How Gender Diversity and National Institutions Shape Technological Innovation: A Multi-Country Study of the Moderating Effect of Evolving Institutions

Zeynep Yavic1, Rafael Corredoira2

1The Ohio State University Department of Management and Human Resources

2Newcastle University, International Business

In recent decades, the participation of women in STEM occupations has significantly increased and, at the same time, the pursuit of innovation has become a worldwide endeavor. Against this backdrop, and to understand how these shifts influence innovation, this study explores the moderating impact of formal and informal national institutions on the relationship between gender diversity and innovation quality. Departing from common assumptions in the extant literature, we argue that gender diversity signifies an underlying diversity (i.e., social cognitive diversity) that enhances innovation performance. As such, we contend that the correlation between gender diversity and social cognitive diversity varies across societies due to differences in norms and regulations. Building on the relationship between diversity and innovation and focusing on the effect of institutions on social cognition, we argue that gender diversity is positively associated with invention quality, but the relationship is negatively moderated by national gender-egalitarian institutions. Leveraging a novel measure of gender equality norms alongside data on gender equality laws from the USPTO and World Bank spanning 1990 to 2008, our findings confirm our predictions. Results show that higher gender diversity correlates with improved innovation outcomes, and the correlation diminishes as institutional gender egalitarianism, both formal and informal, increases. These results corroborate the thesis that gender-diverse teams tend to experience greater advantages in environments with less gender equality. This phenomenon arises from social cognitive differences, which emerge because of entrenched traditional gender roles. Our paper highlights institutional frameworks as a pivotal boundary condition in the study of gender diversity’s effect on innovation.

**Introduction**

Over the past few decades, there has been a notable rise in women's involvement in innovation (Schneid et al. 2015 & Kabst, 2015, Dwivedi and Paolella 2023). Research on this phenomenon has revealed a crucial insight: gender-diverse teams tend to generate more novel and impactful scientific ideas (Yang et al. 2022). Central to this creativity research is how cognitive diversity enhances problem-solving in teams (Hong and Page 2004, Xie et al. 2020). Gender diversity, as a significant source of cognitive diversity in teams, enriches creative output by providing varying perspectives and approaches to problem-solving. Recognizing this cognitive aspect is crucial for understanding the presumed positive impacts of gender diversity on innovation outcomes (Hong and Page 2004).

Research in this area has emphasized the foundational significance of the mental processes through which individuals perceive, interpret, and understand information about themselves, others, and their social environment. This research encompasses various cognitive mechanisms that shape how individuals navigate and comprehend social interactions (Bandura, 1986). In addition, recent work has shown that egalitarian institutional contexts affect practices in the international arena (e.g., Bourmault and Siegel 2022, Kim and Siegel 2024). However, despite this awareness, studies have neglected to consider the impact of sociocultural and institutional contexts on cognitive processes when investigating the relationship between gender diversity and innovation (Dickman & Schmader, 2020). Institutional influences on gender behavior give rise to varied connections between gender and cognitive diversity across different contexts and historical periods (Zhao & Yang, 2020; Henrich et al., 2010). This reflects the fact that cognition associated with gender is not developed in isolation but is deeply entrenched within institutions, which encompass societal norms and structure and shape cognitive processes and behaviors (Bussey & Bandura, 1999; Markus & Kitayama, 2010; Dickman & Schmader, 2020). This interplay between cognition and social context underscores the dynamic nature of gender cognitions (Markus & Kitayama, 2010).

Building upon previous research, our focus on the longitudinal interplay between gender, social cognition, and national institutional context motivates our research question: How do national institutions moderate the effects of gender diversity on the resulting technological influence of inventions over time? We argue that this unexplored aspect may be behind the inconsistent findings observed in studies examining the relationship between gender diversity and innovation across different countries. For instance, research from China and Denmark has suggested a positive impact on innovation efficiency and likelihood (Østergaard, Timmermans & Kristinsson, 2011; Xie et al., 2020). Conversely, research in Spain found a curvilinear effect on innovation outputs, while in Singapore there was no significant association (Sastre, 2015; Faems & Subramanian, 2013). These diverse findings suggest the potential influence of institutional settings on the relationship between gender diversity and innovation outcomes.

We utilize the principles of institutional economics regarding institutions’ role in shaping economic activity, particularly innovation, through individuals' cognitive traits and interactions (Chappell & Waylen, 2013; Ioannou & Serafeim, 2012; Makhija & Stewart, 2002). By integrating the principles of institutional economics with gender-based cognitive differences, which are significantly influenced by social context (Nielsen et al., 2018), we argue that the relationship between gender diversity and innovation depends on the institutional context. Nevertheless, the impact of social policies and norms on innovation outcomes remains uncertain (Vakili & Zhang, 2018). By answering our research question, this paper aims to advance our understanding of this relationship.

We test our research question using United States Patent and Trademark Office (USPTO) data and measuring the effect of gender diversity within inventor teams on patent influence—a variable that accounts for indirect ripple effects as it gauges the degree to which a patent shapes subsequent technological advancement (Corredoira & Bannerjee, 2015). To test the moderating effects of national context, we (a) introduce a novel longitudinal measure of a country's informal institutions—gender egalitarianism (derived from a textual analysis of thousands of news articles, spanning 21 countries over 18 years)—and (b) derive gender-egalitarian law measures from the Women, Business and the Law survey (World Bank, 2020). Consistent with Yang et al. (2022), we find that on average, increasing the gender diversity of a patent team enhances its influence on subsequent technologies. However, our study also reveals a counterintuitive relationship: when institutions endorse gender-egalitarian norms, this diminishes the positive impact of gender diversity on innovation outcomes, which is attributable to the converging social cognition of men and women. Our results remain unchanged after controlling for potential endogeneity in gender-diverse team characteristics through coarsened exact matching (CEM) and the application of several other statistical techniques.

This paper bridges the gap between the diversity literature and institutional economics, shedding light on how legal and cultural environments in different countries shape the effect of gender diversity's influence on innovation outcomes. The contributions of this paper are threefold: (a) to the diversity literature (answering Zhang’s [2020] call), by examining how institutions shape diverse teams’ outcomes; (b) to the research on the impact of gender diversity on innovation, by explaining one source for the mixed findings we see in prior work; and (c) to research on informal institutions, by introducing a longitudinal measure of gender egalitarianism for 21 countries. As such, this is a first step in stimulating future research on the complex interplay of team diversity and the broader social context in which the team is situated.

**Theory**

Gender, one of the most salient social categories or surface-level diversity attributes (Phillips and Loyd 2006), is pivotal in shaping team dynamics. The impact of gender diversity on team outcomes has captured significant attention among management scholars studying the dynamics of diverse teams. A salient observation made by these scholars underscores that the overall influence of gender diversity on team performance is primarily contingent on task nature and complexity (Wegge et al. 2008). On the one hand, gender diversity can significantly enhance performance in complex tasks that require innovative and creative solutions due to the representation of diverse cognitive frameworks (Hong and Page 2004). On the other hand, gender diversity can significantly hurt performance (Byrne 1971, Van Maanen and Schein 1979) when communication challenges and conflicts rise (Adams and Funk 2012, Hoever et al. 2012), as argued under similarity attraction and social categorization theories (Byrne 1971, Van Maanen and Schein 1979). Modern inventor teams tend to engage in complex tasks with limited communication challenges (due to their shared language and reliance on scientific methods and evidence) more than other professions. While this is an empirical question, we expect the positive effect of gender diversity to be dominant in our context. (Hong and Page 2004) Innovation scholars have repeatedly linked team cognitive diversity with creativity in solving complex and uncertain problems (Moreland and Levine 2014). Studies have demonstrated that the varied perspectives, knowledge, and skills brought by team members of different genders tend to surpass potential adverse effects (Herring 2009). Cognitive diversity is recognized as the primary way in which gender diversity influences innovation, and recent empirical research supports the idea that gender is the most critical demographic characteristic associated with cognitive diversity (Lix et al. 2022 & Valentine, 2022), suggesting that gender diversity's benefits for innovation are connected to social cognitive diversity.

Our study builds on the extensive body of management research that has examined the relationship between gender diversity and innovation within firms’ upper echelons (Ruiz-Jiménez et al. 2016, Spender et al. 2017 & Rippa, 2017, Hemmert et al. 2022). Scholars have scrutinized how the gender composition of top management teams (TMT) influences innovation outcomes, primarily in terms of strategic decisions, such as R&D investment and acquisition choices. However, our paper diverges from the predominant trajectory of gender diversity research in management by shifting our focus from TMTs to inventor teams. We explore the natural dynamics and subsequent innovation outcomes of interactions within diverse teams, reflecting our commitment to understanding the impact of teams' social cognition, specifically team gender diversity, on innovation. To truly understand why and how gender diversity affects innovation quality, we must examine the teams in which it occurs, not just where strategies are determined.

A new research stream has started shifting the focus towards inventor teams, exploring the relationships between gender diversity and innovation teams' efficiency, radicalness, knowledge diversity, and novelty {Díaz-García, González-Moreno, & Jose Sáez-Martínez, 2013; Sastre, 2015; Teruel & Segarra-Blasco, 2017; Xie et al., 2020}. These studies are either descriptive or draw from multiple theories regarding the relationship between gender diversity and innovation, such as inherent gender differences in conflict management, skills, compromising, and communication styles. What sets our research apart from prior studies that analyze inventor teams is our explicit emphasis on social cognition as the mechanism through which gender diversity affects innovation and, building on social cognition theory, our exploration of how distinct institutional environments can moderate the impact of gender diversity on innovation outcomes. This approach challenges the implicit assumption of gender diversity being associated with cognitive diversity without variation across time and geographies. By exploring the interaction between gender diversity and institutional environments, our study aims to shed light on the complex relationship between gender diversity and innovation outcomes in inventor teams.

**Gender, Social Cognition, and Innovation**

Social cognition encompasses various cognitive processes contributing to how individuals navigate and make sense of social interactions. Thus, social cognitive theory provides significant insights into the cognitive processes involved in acquiring, processing, and applying information within a social context (Bandura 1986). When this theoretical framework is applied to gender, it elucidates the gender identity and roles acquired through mechanisms such as observational learning, modeling, and reinforcement within a social context.

Institutions are organized with respect to gender, giving rise to gender-specific norms and expectations. These elements influence the dynamics of interpersonal interactions within and between gender lines and chosen experiences (Diekman and Schmader 2021). Gender conceptions develop through a complex interplay of experiences, interacting with motivational and self-regulatory mechanisms. This dynamic shapes gender-linked behavior, impacting nearly every aspect of individuals' daily lives (Bussey and Bandura 1999). As social systems integrate and maintain the meanings attached to gender categories, they transcend individual perceptions and take on tangible reality (Diekman and Schmader 2021). Contextual cues affect the applicability of gender-related cognitions in different contexts, yet shared values and institutional frameworks frequently maintain these cues. Men and women can therefore have very diverse experiences in families, businesses, and societal institutions due to disparities in information processing and variations in socialization processes, even within the same social settings.

In forming our hypothesis, we adopted social cognitive theory's perspective of gender as a social cognition embedded throughout multiple levels of psychology and social structure (Diekman and Schmader 2021). According to the social cognitive perspective, while specific gender differences may have biological roots, the majority of stereotypical gender attributes and roles stem more from social and cultural influence than inherent biological traits (Bandura 1986, Beall 1993, Epstein 1997, Bussey and Bandura 1999). Consistent with the studies suggesting that the gender diversity of inventor teams positively influences the innovation process (Gibson and Vermeulen 2003, Lix et al. 2022 Valentine, 2022), we argue that the cognitive diversity resulting from gender diversity within inventor teams enhances the transformative quality of inventions (i.e., their breakthrough characteristics), thereby increasing their significance for technological evolution (i.e., invention influence).

The assessment of an invention's influence hinges on its transformative quality, which includes its ability to introduce new technological concepts, drive technological progress, and have a lasting impact on subsequent innovations (Rafael A. Corredoira and Banerjee 2015). Creating influential innovations is a challenging task, yet it becomes more attainable when inventors with diverse cognitive perspectives collaborate to develop more effective strategies and inventive solutions (Campbell 1965, Huo et al. 2019). Highly influential inventions increase successive inventive activity and broaden applicability across various technological domains, which are characteristics of breakthrough and not mundane inventions. The cognitive differences stemming from gender within mixed-gender inventor teams play a pivotal role in increasing the likelihood of larger invention influence by bringing diverse perspectives, knowledge domains, and problem-solving capabilities to the table. When teams have cognitive homogeneity, they may be more likely to have converging ideas and neglect the wealth of diverse viewpoints. In contrast, cognitive heterogeneity can help mitigate insular tendencies, promoting a more comprehensive range of perspectives and ideas that ultimately lead to more impactful innovations.

The unique cognitive attributes of men and women contribute to an expanded spectrum of knowledge and perspectives within the team, engendering facilitation in information sharing and integration within the innovation process. This interaction, in turn, augments the inventive capacities of teams, leading to more effective solutions to complex technological challenges and amplifying the influence of innovation. Overall, the ability to combine various viewpoints, knowledge domains, and diverse teams’ problem-solving capabilities is a critical determinant in significantly influencing subsequent technologies. Therefore, we hypothesize that gender diversity can improve the sustained impact of innovation on subsequent technological advancements.

*Hypothesis 1: Gender diversity of inventor teams will increase the technological influence of invention.*

**Institutions and Social Cognition**

Social cognition does not occur independently of the social environment. Its social nature is defined by the contexts in which it occurs and the sociocultural framework that shapes both its content and processes (Diekman and Schmader 2021). Cognitions relating to gender are the result and persist within a more extensive system where culture, individuals values, and behaviors continually shape each other (Markus and Kitayama 2010, Diekman and Schmader 2021). As legal systems and cultures evolve globally, so do cognitions, including those related to gender.

Gender equality laws and norms extend beyond workplace representation, shaping perceptions and behaviors in social and organizational settings. They provide individuals with cues for interpreting gender roles, interactions, and expectations. In environments prioritizing gender equality, individuals may challenge traditional stereotypes, while those who do not emphasize equality may perpetuate biases. Therefore, the influence of laws and norms on gender cognitions goes beyond surface-level representation, impacting deeply ingrained perceptions, attitudes, and behaviors associated with gender roles and identities.

Consistent with this, recent research highlights institutions' crucial role in innovation, prompting scholars to analyze innovation outcomes within institutional contexts (Furman et al. 2002 2002, Bradley et al. 2021 McMullen, & Wennberg, 2021). Scholars emphasize the institutional environment's impact on national innovative capacity and regional variations. Additionally, social context significantly influences innovation, with empirical evidence showing how state policies affect innovation within countries (Acemoglu et al. 2014 2014, Vakili and Zhang 2018). Recognizing institutions' importance in the relationship between gender diversity and innovation deepens our understanding of innovation implications.

Social cognition theory links with institutions, framing individual behavior as inherently "institutional," and this perspective provides a novel analytical framework (Rizzello and Turvani 2002). Institutional economics shows that individuals operate within formal and informal rules, influencing behavior and creative output (North 1990, Makhija and Stewart 2002, Perry-Smith 2006, Ioannou and Serafeim 2012, Chappell and Waylen 2013). As the roles and perceptions of women and men evolve within diverse formal and informal institutions, corresponding shifts occur in how gender is understood and interpreted.

Despite institutions' impact on social cognition and calls from diversity literature to consider the external environment (Jackson et al. 2003, Joshi and Roh 2009), our understanding of how institutions shape the relationship between gender diversity and innovation remains limited. While management research’s substantial support for gender diversity's positive influence on innovation outcomes, studies in different countries have shown inconsistent results (Nielsen et al. 2018).

For instance, Xie et al. (Xie et al.) found a positive effect of gender diversity on innovation efficiency in China, while Østergaard et al. (Østergaard et al.) showed strong correlations between R&D gender diversity and innovation outputs in Denmark. In contrast, Stvilia et al. (Stvilia et al.) find no significant relationship in US magnetic field laboratories. Similarly, Faems and Subramanian (Faems and Subramanian) found a not significant association in Singapore, and Sastre (Sastre) a curvilinear relationship in Spain. Although these tasks should benefit from gender diversity, contextual variations seem to influence its impact on innovation.

Considering the institutional context, formal and informal rules on gender equality may moderate gender diversity's contribution to innovation. While gender equality fosters innovation by increasing women's inclusion, its effect on the benefits of gender diversity varies. Societies with minimal gender differences may not experience the same advantages from gender diversity as those with pronounced ones. Recognizing this complexity is crucial for further understanding gender diversity's impact on innovation.

*Formal Institutions and Innovation*

Formal institutions, with their written laws and regulations, significantly shape societal behaviors and gender assumptions in both social and workplace contexts (North and Thomas 1973, Williamson 1991, Kostova 1997, Chappell and Waylen 2013). These regulations have a considerable influence on the effects of gender diversity on vital business outcomes like innovation and financial performance. For instance, legal reforms in the United States concerning married women have led to increased patenting rates, encouraging women's involvement in patents and business activities (Khan 1996). Recent studies demonstrate that a country's institutional environment influences how the presence of women in a firm affects its market value and revenue (Zhang 2020). Notably, the importance and prioritization of gender equality vary significantly among countries.

The legal institutions that define gender roles and importance profoundly influence gender cognitions (Bank 2020). *Social gender equality laws* promote equal rights and opportunities, prohibiting gender-based discrimination and fostering gender-neutral representation in education, employment, and politics. Shared experiences play a crucial role in shaping individuals' viewpoints, aligning them more closely. As a result, institutional frameworks prioritizing gender-based *social equality laws* may mitigate gender viewpoint differences and reduce cognitive diversity, increasing the similarity of perspectives between genders.

In contrast, the absence of social gender equality laws grants fewer gender equality rights, perpetuating gender-based discrimination and dissuading women from pursuing career paths similar to those of men. Such laws can exacerbate cognitive differences between genders, leading to separate social spaces and distinct communication styles and problem-solving approaches. As a result, institutional frameworks not prioritizing gender-based social equality laws reinforce gender viewpoint differences and cognitive differences, decreasing the similarity in perspectives between genders.

Of particular interest are laws and regulations promoting *workplace gender equality*, which specifically aim to reduce gender disparities in work settings with methods such as prohibiting the dismissal of pregnant workers and providing paid leave to fathers. These laws significantly influence career advancement expectations and life paths for both men and women through selection processes (Bussey and Bandura 1999). As a result, in societies with stringent workplace equality laws, instances of gender-based workplace discrimination are fewer, thus ensuring the legal entitlement to equal rights for both genders. This reduces gender dominance in industries and educational fields, with education and professional backgrounds influencing cognitive traits (Glymour et al. 2005) and resulting in reduced gender-based differences in cognitive characteristics.

In contrast, in societies with weaker workplace equality protections, there are substantial differences in occupational and career opportunities between genders, which reinforces gender-based career choices and discourages women from male-dominated STEM fields. Being confronted with this workplace inequality may lead women to opt for more accessible career options. Consequently, countries with fewer workplace equality regulations tend to exhibit larger gender-based cognitive disparities, resulting in increased gender-based differences in cognitive characteristics. Therefore, gender-diverse teams in societies with solid workplace gender equality rights are likely to have fewer gender-based cognitive differences compared to those in places with less stringent regulations.

In sum, given that gender diversity's value for innovation is primarily driven by social cognitive differences and that gender-based cognitive diversity is less pronounced in societies with strong social equality and workplace equality laws, we argue that laws that strongly support gender equality formal institutions (i.e., social and workplace equality laws) will reduce the positive impact of gender diversity on the technological influence of innovation. Thus, we hypothesize the following:

*Hypothesis 2a: Social gender equality laws decrease the positive effect of gender diversity on the technological influence of invention.*

*Hypothesis 2b: Workplace gender equality laws decrease the positive effect of gender diversity on the technological influence of invention.*

*Informal Institutions and Innovation*

Informal institutions encompass unwritten, implicit rules outside formal legal systems (North 1990, Helmke and Levitsky 2006) and evolve in response to social and economic challenges (North and Thomas 1973). These institutions persist through ongoing behavioral tendencies rather than explicit regulations (Van Essen et al. 2012). While measuring informal institutions has posed challenges, scholars emphasize their inclusion in analyses, recognizing their joint influence with formal institutions on individual, group, and firm behaviors (Crossland and Hambrick 2011, Ioannou and Serafeim 2012).

Researchers have studied how the role assumptions and normative expectations associated with gender (including biological sex differences) shape self-perceptions and societal views of gender dynamics (House et al. 2004, Beckwith 2010). Women are more likely to adhere to these expectations, affecting their thoughts and behaviors. Norms in this context assume a distinct form of exchange, articulated through expectations (Rizzello and Turvani 2002). Informal rules significantly influence the attitudes, values, and beliefs around gender roles in ways that are comparable to formal regulations (Wu et al. 2008, Crossland and Hambrick 2011). Societal variations in gender role attitudes range from emphasizing men's economic achievements and women's family roles to promoting shared responsibilities between genders (Hofstede 2001, Parboteeah et al. 2008).

As a result, in more egalitarian societies, shared norms and expectations lead to more aligned perspectives and values between genders (House et al. 2004). These similarities manifest in reduced team cognitive diversity and more limited problem-solving approaches. In contrast, in less egalitarian societies, there are significant differences in gender roles and expectations, enforced through stricter social norms and penalties for deviation, leading to pronounced disparities in values, priorities, and perspectives. These differences manifest in inventor teams with gender diversity, expanding problem-solving approaches.

As the positive impact of gender diversity within inventor teams on technological innovation primarily stems from cognitive differences, and since gender-egalitarian informal institutions tend to diminish cognitive diversity between men and women, we anticipate that informal institutions that promote gender egalitarianism will reduce the influence of gender diversity on technological innovation. Additionally, the more a society promotes gender egalitarianism through its informal institutions, the weaker the impact of gender diversity on innovation will be. Thus, we hypothesize the following:

*Hypothesis 3: Gender egalitarianism norms decrease the positive effect of gender diversity on the technological influence of innovation.*

**Methods**

**Sample and Data Sources**

Our sample includes over a million patents, originating from 22 countries, granted by the USPTO between 1990 and 2008. We gathered patent information from PatentsView (USPTO 2019), an online database of all inventions patented at the USPTO. We selected countries with the highest number of patents in the USPTO database for which country-level institutional data were available[[1]](#footnote-1) and only included patents with more than one inventor, totaling 1,182,522 patents. We obtained information on formal gender-egalitarian institutions from the 2020 Women, Business and the Law report by the World Bank. These data include laws against gender-based discrimination and efforts at incentivizing equal roles for men and women in social life and the workplace (Bank 2020). We obtained information on gender-egalitarian informal institutions by analyzing more than 39,900 Reuters news articles from the 22 countries being studied over the observation period.

**Dependent Variable**

Our dependent variable, *patent influence*, measures an invention's technological influence by accounting for the number and tree topology of a focal patent's direct and indirect forward citations. It captures a descendant's utilization of the knowledge derived from the focal patent. The number of direct and indirect forward citations systematically differ across years and classes, as the patenting regime changed in the 2000s, when the TRIPS agreement was implemented (Introduction to the TRIPS Agreement 2020) and technological stages changed over time. Additionally, the patterns of direct and indirect citation counts are different across technology classes depending on the technological stage of each class. These systematic differences can be problematic for comparing patent influence across years and classes. To allow for comparison across time and classes, we standardized the dependent variable by year and class using the USPTO Cooperative Patent Classification (CPC).[[2]](#footnote-2) Our standardized measure for a patent is the influence value divided by the interquantile range for the patents in the same CPC class and with a publication date during the year of observation. We eliminated those belonging to CPC classes with less than 30 patents with a publication date not in the year of observation. This method significantly reduces potential concerns that results may be driven by year and technology class and the issues caused by outliers (as patents of extreme influence—breakthroughs—should not be winsorized due to their particular interest).

Consideration of indirect citations in measuring the quality of inventions is particularly crucial for patents because, unlike academic papers, (a) only the immediate precedents of inventions are required to be cited and (b) inventors and firms have no incentive to cite more than what is necessary (Nagaoka et al. 2010 2010, Rafael A. Corredoira and Banerjee 2015, Rafael A Corredoira et al. 2018 2018). As a measure of patent quality, the patent’s forward citations (*impact*) are associated with inventions that are closer to being brought to market and require less inventing around to monetize them compared to patents of the highest *influence* (Rafael A Corredoira et al. 2018). Research on patent impact has associated this metric with the economic value of the invention, while patent influence has been seen as being more closely related to the characteristics of technological breakthroughs. In this sense, higher patent influence is associated with superior inventor team performance and problem-solving.

*Patent influence* is constructed from a citation tree that contains a patent's direct and indirect citations over a 7-year window following the publication of the focal patent (Rafael A. Corredoira and Banerjee 2015, Rafael A Corredoira et al. 2018). A patent that directly cites a focal patent belongs to the first generation; a patent citing the first-generation patent belongs to the second generation, and so on (Rafael A. Corredoira and Banerjee 2015). The value is calculated using the following formula:

 *Patent influence* $=(\sum\_{k=1}^{\infty }a^{k}A^{Tk })$ *e,*

where a is the attenuation factor, *k* is the generation of the citation, and *AT* is the transpose of the adjacency matrix defined by patent citation (see Corredoira & Banerjee, 2015, for a more detailed explanation of the adjacency matrix of a technology network). The weight given to each future generation of citations is controlled by *e*. In our case, *e* = 1 gives the same value to all patents in the citation tree (direct and indirect citations) and captures the technological influence on successive inventive activity. Following prior research (Rafael A. Corredoira and Banerjee 2015, Rafael A Corredoira et al. 2018, Khanna and Guler 2022), we took the log of influence to address the skewness of the variable and for consistency when comparing to research on forward citations (i.e., impact). We also ran models on impact as described in the robustness section.

**Independent Variables**

*Gender diversity.*The gender diversity of the inventors’ team was calculated based on Blau's heterogeneity index (Blau 1977), a commonly used measure of diversity for categorical variables (Harrison and Klein 2007). Thus, the following equation was used to create our diversity variable:

*Gender diversity* $=1-\sum\_{i=1}^{K}π\_{i}^{2}$,

where *K* is the number of gender categories under study, and $π\_{i}$ is the proportion of unit members in each category (Harrison and Klein 2007, De Meulenaere 2016). *Gender diversity* equals 0 when the gender composition of a team is homogenous, consisting entirely of either male or female inventors. The value increases as team members are more evenly distributed by gender (De Meulenaere 2016). We obtained the gender of the inventors from PatentsView (Lax-Martinez et al. 2021).[[3]](#footnote-3)

*Formal Institutions.*We utilized the *Women, Business and the Law 2020* reportby the World Bank (2020) to gather the formal institutions operating in each country. The report contains a comprehensive list of rules and regulations around women in social and professional life. A factor analysis of countries' different laws and regulations allowed us to identify subgroups pertaining to social and workplace equality laws. When a law was present, the corresponding item was assigned value of 1; otherwise, the value was 0. We employed the oblique rotation method using the Promax command in STATA, as oblique rotation is the preferred method for factors whose correlation matrix is .32 and above (Tabachnick et al. 2007). We obtained three factors, with reliability coefficients (Cronbach 1951) of 0.86, 0.86, and 0.65. As the reliability coefficient of .70 or higher is considered acceptable in most social science research (Heppner 2008), we only utilized the two factors with reliability higher than 0.70. We named the selected factors *workplace equality laws* and *social equality laws.* They comprise 13 and 11 items from the original Women, Business and the Law report, respectively. The complete list of items under each formal institutional measure is shown in Figure 1.

[Insert Figure 1 Here]

For each country-year, we calculated the value of the index created from each factor. *Workplace equality laws* (the count of laws present in the country and associated with the homonymous factor) takes values between 1 and 12. *Social equality laws* (the count of laws present in the county and associated with the homonymous factor)takes values between three and 11.

***Informal institutions for gender egalitarianism.*** We created a gender egalitarianism measure by conducting a comprehensive quantitative text analysis of 39,900 news articles from Reuters. This measure captures the effect of informal institutions and addresses two issues regarding the measurement of gender egalitarianism in the current literature. First, the commonly used cultural or informal institutional measures of gender egalitarianism (i.e., Hofstede and GLOBE) provide a snapshot of gender egalitarianism at one point in time rather than a time-variant measure. This limits the options for empirical strategies and methodological approaches for researchers who strive to enhance research on the antecedents and outcomes of nations' gender egalitarianism. And second, the conventional measures do not consider the trends and changes in countries' gender egalitarianism. While cultures and informal institutions are slow to change, societies have witnessed significant shifts in the awareness of gender equality and have taken steps towards more gender-egalitarian systems (Nahkur and Taagepera 2019). These longitudinal changes, however, cannot be captured and studied with the available measures. By introducing a gender egalitarianism measure that is time-variant and captures societal changes in our sample of countries, we aim to have an advanced the analysis of informal institutions' moderating effect.

To create the gender egalitarianism measure, we used supervised machined learning (SML) to leverage computers' ability to detect patterns and human coders' ability to interpret textual meaning (Nelson et al. 2021 & McCall, 2021). We chose this method over other computer-assisted text analysis methods because SML is the closest to human coding and performs best at replicating hand-coded results (Nelson et al. 2021). We report the step-by-step procedure for the text analysis and its validation in the online appendix (see Online Appendix, page 1). The evolution of gender egalitarianism across countries is indicated in the Figure 2. The range of gender egalitarianism in our sample is between 1 and 3.

**Control Variables**

To address alternative explanations and omitted variables, we included a comprehensive set of controls for patents, inventor teams, firms, and countries based on established theory and prior research. Specifically, we introduced controls for heterogeneous female inventor and inventor skills associated with countries, which, if omitted, could bias our estimations regarding gender-egalitarian institutions. We included controls at the patent, assignee, and country levels to account for factors that may provide alternative explanations to our predictions.

At the patent level, consistent with existing literature, we include the *number of claims* and *number of inventors* in the patenting team to capture potential effects associated with forward citations of the patented invention (B.H. Hall et al. 2001 2001). Additionally, we consider the *highest skill in the team*, which represents the number of patents filed in the last 5 years by the most productive inventor in the team, capturing team skill differences. The *team internationality* variable, indicating the number of countries represented in the inventor team, captures the potential effect on the creativity of the team. Furthermore, *same country*, a dummy variable taking a value of 1 when the inventor and the assignee are located in the same country and 0 otherwise, captures potential systemic differences when the inventor team is located in a host country.

At the assignee level, we control for *technological diversification*, a Herfindhal-like measure based on the technological classes of the assignee’s 5-year patent portfolio, which controls for the technological diversity of the firm and has been associated with patent influence. Additionally, we include *patent portfolio*, representing the count of patents filed within the past 5 years, to capture technological capability differences, and *log of international research centers*, the natural log of the number of countries with the assignee’s research centers, captures the potential access to diverse technological knowledge and its effect on patent influence.

Finally, at the country level, we control for *mean female inventor productivity*, which is the average number of patents with female inventor contributions filed in the prior 5 years per inventor, capturing female inventor skill differences across countries. The *log of GDP per capita* accounts for a country’s resources that may be associated with innovation outcomes. Additionally, *female labor participation*, representing the percentage of females in the labor force, accounts for heterogeneities in the gender distribution of the labor force.

For all control variables with skewed distribution, we utilized a natural log transformation.

**Model Specification**

Our unit of analysis is the patent, and patent data enables us to assess inventor characteristics (e.g., gender, location, portfolio of patents), inventor team composition, country of the invention, inventing organization characteristics (e.g., patent portfolio, technological profile, geographic span, etc.), and patent characteristics (e.g., technology class, number of claims). We used the country where most of the inventors were located as the invention location for patents that involved inventors from multiple countries.

We tested our hypotheses using the ordinary least square (OLS) method with robust standard errors. The equation of our full model with all interactions is as follows:

$$Patent Influence\_{i}= β\_{1}Gender diversity\_{i}+ β\_{2}social equality\_{i}+β\_{3}workplace equality\_{i}+β\_{4}gender egaltarianism\_{i}+β\_{5}gender diversity\* social equality\_{i}+β\_{6}gender diversity\* workplace equality\_{i}+β\_{7}gender diversity \* gender egalitarianism\_{i}+ γ(control variables)\_{i}+ ζ(fixed effects)\_{i}+ε\_{i},$$

where *i* reflects individual patents. We included the fixed effect of the main *technology class* of patents and the *patent application year* to control for idiosyncratic difference across technologies and years. We characterized firms and countries using several variables and chose not to include firm and country fixed effects in our main models to minimize endogeneity concerns in our estimations. Introducing those fixed effects would discard all available between-firm and between-country variance (Certo et al. 2017 2017). This loss would include the institutional context of inventor teams and would thus limit our ability to interpret how country-level variables moderate the effect of gender diversity, as within-country variation is significantly lower than between-country variation in institutions. Nevertheless, despite the loss of information, we conducted robustness tests incorporating country and firm fixed effects to address endogeneity concerns over unobserved and invariant characteristics.

Lastly, we standardized all variables by mean centering to improve model interpretability, as recommended for models testing cross-level interactions (Aguinis et al. 2013 2013). Our mean centering of independent variables obtains more accurate estimations by reducing the correlation between variables in the model.

**Results**

Sample descriptive statistics and a correlation matrix are presented in Table 1. We centered our predictors at their mean to prevent multicollinearity problems, a standard method for interaction and multilevel models (Enders and Tofighi 2007). VIF tests show that our models do not present multicollinearity issues (VIF values are less than 4, below the cutoff value of 10) (Vittinghoff et al. 2006).

[Insert table 1 about here]

Across all models, control variables generally behave as expected. For example, in the main model (See Table 2), coefficients for the *number of claims*, *number of inventors*, *team internationality*, *log of GDP per capita*, *female labor participation*, *patent portfolio*, and *highest skill in team* are positive and significant at the 0.05 level across models. Meanwhile, coefficients for *technological diversification*, *log of international research centers*, *same country*, and *mean female inventor productivity in country* are negative and also significant. Among these results, the negative coefficient for *same country* suggests that the co-location of inventors and assignees is negatively associated with patent influence. Additionally, the negative coefficient for *mean female inventor productivity* for a country deserves future research attention to understand the underlying factors contributing to the implied negative association between the average number of patents with female participation in the country and innovation quality.

In Table 2, we present our main models. Our series of models starts with all control variables and successively adds *gender diversity*, its interaction with each institution one by one, and all the institutions and interactions at once. Hypothesis 1 (H1) finds support in the positive coefficient estimate for *gender diversity* (β = .125, *p* = .020, see Model 2), revealing a positive relationship with technological influence.

Hypothesis 2a (H2a) finds support in the negative coefficient estimate for the interaction between *gender diversity* and *social equality laws* (β = -.381, *p* = .025, see Model 3), revealing a negative moderating effect for these laws on the relationship between *gender diversity* and technological influence.

Hypothesis 2b (H2b) finds support in the negative coefficient estimate for the interaction between *gender diversity* and *workplace equality laws* (β = -.192, *p* < .001, see Model 4), revealing a negative moderating effect for these laws on the relationship between *gender diversity* and technological influence.

Hypothesis 3 (H3) finds support in the negative coefficient estimate for the interaction between *gender diversity* and *gender egalitarianism* (β = -.805, *p* = .006, see Model 6), revealing a negative moderating effect for gender egalitarianism on the relationship between *gender diversity* and technological influence. All coefficients retained direction and significance level, as we simultaneously added all the interaction terms in the last model (see Model 6). The only difference was in the interaction with *gender egalitarianism*, where the *p*-value increased to .069.

[Insert table 2 about here]

**Robustness Checks**

While we took several measures to control for potential biases from unobserved factors, some alternative explanations and potential endogeneity concerns persist regarding selection to treatment and unobserved heterogeneity (Wooldridge 2002). To mitigate these concerns and increase the confidence in our arguments, we ran a series of tests to rule out potential alternative explanations.

*Inventor Skill Heterogeneity and Its Potential Association With Institutional Environments*

Regarding skill heterogeneity, one could argue that women in nonegalitarian countries may need exceptional skills to be part of a team, which would result in female inventors bringing exceptional inventive capabilities to the team and would explain by itself why gender-diverse teams in less egalitarian societies have higher innovation quality.

At the same time, it is possible that the highest performer of the team is more critical in explaining group outcomes than the average inventor skill in teams. In that case, if inventors of the highest skills were associated with teams and institutions with higher gender diversity, their association with invention quality could be spurious. First, our models included control variables to address this issue: inventor competence within the team (*highest skill in the team*) and the female inventor skills associated with the country of the inventor (*mean female inventor productivity*)control for those possible explanations. The above results include those controls, accounting for the potentially different levels of different inventor’s skills (for all and female inventors) across different institutions. For this reason, we argue our results are unlikely to be driven by the skill differences of women in teams from different countries.

Second, we analyzed the Pearson correlation coefficient between the institutional variables (e.g., *social equality laws, workplace equality laws*, and *gender egalitarianism*) and *gender productivity gap* (measured as the difference in number of patents filed by men and women from one country within the 5 years before the year of observation). Results indicate that *gender productivity gap* is not significantly correlated with *social equality laws*, *workplace equality laws*, or *gender egalitarianism* (*rho* = .03, *p* = .51; *rho* = -.07, *p* = .13; and *rho* = -.08, *p* = .12, respectively), suggesting that systematic differences in female inventor competence are not driving our findings.

Third, we compared the influence of patents from female and male inventor teams across different institutional environments. To do so, we used the median scores for formal and informal institutions to classify countries into low and high groups of *gender egalitarianism*, resulting in a two-by-two classification. Then we compared the difference in average influence for female team and male team patents across quadrants. Our results show no significant differences across the four institutional environments. This suggests that our results are not driven by systematic differences in *patent influence* for female inventors that are related to institutional environment. Detailed findings are accessible upon request.

Last, we assessed women's innovation quality at the country level relative to men's innovation quality. We calculated the *gender patent influence gap* (measured as the difference in average *patent influence* between all-female and all-male inventor teams from one country within the 5 years before the year of observation) and compared them across countries with low and high levels of *workplace equality* and *gender egalitarianism* (i.e., below and above the median). The comparisons for *workplace equality* were conditional on *gender egalitarianism*, and those for *gender egalitarianism* were conditional on *workplace equality*. The results of our *t*-tests reveal no significant invention quality differences across female and male inventor teams associated with any of the institutions. This also suggest that our results are not driven by systematic differences in the skills of female inventors associated with less egalitarian societies.

In sum, results from these three analyses failed to support the thesis of our findings not being driven by inventor team gender diversity but by differences in invention skill and/or competencies associated with less gender-egalitarian institutions.

[Insert table 3 about here]

*Selection Bias and Omitted Variable Issues*

Our analyses may be susceptible to self-selection bias and imbalanced covariates since gender diversity is not randomly assigned to teams. To address this issue, we employed different approaches that mitigate the bias of these potential endogenous covariates.

First, we utilized coarsened exact matching (CEM) to identify comparable groups with gender-diverse and gender-homogeneous teams based on observable team characteristics such as the number of inventors, team internationality, and highest skill in the team. We created a dichotomous gender diversity variable that takes a value of 1 when the inventor team is gender diverse and 0 otherwise. The matched sample resulting from our procedure improved the balance between the groups, with a sample multivariate L distance of 0.06 (post-matching) compared to 0.30 (pre-matching) {Blackwell, 2009 #1}. As shown in Table 4, comparing team characteristics for the two levels of gender diversity reveals no significant differences for the post-matching sample, contrasting with the differences found in the pre-matching one. Our regressions on the matched sample indicate that the results did not change significantly, further supporting our hypotheses (see Table 5).

Second, to account for invariant systemic differences, we included firm fixed effects in addition fixed effects around year and class and estimated our main model, regressing *gender diversity* on technological influence (Model 2). Due to the inclusion of the three fixed effects, we excluded institutional variables from the model, as the specification eliminates the between-group variation needed to capture their effects. The results support Hypothesis 1, with a positive and significant coefficient estimate for *gender diversity* (*b* = [value], *p* = .02). Detailed results are available upon request.

Finally, we excluded international teams from our sample to better examine the direct moderating impact of institutions, as international teams may reflect institutional differences across the multiple countries they operate in. Our analysis focused on patent teams comprised of inventors from the same country, and the findings remained consistent (see Table 7).

*Gender Egalitarianism and Patent Influence Measurement Concerns*

To bolster confidence in our results and considering the newness of our variables (i.e., *gender egalitarianism* and *patent influence*), we conducted additional analyses utilizing other variables commonly found in the literature and model specifications as similar as possible to our main analysis.

First, to compare the results of our *gender egalitarianism* variable, which offers a significant improvement over other measures due to its longitudinal aspect and ability to capture underlying gender-egalitarian norms in a country (e.g., Hofstede 1997, House et al. 2004), we employed a well-established variable: GLOBE’s gender egalitarianism (House et al. 2004, Brewer 2010, Batjargal et al. 2013). Since GLOBE’s culture measures are time-invariant and were published in 2004 (House et al. 2004), we limited our analysis to sample patents filed in 2004. The main model estimation utilized GLOBE’s *gender egalitarianism (practices)* as the measure for informal institutions, and the results remained unchanged. The estimate for the interaction between gender diversity and gender egalitarianism remained negative and significant, providing additional reassurance to our main results.

Second, to align our results with the existing literature, we used *patent impact* (i.e., the count of direct forward citations) instead of *patent influence* as our dependent variable. The results remained unchanged in direction and significance for gender diversity and institution interactions, lending support to hypotheses 2a, 2b, and 3 (see Table 6, Models 1–6). However, *gender diversity* did not significantly affect a patent's impact, suggesting that the benefits of inventor team cognitive diversity mostly manifest in the long-term influence of the inventions.

**Discussion**

Consistent with prior research, our results confirm the positive association between gender diversity and the quality of inventions. This aligns with our expectation that gender diversity improves problem-solving abilities by bringing cognitive diversity to teams. It also accords with the previous literature, which has shown a positive effect of gender diversity on various innovation outcomes, such as efficiency (Xie et al. 2020 & Lu, 2020), radicalness (Díaz-García et al. 2013 2013), and knowledge diversity and novelty (Hyun 2023). While these studies reveal essential consequences of gender diversity on innovation, gender diversity's value in enhancing innovation extends beyond the known outcomes. Integrating diverse cognitive characteristics should also boost innovation quality as measured by the technological influence of inventions.

This study reveals the moderating effect of institutions promoting gender egalitarianism on the relationship between gender diversity and inventive quality. Our findings show that formal and informal rules fostering gender equality attenuate the positive association between gender diversity and the quality of inventions. These results can be attributed to the homogenizing effect of gender-egalitarian institutions on educational and professional experiences. By promoting the pursuit of similar qualifications and backgrounds for both men and women, these institutions inadvertently reduce the potential for diverse perspectives and experiences within inventor teams. Consequently, institutions promoting gender equality may unintentionally diminish the positive contribution of gender diversity to inventive quality. This finding has broader implications and extends to collaborative problem-solving endeavors in general. It suggests the need for a nuanced approach to gender egalitarianism, one that upholds equal opportunities while at the same time encouraging diverse educational and professional pathways. Such an approach would maximize the benefits of gender diversity on solution generation.

It is important to keep in mind that in our sample countries, women have access to at least the minimum level of education and training required for participation in invention activities. In that sense, our study remains silent regarding societies characterized by extreme gender inequality, where women are effectively excluded from the workforce and have severely limited educational and employment opportunities. In essence, for institutions to moderate the relationship between gender diversity and innovation, there must be a baseline level of gender diversity within inventor teams. This baseline level can only be achieved through rules and norms that permit women's participation as inventors. Therefore, our analysis centers on the multifaceted, countervailing effects of gender-egalitarian institutions.

Furthermore, our results should not be construed as negating a positive influence of gender egalitarianism on scientific participation and women’s contributions to technology. As long as gender-egalitarian institutions facilitate increased female representation in scientific fields, a rise in the number of patents with contributions from women is anticipated in addition to the positive effect of gender diversity on quality found in our models. While a comprehensive analysis of this effect falls outside the scope of this present investigation, we posit that pro-gender-equality institutions likely contribute to a positive influence on innovation quality by fostering increased female participation in innovative endeavors, ultimately enhancing team diversity. This perspective is corroborated by existing research and the positive association between gender diversity and innovation observed within our models.

However, when controlling for the level of gender diversity within inventor teams, our findings suggest that the additional contribution of gender diversity to inventive quality is diminished in countries with strong gender egalitarianism compared to those with weaker gender-egalitarian structures. In essence, we challenge the prevailing assumptions and prior research (Nielsen et al. 2018) by proposing that formal and informal rules promoting gender equality may inadvertently reduce the potential benefits of gender diversity for inventive outcomes. Consequently, businesses with research and development centers located in countries with less stringent enforcement of gender egalitarianism may potentially experience a greater return on investment from gender diversity in terms of inventive quality.

While the effect of gender diversity is grounded in gender-based cognitive differences, our analysis does not fully specify the origin of those differences. As discussed above, the only relevant sources we have explicitly proposed for these differences are cognitive and perspective differences between genders (O'Reilly et al. 1997, Jehn et al. 1999, Phillips and Loyd 2006). We are aware that the effect of gender diversity is multifaceted, with cognitive diversity being only one mechanism among many. We have mentioned some of them in discussing the relevant literature (e.g., social categorization), noting that they can cause both positive and negative outcomes, such as effective group discussion and relational conflict. While a thorough analysis of the reasons underlying gender differences is outside the scope of this paper, those mechanisms are unlikely to be as influential as cognitive diversity when the outcome variable is innovation and creative tasks. Having stated that, our theory may depend on the basic grounding prevalent within inventor teams (regarding scientific language and paradigms) in order to achieve these effects on innovation outcomes. They may not extend to the teams, as they are primarily occupied with routine tasks and the lack of common grounding between member may negatively affect the communication and collective problem-solving efforts . Future research can investigate how gender-related institutions may interact with the gender diversity of teams that work on more routine or repetitive jobs.

Though our hypotheses received support, our robustness test incorporating country fixed effects did not validate our second hypothesis, which pertains to the moderating influence of social equality laws on the correlation between gender diversity and technological impact. Several factors might account for this outcome. First, it is plausible that social equality laws offer no additional benefit beyond what workplace equality laws already provide. Second, limited variations in social equality laws within countries may diminish the efficacy of our models. Third, the discrepancy could be attributed to the sometimes more complex dynamics in formal institutions compared to informal ones. Existing literature suggests that formal and informal institutions can either act as substitutes or complements. In the context of gender equality, formal and informal institutions may serve as substitutes for each other (P.A. Hall et al. 2009, Van Essen et al. 2012). It is possible that only in instances where unambiguous informal norms are lacking, social equality laws step in to alleviate uncertainty regarding expected behaviors and offer guidance.

Finally, our robustness check reveals that gender diversity does not significantly affect patent impact when only the direct forward citations are accounted for. However, institutional variables still negatively moderate the relationship between gender diversity and patent impact. The lack of consideration for indirect forward citations may lead to confounding factors like gender biases, the social network of inventors, and proximity in citation patterns limiting patent impact's representativeness for innovation quality (Håkanson 2005, Sugimoto et al. 2015 & Lariviére, 2015, Crescenzi et al. 2016 2016). Novel combinations of knowledge and complex solutions to difficult problems are not always immediately recognized because it can be challenging to understand and appreciate the value of new and unfamiliar knowledge (Rafael A. Corredoira and Banerjee 2015). On the other hand, it is less likely that such factors will affect the patent influence measure, which considers the forward indirect citations in addition to the direct citations, as noise tends to decrease over time. Consequently, subsequent inventions will likely recognize the value of such knowledge and technological solutions in the long run. Future research can analyze the factors causing a disparity between these two innovation quality measures, including factors affecting citation patterns beyond relevance and quality.

A cautionary note regarding the benefits of gender diversity in an inventor team. While we acknowledge that gender diversity may negatively affect team performance, limitations in our data (despite their spanning over two decades, more than 20 countries, and in excess of 1,000,000 patents and their inventor teams’ compositions) we are not able to study the effect of such communication or organizational challenges. For that reason, the negative effect of gender diversity associated with those challenges is beyond the scope of this paper. However, we argue that if the negative consequences of team gender diversity were the dominant force, the results would not align with our predictions. Future research analyzing the nuanced relations between communications, management and gender diversity within inventor teams has the potential to offer a valuable contributions to the field.

Overall, our results are consistent with recent research on how the normative and regulatory acceptance of gender diversity in the broader environment moderates the relationship between gender diversity and firm performance (Zhang 2020) and on the association of gender diversity with team output quality (Yang et al. 2022). At the same time, our study advances our understanding of the role of institutions by theorizing about why different institutions moderate the relationship between gender diversity and innovation. When taken together, our results on gender diversity’s effect on innovation and the moderating role of institutions are consistent with our assumption of cognitive diversity being a driver of the effect of gender diversity on team performance. At the same time, it is widely acknowledged that the pace of change in culture and informal institutions is generally slow (e.g., Hofstede 1997, Risman 2018, Bates et al. 2022), but that appears not to be the case for gender egalitarianism. The last few decades have witnessed significant shifts in gender norms, with female employees composing more than 50% of the US workforce, increased social awareness for gender equality, and DEI awareness being some indicators. This raises two issues that we anticipate future research will address. First, given the evolving conceptualization of gender that has begun in past few decades (Muehlenhard and Peterson 2011, Risman 2018, Bates et al. 2022), it is worth considering whether measuring gender diversity based solely on sex at birth is sufficient to capture cognitive diversity. Secondly, understanding the effect of gender-related social norms on cognitive diversity (which affects the outcomes of gender-diverse teams) is increasingly important considering the documented changes in these norms in recent years (Risman 2018, Coffman et al. 2024).

**Conclusion**

This study investigates how national institutions promoting gender equality affect the relationship between gender diversity and the quality of inventions. We found that while gender diversity typically improves problem-solving within inventor teams, institutions advocating for gender equality may unintentionally weaken this positive effect. This is because such institutions often promote similar qualifications and backgrounds for both men and women, thereby limiting the diversity of perspectives within teams. Consequently, businesses operating in countries with less emphasis on gender equality may derive greater benefits from gender diversity in terms of inventive quality. We anticipate this finding to be generalizable to phenomena involving complex, uncertain decision-making.

Our study focuses on a setting where specialization and training facilitate communication, discussion, and problem-solving, such as invention teams where decision-making relies more on facts and evidence and less on trust and relationships. In general, modern inventors, by the nature of their trade, rely more on evidence and scientific methods than some other professions, which may depend more on tacit knowledge and artisan skills. Future research could extend this investigation to less codified activities (e.g., artistic work) or less creative occupations (e.g., routinized tasks or repetitive work).

By integrating the diversity literature with institutional economics, our study contributes to understanding the mechanisms driving innovation in gender-diverse teams across various national contexts. Additionally, by developing a new measure of gender egalitarianism as an informal institution evolving over time in many countries, we provide opportunities for future studies to explore how constructs associated with gender, such as gender diversity, operate in different environments. Finally, our findings offer valuable theoretical insights and have significant implications in real-world settings where diverse teams drive innovation. They highlight the positive impact of gender diversity on innovation performance while also presenting evidence on the unintended consequences of gender egalitarianism.

**References**

Acemoglu D, Akcigit U, Celik MA (2014) Young, restless and creative: Openness to disruption and creative innovations*.* Report.

Adams RB, Funk P (2012) Beyond the glass ceiling: Does gender matter? *Management science* 58(2):219-235.

Aguinis H, Gottfredson RK, Culpepper SA (2013) Best-practice recommendations for estimating cross-level interaction effects using multilevel modeling. *Journal of Management* 39(6):1490-1528.

Bandura A (1986) *Social foundations of thought and action : a social cognitive theory* (Prentice-Hall, Englewood Cliffs, N.J.).

Bank W (2020) Women, business and the law 2020. The World Bank.

Bates N, Chin M, Becker T (2022) Measuring Sex, Gender Identity, and Sexual Orientation*.* Report.

Batjargal B, Hitt MA, Tsui AS, Arregle J-L, Webb JW, Miller TL (2013) Institutional polycentrism, entrepreneurs' social networks, and new venture growth. *Academy of Management Journal* 56(4):1024-1049.

Beall AE (1993) A social constructionist view of gender.

Beckwith K (2010) A comparative politics of gender symposium introduction: Comparative politics and the logics of a comparative politics of gender. *Perspectives on Politics* 8(1):159-168.

Blau PM (1977) *Inequality and heterogeneity: A primitive theory of social structure* (Free Press New York).

Bourmault N, Siegel J (2022) Why Local Adaptation Sometimes Fails to be Effective for MNEs: Exploring the Dynamics of Collective Bonuses, Egalitarianism, and Informal Norms. *Journal of Management Studies* 59(4):886-924.

Bradley SW, Kim PH, Klein PG, McMullen JS, Wennberg K (2021) Policy for innovative entrepreneurship: Institutions, interventions, and societal challenges. *Strategic Entrepreneurship Journal* 15(2):167-184.

Brewer MB (2010) *Intergroup relations* (Oxford University Press).

Bussey K, Bandura A (1999) Social cognitive theory of gender development and differentiation. *Psychological review* 106(4):676.

Byrne DE (1971) *The attraction paradigm* (Academic Press).

Campbell DT (1965) Variation and selective retention in socio-cultural evolution. Barringer HR, Blanksten GI, Mack RW, eds. *Social change in developing areas: a reinterpretation of evolutionary theory* (Schenkman Pub. Co., Cambridge, Mass.), 19-49.

Certo ST, Withers MC, Semadeni M (2017) A tale of two effects: Using longitudinal data to compare within- and between-firm effects. *Strategic Management Journal* 38(7):1536-1556.

Chappell L, Waylen G (2013) Gender and the hidden life of institutions. *Public Administration* 91(3):599-615.

Coffman KB, Coffman LC, Ericson KM (2024) Non-Binary Gender Economics. *National Bureau of Economic Research Working Paper Series* No. 32222.

Corredoira RA, Banerjee PM (2015) Measuring patent's influence on technological evolution: A study of knowledge spanning and subsequent inventive activity. *Research Policy* 44(2):508-521.

Corredoira RA, Goldfarb BD, Shi Y (2018) Federal funding and the rate and direction of inventive activity. *Research Policy* 47(9):1777-1800.

Crescenzi R, Nathan M, Rodríguez-Pose A (2016) Do inventors talk to strangers? On proximity and collaborative knowledge creation. *Research Policy* 45(1):177-194.

Cronbach LJ (1951) Coefficient alpha and the internal structure of tests. *psychometrika* 16(3):297-334.

Crossland C, Hambrick DC (2011) Differences in managerial discretion across countries: how nation‐level institutions affect the degree to which CEOs matter. *Strategic Management Journal* 32(8):797-819.

De Meulenaere K (2016) A Critical Note on the Prevalent Use of the Standard Deviation as Diversity Measure. *Academy of Management Proceedings* (Academy of Management Briarcliff Manor, NY 10510), 13727.

Díaz-García C, González-Moreno A, Sáez-Martínez FJ (2013) Gender diversity within R&D teams: Its impact on radicalness of innovation. *Innovation* 15(2):149-160.

Diekman AB, Schmader T (2021) Gender as embedded social cognition.

Dwivedi P, Paolella L (2023) Tick Off the Gender Diversity Box: Examining the Cross-Level Effects of Women’s Representation in Senior Management. *Academy of Management Journal* (ja):amj. 2021.0506.

Enders CK, Tofighi D (2007) Centering predictor variables in cross-sectional multilevel models: a new look at an old issue. *Psychological methods* 12(2):121.

Epstein D (1997) Boyz'Own Stories: Masculinities and sexualities in schools [1]. *Gender and education* 9(1):105-116.

Faems D, Subramanian AM (2013) R&D manpower and technological performance: The impact of demographic and task-related diversity. *Research Policy* 42(9):1624-1633.

Furman JL, Porter ME, Stern S (2002) The determinants of national innovative capacity. *Research policy* 31(6):899-933.

Gibson C, Vermeulen F (2003) A healthy divide: Subgroups as a stimulus for team learning behavior. *Administrative science quarterly* 48(2):202-239.

Glymour MM, Weuve J, Berkman LF, Kawachi I, Robins JM (2005) When is baseline adjustment useful in analyses of change? An example with education and cognitive change. *American journal of epidemiology* 162(3):267-278.

Håkanson L (2005) Epistemic Communities and Cluster Dynamics: On the Role of Knowledge in Industrial Districts. *Industry and Innovation* 12(4):433-463.

Hall BH, Jaffe AB, Trajtenberg M (2001) The NBER patent citation data file: Lessons, insights and methodological tools*.* Report.

Hall PA, Gingerich DW, Alt J, Amable B, Bertoldi M, Boyer R, Crouch C, et al. (2009) Varieties of Capitalism and Institutional Complementarities in the Political Economy: An Empirical Analysis. *British Journal of Political Science* 39(3):449-482.

Harrison DA, Klein KJ (2007) What's the difference? Diversity constructs as separation, variety, or disparity in organizations. *Academy of management review* 32(4):1199-1228.

Helmke G, Levitsky S (2006) *Informal institutions and democracy: Lessons from Latin America* (jhu Press).

Hemmert M, Cho CK, Lee JY (2022) Enhancing innovation through gender diversity: a two-country study of top management teams. *European Journal of Innovation Management* (ahead-of-print).

Heppner W (2008) Kivlighan. 2008. *Research design in counseling*.

Herring C (2009) Does diversity pay?: Race, gender, and the business case for diversity. *American sociological review* 74(2):208-224.

Hoever IJ, Van Knippenberg D, Van Ginkel WP, Barkema HG (2012) Fostering team creativity: perspective taking as key to unlocking diversity's potential. *Journal of applied psychology* 97(5):982.

Hofstede G (1997) *Cultures and organizations : software of the mind*, [Rev. ]. ed. (New York : McGraw-Hill, New York).

--- (2001) *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations* (Sage publications).

Hong L, Page SE (2004) Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proceedings of the National Academy of Sciences* 101(46):16385-16389.

House RJ, Hanges PJ, Javidan M, Dorfman PW, Gupta V (2004) *Culture, leadership, and organizations: The GLOBE study of 62 societies* (Sage publications).

Huo D, Motohashi K, Gong H (2019) Team diversity as dissimilarity and variety in organizational innovation. *Research Policy* 48(6):1564-1572.

Hyun E-J (2023) The Influence of Gender Diversity in Inventor Teams on Technological Innovation in the Korean Automobile Industry: Evidence from Patent Data.

Introduction to the TRIPS Agreement. (2020) Taubman A, Wager H, Watal J, eds. *A Handbook on the WTO TRIPS Agreement* (Cambridge University Press, Cambridge), 1-38.

Ioannou I, Serafeim G (2012) What drives corporate social performance? The role of nation-level institutions. *Journal of International Business Studies* 43(9):834-864.

Jackson SE, Joshi A, Erhardt NL (2003) Recent research on team and organizational diversity: SWOT analysis and implications. *Journal of management* 29(6):801-830.

Jehn KA, Northcraft GB, Neale MA, Thatcher S, Cummings A, Weigelt K, Wilk S, Brass D, Murnighan K (1999) Why Differences Make a Difference: A Field Study of Diversity, Conflict and Performance in Workgroups. [*https://doi.org/10.2307/2667054*](https://doi.org/10.2307/2667054) 44(4):741-763.

Joshi A, Roh H (2009) The role of context in work team diversity research: A meta-analytic review. *Academy of management journal* 52(3):599-627.

Khan BZ (1996) Married women's property laws and female commercial activity: Evidence from United States patent records, 1790–1895. *The Journal of Economic History* 56(2):356-388.

Khanna R, Guler I (2022) Degree assortativity in collaboration networks and invention performance. *Strategic Management Journal* 43(7):1402-1430.

Kim JH, Siegel JI (2024) Paying for Legitimacy: Autocracy, Nonmarket Strategy, and the Liability of Foreignness. *Administrative Science Quarterly* 69(1):131-171.

Kostova T (1997) Country institutional profiles: Concept and measurement. *Academy of management proceedings* (Academy of Management Briarcliff Manor, NY 10510), 180-184.

Lax-Martinez G, Saenz de Juano-i-Ribes H, Yin D, Le Feuvre B, Hamdan-Livramento I, Saito K, Raffo JD (2021) Expanding the World Gender-Name Dictionary: WGND 2.0. In *Economic Research Working Paper Series* edited by Organization WIP.

Lix K, Goldberg A, Srivastava SB, Valentine MA (2022) Aligning differences: Discursive diversity and team performance. *Management Science* 68(11):8430-8448.

Makhija MV, Stewart AC (2002) The effect of national context on perceptions of risk: A comparison of planned versus free-market managers. *Journal of International Business Studies* 33(4):737-756.

Markus HR, Kitayama S (2010) Cultures and selves: A cycle of mutual constitution. *Perspectives on psychological science* 5(4):420-430.

Moreland RL, Levine JM (2014) Socialization in organizations and work groups. *Groups at work* (Psychology Press), 69-112.

Muehlenhard CL, Peterson ZD (2011) Distinguishing Between Sex and Gender: History, Current Conceptualizations, and Implications. *Sex Roles* 64(11):791-803.

Nagaoka S, Motohashi K, Goto A (2010) Patent statistics as an innovation indicator. *Handbook of the Economics of Innovation*,vol. 2 (Elsevier), 1083-1127.

Nahkur O, Taagepera R (2019) Was pinker on the right track? The speed of recent decline of violence and gender inequality. *Comparative Sociology* 18(2):148-172.

Nelson LK, Burk D, Knudsen M, McCall L (2021) The future of coding: A comparison of hand-coding and three types of computer-assisted text analysis methods. *Sociological Methods & Research* 50(1):202-237.

Nielsen MW, Bloch CW, Schiebinger L (2018) Making gender diversity work for scientific discovery and innovation. *Nature Human Behaviour* 2(10):726-734.

North DC (1990) *Institutions, institutional change and economic performance* (Cambridge university press).

North DC, Thomas RP (1973) *The rise of the western world: A new economic history* (Cambridge University Press).

O'Reilly CA, Williams KY, Barsade SG (1997) Group Demography and Innovation: Does Diversity Help? *Research on Managing Groups and Teams*,vol. 1.

Østergaard CR, Timmermans B, Kristinsson K (2011) Does a different view create something new? The effect of employee diversity on innovation. *Research policy* 40(3):500-509.

Parboteeah KP, Hoegl M, Cullen JB (2008) Managers' gender role attitudes: A country institutional profile approach. *Journal of International Business Studies* 39(5):795-813.

Perry-Smith JE (2006) Social yet creative: The role of social relationships in facilitating individual creativity. *Academy of Management journal* 49(1):85-101.

Phillips KW, Loyd DL (2006) When surface and deep-level diversity collide: The effects on dissenting group members. *Organizational Behavior and Human Decision Processes* 99(2):143-160.

Risman BJ (2018) *Where the millennials will take us : a new generation wrestles with the gender structure* (New York, NY : Oxford University Press).

Rizzello S, Turvani M (2002) Subjective diversity and social learning: A cognitive perspective for understanding institutional behavior. *Constitutional political economy* 13(2):197-210.

Ruiz-Jiménez JM, Fuentes-Fuentes MdM, Ruiz-Arroyo M Knowledge combination capability and innovation: The effects of gender diversity on top management teams in technology-based firms. *Journal of business ethics* 135(3):503-515.

Sastre JF (2015) The impact of R&D teams' gender diversity on innovation outputs. *International Journal of Entrepreneurship and Small Business* 24(1):142-162.

Schneid M, Isidor R, Li C, Kabst R (2015) The influence of cultural context on the relationship between gender diversity and team performance: A meta-analysis. *The International Journal of Human Resource Management* 26(6):733-756.

Spender J-C, Corvello V, Grimaldi M, Rippa P (2017) Startups and open innovation: a review of the literature. *European Journal of Innovation Management*.

Stvilia B, Hinnant CC, Schindler K, Worrall A, Burnett G, Burnett K, Kazmer MM, Marty PF (2011) Composition of scientific teams and publication productivity at a national science lab. *Journal of the American Society for Information Science and Technology* 62(2):270-283.

Sugimoto CR, Ni C, West JD, Larivière V (2015) The Academic Advantage: Gender Disparities in Patenting. *PLOS ONE* 10(5):e0128000-e0128000.

Tabachnick BG, Fidell LS, Ullman JB (2007) *Using multivariate statistics* (Pearson Boston, MA).

USPTO (2019) PatentsView. edited by USPTO.

Vakili K, Zhang L (2018) High on creativity: The impact of social liberalization policies on innovation. *Strategic Management Journal* 39(7):1860-1886.

Van Essen M, Heugens PPMAR, Otten J, Van Oosterhout J (2012) An institution-based view of executive compensation: A multilevel meta-analytic test. *Journal of International Business Studies* 43(4):396-423.

Van Maanen J, Schein E (1979) Towards a theory of organizational socialization. In BM Staw (Ed.), Research in organizational behavior, Vol. 1: 209-264. Greenwich, CT: JAI.

Vittinghoff E, Glidden DV, Shiboski SC, McCulloch CE (2006) Regression methods in biostatistics: linear, logistic, survival, and repeated measures models.

Wegge J, Roth C, Neubach B, Schmidt K-H, Kanfer R (2008) Age and gender diversity as determinants of performance and health in a public organization: the role of task complexity and group size. *Journal of Applied Psychology* 93(6):1301.

Williamson OE (1991) Comparative economic organization: The analysis of discrete structural alternatives. *Administrative science quarterly*:269-296.

Wooldridge JM (2002) *Econometric analysis of cross section and panel data* (MIT Press, Cambridge, Mass.).

Wu C, Lawler JJ, Yi X (2008) Overt employment discrimination in MNC affiliates: home-country cultural and institutional effects. *Journal of International Business Studies* 39(5):772-794.

Xie L, Zhou J, Zong Q, Lu Q (2020) Gender diversity in R&D teams and innovation efficiency: Role of the innovation context. *Research Policy* 49(1):103885-103885.

Yang Y, Tian TY, Woodruff TK, Jones BF, Uzzi B (2022) Gender-diverse teams produce more novel and higher-impact scientific ideas. *Proceedings of the National Academy of Sciences of the United States of America* 119(36).

Zhang L (2020) An Institutional Approach to Gender Diversity and Firm Performance. *Organization Science* 31(2):439-457.

|  |
| --- |
| **Tables and Figures** **Figure 1:** Factor Analysis Results (Categories of Formal Institutions) |
| Social Equality Laws  | Workplace Equality Laws |
| Men and married women have equal ownership rights to immovable property  | The law prohibits discrimination in access to credit based on gender |
| The law grants spouses equal administrative authority over assets during marriage | There is legislation specifically addressing domestic violence  |
| A woman can open a bank account in the same way as a man | Dismissal of pregnant workers is prohibited |
| A woman can register a business in the same way as a man  | Paid leave is available to fathers  |
| A woman can sign a contract in the same way as a man  | Paid leave of at least 14 weeks is available to women  |
| A woman can be head of household in the same way as a man  | The government administers 100% of maternity leave benefits  |
| There is no legal provision that requires a married woman to obey her husband  | There is paid parental leave |
| A woman can choose where to live in the same way as a man | Law mandates equal remuneration for females and males for work of equal value  |
| The ages at which men and women can retire with partial pension benefits are equal | Women are able to work in the same industries as men  |
| The mandatory retirement age for men and women are equal  | There are periods of absence due to child care accounted for in pension benefits |
| A woman can get a job in the same way as a man  | Criminal penalties or civil remedies exist for sexual harassment in employment  |
|  | Law prohibits discrimination in employment based on gender |
|  | There is legislation on sexual harassment in employment  |

**Figure 2:** Gender Egalitarianism by Country by Year



**Table 1:** Correlation Matrix and Summary Statistics

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  Variables |  Mean |  *SD* |  (1) |  (2) |  (3) |  (4) |  (5) |  (6) |  (7) |  (8) |  (9) |  (10) |  (11) |  (12) |  (13) |  (14) |  (15) |
|  (1) Patent influence  | 7.326 | 5.686 | 1.000 |
|  (2) Patent impact | 1.491 | 0.823 | .631 | 1.000 |
|  (3) Number of claims | 16.355 | 13.856 | .160 | .200 | 1.000 |
|  (4) Number of inventors | 3.199 | 1.611 | .030 | .029 | .050 | 1.000 |
|  (5) Technological diversification | 0.802 | 0.219 | -.020 | -.060 | -.088 | .036 | 1.000 |
|  (6) Log of international research centers | 0.712 | 0.678 | .012 | -.009 | -.057 | .047 | .314 | 1.000 |
|  (7) Log of GDP per capita | 10.219 | 0.406 | .056 | .031 | .042 | .028 | .009 | -.016 | 1.000 |
|  (8) Female labor participation | 54.274 | 4.999 | .134 | .155 | .194 | -.044 | -.155 | -.180 | .199 | 1.000 |
|  (9) Patent portfolio | 993.918 | 2111.572 | .066 | .034 | -.003 | .067 | .208 | .454 | .092 | -.021 | 1.000 |
|  (10) Highest skill in team | 11.682 | 20.553 | .026 | .005 | .041 | .127 | -.055 | .047 | .047 | .065 | .101 | 1.000 |
|  (11) Mean female inventor productivity in country | 1.911 | 0.293 | -.017 | -.094 | -.089 | .076 | .125 | .138 | .318 | -.419 | .147 | .035 | 1.000 |
|  (12) Gender diversity  | 0.069 | 0.159 | -.015 | -.046 | .017 | .162 | .004 | -.020 | -.020 | .055 | .005 | .066 | -.056 | 1.000 |
|  (13) Social equality laws | 10.967 | 0.315 | .028 | .033 | .017 | .017 | .015 | .001 | .087 | .027 | .029 | .018 | -.145 | .007 | 1.000 |
|  (14) Workplace equality laws | 6.478 | 1.632 | .050 | -.006 | .042 | -.025 | -.047 | -.028 | .072 | .058 | .014 | -.017 | -.053 | .044 | .035 | 1.000 |
|  (15) Gender egalitarianism  | 1.918 | 0.219 | -.012 | -.095 | -.059 | .032 | .059 | .088 | .175 | -.305 | .082 | -.006 | .508 | -.017 | -.131 | .370 | 1.000 |
|  |  |  |  |

**Table 2:** OLS Regressions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | Influence | Influence | Influence | Influence | Influence | Influence |
| Number of claims | 0.0481\*\*\* | 0.0481\*\*\* | 0.0482\*\*\* | 0.0482\*\*\* | 0.0488\*\*\* | 0.0489\*\*\* |
|  | (0.000951) | (0.000950) | (0.000953) | (0.000963) | (0.000876) | (0.000884) |
|  |  |  |  |  |  |  |
| Number of inventors | 0.169\*\*\* | 0.167\*\*\* | 0.166\*\*\* | 0.168\*\*\* | 0.173\*\*\* | 0.173\*\*\* |
|  | (0.00915) | (0.00956) | (.00947) | (.00963) | (0.00913) | (0.00905) |
|  |  |  |  |  |  |  |
| Team internationality  | 0.0677\*\* | 0.0676\*\* | 0.0837\*\*\* | 0.0662\*\* | 0.0678\*\* | 0.0816\*\*\* |
|  | (0.0238) | (0.0238) | (0.0225) | (0.0247) | (0.0275) | (0.0251) |
|  |  |  |  |  |  |  |
| Technological diversification | -0.344\*\*\* | -0.346\*\*\* | -0.354\*\*\* | -0.349\*\*\* | -0.354\*\*\* | -0.364\*\*\* |
|  | (0.0383) | (0.0386) | (0.0386) | (0.0382) | (0.0417) | (0.0414) |
|  |  |  |  |  |  |  |
| Log of international research centers | -0.0418\*\*\* | -0.0415\*\*\* | -0.0410\*\*\* | -0.0394\*\*\* | -0.0464\*\*\* | -0.0441\*\*\* |
|  | (0.0128) | (0.0128) | (0.0130) | (0.0128) | (0.0121) | (0.0123) |
|  |  |  |  |  |  |  |
| Log of GDP per capita | 0.292\*\* | 0.292\*\* | 0.248\*\* | 0.290\*\*\* | 0.288\*\* | 0.232\*\* |
|  | (0.103) | (0.103) | (0.0983) | (0.0996) | (0.102) | (0.0912) |
|  |  |  |  |  |  |  |
| Female labor participation | 0.112\*\*\* | 0.112\*\*\* | 0.115\*\*\* | 0.113\*\*\* | 0.115\*\*\* | 0.118\*\*\* |
|  | (0.00764) | (0.00763) | (0.00761) | (0.00714) | (0.00667) | (0.00628) |
|  |  |  |  |  |  |  |
| Patent portfolio | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | .0.00005\*\*\* |
|  | (0.00001) | (0.00001) | (0.00001) | (0.00001) | (0.00001) | (0.00001) |
|  |  |  |  |  |  |  |
| Same country  | -0.143\*\*\* | -0.142\*\*\* | -0.168\*\*\* | -0.135\*\*\* | -0.137\*\*\* | -0.153\*\*\* |
|  | (0.0356) | (0.0355) | (0.0336) | (0.0381) | (0.0433) | (0.0380) |
|  |  |  |  |  |  |  |
| Highest skill in team | 0.0036\*\*\* | 0.0036\*\*\* | 0.0035\*\*\* | 0.0036\*\*\* | 0.0035\*\*\* | 0.0035\*\*\* |
|  | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) |
|  |  |  |  |  |  |  |
| Mean female inventor productivity in country | -0.527\*\*\* | -0.521\*\*\* | -0.429\*\*\* | -0.487\*\*\* | -0.493\*\*\* | -0.342\*\* |
|  | (0.118) | (0.117) | (0.128) | (0.136) | (0.105) | (0.146) |
|  |  |  |  |  |  |  |
| Gender diversity |  | 0.125\*\* | 0.134\*\* | 0.231\*\*\* | 0.107\*\* | 0.219\*\*\* |
|  |  | (0.0489) | (0.0489) | (0.0443) | (0.0459) | (0.0526) |
|  |  |  |  |  |  |  |
| Social equality laws |  |  | 0.409\*\*\* |  |  | 0.427\*\*\* |
|  |  |  | (0.0818) |  |  | (0.0997) |
|  |  |  |  |  |  |  |
| Gender diversity \* social  |  |  | -0.381\*\* |  |  | -0.415\*\* |
| equality laws |  |  | (0.156) |  |  | (0.178) |
|  |  |  |  |  |  |  |
| Workplace equality laws |  |  |  | 0.0253 |  | 0.0316 |
|  |  |  |  | (0.0158) |  | (0.0197) |
|  |  |  |  |  |  |  |
| Gender diversity \*  |  |  |  | -0.192\*\*\* |  | -0.158\*\*\* |
| workplace equality laws |  |  |  | (0.0305) |  | (0.0349) |
|  |  |  |  |  |  |  |
| Gender egalitarianism |  |  |  |  | -0.00451 | -0.0381 |
|  |  |  |  |  | (0.279) | (0.302) |
|  |  |  |  |  |  |  |
| Gender diversity \* gender  |  |  |  |  | -0.805\*\*\* | -0.476\* |
| egalitarianism |  |  |  |  | (0.256) | (0.262) |
|  |  |  |  |  |  |  |
| Year fixed effects | Included | Included | Included | Included | Included | Included |
| Technology class fixed effects | Included | Included | Included | Included | Included | Included |
|  |  |  |  |  |  |  |
| Constant | 2.317\*\*\* | 2.321\*\*\* | 2.334\*\*\* | 2.290\*\*\* | 2.486\*\*\* | 2.453\*\*\* |
|  | (0.297) | (0.298) | (0.299) | (0.302) | (0.311) | (0.317) |
| Observations | 1182522 | 1182522 | 1182522 | 1182522 | 1091494 | 1091494 |
| *R*2 | .090 | .090 | .090 | .090 | .092 | .092 |
| Adjusted *R*2 | .090 | .090 | .090 | .090 | .091 | .091 |

Robust standard errors in parentheses,

\* *p* < .10, \*\* *p* < .05, \*\*\* *p* < .01

**Table 3:** Difference in Patent Influence Between All-Female and All-Male Inventor Teams by Institutions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Low (mean) | High (mean) | Difference in means | *SD* | *p*-value |
| Social equality | 0.83 | 0.88 | 0.05 | 0.69 | .94 |
| Workplace equality | 0.97 | 0.76 | 0.22 | 0.40 | .59 |
| Gender egalitarianism  | 0.83 | 0.92 | 0.09 | 0.41 | .82 |

**Table 4:** Pre- and Post-Balancing Using CEM: Comparison of Gender-Diverse and Homogenous Teams

|  |
| --- |
| Table X: Pre- and Post-Balancing Using CEM |
|  | Comparison of Gender Diverse and Homogenous Teams |
|  |  |
|  | Pre-CEM | Post-CEM |
| Number Inventors | -1.033 (0.003)\*\*\* | -0.003 (0.006) |
| Internationality of Inventors | -0.040 (0.000)\*\*\* | 0.000 (0.001) |
| Highest Productivity in Team | -4.298 (0.044)\*\*\* | 0.019 (0.062) |
| Average Productivity in Team | -1.217 (0.022)\*\*\* | 0.030 (0.032) |
| Female Star Inventor | -0.059 (0.000)\*\*\* | 0.000 (0.000) |
|  |  |  |
| Difference in means and standard errors |  |

Standard errors in parentheses, \*\*\* *p* < .01

**Table 5:** CEM Regressions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | Influence | Influence | Influence | Influence | Influence | Influence |
| Number of claims | 0.0452\*\*\* | 0.0452\*\*\* | 0.0453\*\*\* | 0.0453\*\*\* | 0.0461\*\*\* | 0.0461\*\*\* |
|  | (0.0018) | (0.0018) | (.0018) | (0.0018) | (0.0018) | (0.0019) |
|  |  |  |  |  |  |  |
| Number of inventors | 0.154\*\*\* | 0.157\*\*\* | 0.156\*\*\* | 0.158\*\*\* | 0.162\*\*\* | 0.162\*\*\* |
|  | (.0084) | (0.0086) | (0.0086) | (0.0087) | (0.0091) | (0.0091) |
|  |  |  |  |  |  |  |
| Team internationality  | 0.0199 | .0249 | 0.0384 | 0.0233 | 0.0311 | 0.0421 |
|  | (.0348) | (.0346) | (0.0337) | (0.0346) | (0.0363) | (0.0352) |
|  |  |  |  |  |  |  |
| Technological diversification  | -0.546\*\*\* | -0.553\*\*\* | -0.562\*\*\* | -0.558\*\*\* | -0.562\*\*\* | -0.573\*\*\* |
|  | (.173) | (0.174) | (0.175) | (0.175) | (0.184) | (0.184) |
|  |  |  |  |  |  |  |
| Log of international research  | -0.0575\* | -0.0566\* | -0.0564\* | -0.0517 | -0.0591\* | -0.0557 |
| centers | (0.0328) | (0.0328) | (0.0327) | (0.0329) | (0.0349) | (0.0349) |
|  |  |  |  |  |  |  |
| Log of GDP per capita | 0.362\*\*\* | 0.362\*\*\* | 0.334\*\*\* | 0.369\*\*\* | 0.356\*\*\* | 0.326\*\*\* |
|  | (0.0561) | (0.0561) | (0.0568) | (0.0606) | (0.0596) | (0.0643) |
|  |  |  |  |  |  |  |
| Female labor participation | 0.116\*\*\* | 0.115\*\*\* | 0.117\*\*\* | 0.114\*\*\* | 0.118\*\*\* | 0.119\*\*\* |
|  | (0.0067) | (0.0066) | (0.0066) | (0.0065) | (0.0067) | (0.0066) |
|  |  |  |  |  |  |  |
| Patent portfolio | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00004\*\*\* |
|  | (0.00001) | (0.00001) | (0.00001) | (0.00001) | (0.00001) | (0.00001) |
|  |  |  |  |  |  |  |
| Same country | -0.227\*\*\* | -0.224\*\*\* | -0.245\*\*\* | -0.225\*\*\* | -0.224\*\*\* | -0.242\*\*\* |
|  | (0.0755) | (0.0753) | (0.0740) | (0.0779) | (0.0791) | (0.0784) |
|  |  |  |  |  |  |  |
| Highest skill in team | 0.0073\*\*\* | 0.0074\*\*\* | 0.0073\*\*\* | 0.0074\*\*\* | 0.0073\*\*\* | 0.0073\*\*\* |
|  | (0.0022) | (0.0022) | (0.0022) | (0.0022) | (0.0023) | (0.0023) |
|  |  |  |  |  |  |  |
| Mean female inventor productivity  | -0.572\*\*\* | -0.552\*\*\* | -0.482\*\*\* | -0.564\*\*\* | -0.488\*\*\* | -0.416\*\* |
| in country | (0.154) | (0.154) | (0.157) | (0.175) | (0.150) | (0.173) |
|  |  |  |  |  |  |  |
| Gender diversity |  | 0.229\*\* | 0.234\*\* | 0.390\*\*\* | 0.207\* | 0.384\*\*\* |
|  |  | (0.102) | (0.102) | (0.0960) | (0.107) | (0.104) |
|  |  |  |  |  |  |  |
| Social equality laws |  |  | 0.404\*\*\* |  |  | 0.413\*\*\* |
|  |  |  | (0.0967) |  |  | (0.107) |
|  |  |  |  |  |  |  |
| Gender diversity \* social equality  |  |  | -0.224 |  |  | -0.181 |
| laws |  |  | (0.261) |  |  | (0.273) |
|  |  |  |  |  |  |  |
| Workplace equality laws |  |  |  | 0.0545\*\*\* |  | 0.0543\*\*\* |
|  |  |  |  | (0.0202) |  | (0.0191) |
|  |  |  |  |  |  |  |
| Gender diversity \* workplace equality  |  |  |  | -0.324\*\*\* |  | -0.286\*\*\* |
| Laws |  |  |  | (0.0544) |  | (0.0645) |
|  |  |  |  |  |  |  |
| Gender egalitarianism |  |  |  |  | 0.0706 | 0.00814 |
|  |  |  |  |  | (0.161) | (0.154) |
|  |  |  |  |  |  |  |
| Gender diversity \* gender  |  |  |  |  | -1.046\*\*\* | -0.411 |
| egalitarianism |  |  |  |  | (0.284) | (0.311) |
|  |  |  |  |  |  |  |
| Year fixed effects | Included | Included | Included | Included | Included | Included |
| Technology class fixed effects | Included | Included | Included | Included | Included | Included |
|  |  |  |  |  |  |  |
| Constant | -1.142\*\*\* | -1.169\*\*\* | -1.143\*\*\* | -1.147\*\*\* | -0.888\*\*\* | -0.854\*\*\* |
|  | (0.0984) | (0.102) | (0.103) | (0.0901) | (0.100) | (0.0938) |
| Observations | 369142 | 369142 | 369142 | 369142 | 344730 | 344730 |
| *R*2 | .055 | .055 | .055 | .055 | .048 | .048 |
| Adjusted *R*2 | .054 | .055 | .055 | .055 | .048 | .048 |

Robust standard errors in parentheses, clustered by technology class, \* *p* < .10, \*\* *p* < .05, \*\*\* *p* < .01

**Following are supplemental analyses, which will be in online appendix.**

**Table 6:** Technological Impact

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | Impact | Impact | Impact | Impact | Impact | Impact |
| Number of claims | 0.0089\*\*\* | 0.0089\*\*\* | 0.0089\*\*\* | 0.0089\*\*\* | 0.0088\*\*\* | 0.0088\*\*\* |
|  | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
|  |  |  |  |  |  |  |
| Number of inventors | 0.0344\*\*\* | 0.0345\*\*\* | 0.0343\*\*\* | 0.0347\*\*\* | 0.0346\*\*\* | 0.0345\*\*\* |
|  | (0.0007) | (0.0008) | (0.0007) | (0.0008) | (0.0008) | (0.0008) |
|  |  |  |  |  |  |  |
| Team internationality  | 0.0152\*\*\* | 0.0152\*\*\* | 0.0177\*\*\* | 0.0146\*\*\* | 0.0149\*\*\* | 0.0168\*\*\* |
|  | (0.00290) | (0.00290) | (0.00278) | (0.00293) | (0.00326) | (0.00297) |
|  |  |  |  |  |  |  |
| Technological diversification  | -0.112\*\*\* | -0.112\*\*\* | -0.113\*\*\* | -0.112\*\*\* | -0.115\*\*\* | -0.117\*\*\* |
|  | (0.0075) | (0.0074) | (0.0076) | (0.0073) | (0.0075) | (0.0075) |
|  |  |  |  |  |  |  |
| Log of international research centers | -0.0062 | -0.0062 | -0.0062 | -0.0057 | -0.0097\*\*\* | -0.0092\*\* |
|  | (0.0038) | (0.0039) | (0.0039) | (0.0039) | (0.0031) | (0.0032) |
|  |  |  |  |  |  |  |
| Log of GDP per capita | 0.0273 | 0.0273 | 0.0204 | 0.0258 | 0.0293 | 0.0194 |
|  | (0.0200) | (0.0200) | (0.0196) | (0.0192) | (0.0204) | (0.0192) |
|  |  |  |  |  |  |  |
| Female labor participation | 0.0172\*\*\* | 0.0172\*\*\* | 0.0175\*\*\* | 0.0173\*\*\* | 0.0171\*\*\* | 0.0176\*\*\* |
|  | (0.0010) | (0.0010) | (0.0010) | (0.0009) | (0.0010) | (0.0009) |
|  |  |  |  |  |  |  |
| Patent portfolio | -0.0000002 | -0.0000002 | -0.0000003 | -0.0000002 | 0.0000005 | 0.0000004 |
|  | (0.000001) | (0.000001) | (0.000001) | (0.000001) | (0.000001) | (0.000001) |
|  |  |  |  |  |  |  |
| Same country | -0.00001 | -0.00006 | -0.0041 | 0.0023 | -0.00003 | -0.0017 |
|  | (0.0055) | (0.0055) | (0.0052) | (0.0060) | (0.0067) | (0.0061) |
|  |  |  |  |  |  |  |
| Highest skill in team | 0.00035\*\*\* | 0.00035\*\*\* | 0.00035\*\*\* | 0.00036\*\*\* | 0.00035\*\*\* | 0.00034\*\*\* |
|  | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
|  |  |  |  |  |  |  |
| Mean female inventor productivity in  | -0.0407\*\* | -0.0412\*\* | -0.0268 | -0.0293\* | -0.0360\*\* | -0.00424 |
| country | (0.0155) | (0.0153) | (0.0169) | (0.0155) | (0.0168) | (0.0202) |
|  |  |  |  |  |  |  |
| Gender diversity |  | -0.0097 | -0.0079 | 0.0101\* | -0.0155\*\* | 0.0043 |
|  |  | (0.0075) | (0.0074) | (0.0058) | (0.0054) | (0.0061) |
|  |  |  |  |  |  |  |
| Social equality laws |  |  | 0.0638\*\*\* |  |  | 0.0660\*\*\* |
|  |  |  | (0.0102) |  |  | (0.0132) |
|  |  |  |  |  |  |  |
| Gender diversity \* social equality laws |  |  | -0.0838\*\*\* |  |  | -0.0942\*\*\* |
|  |  |  | (0.0232) |  |  | (0.0272) |
|  |  |  |  |  |  |  |
| Workplace equality laws |  |  |  | 0.0078\*\*\* |  | 0.0085\*\* |
|  |  |  |  | (0.0024) |  | (0.0034) |
|  |  |  |  |  |  |  |
| Gender diversity \* workplace equality  |  |  |  | -0.0370\*\*\* |  | -0.0281\*\*\* |
| laws |  |  |  | (0.00502) |  | (0.00538) |
|  |  |  |  |  |  |  |
| Gender egalitarianism |  |  |  |  | -0.000121 | -0.0153 |
|  |  |  |  |  | (0.0473) | (0.0517) |
|  |  |  |  |  |  |  |
| Gender diversity \* gender  |  |  |  |  | -0.132\*\* | -0.0763 |
| Egalitarianism |  |  |  |  | (0.0482) | (0.0449) |
|  |  |  |  |  |  |  |
| Year fixed effects | Included | Included | Included | Included | Included | Included |
| Technology class fixed effects | Included | Included | Included | Included | Included | Included |
|  |  |  |  |  |  |  |
| Constant | 1.575\*\*\* | 1.575\*\*\* | 1.577\*\*\* | 1.565\*\*\* | 1.588\*\*\* | 1.578\*\*\* |
|  | (0.0351) | (0.0351) | (0.0352) | (0.0357) | (0.0317) | (0.0336) |
| Observations | 1182522 | 1182522 | 1182522 | 1182522 | 1091494 | 1091494 |
| *R*2 | .205 | .205 | .205 | .205 | .207 | .208 |
| Adjusted *R*2 | .205 | .205 | .205 | .205 | .207 | .207 |

Robust standard errors in parentheses

\* *p* < .10, \*\* *p* < .05, \*\*\* *p* < .01

**Table 7:** OLS Regressions Only With Single-Country Inventors

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | Influence | Influence | Influence | Influence | Influence | Influence |
| Number of claims | 0.0481\*\*\* | 0.0481\*\*\* | 0.0481\*\*\* | 0.0482\*\*\* | 0.0487\*\*\* | 0.0488\*\*\* |
|  | (0.0010) | (0.0010) | (0.0010) | (0.0010) | (0.0010) | (0.0010) |
|  |  |  |  |  |  |  |
| Number of inventors | 0.176\*\*\* | 0.174\*\*\* | 0.173\*\*\* | 0.175\*\*\* | 0.181\*\*\* | 0.181\*\*\* |
|  | (0.0089) | (0.0093) | (0.0093) | (0.0094) | (0.0087) | (0.0086) |
|  |  |  |  |  |  |  |
| Technological diversification | -0.352\*\*\* | -0.354\*\*\* | -0.362\*\*\* | -0.359\*\*\* | -0.364\*\*\* | -0.375\*\*\* |
|  | (0.0374) | (0.0377) | (0.0377) | (0.0371) | (0.0412) | (0.0405) |
|  |  |  |  |  |  |  |
| Log of international research  | -0.0201 | -0.0198 | -0.0196 | -0.0168 | -0.0245\* | -0.0215 |
| centers | (0.0125) | (0.0125) | (0.0127) | (0.0125) | (0.0120) | (0.0123) |
|  |  |  |  |  |  |  |
| Log of GDP per capita | 0.301\*\* | 0.302\*\* | 0.256\*\* | 0.298\*\* | 0.291\*\* | 0.232\*\* |
|  | (0.120) | (0.120) | (0.117) | (0.116) | (0.115) | (0.107) |
|  |  |  |  |  |  |  |
| Female labor participation  | 0.121\*\*\* | 0.121\*\*\* | 0.123\*\*\* | 0.122\*\*\* | 0.125\*\*\* | 0.128\*\*\* |
|  | (0.00836) | (0.00835) | (0.00838) | (0.00764) | (0.00723) | (0.00682) |
|  |  |  |  |  |  |  |
| Patent portfolio | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* | 0.00005\*\*\* |
|  | (0.00001) | (0.00001) | (0.00001) | (0.00001) | (0.00001) | (0.00001) |
|  |  |  |  |  |  |  |
| Same country | -0.0506\* | -0.0499 | -0.0744\*\* | -0.0400 | -0.0395 | -0.0532\* |
|  | (0.0291) | (0.0290) | (0.0289) | (0.0300) | (0.0335) | (0.0301) |
|  |  |  |  |  |  |  |
| Highest skill in team | 0.0034\*\*\* | 0.0034\*\*\* | 0.0034\*\*\* | 0.0034\*\*\* | 0.0033\*\*\* | 0.0033\*\*\* |
|  | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) |
|  |  |  |  |  |  |  |
| Mean female inventor productivity  | -0.439\*\*\* | -0.433\*\*\* | -0.358\*\* | -0.372\*\* | -0.419\*\*\* | -0.249 |
| In Country | (0.134) | (0.133) | (0.141) | (0.155) | (0.126) | (0.170) |
|  |  |  |  |  |  |  |
| Gender diversity |  | 0.120\* | 0.133\*\* | 0.222\*\*\* | 0.0962\* | 0.211\*\*\* |
|  |  | (0.0575) | (0.0580) | (0.0501) | (0.0527) | (0.0589) |
|  |  |  |  |  |  |  |
| Social equality laws |  |  | 0.431\*\*\* |  |  | 0.454\*\*\* |
|  |  |  | (0.0797) |  |  | (0.0979) |
|  |  |  |  |  |  |  |
| Gender diversity \* social  |  |  | -0.504\*\* |  |  | -0.488\*\* |
| equality laws |  |  | (0.195) |  |  | (0.220) |
|  |  |  |  |  |  |  |
| Workplace equality laws |  |  |  | 0.0412\* |  | 0.0467\* |
|  |  |  |  | (0.0200) |  | (0.0242) |
|  |  |  |  |  |  |  |
| Gender diversity \* workplace  |  |  |  | -0.199\*\*\* |  | -0.165\*\*\* |
| equality laws |  |  |  | (0.0333) |  | (0.0400) |
|  |  |  |  |  |  |  |
| Gender egalitarianism  |  |  |  |  | 0.0804 | -0.00132 |
|  |  |  |  |  | (0.299) | (0.323) |
|  |  |  |  |  |  |  |
| Gender diversity \*  |  |  |  |  | -0.767\*\* | -0.430 |
| gender egalitarianism  |  |  |  |  | (0.281) | (0.298) |
|  |  |  |  |  |  |  |
| Technology class FE | Included | Included | Included | Included | Included | Included |
| Year FE | Included | Included | Included | Included | Included | Included |
|  |  |  |  |  |  |  |
| Constant | 2.032\*\*\* | 2.036\*\*\* | 2.049\*\*\* | 1.991\*\*\* | 2.186\*\*\* | 2.137\*\*\* |
|  | (0.294) | (0.295) | (0.296) | (0.298) | (0.309) | (0.316) |
| Observations | 1104717 | 1104717 | 1104717 | 1104717 | 1017487 | 1017487 |
| *R*2 | .089 | .089 | .089 | .089 | .090 | .090 |
| Adjusted *R*2 | .088 | .088 | .088 | .088 | .090 | .090 |

Robust standard errors in parentheses

\* *p* < .10, \*\* *p* < .05, \*\*\* *p* < .01

1. These are the 29 countries with more than 1,500 USPTO patents granted during the period of observation along with the percentage of patents granted from this group presented in parentheses: the United States (52.7%), Japan (21.1%), Germany (6.5%), France (2.4%), United Kingdom (2.3%), Canada (2.1%), Switzerland (0.9%), Italy (1.0%), Netherlands (0.8%), Sweden (0.8%), Israel (0.6%), Belgium (0.4%), Australia (0.6%), Finland (0.4%), Austria (0.6%), Denmark (0.3%), India (0.2%), Spain (0.2%), Norway (0.1%), Ireland (0.1%), New Zealand (0.1%), Brazil (0.1%). We dropped the following countries from the sample: Taiwan (2.7%), South Korea (2.2%), Singapore (0.2%), China (0.2%), Hong Kong (0.1%), Russia (0.1%), and South Africa (0.1%), as the estimations of gender egalitarianism could not be calculated. The 22 countries remaining in the sample account for account for 94% of the granted patents during the observation period. [↑](#footnote-ref-1)
2. We utilized the current (2019) USPTO CPC classes as reported by PatentsView. [↑](#footnote-ref-2)
3. The methodology utilized by PatentsView is available at patentsview.org {, #42}. [↑](#footnote-ref-3)