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The impact of gender diversity within R&D teams

By GULAY KAYMAKAM (S1084891)

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Program: Master's Program in Economics
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Supervisor: IM. Sıfat

Radboud Universiteit

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1 Introduction

Government authorities all across the world are establishing policies to enhance the representation of women on corporate boards. These policies are usually supported by the idea that women's participation has a favourable impact on how effective organisations operate and enhance their innovative practices. Leadership leaving out women's full corporation not only excludes women individually and collectively, but also is a massive waste of ability, knowledge and experience. Given the status of society and the world today, this component of gender inequality is likely to become much more significant (Husu et al., 2011).

According to some research, the diversity that women offer to boards and their unique management styles improves operations, whilst others argue that women's lack of leadership experience and their limited drive to climb the ladder makes them less effective board members (Dargnies, 2012). As women act differently during investment processes within a firm, this has some significant consequences for corporate decision-making. According to study, gender diversity within a corporation has a negative impact on innovation (Chen, 2016). Chen (2016), suggests that women are inclined to take less risks compared to their male peers. Furthermore, since innovation and research and development are largely risky investments, the costs of investing in these increases further. Hence, a company's innovative practices suffer when there is gender diversity within the board of directors.

On the other hand, it is argued that having a more diverse board gives a company a competitive advantage over companies with less diverse boards. This argument is articulated by Robinson and Dechant (1997). It is asserted that diversity fosters a greater awareness of the market place and helps match the firm's directors to the variety of its potential clients and employees. Enhancing its capacity to enter markets. Also, Campbell, (2008) believes that gender diversity fosters more creativity and innovation. If a company's image is enhanced, this will have a positive impact on performance. Therefore, a greater gender diverse board will also help leverage a firm's competitive advantage (Smith et al., 2006).

Therefore, this thesis hypothesises that gender diversity and innovation have a positive relationship. The majority of literature ignores the impact of culture on the linkage between gender diversity and innovation. Consequently, to the best of our knowledge this thesis will

attempt to explain how culture affects the relevance between gender diversity and innovation. According to pioneering studies like Friedland and Alford (1991), Hofstede (1991), and Hickson and Pugh (1996), a nation's cultural and social traits significantly affect how corporate management is structured. Yang (2011), suggests that when employee participation programs fail to consider cultural and power differences amongst identity groups the implementation of minority groups' decision becomes challenging. Sociologist Max Weber has articulated social closure theory as a practice of setting boundaries to occupy limited resources for one's own benefit and discriminate against other groups from using them Therefore, according to social closure theory, historically underrepresented groups are more likely to be denied access to the necessary assets in order to preserve their power and can be discriminated from participating in decision-making by historically major groups (Tomaskovic-Devey, 1993).

Hence, strong demographic groups may prevent weaker groups from taking part in the engagement process. However, in a setting with a high degree of autonomy and weak diversity management, certain demographic groups may take on traditional roles (Harrison and Humphrey, 2010). Restricting the chance for underrepresented populations to participate. As such, in various organisations, engagement practices could not produce the expected results. Thus, such nations might have fewer women in decision-making processes.

Some argue that representation of minorities like women in decision-making process is frequently more sensitive in collectivist cultures, ensuring the voices of a wider spectrum of social groups are represented (Schuler & Rogovsky, 1998). However, Davis and Williamson (2019), presents evidence how individualistic principles advances gender equality. As they discuss, norms of individualism are affiliated with personal autonomy, respect to civil rights and support societal understanding of women as morally equal to men. Contrarily, collectivist societies have a tendency to prioritise women's perceived responsibilities as members of multiple collectives, including family, religion and nation over their own aspirations (Davis & Williamson, 2019). Culture is referred to as a nation's standards and values (Hofstede, 1980). Therefore, the relationship between gender diversity and innovation may be influenced by a nation's culture. This thesis will devote to society as much as science, contributing to the outcomes of debate on

innovation which is now on rise due to the heated discussions around gender diversity in the workplace. Consequently, the research question and focus of the study will be on:

How culture affects the link between gender diversity and inventiveness within R&D teams?

As claimed by the current literature this paper hypotheses that Power Distance reinforces the impact of gender diversity on innovation. This is due to the fact that in countries with high Power Distance the centralised organisation emerges where women are acknowledged more (Van Everdingen and Waarts, 2003: Yilmaz 2020). Therefore, this has further strengthened the influence of gender diversity on innovation. Additionally, other cultural aspects Uncertainty Avoidance, Individualism and Masculinity introduced by Hofstede (1980) should lead to lower impact of gender diversity on innovation. These cultural dimensions may cause exclusion and discrimination towards the minorities (Yang, 2011). This may therefore result in women lacking enough power to render decisions and gender diversity's influence on innovation reduces.

The implication of this study is that culture, as well as, gender norms plays an important role on the impact of gender diversity on innovation and should therefore not be excluded from the analysis. Culture factors also amplify regional differences in the potential impact that women may have in organisations.

This thesis attempts to examine and evaluate the theoretical hypothesis by using cross-sectional analysis, Ordinary Least Square for board members in 42 countries between 2013 and 2022 time period and merge it with Innovation Index for R&D data.The results of this model suggests that the impact of women on board indeed strengthens the innovation within R&D teams.

The thesis first will provide a literature review of the knowledge base before developing a hypothesis. Then it will detail the methodology used for testing the hypothesis and explain the results. The outcomes of this approach will then be reviewed and presented. Finally, the study's implications and shortcomings will be examined and a conclusion will be offered.

2 Literature Review

This chapter reviews the research on the relationship between innovation and gender diversity. First, the impact of gender diversity on decision-making and outcome of the companies will be discussed and this will then be connected to diversity in the boardroom. Then, when the general impact of women directors' involvement on innovation and creativity is explained, the impact that culture might have on this event is explained. As a result, the research question can be appropriately hypothesised using this thesis.

2.1 Gender Diversity in decision-making and company outcome

Recently, the gender of CEOs has received a lot of attention in the literature on financial reporting. Behavioural differences of genders in decision-making, interests and values are noted in corporate ethics literature. Also, they each have separate obligations, understanding and risk attitudes according to Habib and Hossain (2013). Moreover, The Upper Echelon Theory, alongside an extensive body of empirical research that adopts this framework, considers top management team characteristics vital in shaping organisational outcomes. These characteristics encompass a diverse range of factors like demographics, socio-cultural values, personal histories, individual skills, prior experiences (Hambrick & Mason, 1984). Furthermore, these attributes have a bi-directional relationship with the socialisation and selection dynamics within the organisation, which in turn shape the top management team's perspective and decision-making process.

Female board members make decisions fundamentally differently than their male partners in many ways. For example, males are more likely to breach the law in order to succeed greatly and are more focused in expanding their financial gains. Yet, female managers make more ethical decisions and have more ethical attitudes (Butz & Lewis, 1996). Therefore, Gul et al. (2011) argues that female directors improves shareholder value and enhances organisational outcome. Furthermore, it is discovered that female CEOs are more ethical than male CEOs, which results in higher levels of honesty in their financial statements (Ho et al., 2015).

Female board members are less likely to engage in dangerous conduct compared to their male counterparts, and they avoid taking risky actions on behalf of the group they are part of

(Ertac & Gurdal, 2012). Women's aversion to taking risks can therefore be used to explain their lower risk-taking in the board of directions. So, it is anticipated that this will hold true for every board of directors that is gender diverse. There may be less risky decisions taken within a corporation if the board of directors has a sizable proportion of female members.

Confidence can be another factor contributing to gender differences in risk perception and risk evaluation. Uncertainty invokes different emotional reactions in men and women. Both assessment of outcomes and the probabilities are impacted by emotions (Croson & Gneezy, 2009). It is further discussed by Croson and Gneezy (2009) that perception differences among genders in risk choices are not solely caused by emotions. In addition to being more confident than women, men may also perceive the probability distribution of a particular risk differently (Elizabeth Arch, 1993). Therefore, males have a propensity to interpret risky circumstances as challenges rather than threats, which increases the risk tolerance.

Furthermore, the question arises whether one female president in the board of directors is sufficient enough to alter the company's investment behaviour. As it might be possible that the female's voices are unheard when there are more males on the board of directors than women. Almor et al. (2022), has conducted an interview in an attempt to answer the question how gender diversity affects innovation decisions. Female senior managers were interviewed by Almor et al. (2022) to determine their current position on the board of directors. In one of the interviews one respondent claims that she is the only female in senior management and argues that her male co-workers are rushing through her decisions. This may indicate that her voice and ideas are not heard enough. Whereas another responder states that they are 50% women in the board of directors and gender does not play a big role in their boards. Furthermore, there are theories which suggest the same. According to critical mass theory, the minority group's size affects the decision-making inside a group (Torchia et al., 2010). Therefore, decision-making within the group is directly impacted by the minority group's increasing number. A minority group's impact will also become more apparent as it surpasses a particular threshold or a critical mass. According to Women on boards - international labour organisation report Germany has become the latest country to introduce gender quotas in the boardroom in March 2015 and has mandated that by 2016 some of Europe's largest companies should have 30% of board members as women. It was

anticipated that the gender quotas would help achieve long-term positive effects via gradually changing perceptions and supplying mentors, role models for future women leaders.

2.2 Gender Diversity in the Boardroom

The relevance of gender diversity in the boardroom has been emphasised in recent suggestions for governance reform. One justification for this suggestion is that by selecting directors from a wider pool of talents, boards could become more effective (Adams & Ferreira, 2007). Besides, more diverse boards may foster better relationships with suppliers, employees and customers (Ellis & Keys, 2015). However, Adams and Ferreira (2007) further argues that adding more female directors to the boardroom would not be sufficient to improve board effectiveness; diverse boards could also need additional mechanisms to achieve greater efficiency. Additionally, Kanter (1978) was one of the earliest to propose that modifying the gender diversity of top management teams may have ramifications for organisational design. She elaborates that because social resemblance fosters trust, homogeneous top-level management teams work more efficiently. More coercive measures are needed for diverse teams. She contends that when uncertainty is high, businesses rely more on the leadership team's homogeneity. Therefore, high uncertainty will cause the board to elect a higher percentage of male directors rather than female in the context of boardrooms, which are traditionally made up mostly by men.

However, gender diversity has also been found to have a positive impact on company performance according to Carter et al. (2003). The research found a significant relationship between the gender and racial diversity of the board and firm performance, as measured by Tobin's Q. Elis and Keys (2003) has also discovered evidence that is consistent with this relationship even though they did not concentrate on the board of directors. They show that when diversity-promoting activities were announced, stock prices reacted positively. Cox et al. (1991) further argues that gender diversity has a positive impact on firm value at the group level among the board of directors. This is because diversity stimulates creativity, encourages information exchange and increases the board of director's ability to make decisions. Therefore, invoking the "value-in-diversity hypothesis" in the boardroom may bring value to firms and ultimately enhance their performance.

2.3 Gender Diversity and Innovation

Innovation generates a wide range of competitive positions and innovative firms are more likely to succeed in the market. This effect is crucial for both start-up firms and established firms. Innovation may boost the chances of survival of firms enabling the use of effective niche strategies (Christensen, 2011). Amabile (1998) explains that "Innovation is built on creative ideas as the basic element". Organisational innovation is the effective application of creative ideas inside a company (Amabile, 1988).

According to Tushman and O'Reilly (2004), there is a correlation between creativity, risk-taking and innovation. This is so because applying innovation requires both risk-taking and creativity. This requirement for creativity stems from the ability for business to think creatively and develop solutions for their issues within the firm. While innovation can offer many benefits, risk is also necessary. However, it can be destructive for the firm's values. Therefore, companies face many risks from engaging in innovative activities (Petrescu, 2012).

Given that innovation is largely driven by creativity, a hypothesis on the impact of gender diversity on innovation can be explained by the distinction in creativity that a gender diversified board offers in contrast to a non-gender diversified board. When there is greater gender diversity, creativity and diverse viewpoints the innovative ideas are highly encouraged. Additionally, it is asserted that a diverse board of directors fosters a wider range of problem-solving approaches.Therefore, it is argued that creativity is favourably correlated with demographic aspects like gender (Campbell et al., 2008). Given that creativity may boost innovation, gender diversity may also help increase innovation within a company. Consequently, there would be a positive link between gender diversity and innovation if the boards were more gender diverse.

Social exclusion theory might be the cause of an adverse relationship between gender diversity and innovation, since historically minority groups were frequently excluded by the dominant groups. However, as described in the previous part, critical mass theory assumes that when there are 3 or more women present in the board of directors this consequence would be abandoned.

Also according to the empirical findings of Gallego and Gutiérrez (2018), women's participation in R&D has favourable and statistically significant influence on women's engagement in innovation. The results were positive for both technological and non-technological outcomes.

Therefore, Voeten (2016), further argues this in their research that it is crucial that managers raise a top-down change and awareness within the organisational culture, promote women to get involved in decision-making, and urge men to acknowledge women's viewpoints and expertise in the innovative processes.

It is evident that gender diversified boards are more innovative and this leverages the achievement of company goals (Ferreira, 2010). However, board diversity may also have a negative impact on how effectively and efficient decisions are made, which suggests that gender diversity in the boardroom also has costs (Ferreira, 2010). This is because male board members are more competitive and success oriented, whereas female board members are more people oriented, transformative and more emphatic (Syed & Murray, 2008). Thus, according to Erhardt et al. (2003) this may cause conflict concerning strategy and management styles a less cooperative atmosphere may harm the firm's allocation of resources and increased range of professional interests. Lastly, due to this having more diversity in the boardroom may lower the effectiveness of action taking in innovation and slower the reaction to rival's initiatives (Erhardt et al., 2003).

2.4 Cultural influence on the link between innovation and gender diversity

According to the Upper Echelons Theorem, top corporate managers tend to base their decisions mostly on two factors. Firstly, top managers' individual perspectives on the organisational environment they operate in. Secondly, these interpretations are found on the experience, principles and character of a top manager (Hambrick, 2007). Thus, Hambrick (2007), argues that strategic-decision making in large organisations is a collaborative effort that utilizes the collective talents, cognitions and interpretations. Furthermore, Goll and Rasheed (2005), says that it is anticipated that the demography of a top management will affect business performance. Moreover, Hambrick (2007), claims that a firm's strategic decision-making processes are nation-specific and that certain nations may have stronger national-specific traits than others. As a result, we would anticipate that culture will influence the direct link between gender diversity and innovativeness.

Also, business professors David Ross and Cristian Deszö from Columbia University and University of Maryland examined how gender diversity has affected the top companies. They looked at the gender composition of top management teams at various companies. According to the research, female representation in the top management teams leads to an increase in firm's value and they discovered that companies that prioritised innovation experienced greater gain when women were part of the top management team (Phillips, 2014). Phillips (2014) further argues that women in general are better at on board tasks, especially with work that requires qualitative nature like strategy development, monitoring and corporate social responsibility. Therefore, our initial and main premise is:

H1: The impact of women on board is positively correlated on innovation within R&D teams.

Culture is defined as the traditions and values of a nation's citizens collectively (Hofstede, 1980). The first of Hofstede's four cultural categories is Power Distance. This is the openness to acknowledge the unequal distribution of power among institutions and organisations. This is also the fundamental issue which is related to social inequality (Hofstede, 1984). Consequently, it is possible that there will be less distributed power in a nation where there is a weaker inclination to agree that power should be spread evenly. More distributed power results in greater communal decision-making in nations where there is greater willingness to accept power being distributed equally (Yilmaz, 2020). Resulting in a centralized organisation. High centralization and formalisation levels have been demonstrated to be related with lower innovation rates being adopted (Zmud, 1982). One explanation might be that top management in centralized companies often struggles to recognize operational issues and struggles to recommend the adoption of innovation to address them (Van Everdingen and Waarts, 2003).

As the company is centralized and women are more likely to be taken seriously on the board of directors, women will have more influence in countries with larger Power Distance. This may result in women having more power within the board of directors and this will therefore result in less social exclusion. Hence, this may increase the influence the women have on R&D investments as they usually have less say within an organisation. Thus, gender diversity may have a stronger

impact on innovation in a nation due to having an equal number of women on boards with a higher Power Distance. As a result, our premise is:

H2: Gender diversity has a stronger impact on innovation in nations with higher Power Distance.

The avoidance of uncertainty is the second cultural category. This is the degree to which people feel threatened by uncertain decision-making (Hofstede, 1984). According to Hofstede (2001), organisations in a nation with a high uncertainty avoidance index frequently exhibit resistance to innovation. As per Caraso et al (2012)'s hypothesis and findings, uncertainty avoidance reduces the proportion of female board members in a company. This is due to the fact that nations with high Uncertainty Avoidance are less tolerant to different viewpoints and are less risk-taking. This would reduce the influence of gender diversity on innovation since women might have less impact in these nations. The opposite is also true, nations with low Uncertainty Avoidance are more open to different viewpoints and are more willing to take risks, which leads to a larger proportion of women serving on boards of directors. Hence, a reduced Uncertainty Avoidance would result in less social inequality with greater power to women as female board members would have more voice. As there is less Uncertainty Avoidance in a nation, gender diversity will have a greater impact on creativity. As a result, there may be lessened impact of gender diversity on innovation in a nation with an equal number of women on boards but a higher level of Uncertainty Avoidance. This brings us to our third assumption:

H3: The impact of gender diversity on innovation is weaker in nations with stronger Uncertainty Avoidance.

Individualism VS. Collectivism is the third cultural dimension. The relationship between the group and the individual is described by this dimension. Collaborative choices are the hallmark of business in collectivistic cultures, which might cause the adaptation decision process to take longer (Hofstede, 1984). Individualistic nations allow people to make their own decisions (Hofstede, 1984). Female board members may be underrepresented in decision-making as

individualistic nations operate more independently. This is discovered by (Carrasco et al., 2012). They discovered that Individualism is negatively correlated with the number of female board members. Given that the debate over the female board members touches up on societal collective ideas, it is believed that individualism would adversely correlate with the number of board members on the board of directors. They, however, do not discover any empirical support for this. As female values are frequently associated with collectivism and as the adaptation of collective decision-making is longer, it is anticipated that female board members will be underrepresented in nations with strong individualistic traits. Moreover, minority groups' ability to engage in decision-making might be constrained in a setting with high autonomy and weak diversity components (Harrison & Humphrey, 2010). Hence, social exclusion is created when a nation is culturally individualistic. As a result, this would reduce the impact of gender diversity on innovativeness as the women's influence in these countries is reduced. Therefore, the impact of gender diversity on innovation is reduced when a nation has a higher level of individualism. So hypothesis will be:

H4: Gender diversity has a weaker impact on innovation in countries when there are high levels of individualism.

Masculine VS. Feminine countries make up the last cultural division. This shows that a country's ideas are heavily dependent on material achievement like wealth and possessions. Values like equality, solidarity, social interactions and managers using their intuition and seeking agreement defines feminine cultures. In contrast, masculine cultures are characterized by ambition, rivalry, material interest and an emphasis on performance (Hofstede, 1984). According to Hofstede (2001), firms with Masculine cultures tend to place more focus on training, personal development and performance recognition which are unique to innovative organisations. Niederle and Vesterlund (2011) says that men are more competitive than women so it is possible that female board members are underrepresented in decision-making in Masculine countries since they are less compatible with the company's norms and ideals. Therefore, this leads to social exclusion in a nation with higher levels of masculinity and may result in female board members having limited

decision-making authority. Consequently, it is plausible that the impact of gender diversity on innovation declines in countries with high levels of Masculinity. The final hypothesis would be:

H5: The impact of gender diversity on innovation is weaker in countries with greater levels of Masculinity.

3 Methodology

In order to answer the research question, the given variables will be defined in this thesis. After the variables have been defined the influence of culture on the impact of gender diversity on innovation will be estimated by a regression. Hence, following the regression analysis, the presumptions are evaluated to verify if they are true. Thus, we can verify our findings. This thesis provides an explanation of the methods used and the rationale for using these techniques to be able to answer our research question. Furthermore, to define the fine period between accuracy and range of available data, a 10 year time period has been set as a limit, therefore,data is used from 2013 to 2022 for 42 countries.

Countries annual innovation indexes which includes; Institutions, Human and Capital research, Market and Business sophistication, Infrastructure, Knowledge, Technology and Creative outputs as well as R&D Gross domestic expenditure made by all resident companies, research organisations, universities and government laboratories in a nation are drawn from the Global Economy database for the given time period. Furthermore, for the gender diversity data proportion of female seats on boards of the biggest publicly listed companies are used from OECD Stat database. Also, the Hofstede insights database is used for the culture of nations where the company is placed. Database illustrates a score for six cultural dimensions for each country and four of the dimensions are used for the study.

3.1 Dependent Variable

Innovation will be used as the dependent variable in this thesis to measure the influence of gender diversity on innovation. Innovation is the application, acceptance and generation of new concepts, procedures and products (Mahemba and De Bruijn, 2003).

Some researchers rely on innovation proxies driven via patent counts, survey-based indicators like survey of managers or R&D expenditures. The number of patents a company attains may serve as a suitable technique to quantify innovation since patent agreements enable a company to use the researched product specifically. Yet, one problem that might arise with using patents as a measure of innovation is that some companies utilizes patents more frequently than others

(Jansen, 2009). Also, patents may greatly vary in terms of their significance and worth; consequently patent numbers are unlikely to represent innovative output (Burhan et al., 2017). Thus, these may bias our findings. Therefore, the number of patents might not be a useful proxy for innovation for our study on cultural effects on the link between gender diversity and innovation.

Furthermore, survey-based measures attempt to deepen our knowledge on adaptation of various innovation metric matters. However, this thesis cannot use surveys of managers as a proxy for innovation due to time constraints since conducting this is often time consuming and there is possibility of low sample.

The company's R&D expenses might be a suitable proxy for innovation. R&D expenditures may assist businesses in three different possibilities, making them a useful indicator of innovation. The first way is that R&D may develop new goods, promotional strategies and other activities that are significantly altering the nature of innovation within a company. The second way is that by investing in R&D the company may influence the degree of change and improvement on the products. Lastly, the third potential is that by investing in R&D, the company may produce goods that are novel innovations (Petrescu, 2012). However, a potential disadvantage could be that R&D expenditures may not reflect the costs for innovation. According to Jensen and Webster (2009) the primary issue with using R&D spending as a proxy for innovation is systematic data collection because R&D expenditure is not subject to mandatory spending. Jensen and Webster (2009) further argue disadvantages that depending on the company's strategic goals, the R&D spending may not be reported. Considering the fact that R&D spending may have disadvantages in measuring innovation in this thesis it is scrutinised that R&D expenditure is not considered to be the best alternative to assess Innovation. Therefore, Global Innovation Index (GII) will be used which analyses the current state of global innovations and ranks the innovative performance of countries since 100 % of the sample countries had invested in R&D expenditure, making innovation a useful indicator of R&D.

The Global Innovation Index (GII) is an indicator that is composed of seven components that adds up to a single score of innovative capability of a country with two sub-indices. The first sub-index consists of five of the components measuring the strength of different variables related to

innovative inputs, which is the Innovation Input Sub-Index. They are institutions, human resources and research, both market and business sophistication and infrastructure. The second sub-index Innovation Output Sub-Index consists of two pillars: technical and knowledge outputs and creative outputs. The average of both Innovation Input Sub-Index and the Innovation Output Sub-Index sums up to a final mark, The Global Innovation Index (GII) (Organization, 2022). This indicator is often used as a dependent variable in innovation and R&D related research (Cox et al., 1991). Additionally, Cox et al. (1991) suggests that the GII index is regarded as a reliable, consistent and robust measure of innovation.

3.2 Independent Variable

This paper will attempt to use the female share of seats on boards in the largest publicly listed firms per country as a proxy for gender diversity. The data indicates the fraction of women on boards for the biggest 50 affiliates of the primary blue-chip index and covers a sample of 4,218 global companies of the MSCI, ACWI, EAFE, and Emerging Market indexes with additional 1,700 large to mid-cap developed market economies. According to the critical mass theory suggested by (Torchia et al., 2010) the number of female directors on the board should be at least three in order to make women decision-making be effective (Kramer, 2007).

This thesis will build on the work of Attah-Boakye et al. (2020), who investigated the impact of culture on the link between gender diversity and innovativeness in emerging firms to investigate the impact of culture on the association between gender diversity and innovation.

The cultural elements of Hofstede (1980) will be used in this research as a proxy for national culture. This paper employs cultural aspects as it is claimed that there is a link between national culture and innovation as well as impact of national culture on the relationship between gender diversity and innovation. Power Distance, Individualism, Masculinity and Uncertainty Avoidance makes up the cultural aspects.

3.3 Control Variable

The link between gender diversity and innovation will be controlled by a few different external factors. Several control variables are incorporated into the analysis to capture factors that might

affect the board performance. In order to avoid identification errors the following control variables are considered in the analysis: RnD per GDP, Power Distance category (pdi), Uncertainty Avoidance category (uai), Individualism category (idv), Masculinity category (mas).

Innovation Index is a good proxy for Research and Development for the main regression therefore RnD per GDP it will be included for the first hypotheses' regression as a control variable.

Categorical control variables for hypothesis 2, 3, 4 and 5 which are pdi, uai, idv and mas are decided according to Hofstede (1980) cultural dimension score. For pdi, uai, idv and mas countries that score above 50 are categorised as high and countries scored below 50 are categorised as low.

Lastly, year is included to control for time-specific effects (Barkema & Shvyrkov, 2007).

3.4 Regression analysis

Since the Innovation Index which is used as a proxy for R&D spending is time dependent and culture is cross sectional data, this thesis does not require to use panel data. To find how culture affects the link between gender diversity and innovation within R&D teams, a cross- sectional analysis is used. One of the advantages of cross-sectional analysis is that it is less time consuming. Since cultural variations between countries are often stable, it is possible to use cross-sectional study rather than a longitudinal study without affecting the quality of the research. (Hofstede, 2001)The Ordinary Least Square for the main regression will be as the following:

$$InnovationIndex = \beta_0 + \beta_1 GenderDiversity + \beta_2 PowerDistance + \beta_3 Individualism + \beta_4 Masculinity + \beta_5 UncertainityAvoidance + \beta_6 PowerDistance * GenderDiversity + \beta_7 Individualism * GenderDiversity + \beta_8 Masculinity * GenderDiversity + \beta_9 UncertainityAvoidance * GenderDiversity + Controls + \epsilon$$

If an interaction effect is significant in the analysis then this thesis can conclude that there is an influence of at least one of the cultural factors on the relation between gender diversity and innovation. Thus, this approach can adequately answer the research topic. Additionally, this thesis tests for heteroscedasticity using the Breusch-Pagan test in order to test the model's underlying assumption. Since, the Breusch-Pagan tests for heteroscedasticity the results are significant and indicates that heteroscedasticity does not arise.

3.5 Sample description

Table 1 provides all the descriptive statistics of the variables. Displaying the number of observations, mean, standard deviation, minimum and maximum values. Our sample covers 42 country observations due to limited availability of data. According to Hofstede (1980), countries that score higher than 50 are classified as high Uncertainty Avoidance countries where people want to make the future as predictable as possible. Table 1 shows that Uncertainty Avoidance Index (uai) have the largest mean with 66.6190 indicating that the majority of the sample are high Uncertainty Avoidance countries. Also, the dependent variable Innovation Index has a mean of 47.8198, a standard deviation of 9.5821 and varies between 29.38 and 66.55.

Table 2 illustrates the correlation between the main and control variables, denoting the strength of associations between variables. The Innovation Index and RnD per GDP is highly correlated with (0.795, $p<0.05$), therefore it indicates that Innovation Index is a good proxy for R&D. Also as it can be seen in the correlation matrix the correlation between all the variables are quite high.

3.6 Results

The results are displayed in this section, first the impact of gender diversity on innovation is described and followed by the impact of culture on this relation. The results are then tested for robustness.

Table 1 shows the OLS regression for the main hypothesis for the impact of women on board. Several OLS regressions are conducted in order to test for the hypothesis and it is found that the general impact of gender diversity on innovation is beneficial. According to the empirical results, the impact of women on board does have a positive and significant effect on innovation within R&D teams. As it can be seen in Table 3 according to our R-squared which is 0.8, there is a high correlation between women on board and innovation within R&D teams. Since, we found a strong correlation for the main hypothesis this will accept the first hypothesis as true that the impact of women on board is positively correlated on innovation within R&D teams.

This is consistent with the empirical results of Gallego and Guettierez (2018). This might be because creativity stimulates innovation. As gender diversity promotes more creativity with

innovation, having more women may convey more creativity within an organisation, leading to a positive effect of gender diversity on innovation (Tushman & O'Reilly, 2004).This result is also consistent with previous study of Attah-Boakye (2020), who argued that encouraging more women into upper echelons will boost firm's innovation. As discussed prior, adding more women to the board will increase board efficiency. Also, a viable reason for this result might be that increasing the number of women in top management positions assists the strategic decisions to be assessed from several pragmatic viewpoints, which will help boost the innovation and increase the R&D spending.

This is consistent with the empirical results of Gallego and Guettierez (2018) and Attah-Boakye (2020). This might be because creativity stimulates innovation. As gender diversity promotes more creativity with innovation, having more women may convey more creativity within an organisation, leading to a positive effect of gender diversity on innovation (Tushman & O'Reilly, 2004).

This thesis further examines the hypothesis that social exclusion arises from culture and as a result has an impact on the relationship between gender diversity and innovation. As it can be seen in Figure 1 Power Distance has a positive impact on the relationship between gender diversity and innovation. Indicating that Power Distance has an increasing impact of gender diversity and innovation when a nation has more women on the board of directors. Women have more voice and influence in a nation with higher Power Distance since the organisations are more centralized and they are more inclined to be taken seriously by the board of directors. Therefore, this will result in decrease in social exclusion. This leads to women having more power and influence on the board of directors. Thus, this leverages the impact the women have on R&D practices. A company located in a higher Power Distance country functions as an entity that takes decisions collectively. This asserts that the decisions of women within the board of directors are equally important.

The empirical evidence shows that gender diversity has a positive impact in both lower Power Distance countries and high Power Distance countries in Table 4 and 5 but the effect is larger on high Power Distance countries compared to low Power Distance countries. Therefore, in high Power Distance countries employing gender diversity indeed is more likely to increase innovation.

Meaning that women's participation in R&D teams can increase the likelihood of firm innovativeness. Since, firms located in high Power Distance countries frequently exhibit centralized decision making where decisions are made from top of the business and commands are distributed down the chain, appointing more women to the board of directors in high Power Distance may increase innovation and therefore R&D spending.

The following equation is for gender diversity's impact on innovation in High Power Distance countries:

$$Innovation\ Index = 0.4123 \times Gender\ Diversity + 34.6124$$

The following equation is for gender diversity's impact on innovation in Low Power Distance countries:

$$Innovation\ Index = 0.2204 \times Gender\ Diversity + 47.114$$

This finding is also consistent with findings of Attah-Boakye's (2020). Thus, this thesis can accept the second hypothesis that gender diversity on innovation in higher Power Distance countries is positively accounting for culture.

Figure 1: Scatter plot of impact of gender diversity on innovation in Low Power Distance and High Power Distance countries.

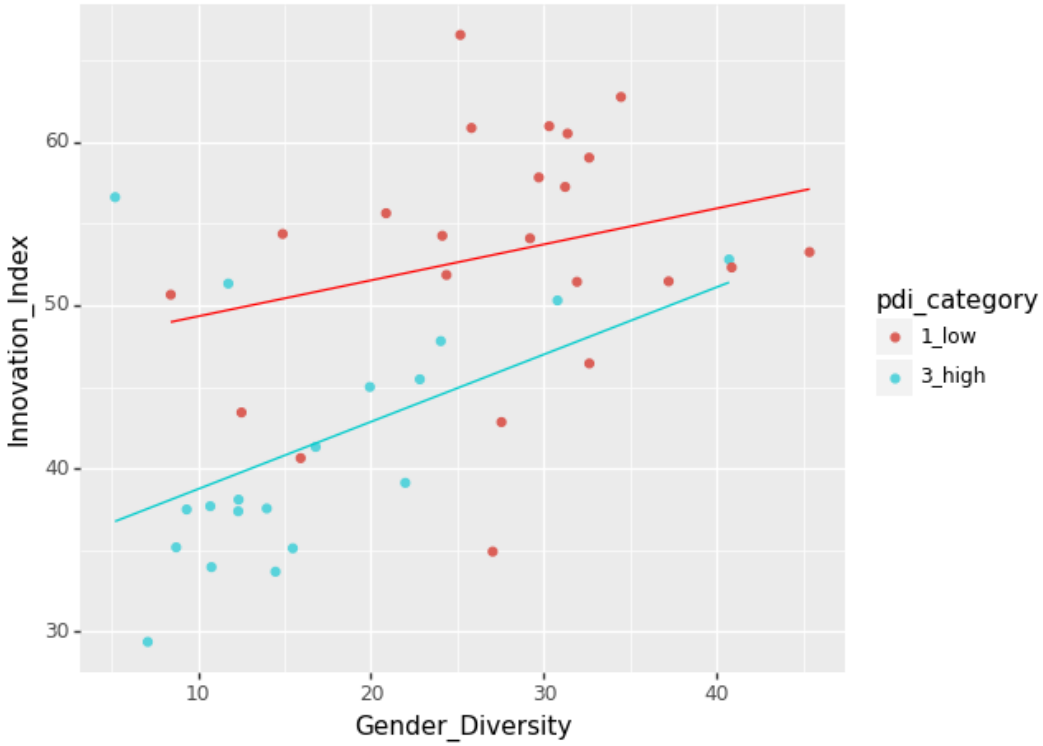


Figure 2 illustrates the relationship between innovation and gender diversity in low and high Uncertainty Avoidance countries. Table 6 and 7 also demonstrates the relationship of High and Low Uncertainty Avoidance countries impact of gender diversity on innovation. The empirical evidence shows that gender diversity has a positive impact in both Low Uncertainty Avoidance and High Uncertainty Avoidance countries, however, the effect is slightly larger on High Uncertainty Avoidance countries. We did not find support for the third hypothesis where the impact of gender diversity on innovation is weaker in nations with stronger Uncertainty Avoidance. Therefore, this thesis needs to reject the third hypothesis since the empirical findings suggest that the opposite is true. A possible explanation for this might be that the general impact of gender diversity on innovation is stronger than the impact of Uncertainty Avoidance. However, there is a need for additional research to be done.

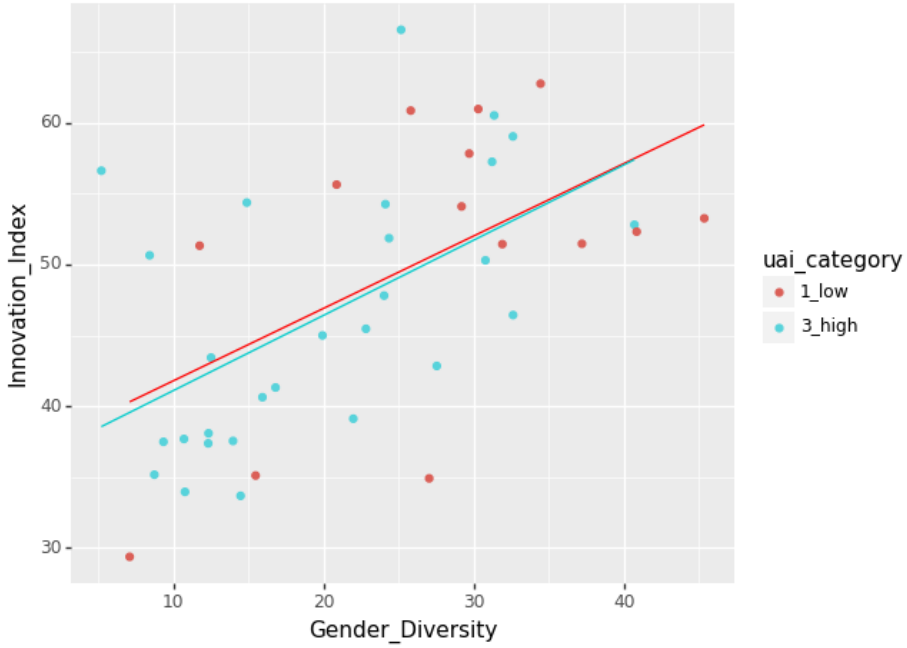
The following equation is for the gender diversity's impact on innovation in High Uncertainty Avoidance countries:

$$Innovation\ Index = 0.5304 \times Gender\ Diversity + 35.7953$$

The following equation is for the gender diversity's impact on innovation in Low Uncertainty Avoidance countries:

$$Innovation\ Index = 0.5107 \times Gender\ Diversity + 36.6832$$

Figure 2: Scatter plot of impact of gender diversity on innovation in Low Uncertainty Avoidance and High Uncertainty Avoidance countries.



The relationship of Individualistic countries on the impact of gender diversity on innovation is shown on Figure 3 and compared the high Individualistic and low Individualistic countries effect on the gender diversity on innovation.Table 8 and Table 9 shows the OLS regression of low Individualistic and high Individualistic countries respectively. As illustrated, both national culture's effects are positively correlated with gender diversity and innovation. However, high Individualistic countries have more significant effects compared to low Individualistic countries. This indicates that if individuality is higher in a country the effect of gender diversity on innovation is more significant. Therefore, the fourth hypothesis of this thesis needs to reject that gender diversity has a weaker impact on innovation in countries when there is high levels of individualism. This may suggest that Higher Individualistic countries may serve to affirm women's pursuit of their personal objectives and preferences where their contribution to board positions are promoted rather than hindered.

The following equation is for the gender diversity's impact on innovation in High Individualistic countries:

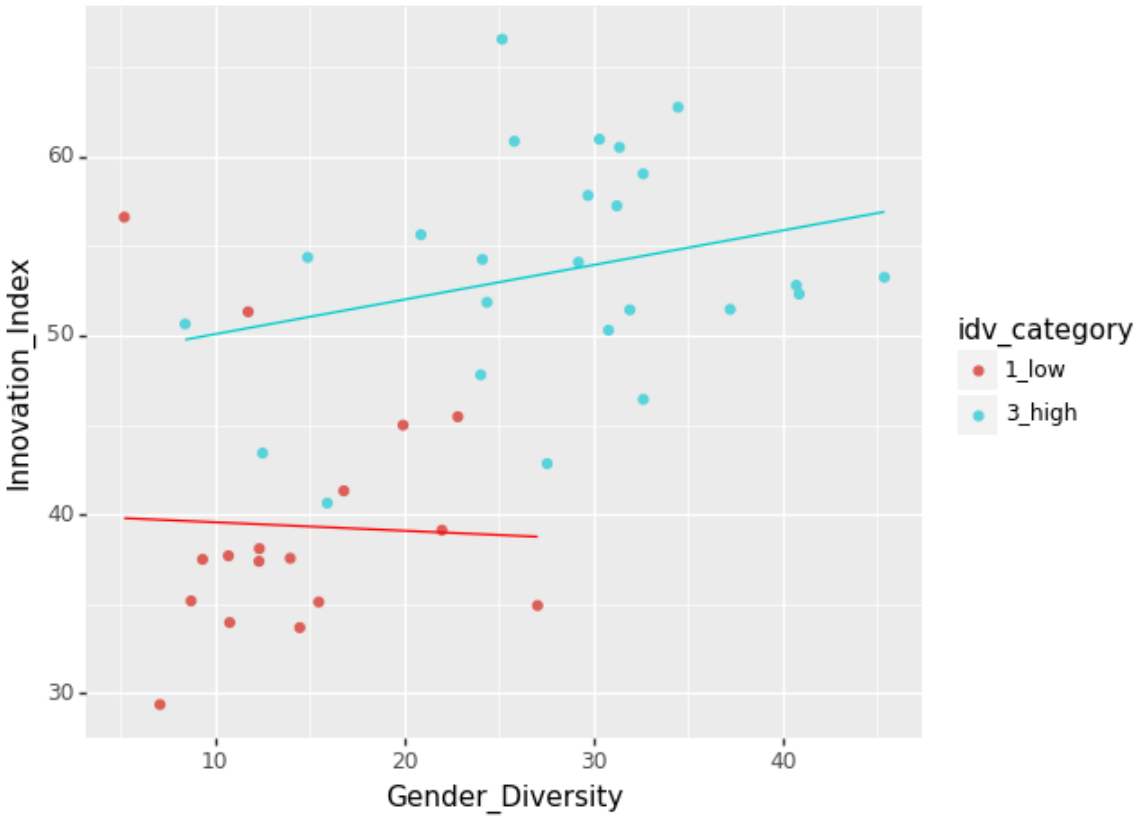
$$Innovation\ Index = 0.1933 \times Gender\ Diversity + 48.1394$$

The following equation is for the gender diversity's impact on innovation in Low Individualistic countries:

$$Innovation\ Index = -0.0475 \times Gender\ Diversity + 40.0397$$

Empirical evidence found by Davis and Williamson (2019) also implies that a country which is more individualistic has a more supportive attitude towards women's involvement in a variety of dimensions in social, economic and political life.

Figure 3: Scatterplot of impact of gender diversity on innovation in High Individualistic and Low Individualistic countries.



Lastly, Table 10 and 11 shows the relation of low and high Masculinity on the impact of gender diversity on innovation respectively. Figure 4 also illustrates the relationship of high and low Masculine countries on the effect of gender diversity and innovation. The slope of high Masculinity indicated with a blue line on Figure 4 is seen to be positive on gender diversity on innovation. This indicates that the higher Masculinity in a nation, higher the impact of gender diversity on innovation and this further suggests that countries that are characterised as Masculine results in stronger impact on gender diversity. Thus, considering this fact this thesis needs to reject the fourth hypothesis that the impact of gender diversity on innovation is weaker in countries with greater levels of Masculinity.

The following equation is for the gender diversity's impact on innovation in High Masculine countries:

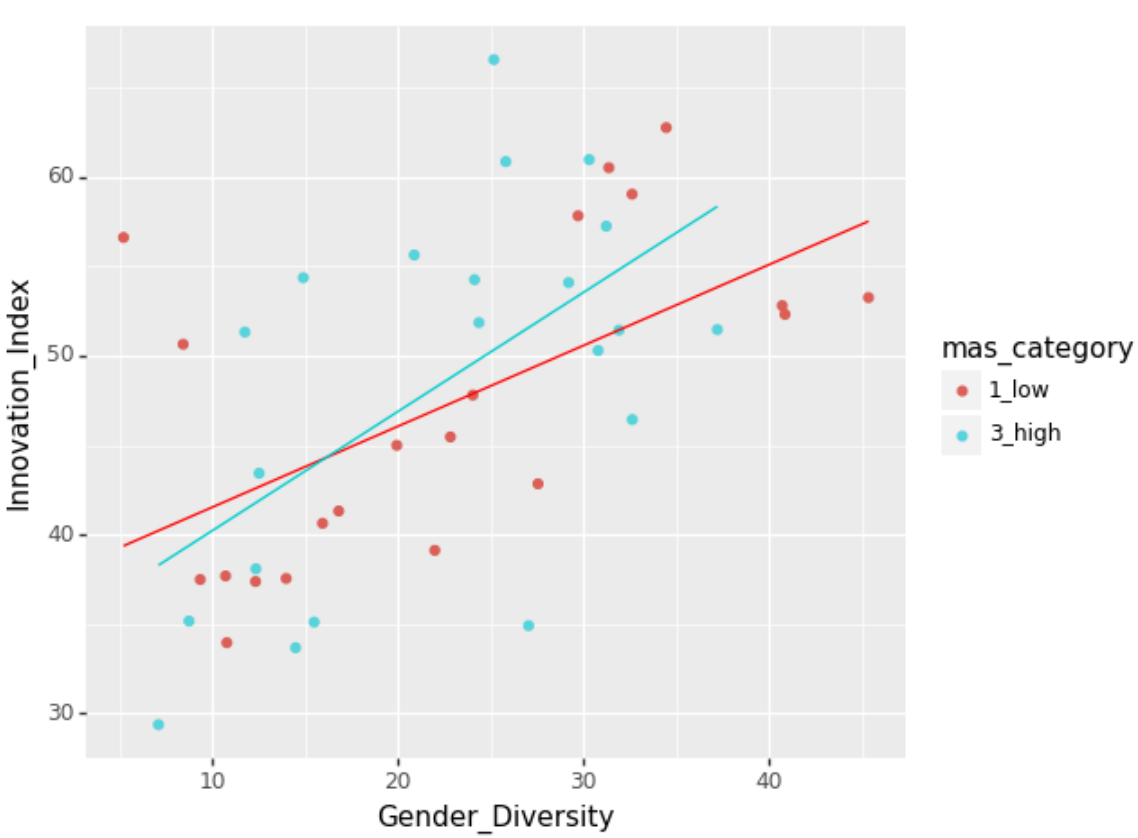
$$Innovation\ Index = 0.6658 \times Gender\ Diversity + 33.5654$$

The following equation is for the gender diversity's impact on innovation in Low Masculine countries:

$$Innovation\ Index = 0.4519 \times Gender\ Diversity + 37.0149$$

Additionally, results of Attah-Boakye et al. (2020), also indicates a positive impact of Masculinity on gender diversity on board innovation, suggesting that nations with a high Masculinity are more likely to innovate due to dominant cultural characteristics like intense competition and focus on achievement.

Figure 4: Scatterplot of impact of gender diversity on innovation in High Masculine and Low Masculine countries



4 Conclusion and Discussion

This thesis examines the impact of culture on the relation between gender diversity and innovation within R&D teams. Therefore, attempts to answer the research question: “How culture affects the link between gender diversity and inventiveness within R&D teams ?”. This concept has recently gained attention among scholars with the urge to enhance gender diversity in many aspects of social life. Therefore, this question may contribute to societal discussion. However, the impact of national cultural dimensions on this connection has not received an extensive study. Therefore, this research attempts to explain how culture affects the relationship between gender diversity and innovation.

This thesis uses cross-sectional analysis and OLS regression for 42 country observations to test for the hypotheses and uses variables that are proxies for innovation and gender diversity.

The following findings were obtained. First, empirical evidence of this study suggests that women on board does effectively promote innovation within R&D teams (H1). This is in line with the main hypothesis suggested in this thesis. This might be because female directors help bring unique knowledge and different perspectives to the board helping boost innovation and R&D investment. This effect intensifies especially when their number is over three. Second, gender diversity has a greater effect on innovation when there is high Power Distance (H2). This indicates that in companies in high Power Distance companies gender diversity has a greater impact on innovation. This is also in line with the hypothesis suggested in the thesis. However, suggested H3,H4 and H5 of national cultural perspectives are not in line with the empirical evidence. Therefore, this thesis rejects that the impact of gender diversity on innovation is weaker in nations with strong Uncertainty Avoidance, high Individualism and high Masculinity. Therefore, it is recommended by Hofstede (1980) to consider cultural factors in research on this subject as they are moderating the gender diversity on innovation.

Since the research question attempts to explain behavioural and cultural aspects, interviewing board of directors from various cultural backgrounds and companies could be a better solution to answer the research question. Also, our study’s small sample size is one of the limitations in the thesis. Furthermore, a further study might also want to utilize additional indicators for R&D

like patents, however, this also has some drawbacks. Thus, to be able to fully accept the hypotheses, it might be necessary to validate the results.

Moreover, we recommend that policymakers and Multinational Enterprises to focus more on female directors' representation, voice and the national culture to reinforce corporate social responsibility via policy enhancements like imposing volunteering gender quotas or mandatory gender quotas.

Finally, it would be interesting for future study to include more control variables in the future studies. The board experience, skills and education could be included. This is suggested as these three characteristics have a beneficial effect on the board performance (Francoeur et al., 2007)

5 Appendix

Table 1: Descriptive statistics of variables.

	Obs	Mean	Std	Min	Max
Gender_Diversity	42	22.453074	10.384254	5.2143	45.36
Innovation_Index	42	47.81984	9.582123	29.38	66.55
RnD_PerGDP	42	1.736343	1.071117	0.225	4.6106
pdi	42	50.904762	21.141578	11	93
idv	42	54.52381	22.835828	13	91
mas	42	45.309524	21.197662	5	88
uai	42	66.619048	21.8966	23	100

Table 2: Correlation matrix between variables.

	Gender_Diversity	Innovation_Index	RnD_PerGDP	pdi	idv	mas	uai
Gender_Diversity	1	0.573565	0.391222	-0.582145	0.680361	-0.232854	-0.371711
Innovation_Index	0.573565	1	0.795954	-0.69507	0.663257	-0.084447	-0.449816
RnD_PerGDP	0.391222	0.795954	1	-0.569891	0.37882	-0.06536	-0.204871
pdi	-0.582145	-0.69507	-0.569891	1	-0.679417	0.050845	0.485956
idv	0.680361	0.663257	0.37882	-0.679417	1	0.053568	-0.456062
mas	-0.232854	-0.084447	-0.06536	0.050845	0.053568	1	0.062529
uai	-0.371711	-0.449816	-0.204871	0.485956	-0.456062	0.062529	1

Table 3: OLS Regression results for the main hypothesis that the impact of women on board is positively correlated on innovation within R&D teams.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.808
Model:	OLS	Adj. R-squared:	0.746
Method:	Least Squares	F-statistic:	13.01
Date:	Mon, 26 Jun 2023	Prob (F-statistic):	1.57e-08
Time:	18:09:29	Log-Likelihood:	-119.39
No. Observations:	42	AIC:	260.8
Df Residuals:	31	BIC:	279.9
Df Model:	10		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	44.9148	14.068	3.193	0.003	16.223	73.606
Gender_Diversity	-0.1509	0.542	-0.278	0.783	-1.257	0.955
pdi	-0.2011	0.156	-1.290	0.207	-0.519	0.117
idv	0.0296	0.130	0.228	0.822	-0.236	0.295
mas	-0.0110	0.109	-0.101	0.920	-0.233	0.211
uai	0.0158	0.109	0.145	0.886	-0.207	0.238
pdi:Gender_Diversity	0.0086	0.007	1.249	0.221	-0.005	0.023
idv:Gender_Diversity	0.0024	0.006	0.406	0.688	-0.010	0.014
mas:Gender_Diversity	0.0001	0.004	0.025	0.980	-0.008	0.009
uai:Gender_Diversity	-0.0051	0.006	-0.891	0.380	-0.017	0.007
RnD_PerGDP	5.4559	0.898	6.073	0.000	3.624	7.288

Omnibus:	1.128	Durbin-Watson:	2.181
Prob(Omnibus):	0.569	Jarque-Bera (JB):	0.391
Skew:	-0.127	Prob(JB):	0.822
Kurtosis:	3.399	Cond. No.	5.06e+04

Table 4: OLS Regression results of the relationship of Low Power Distance countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.065
Model:	OLS	Adj. R-squared:	0.020
Method:	Least Squares	F-statistic:	1.460
Date:	Wed, 21 Jun 2023	Prob (F-statistic):	0.240
Time:	16:19:38	Log-Likelihood:	-78.072
No. Observations:	23	AIC:	160.1
Df Residuals:	21	BIC:	162.4
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	47.1114	5.266	8.946	0.000	36.159	58.064
Gender_Diversity	0.2204	0.182	1.208	0.240	-0.159	0.600

Omnibus:	1.702	Durbin-Watson:	1.324
Prob(Omnibus):	0.427	Jarque-Bera (JB):	0.969
Skew:	-0.503	Prob(JB):	0.616
Kurtosis:	3.023	Cond. No.	96.7

Table 5: OLS Regression results of the relationship of High Power Distance countries on gender diversity on innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.231
Model:	OLS	Adj. R-squared:	0.186
Method:	Least Squares	F-statistic:	5.108
Date:	Wed, 21 Jun 2023	Prob (F-statistic):	0.0372
Time:	16:19:38	Log-Likelihood:	-62.331
No. Observations:	19	AIC:	128.7
Df Residuals:	17	BIC:	130.6
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	34.6124	3.356	10.314	0.000	27.532	41.693
Gender_Diversity	0.4123	0.182	2.260	0.037	0.027	0.797

Omnibus:	15.200	Durbin-Watson:	2.662
Prob(Omnibus):	0.001	Jarque-Bera (JB):	13.898
Skew:	1.618	Prob(JB):	0.000960
Kurtosis:	5.662	Cond. No.	39.6

Table 6: OLS Regression results of Low Uncertainty Avoidance countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.286
Model:	OLS	Adj. R-squared:	0.226
Method:	Least Squares	F-statistic:	4.799
Date:	Wed, 21 Jun 2023	Prob (F-statistic):	0.0490
Time:	16:19:39	Log-Likelihood:	-49.733
No. Observations:	14	AIC:	103.5
Df Residuals:	12	BIC:	104.7
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	36.6832	6.892	5.323	0.000	21.667	51.699
Gender_Diversity	0.5107	0.233	2.191	0.049	0.003	1.019

Omnibus:	2.582	Durbin-Watson:	1.449
Prob(Omnibus):	0.275	Jarque-Bera (JB):	1.163
Skew:	-0.285	Prob(JB):	0.559
Kurtosis:	1.708	Cond. No.	83.7

Table 7: OLS Regression results of High Uncertainty Avoidance countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.300
Model:	OLS	Adj. R-squared:	0.273
Method:	Least Squares	F-statistic:	11.14
Date:	Wed, 21 Jun 2023	Prob (F-statistic):	0.00256
Time:	16:19:39	Log-Likelihood:	-95.707
No. Observations:	28	AIC:	195.4
Df Residuals:	26	BIC:	198.1
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	35.7953	3.472	10.309	0.000	28.658	42.932
Gender_Diversity	0.5305	0.159	3.337	0.003	0.204	0.857

Omnibus:	5.511	Durbin-Watson:	2.527
Prob(Omnibus):	0.064	Jarque-Bera (JB):	4.483
Skew:	0.979	Prob(JB):	0.106
Kurtosis:	3.076	Cond. No.	52.5

Table 8: OLS Regression results of the relationship of Low Individualism countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.002
Model:	OLS	Adj. R-squared:	-0.065
Method:	Least Squares	F-statistic:	0.02562
Date:	Mon, 26 Jun 2023	Prob (F-statistic):	0.875
Time:	18:09:32	Log-Likelihood:	-56.238
No. Observations:	17	AIC:	116.5
Df Residuals:	15	BIC:	118.1
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	40.0397	4.539	8.820	0.000	30.364	49.715
Gender_Diversity	-0.0475	0.297	-0.160	0.875	-0.680	0.585

Omnibus:	5.825	Durbin-Watson:	2.950
Prob(Omnibus):	0.054	Jarque-Bera (JB):	3.417
Skew:	1.057	Prob(JB):	0.181
Kurtosis:	3.596	Cond. No.	40.8

Table 9: OLS Regression results of the relationship of High Individualism countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.073
Model:	OLS	Adj. R-squared:	0.032
Method:	Least Squares	F-statistic:	1.798
Date:	Mon, 26 Jun 2023	Prob (F-statistic):	0.193
Time:	18:09:32	Log-Likelihood:	-80.374
No. Observations:	25	AIC:	164.7
Df Residuals:	23	BIC:	167.2
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	48.1394	4.239	11.357	0.000	39.371	56.908
Gender_Diversity	0.1933	0.144	1.341	0.193	-0.105	0.491

Omnibus:	0.209	Durbin-Watson:	1.082
Prob(Omnibus):	0.901	Jarque-Bera (JB):	0.407
Skew:	0.118	Prob(JB):	0.816
Kurtosis:	2.421	Cond. No.	99.3

Table 10: OLS Regression results of the relationship of Low Masculinity countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.360
Model:	OLS	Adj. R-squared:	0.327
Method:	Least Squares	F-statistic:	10.71
Date:	Mon, 26 Jun 2023	Prob (F-statistic):	0.00401
Time:	18:09:32	Log-Likelihood:	-70.511
No. Observations:	21	AIC:	145.0
Df Residuals:	19	BIC:	147.1
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	37.0149	3.507	10.554	0.000	29.674	44.355
Gender_Diversity	0.4519	0.138	3.272	0.004	0.163	0.741

Omnibus:	4.171	Durbin-Watson:	2.103
Prob(Omnibus):	0.124	Jarque-Bera (JB):	3.286
Skew:	0.960	Prob(JB):	0.193
Kurtosis:	2.742	Cond. No.	55.9

Table 11: OLS Regression results of the relationship of High Masculinity countries on gender diversity and innovation.

OLS Regression Results

Dep. Variable:	Innovation_Index	R-squared:	0.332
Model:	OLS	Adj. R-squared:	0.297
Method:	Least Squares	F-statistic:	9.441
Date:	Mon, 26 Jun 2023	Prob (F-statistic):	0.00627
Time:	18:09:32	Log-Likelihood:	-74.233
No. Observations:	21	AIC:	152.5
Df Residuals:	19	BIC:	154.6
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	33.5654	5.191	6.466	0.000	22.701	44.430
Gender_Diversity	0.6658	0.217	3.073	0.006	0.212	1.119

Omnibus:	0.525	Durbin-Watson:	2.249
Prob(Omnibus):	0.769	Jarque-Bera (JB):	0.582
Skew:	0.043	Prob(JB):	0.747
Kurtosis:	2.189	Cond. No.	65.4

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