greater productivity compared with other firms and whether the number of female managers on the board of directors statistically influences the productivity of firms compared with firms run by males only. The expected signs of the two type of capital input parameters are positive, whilst the expected signs for the gender management variables (*Fem*, *Women*) are less obvious since they link gender with productivity. Negative signs would confirm the common wisdom that female managers are less productive than male managers and discrimination in terms of the number of females on the BoD and lower salary is justified. On the other side, a positive sign parameter for both female manager variables would be interpreted as a confirmation of our hypothesis that women managers could contribute to firm productivity growth. A negative or positive sign of the control variable for the female manager characteristic, the interactive variable *Cash_propensity_Fem,* would clarify if female managers are risk averted but male managers, whilst a positive sign of *Age_Fem* variable would confirm whether experience is a crucial characteristic of female managers for productivity growth or not. Unfortunately, we could not include in the model any variable on education since in the AIDA database this information about managers is scarcely or not reported at all.

The model is estimated using both Ordinary Least Square (OLS) and Two-Stage Least Square (2SLS) methodology. Taking into account the endogeneity problem that arises from firm endogenous choice of inputs, we estimate the 2SLS model for the 2012 year and we use the lagged variables (2004) as instruments.

Data and variables

The analysis is carried out by utilising data extrapolated from AIDA (Analisi Informatizzata Delle Aziende) database, by Bureau van Dijk. The AIDA database contains detailed accounts

following the scheme of the 4th Directive EEL, indicators and trade description of Italian limited companies, divided by economic sector and geographical area. It is constructed primarily on the information from the mandatory national registry of firms held by the Italian Chambers of Commerce and contains information on firms' registry, sales, managers, employment, capital assets and industrial sector. The use of balance sheet data in economic analysis is not new, since firm book data presents reliable data on firm balance, capital, employment, financial accounts, firm characteristics, ownership and board composition. The analysis covers Italian manufacturing firms (industries 10-33) relative to 2004 (62,618 firms) and 2012 (139,321 firms).

A few words should be spent on the used variables. Productivity is defined as the sales revenue divided by the number of employees. The revenues from sales of goods or services is indicated by the net of returns, discounts, bonuses and sales taxes. The tangible assets per worker are measured by the ratio between tangible fixed assets and the number of employees. Tangible assets correspond to "buildings, installations and machineries" by considering the costs, net amortisation and loss of value or considering market prices. Intangible assets per worker represent a relevant variable for our analysis given that it includes investments in R&D and patents; although, under the Italian balance sheet rules this variable also includes advertising expenditure.

The presence of women on the boards of directors and their numbers were determined for each firm in 2004 and 2012 using the database. That same database was used to calculate the average age (in years) of the firms' board managers and the value of the cash holding for each firm. Finally, as for geographic distribution, it should be noted that in the North-West the number of firms in 2004 was 25,940 and in 2012 it was 51,795, while the North-East accounted for 10,493 and 19,663, the Centre for 13,872 and 33,230, and the South and Islands for 12,313 and 34,633, respectively. The model gives us the possibility to investigate the

differences in productivity in different geographic areas in relation to gender differences by considering either interactive dummies or geographical area subsample.

Results and Discussion

Descriptive analysis

Table 1 reports important information such as the number of firms, the number of men and women managers distributed in each macro-territorial area. It can be seen that the distribution of Italian manufacturing firms is differentiated according to the industrial development pattern that the four-macro areas had in the past century. Manufacturing firms are more concentrated in the so-called "industrial triangle", defined by the cities of Turin, Milan and Genoa, located in the four North-Western Italian regions (Piedmont, Valle d'Aosta, Liguria and Lombardy). In the two years under consideration, the percentage of firms located in this area is around 40% of the total number of firms. In the North-East (Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia and Emilia Romagna) area the percentage is around 15%. In the four Italian regions located in the Centre (Tuscany, Umbria, Marche and Lazio) the concentration of the firms is around 23%, while in the less industrialized area of the country, South and Islands (Abruzzi, Molise, Campania, Apulia, Basilicata, Calabria, Sicily and Sardinia) the concentration is equal to 19% in 2004 and 25% in 2012.

Table 1: Number of firms and number of managers (men and women) in Italian manufacturing firms

Regions	Manufacturing firms		Men managers		Women managers	
	Number	%	Number	%	Number	%
			2004			
North-west	25,940	41.43	11,153	49.29	6,512	54.49
North-east	10,493	16.76	4133	18.26	2297	19.22
Centre	13,872	22.15	4,205	18.58	2,076	17.37
South and Islands	12,313	19.66	3138	13.87	1066	8.92
Italy	62,618	100.00	22,629	100.00	11,951	100.00
			2012			
North-west	51,795	37.18	23,366	45.80	10,995	51.56
North-east	19,663	14.11	8949	17.54	3861	18.11
Centre	33,230	23.85	10,540	20.66	4,250	19.93
South and Islands	34,633	24.86	8162	16.00	2217	10.40
Italy	139,321	100.00	51,017	100.00	21,323	100.00

Taking into account that not all of the firms report gender information about managers, the number of firms that have at least one male manager is equal to 22,629 in 2004, and the number of firms that have at least one female manager is 11,951, while in 2012 the numbers are 51,017 and 21,323, respectively. Figure 1 shows the number of male and female managers in 2004 and 2012. It can be noted that while the picture does not change drastically from one macro territorial area to the other, the number of firms with at least one female manager is always lower. These results are also confirmed in Figure 2, that shows the ratio between men and women managers in 2004 and 2012 where, regardless of the increase of the number of firms over time, the ratio between men and women does not change significantly.

Figure 1: Number of male and female managers in Italian manufacturing sector by geographic area

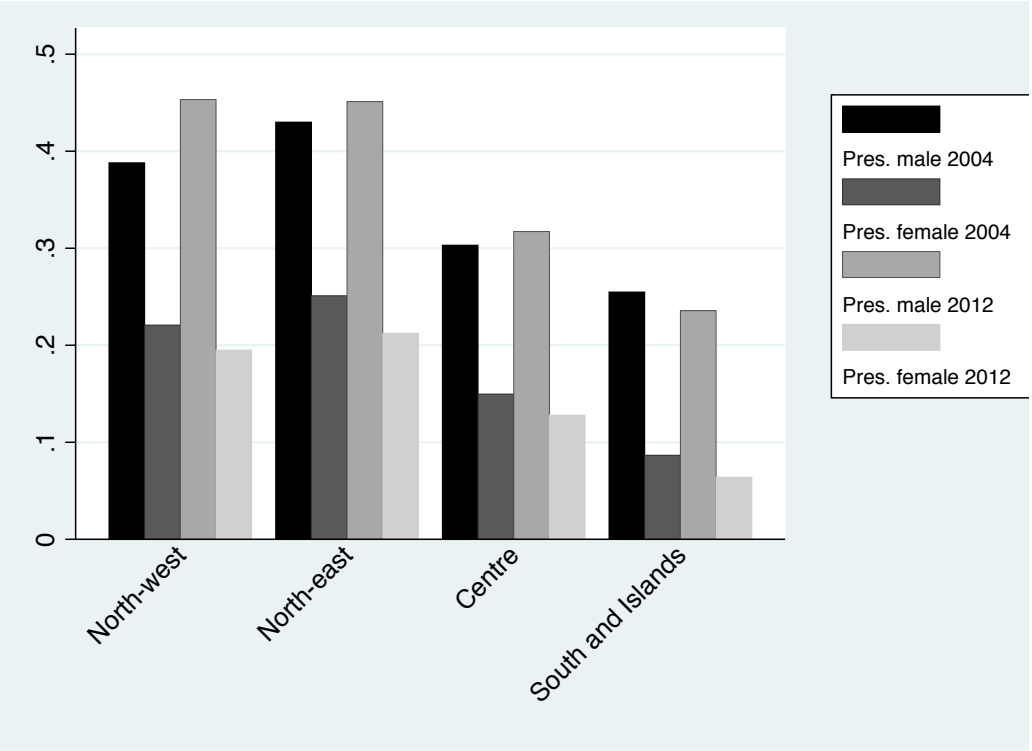

Figure 2: Ratio between male and female managers in Italian manufacturing sector by geographic area

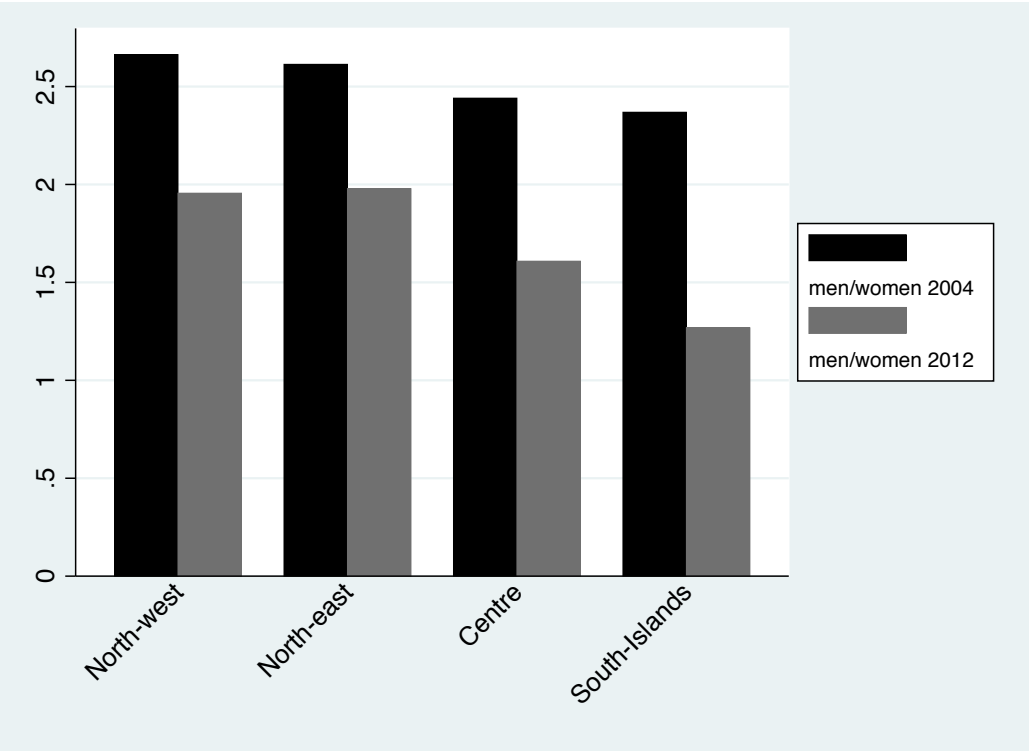

Table 2 shows the descriptive statistics of the variables used in our analysis for the 2004 and 2012 year samples. The number of observations drastically decreases due to the high number of missing values in both years.

Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
			2004		
ln(k)	21,446	3.237	1.328	-7.601	9.283
ln(Imm)	19,511	0.266	1.934	-10.859	8.465
ln(Cash_propensity)	60,226	-2.284	2.704	-15.000	16.097
ln(Cash_propensity_Fem)	60,226	-0.515	1.567	-14.750	14.816
			2012		
ln(y)	105,562	4.864	1.021	-11.019	12.547
ln(k)	103,614	2.880	1.784	-8.294	12.059
ln(Imm)	85,461	0.456	2.101	-13.162	9.658
Fem	129,924	0.194	0.395	0.000	1.000
Women	129,924	0.278	0.725	0.000	39.000
ln(Cash_propensity)	123,213	-2.246	2.967	-15.563	13.922
ln(Cash_propensity_Fem)	123,213	-0.525	1.678	-15.538	12.376

Econometric analysis

The equation (4) is estimated by using both OLS and 2SLS methodologies due to the possible endogeneity of the firm's choice of production function inputs. The results are consistent across the two methods, for this reason we discuss only the 2SLS results.[1]

Table 3 reports the 2SLS results, for different specifications of the model, for the year 2012, taking 2004 variables as instruments. Column 1 shows the results of our baseline model specification where tangible (*k)* and intangible assets (*Imm*) per worker, dummy *Fem*, that is equal to 1 if there is at least one female manager in a firm and 0 otherwise, dummies for three macro-areas (*North-West, North-East, South and Islands,* with the *Centre* as reference category), firm size (*small, medium and large,* with the *Micro sized firms* as reference category), and industry effects are taken into account. Column 2 introduces into the previous

[1] OLS and first stage results are available upon request from the authors

specification the continuous variable *Women* that is equal to the number of female managers in a firm and 0 otherwise, instead of the dummy *Fem*. Column 3 shows the results when both variables (*Fem and Women*) are included in the model. Column 4 introduces into the model the propensity for cash holding (*Cash_propensity*), defined as the ratio of cash and cash equivalents divided by total assets. Column 5 presents the estimation results of the previous model that, after eliminating the variable *Cash_propensity*, considers the interaction of two variables *Fem* and *Cash_propensity (Cash_propensity_Fem)*. The results shown in column 6, after adding age-fem to column (4), substitutes the macro-area dummies with the interactive dummy between the *macro-area* and *Fem*.

The analysis of the estimation results of the baseline model (Column 1) demonstrates that the contribution to firm productivity is significantly positive for both types of capital per worker in manufacturing production, although the intensity of tangible assets gives a higher contribution to firm productivity than that of intangible capital (0.165 vs. 0.115 respectively). The dummy variable related to the presence of a female manager in the production function shows a contribution for firm productivity which is significantly positive. For given levels of capital intensities, the difference in productivity between a firm that has a female manager and another firm that does not is 0.102, i.e. a firm with female managers is predicted to produce about 0.102 more, holding other factors unchanged.

Table 3: Firm productivity and female managers. 2SLS results

Variable	(1)	(2)	(3)	(4)	(5)	(6)
K	0.165***	0.166***	0.166***	0.250***	0.186***	0.235***
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Imm	0.115***	0.113***	0.114***	0.128***	0.117***	0.135***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Fem	0.102***		0.061***	0.019	0.217***	-0.022
	(0.013)		(0.017)	(0.017)	(0.056)	(0.007)
Women		0.043***	0.026***	0.031***	0.033***	0.035***
		(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Cash_propensity				0.122***		0.119***
				(0.006)		(0.006)
Age_Fem					0.001***	0.001***
					(0.000)	(0.000)
Cash_propensity_Fem					0.081***	
					(0.017)	
North-west	0.030**	0.030**	0.029**	0.036**	0.030**	
	(0.015)	(0.015)	(0.015)	(0.015)	(0.000)	
North-east	0.030	0.031	0.030	0.043**	0.034*	
	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	
South and Islands	-0.328***	-0.333***	-0.328***	-0.338***	-0.331***	
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	
NW_Fem						0.015
						(0.021)
NE_Fem						0.043
						(0.029)
SI_Fem						-0.163***
						(0.042)
small	0.055***	0.061***	0.054***	0.089***	0.056***	0.099***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
medium	0.087***	0.092***	0.084***	0.115***	0.085***	0.130***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
large	0.101***	0.071**	0.073**	0.150***	0.095***	0.161***
	(0.034)	(0.035)	(0.035)	(0.035)	(0.034)	(0.035)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cons.	5.102***	5.112***	5.105***	5.090***	5.027***	5.064***
	(0.043)	(0.043)	(0.043)	(0.042)	(0.048)	(0.042)
Obs.	15,956	15,956	15,956	15,956	15,833	15,833
Wald chi2	3389.91	3384.08	3407.07	3903.40	3485.09	3637.87
Prob.	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Robust standard errors in parenthesis
*significant at 10%; ** significant at 5%; *** significant at 1%.

If we take into account the number of women managers on the board (column 2), adding women to the board results in a substantial productivity increases of 4.3%. When both discrete and continuous dummy female variables are introduced (column 3), both variables remain statistically significant, showing a positive productivity differential. These results, despite the findings of Farrell and Hersch (2005) for the Fortune 500 firms, Gagliarducci and Peserman (2015) for the German case, Depalo and Lotti (2013) and, partially, Flabbi et al. (2016) for the Italian case, demonstrate that increasing female managers does have a significant impact on firm performance, even after controlling for geographical area, firm size, and industry effects. The productivity gains that could arise from enlarging gender quotas in firm management would be substantial for firms and for the competitiveness of the Italian manufacturing sector.

The contribution of the variable that refers to cash-propensity (column 4) is positive, showing that holding cash for a firm is a necessary condition to increase its productivity. Increasing cash holding of 1 percent results in a productivity gain of 0.12 percent. This finding demonstrates that cash holding is beneficial for firm performance. In a period of credit rationing, as it happens in the Italian economy during the last decade, managers use internal sources to pursue their restructuring and devolopment projects without resorting to capital markets.

We now introduce into the model some manager characteristics that can influence firm performance, such as experience and attitude to risk. Column 5 shows the effect of female manager experience, as approximated by the average age of female managers, on firm productivity. As the result shows, the performance of a firm with female managers increases with their age. The estimate indicates that a one-year increase in the average age of female manager increases productivity by 0.1%, confirming that, also for women managers, the

accumulation of experience through age (Daveri nd Parisi 2015) is important for firm performance.

For the risk attitude as manager characteristic, we consider the interaction dummy for cash holding propensity and the presence of women on the board of directors. The influence of this variable on firm productivity, contrary to part of the literature (Schubert et al. 2000, Wei 2007) that asserts that excessive caution is mainly a female feature, is positive and statistically significant. A 1 percent increase of cash holding exercised by female managers increases firm productivity by about 0.081 percent. This is the result that contrasts the common wisdom that female managers who hold cash may limit the possibility of investing in firm development and innovation, harmening firm productivity. According to our results, female managers seem more oculate in using external financial sources and use more internal cash not for precautionary reasons but to increase firm performance.

The substantial differences in firm productivity among territorial macro-areas are shown in columns 1-5 (the reference category is the Centre macro-area). The significance of these parameters stays approximately the same for different specifications. However, firms located in the North-West and North-East present a significant positive productivity differential of around 0.03, whilst firms located in the South and Islands show a significant negative productivity differential of about 0.3, with the respect to firms located in the Central regions.

In columns 6 we check the previous results by introducing macro-area dummies interacted with female dummies. The results on the presence of female managers in firms located in the North-West and North-East shows no productivity differential with firms located in the Central regions that have female managers. In the same time, when considering this interactive dummy (*SI_Fem*) for manufacturing firms located in the South and Islands, it significantly increases the negative gap registered by the area with respect to the reference category of the Centre macro-area. Nonetheless, the negative productivity gap registered by

female managed firms in the South and Islands is lower than that registered by all firms in the macro-area (columns 1-5). This confirms that female managed firms perform better than the rest of the local firms in this macro-area.

Table 3 also reports the results with regard to the size variable. In all model specifications the results indicated that size has a significant impact on firm productivity with respect to the micro sized firms (that is the 0-9 employees reference category). In particular large firms (250 or more employees) are more productive than the small firms (10-49 employees) and medium sized firms (50-249 employees) with a coefficient of a magnitude that varies between 0.101 and 0.161.

Robustness checks

The previous results obtained by estimating the 2SLS model[2] confirm our hypothesis, demonstrating that the presence of women in firm management could increase productivity of manufacturing firms.

As an additional check for the previous results we have estimated the productivity model at the regional level. Table 4 reports the estimated results when the sample is divided into the four-macro territorial areas. This analysis is necessary if we are to understand if the presence of females at the management level can be considered as an important determinant of firm productivity, contributing to enlarge/reduce geographic productivity gaps. In particular, Table 4 displays the results for firms operating in the four considered geographical areas (*North-West*, *North-East*, *Centre*, and *South and Islands*).

In the table, it emerges that in the North-West area (Panel A) the contribution to firm productivity of tangible and intangible assets is almost equal confirming that this is the area

[2] To check the robustness of the model, we provide OLS estimations for the two years separately (2004 and 2012). The tables are available upon request. Moreover, the model is also estimated for the reduced sample, considering the firms that are present in both years, with OLS for each year separately. The output is not statistically different from that presented in the previous section.

that most faced the transition to the IT paradigm that requires firms to use less tangible capital and more intangible assets. On the contrary, in the other three geographical areas (Panel 2, 3 and 4) the contribution of tangible assets results higher than the intangible ones. This means that for firms operating in these three macro-areas the old technology paradigm based on tangible capital is still the main factor of productivity growth. Another particular territorial feature emerges when we look at the number of female managers. In fact, when the number of female managers is introduced into the model the impact on firm productivity is significant for firms located in the North-West area and, partially, in the North-East and South and Islands areas, whilst in the other Centre area it is not significant. As for the characteristics of female managers, we find that experience, as proxied by female managers average age, positively increases firm productivity between 0.1 and 0.5 percent according to different areas and model specifications. We also find that cash-propensity for firms that have at least one female manager on the board, significantly increases firm performance by 0.07-0.08 percent in the North-West area, by 0.12-0.14 percent in the North-East, and by 0.10 percent in the *Centre*. In the *South and Islands*, the female cash-propensity has no effect. These results are obtained by controlling for *firm size* and *industry* effects, demonstrating that firms that have female managers use their cash to stimulate productivity.

Table 4: Firm productivity and female managers in macro-areas

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable								
	Panel A - North_West				Panel A - North_East			
k	0.126***	0.126***	0.149***	0.154***	0.244***	0.244***	0.286***	0.289***
	(0.011)	(0.011)	(0.013)	(0.013)	(0.019)	(0.019)	(0.025)	(0.025)
Imm	0.129***	0.125***	0.134***	0.129***	0.123***	0.123***	0.135***	0.136***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.019)	(0.019)	(0.020)	(0.020)
Women		0.043***		0.076***		-0.039		0.082***
		(0.009)		(0.012)		(0.019)		(0.034)
Age_Fem	0.001***	0.001*	0.003***	0.002***	0.001***	0.001***	0.005***	0.004***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.057)	(0.000)	(0.001)	(0.001)
Cash_propensity_Fem			0.072***	0.085***			0.119***	0.135***
			(0.019)	(0.020)			(0.038)	(0.043)
Size dummies	yes	yes	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes	yes	yes
Cons.	5.295***	5.293***	5.224***	5.205***	4.772***	4.771***	4.631***	4.612***
	(0.065)	(0.065)	(0.070)	(0.070)	(0.115)	(0.115)	(0.070)	(0.070)
Obs.	6782	6729	6729	6729	2525	2525	2525	2525
Wald chi2	1215.48	1247.74	1227.97	1265.3	660.11	660.06	639.92	634.25
Prob.	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Panel C - Centre				Panel C - South and Islands			
k	0.157***	0.158***	0.179***	0.178***	0.243***	0.245***	0.226***	0.226***
	(0.020)	(0.020)	(0.028)	(0.027)	(0.028)	(0.028)	(0.033)	(0.034)
Imm	0.097***	0.098***	0.100***	0.100***	0.066**	0.067**	0.070**	0.071**
	(0.023)	(0.023)	(0.023)	(0.023)	(0.030)	(0.030)	(0.031)	(0.031)
Women		-0.005		0.043		0.076*		0.022
		(0.018)		(0.044)		(0.041)		(0.104)
Age_Fem	0.002***	0.002***	0.005***	0.004**	0.003***	0.002*	-0.008	-0.001
	(0.000)	(0.001)	(0.002)	(0.002)	(0.000)	(0.001)	(0.004)	(0.003)
Cash_propensity_Fem			0.100***	0.100			-0.094	-0.091
			(0.085)	(0.084)			(0.096)	(0.104)
Size dummies	yes	yes	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes	yes	yes
Cons.	4.907***	4.907***	4.844***	4.844***	4.688***	4.460***	4.542***	4.538***
	(0.118)	(0.119)	(0.135)	(0.133)	(0.146)	(0.146)	(0.167)	(0.172)
Obs.	2305	2305	2305	2305	1,638	1,638	1,638	1,638
Wald chi2	484.71	484.7	486.13	487.72	468.17	471.51	452.4	455.34
Prob.	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: see Table 3

To further test the validity of the results that female managers positively contribute to firm productivity, we now examine separately the subsamples of firms that are managed by men only, by women only, and by both men and women. The first three columns of Table 5 present our baseline productivity model estimated for these three subsamples with the macro geographical area dummies, controlling for firm size and industry.

The results (Panel A) show that the contributions of tangible and intangible assets are still significantly positive. However, the magnitude of the parameters changes according to the type of gender management of firms. While for the firms managed only by men the tangible capital elasticity is equal to 0.233, for the firms managed only by women it is higher and equal to 0.294. The same result is valid as regards intangible capital, with the value of 0.123 for only men managers and 0.183 for only women managers. For the firms managed by both men and women the magnitude of tangible assets coefficient is slightly smaller with respect to the only men and only women cases. As for intangible assets, the magnitude of mixed team specification is smaller with respect to the only women managers case and greater than those with the only men managers case. The results for *Cash-propensity* are clear-cut since the variable maintains its significance and signs in all the specifications, confirming our previous finding that women are better performing in managing internal resources. Firms that have only woman managers achieve higher productivity from cash holding by about 0.193 percent with respect to the only men managers case (0.131) and by about 0.08 with respect to a mixed team. As far as the experience variable is concerned, we find that experience (the age of managers) has a significant value only for men managed firms.

As a result, these estimations confirm that women managers do better in the use of physical than immaterial capital. It seems that they move along the material economy paradigm, whilst men perform better in the digital economy. However, for the sake of clarity, it should be noted that the Italian manufacturing firms managed only by women (present in

both 2004 and 2012 samples) number only 443, while the corresponding number of firms managed only by men is 7184. At the same time, the number of firms managed by both men and women is 6564.

Table 5: Firm productivity and gender management

Variable	Only men managers	Only women managers	Men & women managers	Only men managers	Only women managers	Men & women managers
	Panel A			Panel B		
k	0.233***	0.294***	0.195***	0.260***	0.297***	0.201***
	(0.013)	(0.056)	(0.012)	(0.013)	(0.056)	(0.012)
Imm	0.123***	0.183***	0.149***	0.118***	0.177***	0.148***
	(0.012)	(0.046)	(0.012)	(0.011)	(0.049)	(0.012)
cash_propensity	0.131***	0.193***	0.080***	0.135***	0.194***	0.082***
	(0.009)	(0.044)	(0.008)	(0.008)	(0.044)	(0.008)
Age	0.001***	0.002	0.0002	0.001*	-0.0001	0.0002
	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)	(0.000)
North-west				0.036*	-0.013	0.019
				(0.021)	(0.105)	(0.020)
North-east				0.040	0.023	0.050*
				(0.027)	(0.138)	(0.027)
South and Islands				-0.347***	-0.126	-0.187***
				(0.029)	(0.134)	(0.042)
Size dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes
Cons.	5.322***	5.381***	5.451***	5.380***	5.443***	5.441***
	(0.067)	(0.240)	(0.073)	(0.065)	(0.237)	(0.075)
Obs.	7,184	443	6,564	7,184	443	6,564
Wald chi2	1596.97	136.84	1680.08	1773.07	139.6	1714.55
Prob.	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: see Table 3

Panel B of Table 5 repeats the previous specification but includes the macro geographic dummies as control variables. As can be seen, a similar pattern emerges. Firms that are managed by women present a higher elasticity of physical capital, intangible capital and cash holding with respect to firms managed by men and with respect to mixed teams (with the exception of intangible assets capital that for the mixed team is higher than that for the only

men managed firms). Not all geographical dummies are significant. However, we can note that firms run by men managers demonstrate a positive productivity gap of 0.036 in *North-West* macro-area. As expected, firms managed by only men, only women and by both men and women present a productivity gap in the South and Islands. Firms run by males in the *South and Islands* demonstrate a lower performance with respect to firms located in the *Centre* (our reference category). However, this is less than that shown by firms run by only females and by both females and males. The negative productivity gap is 0.347, 0.126 and 0.187, respectively.

The results derived from this analysis again confirm the importance of the female contribution to firm productivity and put in evidence the disadvantage of firms run by males only. In the Southern and Islands regions, from the point of view of productivity, at least a mixed team that presents gender complementarity should be preferred to a strictly male managed team.

Conclusion

Based on a large database of Italian manufacturing firms extracted from the Bureau van Dijk AIDA dataset referring to 2004 and 2012, we test whether the presence of females at the management level contributes to an increase in firm productivity and investigate how this phenomenon varies between the geographical macro-areas of the country.

The peculiarities of the Italian economy, based on small and medium enterprises concentrated in traditional industries, suggest a particular importance for the role of the entrepreneurs for firm productivity, and therefore, of gender differences. However, there is little empirical evidence on productivity differences between male and female managers in Italian firms. Our results differ from previous studies in several respects. Firstly, we consider female participation for each firm in a large sample of Italian manufacturing firms (62,618 for

the year 2004 and 139,321 for the year 2012). Secondly, gender differences in productivity are considered in different ways. We take into consideration whether the firm has at least one female on the board. Then, we account for the number of female managers and their characteristics. Thirdly, we apply our model to check whether there are significant regional differences of gender management in firm performance. Finally, we split the sample to check the differences of the productivity of firms with or without female management participation and of firms with both male and female participation. The results were tested by different econometric techniques, providing a robustness check of the validity of the model.

Our main finding is that the contribution to productivity of female managers is significantly positive, raising productivity substantially from 0.016 to 0.22, depending on model specification, keeping other factors constant, and controlling for firm size and industry effects. Interestingly, female participation increases the productivity of tangible assets more than that of intangible assets. We find that firm performance increases the larger the female presence in managerial positions. Contrary to much of the current literature we also find that female managers are not risk-averted in the use of firm cash and gender specific risk behaviour may be due to their opportunity sets rather than stereotypic risk attitudes (Schubert et al. 1999).

After controlling for firm size and industry, we find that, these results are sensitive to geographic location, given Italy's historical regional socio-economic differences. The positive productivity differential of firms with female participation in management in the North-West area is found to be higher than that of similar firms located in the Centre, and the South and Islands areas. However, surprisingly, we find that for the firms located in the South and Islands area the existing productivity gap could be slightly decreased by only women and mixed participation of men and women in firm management, showing complementarities of genres in management. In the South and Islands, firms run by male managers are less

productive than firms run by only men in other areas of the country. These results are obtained on a sample of 443 female managed firms that represents only 3.12 percent of the total sample of 14.160 firms, whilst 46,12 percent (6564 firms) are mixed genre managed, and more than 50 percent (7134 firms) of the Italian manufacturing firms, still in 2012, are managed by men only.

In terms of policy implications, our results demonstrate that the low representation of females in firm management is not grounded on a solid microeconomic evidence. Our findings demonstrate that female managers present a higher productivity in absolute terms when considered as number of females, and in relative terms when their managed firms are compared with only male managed firms and mixed genre managed firms. Henceforth, if female manager discrimination persists it is because of non-economic factors, leaving future research room "*à la recherche*" of these non-economic factors (psychological sources, stereotypes, social services, educational and marital statuses, etc.). In any case, our results confirm the necessity of government policies aimed at increasing female occupation and participation in firm management. Increasing female participation at the firm management level would increase the level of female manager experience that in turn would contribute to raise firm productivity and lower regional productivity gaps. Following our results, if manufacturing firms that do not have any female manager would introduce at least a female manager, their productivity could raise substantially, and they would go a step further in recovering their lost competitiveness.

It should be noted that the Italian law n. 120/2011 on gender quotas in BoD regards listed companies only that were required to have at least one female manager in the Board. But what would happen to the Italian manufacturing sector if the same rule would be extended to all limited companies of the sector? Our results suggest that this policy could greatly contribute to the recovery and development of the Italian manufacturing sector.

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