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Gender Diversity in Senior Positions and Firm Performance: Evidence from Europe

by Lone Christiansen, Huidan Lin, Joana Pereira, Petia Topalova, and Rima Turk

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Gender Diversity in Senior Positions and Firm Performance: Evidence from Europe

Prepared by Lone Christiansen, Huidan Lin, Joana Pereira,

Petia Topalova and Rima Turk[*]

Authorized for distribution by Petya Koeva Brooks

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Abstract

This paper examines the link between gender diversity in senior corporate positions and financial performance of 2 million companies in Europe. We document a positive association between corporate return on assets and the share of women in senior positions and establish two potential channels through which gender diversity may affect firm performance. The positive correlation is more pronounced in, first, sectors where women form a larger share of the labor force (such as the services sector) and, second, where complementarities in skills and critical thinking are in high demand (such as high-tech and knowledge-intensive sectors).

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Author's E-Mail Address: : LChristiansen@imf.org, HLin@imf.org, JPereira@imf.org, PTopalova@imf.org, RTurk@imf.org

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I. INTRODUCTION

With millions of women joining the labor force in Europe over the past three decades, it is striking that only few senior positions in the top corporate firms are held by women. In contrast to relatively moderate gender gaps in the European prime-age workforce in 2014, women occupied on average only 19 percent of corporate board seats and 14 percent of senior executive positions in the top 600 largest companies in Europe. Even more striking is that only 4 percent of the chief executive officers of these companies were female.[1]

These gender disparities at the top of the corporate ladder have prompted several European countries to institute quotas for women on boards of publicly listed companies. Since Norway passed a law in 2003 mandating 40 percent representation of both men and women on the board of publicly listed companies, sixteen European countries have legislated similar reforms. Most recently, Germany passed a law requiring publicly listed companies to have 30 percent of supervisory seats occupied by women as of 2016. Even where no legal requirements are in place, boards are under increasing pressure to appoint female directors. The European Commission (EC) has called on publicly listed companies to voluntarily commit to increasing the presence of women on boards to 30 percent by 2015 and 40 percent by 2020 among non-executive directors by actively recruiting qualified women to replace outgoing male members (European Commission, 2012).[2]

Gender diversity in senior positions could improve financial performance of firms through a number of channels.[3] Greater representation of women could bring in heterogeneity in values, beliefs, and attitudes, which would broaden the range of perspectives in the decision making process (OECD, 2012) and stimulate critical thinking and creativity (Lee and Farh, 2004). Given well-documented differences in preferences and behavior along gender lines, important complementarities may also arise between the managerial style of men and women.[4] Furthermore, with the rise of women in the labor force, increasing their

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[1] Computed using data from the European Commission (http://ec.europa.eu/justice/gender-equality/gender-decision-making/database/business-finance/executives-non-executives/index_en.htm). The sample covers the largest publicly listed companies in each country. A maximum of 50 companies, members of the primary blue-chip index in each country, are included. Data on board members cover all members of the highest decision-making body in each company, which is typically either the supervisory board or the board of directors. Data on executives cover senior executives in the two highest decision-making bodies in each company. These are typically the supervisory board and the management board (in case of a two-tier governance system) and the board of directors and executive/management committee (in a unitary system).

[2] The EC's proposal applies to companies listed on the stock exchange in the EU member states but excludes all listed small- and medium-sized firms, affecting about 5,000 companies of the total 7,500 listed firms. It also keeps open the possibility to exclude firms with a strong gender imbalance in the workforce, measured at less than 10 percent of the under-represented gender.

[3] Increasing diversity could also undermine performance if it is associated with greater misunderstandings, communication problems, personal conflicts, or negative reactions from stakeholders (Akerlof and Kranton, 2000; Becker, 1957; Choi, 2007; Kremer, 1993; Lazear, 1999).

[4] See Croson and Gneezy (2009) for a review of the literature on gender differences in preferences and other factors that might affect managerial style. McKinsey (2009) argue that certain leadership behaviors were seen

(continued…)

representation in senior positions would mitigate gender differences between managers and subordinates, which could enhance workers' productivity (Giuliano and others, 2006). Some have even argued that female managers could be better positioned to serve consumer markets that are dominated by women (CED, 2012; CAHRS, 2011).

Nevertheless, existing evidence on the impact of gender diversity in the boardroom on firm performance is inconclusive.[5] Influential work by McKinsey (2007) and Catalyst (2007) documented a strong positive association between the representation of women on the boards of Fortune 500 companies and corporate performance. Other studies have also linked more women in senior management and in the board room to better financial outcomes and governance of listed firms.[6] However, later studies that plausibly identify the causal impact of raising the share of women in corporate boards on firm performance have challenged this evidence (see, for example, Ahern and Dittmar, 2012 and Appendix Table A1).

Common to all studies is an important limitation: data availability typically constrains the analysis to *publicly listed companies* in individual countries.[7] The resulting small sample size makes it hard to detect a statistically significant effect of gender diversity, particularly if its magnitude is small. Further, little is known about how women fare in senior management positions in the *broader corporate sector* and how their presence—both in management and in the board room—shapes the financial performance of firms. This shortcoming is relevant in Europe, where small- and medium-sized enterprises often comprise a large share of overall output and employment.

In this paper, we present new evidence on the prevalence of women in managerial and board positions and their role in shaping firms' financial performance in a large sample of non-financial companies. Contrary to existing studies, which typically focus on a small sample of listed firms in a particular country, we analyze more than 2 million listed and non-listed firms with at least two people in the senior management team or in the corporate board across 34 European countries.

Compared to evidence from Europe's largest listed firms, women working in the broader corporate sector have made somewhat greater strides in senior positions. On average, almost a quarter of senior management and board positions in our sample were held by women in 2013. That said, whereas cross-country variation is large, there is still a sizable gap between

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more often in women than men, namely people-development, setting expectations and rewards, providing role models, and participative decision-making.

[5] See Rhode and Packel (2014) for a survey of the literature on the gender composition of boards and financial performance and Appendix Table A1.

[6] See, for example, Adler (2001); Carter and others (2003); and Khan and Vieito (2013) for evidence from the U.S.

[7] Studies that use the introduction of quotas for women on corporate boards as an exogenous source of variation to gender diversity understandably focus only on publicly listed companies, for which the legal requirement is binding (Matsa and Miller, 2012; Bertrand and others, 2014).

the gender composition of the work force and the gender composition of senior positions in almost all countries.

Our analysis reveals that firms with a larger share of women in senior positions have significantly higher return on assets (ROAs), even within narrowly defined industries.[8] Replacing one man by a woman in senior management or on the corporate board is associated with 8–13 basis points higher ROAs. As causal interpretation of this correlation is difficult, we use a simple difference-in-difference strategy to shed light on the underlying mechanisms behind the better financial outcomes. We find strong evidence for two specific channels at work:

- First, the positive association between gender equality in senior positions and firm performance is significantly stronger in sectors that employ more women in the labor force. Specifically, for a firm in an industry in the top quartile in terms of female intensity, having one more woman on the board or in senior management, while keeping the size of the board unchanged, is associated with about 20 basis points higher ROAs. In contrast, a firm in an industry with relatively few women in its labor force would not see a positive change in its profitability.

- Second, knowledge intensive and high-technology sectors—which demand higher creativity and critical thinking that diversity in general may bring—seem to benefit significantly more from a higher share of women in senior management. In these sectors, an additional woman on the board or in senior management is associated with about 30 basis points higher ROAs.

[8] For the purposes of this paper we refer to 'increased gender diversity' and 'greater female representation' interchangeably as an increase in female representation from current levels will lead to increased gender diversity.

The findings suggest that boosting gender diversity in senior positions could have a sizable impact on the financial performance of firms in Europe, especially in certain sectors. To that end, leveling the playing field by strengthening policies to facilitate women's full-time attachment to the labor force—such as removing fiscal disincentives and providing services complementary to women's market work—could help build the pipeline of women for senior corporate positions, with important macroeconomic implications.

The remainder of this paper is organized as follows. In Section II, we briefly review related literature. Section III describes the data used in the analysis and measurement of key variables, and Section IV lays out the key stylized facts about women's representation in senior positions across countries. Section V discusses our empirical strategy, while Section VI presents the main findings and their robustness. Section VII concludes.

II. Related Literature

The large literature on the consequences of gender diversity has not led to clear conclusions. Existing studies have examined both the reduced-form relationship between board composition—typically of large, publicly listed firms—and (i) firm financial performance, and (ii) the actions that more diverse boards take (Appendix Table A1).[9] However, it remains unclear whether gender diversity has a meaningful impact on firm performance and board actions. In a comprehensive review of the literature, Rhode and Packel (2014) conclude that there is no evidence of a robust and consistent relation between the gender composition of boards and financial performance, although a company's public image is enhanced by promoting equal opportunity and greater inclusion.

A common empirical strategy in the literature is to estimate the correlation between the gender composition of boards and firms' financial performance (measured in both accounting and market value terms). Some studies in this vein find a strong positive relationship among Fortune 500 companies (McKinsey, 2007; Catalyst, 2007), among U.S. firms (Dezso and Ross, 2012; Khan and Vieito, 2013), or among public firms in a cross-country sample (Terjesen and others, 2015). On the other hand, studies focusing on other individual countries do not find such association (Du Reitz and Henrekson, 2000, for Swedish firms and Lam and others, 2013, for Chinese firms).

A key challenge in the literature is how to interpret the associations it uncovers. The board composition of the firm is jointly determined with firm performance. Therefore, while it is likely that greater presence of women improves firm performance, the causality could also go the other way—better performing firms are simply able to attract more women or afford to bring more women on their boards.

[9] There are some notable exceptions that employ large datasets. For example, Castaglione and others (2014) examine the link between firm productivity and gender diversity using a dataset of 58,410 Italian manufacturing firms. Huang and Kisgen (2013) also assess gender differences in making executive financial and investment decisions in a sample of 1,866 U.S. firms.

To overcome this shortcoming, some studies have exploited the exogenous increase in women in the boardroom, resulting from legislation of gender quotas for corporate boards of directors, as in France, Norway, and Spain. Matsa and Miller (2009) investigate the effect of introducing gender board quotas in Norway, where the female share of corporate directorship more than doubled from 18 to 40 percent within three years. They find that introducing quotas reduced short-term profitability for firms that had no female board membership beforehand, owing to increased labor costs from fewer layoffs and higher relative employment. Ahern and Dittmar (2012) similarly cast doubt on the positive effects of gender diversity on corporate boards in response to the legislative changes in Norway, as listed firms experienced a decline in their stock price at announcement, and their market value also declined in subsequent years. However, Campbell and Vera (2010), who examine the effect of legislative changes in Spain, conclude that positive discrimination in favor of female board appointments and the gender equality act make economic sense. Stock markets react positively to the appointment of female board managers and a positive association with firm value is recorded over a sustained period.

Other studies tackle omitted variables and reverse causality problems using alternative identification strategies. Smith and others (2005) use the average length of education of the spouses of other CEOs as an instrument to assess the direction of causality between female top executives and firm performance, as CEOs with well-educated spouses may have a more positive view on the competence of female CEOs. Adams and Ferreira (2009) propose that gender diversity only increases value when additional board monitoring enhances firm value, examining its differential impact in firms with different levels of shareholder rights. They find that the average effect of gender mix on the board on financial performance of 9,000 U.S. firms is negative, and that the beneficial effects only materialize for firms with weak shareholder rights. They thereby question whether gender quotas can increase shareholder value for well-governed firms. Another study by Huang and Kisgen (2013) uses a difference-in-differences empirical framework on a hand-collected data set of executive transitions in the U.S. to show how gender differences in executive financial and investment decision making affect firm financial outcomes. In turn, they document evidence of overconfidence by male executives relative to female executives. Finally, Flabbi and others (2014) use matched employer-employee panel data from about 850 Italian manufacturing firms, allowing them to control for firm and employee fixed effects, to examine the effect of the gender of the executive on firm productivity, and the wage distribution of female workers.

This paper contributes to the literature in two ways. Instead of focusing exclusively on publicly listed companies as most other studies do, it covers firms of all sizes across 34 European countries. It is, to our knowledge, the first study to examine the association between the presence of women in senior positions and corporate performance in such a rich cross-country sample. The very large sample size allows us to more precisely estimate existing trends in the data, within narrowly defined country-industry groups. In addition, this paper is one of the first studies to highlight the sectoral differences that exist between the observed correlation in female representation in senior positions and financial performance. While unable to precisely identify the causal effect of gender diversity on performance due to the cross-sectional nature of our data, we shed light on the mechanisms through which greater female presence at the top could help firms' performance.

III. Data and Measurement

The data are primarily from the European subset of the Orbis database, compiled by Bureau van Dijk Electronic Publishing (BvD). The database provides firm-level data for many countries worldwide from administrative data collected by local Chambers of Commerce and then relayed to BvD.

The Orbis database has financial accounting information from detailed harmonized balance sheets, income statements, and profit and loss accounts of firms. The key distinguishing feature of the Orbis database is the extraordinary broad coverage of the corporate sector. Roughly 99 percent of companies in the database are private, compared to other databases, such as Worldscope or Dealscan, which contain information only on large listed companies (Gopinath and others, 2015).

Our analysis relies on a sample of firms that report basic financial data for 2013 (namely, total assets and various measures of profits), industrial affiliation,[10] and information on the composition of senior management and the board of the company. The raw dataset, extracted in July 2015, contains the unconsolidated financial statements of 4.4 million firms across 34 European countries. We focus on firms that report having at least two members in senior management/board, abstracting from the large number of sole proprietorships.

The reason for this sample selection is twofold. First, we are interested in examining the role of gender diversity in senior positions, rather than documenting differences in male versus female entrepreneurs. Economic theory provides some clear channels through which gender diversity in senior positions may benefit firms, which do not extend to single-manager firms. Second, there is a large variation in the prevalence of "one-manager" firms across European countries, from close to 80 percent of firms in Romania, to one percent of firms in Finland. By focusing on firms where the board/senior management comprises at least two people, we can ensure a more homogeneous sample across countries.

To measure female representation, we calculate the share of total members of senior management or the company board who are women.[11] Following the corporate finance literature, our preferred indicator of firm financial performance is return on assets, which we measure in three different ways: net income over total assets; profits before taxes over total assets; and earnings before interest and taxes (EBIT) over total assets.[12] To avoid distortions from extreme outliers, the top and bottom five percent of values of our firm performance

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[10] We use the primary industrial affiliation report by the firm to classify companies into industries.

[11] For the purposes of this study, we do not distinguish between the seniority of the positions held. Accounting for the number of positions that the various members of the board/senior management hold does not change our findings.

[12] Given their focus on publicly listed firms, previous studies have examined the effect of gender diversity on firm value and Tobin's q.

variables are excluded.[13] Data cleaning, missing variables, and selection of firms with at least two members in management/board reduce the sample to about 2 million firms.

It is important to note the significant differences in the rate of attrition of firms due to missing data across countries. For example, a very small share of firms in Austria, Netherlands, Germany, and the United Kingdom (5–11 percent) report profits. Firms in Ukraine, on the other hand, often do not report the gender of their board members. Our main findings are robust to the exclusion of any one country from the analysis.

We complement the Orbis dataset with a measure of the female intensity in various sectors. We rely on Do and others (2016), who calculate the share of female workers in total employment across 61 distinct ISIC Rev. 3 manufacturing sectors using UNIDO Industrial Statistics Database averaged over all countries and years for which such data are available. We use OECD annual labor force employment statistics to construct female intensity of the remaining non-manufacturing sectors (Appendix Table A2).

Finally, we use Eurostat's taxonomy of high- and medium-technology manufacturing sectors and knowledge intensive services at the NACE 3-digit level (Appendix Table A3). Eurostat classifies manufacturing industries according to their technology intensity (based on the ratio of R&D expenditures to value added) and services according to their degree of knowledge intensity (based on the share of people with tertiary education in the activity).

IV. Stylized Facts: Prevalence of Women in Senior Positions

Serving in senior management and/or being a corporate board member in a European firm remains predominantly a male phenomenon. Table 1 presents the average prevalence of women in managerial positions across European countries in 2013. It lists values both for the full set of firms (columns 1–4) and for the sample used in our study (columns 5–8)—that is, companies that have at least two members on their board of directors. Indeed, even though women accounted for 46 percent of the labor force in Europe in 2013, less than a quarter of senior positions were held by women. Nonetheless, this representation in senior positions in the broader corporate sector is larger than in top European publicly listed firms. According to Eurostat, in 2015, the share of female executives and female board members was, respectively, 14 and 19 percent in the 620 largest listed companies—substantially less than what we find in the Orbis data.

There are wide differences across countries in representation of women in managerial positions and corporate boards. For example, in the Austrian firms in our sample, less than 10 percent of the managerial positions are held by women. In Ukraine, on the other hand, women hold 40–50 percent of such positions.

Various hypotheses have been offered for the underrepresentation of women in leadership positions in the corporate world as well as in politics: from demand-side constraints, such as preexisting social norms and gender stereotypes that create a glass ceiling for women, to

[13] Our results are robust to excluding firms in the top and bottom 1 and 2 percentiles with respect to the return on assets, and to winsorizing, rather than dropping, extreme values.

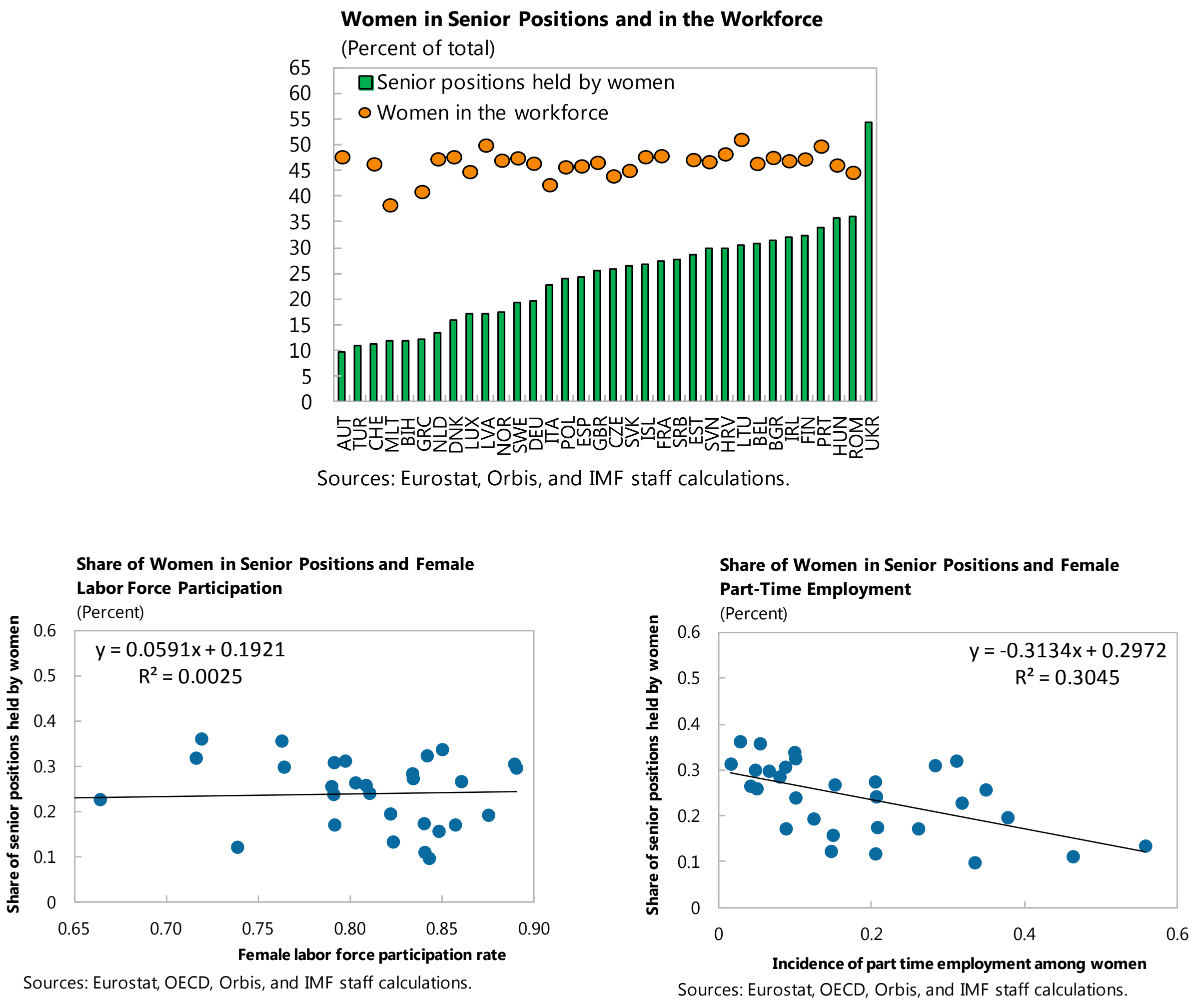
supply-side explanations, such as women's shorter work hours. Preexisting social norms and gender stereotypes may serve to bias bosses and shareholders against appointing women as managers and leaders (Huddy and Terkildsen, 1993; Eagly and Karau, 2002). Lack of exposure to female leaders, in turn, may perpetuate biased perceptions of women's effectiveness in leadership roles (Beaman and others, 2009). Women themselves might not believe in their ability to lead, since they rarely see other women succeed in such positions (Beaman and others, 2012). They may also leave high-power career tracks to have children (Bertrand and others, 2010).

While pinning down the exact causes for the underrepresentation of women in senior positions is beyond the scope of this paper, two stylized facts emerge from our European sample of firms.

- The overall female labor force participation rate is not a good predictor of the representation of women in senior positions in the broader corporate sector (Figure 1). For example, whereas Nordic countries stand out in terms of female labor force participation, they are on par with other advanced European economies in terms of female presence in senior positions.

- However, there is a very strong positive association between the incidence of *full-time* employment among working women and the share of women in senior corporate positions. Countries with higher prevalence of part-time work have substantially lower share of women in senior management and the board room, lending some support to the supply-side explanations for the existing gender gaps in senior levels.

Figure 1. Women in Senior Positions



V. EMPIRICAL STRATEGY

In order to gauge whether there is a link between gender diversity in senior positions and firm performance, we begin by estimating the simple correlation between measures of corporate financial performance and the share of women in senior positions at the firm. Specifically, we estimate the following regression model:

$$y_{inc} = \beta * sh\_wmn_{inc} + \gamma * x_{inc} + \alpha_{nc} + \varepsilon_{inc} \qquad (1)$$

Here, y_{inc} is ROAs of firm *i*, in industry *n*, operating in country *c*; sh_wmn_{inc} is the share of women in senior positions of the firm, x_{inc} are firm-specific controls (indicators for the size of the firm, indicators for firm age, the number of directors/senior managers, and the log of tangible assets).[14] The regressions include α_{nc}, a full set of roughly 16,000 country-industry fixed effects, which control for all time-invariant differences of firm performance across industry-country pairs. Standard errors, ε_{inc}, are clustered at the industry level.[15]

Though these very granular fixed effects absorb a significant amount of heterogeneity, a causal interpretation of the coefficient of interest, β, is still difficult. The Orbis database does not provide information on changes in the board or management team over time, which precludes us from examining how an increase in the prevalence of women correlates with changes in firm performance. In the cross section, the share of women in management may be correlated with numerous unobserved characteristics of the firm, which affect its financial performance. Further, in equilibrium, board composition is jointly determined with firm performance, making it difficult to distinguish whether greater presence of women improves firm performance or better performing firms are simply able to attract more women.

To shed light on the potential causal effect of greater female participation in senior positions, we therefore examine the mechanisms behind the simple correlation. Inspired by the Rajan and Zingales (1998) approach, we use a simple difference-in-difference strategy. Our identifying assumption is as follows: if women in senior positions can help improve firm performance, their impact must be stronger in two different types of industries:

- *Industries with relative more female labor.* The assumption that certain industries employ primarily women, while others employ primarily men, is standard in theories of gender and the labor market[16] and has been well documented in the data (Do and others, 2016). Abstracting from the reasons underlying the greater representation of women in certain sectors, it is reasonable to expect that these sectors may benefit more from gender diversity in senior positions. Women in leadership positions may be more likely to support family-friendly changes in corporate policies[17] or serve as role models for other women, thereby raising the productivity of female workers. Women managers may also be better able to match female workers to tasks in the firms, evidence of which was recently provided by Flabbi and others (2014) in a sample of Italian firms. Women's

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[14] For the remainder of the paper, we use industry and sector interchangeably.

[15] Since clustering at the country-industry level results in smaller standard errors, we present the more conservative clustering at the industry level.

[16] See, for example, Galor and Weil (1996); Black and Juhn (2000); Qian (2008); Black and Spitz-Oener (2010); Rendall (2010), Pitt and others (2012); Alesina and others (2013), Do and others (2016).

[17] Empirical evidence on this channel is mixed. For example, Duflo and Chattopadhyay (2004) and Beaman and others (2009) find that female leaders were more likely to invest in public goods demanded by women. Bertrand and others (2014) do not find evidence that the rise in women in the boardroom of publicly listed companies as a consequence of Norway's quota had significant impacts on the labor market outcomes of other women.

leadership style may also be more effective in female-dominated or female-oriented settings (Eagly and others, 1995).[18]

- *Industries with greater demand for creativity and critical thinking.* A sizable literature has argued that the benefits of workforce diversity depend on sectoral characteristics.[19] Garnero and others (2014) provide empirical evidence on the heterogeneous effects of workforce diversity across sectors in Belgium. Extending the arguments of this literature to diversity in senior positions, it follows that sectors characterized by complex tasks and innovative output stand to benefit more from greater diversity—including along gender lines—to the extent that it increases the set of ideas and potential solutions.

Thus, we estimate the following specification:

$$y_{inc} = \delta * SEC_n * sh\_wmn_{inc} + \beta * sh\_wmn_{inc} + \gamma * x_{inc} + \alpha_{nc} + \varepsilon_{inc} \qquad (2)$$

Here, SEC_n denotes either (i) the female intensity of the sector to which the firm belongs and (ii) an indicator for whether the sector is a high-technology or knowledge-intensive sector. The coefficient of interest in this specification is δ, which captures the extent to which women in senior positions lead to better financial outcomes in more female-intensive sectors or in more knowledge-intensive sectors.

VI. Results

A. Establishing correlations: Gender diversity and firm financial performance

Table 2 reports the results from estimating equation (1) for the full set of European firms with at least two members in senior positions for our three measures of financial performance (net income, profit before taxes, and EBIT over total assets). Columns (1)–(3) focus on the sample of firms with at least two people on the senior management/corporate board team. In columns (4)–(9), we examine the effect for firms with at least 3 or 4 reported senior positions.

Across all measures and in all samples, higher share of women in the decision-making team is associated with better financial performance. The estimated coefficients of our gender diversity measures are positive and significant. The orders of magnitude are best seen in the lower part of the table, which shows the average ROAs in the sample, the average size of the senior team, and the average share of women in it (from which one can compute the expected boost to ROA if a woman were to replace a man in the senior team). The estimated boost to profitability is relatively small but highly statistically significant. Exchanging just one male

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[18] Introducing the concept of identity in a model of economic behavior, Akerlof and Kranton (2000) argue that the utility of a person joining a group (e.g. a firm) increases with the proportion of group members of the same social category. This would suggest that the benefits of gender diversity would rise with the share of women in the workforce.

[19] Prat (2002) and Jehn and others (1999) examine the role of sectoral characteristics, such as the complexity of tasks, in shaping optimal labor diversity.

member of the senior management team/board for a female member would be associated with 8–13 basis points higher ROA, or about a 3–8 percent increase in profitability. Alternatively, bringing gender balance in the senior team, without increasing its size, would be associated with 7-11 basis points higher ROA.

This pattern is surprisingly robust across firms with varying size of the board/senior management. The estimated coefficient on the share of women in senior positions is larger for companies with larger boards. However, the marginal effect of adding one more woman to the board remains roughly similar across the different samples.

B. Main findings: Uncovering channels

We now examine the potential channels underlying this positive correlation by exploring heterogeneity across sectors. As mentioned, if gender diversity in senior positions has a causal effect on firm financial performance, this effect should be stronger in (i) industries that employ significantly more women in the labor force; and (ii) industries with greater demand for high creativity and critical thinking.

Indeed, the role of women in senior positions in shaping corporate financial outcomes varies across different sectors. Table 3 estimates equation (1) for four broad economic sectors: services, manufacturing, trade, and construction. The positive association between the share of women and return on assets is significantly stronger for firms in the services sector (columns 1–3). In this sector, an additional woman in senior positions is associated with a 21 basis points increase in ROA (based on profits). In manufacturing, an additional woman in senior positions is associated with a 12 basis points increase in ROA, significantly less than in the services sector. Finally, in the trade and construction sectors, we find no statistically significant difference in the financial performance of firms based on the share of women in senior positions.

Table 4, columns (1)–(3), examine the hypothesis that gender diversity would raise firm performance to a greater extent in sectors where women are more prevalent in the labor force. By estimating equation (2), we find strong evidence in support of this hypothesis. The estimated coefficient on the interaction between female intensity in a sector and the share of women in senior positions is positive and highly statistically significant. For a firm operating in a sector with female intensity at the 75th percentile of the distribution (where women comprise about 52 percent of the workforce), the expected boost to ROA if a man were to be replaced by a woman in the senior team is estimated to be about 14-18 basis points. In a sector at the 25th percentile of the distribution of female intensity (where women comprise just under a quarter of the labor force), the boost to ROA would be only 0-4 basis points. These results are very similar to the findings of Flabbi and others (2014), who document a strong positive effect of the interaction between having a female CEO and the share of female workers *in the firm* on firm’s output per worker and TFP in a panel of manufacturing companies in Italy.

In Table 4, columns (4)–(6), we examine more rigorously the hypothesis that the technological characteristics of sectors would also shape the impact of gender diversity in senior positions. We estimate equation (2) with an indicator for high-tech and knowledge-intensive sectors. Indeed, there is strong evidence that representation of women in senior positions improves financial performance more so among firms in such sectors. An additional woman in a senior position is associated with a 34–40 higher ROA in a high-techmanufacturing sector or a knowledge-intensive services industry; while in the remaining sectors the boost to the ROA is only 0–4 basis points and not statistically distinguishable from zero.

In Table 5, we run a horse-race between the two competing hypotheses. That is, is it the prevalence of women in the labor force or the technological characteristics of the sector that best describes the main channel through which gender diversity in senior positions may impact firm performance? In equilibrium, it is difficult to distinguish empirically between the two hypotheses as sectors that benefit from gender diversity because of their technological characteristics already have a higher prevalence of women in the labor force (Garnero and Rycx, 2014). Table 5 shows that when both hypotheses are accounted for in the regression, the female intensity of the sector becomes statistically insignificant, suggesting that it may be the nature of technology rather than the gender composition of the workforce that matters. However, due to the challenges outlined above, this result should be interpreted as suggestive at most.

The positive association between firm performance and the share of women in senior positions raises the question: should women hold all senior positions in the corporate world? In Table 6, we examine this question by including the squared term of the share of women in senior positions to establish whether there are diminishing returns to the prevalence of women in senior positions. We find that this is indeed the case—the peak optimal share of women in senior position is about 60 percent. The square of the share of women in senior positions has a negative and statistically significant coefficient, both for the main result and when interacted with a sector's female intensity or, alternatively, its knowledge-intensity.

C. Robustness

Our findings are robust to various empirical modifications. Results are robust to the treatment of outliers, they are not driven by firms in a particular country, and they are robust to using alternative measures of firms' performance. Table 7 presents some of the robustness checks when considering the interaction with female intensity, while Table 8 presents these checks when focusing on the high-tech- / knowledge-intensity of sectors.

Outliers

In our baseline, we exclude the top and bottom five percent of values of firm performance variables to avoid distortions that might be introduced by extreme values. In Tables 7 and 8, we present several modifications to this approach. In column (2), we winsorize the top and bottom five percent of values. In column (3), we exclude the top and bottom two percent of values, and in column (4), we winsorize at the 2^{nd} and 98^{th} percentile of the distribution of ROA. Across all of these treatments of outliers, the estimated point estimate on the interaction between the share of women in senior positions and female intensity/knowledge intensity of sectors remains quite similar in magnitude and statistically significant.

Country sample

We examine whether the findings are driven by a particular country. We estimate equation (2) 34 times, each time dropping one country at time. In columns (5) and (6), we report the minimum and maximum coefficients we obtain on the interaction between the share of women in senior positions and the female-/knowledge-intensity of the sector. The estimated coefficients fall within a very narrow range.

Alternative time period

Greater representation of women may boost firm profitability but at the expense of greater volatility of profits (if, for example, women are less risk averse as managers than men). By focusing only on one year of financial data, we are unable to shed much light on this potential channel. However, as an exercise we examine whether we find a similar correlation between gender diversity in the senior team (measured in 2013) and firms' ROAs in 2012, 2011 and 2010 under the assumption that changes in management are infrequent enough in our large sample so as to minimize the measurement error that results from the mismatch in years. As illustrated in Tables 7 and 8, column 7, our main findings are very similar if 2012 financial data are used.[20]

Alternative measure of firm performance

So far the analysis has followed closely the corporate finance literature and focused on the financial performance of firms as the outcome of interest. However, while data availability is rather uneven across countries in the Orbis database, it is also possible to construct a measure of firms' labor productivity. To maximize the sample of firms, we build the ratio of the total output to the number of employees/total labor cost.[21] Using this alternative measure of firm performance, we again find a positive and statistically significant coefficient on the interaction between gender diversity in senior positions and the female-/knowledge-intensity of a sector (column 8 in Tables 7 and 8).

However, it is important to note that the point estimate of the main effect of gender diversity is negative.[22] While this may appear at odds with the findings on financial performance, it may simply reflect the different choices made by female managers. For example, using the introduction of gender quotas in Norway, Matsa and Miller (2013) find that firms affected by

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[20] Results with financial data from 2010 and 2011, available from the authors upon request, are qualitatively very similar.

[21] Ideally such a measure would be based on the value added rather than total output of firms to account for differential use of intermediate inputs. However, in a number of European countries, information on value added is not available. Moreover, firms in some countries are more likely to report number of workers, while in others, they are more likely to report the wage bill. We construct labor productivity using either the number of workers or the wage bill for all firms in a country, depending on variable coverage.

[22] Flabbi and others (2014) document a similar negative main effect of having a female CEO on firm labor productivity and TFP in Italian manufacturing firms.

the quota undertake fewer workforce reductions than comparison firms, increasing relative labor costs and employment levels. Similarly, during the Great Recession, Matsa and Miller (2014) discover that female-led private firms in the United States were significantly less likely to downsize their workforce. As such, our findings are consistent with the existing evidence associating female business leadership with increased labor hoarding. However, we also document that this management style does not come at the expense of lower profitability.

VII. Conclusion

This paper presents new evidence on the link between gender diversity in senior positions and firm performance in Europe. Using a sample of more than 2 million companies across 34 European countries in 2013, we find a strong positive association between the share of women in senior positions and firms' ROAs. Substituting one male for one female person in senior management or on the corporate board is associated with between 8 and 13 basis points higher ROAs.

Using a difference-in-difference strategy, we explore the potential channels underlying this positive correlation. In line with existing theoretical and empirical studies, we find a positive association between gender diversity in senior positions and financial performance in two types of sectors: (i) sectors that employ significantly more women in the labor force; and (ii) industries with greater demand for the higher creativity and critical thinking that diversity in general may bring, namely high-tech and knowledge intensive sectors. These findings are robust to various alternative specifications.

Our findings suggest that increased female representation in senior positions could play an important role in boosting Europe's potential output. To the extent that higher involvement by women in senior positions improves firm profitability, it may also help support corporate investment and productivity, mitigating the slowdown in potential growth. To that end, leveling the playing field through policies to facilitate women's full-time attachment to the labor force (see Christiansen and others, 2016) could help build the pipeline of women for senior corporate positions, with important macroeconomic implications.

Table 1. Prevalence of Women in Senior Positions

Country	All firms 1/				Firms with at least 2 members of board/senior management			
	Share of firms with at least one woman in senior positions	Share of senior positions held by women			Share of firms with at least one woman in senior positions	Share of senior positions held by women		
		Mean	StDev	N firms		Mean	StDev	N firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Austria	0.208	0.094	0.223	7,074	0.271	0.099	0.188	4,680
Belgium	0.409	0.253	0.349	314,593	0.641	0.314	0.273	149,825
Bosnia and Herze	0.157	0.138	0.334	2,287	0.252	0.116	0.218	309
Bulgaria	0.345	0.285	0.422	137,439	0.562	0.293	0.299	30,364
Croatia	0.338	0.267	0.406	56,468	0.593	0.300	0.287	13,760
Czech Republic	0.355	0.221	0.341	79,420	0.507	0.248	0.280	41,191
Denmark	0.217	0.119	0.267	145,237	0.413	0.158	0.215	55,836
Estonia	0.360	0.263	0.391	54,950	0.547	0.280	0.296	19,795
Finland	0.681	0.320	0.261	108,340	0.688	0.323	0.259	106,783
France	0.293	0.221	0.377	804,870	0.566	0.276	0.280	199,643
Germany	0.419	0.168	0.250	33,418	0.567	0.200	0.215	22,832
Greece	0.225	0.116	0.250	20,110	0.290	0.122	0.212	12,991
Hungary	0.402	0.322	0.426	222,593	0.668	0.355	0.294	57,332
Iceland	0.346	0.213	0.334	16,298	0.563	0.267	0.267	7,335
Ireland	0.729	0.316	0.272	10,997	0.731	0.316	0.270	10,945
Italy	0.352	0.232	0.365	702,149	0.502	0.230	0.272	308,033
Latvia	0.242	0.183	0.354	51,391	0.378	0.183	0.259	15,418
Lithuania	0.334	0.206	0.333	6,287	0.638	0.305	0.274	2,417
Luxembourg	0.358	0.160	0.262	2,151	0.460	0.177	0.228	1,501
Malta	0.302	0.127	0.236	348	0.326	0.117	0.195	291
Netherlands	0.299	0.115	0.228	20,127	0.421	0.132	0.191	12,803
Norway	0.373	0.159	0.235	194,233	0.422	0.172	0.225	166,234
Poland	0.239	0.195	0.372	55,548	0.491	0.240	0.277	9,660
Portugal	0.586	0.322	0.324	227,866	0.695	0.341	0.271	170,343
Romania	0.394	0.332	0.439	307,853	0.649	0.355	0.301	64,913
Serbia	0.304	0.227	0.380	31,526	0.575	0.276	0.280	8,067
Slovak Republic	0.333	0.231	0.362	74,775	0.506	0.261	0.285	31,362
Slovenia	0.388	0.230	0.327	10,632	0.610	0.298	0.266	5,401
Spain	0.345	0.227	0.359	533,954	0.509	0.242	0.278	235,582
Sweden	0.245	0.162	0.322	241,318	0.416	0.187	0.256	88,220
Switzerland	0.643	0.111	0.123	532	0.643	0.111	0.123	532
Turkey	0.183	0.089	0.221	10,186	0.283	0.109	0.194	5,534
Ukraine	0.553	0.425	0.425	58,430	0.919	0.544	0.247	19,998
United Kingdom	0.621	0.244	0.256	132,966	0.655	0.249	0.242	123,349
All 2/	0.370	0.215		4,676,366	0.528	0.241		2,003,279

Sources: Orbis and IMF Staff calculations. Senior positions include senior management and corporate board members.

1/ Summary statistics based on industrial firms with non-missing information on total assets, net income and gender of board members for 2013, excluding firms in the top and bottom 5 percent of return on assets.

2/ Simple average of the share of firms with at least one women in senior positions and share of senior positions held by women across countries.

Table 2. Share of Women in Senior Positions and Firm Financial Performance

Sample 1/	At least 2 people			At least 3 people			At least 4 people		
ROA based on	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Share of women	0.0041 ***	0.0044 ***	0.0028 ***	0.0082 ***	0.0089 ***	0.0061 ***	0.0116 ***	0.0133 ***	0.0103 ***
in senior positions	(0.0009)	(0.0011)	(0.0010)	(0.0010)	(0.0011)	(0.0012)	(0.0012)	(0.0014)	(0.0013)
Observations	2,003,279	2,000,422	1,992,658	928,133	927,227	925,399	494,870	494,794	493,866
Mean dep. variable	0.016	0.027	0.032	0.015	0.026	0.031	0.016	0.026	0.030
Mean share of women	0.26	0.26	0.26	0.23	0.23	0.24	0.23	0.23	0.23
Mean N senior positions	3.29	3.29	3.29	4.78	4.79	4.79	6.35	6.36	6.35
Increase in ROA (basis points)	12	13	8	17	19	13	19	20	16
Increase in ROA (percent)	7.9	5.0	2.6	11.3	7.2	4.1	12.2	7.9	5.3

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. Robust standard errors are clustered at the industry level.

1/ Sample includes all firms with at least two, three or four members in senior positions in columns (1)-(3), (4)-(6) and (7)-(9) respectively.

Table 3. Share of Women in Senior Positions and Firm Financial Performance: Sectoral Differences

Sample	Services			Manufacturing			Trade			Construction		
ROA based on	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(7)	(8)	(9)
Share of women	0.0070 ***	0.0074 ***	0.0062 ***	0.0044 ***	0.0044 ***	0.0036 ***	0.0016	0.0013	0.0010	0.0018	0.0023	-0.0020
in senior positions	(0.0017)	(0.0020)	(0.0018)	(0.0012)	(0.0014)	(0.0014)	(0.0010)	(0.0010)	(0.0011)	(0.0018)	(0.0020)	(0.0015)
Observations	777,462	775,053	771,695	265,520	265,537	264,561	420,615	420,415	418,360	444,105	443,690	442,817
Mean dep. variable (ROA)	0.020	0.033	0.034	0.016	0.028	0.037	0.010	0.021	0.029	0.014	0.024	0.030
Mean share of women	0.28	0.28	0.28	0.23	0.23	0.23	0.28	0.28	0.28	0.23	0.23	0.23
Mean N senior positions	3.50	3.51	3.50	3.56	3.56	3.56	2.97	2.97	2.97	2.97	2.97	2.97
Increase in ROA (basis points)	20	21	18	12	12	10	5	4	3	6	8	-7
Increase in ROA (percent)	9.9	6.4	5.2	7.5	4.4	2.7	5.4	2.2	1.2	4.3	3.3	-2.2

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. Robust standard errors are clustered at the industry level.

Table 4. Female Intensity and Knowledge Intensity

ROA based on	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT
	(1)	(2)	(3)	(4)	(5)	(6)
Share of women	-0.0026	-0.0028	-0.0052 ***	0.0013	0.0011	-0.00041
in senior positions	(0.0024)	(0.0026)	(0.0022)	(0.0009)	(0.0011)	(0.0009)
Share of women * Female intensity	0.0163 ***	0.0174 ***	0.0192 ***			
	(0.0057)	(0.0065)	(0.0055)			
Share of women *				0.0102 ***	0.0119 ***	0.0115 ***
High tech/knowledge intensity				(0.0019)	(0.0023)	(0.0021)
Observations	2,003,279	2,000,422	1,992,658	2,003,279	2,000,422	1,992,658

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. Robust standard errors are clustered at the industry level.

Table 5. Female Intensity and Knowledge Intensity: A Horse Race

ROA based on	Net income	Profit BT	EBIT
	(1)	(2)	(3)
Share of women in senior positions	-0.00048	-0.00024	-0.0028
	(0.0024)	(0.0026)	(0.0022)
Share of women * Female intensity	0.0049	0.0037	0.0064
	(0.0062)	(0.0068)	(0.0057)
Share of women * High tech/knowledge intensity	0.0094 ***	0.0113 ***	0.0105 ***
	(0.0021)	(0.0026)	(0.0023)
Observations	2,003,279	2,000,422	1,992,658

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. Robust standard errors are clustered at the industry level.

Table 6. Nonlinearities

	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT	Net income	Profit BT	EBIT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Share of Women in Senior Positions	0.0081 ***	0.0094 ***	0.0066 ***	-0.0038	-0.0048	-0.006	0.004 ***	0.0045 ***	0.0023
	(0.0019)	(0.0022)	(0.0022)	(0.0043)	(0.0049)	(0.0045)	(0.0017)	(0.0019)	(0.0019)
Share of Women in Senior Positions ^ 2	-0.0056 ***	-0.007 ***	-0.0054 ***	0.00092	0.0021	0.00036	-0.0039 **	-0.0048 ***	-0.0038 *
	(0.0018)	(0.0021)	(0.0021)	(0.0047)	(0.0055)	(0.0053)	(0.0017)	(0.0019)	(0.0020)
Share of Women * Female Intensity				0.0308 ***	0.0365 ***	0.0329 ***			
				(0.0106)	(0.0122)	(0.0110)			
Share of Women ^ 2* Female Intensity				-0.0183 *	-0.0244 **	-0.0171			
				(0.0106)	(0.0124)	(0.0118)			
Share of Women * Knowledge Intensity							0.0157 ***	0.0189 ***	0.0169 ***
							(0.0037)	(0.0044)	(0.0042)
Share of Women ^ 2* Knowledge Intensity							-0.0075 **	-0.0095 **	-0.0072 *
							(0.0038)	(0.0043)	(0.0042)
Observations	2,003,279	2,000,422	1,992,658	2,003,279	2,000,422	1,992,658	2,003,279	2,000,422	1,992,658

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. Robust standard errors are clustered at the industry level.

Table 7. Robustness: Role of Female Intensity

	Baseline	Winsorize at top and bottom 5th prcntl	Drop Top and Bottom 2nd prcntl	Winsorize at top and bottom 2nd prcntl	Country Selection: Min	Country Selection: Max	2012 Financial data	Labor productivity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of women	-0.0026	-0.0025	-0.0026	-0.0030	-0.0004	-0.0035	-0.0045	-0.1713 ***
in senior positions	(0.0024)	(0.0033)	(0.0024)	(0.0042)	(0.0024)	(0.0023)	(0.0023)	(0.0234)
Share of women * Female Intensity	0.0163 ***	0.0261 ***	0.0163 ***	0.0371 ***	0.0130 **	0.0198 ***	0.0180 ***	0.1979 ***
	(0.0057)	(0.0086)	(0.0057)	(0.0120)	(0.0060)	(0.0057)	(0.0054)	(0.0561)
Observations	2,003,279	2,110,620	2,002,970	2,110,620	1,803,636	1,767,697	1,893,589	1,279,949

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. ROA based on net income. Robust standard errors are clustered at the industry level.

Table 8. Robustness: Role of Knowledge Intensity

	Baseline	Winsorize at top and bottom 5th prcntl	Drop Top and Bottom 2nd prcntl	Winsorize at top and bottom 2nd prcntl	Country Selection: Min	Country Selection: Max	2012 Financial data	Labor productivity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of women	0.0013	0.0027 **	0.0012	0.0040 **	0.0023 ***	0.0014	0.0002	-0.1089 ***
in senior positions	(0.0009)	(0.0014)	(0.0014)	(0.0020)	(0.0009)	(0.0010)	(0.0009)	(0.0122)
Share of women * Knowledge Intensity	0.0102 ***	0.0202 ***	0.0196 ***	0.0297 ***	0.0093 ***	0.0115 ***	0.0097 ***	0.0695 ***
	(0.0019)	(0.0032)	(0.0029)	(0.0047)	(0.0018)	(0.0020)	(0.0018)	(0.0238)
Observations	2,003,279	2,110,620	2,078,719	2,110,620	1,832,936	1,767,697	1,893,589	1,279,949

Note: All regressions include country-industry fixed effects, indicators for firm size, firm age, and control for the log of firm's fixed assets and number of senior positions. Robust standard errors are clustered at the industry level.

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Table A1. Overview of the Literature on the Impact of Women on Boards

Paper	*Scope*	*Period*	*Number of firms*	*Listing status*	*Method*	*Dependent variables*	*Explanatory variables*	*Impact*	*Finding*
Adams and Ferreira (2009)	U.S.	1996–2003	1,939	Public	Panel regressions & GMM estimation	Attendance problem; Tobin's Q; ROA; compensation	Dummy for at least one female manager; fraction of female directors	Negative	Whereas female directors have a significant impact on board inputs and firm outcomes, the average effect of gender diversity on firm performance is negative.
Ahern and Dittmar (2012)	Norway	2001–2009	248	Public	Event study; panel IV regressions	Cumulative abnormal returns; Tobin's Q; leverage; asset turnover	Dummy for at least one female director; percentage of female board members	Negative	The law quota announcement caused a significant drop in the stock price, less experienced boards, increase in leverage and acquisitions, and a deterioration in firm performance.
Matsa and Miller (2009)	Norway & other Nordic countries	2006 and 2009	1,620	Public/ private	Cross-section; difference-in-difference regressions	Operating ROA; employment; labor costs; large decrease in employment	Firms affected by the quato matched with non-affected firms	Negative	Firms affected by the quota in Norway undertook fewer workforce reductions than other firms, increasing their relative costs and lowering profitability, especially for firms without female board members beforehand. Other corporate decisions were unchanged.
Du Reitz and Henrekson (2000)	Sweden	1995	4,200	Private	Logistic regression of survey results	Sales, profitability; employment; orders	Gender	Insignificant	Systematic differences between female- and male-headed firms, but no evidence of female underperformance, especially at firms with only one employee.
Lam and others (2013)	China	2000–2008	1,574	Public	Panel regressions	Woman CEO; ROA; ROE	Female CEO in profitability regressions	Limited evident of a link	Female CEOs are more likely to emerge in firms where at least one female director is present but their copmensation has less favourable terms compared to male CEOs.
Smith and others (2005)	Denmark	1993–2001	2,500	Public/ private	Panel regressions	Net turnover; net assets	Proportion of female CEO & other top executives	Varies from none to positive	Gender diversity in top management positively affects firm performance.
Campbell and Vera (2010)	Spain	1989–2001	4,050	Public	Event study & GMM estimation	Cumulative abnormal returns; Tobin's Q	Dummy for presence of women on boards and share of women on boards	Positive	Positive stock market reaction to appointment of female director and also over the long run.
Castiglione, Infante, and Smirnova (2014)	Italy	2004 and 2001	58,410	Public/ private	OLS and 2SLS	Labor productivity	Dummy for at least one female manager; number of female managers	Positive	The presence of female managers increases productivity differential due to geographical localization. Also, management-diverse firms are more productive than female- or male-only managed firms.
Dezso and Ross (2012)	U.S.	1992–2006	1,500	Public	Panel regressions	Tobin's Q	Dummy if any of the managers is female	Positive	Gender diversity in top management brings in informational and performance benefits to the extent that the firm's strategy is focused on innovation.
Farrell and Hersch (2005)	U.S	1990–1999	1,000	Public	Poisson model	Number of female directors added	ROA	Positive	Female additions on boards are not a result of better qualified female labor but a gender call, and they do not generate significant market reaction.
Huang and Kisgen (2013)	U.S.	1993–2005	1,866	Public	Difference-in-difference; 2SLS	Acquisition; asset growth; financing; cumulative abnormal announcement return	Dummy for executive male-to-female transition firm; Dummy for female CEO	Positive	Male executives exhibit overconfidence in decision making relative to female executives: they undertake more acquisitions and issue more debt, but their decisions yield lower announcement returns.
Kang, Ding, and Charoenwong (2010)	Singapore	1994–2004	45	Public	Event study	Cumulative abnormal returns	Proportion of independent women directors; separate CEO and chair	Positive	Investors are most receptive to announcement of female appointment when the new director is independent and least receptive when the director assumes the role of CEO.
Khan and Vieito (2013)	U.S.	1992–2004	1,043	Public	2SLS	Compensation, ROA, volatility	Dummy for female CEO	Positive	Firms managed by a female CEO associate with better performance compared to male CEO firms; equity compensation packages can act as an incentive for female CEOs to take risks.

Table A2. Sectoral Female Intensity

NACE Rev. 2	Sector	Share of women in employment
A	Agriculture, forestry, and fishing	0.25
B	Mining and quarrying	0.17
C	Manufacturing	0.33
D	Electricity, gas, steam, and air conditioning supply	0.24
E	Water supply; sewerage, waste management, and remediation activities	0.24
F	Construction	0.09
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	0.46
H	Transportation and storage	0.22
I	Accommodation and food service activities	0.56
J	Information and communication	0.52
K	Financial and insurance activities	0.52
L	Real estate activities	0.41
M	Professional, scientific, and technical activities	0.52
N	Administrative and support service activities	0.56
O	Public administration and defense; compulsory social security	0.43
P	Education	0.70
Q	Human health and social work activities	0.64
R	Arts, entertainment, and recreation	0.70
S	Other service activities	0.38
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.92
U	Activities of extraterritorial organizations and bodies	0.41

Source: OECD Annual Labor Force Statistics and IMF staff calculaitons. Employment data are reported by the OECD at the ISIC Rev. 3 and are converted to the NACE Rev. 2 industrial code level. Female intensity for the individual industries within the manufacturing sector is from Do and others (2016).

Table A3. High-Tech and Knowledge-Intensive Sectors (NACE Rev. 2)

Manufacturing

High-technology:

Manufacture of basic pharmaceutical products and pharmaceutical preparations (21)
Manufacture of computer, electronic and optical products (26)
Manufacture of air and spacecraft and related machinery (30.3)

Medium-high-technology:

Manufacture of chemicals and chemical products (20)
Manufacture of weapons and ammunition (25.4)
Manufacture of electrical equipment (27)
Manufacture of machineryand equipment n.e.c. (28)
Manufacture of motor vehicles, trailers and semi-trailers (29)
Manufacture of other transport equipment (30) excluding Building of ships and boats (30.1) and excluding Manufacture of air and spacecraft and related machinery (30.3)
Manufacture of medical and dental instruments and supplies (32.5)

Services

High-tech knowledge-intensive services:

Motion picture, video and television programme production, sound recording and music publishing activities (59)
Programming and broadcasting activities (60)
Telecommunications (61)
Computer programming, consultancy and related activities (62)
Information service activities (63)
Scientific research and development (72)

Knowledge-intensive market services (excluding financial intermediation and high-tech services):

Water transport (50)
Air transport (51)
Legal and accounting activities (69)
Activities of head offices; management consultancy activities (70)
Architectural and engineering activities; technical testing and analysis (71)
Advertising and market research (73)
Other professional, scientific and technical activities (74)
Employment activities (78)
Security and investigation activities (80)

Knowledge-intensive financial services:

Financial service activities, except insurance and pension funding (64)
Insurance, reinsurance and pension funding, except compulsory social security (65)
Activities auxiliary to financial services and insurance activities (66)

Other knowledge-intensive services:

Publishing activities (58)
Veterinary activities (75)
Public administration and defence; compulsory social security (84)
Education (85)
Human health activities (86)
Residential care activities (87)
Social work activities without accommodation (88)
Creative, arts and entertainment activities (90)
Libraries, archives, museums and other cultural activities (91)
Gambling and betting activities (92)
Sports activities and amusement and recreation activities (93)

Source: Eurostat, European Commission websites:
http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries
http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge-intensive_services_(KIS).