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# **The effect of gender diversity on R&D investment: A cultural perspective**

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## 1 Introduction

Nowadays, firms try to increase their female employments. They also try to put more females in high positions to increase the gender equality within a firm. Moreover, in the US, new rules regarding the quantity of women in the board of directors are applied (Gormeley et al., 2021). Furthermore, in 2019 it is even more striking that firms not only solely observe the gender of their employments as male or female, but also as other gender indications (Shropshire, 2019). For example, IBM is making their company gender equal by addressing no one with mr. or mrs. but instead, they use they to address a person.

As females behave differently in making investment decisions within a firm, this has some major implications for corporate decision making. Research shows that gender diversity has a negative effect on innovation within a company (Chen, 2016). Chen (2016), argues that women are likely to be less risk taking then their male counterparts. Thus, as Research and Development (R&D), and innovation is most often a risky investment, the innovation and R&D costs related to innovation decrease. Therefore, gender diversity in the board of directors has a negative impact on innovation within a company.

Almor et al. (2019), find the same negative relationship between R&D development even when there only is one female in the board of directors since this already impacts the decision making within a company. Furthermore, Chen (2016) finds that gender diversity helps reduce the positive relationship on innovation.

On the other hand, the relationship between gender diversity and innovation might be positive. This is due to the fact that creativity is one of the main drivers of innovation (Tushman & O'Reilly, 2004). As a gender diversified board often increases creativity and the relationship between creativity and innovation is also positive (Campbell, 2008). It is expected that the relationship between gender diversity and innovation is also positive. Furthermore, empirical evidence to the positive relationship as described is also found in Attah-Boakye (2020) and Gallego and Guitierrez (2018).

This thesis therefore argues that there arises a positive relationship between gender diversity and innovation. In most literature the effect of culture on the relationship between gender diversity and innovation is not taken into account. Therefore, this thesis is by the best knowledge the first

that tries to explain the effect of culture on the relationship between gender diversity and innovation.

Yang (2011), argues that if firms do not include cultural influences on the board of directors and also do not include power relationships, there are difficulties with implementing the decisions of minority groups. This is due to the fact that historically major groups are likely to exclude minority groups from important power resources to maintain their power. Employment involvement programs, which are aimed to push power, information and knowledge to lower job levels, may be considered as constituting important resources (Lawler, 1986). Therefore, historically major groups may exclude minority groups in participating in decision making (Yang, 2011).

In advance, in an environment with high autonomy and without a strong diversified component, minority groups may be limited to participate in decision making (Harrison and Humphrey, 2010). Therefore, societies which have high autonomous and individual norms and values, have lower minority group involvement. Thus, these countries may have lower decision making by women. As it was argued, this might have consequences for decision making. As women are less risk taking, innovation decreases. However, in countries where individuality is high it is expected that these women might not have decisional power and the gender diversity effect thus weakens as the most decisional power is still in the hands of men. Culture is defined as the norms and values within a country (Hofstede, 1980). Thus the culture of a country may affect the relationship between gender diversity and innovation.

This thesis will not only contribute to science but also to the society. As the debate about gender diversity within firms is heated also in society, this thesis will contribute to the outcomes of this debate on innovation. Thus this thesis will contribute to arguments in favor (or against) of gender diversity. Therefore, this research question will be:

*What is the effect of culture on the relationship between gender diversity and innovation?*

Based on the current literature this thesis hypothesizes that Power distance strengthens the effect of gender diversity on innovation. This is because in countries where Power Distance is higher there arise a centralized organization in which women are heard more (Van Everdingen and Waarts, 2003; Yilmaz 2020). This in turn lead to an increase of strength of the effect of gender diversity on innovation. Furthermore, all other three cultural aspects proposed by Hofstede (1980) should lead to a weaker effect of gender diversity on innovation. As these cultural aspects might

lead to social exclusion and exclusion to the minority group (Van Everdingen and Waarts, 2003; Yilmaz, 2020; Carasco, 2012). This would in turn lead to women not having enough power to make decisions and the effect of gender diversity on innovation weakens.

This thesis tries to examine and validate the theoretical hypotheses by using a Random Effects Model for board members in 41 countries in a time period of 2013-2019 and merge it with company dependent R&D data.

The results of this method suggest that indeed Power Distance strengthens the effect of gender diversity and innovation. Therefore, the first hypothesis is accepted. However, all other three cultural aspects are not in line with the hypothesis. All of them are strengthening the effect of gender diversity on innovation. This is in line with the effect what Attah-Boakye (2020) finds, however they only study the developing countries. While this thesis also studies developed countries.

The contribution of this study is thus that in researches of the effect of gender diversity on innovation culture plays a role and thus should not be excluded from the analysis also in developed countries and cultural aspects increase differences between countries in the effect that women might have in organizations.

This thesis is built up as follows. First it gives a literature review on what is already known and develop hypothesis. Then it will develop a method that can help explain the effect. Thereafter, the results of this method are discussed and displayed. Then finally, the implications and drawbacks of this study will be discussed and a conclusion will be given.

## 2 Literature Review

In this chapter the literature about the link between gender diversity and innovation is reviewed. First the effect between gender diverse boards on decision making will be explained and thereafter this is linked to innovation. Then, when the general effect of gender diverse board on innovation is made clear, the effect that culture can have on this effect is explained. Thus this thesis can make an educated hypothesis for the research question.

### 2.1 Gender Diversity in the board of directors

Diverse boards are created when there are people in the boards from different genders, different cultural perspectives and have different skills and analyzing techniques. They can have a more diverse view on the firm. Gender diverse boards are boards that have one or more female members.

In general, the effect of individual gender diversity in the board of directors on firm outcomes is not to be ruled out (Ranasinghe, 2019). Some scholars argue for negative impact of gender diversity on firm performance (Shore, 2009; Arena, 2015; Pucheta-Martínez, M. C., Bel-Oms, I., & Olcina-Sempere, G., 2018). The reason for this is that there are three assumptions given that lead to negative group productivity. The first assumption is that in the absence of information humans judge each other on aspect that are visible on the surface, such as gender or racial ethnicity. The second assumption is that these judgements will lead to in-group members and out-group members of an organization as there arises differences between people. Finally, these judgements may cause that there arises in-groups or out-groups and this will result in less productive group members. This stimulates that the board of directors are less productive.

However, there is also found a positive effect of gender diversity on firm performance (Kılıç, M., & Kuzey, C., 2016; Reguera-Alvarado, N., de Fuentes, P., & Laffarga, J., 2017). They argue that agency theory can help explain this positive effect. According to this theory, diverse boards of directors can increase firm performance due to healthier decision making and lower potential agency costs.

Moreover, the effect of gender diversity on the group level within the board of directors on firm value is positive (Cox, 1991). This is due to the fact that diversity stimulates creativity, stimulate information exchange and increase better decision making within the board of directors.

Thus (Gender) diversity in the board of directors has an impact on decision making which can be both negative or positive.

## **2.2 Gender Diversity and decision making**

The upper echelons theorem suggests that decision making is influenced among others by cultural factors, personal factors such as gender and so forth (Hambrick, 1991). Since the board of directors can have major influence in decision making especially in innovation, these characteristics may influence the decision making about innovation in a firm (Zahra, 2000).

As in many aspects female board members are fundamentally different in their decision making than their male counter parts. For example, in general population, females are generally known for their less risk taking behavior (Byrnes, Miller and Schafer, 1999; Fehr-Duda et al., 2006; Eckel and Grossman, 2008; Eckel and Grossman, 2002).

The willingness of female members of the board of directors to take on risky behavior is also generally lower, and female directors dislike making risky decisions for the group in which they belong to (Ertac and Gurdal, 2012). Therefore, the fact that women dislike to make risky decisions for a group can explain why women are less risk taking in the board of directors. Thus this is expected to hold for every board of directors which is gender diversified. If there is a significant amount of female board members in the board of directors it might be that there are less risky decisions made within a company. These results may lead to different firm investment decisions when there are predominantly more females in the board of directors.

Furthermore, women are less overconfident in their abilities than their male counterparts (Croson, 2009). This is also found within the top-level management of the firm (Hardies, 2013). This means that female top-level management is generally less overconfident than their male counterparts. As Odean (1998) theoretically has shown that overconfidence increases the risk of a portfolio due to the fact that an overconfident investor or board member is overconfident in their abilities to make the best of their investment and thus invest in high risk investment, this would mean that more overconfident boards take more risk in their investment decision. If a board is more gender diversified it should take less risk as women are better able to estimate their own capabilities and take less risk than their male counterparts leading to less risky investment decisions. This would lead to less risk taking activities such as innovation. However, it efficiency of innovation is

higher within more diversified boards meaning that the successfulness of innovation is increased within gender diversified boards (Xie, 2020).

Not only risk determines the level and successfulness of innovation. So does creativity. Tushman and O'Reilly (2004), hypothesize that there arises a positive relationship between creativity, risk taking behavior and innovation. This is because both creativity and risk is needed to implement innovation. Creativity is needed because this allows companies to be creative in their thinking and come up with new ideas for their remaining problems within a firm. While risk is needed because innovation can add value. However, it can also destroy value. Because the new organizational changes may be destructive for the value of a firm, and the old organizational changes may never come back. Thus it might not turn out to be a good innovation within a firm. Therefore, there arises risk with innovation for a firm (Petrescu, 2012). As women are more creative and a diversified board leads to a more creative board with multiple different perspectives it might arise that gender diversity within the board of directors, increases innovation and the success of innovation.

Then the question arises if one female in the board of directors is enough to change the firms investing behavior. As it might be that the females in the board of directors are not heard completely as there are more males in the board of directors. Interviews with board members in published papers that observe the effect of gender diversity on innovation decisions might give an answer to this question. Almor et al. (2019), conducted interviews in which female senior-managers talk about their current status within the board of directors. There is one interviewee which states that she is the only one women in senior-management and she states that her male colleagues are rushing through their decisions. This may imply that she is not heard enough. Another interviewee states that they are with 50% women in the board of directors, and that gender does not so much matter in their boards.

Moreover, there are theories which are suggesting the same. The critical mass theory suggests that decision making within a group depends on the minority group size (Torchia et al., 2010). If the group size of the minority increases this have direct influence on the decision making within the group. Moreover, if a minority group achieve a certain amount, the impact of the minority group will become more visible, a critical mass.

Then the question arises what the critical mass will be. There is no consensus about the critical mass in research yet. However, the main research line is now that three or more women

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need to be in the board of directors to have a serious impact (Torchia et al., 2010; Kramer et al., 2007; Redor, 2018). Kramer (2007), argues that a woman's decision is better heard and the likelihood that these ideas are implemented increases with a higher amount of women in the board of directors. A lone woman can certainly make influence, however the odds are higher that a lone woman is viewed as a "woman" by her male counterparts and her ideas are not objectively viewed equal and her ideas might be discarded. A second woman in the board of directors certainly helps. They can back up on each other when one woman is not heard enough but with two women in the board of directors, men and women both are still aware of the gender difference. As there are three female board members this difference is erased. Thus three seems to be the critical mass in this case. Empirically, this is also find with in Torchia et al. (2010). The researchers found that with three female members in the board of directors there is enough strength of women to pursue their views on the firm.

Moreover, Redor (2018) found that share price reaction is negative when the critical mass of three women in the board of directors is depleted when a female board of directors makes place for their male counterpart. This is in favor of the critical mass theory as firm performance is perceived to go down with less than three female board members. This might imply that with less than three female members of the board of directors the firms view is less diversified resulting in worse decision making. Considering the above given arguments, change in decision making with gender diverse boards may only be weak if there is no critical mass, being less than three women, in the board of directors. Thus the effect of gender diversity on innovation may be weaker with less than three female members in the board of directors. Therefore, this thesis defines gender diversity as having 3 or more women in the board of directors as there arises a critical mass and these women can have influence within the organization.

### **2.3 Board of directors and Innovation**

To be successful over time firms need to have ambidextrous innovation (He and Wong, 2004). That is innovation need to be exploitation and exploration. On the one hand, exploitation is that firms competence their own innovation by expanding the innovation paths they already began with. On the other hand, exploration is exploring new exiting areas in technology which are not known within a firm (March, 1991; Levinthal and March, 1993; Tushman and O'Reilly, 1996; O'Reilly, 2004). Both are necessary present to be successfully innovative.

Tushman and O'Reilly (2004), hypothesize that there arises a positive relationship between creativity, risk taking behavior and innovation. This is because both creativity and risk is needed to implement innovation. Creativity is needed because this allows companies to be creative in their thinking and come up with new ideas for their remaining problems within a firm. While risk is needed because innovation can add value. However, it can also destroy value. Because the new organizational changes may be destructive for the value of a firm, and the old organizational changes may never come back. Thus it might not turn out to be a good innovation within a firm. Therefore, there arises risk with innovation for a firm (Petrescu, 2012).

As creativity is one of the main drivers for innovation, a hypothesis on the effect of gender diversity on innovation can be explained by the difference in creativity that a gender diversified board has in comparison to a non-gender diversified board. Gender diversity increases creativity as there is more diversity and thus different views and creative new ideas are promoted when there is less diversity. Also it is argued that a new vary of problem solving ideas are promoted with diversity in the board of directors. Thus creativity is argued to be positively related with demographic factors such as gender (Campbell et al., 2008). As it is the case that creativity might increase innovation, this might thus cause that gender diversity increases the innovation within a firm. Therefore, gender diversity would lead to a positive relationship between gender diversity and innovation.

What might be driving a negative relationship between gender diversity and innovation is the social exclusion theory. Social exclusion theory is the idea that historically minority groups are left outside the majority group. The consequence is that there arise negative effects for the vulnerable group (Loury, 2000). One possible negative consequence of this theory is that the minority group has less impact on decision making. Thus if there are not enough women in the board of directors, there might be a negative effect of gender diversity on innovation as the women do not have enough

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power to change decision making within the firm. However as explained in the previous section, critical mass theory suggests that when there are 3 or more women in the board of directors, this effect would be abandoned. Thus this thesis expects that when there are more than three women in the board of directors, the effect of gender diversity on innovation is positive. Because the women in the board of directors can make an impact in stimulating creativity within firms which causes a positive effect of gender diversity on innovation.

As proxy for innovation this thesis uses Research and Development (R&D) costs incurred by a company. As R&D costs can help firms to innovate in three possibilities it can be a good proxy for innovation. The first possibility is that R&D may create new products, marketing techniques and other things that are changing the nature of innovation within a firm. The second being that the degree of change can be changed within a firm by investing with R&D. Finally, the third is that the firm can create things that are new to the firm, the market, or even the world by investing in R&D (Petrescu, 2012).

The drawback of measuring innovation with R&D Expenses, would be that R&D costs are not generally representing the costs occurred for innovation. As a firm might play around with the costs they want to incur and not all R&D accounting book values are representing the amount of R&D costs by a firm there might be a small chance that the R&D costs are over or understated and do not fully represent innovation costs (Jensen et al., 2009). Thus what might be useful is to search for another proxy.

Another proxy for innovation would be the number of granted patents by a firm. This however is not a very good proxy as patents might take several years to be implemented within a firm and also there is no guarantee that patents will turn out novel and useful (Griffin, 2019). As both of the proxies have serious problems, there is not one proxy that is best. However, as the chance that a patent is not used or might not be innovative is higher than the chance that R&D costs is overvalued, this thesis uses R&D costs incurred by a company as proxy for innovation. R&D is viewed as risky as it is often a long term investment which needs to be proven itself to be successful (or not) in the long term as these changes might not occur in the short term immediately. It furthermore has a low probability of success (Almor et al., 2019).

If it is assumed that R&D is indeed a risky investment and given that women are in general less risk taking, a gender diversified board might lead to less investment in R&D and thus innovation, as measured as R&D costs, will be lower when there are more females in the board of

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directors. As risk is also one of the main drivers of innovation for a firm. However, this might not be true if there isn't a critical mass in the board of directors since she might not have the power to influence decision making on her own. Thus, it might be the case that due to more creativity with women in the boards of directors, there is a positive relationship between gender diversity and innovation.

However, as women are less risky and due to reaching a critical mass, the decision making changes. This is because women now have more influence within the decision making in the firm, there might be a negative relationship. Therefore, the relationship of gender diversity on innovation may be twofold.

There is empirical evidence that both of the cases are true. Gallego and Gutierrez (2018) for example found a positive relationship between gender diversity and innovation in Colombia. This however only is true for one country and thus not very generalizable thus this thesis needs to look for empirical evidence that might be more generalizable. Furthermore, Attah-Boakye et al. (2020), find a positive relationship between gender diversity and innovation in emerging countries. They furthermore found that in these emerging countries culture and the interaction between culture and gender diversity is positively significantly related to innovation suggesting that their culture moderates the effect between gender diversity and innovation. Thus according to this result there are moderator variables that needs to be taken account in this research.

On the other hand, Almor et al. (2019), find a negative relationship between gender diversity and innovation within developed countries. It might be suggested that the effect of gender diversity on innovation is different in developed countries and emerging countries. However, Almor et al. (2019) do not control for culture in their study, as explained culture affects the relationship between gender diversity and innovation. Thus, there might be another result if the effect of culture is included. Moreover, Chen (2016), finds that gender diversity helps reduce the positive relationship on R&D expenditure. However, this research does not show the relationship that culture can have on this relationship and thus this needs to be further developed. As the critical mass theory suggest that women can have more impact in firms, and women can help stimulate the creativity within firms and the empirical evidence is that with taking into account culture the effect of gender diversity on innovation is positive. The effect of gender diversity on innovation with a critical mass is expected to be positive.

## 2.4 Cultural effects on the relationship between gender diversity and innovation

The upper echelons theorem suggest that firm decisions of top corporate managers are based mainly upon two things. First, the personal interpretation of top managers on the corporate situation they face. Secondly, these interpretations are based on the experiences, values and personalities of a top level manager (Hambrick, 2007). Furthermore, Hambrick (2007), argues that research in top level management can better explain organizational outcomes according to the upper echelons theorem, then researching the individual level. Hambrick (2007), argues that leadership within a big organization is a team effort and this brings that the collective capabilities, cognitions and interactions are used into strategic decision making. Furthermore, demographic factors influence the strategic decision making in top level management (Eisenhardt & Schoonhoven 1990). Also Hambrick (2007), argues that strategic decision making within a firm is national specific and these national specific characteristics may be more valid in some countries then others. Thus we would expect that culture moderates the direct relationship between gender diversity and innovation.

Culture is defined as the norms and values of the collective inhabitants in a country (Hofstede, 1980). Hofstede, defines four cultural categories, the first being Power Distance. That is the willingness to accept that power in institutions and organizations is distributed unequally. The basic issue with which this is connected is social inequality (Hofstede, 1984). Thus it might arise that in a country where the willingness to accept the power to be distributed equally is lower, there is lower distributed power. In countries where the willingness to accept the power to be distributed equally is higher there is higher distributed power which will result in more collective decision making (Yilmaz, 2020). Creating a centralized organization.

As the board of directors with firms with centralized organization is not always able to identify operational problems and also subordinates may also take less initiative to introduce new products within the company, this result in lower innovation (Van Everdingen and Waarts, 2003). This influences the relationship between gender diversity and innovation. Women have more to say in a country with higher Power Distance as the organization is centralized and women's are more likely to be taken seriously in the board of directors. This will lead to a reduction of social execution. This might result in more power for women within the board of directors. Thus, this might increase the effect that women have on R&D expenses as they have less to say in a company as a collective decision making suggest that the decision that females in the board of directors make contributes equally. Thus, in a country with equal amount of women in a board but with higher

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Power Distance there might be a stronger effect of gender diversity on innovation. Therefore, our first hypothesis is:

*H1: In countries with higher Power Distance, the effect of gender diversity on innovation is stronger.*

The second cultural category is Uncertainty Avoidance. This is the extent that people are feeling threatened by uncertain decisions that need to be taken (Hofstede, 1984). In countries with high Uncertainty Avoidance there is lower risk taking and thus more risk averse attitudes towards investments. Firms in these countries will only invest in innovation that have proven to be worth investing in (Van Everdingen and Waarts, 2003). Carasco et al. (2012) hypothesize and find that Uncertainty Avoidance has a negative effect on the number of female board members within a firm. This is because countries with higher Uncertainty Avoidance are less tolerant to alternative perspectives and are less willing to take risk. Other way around, countries that have a low Uncertainty Avoidance are more tolerant to alternative perspectives and are more willing to take risk resulting in a higher amount of female participants in the board of directors. If these countries indeed have lower tolerance to different opinion, female board members would have more to say in countries where Uncertainty Avoidance is lower. Thus lower Uncertainty Avoidance would lead to less social exclusion with more power to women. This leads to an increased effect of gender diversity on innovation when there is less Uncertainty Avoidance in a country. Other way round, higher Uncertainty Avoidance will lead to higher social exclusion with less power to women. This leads to a decreased effect of gender diversity on innovation when there is more Uncertainty Avoidance in a country. When Uncertainty Avoidance in a country is higher this would therefore decrease the effect of gender diversity on innovation as the impact that women can make in these countries will be lower. Therefore, in a country with equal amount of women in a board but with higher Uncertainty Avoidance, the result of this is that there might be a weaker effect of gender diversity on innovation. This leads to our second hypothesis:

*H2: In countries where there is higher Uncertainty Avoidance, the effect of gender diversity on innovation is weaker.*

The third cultural category is Individualism VS. Collectivism. This is how people are operating and take care of each other. A more individualistic country is thus more selfish in its behavior and is much more related in working and have success individually (Hofstede, 1984).

Other way round, collectivistic countries are much more focused on the group and will try to operate as a group all together and will take decisions as a group (Yilmaz, 2020). As individualistic countries work more individualistically, it might happen that female board members are less represented in decision making. This is found by Carasco et al. (2012). They find that Individualism correlates negatively with the number of board members as the debate about female board members does touch upon collective values in the society it is expected that Individualism correlates negatively with the number of board members within the board of directors. However, they do not find empirical evidence for this. Furthermore, due to the collectivistic decision making it is more likely that the adaptation to new products is much slower (Van Everdingen and Waart, 2003). Also, they argue that employees in countries where individualism is high are educated and stimulate to make decision on their own and they do have more freedom to invent new products for a firm. As female values are often linked to collectivism and since the adaption of collective decision making is slower it is expected that in countries with high individualism, female board members are less presented. Moreover, in an environment with high autonomy and without a strong diversified component, minority groups may be limited to participate in decision making (Harrison and Humphrey, 2010). Thus if a culture of a country is focused on individuality, this causes social exclusion. This would decrease the effect of gender diversity on innovation as the impact that women can make in these countries is lower. Therefore, the effect of gender diversity on innovation is weaker when there is more individuality in a country.

*H3: In countries where there is higher Individualism, the effect of gender diversity on innovation is weaker.*

The last cultural category is Masculine VS. Feminine countries. This is that a countries values are more based on success, money and things. A feminine country is a country in which the values are more based on the quality of living and caring for each other (Hofstede, 1984). In general, in more masculine countries people are more educated as entrepreneur (Yilmaz, 2020). As people are more specialized in entrepreneurship they might invest more in innovation, as that is what is needed to make an enterprise successful (He and Wong, 2004). Furthermore, van

Everdingen and Waarts (2003) argue that Masculine countries are more competitive and the emphasis from this cultures is on performing optimally and reward of this performance which is optimal for innovation. According to Niederle et al. (2011) men are more competitive then woman so it might arise that female board members are less represented in decision making within masculine countries because they are less fitted with the norms and values of this company. This will lead to social exclusion in a country with high masculinity. Finally, this leads to less decision power for female board members. Thus it might arise that within a country with high masculinity the effect of gender diversity on innovation decreases.

This is also found in Carasco et al. (2012). As higher masculinity prevails the more value related the country is towards the values of men and these countries are more competitive, female board members are less likely to in the board of directors. Thus it is expected that when a country is more masculine this will lead to lower presentation of female board members within the board of directors. Therefore, the view of female board members is less depicted in more masculine countries. Leading to female board members having less decision power. This might lead to social exclusion and thus a more men oriented view on innovation. This leads to a weaker effect of gender diversity on innovation with more Masculinity in a country. Therefore, the fourth hypothesis would be that:

*H4: In countries where there is higher Masculinity, the effect of gender diversity on innovation is weaker.*

### 3 Methodology

To answer the research question this thesis needs to operationalize the variables stated in the research question. When the variables are operationalized the effect of culture on the effect of gender diversity on innovation can be measured through a regression. This regression generally has assumptions which needs to be tested for. Thus, after the regression is done there is tested if these assumptions hold. Thus we can have validated our results. Furthermore, for robustness there are alternative approaches to our regression. After the validation of the model these robustness checks are then used to test whether the result is robust. Thus, in this section this thesis explains what the method is to answer the research question and why these methods are used to answer the research question. Furthermore, there is data used from 2013 to 2019 as there is no crisis within this data time frame that would systematically decrease the expenditure in research and development. Thus this time frame is used as the crisis might bias results. Therefore, the time frame does not systematically bias our results.

The firm financial data can be found on the Thomson Eikon Reuters Database, as well as the corporate governance quality data. Furthermore, the gender diversity data can be found at the Thomson Eikon Reuters database. The culture of a country in which the company is placed can be found in the Hofstede insights database, they deliver a score for all the cultural dimensions in which for example, the higher the score, the more a culture is individualistic. Furthermore, the industries of the companies are taken from the Orbis Dataset. The firms are all classified as industries taken the BvD Orbis Company classification.

#### 3.1 Dependent Variables

To measure the effect of gender diversity on innovation this thesis uses innovation as the dependent variable. Innovation can be defined as the implementation, acceptance and generation of new ideas, processes and products (Ritters-Hayashi, 2019). Thus to operationalize this variable this thesis needs to search for proxies that stimulate firms' capability to implement, accept and generate new ideas processes and products.

One proxy for innovation would be the patents that a firm gets. As patents are contracts for a firm to use the researched products only this might be a good way to measure innovation (Jensen, 2009). The benefit of measuring innovation with patents is that there is long time-series data

available, and these patents give information that are both new to the firm and to the world. However, the drawback of patents as a proxy for innovation is that certain industries tend to use patents more often than others (Jensen, 2009). This might bias our results. Moreover, patents might take several years to be implemented within a firm and also there is no guarantee that patents will turn out novel and useful (Griffin, 2019). Thus for our research on the cultural effect on the relationship of gender diversity and the patent count might not be a good proxy for innovation.

Another proxy for innovation might be surveys to boards of directors of companies to ask whether they have produced new products, due to the likelihood of a low sample and as this is often very time consuming and due to time constraints this thesis is not able to use this as a proxy for innovation. However, it might be a good alternative for further research to use this proxy as if a survey can also include cultural backgrounds this might a good alternative to answer the research question.

The final proxy for innovation might be the R&D costs incurred by a company. As R&D costs can help firms to innovate in three possibilities it can be a good proxy for innovation. The first possibility is that R&D may create new products, marketing techniques and other things that are changing the nature of innovation within a firm. The second being that the degree of change can be changed within a firm by investing with R&D. Finally, the third might is that the firm can create things that are new to the firm, the market, or even the world by investing in R&D (Petrescu, 2012). A potential drawback would be that R&D costs are not generally representing the costs occurred for innovation. As a firm might play around with the costs they want to incur and not all R&D accounting book values are representing the amount of R&D costs by a firm there might be a small chance that the R&D costs are over or understated (Jensen et al., 2009). As the expenditure of R&D may not fully measure all innovative potential of a firm, an alternative for innovative behavior and the innovative impact within a firm is whether or not R&D expenditure is used in a firm. This might reduce the problem that the expenditure is overstated or understated. Thus as a robustness test this thesis will also implement a model with the dependent variable being a dummy variable. The dummy is 1 if the firm invests in R&D and 0 otherwise. The company might also have no data available about R&D investment. The companies that do not have data available are left out the dummy analysis as this thesis cannot make sure that these companies have invested nor not invested in R&D. Thus, the dummy is 1 if the firm invests in R&D and 0 otherwise. Most studies that research the effect of gender diversity on innovation use the R&D expenditure to

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research the effect of gender diversity on innovation (Almor et al, 2019; Teruel and Serrara-Blasco, 2017; Chen 2016) Thus in this thesis it is considered that although R&D expenditures might have drawbacks in measuring Innovation it is the best alternative for this thesis to measure innovation and will be used as a proxy to measure innovation. To control for outliers in R&D expenditure, the R&D expenditure is transferred to its logarithm. This is done as this tackles the problem of having possible outliers.

### **3.2 Independent variable**

As a proxy for gender diversity this thesis will use the quantity of female board members within the board of directors. As the critical mass theory argues (see, Torchia et al., 2010), women decision making is only effective when there are three or more female board members in the board of directors (Kramer, 2007). Therefore, this thesis follows the model of Torchia et al. (2010) and the model of Kramer (2007) in which gender diversity with a critical mass is measured as a dummy. This dummy is equal to 1 if there is higher than or equal to three or more female board members within the board of directors of a firm and 0 otherwise. This is due to the fact that female members of the board may only have impact in decision making within the board of directors when there are three or more females in the board of directors (Kramer et al., 2007; Torchia et al., 2010; Redor, 2018). Therefore, gender diversity is defined as having three or more women in the board of directors. To test the theory for robustness there is another measure used for gender diversity. This is also a dummy. The dummy is one when the amount of women in the board of directors is higher than 30% (Joecks, 2013). As it is found that the critical mass also holds when this percentage is reached. Therefore, this thesis expects that there will be no different effects of this measure of gender diversity compared to the other measure used in this thesis.

To research the effect of culture on the relationship between gender diversity and innovation, this thesis follows the research of Attah-Boakye (2020) who research the effect of culture on the relationship between gender diversity and innovation in emerging firms. Our thesis however tries to find the general relationship in both emerging and developed countries and thus is different. This thesis can use the same approach to cultures as Attah-Boakye (2020) because it is a similar research question as this thesis has. Thus the approach may not be that different.

This thesis uses the Hofstede (1980), cultural dimensions for a proxy as national culture. As it is hypothesized that there is a relationship between the national culture and innovation and

there is an effect of national culture on the relationship of gender diversity and innovation this thesis uses the cultural dimensions. The cultural dimensions are Power Distance, Individualism, Masculinity and lastly, Uncertainty Avoidance. To test whether or not there is an effect of culture on the relationship of gender diversity on innovation this thesis uses an interaction variable between the dimensional culture score of a country in which the firm is in and the gender diversity dummy. As hypothesized, there might be an extra effect of culture on the relationship between gender diversity and innovation. The impact of this extra effect can be measured with an interaction effect (Studenmund, 2017). A significant effect of this variable would thus say that culture has an impact on the relationship between gender diversity and innovation.

### **3.3 Control variables**

For controlling for other external factors on the relationship between gender diversity and innovation this thesis uses multiple control variables. The first control variable is the firm financial performance. As the firm financial performance of a firm might affect the height of R&D expenditure or even the decision if a firm invests in expenditure, there need to be controlled for this possibility. To measure firm financial performance this thesis follows Attah-Boakye (2020). Thus this thesis uses Return On Assets, Return On Equity and Market to book ratio. Furthermore, there is controlled for corporate governance quality of a board, because if monitoring is better, a firm might invest more in Research and Development as it is more likely that the R&D turned out to be successful. As this might also affect the height of R&D expenditure this thesis controls for this possibility. As a proxy of corporate governance quality this thesis also follows Attah-Boakye (2020). As corporate governance quality directly impacts financial decision making there need to be controlled for the fact that firms differ in corporate governance quality. The following variables are thus used for the corporate governance quality: The board size, leverage and the single largest shareholder.

The board size is measured as the quantity of people in the board of directors. The leverage is the amount of debt divided by the amount of equity that a company has and the single largest shareholder is the amount in percentage that the largest shareholder has in stocks within that company.

Furthermore, there is controlled for the industry in which the company is operating as for example, tech companies might have more benefit with investing in innovation. Thus the R&D costs are higher. To control for this possibility this thesis uses industry dummies. Which is 1 for the respective industry in which the company is operating and 0 if the company is not operating in this respective industry.

Also there is controlled for the country in which the company is operating. As there might be regulations in countries regarding investing in R&D or gender diversity which impacts the relationship between gender diversity and innovation or which can increase R&D investment. The control variable for country is a dummy. The dummy is 1 for the respective country in which the firm is operating and 0 otherwise.

### 3.4 Regression analysis

Because R&D expenses are time dependent and culture and firm identity is cross sectional data this thesis does need to use panel data. To determine whether to use Random effects or Pooled OLS there is a Breusch-Pagan test conducted. This test was significant for all regressions. This means that the variance with random effects is not equal to 0 and this thesis is allowed to run a Random effects regression. Pooled OLS regression will not be used. To decide whether to use a Fixed effects or a Random effects model a hausman test is conducted. As Fixed Effects throw out the country and industry effects and the cultural aspects which are variables of interest, and the Fixed effects and Random Effects thus cannot be compared with an hausman test, this thesis will conduct a Random effects model. Therefore, this thesis will use Random effects regressions to find whether there is an effect of culture on the relationship between gender diversity and innovation.

The OLS Regression will look like the following

$$R\&D\ Expenditure_{it} = \alpha_{it} + \beta_0 * gender\ diversity_{it} + \beta_1 * Power\ Distance_{it} + \beta_2 * Individualism_{it} + \beta_3 * Masculintiy_{it} + \beta_4 * Uncertainty\ Avoidance_{it} + \beta_5 * Power\ Distance_{it} * gender\ diversity_{it} + \beta_6 * Individualism_{it} * gender\ diversity_{it} + \beta_7 * gender\ diversity_{it} * Masculintiy_{it} + \beta_8 * gender\ diversity_{it} * Uncertainty\ Avoidance_{it} + \beta_9 * Controls_{it} + U_i + e_{it}$$

The subscript t stands for the time varying aspect of the data while the subscript i stands for the firm specific data. E is the error term and U is the company specific random term.

If one of the interaction effects is significant, this thesis can say that there is an effect of at least one cultural aspect on the relationship between gender diversity and innovation. Thus this method can answer the research question properly.

Furthermore, to test the assumptions of our model this thesis test for heteroscedasticity and multicollinearity.

This thesis test whether the models contain multicollinearity and heteroscedasticity. Because there is an interaction effect between the gender diversity and culture there is a higher chance that there is multicollinearity in the models. As interaction effects have high correlation with each other by design. However, this will still influence the relationship. Therefore, the effect of gender diversity on innovation is dropped and only the interaction effect is taken into account in the Random effects model. Furthermore, multicollinearity is an issue in the Fixed Effects model. Therefore, a Random effects model is used. There does not arise multicollinearity in the Random Effects model and thus this thesis uses a Random effects model. Also the correlation table does not show big correlations between variables and thus there should be no indication of multicollinearity.

There does not arise Heteroscedasticity in the Random Effects model as the Breusch-Pagan test for heteroscedasticity turns out to be significant. Therefore, Random Effects seems to be the best model.

## 4 Results

### 4.1 Sample description

Table 1 provides all the descriptive statistics of the variables. Due to data availability our final sample consists of 8167 single observations. To cope with outliers this thesis transforms the R&D expenditure to its natural logarithm. An outlier is an individual case which influences the general relationship. The mean of the logarithm of R&D expenditure was 11.22

Furthermore, the leverage is transformed to the natural logarithm to cope with outliers. Also the natural logarithm of the leverage is taken to cope with outliers. There are outliers in the return on equity variable which are erased as they had too much influence on the relationship. The value of the return on equity was where the variables had too much influence was bigger than 1000 and lower than -1000. This was measured with the cooks' distance. Those observations are removed. Furthermore, observations which have a higher market to book ratio than 100 or -100 with outliers in the variable of the market to book ratio this was also checked by the cook's distance. These are also removed.

Furthermore, 100% of the sample had invested in R&D expenditure. Thus the dummy of R&D expenditure will probably give different results than the logarithm of R&D expenditure and thus might not be a good proxy for measuring innovation. Thus the robustness test for measuring innovation cannot be used properly and thus will not be used. Around 22% of the board has a higher number than 3 female board members. This number is in line with what is seen in similar research that is done. (Almor et al., 2019) Almor et al. (2019) also found around 27% of 2 female directors or more in the board of directors. This indicates that the number of women in the board of directors is representative for the population. Thus there are enough firms that have women in the board of directors. Furthermore, there are 14% of the boards which have 30% or more female in the board of directors. This is also an indication that the number of female in the board of directors is representative compared to other studies.

Moreover, the countries in which the firms are located in are mostly evenly spread. This can be seen in table 2. However, compared to other countries United States (almost 22,49% of the population), and Japan (almost 23,62% of the population) are over represented. This might bias the results. To control for this possibility this thesis takes into account the country in which the firm is operating. Furthermore, there might be a good explanation to why these countries are more

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represented in the sample. These countries are often referred to being Market-based countries (Allan and Gale, 1999). These Market-based countries are often taken riskier investments and are better able to finance risky investments (Allan and Gale, 1999) As R&D is a risky investment the Market-based countries may be more represented within the sample. As there is a higher chance that these countries invest in R&D. This is also true if there is a look at our sample. To decrease this bias for robustness this thesis splits the sample in countries where there actually is a gender quota and a sample in which this quota is not legally binding. The countries that have a gender quota are at least: Norway, Spain, Finland, Canada, Israel, Iceland, France, Italy, Belgium, Austria, Germany, Portugal, India, South Korea, Taiwan, Chile, Colombia (Terjesen, 2014; Mensi-Klarbach 2021; Koningsburg et al. 2021).

In table 3, the correlation matrix between all the variables is displayed. As is visible the correlation between all the interaction effects is really high. Therefore, this thesis for every will have another regression for every interaction effect. This is because there will be the problem of multicollinearity. Furthermore, there is a high correlation between the interaction effect and the quantity of women in board of directors is high. Therefore, in the models to test the effect of culture on the relationship between innovation and culture the variable to measure the gender diversity is removed. Also, there is no sign of multicollinearity between other variables.

## 4.2 Results

In this section the results are displayed, first the results for the effect of gender diversity on innovation is explained and thereafter the effect of culture on this relationship. Lastly, the results are tested for robustness.

The effect of gender diversity on innovation can be seen in table 4. As can be seen the general effect of gender diversity on innovation, is positive. Meaning that the expenditure of R&D is bigger when there are three or more women in the board. Also if gender diversity is measured as having more than or equal to 30% of women in the board of directors the effect of gender diversity on innovation is positive. The size of the coefficient however is only 0.09 and 0.06 respectively which means that the investment of R&D goes up also but with a small amount, when there is a critical mass. Thus the effect of gender diversity on the board of directors is not so strong but there is still a positive effect. Furthermore, in the sample when there is no quorum the effect is also positively significant. Also in the countries where there is a quorum on women in the board of

directors the effect is positive. However, the effect is not significant. Meaning that Japan and USA are indeed somewhat biasing the results. However, in this case, they are only making the results more significant and the sign of the coefficient does not change. Therefore, this thesis can accept the hypothesis that in general the effect of gender diversity on innovation is positive accounting for culture.

This is in line with the empirical findings of Gallego and Guettierrez (2018) and Attah-Boakye (2020).

The reason for this might be that creativity stimulates innovation. As gender diversity would lead to more creativity with innovation and women might bring more creativity in organizations and creativity is needed to stimulate innovation, this would lead to a positive impact of gender diversity on innovation (Tushman & O'Reilly, 2004).

To further test the hypothesis that culture leads to social exclusion and therefore has an effect on the relationship between gender diversity and innovation, this thesis uses an interaction effect. The results of this interaction effects are displayed in table 5. As is visible the effect of Power Distance on the relationship between gender diversity and innovation is positive. Meaning that Power Distance increases the effect of gender diversity on innovation when there are three or more women in the board of directors in a country. Women have more to say in a country with higher Power Distance as the organization is centralized and women's are more likely to be taken seriously in the board of directors. This will lead to a reduction of social execution. This results in more power for women within the board of directors. Thus, this increases the effect that women have on R&D expenses. As a company in higher power distance countries operates as a collective decision making organization. This suggest that the decision that females in the board of directors make contributes equally.

The empirical evidence finds that in a country with equal amount of women in a board but with higher Power Distance there might be a more positive effect of gender diversity on innovation. However, this effect size of the effect is small meaning that Power Distance has a small but positive impact on the relationship between gender diversity and innovation. With this result this thesis would accept the first hypothesis. This would suggest that indeed in countries with high Power Distance there is a higher effect of gender diversity on innovation with an equal amount of women in the board of directors. This result is also in line with what Attah-Boakye (2020), finds and thus evidence that Power Distance increases the effect of gender diversity on innovation.

To further strengthen the hypothesis that less social exclusion in countries with higher Power Distance lead to a bigger effect of gender diversity on innovation, there is some robustness test done. The effect of gender diversity on innovation when gender diversity is measured as having 30% or more women in the board of directors is also positive. Furthermore, in the sample when there is no quorum the effect is also positively significant. Also in the countries where there is a quorum on women in the board of directors the effect is positive. However, the effect is not significant. Meaning that Japan and USA are indeed somewhat biasing the results. However, in this case, they are only making the results more significant and the sign of the coefficient does not change. This would thus strengthen the analysis and therefore, the hypothesis that Power Distance makes the effect of gender diversity on innovation stronger can be accepted.

Due to the fact that with the result that the interaction effect is positive given that there are 3 or more women in the board of directors and the interaction effect of 30% of the board of is female is also positive. This thesis would accept the first hypothesis that in countries with higher Power Distance the effect of gender diversity on innovation increases and an insignificant negative result in the robustness test.

In table 6 there is shown the relationship of Uncertainty Avoidance on the effect of gender diversity on innovation, as can be seen the interaction effect of Uncertainty Avoidance on the relationship between gender diversity and innovation is positive. Which means that in countries where there is higher Uncertainty Avoidance with 3 or more women in the board of directors, the effect of gender diversity on innovation is stronger. Also in the countries where there is a quorum on women in the board of directors the effect is positive. However, the effect is not significant. Furthermore, in the sample when there is no quorum the effect is also positively significant. Meaning that Japan and USA are indeed somewhat biasing the results. However, in this case, they are only making the results more significant and the sign of the coefficient does not change.

Given this fact this thesis has to reject the second hypothesis that higher Uncertainty Avoidance leads to a decreased effect of gender diversity on innovation. The empirical evidence suggest that the opposite is true.

Therefore, the second hypothesis that Uncertainty Avoidance leads to a decreased effect of gender diversity on innovation is rejected.

A possible explanation maybe that in critical mass women have more to say and thus in the interaction effect the effect of gender diversity is stronger than the Uncertainty Avoidance effect.

We cannot say this with certainty as the gender diversity effect is filtered out of this model. Therefore, there needs to be additional research done to exploit this theory. What however might be an indication of this is that the effect of gender diversity is more significant compared to the effect of UAI on innovation. This means that the general effect of gender diversity on innovation is stronger than the general effect of UAI. However, this cannot be said with certainty as we cannot measure this in the way this thesis tries to measure the effect of culture on innovation. Thus there needs to be additional research done. What this thesis however can conclude is that UAI definitely has an impact on the effect of gender diversity on innovation and thus needs to be taken into account when the effect of gender diversity on innovation is tested.

In table 7 there is shown the relationship of Individuality on the effect of gender diversity on innovation. The relationship of Individuality on the effect of gender diversity and innovation is positive. This means that if there is more individuality in a country the effect of gender diversity on innovation is stronger. Also this is found in the robustness tests. In the countries where there is a quorum on women in the board of directors the effect is positive. However, the effect is not significant. Furthermore, in the sample when there is no quorum the effect is also positively significant. Meaning that Japan and USA are indeed somewhat biasing the results. However, in this case, they are only making the results more significant and the sign of the coefficient does not change. Therefore, this thesis needs to reject the third hypothesis that individuality leads to a weaker effect of gender diversity on innovation.

An explanation for this might be that in a critical mass women have more to say and thus in the interaction effect the effect of gender diversity on innovation is stronger than the effect of Individuality. We cannot say this with certainty as the gender diversity effect is filtered out of this model. Therefore, there needs to be additional research done to exploit this theory. What however might be an indication of this is that the effect of gender diversity is higher compared to the effect of Individuality on innovation. This means that the general effect of gender diversity on innovation is higher than the general effect of Individuality. However, the significance of both effects is the same which suggest that both influences of effects is equal. This would suggest this explanation also does not hold. Thus there needs to be additional research done. What this thesis however can conclude is that Individuality definitely has an impact on the effect of gender diversity on innovation and thus needs to be taken into account when the effect of gender diversity on

innovation is tested. Thus with this results this thesis would reject the third hypothesis as the effect is not significant.

Lastly, in table 8 there is shown the relationship of Masculinity on the effect of gender diversity on innovation. As can be seen, the interaction effect of Masculinity on the effect of gender diversity on innovation is significantly positive. This means that the higher the Masculinity in a country is the higher the effect of gender diversity on innovation is when there are three or more women in the board of directors. This suggest that countries that have higher Masculinity lead to stronger effect of gender diversity. The robustness test also indicates that this might be the case. In the countries where there is a quatum on women in the board of directors the effect is positive. However, the effect is not significant. Furthermore, in the sample when there is no quatum the effect is also positively significant. Meaning that Japan and USA are indeed somewhat biasing the results. However, in this case, they are only making the results more significant and the sign of the coefficient does not change. This would reject the fourth hypothesis, that masculinity leads to a weaker effect of gender diversity on innovation.

Again the explanation might be that the effect of gender diversity is stronger in the interaction effect than the effect of masculinity. What might be an indication of this is that the effect of gender diversity is more significant compared to the effect of masculinity on innovation. This means that the general effect of gender diversity on innovation is stronger than the general effect of masculinity. However, this cannot be said with certainty as we cannot measure this in the way this thesis tries to measure the effect of culture on innovation. Thus there needs to be additional research done. What this thesis however can conclude is that Masculinity definitely has an impact on the effect of gender diversity on innovation and thus needs to be taken into account when the effect of gender diversity on innovation is tested.

## 5 Conclusion and Discussion

This thesis answers the research question “What is the effect of culture on the relationship between gender diversity and innovation?”. This question is important first because the urge to improve the gender diversity in society is high. Therefore, this question might contribute to this societal discussion. And secondly there is little research done on the impact of culture on the effect of gender diversity on innovation. By the best knowledge, this research is the first that tries to explain the impact that culture has on the relationship between gender diversity and innovation.

To test whether these hypotheses are holding, this thesis uses a Random Effects OLS regression with 8167 Observations and creates variables that are proxies for innovation and gender diversity.

The empirical evidence of this study suggest that Power distance increases the effect of gender diversity on innovation. This is in line with the hypothesis suggested in this thesis. This implicates that in firms in countries where there is more power distance the impact of gender diversity on innovation increases. Furthermore, what is not in line with the hypothesis is that all other interaction effects of cultural aspects on the effect of gender diversity on innovation are also positive. The reason for this might be that the effect of gender diversity in the relationship on innovation is generally stronger than the effect of the cultural indices suggested by Hofstede (1980).

However, as this thesis drops out the effect of gender diversity this additional theory might be studied more intensified in further research. Although the three cultural perspectives are not in line with the suggested hypothesis in further research culture needs to be taken into account when exploiting the effect of gender diversity on innovation as all interaction effects are significantly positive. Which means that the cultural aspects as suggested by Hofstede (1980) are moderating the effect of gender diversity on innovation and thus need to be taken into account in research in this topic. This is also in line with what Attah-Boakye (2020) finds. However, they find it in developing countries while this thesis finds it in a sample mostly consisting of developed countries. This implicates that, in general the effect of culture needs to be taken into account when research the effect of gender diversity on innovation.

With the sample however there is a first drawback of the study. The sample largely consist of firms in both US and Japan. As these countries are most often Market-based this would lead to

an overestimation of R&D Expenses. This might bias the results. Furthermore, a potential drawback of this study is that the R&D Expenditure is not solely expended for innovation but there is earnings management and thus the R&D Expenditure is truly lower than stated in the books. This might also bias the results of this study. Furthermore, since the research question is trying to explain behavior and cultural aspects, the solution to answering the research question might be interviewing board of directors from different cultural backgrounds and companies with different cultural backgrounds.

For further research it thus might be interesting to do so to validate the hypotheses that are empirically found in this thesis. Furthermore, a further research might also want to use other proxy for innovation like the patents that a company gives out. But this also has major drawbacks. Therefore, to fully accept the hypotheses this might be done to validate the founded results and hypotheses with this results.

For further research it might be interesting to see which countries benefit from this idea and whether there is a difference of effect in certain countries where Power Distance is high.

Moreover, for further research about gender diversity, it might be interesting to see whether there arises a difference within countries that have certain high values of cultural aspects and the extend in which the hypothesis that are holding now are holding in crisis situations or if this might be different in crisis situations.

## 6 Appendix

Table 1, descriptive statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Logarithm R&D Expenses	8167	11.217	2.142	1.609	17.397
Dummy women in board >3	8167	.222	.415	0	1
Board Size	8167	10.709	3.31	1	29
Return On Assets	8167	5.754	8.993	-229.02	132.37
Return On Equity	8167	12.395	32.038	-862.18	864.52
PDI	8167	55.238	14.271	13	104
IDV	8167	44.958	19.143	13	90
MAS	8167	51.994	14.03	5	88
UAI	8167	54.374	28.462	8	112
Single Biggest Shareholder	8167	18.753	18.025	.245	97.599
Dummy R&D Expenses	8167	1	0	1	1
Market-To-Book ratio	8167	3.136	4.773	-30.95	84.74
Logarithm Leverage	8167	3.686	1.618	-4.605	11.473
Dummy 30 % or more women in the board of directors	8167	.146	.353	0	1

*Table 2 The distribution of Countries within the sample.*

Country	Freq.	Percent	Cum.
Australia	206	2.52	2.52
Austria	46	0.56	3.09
Belgium	55	0.67	3.76
Brazil	84	1.03	4.79
Canada	161	1.97	6.76
Chile	12	0.15	6.91
China	310	3.80	10.70
Colombia	7	0.09	10.79
Czech Republic	3	0.04	10.82
Denmark	90	1.10	11.93
Finland	118	1.44	13.37
France	277	3.39	16.76
Greece	7	0.09	16.85
Hong Kong	237	2.90	19.75
Hungary	5	0.06	19.81
India	284	3.48	23.29
Indonesia	38	0.47	23.75
Ireland	40	0.49	24.24
Israel	32	0.39	24.64
Italy	52	0.64	25.27
Japan	1929	23.62	48.89
Luxembourg	7	0.09	48.98
Malaysia	49	0.60	49.58
Mexico	7	0.09	49.66
Netherlands	74	0.91	50.57
New Zealand	13	0.16	50.73
Norway	51	0.62	51.35
Philippines	26	0.32	51.67
Poland	11	0.13	51.81
Russia	24	0.29	52.10
Singapore	25	0.31	52.41
South Africa	110	1.35	53.75
South Korea	477	5.84	59.59
Spain	94	1.15	60.74
Sweden	116	1.42	62.16
Switzerland	201	2.46	64.63
Taiwan	552	6.76	71.38
Thailand	4	0.05	71.43
Turkey	56	0.69	72.12
United Kingdom	440	5.39	77.51
United States	1837	22.49	100.00
Total	8167	100.00	

Table 3 correlation matrix between variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) logarithm R&D Expenses	1.00														
(2) dummy women in board	0.14	1.00													
(3) dummy 30 % or more	0.05	0.70	1.00												
(4) PDI_dummy women in board	0.15	0.95	0.66	1.00											
(5) IDV X dummy women in board	0.13	0.91	0.69	0.81	1.00										
(6) MAS X dummy women in board	0.12	0.93	0.61	0.93	0.82	1.00									
(7) UAI X dummy women in board	0.17	0.95	0.67	0.97	0.83	0.92	1.00								
(8) PDI	-	0.10	0.04	0.24	-	0.16	0.20	1.00							
(9) IDV	0.03	0.16	0.20	0.08	0.34	0.12	0.11	-	1.00						
(10) MAS	0.03	0.34	0.31	0.27	0.35	0.13	0.28	0.21	0.07	1.00					
(11) UAI	0.07	0.32	0.24	0.37	0.25	0.33	0.41	0.53	-	-	1.00				
(12) Board Size	0.12	0.20	0.00	0.21	0.18	0.22	0.19	0.03	-	0.14	-	1.00			
(13) Return On Assets	0.07	0.05	0.03	0.04	0.03	0.04	0.04	0.06	-	-	0.06	-	1.00		
(14) Return On Equity	0.08	0.08	0.05	0.08	0.05	0.07	0.09	0.07	-	-	0.10	0.02	0.62	1.00	
(15) logarithm Leverage	0.09	0.12	0.06	0.13	0.11	0.13	0.14	0.12	0.03	-	0.22	0.13	-	0.02	1.00

Table 4. Regression coefficients effect gender diversity on innovation measured as the logarithm of R&D cost, Model 2 gender diversity measured as having 30% or more female in the board of directors. Model 3 gender diversity measured as having 3 or more women in the board of directors without a quorum, Model 4 With quorum and gender diversity measured as having 3 or more women in the board of directors.

Innovation	(1)	(2)	(3)	(4)
Dummy Women in Board 3 or more	.09056*** (4.23)		.0932*** (4.23)	.06467 (1.94)
Dummy more than 30% women in the board of directors		.0646*** (2.91)		
PDI	.0623 (0.78)	.0619 (0.77)	.082639 (1.40)	-.1152 (-1.22)
IDV	.02849*** (3.63)	.0283*** (3.58)	.0375158 (1.10)	-.0000108 (-0.00)
MAS	.06757 (0.56)	0.069471 (0.57)*	.0461558 (0.74)	.0464702* (1.66)
UAI	-.10019* (-1.84)	-.1007 (-1.84)	-.09578* (-1.71)	.0344183 (1.35)
Board Size	.0002312 (0.07)	.0024	.0059342 (1.57)	-.01329* (-1.68)
Return On Assets	-0.00297*** (-2.80)	-0.00306*** (-2.89)	-0.002686*** (-2.61)	-0.006397* (-1.68)
Return On Equity	-0.00025 (-0.99)	-0.00095 (-0.93)	-0.0003019 (-1.23)	.0005659 (0.60)
Logarithm	0.0029	.002747	.001543	.0056615
Leverage	(0.37)	(0.37)	(0.20)	(0.29)
Single Biggest Shareholder	-.0018451 (-1.46)	-.0018 (-1.40)	-.0009173 (-0.68)	-.0047084* (-1.65)
Market-to-book Ratio	-0.00092 (-0.53)	-0.00095 (-0.55)	-0.0013046 (-0.75)	.0030817 (0.51)
Constant	9.028** (2.00)	8.98** (1.97)	7.49048 (0.95)	11.4885*** (3.34)
Industry Dummy	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes
R-squared	0.3727	0.3727	0.3825	0.3743
Observations	8167	8167	5949	2218

(T-values in parenthesis)

Table 5. Regression effect Power Distance on relationship between gender diversity and innovation, model 1 is innovation measured as the logarithm of R&D Expenses. Model 2 is the model where gender diversity is measured as having more than 30% of women in the board of directors. Model 3 is a Model without a quorum and gender diversity measured as having 3 or more women in the board of directors.

Innovation	(1)	(2)	(3)	(4)
Dummy women in board > 3	-	-	-	-
PDI	.0621267 (0.78)	.0619 (0.77)	.0824795 (1.40)	-0.1176528 (-1.24)
IDV	.02847*** (3.62)	.028*** (3.58)	.0375011 (1.10)	-.0003003 (-0.01)
MAS	.00677 (0.56)	.069 (0.57)	.0462241 (0.74)	.0467* (1.67)
UAI	-.1002* (-1.84)	-.1007* (-1.84)	-.09580* (-1.71)	.0351341 (1.38)
PDI X dummy Gender diversity	.00143*** (3.99)	0.0011*** (2.98)	.00148*** (4.04)	.0009269 (0.97)
Board Size	.0004 (0.12)	.0025 (0.72)	.00608 (1.61)	-.0130162* (-1.65)
Return On Assets	-.0030*** (-2.81)	-.0031*** (-2.89)	-.00269*** (-2.61)	-.0064335* (-1.72)
Return On Equity	-.0002449 (-0.99)	-.0002283 (-0.92)	-.000301 (-1.22)	.0005685 (0.60)
Leverage	.0027 (0.36)	.0026*** (0.35)	.0015 0.20	.0053008 (0.27)
Single Biggest Shareholder	-.00183 (-1.45)	-.00177 (-1.40)	-.0009051 (-0.67)	-.0047114* (-1.65)
Market-to-Book Ratio	-.000904 (-0.52)	-.00096 (-0.55)	-.0012814 (-0.73)	.003075 (0.51)
Constant	9.033** (2.00)	8.9855** (1.98)	7.9119 (0.95)	11.57*** (3.37)
Dummy Industry	Yes	Yes	Yes	Yes
Dummy Country	Yes	Yes	Yes	Yes
R-Squared	0.3745	0.3727	0.3822	0.3742
Observations	8167	8167	5949	2218

(T-value in parenthesis)

Table 6. Regression effect Uncertainty Avoidance on relationship between gender diversity and innovation, Model 1 is innovation measured as the logarithm of R&D Expenses. Model 2 is the model where gender diversity is measured as a dummy which is one when there is more than 30% of women in the board of directors. Model 3 is a Model without a quorum and gender diversity measured as having 3 or more women in the board of directors. Model 4 is with a quorum.

Innovation	(1)	(2)	(3)	(4)
Dummy women in board 3 or more	-	-	-	-
PDI	.06229 (0.78)	.06199 (0.77)	.0825466 (1.40)	-.1155 (-1.22)
IDV	.02850*** (3.63)	.028319*** (3.58)	.03748 (1.10)	-.0001916 (-0.01)
MAS	.06744 (0.56)	.06941 (0.57)	.0460928 (0.74)	.04641* (1.66)
UAI	-.1002* (-0.93)	-.1008* (-1.84)	-.0958915* (-1.71)	.03405 (1.33)
UAI X dummy Gender diversity	.00127*** (4.38)	.000953*** (3.13)	.001255*** (4.27)	.0010595 (1.34)
Board Size	.00025 (0.07)	.0025 (0.72)	.0060064 (1.59)	-.01341* (-1.70)
Return On Assets	-.0030*** (-2.80)	-.00306*** (-2.89)	-.00268*** (-2.61)	-.0064049* (-1.72)
Return On Equity	-.000245 (-0.99)	-.000228 (-0.92)	-.000301 (-1.22)	.0005667 (0.60)
Leverage	.0027 (0.36)	.002656 (0.35)	.0015072 (0.20)	.0056603 (0.29)
Single Biggest Shareholder	-.0019 (-1.47)	-.001785 (-1.44)	-.0009386 (-0.69)	-.0047052* (-1.65)
Market-To-Book Ratio	-0.00090 (-0.52)	-.0009493 (-0.55)	-.0012975 (-0.74)	.0031446 (0.52)
Industry dummy	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes
Constant	9.038** (2.00)	8.99** (1.98)	7.9227 (0.95)	11.5401*** (3.36)
R-Squared	0.3749	0.3728	0.3825	0.3742
Observations	8167	8167	5949	2218

(*T-values in parenthesis*)

Table 7. Regression effect Individuality on relationship between gender diversity and innovation, Model 1 is innovation measured as the logarithm of R&D Expenses. Model 2 is the model where gender diversity is measured as a dummy which is one when there is more than 30% of female board members, and model 3 is a model with countries that do not have a quorum. Model 4 is with a quorum

Innovation	(1)	(2)	(3)	(4)
Dummy 3 or more women in board of directors	-	-	-	-
PDI	.0619 (0.78)	.0617 (0.77)	.0825466 (1.40)	-0.1122355 (-1.18)
IDV	.02830*** (3.60)	.02828*** (3.58)	.003748 (1.10)	.0003591 (0.02)
MAS	.0683163 (0.56)	.06955 (0.57)	.046092 (0.74)	.0457499 (1.63)
UAI	-.1001* (-1.84)	-.1005* (-1.84)	-.09589* (-1.71)	.0335297 (1.31)
IDV X dummy 3 or more women in board	.0016347*** (3.86)	.00103** (2.52)	.00126*** (4.27)	.0011897 (1.19)
Board Size	.0006438 (0.18)	.00236 (.68)	.0060064 (1.59)	-.0131132* (-1.66)
Return On Assets	-.0029704*** (-2.80)	-.00304*** (-2.87)	-.00268*** (-2.61)	-.0063924* (-1.71)
Return On Equity	-.0002475 (-1.00)	-.0002337 (-0.94)	-.000301 (-1.22)	.000564 (0.59)
Leverage	.0031608 (0.42)	.0030588 (0.41)	.0015072 (0.20)	.0055525 (0.28)
Single Biggest Shareholder	-.0001817 (-1.43)	-.0017709 (-1.40)	-.0009386 (0.69)	-.004686 (-1.64)
Market-to-Book Ratio	-.000933 (-0.54)	-.0009186 (-0.53)	-.0012975 (-0.74)	.003131 (0.52)
Constant	9.019026** (1.99)	8.98856** (1.97)	7.9226 (0.95)	11.405*** (3.31)
Industry Dummy	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes
R-Squared	0.3744	0.3726	0.3825	0.3748
Observations	8167	8167	5949	2218

(*T-values in Parenthesis*)

Table 8. regression of effect of masculinity on the relationship between gender diversity. Model 1 is innovation measured as the logarithm of R&D Expenses. Model 2 is the model where gender diversity is measured as a dummy which is one when there is more than 30% woman in the board of directors. And model 3 is a model with countries without a quorum

Innovation	(1)	(2)	(3)	(4)
Dummy 3 or more women in board of directors	-	-	-	-
PDI	0.0622 (0.78)	.06189 (0.77)	.0827081 (1.40)	-0.1132 (-1.19)
IDV	.0285141*** (3.63)	.0283*** (3.58)	.0375739 (1.10)	.0004836 (0.02)
MAS	.0674525 (0.56)	.069456 (0.57)	.0459359 (0.74)	.045091 (1.61)
UAI	-.1001* (-1.84)	-.1006* (-1.84)	-.0957114* (-1.71)	.033463 (1.30)
MAS X dummy 3 or more women in board	.0020617*** (4.52)	.00156*** (3.23)	.00212*** (4.59)	.0013925 (1.14)
Board Size	.0001994 (0.06)	.002484 (0.72)	.0058702 (1.56)	-.0131979* (-1.67)
Return On Assets	-.002965*** (-2.80)	-.003067 (-2.90)	-.00268*** (-2.60)	-.0064034* (-1.72)
Return On Equity	-.00002457 (-0.99)	-.000229 (-0.92)	-.0003008 (-1.22)	.0005667 (0.60)
Leverage	.002655 (0.35)	.002542 (0.34)	.001395 (0.18)	.0055799 (0.28)
Single Biggest Shareholder	-.001859 (-1.47)	-.0017642 (-1.39)	-.000936 (-0.69)	-.0047115* (-1.65)
Market-to-Book Ratio	-.0009103 (-0.53)	-.0009446 (-0.54)	-.0012942 (-0.74)	.003087 (0.51)
Constant	9.03** (2.00)	8.98** (1.97)	7.90474 (0.95)	11.490*** (3.34)
Industry Dummy	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes
R-Squared	0.3750	0.3727	0.3829	0.3742
Observations	8167	8167	5949	2218

(T-values in Parenthesis)

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