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Board Gender Diversity, Corporate Innovation, and Firm Value: International Evidence

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Abstract

We examine how board gender diversity varies across countries and across firms, and whether and how such variation matters. In particular, we examine whether and how board gender diversity relates to corporate innovation novelty and efficiency, and through these channels to firm value. Using a novel database that combines international firm-level patenting output measures with board characteristics across 45 countries and 11,678 firms for 2001-2014, we examine both within- and cross-country determinants of board gender diversity and its relation to corporate innovation, and ultimately to firm value. We find that corporate boards are more likely to include women when firms are large and in those countries with a narrower gender gap, those with formal regulations promoting gender equity, and those lower in the cultural dimension of masculinity. We then find that firms with more gender diverse boards are associated with greater patenting output, more novel patents, greater innovative efficiency, and consequently with higher firm value. Overall, the results are consistent with the view that more gender diverse boards help create firm value via increasing innovation output and efficiency.

Keywords: board gender diversity; firm value; corporate innovation; patent novelty; innovative efficiency; risk of innovation; national culture; regulations
JEL Classification: G18; G31; G32

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Abstract

We examine how board gender diversity varies across countries and across firms, and whether and how such variation matters. In particular, we examine whether and how board gender diversity relates to corporate innovation novelty and efficiency, and through these channels to firm value. Using a novel database that combines international firm-level patenting output measures with board characteristics across 45 countries and 11,678 firms for 2001-2014, we examine both within- and cross-country determinants of board gender diversity and its relation to corporate innovation, and ultimately to firm value. We find that corporate boards are more likely to include women when firms are large and in those countries with a narrower gender gap, those with formal regulations promoting gender equity, and those lower in the cultural dimension of masculinity. We then find that firms with more gender diverse boards are associated with greater patenting output, more novel patents, greater innovative efficiency, and consequently with higher firm value. Overall, the results are consistent with the view that more gender diverse boards help create firm value via increasing innovation output and efficiency.

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1. Introduction

In recent years there is an intense interest among regulators, policy makers, and media on the role of board gender diversity in creating shareholder value. This debate has led to at least one national government to institute a mandatory quota (i.e., at least 40% of the Norwegian corporate boards to be women, Ahern and Dittmar, 2012), and a number of governments to promote voluntary quotas (Spain in 2007, the Netherlands in 2009, France in 2010, and Iceland in 2010, Masta and Miller, 2013). The adoption and/or promotion of such quotas rests on two fundamental propositions: 1) board gender diversity promotes public policy objectives such as increasing female labor market participation and female leadership, and 2) board gender diversity creates firm value. In this paper, we test the more controversial second proposition, which we call the value creation hypothesis, using a novel database that combines international firm-level patenting measures with board characteristics across 45 countries and 11,678 firms for 2001-2014, and explore specific channels through which board gender diversity may affect firm value.

Our theoretical framework builds on the established positive link between organizational diversity and creativity as well as on a number of established gender differences in decision making that have implications for corporate innovation practices. These include gender differences in over-confidence, risk-taking, long-term orientation, and personal values (Beyer, 1990; Croson and Gneezy, 2009; Silverman, 2003). We propose that more gender diverse boards will be associated with higher firm value because they promote lower risk and lower cost innovation as well as more novel innovation.

Unlike corporate investment in physical assets such as property, plant, and equipment, investment in innovation as measured by R&D expenditures is highly risky, characterized by a

prolonged period of resource commitment and a high degree of uncertainty. Patents, a common marker for corporate innovation output, take a number of years to develop, and there is no guarantee that approved patents turn out to be novel and impactful. However, patents are a key factor in determining firm competitiveness, comparative advantages, and long-term productivity growth, and hence firm value (see, for example, Pakes, 1985; Griliches, 1990; Austin, 1993; Hall, Jaffe, and Trajtenberg, 2005; Nicholas, 2008; Kogan, Papanikolaou, Seru, and Stoffman, 2015). Modern corporations are faced with the constant challenge of mitigating the inherent risk in corporate innovation without sacrificing its long-term value, which comes from its novelty and impact. In particular, excessive risk-taking, competitiveness, and over-confidence on the management side might lead to choices of risky innovation projects with negative net present values (because of either the low probability of success or the high cost, see, for example, Heaton, 2002; Baker and Wurgler, 2011). On the other hand, management's excessive focus on short-term profits can lead to refusal to take on innovation projects with only long-term payoffs (Graham, Harvey, and Rajgopal, 2005; Krehmeyer and Orsagh, 2006). Given the evidence of gender differences in decision making, we propose that female directors on corporate boards might help mitigate both excessive risk-taking and excessive short-term focus in corporate innovation practices, resulting in lower risk, lower cost, and higher impact innovation output.

We test the value creation hypothesis in an international setting using data from 45 countries which provides more power for hypothesis testing and also provides information on the cultural and institutional contexts in which the value creation hypothesis holds. Because of the international setting, our data structure is multilevel with firms nested within countries. From a modeling perspective, it is important to distinguish the effects that take place at the country level

from those that take place at the individual firm level, both to understand the role of country- versus firm-level determinants, and to appropriately model their interactions.

Before testing the value creation hypothesis, we first present large-sample evidence on the prevalence of women on corporate boards around the world and examine within- and cross-country determinants of board gender diversity. Consistent with Adams and Kirchmaier (2015), we find that across 45 countries in our sample, the fraction of female directors on corporate boards is 8%, much lower than the rate of female labor force participation of 56%. We further show that corporate boards are more likely to include women when firms are large (consistent with Farrell and Hersch (2005), and Adams and Ferreira (2009)), and in those countries lower in the cultural dimension of masculinity, those with formal regulations promoting gender equity (Adams and Kirchmaier, 2015), and those with a narrower gender gap.

We next explore the innovation channel through which value creation may operate. We show that the proportion of female directors on a corporate board is associated with greater patenting output as measured by the citation-weighted number of patents. Furthermore, the average proportion of female directors in a country is positively associated with average measures of patent quantity in that country. The positive association between board gender diversity and innovation quantity is stronger in countries with greater female labor market participation. We further show that the proportion of female directors on a corporate board is associated with greater innovative efficiency as measured by the citation-weighted number of patents normalized by R&D capital. Furthermore, the average proportion of female directors in a country is positively associated with the average innovative efficiency measure in that country. We also show that the proportion of female directors on a corporate board is associated with more novel patents as captured by the scope of cited patents.

Consistent with the notion that board gender diversity promotes lower risk and lower cost innovation, we show that the proportion of female directors on a corporate board is associated with lower stock return volatility. We further show that the proportion of female directors on a corporate board is associated with lower R&D expenditures. The negative associations between board gender diversity and stock return volatility and between board gender diversity and R&D expenditures are strengthened in more masculine countries.

Finally, we show that across all 45 countries, the proportion of female directors on a corporate board is associated with higher firm value and higher ROA. We further show that the positive association between board gender diversity and Tobin's Q is strengthened in more masculine countries, and in countries with greater female labor market participation.

Overall, the results are consistent with the value creation hypothesis and the proposed innovation channel through which board gender diversity adds firm value.

To address endogeneity concerns related to board gender diversity, we employ an instrumental variables (IV) approach. We follow Adams and Ferreira (2009) to use the fraction of male directors on the board who sit on other boards on which there are female directors. One major impediment to female representation on corporate boards is a lack of business network connections and hence a lack of visibility. The IV captures the degree to which male directors are connected to female directors and therefore appreciate the role of female directors on a corporate board. The positive associations between board gender diversity and innovation and firm value are maintained using the IV approach.

We conduct a large number of robustness checks. First, employing alternative measures of patenting output including the number of patents and the number of citations, we show that the positive association between board gender diversity and patenting output remains. Second, to

examine any possible non-linear effect of the number of women on a board, we introduce indicator variables representing one (versus zero), two (versus one), and three or more (versus two) women on a board and find that in most cases, having one woman on a board (compared to none) or having two women (compared to one) has a significant effect, while the effect of a third woman director is rarely significant. Third, to address the concern that patents might not be a relevant measure for corporate innovation output in some industries, we repeat our analysis across the Fama-French 12 industries and show that the positive relation between board gender diversity and patent output largely concentrate in six out of twelve industries. Finally, another legitimate concern is whether our results depend on the inclusion of countries with a large number of firms in our sample. When we exclude firms from the U.S. that comprise about 40% of our sample observations, we find that our main results remain unchanged.

Our paper makes the following important contributions to the literature. First, we propose and test a specific channel through which board gender diversity affects firm value. In particular, we develop a framework focusing on how board gender diversity lowers the risk of innovation to create a positive association between board gender diversity and firm value.

Second, we use a much larger set of countries (and firms) which provides more power for testing the value creation hypothesis and greater scope for investigating between-country variations in the relation between board gender diversity and innovation practices, and firm value. This is important given the great heterogeneity in the results of studies conducted in different single country samples (see our literature review later).

Finally, we employ a Hierarchical Linear Model framework that distinguishes between across- and within-country effects, and allows for cross-level interactions that provide insights

into how and why the relation between board gender diversity and innovation practices, and firm value varies across countries.

2. Literature review and hypothesis development

2.1. Literature review

Prior literature examining the value creation hypothesis can be grouped into three strands. The first is to conduct event studies relating firm price reaction and performance to the adoption of mandatory quotas. The second strand employs panel data from a single country, relating differences in board gender diversity to differences in firm performance. The third strand conducts cross-country comparisons relating board gender diversity to firm performance.

The first strand mainly relies on the evidence from Norway when it first introduced the 40% female director quota in 2006. Ahern and Dittmar (2012) find that there is a significantly negative price reaction of Norwegian firms to the initial announcement of the boardroom gender quota, followed by declining Tobin's Q in subsequent years. They attribute the worsening performance to newly appointed female directors being younger and less experienced than their departed male counterparts as well as to increases in leverage and acquisitions. Using the same Norwegian natural experiment, Matsa and Miller (2013) find decreased profitability due to the boardroom gender quota and attribute it to increased labor costs. Using a more fine-grained analysis of events leading up to the implementation of the quota as well as a longer post-implementation period, Eckbo et al. (2016) find that there is no value effect from the boardroom gender quota, and that there is no significant change in age and experience between newly appointed female directors and departed male counterparts. Thus results based on single-country studies are mixed, and provide no support for the value creation hypothesis.

In the second strand of the literature, using U.S. data from 1993-2003, Adams and Ferreira (2009) find that the presence of female directors is associated with better director attendance records, stronger CEO turnover-performance sensitivity, more equity-based pay for directors, and within poorly-governed firms, with better firm performance. However, for firms with strong governance, the relation is negative. Campbell and Minguez-Vera (2008) study companies in Spain and find that the percentage of women on boards is positively related to firm value. Using U.S. data again, Carter et al. (2010) find the number of women on the board positively relates to return on assets, but negatively relates to firm value. Haslam et al. (2010) examine large U.K. (FTSE 100) companies and find that the presence of women on boards is not significantly associated with return on assets, but negatively associated with firm market value. Using Chinese data from 1999-2011, Liu, Wei, and Xie (2014) find a significant and positive relation between board gender diversity and firm performance. Moreover, boards with three or more female directors have a stronger impact on firm performance than boards with two or fewer female directors. Thus results based on single-country panel data are mixed, and provide little consistent support for the value creation hypothesis.

In the third strand of the literature, using international data from 19 countries, Adams and Kirchmaier (2015) find a positive association between board gender diversity and firm performance only in countries with high female labor market participation.

Taken together, the evidence on the relation between board gender diversity and firm value is mixed. Given the importance of the topic to both corporate and policy decision making, we examine the value creation hypothesis by developing a theoretical framework focusing on the role of board gender diversity in corporate innovation to predict a positive association between board gender diversity and firm value.

2.2. Conceptual framework

Modern corporations are characterized by the separation of ownership and control. The board of directors is tasked to advise and monitor management on behalf of shareholders. Despite the best effort and intention of expert and experienced board directors, large sample evidence suggests that most mergers and acquisitions are not creating shareholder value (Bouwman, Fuller, and Nain, 2009; Andrade, Mitchell, and Stafford, 2011; Harford, Humphery-Jenner, and Powell, 2012), most corporate investments are distorted by CEO overconfidence (Heaton, 2002; Malmendier and Tate, 2005), and new product development projects are rife with optimistic biases in cost and sales forecasts (Statman and Tyebjee, 1985). This suggests that expertise and experience together are not sufficient for effective advising and monitoring. A number of consulting companies, policy think tanks, and security market regulators have noted that corporate boards tend to lack diversity (European Commission, 2012; Hunt, Layton, and Prince, 2014; White, 2014, 2015) and have suggested that this homogeneity is limiting the effectiveness of board advising and monitoring functions, whereas more diverse boards with different knowledge and perspectives are more likely to question management's decisions and to stimulate novel solutions. Board diversity could come from director gender, age, ethnicity, nationality, education, and professional background (Bernile, Bhagwat, and Yonker, 2016; Giannetti and Zhao, 2016). In this paper, we focus on one commonly-debated dimension of board diversity—the presence of female directors and examine its influence on corporate innovation and firm value.

2.3. Hypothesis development

Theory and evidence from management research suggest that more diverse teams, including more gender diverse teams, at both the top management and research and development levels are more creative than more homogenous teams (Horwitz and Horwitz, 2007; Dezso and Ross, 2012). Management theory argues that more diverse boards should affect corporate innovation practices in three ways. First, members of more diverse boards are more likely to challenge tradition and question status quo. Second, members of more diverse boards bring different knowledge and perspectives to boardroom deliberation of corporate strategies. Third, members of more diverse boards being in the presence of others with different backgrounds, are inspired to explore more radical or disruptive innovation (Díaz-García et al., 2013). The above discussions lead to our first hypothesis:

H1: More gender diverse boards are associated with greater corporate innovation output as measured by more patents and more novel patents as measured by the scope of cited patents.

Research in psychology and economics, largely based on laboratory evidence, has consistently found that women are less over-confident than men whether over-confidence is measured as excessive precision of beliefs or as over-estimation of the likelihood of success (Croson and Gneezy, 2009). This is consistent with field studies in finance including investment decisions by day traders (Barber and Odean, 2001), corporate financial and investment policies by executives (Huang and Kisgen, 2013), and M&A decisions by corporate boards (Levi, Li, and Zhang, 2014). Laboratory evidence also indicates that women are on average more risk averse than men (Croson and Gneezy, 2009); however, survey evidence indicates that this difference might not hold for female directors (in the country of Sweden, Adams and Funk, 2012).[1] More

[1] Further evidence supporting selection effects on gender differences include Sapienza, Zingales, and Maestripieri (2009), and Graham, Harvey, and Puri (2013). Adams (2016) argues that generalizing gender differences found in the general population to corporate executives and directors may lead to stereotyping of women in management.

direct evidence from actual corporate decisions shows greater risk aversion by female leaders in banking (Palvia, Vahamaa, and Vahamaa, 2015), and less corporate risk-taking by female CEOs as measured by leverage, volatility of earnings, and the likelihood of survival (Faccio, Marchica, and Mura, 2016).

Surveys in both psychology and economics (Schwartz and Rubel, 2005; Adams and Funk, 2012) indicate that women tend to be lower on personal values related to success and achievement (e.g., power, stimulation, and self-direction) and higher on personal values related to community (e.g., benevolence and universalism). Similarly, experimental and survey evidence in psychology indicates that women are more patient and less impulsive than men when trading off present versus future values (Silverman, 2003; McLeish and Oxoby, 2007). Although these personal value differences have not been applied to predict corporate decision-making, they imply that female directors might avoid the excessive risk-taking that comes from an over-emphasis on success while still pursuing innovative projects for their long-term benefits.

Taken together, these gender differences imply that female directors might require a higher expected payoff and a higher likelihood of success to approve investment projects, leading to less risky, less costly, and more efficient innovation. The above discussions lead to our second hypothesis:

H2: More gender diverse boards are associated with lower stock return volatility, lower R&D expenditures, and higher innovative efficiency measured by more patents per R&D dollar.

Taken together, these effects of board gender diversity imply that boards with more female directors will be associated with higher firm value—the value creation hypothesis—because such boards promote low risk, low cost as well as highly novel innovation. The above discussions lead to our third hypothesis:

H4: More gender diverse boards are associated with higher firm value as measured by ROA and Tobin's Q.

On the one hand, as we discussed earlier, women should have greater freedom in choosing a career and have their voices heard in less masculine countries. This perspective leads to the prediction that the role of board gender diversity in innovation practices and firm value is stronger in less masculine countries. On the other hand, women board members are more distinctive in more masculine countries because gender roles diverge more in such countries (Hofstede, 2000). This perspective leads to the prediction that the role of board gender diversity in innovation practices and firm value is stronger in more masculine countries. Similarly, female directors may have more influence in countries with lower female labor market participation because female directors are more distinctive meaning that they have a greater impact. Alternatively, female directors may have more influence in countries with greater female labor market participation both because the pool for quality female directors is deeper and because female directors are no longer seen as token representatives meaning that they have a greater voice. The above discussions lead to our final hypothesis:

H5: The relations between board gender diversity and innovation policy and firm risk and value will depend on the level of masculinity and the level of female labor market participation.

3. Empirical framework, sample formation, and key variables

3*.1. A hierarchical linear model*

Our data structure is multilevel. At the country level, we have firms from 45 countries. At the firm level, we have more than 11,000 firms for up to 14 years.

To separate the within-country and across-country effects of firm-level variables such as board gender diversity on firm value, we employ the following hierarchical linear model specification (HLM; see Greene, 2011, Chapter 15.8):

$$y_{i,j,t+1} = \alpha_j + \mathbf{x}'_{i,j,t}\,\beta + u_{i,j,t}, \qquad (1a)$$

$$\alpha_j = \mathbf{w}'_j\gamma + \upsilon_j, \qquad (1b)$$

where $y_{i,j,t}$ is an outcome variable such as firm-level valuation ratio for firm *i* from country *j* in year *t*. $\mathbf{x}_{i,j,t}$ is a vector of firm-level characteristics including the fraction of female directors on a board, board size, board independence, firm size, firm age, and asset tangibility. α_j is a country-level intercept term. To capture the pure firm-level (within-country) relation between $\mathbf{x}_{i,j,t}$ and the outcome variable $y_{i,j,t}$ in β of Equation (1a), we remove the country means from all firm-level observations in $\mathbf{x}_{i,j,t}$.[2] $\mathbf{w}_j$ is a vector of country-level characteristics including national culture. To capture the pure country-level relation between $\mathbf{w}_j$ and the country-level intercept term α_j in γ of Equation (1b), we include in $\mathbf{w}_j$ both country-level variables such as national culture and measures of formal institutions and country-means of firm-level characteristics (as in $\mathbf{x}_{i,j,t}$). We estimate the HLM in Equation (1) using the iterative maximum likelihood fitting procedure available in Stata (using the procedure "mixed").

There are two advantages to using the HLM approach in our setting. First, by decomposing firm-level variables in $\mathbf{x}_{i,j,t}$ into country means and firm-level deviations and by adding the country means to the set of country-level predictors in $\mathbf{w}_j$, we are able to completely separate the within-country and across-country effects (Raudenbush and Bryk, 2002; Li, Griffin, Yue, and Zhao, 2011, 2013). This decomposition allows us to explore the potentially different associations

[2] Note that removing the country means from all firm-level observations in $\mathbf{x}_{i,j,t}$ is equivalent to including country fixed effects in the within-country model of Equation (1a).

between firm-level characteristics such as the fraction of female directors on a board and firm value both within countries and across countries.

Second, the HLM framework corrects for the distortion introduced by varying sample sizes across countries[3] and for the distortion in standard errors due to within-country clustering (the latter is similar to a country random-effects model where the standard errors are adjusted to reflect the cross-correlation between firms due to common country components).

3.2. Sample formation

Our analysis employs data from a number of international databases. To obtain data on gender diversity on corporate boards around the world, we rely on BoardEx, a proprietary database that covers more than 20,000 companies in 101 countries with detailed director information including director gender. To obtain data on firms' R&D expenditures and other financial characteristics, we rely on the Osiris database provided by Bureau van Dijk. To obtain data on corporate innovation, we use the patent and citation data from the US Patent and Trademark Office (USPTO) which covers patents filed in the US by firms from 93 different countries, which has been used by Bena et al. (2015) and Hsu, Tian, and Xu (2014) to study corporate innovation around the world. For country-level variables, we employ Hofstede's cultural dimension of masculinity from his website (Hofstede, 2001), data from Deloitte, Catalyst, and Adams and Kirchmaier (2015) for national policy initiatives regarding board gender diversity, data from the World Bank for female labor market participation, data from the World Economic Forum for its Gender Gap Index on gender equality, data from the World Bank's World Development Indicators Database for economic and financial development

[3] Unlike OLS, where each firm-level observation receives equal weight, HLM simultaneously models regressions at both the country level and the firm level, with the country-level regression weighted by the precision of the firm-level data.

measures, and data from La Porta et al. (1997) for formal institutions such as rule of law. By merging the above databases, we obtain a large international panel of firm-level measures of board gender diversity, corporate innovation, firm value, and other firm-level controls. To our knowledge, this is one of the largest datasets ever compiled for the study of board of directors at the international level. Our final sample is comprised of 11,678 firms with 77,873 firm-year observations from 45 countries over the period 2001-2014. Table IA1 in the Internet Appendix summarizes our sample coverage across countries and over time.[4]

To gain some understanding of the characteristics of firms in our sample, we compare our sample to the Osiris universe of public firms. Table IA2 presents this comparison. Our sample firms are fairly representative of the Osiris universe of public firms.

3.3. Key variables

Measures of patenting output and risk-taking

To capture the quantity of innovation output, we use the citation-weighted number of patents applied for by a firm over a three-year window. To capture the efficiency of corporate innovation, we use the citation-weighted number of patents normalized by R&D capital, i.e., the amount of innovation output per dollar of R&D capital. To capture the novelty of innovation, we use scope which captures the degree to which a firm acquires new knowledge outside of its current expertise, i.e., new citations beyond those citations made by the firm's patents over the past five years.

To capture the extent of corporate risk-taking, we employ two measures. Stock volatility is the standard deviation of monthly returns over a twelve-month period. Our second measure is

[4] The number of firm-year observations included by country varies from 5 for the Czech Republic and Malta on the low end to 38,288 for the U.S. and 13,065 for the U.K. on the high end. The sample coverage is increasing over time.

R&D normalized by total assets, which is commonly employed as a measure of risky corporate policies (Bhagat and Welch (1995), Coles et al. (2006), and Bargeron et al. (2010)). R&D investments are risky because they have a low probability of success and their benefits are distant and uncertain. In brief, our first measure of risk-taking captures the overall risk taken by the firm, and our second measure captures risk-taking in long-term corporate investment.

National culture dimensions

The national culture measure that we use in our analyses is Hofstede's (1980, 2001) masculinity dimension. This measure was constructed from answers to a large survey of 117,000 IBM employees across their worldwide subsidiaries in 70 countries between 1967 and 1973. Note that the specific items used to construct this measure is distinct from the context of corporate decision making that we examine in this paper (see Appendix I for a detailed discussion). For example, one of the most heavily weighted items (negatively) in the masculinity index is rating the importance of "Work with people who cooperate well with one another." This item, like others in the index, represents a guideline for appropriate behavior and does not directly translate into corporate decision making.[5] Countries high in masculinity emphasize conformity to traditional gender roles, thus in these countries, women should be less likely to choose non-traditional career roles.

Regulatory and societal support for gender equity

To characterize the level of national policy initiatives regarding boardroom gender diversity in each country, we use three measures (see Appendix II for detailed variable definitions and data sources). Regulation quota captures whether a country's main stock

[5] We note that Hofstede's cultural dimensions were derived from a sample of IBM employees in the 1960s and 1970s, well before the beginning of our sample period and thus reducing endogeneity concerns. Nonetheless, any changes in cultural values that have occurred over the past 40 years would weaken our conjectured linkages between the measures of national culture and corporate decision making.

exchange or securities laws stipulate minimum quota for either the percentage or number of female directors on board. Regulation code captures whether a country's governance code mentions that gender must be considered in director nominations. Regulation disclosure captures whether a country's main stock exchange or securities laws stipulate that board diversity should be disclosed.

To characterize the level of a country's informal support for gender equity in the labor force, we use two measures. Gender Gap Index (GGI) is an annual index published by the World Economic Forum measuring the extent to which women are disadvantaged compared with men in economic participation and opportunity, educational attainment, political empowerment, and health and survival. A higher value of this measures means a larger gender gap between women and men. Female labor market participation, from the World Bank, captures the percentage of female population aged 15 and above that participate in the labor force.

4. Main results

Descriptive statistics

Table 1, Panel A presents country-level descriptive statistics for the explanatory variables. We note that the average proportion of female directors on a board is highest in Norway, and lowest in Malta. The country with the highest score in masculinity is Japan (0.95), and the country with the lowest score is Sweden (0.05). The highest GGI is found in Morocco (0.42), and the lowest GGI is found in Finland (0.18). Turkey and Morocco have the lowest female labor market participation (0.27), and Peru has the highest (0.67).

Panel B presets country-level correlations for the explanatory variables. We first show that the proportion of female directors on a board is negatively correlated with masculinity and GGI,

and positively correlated with all three measures of policy initiatives regarding board gender diversity, female labor market participation, and GDP per capita. Masculinity is negatively correlated with all three measures of policy initiatives regarding board gender diversity and female labor market participation, and positively correlated with GGI.

Table 2, Panel A provides summary statistics for the firm-level variables. Table 2, Panel B presents Pearson correlations among the firm-level variables after removing their respective country means using 2013 data. We show that the proportion of female directors on a board is positively correlated with board size, board independence, the presence of a female CEO, firm size, and firm age.[6]

Firm- and country-level determinants of board gender diversity

Table 3 presents the estimation results based on Equation (1) where the dependent variable is the proportion of female directors on a board. Comparing firms within countries, we show that corporate boards are more likely to include women when boards are larger (consistent with Farrell and Hersch (2005), and Adams and Ferreira (2009)) and more independent, in firms with a female CEO, and in larger and older firms. Comparing across countries, we show that corporate boards are more likely to include women in countries with larger firms, and in countries with lower asset tangibility.

Furthermore, in terms of country-level determinants, we show that the average level of board gender diversity is lower in more masculine countries, higher in countries with formal quotas, codes, and disclosure requirements promoting gender equity (Adams and Kirchmaier, 2015), lower in countries with a larger gender gap, higher in countries with greater female labor market participation, and higher in countries with higher GDP per capita. Comparing Table 1

[6] Table IA3 in the Internet Appendix presents Pearson correlations among the country-level variables including the country means of the firm-level variables.

Panel B and Table 3, we note that masculinity is close to lose its significance in the multivariate model. We speculate this is due to the fact that the cultural dimension of masculinity has its effect indirectly on such variables as regulations, GGI, and female labor market participation, all of which are highly significantly in the multivariate model shown in Table 3.

The relation between board gender diversity and corporate innovation

Our general hypothesis is that board gender diversity creates firm value by fostering more novel lower risk innovation. Our test of the value creation hypothesis proceeds in three steps. First, we examine the innovation channel by relating board gender diversity to innovation measures that capture patenting quantity, efficiency, and novelty. Second, we examine the role of risk taking by relating board gender diversity to stock return volatility and R&D expenditures. Finally, we relate board gender diversity to firm value as measured by ROA and Tobin's Q.

Reverse causality concerns arise in each step of the above analyses. In particular, firms that are more innovative, less risky, and more valuable may be more likely to have female directors, either because of the firms' choices or the female directors' choices. The resulting positive association would not indicate a causal effect of board gender diversity on innovation and firm value.

To address the reverse causality concern, we need an exogenous determinant of the proportion of female directors on a board that is not related to firm innovation and value—an instrumental variables (IV) approach. We follow Adams and Ferreira (2009) to use the fraction of male directors on the board who sit on other boards on which there are female directors. One major impediment to female representation on corporate boards is a lack of business network connections and hence a lack of visibility. The IV captures the degree to which male directors are connected to female directors and therefore appreciate the role of female directors on a

corporate board. One possibility is that the fraction of men connected to women is correlated with firm innovation and value through industry peer effects (Adams and Ferreira (2009)). Thus in our IV analyses we remove firm-years where there is any male director sitting on the boards of their industry peer firms (defined at the SIC 4-digit level). In each of the three steps of our analyses, we present both the baseline results and instrumented results.

We first explore the innovation channel through which value creation may operate and the results for patenting output are reported in Table 4. Panel A presents the baseline results without instrumenting. Comparing firms within countries, we show that board gender diversity is positively associated with the citation-weighted patent count. We further show that the patent count is higher in firms with larger and more independent boards, larger firms, and firms with higher R&D capital, lower asset tangibility, and lower capital-to-labor ratio. Comparing across countries, we show that board gender diversity in a country is positively associated with the patent count in that country. We further show that the patent count is higher in countries with larger boards, greater board independence, larger firms, younger firms, lower asset tangibility, and higher capital-to-labor ratio.

Furthermore, in terms of country-level determinants, we show that the patent count is higher in countries with greater female labor market participation, higher GDP per capita, and more developed stock markets.

Finally, in terms of interaction effects, we show that the positive association between board gender diversity and the number of patents is stronger in countries with greater female labor market participation, consistent with the deeper talent pool perspective.

We next present results for innovation efficiency.[7] Comparing firms within countries, we show that board gender diversity is positively associated with innovation efficiency in terms of the citation-weighted patent count per R&D dollar. We further show that innovation efficiency is higher in firms with larger boards and more tangible assets, and lower in larger firms and firms with higher capital-to-labor ratio. Comparing across countries, we show that board gender diversity in a country is positively associated with innovation efficiency in that country. We further show that innovation efficiency is higher in countries with greater board independence, smaller boards, larger and younger firms and firms with less tangible assets.

Furthermore, in terms of country-level determinants, we show that innovation efficiency is higher in more masculine countries, countries with greater female labor market participation, and countries with higher GDP per capita.

Finally, in terms of interaction effects, we show that the positive association between board gender diversity and innovation efficiency is not influenced by either a country's masculinity score or its female labor market participation.

Panel A also presents the results when the dependent variable is *Scope*—our measure of innovation novelty. Comparing firms within countries, we show that board gender diversity is positively associated with innovation novelty. We further show that innovation novelty is higher in firms with larger boards, larger firms, older firms, more tangible assets, and firms with lower capital-to-labor ratio, and lower patent stock. Comparing across countries, we show that board gender diversity in a country is positively associated with innovation novelty in that country. We further show that innovation novelty is higher in countries with larger boards, lower board

[7] The sample requires firms with non-zero R&D capital when the outcome variable is innovation efficiency (where R&D capital is the denominator), and firms with at least one patent over our sample period when the outcome variable is innovation novelty (Scope).

independence, larger firms, lower asset tangibility, lower capital-labor ratio, and lower patent stock.

Furthermore, we show that innovation novelty is not significantly associated with any of the four country-level explanatory variables, nor are there any significant interaction effects.

Panel B presents the second stage results of the two-stage instrumental variable analysis. Overall, the instrumented results clearly mirror the pattern found in our baseline analyses. Notably, the positive associations between board gender diversity and measures of corporate innovation remain. When the dependent variable is the patent count, female labor market participation continues to strengthen this positive association. New to this analysis, we show that the positive association between board gender diversity and the patent count is strengthened in more masculine countries, consistent with the distinctiveness perspective. Also new to this analysis, we show that the positive associations between board gender diversity and innovation efficiency and novelty are strengthened in countries with greater female labor market participation. In addition, the positive association between board gender diversity and innovation efficiency is strengthened in more masculine countries. However, the positive association between board gender diversity and innovation novelty is weakened in more masculine countries.

The relation between board gender diversity and corporate risk-taking

We next explore the risk-taking channel through which value creation may operate and the results for stock return volatility and R&D expenditures are reported in Table 5. Panel A presents the baseline results without instrumenting. Comparing firms within countries, we show that board gender diversity is negatively associated with stock return volatility. We further show that stock return volatility is higher in firms with greater board independence, and lower in firms

with larger boards, larger firms, older firms, and firms with greater asset tangibility. Comparing across countries, we show that board gender diversity in a country is negatively associated with stock return volatility in that country. We further show that stock return volatility is higher in countries with larger boards, and lower in countries with larger firms.

Furthermore, in terms of country-level determinants, we show that stock return volatility is higher in countries with greater female labor market participation, and lower in countries with more developed stock markets.

Finally, in terms of interaction effects, we show that the negative association between board gender diversity and stock return volatility is not influenced by either a country's masculinity score or its female labor market participation.

The pattern of results where the dependent variable is R&D expenditures largely mirrors that of results when the dependent variable is stock return volatility, with a few small differences in the significance of control variables and one reversal of sign (regarding board size). In addition, new to this analysis, the negative association between board gender diversity and R&D is strengthened in more masculine countries.

Panel B presents the second stage results of the two-stage instrumental variable analysis. Overall, the instrumented results clearly mirror the pattern found in our baseline analyses. Notably, the negative associations between board gender diversity and stock return volatility and R&D expenditures remain, and masculinity strengthens these negative associations. In addition, the negative associations between board gender diversity and stock return volatility and R&D expenditures are strengthened in countries with greater female labor market participation.

The relation between board gender diversity and firm value

We finally test the value creation hypothesis directly using ROA and Tobin's Q as measure of firm value and report the results in Table 7. Panel A presents the baseline results without instrumenting. Comparing firms within countries, we show that board gender diversity is positively associated with ROA. We further show that ROA is higher in larger firms, older firms, and firms with more tangible assets, and lower in firms with larger and more independent boards. Comparing across countries, we show that board gender diversity in a country is positively associated with ROA in that country. We further show that ROA is higher in countries with greater board independence, larger firms, and older firms, and lower in countries with larger boards.

Furthermore, in terms of country-level determinants, we show that ROA is lower in countries with higher GDP per capita.

Finally, in terms of interaction effects, we show that the positive association between board gender diversity and ROA is not influenced by either a country's level of masculinity or its level of female labor market participation.

Panel A also presents the results when the dependent variable is Tobin's Q. Comparing firms within countries, we show that board gender diversity is positively associated with Tobin's Q. We further show that Tobin's Q is higher in firms with larger and more independent boards, and lower in larger firms, older firms, and firms with greater asset tangibility. Comparing across countries, we show that board gender diversity in a country is not significantly associated with Tobin's Q in that country. We further show that Tobin's Q is higher in countries with lower asset tangibility.

Furthermore, in terms of country-level determinants, we show that Tobin's Q is lower in more masculine countries and in countries with higher GDP per capita.

Finally, in terms of interaction effects, we show that the positive association between board gender diversity and Tobin's Q is stronger in more masculine countries.

Panel B presents the second stage results of the two-stage instrumental variable analysis. Overall, the instrumented results clearly mirror the pattern found in our baseline analyses. Notably, the positive associations between board gender diversity and ROA and Tobin's Q remain, and masculinity continues to strengthen the positive association between board gender diversity and Tobin's Q. New to this analysis, we show that the positive association between board gender diversity and ROA is stronger in more masculine countries and in countries with greater female labor market participation. In addition, the positive association between board gender diversity and Tobin's Q is stronger in countries with greater female labor market participation.

Overall, the results are consistent with the value creation hypothesis and the proposed innovation channel through which board gender diversity adds firm value.

7. Additional investigations

The non-linear effect of board gender diversity

To examine any possible non-linear effect of the number of women on a board, we introduce indicator variables representing one woman (versus zero), two women (versus one), and three or more women (versus two) on a board. Table IA4 presents the results. We find that having one woman on a board (versus zero) is positively and significantly related to two out of three patenting outputs (the patent count and innovation efficiency), is negatively and significantly related to two risk-taking measures, and is positively and significantly related to two firm value measures. Similarly, we find that having two women on a board (versus one) is

positively and significantly related to two out of three patenting outputs (the patent count and innovation novelty), is negatively and significantly related to two risk-taking measures, and is positively and significantly related to two firm value measures. In contrast, we find that having three or more women on a board (versus two) is negatively and significantly related to one risk-taking measure (R&D expenditures).

Industry-level analyses

To address the concern that patents might not be a relevant measure for corporate innovation output in some industries, in Table IA5 we repeat our analysis across the Fama-French 12 industries and show that the positive relation between board gender diversity and patent output largely concentrates in six out of twelve industries.

Subsample analyses

According to Table A1 in the Internet Appendix, U.S. firms contribute 49% of the sample. Thus, it is important to check whether our main findings remain if we exclude firms from those countries.

Table IA6 presents the estimation results after excluding U.S. firms. Our main findings largely remain: There is a positive and significant association between individualism and the CG index, and a negative and significant association between uncertainty avoidance and the CG index. Within countries, there remains a significant and positive association between the CG index and Tobin's Q, whereas across countries, there is no significant association between the CG index and Tobin's Q.

8. Conclusions

In this paper, we examine how board gender diversity varies across countries and across firms, and whether and how such variation matters. In particular, we examine whether and how board gender diversity relates to corporate innovation novelty and efficiency, and through these channels to firm value. Using a novel database that combines international firm-level patenting output measures with board characteristics across 45 countries and 11,678 firms for 2001-2014, we examine both within- and cross-country determinants of board gender diversity and its relation to corporate innovation, and ultimately to firm value. We find that corporate boards are more likely to include women when firms are large and in those countries with a narrower gender gap, those with formal regulations promoting gender equity, and those lower in the cultural dimension of masculinity. We then find that firms with more gender diverse boards are associated with greater patenting output, more novel patents, greater innovative efficiency, and consequently with higher firm value. Overall, the results are consistent with the view that more gender diverse boards help create firm value via increasing innovation output and efficiency.

Appendix I. Variable Definitions and Data Sources

Hofstede country-level cultural dimension:

Masculinity: The index is a weighted sum of the following four statements: 1) Work with people who cooperate well with one another; 2) Have an opportunity for advancement to higher level jobs; 3) Most people can be trusted; and 4) When people have failed in life it is often their own fault. High masculinarity is indicated by ratings of "of very little or no importance" to items (1) and (3), and ratings of "of utmost importance" to items (2) and (4). Masculinity stands for a society in which emotional gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success; women are supposed to be more modest, tender, and concerned with the quality of life. Femininity stands for a society in which emotional gender roles overlap: both men and women are supposed to be modest, tender, and concerned with the quality of life. The masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material rewards for success. Society at large is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented. In the business context masculinity versus Femininity is sometimes also related to as "tough versus tender" cultures.

Country-level control variables:

Regulation_quota: A country-year level dummy equals to one if a country's main stock exchange or securities laws stipulate minimum quota for either the percentage or number of female directors on board. Source: Adams and Kirchmaier (2015); Catalyst (2012, 2014); Deloitte (2010−2014).

Regulatio_code: A country-year level dummy equals to one if a country's governance code mentions that gender must be considered by the board in nominations. Source: Adams and Kirchmaier (2015); Catalyst (2012, 2014); Deloitte (2010−2014).

Regulation_disclosur*e*: A dummy country-year level equals to one if the main stock exchange or securities laws stipulate that board diversity should be disclosed. Source: Adams and Kirchmaier (2015); Catalyst (2012, 2014); Deloitte (2010−2014).

Gender Gap Index (GGI): An annual index published by the World Economic Forum measuring the extent to which women are disadvantaged compared with men in the following four overall areas: 1) Economic participation and opportunity – outcomes on salaries, participation levels and access to high-skilled employment; 2) Educational attainment – outcomes on access to basic and higher level education; 3) Political empowerment – outcomes on representation in decision-making structures; and 4) Health and survival – outcomes on life expectancy and sex ratio. A higher value of this measures means a larger gender gap between women and men.

Female labor market participation: A country-year level variable indicating the percentage of female population of ages 15 and above that participate in the labor force. Source: World Bank's World Development Indicators Database.

Rule of law: From La Porta et al. (1998). Based on the assessment of the law and order tradition in the country produced by the country risk-rating agency International Country Risk (ICR). An average of the guide months of April and October of the monthly index between 1982 and 1995. The scale runs from zero to six, with lower scores for a lower level of law and order.

GDP per capita: Logarithm of GPD per capita. Source: World Bank's World Development Indicators Database.

Stock mkt/GDP: Stock market capitalization as a percentage of GDP. Source: World Bank's World Development Indicators Database.

Firm-level variables:

Female director ratio: The fraction of female directors on board. Source: BoardEx.

Board size: The total number of directors on board. Source: BoardEx.

Board independence: The fraction of independent directors on board. Source: BoardEx.

ROA: Ratio of net income to total assets. Source: Osiris.

Tobin's Q: Ratio of the sum of market value of equity and book value of debt to book assets. Source: Osiris.

Stock volatility: Standard deviation of 12-month monthly stock returns. Source: Osiris.

Capex: Ratio of capital expenditure to total assets. Source: Osiris.

R&D: Ratio of research and development (R&D) expenses to total assets. Missing R&D values are set to zero. Source: Osiris.

Ln(total assets): Logarithm of total assets. Source: Osiris.

Ln(firm age): Logarithm of firm age. Source: Osiris.

Tangibility: Ratio of fixed assets to total assets. Source: Osiris.

Ln(K/L): Logarithm of the ratio of fixed assets to the number of employees. Source: Osiris.

Ln(R&D capital): Logarithm of R&D capital *S*. $S_t = R_t + (1 - \delta) S_{t-1}$, where *S* is the R&D capital, *R* is the R&D expenditures in dollars in year *t*, and $\delta = 0.15$ is the private depreciation rate of knowledge.

Ln(Patent stock): Logarithm of patent stock *PS*. $PS_t = P_t + (1 - \theta) PS_{t-1}$, where *PS* is the patent stock, *P* is the number of patents applied by a firm in year *t*, and $\theta = 0.05$ is the depreciation rate of patents (based on an average patent term of 20 years).

Ln(Patent count): Logarithm of the total number of patents applied by a firm in years *t* to *t+2*.

Ln(Citation count): Logarithm of the total number of citations patents applied by a firm in year *t* received in years *t* to *t+2*.

Ln(Citation-weighted patent count): Logarithm of the total number of patents applied by a firm in years *t* to *t+2*, with each patent weighted by the number of citations it receives from the application year to two years after the application year.

Scope: The number of new citations made by patents applied for in years *t* to *t+2* divided by the total number of citations made by patents applied for in years *t* to *t+2*. New citations are citations that have never been made by the firm in the past five years.

Breakthrough innovation: the number of patents that a firm applied for in years *t* to *t+2* that received 5-year citations within the highest percentile (top 1%) among all patents in the same 3-digit patent class and application year, divided by the total number of patents applied for by the firm in years *t* to *t+2*.

Important innovation: the number of patents that a firm applied for in years *t* to *t+2* that received 5-year citations within the 1st to 10th percentile in the same 3-digit patent class and application year, divided by the total number of patents applied for by the firm in years *t* to *t+2*.

Incremental innovation: the number of patents that a firm applied for in years *t* to *t+2* that received at least one citation in the following 5-year period (excluding the top 10 percentile), divided by the total number of patents applied for by the firm in years *t* to *t+2*.

Failed patents: the number of patents that a firm applied for in years *t* to *t+2* that received at least zero citation in the following 5-year period divided by the total number of patents applied for by the firm in years *t* to *t+2*.

Exploration: The number of exploratory patents applied for in each firm-year. Exploratory patents are patents with less than 20% repeat citations (patents the firm had previously cited) or self-citations (the firm's own previous patents).

Exploitation: The number of exploratory patents applied for in each firm-year. Exploitative patents are patents with more than 80% repeat citations (patents the firm had previously cited) or self-citations (the firm's own previous patents).

Innovation efficiency_ patents: The number of patents applied by a firm in years *t* to *t+2* divided by the firm's R&D capital as of year *t-1*.

Innovation efficiency_citations: The number of citations patents applied by a firm in years *t* received in years *t* to *t+2* divided by the firm's R&D capital as of year *t-1*.

Innovation efficiency_ citation-weighted patents: The number of citation-weighted patents applied by a firm in years *t* to *t+2* divided by the firm's R&D capital as of year *t-1*, with citation weight being the number of citations a patent receives from its application year to two years after the application year.

References:

Abdurazokzoda, F., and L.S. Davis, 2014. Language, culture and institutions: Evidence from a new linguistic dataset, Union College working paper.

Aggarwal, R., I. Erel, R. Stulz, and R. Williamson, 2009. Differences in governance practices between U.S. and foreign firms: Measurement, causes, and consequences, *Review of Financial Studies* 22, 3131-3169.

Ahern, K.R., D. Daminelli, and C. Fracassi, 2015. Lost in translation? The effect of cultural values on mergers around the world, *Journal of Financial Economics* 117, 115-189.

Anderson, A., and P.P. Gupta, 2009. A cross-country comparison of corporate governance and firm performance: Do financial structure and the legal system matter? *Journal of Contemporary Accounting & Economics* 5, 61-79.

Bebchuk, L.A., and A. Hamdani, 2009. The elusive quest for global governance standards, *University of Pennsylvania Law Review* 157, 1263-1316.

Bhagat, S., B.J. Bolton, and R. Romano, 2008. The promise and peril of corporate governance indices, *Columbia Law Review* 108, 1083-1882.

Black, B.S., A.G. de Carvalho, and É. Gorga, 2012. What matters and for which firms for corporate governance in emerging markets? Evidence from Brazil (and other BRIK countries), *Journal of Corporate Finance* 18, 934-952.

Cavalli-Sforza, L.L., P. Menozzi, and A. Piazza, 1994. *The History and Geography of Human Genes*, Princeton, NJ: Princeton University Press.

Demirguc-Kunt, A., and R. Levine, 2001. Bank-based and market-based financial systems: Cross-country comparisons, in: A. Demirguc-Kunt, R. Levine (Eds.), *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development*, Cambridge, MA: MIT Press.

Djankov, S., R. La Porta, F. Lopez-de-Silanes, and A. Shleifer, 2008. The law and economics of self-dealing, *Journal of Financial Economics* 88, 430-465.

Djankov, S., C. McLiesh, and A. Shleifer. 2007. Private credit in 129 countries, *Journal of Financial Economics* 84, 299-329.

Doidge, C., G.A., Karolyi, and R. Stulz, 2004. Why are foreign firms listed in the US worth more? *Journal of Financial Economics* 71, 205-238.

Doidge, C., A. Karolyi, and R. Stulz, 2007. Why do countries matter so much for corporate governance? *Journal of Financial Economics* 86, 1-39.

Durnev, A., and H. Kim, 2005. To steal or not to steal: Firm attributes, legal environment, and valuation, *Journal of Finance* 60, 1461-1493.

European Commission, 2012. Improving the gender balance in company boardrooms factsheet.

Francis, J., I., Khurana, and R. Pereira, 2005. Disclosure incentives and effects on cost of capital around the world, *The Accounting Review* 80, 1125-1162.

Greene, W.H., 2011. *Econometric Analysis* (7th ed.), Upper Saddle River, NJ: Prentice Hall.

Guiso, L., P. Sapienza, and L. Zingales. 2006. Does culture affect economic outcomes? *Journal of Economic Perspectives* 20, 23-48.

Guiso, L., P. Sapienza, and L. Zingales, 2009. Cultural biases in economic exchange? *Quarterly Journal of Economics* 124, 1095-1131.

Hofstede, G.H., 1980. *Culture's Consequences: International Differences in Work-Related Values.* Thousand Oaks, CA: SAGE Publications, Inc.

Hofstede, G.H., 2001. *Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations across Nations* (2nd ed.), Thousand Oaks, CA: SAGE Publications, Inc.

Hope, O.-K., 2003. Firm-level disclosures and the relative roles of culture and legal origin, *Journal of International Financial Management and Accounting* 14, 218-248.

Hunt, V., D. Layton, and S. Prince, 2014. Diversity matters, McKinsey & Company.

Hugill, A., and J. Siegel, 2014. Which does more to determine the quality of corporate governance in emerging economies, firms or countries? Harvard Business School working paper.

Karolyi, G.A., 2015a. The gravity of culture for finance, Cornell University working paper.

Karolyi, G.A., 2015b. *Cracking the Emerging Markets Enigma*, New York, NY: Oxford University Press.

Kashima, E.S., and Y. Kashima, 1998. Culture and language: The case of cultural dimensions and personal pronoun use, *Journal of Cross-Cultural Psychology* 29, 461-487.

Khanna, T., K.G. Palepu, and S. Srinivasan, 2004. Disclosure practices of foreign companies interacting with U.S. markets, *Journal of Accounting Research* 42, 475-508.

Klapper, L., and I. Love, 2004. Corporate governance, investor protection and performance in emerging markets, *Journal of Corporate Finance* 10, 703-728.

Kwok, C.C.Y., and S. Tadesse, 2006. National culture and financial systems, *Journal of International Business Studies* 37, 227-247.

La Porta, R., F. Lopez-de-Silanes, and A. Shleifer, 1999. Corporate ownership around the world, *Journal of Finance* 54, 471-517.

La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. Vishny, 1998. Law and finance, *Journal of Political Economy* 106, 1113-1155.

La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. Vishny, 2002. Investor protection and corporate valuation, *Journal of Finance* 57, 1147-1170.

Li, K., D. Griffin, H. Yue, and L. Zhao, 2011. National culture and capital structure decisions: Evidence from foreign direct investment in China, *Journal of International Business Studies* 42, 477-503.

Li, K., D. Griffin, H. Yue, and L. Zhao, 2013. How does culture influence corporate risk-taking? *Journal of Corporate Finance* 23, 1-22.

Licht, A.N., 2001. The mother of all path dependencies: Toward a cross-cultural theory of corporate governance systems, *Delaware Journal of Corporate Law* 26, 147-205.

Licht, A.N., C. Goldschmidt, and S.H. Schwartz, 2005. Culture, law, and corporate governance, *International Review of Law and Economics* 25, 229-255.

Licht, A.N., C. Goldschmidt, and S.H. Schwartz, 2007. Culture rules: The foundations of the rule of law and other norms of governance, *Journal of Comparative Economics* 35, 659-688.

Rajan, R. G., and L. Zingales, 1998. Financial dependence and growth, *American Economic Review* 88, 559-586.

Raudenbush, S.W., and A.S. Bryk, 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods, Advanced Quantitative Techniques in the Social Science Series*. Thousand Oaks, CA: SAGE Publications, Inc.

Reese, W., and M. Weisbach, 2002. Protection of minority shareholder interests, cross-listings in the United States, and subsequent equity offerings, *Journal of Financial Economics* 66, 65-104.

Sarkissian, S., and M. Schill, 2014, Cross-listing waves, *Journal of Financial and Quantitative Analysis*, forthcoming.

Schwartz, S.H., 1999. A theory of cultural values and some implications for work, *Applied Psychology* 48, 23-47.

Schwartz, S.H., 2004. Mapping and interpreting cultural differences around the world, in: H. Vinkins, J. Soeters, P. Esters (Eds.), *Comparing Cultures: Dimensions of Culture in a Comparative Perspective,* Boston, MA: Brill Academic Publishers.

Shleifer, A., and D. Wolfenzon, 2002. Investor protection and equity markets, *Journal of Financial Economics* 66, 3-27.

Spamann, H., 2010. The "Antidirector Rights Index" revisited, *Review of Financial Studies* 23, 467-486.

Spolaore, E., and R. Wacziarg, 2009. The diffusion of development, *Quarterly Journal of Economics* 124, 469-529.

Stulz, R., 1999. Globalization, corporate finance, and the cost of capital, *Journal of Applied Corporate Finance* 12, 8-25.

Stulz R., 2005. The limits of financial globalization, *Journal of Finance* 60, 1595-1638.

Stulz, R., and R. Williamson, 2003. Culture, openness, and finance, *Journal of Financial Economics* 70, 313-349.

Tabellini, G., 2008. Institutions and culture, *Journal of the European Economic Association* 6, 255-294.

Trompenaars, F., 1993. *Riding the Waves of Culture: Understanding Cultural Diversity in Business,* London: Nicholas Brealey Publishing.

Williamson, O.E., 2000. The new institutional economics: Taking stock, looking ahead, *Journal of Economic Literature* 38, 595-613.

White, M. J., 2014. Completing the journey: women as directors of public companies, U.S. Securities and Exchange Commission.

White, M. J., 2014. The pursuit of gender parity in the American boardroom, U.S. Securities and Exchange Commission.

Table 1. Country-level descriptive statistics

This table presents descriptive statistics for key country-level variables based on 45 countries. Variable definitions are provided in Appendix I. Panel A reports the value of key country-level (average value of country-year level) variables for each country in our sample as well as the number of observations in each country. Panel B presents the pairwise correlations between the country mean of female ratio on board and other country-level cultural, regulatory, and economic variables. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Values of key country-level variables

Country name	Female ratio on board	Masculinity	Regulation _quota	Regulation _code	Regulation _disclosure	Global Gender Gap Index	Female labor market participation	Obs.
ARGENTINA	0.04	0.56	0.00	0.00	0.00	0.29	0.48	60
AUSTRALIA	0.07	0.61	0.00	0.33	0.33	0.28	0.58	3,561
AUSTRIA	0.06	0.79	0.00	0.56	0.00	0.29	0.53	211
BELGIUM	0.09	0.54	0.20	0.38	0.20	0.29	0.45	739
BRAZIL	0.07	0.49	0.00	0.00	0.00	0.32	0.59	309
CANADA	0.07	0.52	0.00	0.00	0.00	0.27	0.62	3,731
CHILE	0.05	0.28	0.00	0.00	0.00	0.32	0.45	64
CHINA	0.09	0.66	0.00	0.00	0.00	0.32	0.64	1,445
COLOMBIA	0.11	0.64	0.00	0.00	0.00	0.30	0.55	15
CROATIA	0.10	0.40	0.00	0.00	0.00	0.29	0.46	9
CZECH REPUBLIC	0.06	0.57	0.00	0.00	0.00	0.32	0.49	5
DENMARK	0.11	0.16	0.11	0.49	0.11	0.24	0.60	259
FINLAND	0.22	0.26	0.00	0.51	0.51	0.18	0.57	330
FRANCE	0.14	0.43	0.34	0.34	0.00	0.33	0.50	2,670
GERMANY	0.07	0.66	0.00	0.40	0.40	0.25	0.52	1,882
GREECE	0.06	0.57	0.00	0.04	0.00	0.33	0.43	333
HUNGARY	0.09	0.88	0.00	0.00	0.00	0.32	0.43	6
INDIA	0.06	0.56	0.00	0.00	0.00	0.38	0.31	1,359
INDONESIA	0.09	0.46	0.00	0.00	0.00	0.34	0.51	72
IRELAND	0.07	0.68	0.00	0.00	0.00	0.26	0.51	778
ISRAEL	0.16	0.47	1.00	0.00	0.00	0.31	0.51	722
ITALY	0.08	0.70	0.13	0.00	0.00	0.34	0.38	633
JAPAN	0.02	0.95	0.00	0.00	1.00	0.35	0.48	555

LUXEMBOURG	0.06	0.50	0.00	0.46	0.00	0.30	0.47	182
MALAYSIA	0.10	0.50	0.00	0.51	0.00	0.35	0.44	233
MALTA	0.02	0.47	0.00	0.00	0.00	0.33	0.34	5
MEXICO	0.06	0.69	0.00	0.00	0.00	0.34	0.43	161
MOROCCO	0.05	0.53	0.00	0.00	0.00	0.42	0.27	11
NETHERLANDS	0.06	0.14	0.01	0.35	0.35	0.27	0.57	892
NEW ZEALAND	0.15	0.58	0.00	0.00	0.03	0.22	0.61	99
NORWAY	0.28	0.08	0.77	0.00	0.77	0.19	0.61	551
PERU	0.06	0.42	0.00	0.00	0.00	0.32	0.67	13
PHILIPPINES	0.04	0.64	0.00	0.00	0.00	0.23	0.51	69
POLAND	0.10	0.64	0.00	0.00	0.39	0.30	0.48	101
PORTUGAL	0.06	0.31	0.00	0.00	0.00	0.30	0.55	202
RUSSIA	0.06	0.36	0.00	0.00	0.00	0.31	0.57	177
SINGAPORE	0.07	0.48	0.00	0.00	0.00	0.31	0.57	653
SOUTH AFRICA	0.16	0.63	0.00	0.68	0.00	0.25	0.45	676
SPAIN	0.08	0.42	0.67	0.74	0.00	0.28	0.48	648
SWEDEN	0.19	0.05	0.00	0.32	0.54	0.20	0.59	1,167
SWITZERLAND	0.06	0.70	0.00	0.00	0.00	0.28	0.60	826
THAILAND	0.08	0.34	0.00	0.00	0.00	0.31	0.64	59
TURKEY	0.10	0.45	0.00	0.00	0.00	0.40	0.27	47
UNITED KINGDOM	0.06	0.66	0.18	0.26	0.10	0.26	0.55	13,065
UNITED STATES	0.09	0.62	0.00	0.00	0.31	0.29	0.58	38,288
Total observations:								77,873
Mean (firm-year level)	0.08	0.59	0.07	0.11	0.22	0.28	0.56	
Mean (country-level)	0.09	0.51	0.08	0.14	0.11	0.30	0.51	

Panel B. Correlations of country-level variables

	Female ratio on board	Masculinity	Regulation quota	Regulation code	Regulation disclosure	Gender Gap Index	Female labor participation	Ln(GDP per capita)	Stock mkt/GDP
Female ratio on board	1.000								
Masculinity	-0.399***	1.000							
Regulation quota	0.445***	-0.196***	1.000						
Regulation code	0.152***	-0.130***	0.252***	1.000					
Regulation disclosure	0.241***	-0.118***	0.220***	0.219***	1.000				
Gender Gap Index	-0.495***	0.385***	-0.182***	-0.262***	-0.261***	1.000			
Female labor participation	0.231***	-0.251***	0.047	0.059	0.115***	-0.597***	1.000		
Ln(GDP per capita)	0.199***	-0.129***	0.193***	0.255***	0.237***	-0.493***	0.266***	1.000	
Stock mkt/GDP	0.023	-0.008	-0.046	0.113**	-0.026	-0.087*	0.170***	0.261***	1.000

Table 2. Firm-level descriptive statistics

This table presents descriptive statistics for key firm-level variables in our analyses. Our main sample contains 77,873 firm-year observations from 45 countries for the period 2001-2014, for which we have board data from BoardEx and firm characteristics data from BvD Osiris. Our innovation sample contains 73,115 firm-years from 45 countries for the period 2001-2013, for which we have patent data from USPTO, board data from BoardEx, and firm characteristics data from BvD Osiris. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. Panel A reports summary statistics for the firm-level variables. Panel B reports pairwise correlations between the firm-level variables after removing country-means based on 2013 data. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Firm-level summary statistics

Variable name	Obs.	Mean	Std. dev.	5th pct	Median	95th pct
Female ratio on board	77,873	0.080	0.103	0.000	0.000	0.286
Board size	77,873	8.228	3.135	4.000	8.000	14.000
Board independence	77,873	0.739	0.173	0.400	0.792	0.929
Female CEO	77,873	0.023	0.150	0.000	0.000	0.000
Ln(total assets)	77,873	13.133	2.568	9.068	13.114	17.378
Ln(firm age)	77,873	3.083	0.880	1.792	3.045	4.654
Tangibility	77,873	0.272	0.259	0.008	0.181	0.824
Stock volatility	77,873	0.122	0.069	0.042	0.105	0.263
R&D/total assets	77,873	0.037	0.094	0.000	0.000	0.209
ROA	77,873	-0.004	0.172	-0.376	0.034	0.174
Tobin's Q	77,873	2.023	2.012	0.758	1.375	5.469
Ln(patent count)	73,115	0.382	1.064	0.000	0.000	2.833
Ln(citation count)	73,115	0.341	1.111	0.000	0.000	2.996
Ln(citation weighted patent count)	73,115	0.543	1.444	0.000	0.000	4.127
Innovation effciency_patent	31,521	0.081	0.289	0.000	0.000	0.419
Innovation effciency_citation	31,521	0.104	0.440	0.000	0.000	0.513
Innovation effciency_citation-weighted patent	31,521	0.374	1.487	0.000	0.000	1.876
Scope	12,454	0.642	0.320	0.069	0.687	1.000
Ln(K/L)	73,115	5.245	1.909	2.529	5.114	8.512
Ln(R&D capital)	73,115	4.555	5.543	0.000	0.000	13.492
Ln(patent stock)	73,115	0.956	1.697	0.000	0.000	4.801

Panel B. Correlation of firm-level variables

	Female ratio on board	Board size	Board independence	Female CEO	Ln(total assets)	Ln(firm age)	Tangibility
Female ratio on board	1.000						
Board size	0.267***	1.000					
Board independence	0.163***	0.308***	1.000				
Female CEO	0.258***	0.028*	0.026*	1.000			
Ln(total assets)	0.214***	0.541***	0.248***	-0.003	1.000		
Ln(firm age)	0.151***	0.227***	0.098***	0.019	0.213***	1.000	
Tangibility	-0.022	0.073***	0.033**	-0.014	0.210***	-0.017	1.000

Table 3. Explaining firm-level board gender diversity

This table presents the estimation results when the dependent variable is the firm-level female director ratio. Our sample contains 62,101 firm-year observations from 43 countries for the period 2001-2014, for which we have board data from BoardEx and firm characteristics data from BvD Osiris. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Panel A presents the HLM results without instrumenting. Panel B presents the HLM results where female director ratio is instrumented with the fraction of male directors on board who sit on other boards on which there are female directors. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Female director ratio	
	Within-country	*Cross-country*
Firm Characteristics		
Board size	0.004***	0.000
	[0.000]	[0.001]
Board independence	0.016***	0.009
	[0.003]	[0.025]
Female CEO	0.159***	-0.010
	[0.002]	[0.041]
Ln(total assets)	0.005***	0.010***
	[0.000]	[0.002]
Ln(firm age)	0.006***	0.007
	[0.000]	[0.005]
Tangibility	-0.002	-0.090***
	[0.002]	[0.021]
Country Characteristics		
Masculinity		-0.071*
		[0.041]
Regulation_quota		0.028***
		[0.002]
Regulation_code		0.010***
		[0.002]
Regulation_disclosure		0.005***
		[0.001]
Gender Gap Index		-0.244***
		[0.031]
Female labor market participation		0.091**
		[0.040]
Ln(GDP per capita)		0.030***
		[0.004]
Stock mkt/GDP		0.001
		[0.004]
Industry FEs		Yes
Year FEs		Yes
No. of countries		45
No. of observations		77,873

Table 4. Board gender diversity and patenting output

This table presents the estimation results when the dependent variables are patent output measured as patent count, citation count, and citation-weighted patent count. Panel A presents the HLM results without instrumenting. The sample contains 73,115 firm-year observations from 45 countries for the period 2001-2013, for which we have patent data from USPTO, board data from BoardEx, and firm characteristics data from BvD Osiris. Panel B presents the HLM results where female director ratio is instrumented with the fraction of male directors on board who sit on other boards on which there are female directors. The sample follows that used in Panel A but excludes firm-years with at least one male director seating on peer firms in the same (4-digit SIC) industry. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. HLM

	Ln(patent count)		Ln(citation count)		Ln(citation-weighted patent count)	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics						
Female ratio	0.343***	0.586**	0.326***	1.140***	0.410***	1.072***
	[0.036]	[0.240]	[0.039]	[0.259]	[0.049]	[0.322]
Board size	0.011***	0.176***	0.010***	0.152***	0.011***	0.203***
	[0.002]	[0.010]	[0.002]	[0.011]	[0.002]	[0.014]
Board independence	0.190***	1.871***	0.170***	1.561***	0.280***	2.983***
	[0.027]	[0.271]	[0.029]	[0.289]	[0.036]	[0.366]
Ln(total assets)	0.076***	0.025	0.074***	0.070***	0.096***	0.050*
	[0.002]	[0.022]	[0.002]	[0.024]	[0.003]	[0.030]
Ln(firm age)	0.010**	-0.861***	0.004	-0.971***	0.005	-1.269***
	[0.004]	[0.066]	[0.005]	[0.070]	[0.006]	[0.088]
Tangibility	-0.112***	-3.049***	-0.109***	-3.121***	-0.196***	-4.270***
	[0.017]	[0.233]	[0.019]	[0.251]	[0.023]	[0.314]
Ln(K/L)	-0.039***	0.164***	-0.038***	0.113***	-0.046***	0.248***
	[0.003]	[0.033]	[0.003]	[0.036]	[0.004]	[0.045]
Ln(R&D capital)	0.042***	0.004	0.041***	0.002	0.058***	0.007
	[0.001]	[0.009]	[0.001]	[0.010]	[0.001]	[0.012]
Country Characteristics						

Masculinity	0.467	0.524	0.931
	[0.630]	[0.595]	[0.910]
Female labor participation	6.029***	5.591***	8.704***
	[0.425]	[0.454]	[0.575]
Ln(GDP per capita)	0.174***	0.167***	0.268***
	[0.038]	[0.040]	[0.051]
Stock mkt/GDP	0.246***	0.172***	0.307***
	[0.038]	[0.041]	[0.051]
Cross-level interactions	*Within-country × Cross-country*	*Within-country × Cross-country*	*Within-country × Cross-country*
Masculinity × Female ratio	0.133	0.209	-0.027
	[0.276]	[0.299]	[0.371]
Female labor participation × Female ratio	2.627***	2.338***	2.973***
	[0.702]	[0.759]	[0.942]
Industry FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
No. of countries	45	45	45
No. of observations	73,115	73,115	73,115

Panel B. Instrumented HLM

	Ln(patent count)		Ln(citation count)		Ln(citation-weighted patent count)	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics						
Female ratio	4.003***	8.884***	3.978***	10.898***	4.947***	13.268***
	[0.147]	[1.890]	[0.158]	[2.002]	[0.199]	[2.563]
Board size	0.011***	0.164***	0.010***	0.137***	0.011***	0.188***
	[0.002]	[0.010]	[0.002]	[0.011]	[0.002]	[0.014]
Board independence	0.089***	0.986***	0.075***	0.732***	0.149***	1.712***
	[0.027]	[0.265]	[0.028]	[0.279]	[0.036]	[0.362]
Ln(total assets)	0.041***	-0.006	0.037***	0.028	0.053***	0.010
	[0.002]	[0.022]	[0.003]	[0.023]	[0.003]	[0.030]
Ln(firm age)	0.015***	-0.574***	0.011**	-0.667***	0.012**	-0.881***
	[0.004]	[0.059]	[0.005]	[0.062]	[0.006]	[0.080]
Tangibility	-0.075***	-2.604***	-0.078***	-2.682***	-0.136***	-3.563***
	[0.018]	[0.233]	[0.019]	[0.248]	[0.024]	[0.316]
Ln(K/L)	-0.030***	0.168***	-0.029***	0.126***	-0.036***	0.254***
	[0.003]	[0.032]	[0.003]	[0.034]	[0.004]	[0.043]
Ln(R&D capital)	0.033***	0.024***	0.032***	0.027***	0.047***	0.033***
	[0.001]	[0.008]	[0.001]	[0.009]	[0.001]	[0.011]
Country Characteristics						
Masculinity		0.202		0.237		0.545
		[0.518]		[0.481]		[0.753]
Female labor participation		5.097***		4.633***		7.576***
		[0.404]		[0.423]		[0.550]
Ln(GDP per capita)		0.100***		0.090**		0.175***
		[0.036]		[0.038]		[0.049]
Stock mkt/GDP		0.192***		0.148***		0.235***
		[0.036]		[0.039]		[0.049]

Cross-level interactions	*Within-country* × *Cross-country*	*Within-country* × *Cross-country*	*Within-country* × *Cross-country*
Masculinity × Female ratio	4.275***	5.059***	6.583***
	[1.038]	[1.111]	[1.401]
Female labor participation × Female ratio	16.686***	17.848***	21.404***
	[2.546]	[2.725]	[3.438]
Industry FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
No. of countries	45	45	45
No. of observations	61,960	61,960	61,960

Table 5. Board gender diversity and innovation efficiency and novelty

This table presents the estimation results when the dependent variables are three innovation efficiency measures and the innovation novelty measure, *Scope*. Panel A presents the HLM results without instrumenting. When the dependent variables are innovation efficiency measures, the sample contains firm-years with non-zero R&D capital (31,521 firm-years from 42 countries over the period 2001-2013). When the dependent variable is the innovation novelty measure, *Scope*, the sample contains firms that have at least one patent in our sample period (12,454 firm-years from 28 countries over the period 2001-2013). Panel B presents the HLM results where female director ratio is instrumented with the fraction of male directors on board who sit on other boards on which there are female directors. The samples follow those used in Panel A but exclude firm-years with at least one male director seating on peer firms in the same (4-digit SIC) industry. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. HLM

	Efficiency_patent		Efficiency_citation		Efficiency_ citation-weighted patent		Scope	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*	*Within-country*	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics								
Female ratio	0.091***	0.762***	0.109***	1.214***	0.390***	4.312***	0.076**	0.506***
	[0.018]	[0.108]	[0.027]	[0.167]	[0.092]	[0.559]	[0.032]	[0.183]
Board size	0.006***	-0.005	0.008***	-0.025***	0.028***	-0.063***	0.003***	0.010**
	[0.001]	[0.004]	[0.001]	[0.007]	[0.004]	[0.022]	[0.001]	[0.004]
Board independence	0.008	0.516***	0.050**	0.956***	0.087	3.115***	-0.038	-0.211***
	[0.013]	[0.108]	[0.020]	[0.169]	[0.066]	[0.570]	[0.024]	[0.051]
Ln(total assets)	-0.007***	0.033***	-0.005***	0.099***	-0.030***	0.300***	0.030***	0.060***
	[0.001]	[0.010]	[0.002]	[0.016]	[0.005]	[0.053]	[0.002]	[0.011]
Ln(firm age)	0.002	-0.258***	-0.006*	-0.478***	-0.013	-1.642***	0.014***	0.018
	[0.002]	[0.029]	[0.003]	[0.046]	[0.011]	[0.154]	[0.003]	[0.032]
Tangibility	0.070***	-0.478***	0.082***	-0.864***	0.303***	-2.904***	0.071***	-0.218**
	[0.010]	[0.099]	[0.016]	[0.154]	[0.054]	[0.517]	[0.019]	[0.106]
Ln(K/L)	-0.032***	0.013	-0.043***	-0.003	-0.158***	-0.009	-0.028***	-0.048***
	[0.001]	[0.016]	[0.002]	[0.024]	[0.007]	[0.083]	[0.002]	[0.012]
Ln(R&D capital)							-0.001	0.006
							[0.001]	[0.004]

Ln(patent stock)				-0.068***	-0.125***
				[0.002]	[0.016]
Country Characteristics					
Masculinity	0.469***	0.846***	2.864***		0.043
	[0.151]	[0.253]	[0.892]		[0.046]
Female labor participation	0.902***	1.856***	6.372***		-0.162
	[0.179]	[0.281]	[0.951]		[0.156]
Ln(GDP per capita)	0.084***	0.113***	0.439***		0.005
	[0.015]	[0.023]	[0.078]		[0.014]
Stock mkt/GDP	0.036**	0.018	0.124		0.015
	[0.017]	[0.025]	[0.086]		[0.018]
Cross-level interactions	*Within-country* × *Cross-country*	*Within-country* × *Cross-country*	*Within-country* × *Cross-country*		*Within-country* × *Cross-country*
Masculinity	0.085	-0.005	0.182		0.314
	[0.127]	[0.194]	[0.651]		[0.259]
Female labor participation	0.031	0.449	0.204		0.836
	[0.362]	[0.554]	[1.858]		[0.879]
Industry FEs	Yes	Yes	Yes		Yes
Year FEs	Yes	Yes	Yes		Yes
No. of countries	42	42	42		28
No. of observations	31,521	31,521	31,521		12,454

Panel B. Instrumented HLM

	Efficiency_patent		Efficiency_citation		Efficiency_ citation-weighted patent		Scope	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*	*Within-country*	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics								
Female ratio	1.018***	5.308***	1.488***	8.491***	5.174***	30.180***	0.326**	1.513
	[0.077]	[0.888]	[0.115]	[1.330]	[0.392]	[4.581]	[0.130]	[1.146]
Board size	0.005***	-0.010**	0.006***	-0.029***	0.024***	-0.083***	0.003***	0.013***
	[0.001]	[0.004]	[0.001]	[0.007]	[0.004]	[0.023]	[0.001]	[0.004]
Board independence	-0.022	0.219*	0.008	0.454***	-0.071	1.532***	-0.011	-0.228***
	[0.014]	[0.112]	[0.021]	[0.170]	[0.072]	[0.594]	[0.027]	[0.061]
Ln(total assets)	-0.013***	0.016	-0.014***	0.065***	-0.061***	0.181***	0.030***	0.043***
	[0.001]	[0.011]	[0.002]	[0.016]	[0.006]	[0.056]	[0.002]	[0.011]
Ln(firm age)	0.000	-0.200***	-0.008**	-0.371***	-0.022*	-1.279***	0.012***	0.016
	[0.002]	[0.029]	[0.003]	[0.044]	[0.012]	[0.151]	[0.004]	[0.033]
Tangibility	0.050***	-0.350***	0.046***	-0.661***	0.181***	-2.270***	0.018	-0.246**
	[0.012]	[0.106]	[0.017]	[0.160]	[0.058]	[0.552]	[0.021]	[0.115]
Ln(K/L)	-0.027***	0.034**	-0.036***	0.030	-0.136***	0.130	-0.030***	-0.041***
	[0.002]	[0.016]	[0.002]	[0.025]	[0.008]	[0.086]	[0.003]	[0.012]
Ln(R&D capital)							-0.001	0.007*
							[0.001]	[0.004]
Ln(patent stock)							-0.072***	-0.102***
							[0.002]	[0.016]
Country Characteristics								
Masculinity		0.310**		0.558***		1.987**		-0.044
		[0.129]		[0.211]		[0.794]		[0.048]
Female labor participation		0.748***		1.551***		5.667***		-0.209
		[0.180]		[0.275]		[0.965]		[0.162]
Ln(GDP per capita)		0.059***		0.073***		0.322***		-0.004

	[0.015]	[0.023]	[0.081]	[0.014]
Stock mkt/GDP	0.035**	0.023	0.143	0.015
	[0.017]	[0.026]	[0.088]	[0.020]
Cross-level interactions	*Within-country × Cross-country*	*Within-country × Cross-country*	*Within-country × Cross-country*	*Within-country × Cross-country*
Masculinity	1.366***	2.250***	6.914***	-2.005**
	[0.454]	[0.673]	[2.301]	[0.932]
Female labor participation	3.859***	5.306***	19.043***	8.534***
	[1.282]	[1.899]	[6.488]	[2.900]
Industry FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
No. of countries	41	41	41	28
No. of observations	24,920	24,920	24,920	9,215

Table 6. Board gender diversity and corporate risk-taking

This table presents the estimation results when the dependent variables are stock volatility and R&D expenditures. Panel A presents the HLM results without instrumenting. The sample contains 77,873 firm-year observations from 45 countries for the period 2001-2014, for which we have board data from BoardEx and firm characteristics data from BvD Osiris. Panel B presents the HLM results where female director ratio is instrumented with the fraction of male directors on board who sit on other boards on which there are female directors. The sample follows that used in Panel A but excludes firm-years with at least one male director seating on peer firms in the same (4-digit SIC) industry. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. HLM

	Stock volatility		R&D/total assets	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics				
Female ratio	-0.024***	-0.025*	-0.023***	-0.056***
	[0.002]	[0.015]	[0.003]	[0.018]
Board size	-0.001***	0.002***	0.001***	0.000
	[0.000]	[0.001]	[0.000]	[0.001]
Board independence	0.007***	-0.020	0.031***	-0.014
	[0.002]	[0.016]	[0.002]	[0.015]
Ln(total assets)	-0.010***	-0.012***	-0.009***	-0.005***
	[0.000]	[0.001]	[0.000]	[0.001]
Ln(firm age)	-0.009***	-0.004	-0.008***	0.013***
	[0.000]	[0.004]	[0.000]	[0.004]
Tangibility	-0.007***	0.013	-0.047***	-0.002
	[0.001]	[0.014]	[0.001]	[0.015]
Country Characteristics				
Masculinity		0.007		-0.021
		[0.020]		[0.013]
Female labor participation		0.095***		-0.015
		[0.024]		[0.023]
Ln(GDP per capita)		0.000		0.000
		[0.002]		[0.002]
Stock mkt/GDP		-0.011***		0.000
		[0.002]		[0.003]
Cross-level interactions		*Within-country* × *Cross-country*		*Within-country* × *Cross-country*
Masculinity × Female ratio		-0.018		-0.057**
		[0.018]		[0.024]
Female labor participation × Female ratio		-0.049		-0.064
		[0.045]		[0.061]

Industry FEs	Yes	Yes
Year FEs	Yes	Yes
No. of countries	45	45
No. of observations	77,873	77,873

Panel B. Instrumented HLM

	Stock volatility		R&D/total assets	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics				
Female ratio	-0.117***	-0.086	-0.024**	-0.410***
	[0.010]	[0.118]	[0.012]	[0.119]
Board size	-0.001***	0.001**	0.001***	0.000
	[0.000]	[0.001]	[0.000]	[0.001]
Board independence	0.010***	-0.023	0.026***	0.006
	[0.002]	[0.017]	[0.002]	[0.014]
Ln(total assets)	-0.009***	-0.012***	-0.008***	-0.003***
	[0.000]	[0.001]	[0.000]	[0.001]
Ln(firm age)	-0.009***	0.002	-0.006***	0.010***
	[0.000]	[0.004]	[0.000]	[0.004]
Tangibility	-0.006***	0.023	-0.037***	-0.019
	[0.001]	[0.015]	[0.001]	[0.015]
Country Characteristics				
Masculinity		0.010		-0.006
		[0.019]		[0.011]
Female labor participation		0.117***		0.010
		[0.024]		[0.021]
Ln(GDP per capita)		-0.003		0.002
		[0.002]		[0.002]
Stock mkt/GDP		-0.010***		-0.001
		[0.002]		[0.002]
Cross-level interactions		*Within-country* × *Cross-country*		*Within-country* × *Cross-country*
Masculinity × Female ratio		-0.513***		-0.369***
		[0.071]		[0.083]
Female labor participation × Female ratio		-1.146***		-1.395***
		[0.175]		[0.210]
Industry FEs		Yes		Yes
Year FEs		Yes		Yes
No. of countries		45		45
No. of observations		65,752		65,752

Table 7. Board gender diversity and firm-value

This table presents the estimation results when the dependent variables are ROA and Tobin's Q. Panel A presents the HLM results without instrumenting. The sample contains 77,873 firm-year observations from 45 countries for the period 2001-2014, for which we have board data from BoardEx and firm characteristics data from BvD Osiris. Panel B presents the HLM results where female director ratio is instrumented with the fraction of male directors on board who sit on other boards on which there are female directors. The sample follows that used in Panel A but excludes firm-years with at least one male director seating on peer firms in the same (4-digit SIC) industry. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. HLM

	ROA		Tobin's Q	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics				
Female ratio	0.061***	0.109***	0.849***	0.139
	[0.006]	[0.035]	[0.044]	[0.285]
Board size	-0.002***	-0.003**	0.071***	-0.006
	[0.000]	[0.001]	[0.002]	[0.012]
Board independence	-0.040***	0.085***	0.251***	-0.170
	[0.005]	[0.026]	[0.033]	[0.299]
Ln(total assets)	0.023***	0.015***	-0.213***	0.016
	[0.000]	[0.002]	[0.003]	[0.019]
Ln(firm age)	0.021***	0.021***	-0.029***	0.081
	[0.001]	[0.008]	[0.005]	[0.072]
Tangibility	0.037***	0.010	-0.440***	-0.680***
	[0.003]	[0.028]	[0.021]	[0.261]
Country Characteristics				
Masculinity		0.033		-1.175***
		[0.021]		[0.400]
Female labor participation		0.054		-0.071
		[0.041]		[0.451]
Ln(GDP per capita)		-0.014***		-0.337***
		[0.003]		[0.040]
Stock mkt/GDP		-0.004		0.064
		[0.005]		[0.045]
Cross-level interactions		*Within-country* × *Cross-country*		*Within-country* × *Cross-country*
Masculinity × Female ratio		-0.035		0.803**
		[0.048]		[0.338]
Female labor participation × Female ratio		-0.017		0.814
		[0.123]		[0.853]

Industry FEs	Yes	Yes
Year FEs	Yes	Yes
No. of countries	45	45
No. of observations	77,873	77,873

Panel B. Instrumented HLM

	ROA		Tobin's Q	
	Within-country	*Cross-country*	*Within-country*	*Cross-country*
Firm Characteristics				
Female ratio	0.115***	0.940***	8.439***	-2.209
	[0.026]	[0.241]	[0.187]	[2.219]
Board size	-0.002***	-0.003**	0.062***	-0.003
	[0.000]	[0.001]	[0.002]	[0.013]
Board independence	-0.033***	0.052**	0.023	0.203
	[0.005]	[0.025]	[0.035]	[0.317]
Ln(total assets)	0.020***	0.013***	-0.250***	0.024
	[0.000]	[0.002]	[0.003]	[0.019]
Ln(firm age)	0.019***	0.015**	-0.020***	0.015
	[0.001]	[0.007]	[0.006]	[0.070]
Tangibility	0.028***	0.026	-0.367***	-0.860***
	[0.003]	[0.028]	[0.023]	[0.283]
Country Characteristics				
Masculinity		0.019		-1.031***
		[0.018]		[0.380]
Female labor participation		0.028		0.468
		[0.037]		[0.454]
Ln(GDP per capita)		-0.014***		-0.278***
		[0.003]		[0.040]
Stock mkt/GDP		-0.002		0.095**
		[0.005]		[0.046]
Cross-level interactions		*Within-country* × *Cross-country*		*Within-country* × *Cross-country*
Masculinity × Female ratio		0.993***		13.000***
		[0.183]		[1.315]
Female labor participation × Female ratio		2.042***		11.000***
		[0.459]		[3.259]
Industry FEs		Yes		Yes
Year FEs		Yes		Yes
No. of countries		45		45
No. of observations		65,752		65,752

Table IA1. Sample coverage across countries and over time

This table presents the distribution of our sample across countries and our sample years based on the main sample used in our analysis.

Country name	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
ARGENTINA	0	0	0	1	1	1	3	5	8	8	8	12	12	1	60
AUSTRALIA	0	2	10	73	153	201	268	350	353	461	498	539	557	96	3,561
AUSTRIA	3	3	3	4	5	7	8	30	29	28	26	25	27	13	211
BELGIUM	10	49	51	55	57	61	54	57	67	67	63	65	65	18	739
BRAZIL	0	0	0	0	0	4	4	10	16	19	65	65	78	48	309
CANADA	1	7	10	86	132	155	211	376	395	424	447	495	536	456	3,731
CHILE	0	0	0	0	0	1	1	3	6	6	6	18	20	3	64
CHINA	3	3	2	7	12	30	41	97	127	152	292	295	294	90	1,445
COLOMBIA	0	0	0	0	0	0	0	0	1	1	1	1	6	5	15
CROATIA	0	0	0	0	0	0	1	2	1	1	1	1	1	1	9
CZECH REPUBLIC	0	0	0	0	0	0	0	0	1	1	1	1	1	0	5
DENMARK	10	11	12	12	13	17	19	19	19	19	24	27	29	28	259
FINLAND	5	8	8	9	10	19	23	27	27	27	37	44	45	41	330
FRANCE	69	114	126	153	171	202	212	229	244	242	243	286	273	106	2,670
GERMANY	78	79	84	88	92	134	142	145	144	147	154	214	216	165	1,882
GREECE	3	4	8	9	13	18	19	36	42	40	39	42	46	14	333
HUNGARY	0	0	0	0	0	0	0	1	1	1	1	1	1	0	6
INDIA	0	0	0	0	4	11	54	170	177	198	223	242	262	18	1,359
INDONESIA	0	0	0	0	0	0	0	1	1	2	3	5	26	34	72
IRELAND	22	42	49	52	55	63	69	70	72	67	66	62	63	26	778
ISRAEL	3	7	13	26	57	66	69	73	75	71	70	73	77	42	722
ITALY	18	21	24	27	31	50	52	64	61	64	68	70	72	11	633
JAPAN	0	0	0	2	2	6	13	27	30	33	60	89	250	43	555
LUXEMBOURG	2	3	6	7	9	13	13	13	17	16	18	27	31	7	182
MALAYSIA	0	0	0	0	0	0	1	25	30	31	27	30	64	25	233
MALTA	0	0	0	0	0	0	0	0	0	1	1	2	1	0	5
MEXICO	0	0	0	0	0	2	3	11	22	21	21	38	37	6	161
MOROCCO	0	0	0	0	0	1	2	2	2	1	1	1	1	0	11

NETHERLANDS	20	54	60	67	70	78	79	78	78	74	74	77	74	9	892
NEW ZEALAND	0	0	0	1	2	3	4	9	8	13	15	13	28	3	99
NORWAY	23	30	37	39	43	42	42	40	39	39	45	50	45	37	551
PERU	0	0	0	0	0	0	0	1	1	1	2	3	4	1	13
PHILIPPINES	0	0	0	0	0	1	1	0	2	2	2	22	26	13	69
POLAND	0	0	0	0	0	0	0	11	12	12	14	13	19	20	101
PORTUGAL	5	6	7	9	9	9	10	21	24	24	23	25	25	5	202
RUSSIAN FEDERATION	1	1	1	3	3	8	9	17	18	18	18	22	29	29	177
SINGAPORE	3	3	3	4	4	8	8	20	33	42	158	149	151	67	653
SOUTH AFRICA	0	0	0	0	1	6	10	40	74	83	133	151	151	27	676
SPAIN	21	24	26	30	31	38	45	50	67	66	73	82	80	15	648
SWEDEN	55	60	73	86	86	86	89	91	88	85	95	97	95	81	1,167
SWITZERLAND	36	37	40	43	52	62	62	61	66	72	73	76	79	67	826
THAILAND	0	0	0	0	0	0	0	0	0	0	1	15	19	24	59
TURKEY	0	0	0	0	0	0	0	4	4	4	4	6	17	8	47
UNITED KINGDOM	458	531	642	824	1,016	1,234	1,377	1,261	1,178	1,117	1,058	1,032	1,015	322	13,065
UNITED STATES	1,181	1,317	1,401	2,802	3,161	3,416	3,500	3,419	3,253	3,069	3,048	3,022	2,966	2,733	38,288
Total	2,030	2,416	2,696	4,519	5,295	6,053	6,518	6,966	6,913	6,870	7,300	7,625	7,914	4,758	77,873

Table IA2. Comparing our sample and the universe of Osiris firms

This appendix compares firm characteristics between our sample and the universe of firms in BvD Osiris. Our sample contains 77,873 firm-year observations from 45 countries for the period 2001-2014. The BvD Osiris universe contains 662,809 firm-year observations from 148 countries for the period 2001-2014. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. Panel A compares means and medians of firm characteristics between our sample and the BvD Osiris universe. Panel B presents the percentiles of our sample means/medians relative to the BvD Osiris universe.

Panel A. Comparing means and median of firm characteristics

Variable	Our sample		Osiris universe		P-value	
	Mean	Median	Mean	Median	T test	Wilcoxon test
Ln(total assets)	13.13	13.11	12.90	13.05	0.00	0.00
Ln(firm age)	3.08	3.04	2.86	2.94	0.00	0.00
Tangibility	0.27	0.18	0.31	0.25	0.00	0.00
Stock volatility	0.12	0.11	0.14	0.12	0.00	0.00
R&D	0.04	0.00	0.02	0.00	0.00	0.00
ROA	0.00	0.03	-0.01	0.02	0.00	0.00
Tobin's Q	2.02	1.38	2.18	1.20	0.00	0.00

Panel B. The percentiles of our sample means/medians in the BvD Osiris universe

	Percentile of our sample mean in BvD Osiris	Percentile of our sample median in BvD Osiris
Ln(total assets)	50.90	50.70
Ln(firm age)	53.39	53.39
Tangibility	50.39	38.63
Stock volatility	34.03	28.19
R&D	89.76	39.15
ROA	29.22	54.07
Tobin's Q	47.90	37.62

Table IA3. Correlations of country-level variables and the country means of firm-level variables

This table presents the pairwise correlations between country-level variables and the country means of firm-level variables. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Masculinity	Regulation quota	Regulation code	Regulation disclosure	Gender Gap Index	Female labor participation	Ln(GDP per capita)	Stock mkt/GDP	Female ratio on board	Board size	Board independence	Female CEO
Masculinity	1.000											
Regulation quota	-0.196***	1.000										
Regulation code	-0.130***	0.252***	1.000									
Regulation disclosure	-0.118***	0.220***	0.219***	1.000								
Gender Gap Index	0.385***	-0.182***	-0.262***	-0.261***	1.000							
Female labor participation	-0.251***	0.047	0.059	0.115***	-0.597***	1.000						
Ln(GDP per capita)	-0.129***	0.193***	0.255***	0.237***	-0.493***	0.266***	1.000					
Stock mkt/GDP	-0.008	-0.046	0.113**	-0.026	-0.087*	0.170***	0.261***	1.000				
Female ratio on board	-0.399***	0.445***	0.152***	0.241***	-0.495***	0.231***	0.199***	0.023	1.000			
Board size	0.283***	-0.124***	-0.042	-0.034	0.226***	-0.351***	-0.102**	-0.340***	-0.226***	1.000		
Board independence	-0.368***	0.150***	0.012	-0.049	-0.307***	0.129***	0.146***	0.054	0.358***	-0.185***	1.000	
Female CEO	0.035	-0.019	0.000	0.013	-0.144***	0.131***	0.058	-0.020	0.121***	-0.143***	0.009	1.000
Ln(total assets)	0.056	-0.218***	-0.200***	0.024	0.309***	-0.295***	-0.330***	-0.130***	-0.154***	0.539***	0.018	-0.120***
Ln(firm age)	-0.023	0.023	0.170***	0.164***	-0.089**	-0.237***	0.185***	-0.020	0.043	0.345***	0.047	-0.103**
Tangibility	-0.004	-0.277***	-0.227***	-0.134***	0.176***	-0.171***	-0.336***	-0.212***	-0.211***	0.356***	-0.016	0.035

Table IA4. Non-linear effect board gender diversity

Panel A presents the linear contrast effects of female directors by employing a set of dummy variables indicating the number of female directors on board being above different thresholds. Panel B presents the non-linear effect of female director count. *Female director_categorial* is a categorical variable equal to 1 if a firm-year has one female director, 2 if a firm-year has two, and 3 if a firm-year has more than two female directors. In both panels the samples and specifications follow those used in Panels A of Tables 4-7. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Incremental effects of female director count

	Ln(patent count)	Ln(citation count)	Ln(citation-weighted patent count)	Efficiency_ patent	Efficiency_ citation	Efficiency_ citation-weighted patent	Scope	Stock volatility	R&D/total assets	ROA	Tobin's Q
Within-country											
female director count>=1	0.076***	0.074***	0.095***	0.018***	0.026***	0.087***	0.007	-0.004***	-0.002***	0.009***	0.131***
	[0.008]	[0.009]	[0.011]	[0.004]	[0.006]	[0.019]	[0.006]	[0.001]	[0.001]	[0.001]	[0.010]
female director count>=2	0.051***	0.048***	0.065***	0.014**	0.006	0.040	0.017**	-0.005***	-0.004***	0.008***	0.182***
	[0.012]	[0.013]	[0.016]	[0.006]	[0.009]	[0.029]	[0.008]	[0.001]	[0.001]	[0.002]	[0.014]
female director count>=3	-0.007	-0.005	-0.023	0.005	0.010	0.044	0.015	0.002	-0.003*	0.005	0.022
	[0.018]	[0.020]	[0.025]	[0.009]	[0.014]	[0.047]	[0.014]	[0.001]	[0.002]	[0.003]	[0.022]
Cross-country											
female director count>=1	0.194**	0.402***	0.395***	0.215***	0.480***	1.555***	0.062	-0.009	-0.008	0.045***	0.174
	[0.094]	[0.101]	[0.126]	[0.042]	[0.065]	[0.219]	[0.050]	[0.006]	[0.007]	[0.014]	[0.114]
female director count>=2	0.050	0.039	0.107	0.106	0.049	0.353	0.146	-0.009	-0.014	0.024	0.163
	[0.141]	[0.153]	[0.190]	[0.066]	[0.101]	[0.338]	[0.125]	[0.009]	[0.011]	[0.022]	[0.166]
female director count>=3	-0.321	-0.296	-0.515*	-0.103	-0.171	-0.697	-0.046	0.019	0.007	-0.067**	-0.521**
	[0.214]	[0.231]	[0.287]	[0.096]	[0.147]	[0.493]	[0.207]	[0.012]	[0.015]	[0.030]	[0.220]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of countries	45	45	45	42	42	42	28	45	45	45	45
No. of observations	73,115	73,115	73,115	31,521	31,521	31,521	12,454	77,873	77,873	77,873	77,873

Panel B. Non-linearity effect

	Ln(patent count)	Ln(citation count)	Ln(citation-weighted patent count)	Efficiency_ patent	Efficiency_ citation	Efficiency_ citation-weighted patent	Scope	Stock volatility	R&D/total assets	ROA	Tobin's Q
Within-country											
female director_categorial	0.097***	0.095***	0.126***	0.022***	0.030***	0.098***	0.005	-0.006***	-0.002**	0.010***	0.166***
	[0.011]	[0.012]	[0.015]	[0.005]	[0.008]	[0.026]	[0.008]	[0.001]	[0.001]	[0.002]	[0.013]
female director_categorial^2	-0.018***	-0.018***	-0.026***	-0.003	-0.006*	-0.015	0.003	0.001***	-0.000	-0.001	-0.014***
	[0.004]	[0.005]	[0.006]	[0.002]	[0.003]	[0.011]	[0.003]	[0.000]	[0.000]	[0.001]	[0.005]
Cross-country											
female director_categorial	0.328**	0.576***	0.631***	0.298***	0.638***	2.114***	0.076	-0.018**	-0.013	0.076***	0.384***
	[0.128]	[0.138]	[0.172]	[0.057]	[0.087]	[0.293]	[0.073]	[0.008]	[0.009]	[0.018]	[0.145]
female director_categorial^2	-0.114**	-0.176***	-0.205***	-0.073***	-0.177***	-0.573***	-0.001	0.006**	0.002	-0.024***	-0.138***
	[0.048]	[0.051]	[0.064]	[0.021]	[0.032]	[0.109]	[0.029]	[0.003]	[0.003]	[0.007]	[0.052]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of countries	45	45	45	42	42	42	28	45	45	45	45
No. of observations	73,115	73,115	73,115	31,521	31,521	31,521	12,454	77,873	77,873	77,873	77,873

Table IA5. The effect of board gender diversity by Fama-French 12 industries

This table presents industry-specific effect of female directors on various corporate outcomes. We interact firm-level female ratio on board with twelve Fama-French industry indicators to obtain the effect of female directors within each industry. The samples and dependent variables follow those used in Panels A of Tables 3-7. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Coefficient on firm-level female_ratio within a FF12 industry	Ln(patent count)	Ln(citation count)	Ln(citation-weighted patent count)	Efficiency_ patent	Efficiency_ citation	Efficiency_ citation-weighted patent	Scope
Consumer Non-durables -- Food, Tobacco, Textiles, Apparel, Leather, Toys	0.276**	0.196	0.407***	0.124*	-0.087	0.386	0.020
	[0.115]	[0.125]	[0.155]	[0.074]	[0.114]	[0.381]	[0.132]
Consumer Durables -- Cars, TV's, Furniture, Household Appliances	0.566**	0.511**	0.454	-0.195*	-0.411**	-1.163**	-0.126
	[0.234]	[0.253]	[0.314]	[0.106]	[0.163]	[0.545]	[0.168]
Manufacturing -- Machinery, Trucks, Planes, Furniture, Paper, Com Printing	0.994***	1.080***	1.270***	-0.030	0.002	-0.079	-0.104
	[0.119]	[0.129]	[0.160]	[0.051]	[0.078]	[0.260]	[0.078]
Oil, Gas, and Coal Extraction and Products	-0.258	-0.284	-0.094	-0.006	-0.119	0.056	-0.380**
	[0.185]	[0.200]	[0.249]	[0.098]	[0.150]	[0.502]	[0.178]
Chemicals and Allied Products	0.416**	0.084	0.401	0.135*	0.136	0.539	0.673***
	[0.185]	[0.200]	[0.248]	[0.073]	[0.111]	[0.373]	[0.110]
Business Equipment-- Computers, Software, Electronic Equipment	1.380***	1.426***	1.571***	0.096***	0.199***	0.512***	0.266***
	[0.095]	[0.102]	[0.127]	[0.033]	[0.050]	[0.169]	[0.053]
Telephone and Television Transmission	0.146	0.192	0.379*	-0.003	-0.010	-0.114	-0.237
	[0.168]	[0.182]	[0.225]	[0.093]	[0.143]	[0.478]	[0.169]
Utilities	-0.586***	-0.554***	-0.789***	0.780***	0.347	2.663***	-0.818***
	[0.187]	[0.203]	[0.251]	[0.142]	[0.218]	[0.730]	[0.256]
Wholesale, Retail, and Some Services (Laundries, Repair Shops)	-0.294***	-0.318***	-0.374***	-0.097	-0.164	-0.512	0.150
	[0.101]	[0.110]	[0.136]	[0.104]	[0.159]	[0.532]	[0.147]

Healthcare, Medical Equipment, and Drugs	0.975***	0.914***	1.121***	0.121***	0.183***	0.560***	-0.060
	[0.115]	[0.124]	[0.154]	[0.039]	[0.060]	[0.200]	[0.063]
Finance	-0.133	-0.170	-0.146	-0.048	-0.114	-0.270	0.584**
	[0.118]	[0.128]	[0.158]	[0.099]	[0.152]	[0.509]	[0.260]
Other -- Mines, Constr, BldMt, Trans, Hotels,	-0.063	-0.066	-0.088	0.215***	0.260***	0.885***	-0.079
Bus Serv, Entertainment	[0.080]	[0.087]	[0.108]	[0.050]	[0.076]	[0.255]	[0.107]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of countries	45	45	45	42	42	42	28
No. of observations	73,115	73,115	73,115	31,521	31,521	31,521	12,454

Continued

Coefficient on firm-level female_ratio within a FF12 industry	Stock volatility	R&D/total assets	ROA	Tobin's Q
Consumer Non-durables -- Food, Tobacco, Textiles,	-0.027***	0.002	0.034*	1.166***
Apparel, Leather, Toys	[0.008]	[0.010]	[0.020]	[0.143]
Consumer Durables -- Cars, TV's, Furniture,	0.036**	-0.000	-0.028	1.582***
Household Appliances	[0.015]	[0.020]	[0.041]	[0.285]
Manufacturing -- Machinery, Trucks, Planes,	-0.006	0.024**	0.019	1.233***
Furniture, Paper, Com Printing	[0.008]	[0.010]	[0.021]	[0.144]
Oil, Gas, and Coal Extraction and Products	-0.072***	0.056***	0.045	0.899***
	[0.012]	[0.016]	[0.032]	[0.222]
Chemicals and Allied Products	-0.094***	-0.315***	0.418***	0.833***
	[0.012]	[0.016]	[0.032]	[0.222]
Business Equipment-- Computers, Software,	-0.029***	-0.071***	0.083***	1.325***
Electronic Equipment	[0.006]	[0.008]	[0.016]	[0.115]
Telephone and Television Transmission	-0.070***	0.012	0.030	1.172***
	[0.011]	[0.014]	[0.029]	[0.202]

Utilities	-0.115***	-0.015	0.063**	-0.553**
	[0.012]	[0.016]	[0.032]	[0.222]
Wholesale, Retail, and Some Services	0.001	0.017**	0.035**	0.881***
(Laundries, Repair Shops)	[0.007]	[0.009]	[0.018]	[0.124]
Healthcare, Medical Equipment, and Drugs	-0.035***	-0.099***	0.181***	0.147
	[0.007]	[0.010]	[0.020]	[0.140]
Finance	0.007	0.025**	-0.019	1.073***
	[0.007]	[0.010]	[0.020]	[0.142]
Other -- Mines, Constr, BldMt, Trans, Hotels,	-0.012**	-0.002	0.029**	0.502***
Bus Serv, Entertainment	[0.005]	[0.007]	[0.014]	[0.098]
Industry FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
No. of countries	45	45	45	45
No. of observations	77,873	77,873	77,873	77,873

Table IA6. Excluding US.

This table presents the effect of board gender diversity on various firm outcomes excluding firm-years in the US. Panel A presents the HLM results without instrumenting. Panel B presents the HLM results where female director ratio is instrumented with the fraction of male directors on board who sit on other boards on which there are female directors. All variables and specifications follow those used in Tables 4-7. All firm-level variables are winsorized at the 1% level in both tails of the distribution. Variable definitions are provided in Appendix I. All regressions include two-digit SIC industry fixed effects and year fixed effects. Standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. HLM

	Ln(patent count)	Ln(citation count)	Ln(citation-weighted patent count)	Efficiency _patent	Efficiency _citation	Efficiency _citation-weighted patent	Scope	Stock volatility	R&D/total assets	ROA	Tobin's Q
Within-country											
Female ratio	0.067*	0.066*	0.107**	0.049***	0.018	0.193***	0.013	-0.013***	-0.012***	0.046***	0.367***
	[0.036]	[0.035]	[0.046]	[0.016]	[0.018]	[0.067]	[0.066]	[0.003]	[0.004]	[0.008]	[0.059]
Cross-country											
Female ratio	-0.872***	-0.536***	-1.068***	0.095**	0.119**	0.348**	-0.043	-0.013	-0.011	0.043	0.115
	[0.178]	[0.174]	[0.228]	[0.042]	[0.060]	[0.176]	[0.220]	[0.015]	[0.016]	[0.035]	[0.285]
Female ratio	-0.367*	-0.236	-0.458*	0.020	-0.070	0.068	-0.076	0.010	-0.009	-0.097**	-0.321
× Masculinity	[0.208]	[0.204]	[0.266]	[0.083]	[0.094]	[0.349]	[0.288]	[0.019]	[0.020]	[0.048]	[0.344]
Female ratio	1.087**	0.985*	1.623**	-0.136	0.073	-0.377	0.535	-0.009	0.017	-0.056	-2.679**
× Female labor participation	[0.544]	[0.533]	[0.698]	[0.238]	[0.271]	[1.006]	[1.026]	[0.048]	[0.053]	[0.125]	[0.885]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of countries	44	44	44	41	41	41	27	44	44	44	44
No. of observations	37560	37560	37560	16127	16127	16127	2924	39585	39585	39585	39585

Panel B. Instrumented HLM

	Ln(patent count)	Ln(citation count)	Ln(citation-weighted patent count)	Efficiency _patent	Efficiency _citation	Efficiency _citation-weighted patent	Scope	Stock volatility	R&D/total assets	ROA	Tobin's Q
Within-country											
Female ratio	1.543***	1.503***	1.923***	-0.000	0.053	0.091	0.283	-0.027	0.119***	-0.118***	4.391***
	[0.180]	[0.177]	[0.232]	[0.073]	[0.083]	[0.314]	[0.275]	[0.016]	[0.017]	[0.041]	[0.298]
Cross-country											
Female ratio	-4.043**	-4.754***	-6.264***	0.401	0.474	1.727	-0.951	0.110	-0.163	0.511*	-5.502**
	[1.666]	[1.624]	[2.141]	[0.352]	[0.461]	[1.507]	[1.690]	[0.129]	[0.129]	[0.279]	[2.515]
Female ratio	-4.332***	-3.909***	-4.167***	-0.508	-0.189	-1.816	-1.976*	-0.322***	0.067	0.521**	4.940***
× Masculinity	[0.904]	[0.885]	[1.162]	[0.322]	[0.365]	[1.381]	[1.051]	[0.081]	[0.087]	[0.205]	[1.488]
Female ratio	-6.187***	-6.495***	-7.516**	-0.945	-1.184	-3.236	9.111**	-0.704***	-0.264	1.009*	-11.791**
× Female labor participation	[2.291]	[2.244]	[2.946]	[0.939]	[1.063]	[4.021]	[3.899]	[0.205]	[0.223]	[0.528]	[3.748]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of countries	44	44	44	41	41	41	27	44	44	44	44
No. of observations	33622	33622	33622	14323	14323	14323	2593	35360	35360	35360	35360