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# The Gender Effect on a Firm's Innovative Activities in the Emerging Economies

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**Abstract:** This study examines the impact of gender at three different positions in a firm's hierarchy on innovative activities, looking at over 6474 firms in 30 emerging countries. We create a dummy variable for each of the six survey questions on product innovation, process innovation, organizational innovation, marketing innovation, and R&D (Research & Development) spending. Each dummy acts as a dependent variable in a separate logit regression, and the sum of the dummies acts as the dependent variable in another ordered logit regression. We use the female ownership percentage, female top management, and female majority in the workforce as test variables. We use the Heckman two-stage model to address endogeneity concerns with gender. We find that the female ownership percentage is generally positively related to individual innovation measures as well as the composite measure, while female top management is positively associated with marketing innovation only, and a female majority in the workforce is not significantly related to any measure. The results suggest that promoting innovation in emerging countries would involve governments encouraging further market participation by women and supporting female CEOs (Chief Executive Officers) to innovate, and firms fostering innovation among female workers.

**Keywords:** emerging markets; innovation; gender; female ownership; female top manager; female employees

## 1. Introduction

Since Schumpeter, innovation has been widely accepted as a crucial factor for business productivity and sustainable economic growth [1,2]. Although there are varying definitions, innovation in business encompasses anything new that contributes to the firm, such as new products, technology, or processes, new marketing approaches, new organizational structures and so on [3,4]. Innovation can improve or reinforce a firm's capacity for performance, which fuels the growth of the firm. In particular, a firm's innovation can contribute to its sustainable growth by enhancing its core competencies [5] and generating long-term future financial performance [6–9].

Compared to developed countries with a matured but slow economy, emerging markets have an unstable but rapidly growing economy. To survive in the global market and catch up to their counterparts in developed countries, firms in emerging markets are often forced to innovate and achieve high, sustainable growth [10–14]. Dawar and Frost [14] and Krishnan and Jha [13] both present case studies of firms in emerging markets that have survived and have grown immensely through innovation. Empirical studies like Atalay et al. [12] show how specific types of innovation, such as technological innovation, have a positive impact on the performance of firms in emerging markets.

With the research on innovation and firm performance in emerging markets showing positive results, the focus has shifted to identifying the factors that influence innovation. Some papers identify the taste of the consumers in the emerging markets as a key driver of innovation [15,16]. Others find that firm-level characteristics, such as external financing, foreign competition, manager education, and R&D (Research & Development), all increase innovation activities [17,18]. Some studies examine the effect of institutions such as government and business groups, and find mixed results. For example, Radosevic and Myrzakhmet [18] find that the technoparks located in Kazakhstan, while great at starting businesses, ultimately fail to promote innovation. In contrast, Zhou et al. [19] argue that firms in the Chinese manufacturing industry are the most innovative with minority state ownership. Mahmood and Mitchell [20] show that business groups in emerging markets can be both a blessing and a curse for innovation, while Chang et al. [21] claim that business group affiliates outperform independent firms in terms of innovativeness, depending on the availability of alternative institutions.

A branch of research approaches the question of factors influencing innovation from the perspective of human capital. They suggest that specific characteristics of human capital can improve or deteriorate the innovation performance of a firm. Both Reuvers et al. [22] and Arvanitis and Stucki [23] demonstrate how the characteristics of leaders can influence innovative activities in general. Marvel and Lumpkin [24], who focus on radical innovation, state that while greater education, experience, and knowledge of the product or the technology can improve innovation, more knowledge on the delivery of the product deteriorates innovation. Østergaard et al. [25] look at the diversity of the employee population, and find that gender and education diversity improves innovation performance, but age diversity has a negative relationship with innovation. Galia et al. [26] show that gender diversity and age diversity in the board of directors improve innovation, but the proportion of employee directors reduces innovation. Unfortunately, studies taking this approach for innovation generally focus on developed economies, and only a handful look at emerging markets. To fill this gap, this study investigates the impact of female participants on innovation of a firm in an emerging market.

Innovation can be influenced by people at three different positions in a firm: shareholder, top manager, and employee. First, as the equity owners of a company, the shareholders can make crucial decisions that may make or break the company. Such decisions may include appointing a new director who is more inclined towards innovative activities, or demanding a change in the firm structure to promote innovation. Second, the top manager or the CEO (Chief Executive Officer) is responsible for making operational decisions for a firm. The top manager can instruct the development of new products, services, marketing methods, or logistics. The top manager also decides the magnitude of R&D spending and the provision of employee training to promote innovation. Finally, the employees actually perform these operations. As such, they would be directly involved in firm innovation, whether the innovation is driven by the top manager's decisions or by their own interests. Based on this discussion, among the female participants, this study focuses on the female ownership percentage, female top manager, and the female majority of the employee population.

We use the firm level data from emerging countries located in Eastern Europe and Central Asia. To estimate innovative activities, six survey questions on innovation are used. Since all questions required a yes or no answer, we create a dummy and construct a separate logit regression for each question. We also use the sum of the six dummies as an aggregate measure and construct an ordered logit regression. One key concern with studying the effect of gender is the issue of endogeneity—the effects that seem to be driven by gender differences could be influenced by omitted factors correlated to gender difference [27]. To address this concern, we adopt the Heckman two-stage least square model [28,29].

The results of this study contribute to the related literature in the following ways. First, although previous studies examine the gender effects on a firm, most of them focus on the relationships between gender and attitude toward risk or between gender and the firm's performance. This study differs from such studies, since we focus on the impact of female participants on innovation. Furthermore, many of these studies look at developed countries, while we look at firms in emerging markets. Our

findings can be used as additional empirical evidence of the role of gender on a firm's innovation in the context of an emerging country. Third, the results of this study could provide further insight into the relationship between gender and firm innovation from various perspectives, such as that of a shareholder, a top manager, and an employee.

The rest of this study is organized as follows. Section 2 reviews related literature, while Section 3 discusses data and research design. Section 4 presents the results. And finally, Section 5 concludes this study.

## 2. Literature Review and Theoretical Background

### *2.1. Innovation in Emerging Markets*

In most countries, economic growth heavily depends on the sustainable growth of their domestic firms. To achieve growth, a firm must find an opportunity to sell its products or services in the marketplace, and deliver the right value to the consumer to make profits. However, short-term profits alone do not guarantee a firm's sustainable growth, it must also be supported by other activities, such as innovation.

Innovation is crucial for a firm to survive and achieve sustainable growth in the long run. Defined as the development and implementation of a new idea, including new technology, products, processes, or arrangements [3,4], innovation can come in various forms. Innovation could be radical or gradual innovation in technology, products, and processes; organizational innovation to improve productivity or efficiency; marketing innovation to widen the consumer base; logistics innovation to enhance linkage in the value chain; or one of many other forms. These various forms of innovation all contribute to the firm's core competencies, productivity improvement, and market share expansion, ultimately enhancing the firm's performance and leading to sustainable growth [5]. Many studies highlight this relationship between innovation and sustainable firm growth. For example, Cho and Pucik [8] delve into the effects of innovativeness and product quality, two aspects that compete for the limited resources available to a firm, on the firm's growth, profitability, and market value. Their results suggest that innovativeness is a direct driver of firm growth. Kleinschmidt and Cooper [9], who look at the relationship between product innovativeness and firm performance, show that firms with high-intensity product innovation perform better than those with both mid-intensity and low-intensity innovation.

Although many studies focus on innovation in developed economies, the importance of innovation on firms' long-term performance can be applied to emerging markets as well [30], especially since emerging markets aim to achieve high economic growth. As such, there has been an increase in literature that investigates the impact of innovation in emerging countries. Krishnan and Jha [13] provide a case study of five firms that have become market leaders in India after deregulation. They argue that these firms have become market leaders through innovativeness: those with existing capacities adapt their products to suit the changing markets, while those without explore other paths and quickly exploit the results of such exploration. In the same vein, Dawar and Frost [14] investigate the anecdotal evidence on how local businesses in emerging markets have survived against multinational corporations in the global era. The answer lies in innovation—the firms in emerging countries have aligned their competitive assets to their target market, whether it is by producing new products tailored to the market, shifting the focus of the firm to a different position in the value chain, or adopting new technologies and strategies to improve productivity. Empirical studies also support the importance of innovation in emerging markets. Kurt and Kurt [10] analyze the effect of innovation on labor productivity in BRICs (Brazil, Russia, India and China). Using the growth in patent applications by residents and the number of internet users as measures of innovation, they find that innovation has a significant positive effect on labor productivity growth. Atalay et al. [12] find that technological innovation has a significant positive impact on firm performance for the automotive supplier industry in Turkey. Lynch and Jin [11] argue that Chinese automobile multinationals need to

utilize non-technical innovations and incremental technological advances to close the gap with their developed country counterparts.

Given the importance of innovation in emerging markets, previous literature has moved to identify ways of enhancing the innovation of firms in emerging markets, where the conditions for innovation are lesser relative to developed countries [31]. For example, several case studies present the taste of the consumers in emerging markets for value, i.e., "doing more with less", as a source of innovation. Ray and Ray [16] investigate the case of the Centre for Development of Telematics, an Indian telecommunications enterprise. After the deregulation of the market, the firm implemented a number of innovative strategies to reduce the cost of its products while providing the essential functionalities to the consumers, who wanted value out of their products over additional features. Petrick and Juntiwasarakij [15] come to a similar conclusion after performing a case study on four industries—mobile banking, transportation, energy and natural resources, and health care—in different emerging markets. They claim that since consumers look for value, firms are forced to innovate by distilling their products and services down to the essence.

Other empirical studies try to identify firm-level characteristics that can influence innovation. Ayyagari et al. [17] investigate the firm-level characteristics of firms across forty-seven emerging economies, and find that access to external financing, ownership by families, individuals, or managers, the presence of managers with a high-level education, and exposure to foreign competition all contribute to more innovation. Gorodnichenko et al. [32] also agree that exposure to foreign competition drives innovation, both in manufacturing and service sectors. Wang and Kafouros [33], who look at the Chinese manufacturing industry from an investment perspective, conclude that R&D, foreign direct investment, and international trade all positively affect innovation, but R&D has a stronger influence than the other two factors.

Another branch of research investigates the institutional factors driving innovation. Some studies look at the effect of governmental institutions. Radosevic and Myrzakhmet [18] look at the effectiveness of technoparks located in Kazakhstan, and find that, while the technoparks are great business incubators, they ultimately fail to promote innovation. Zhou et al. [19] analyze the effect of state ownership on innovation in the Chinese manufacturing industry, and find that firms are the most innovative at the middle level—minority state ownership. In contrast, other studies highlight the relationship between business groups and innovation. Mahmood and Mitchell [20] show that business groups in emerging markets, such as South Korea and Taiwan, can both nurture and hinder innovation—they nurture innovation in that they provide the institutional infrastructure necessary for innovation, while they hinder innovation in that they create entry barriers for non-group companies and thus prevent proliferation of new ideas. Chang et al. [21] also look at South Korea and Taiwan, and find that business group affiliates outperform independent firms in terms of innovativeness in South Korea but not in Taiwan, before the 1990s but not after the 1990s. They attribute this difference to the existence of alternative institutional infrastructure for innovation.

### *2.2. Human Capital and Innovation: Theory and Evidence*

According to Barney [34], a strategic resource of a firm is any resource directly associated with the company's core competencies. Strategic resources can be divided into two categories: (1) tangible resources such as raw materials, production facilities, or funds, and (2) intangible resources such as know-how, reputation, and brand. In particular, intangible resources are often derived from human capital, the aggregate of human labor, relations, knowledge, and skills in a firm. Since innovation improves the core competencies of a firm [5], it should require the intangible resources of a firm, and therefore would be affected by human capital. For example, Reuvers et al. [22] find that transformational leadership—where a leader earns the admiration, loyalty, trust, and respect of his or her followers—is positively and significantly related to innovative work behavior of the employees. Arvanitis and Stucki [23] agree with this notion, finding that start-ups with well-educated, experienced founders with a strong motivation to realize their own ideas have a higher likelihood

of having innovative activities. In contrast, Marvel and Lumpkin [24] find that radical innovation is positively associated with not only greater formal education, depth of experience, and prior knowledge of the technology, but also less know-how on delivering that technology to the market. In other words, the characteristics of human capital affect its influence on innovation. In particular, the role of human capital is more emphasized in science-based industries such as the biotechnology industry, because the tacit knowledge accumulated in human beings is likely to manifest itself as innovation [35,36].

One way to gain access to different human capital is diversifying the worker population. People belonging to different population groups have distinct sets of knowledge, skills, and networks. Consequently, increased diversity would give the firm access to a wider set of these resources, which in turn should increase the diversity of human capital and hopefully increase innovation performance. This idea is supported by a number of studies. Daunfeldt and Rudholm [37] show that innovation activities of a firm can be influenced by the individual characteristics of the CEO, employees, board of directors, and the workforce group. Østergaard et al. [25] look at the diversity of the employee population in terms of gender, age, ethnicity, and education. They find that gender and education diversity improves innovation performance, but that the other two forms of diversity do not have a positive relation with innovation. In fact, they show that age diversity has a negative relationship with innovation. The study suggests that, unlike gender and education, age diversity could cause disagreements between generations, decreasing innovation. Galia et al. [26] look at the effect of diversity in the board of directors on environmental innovation, and suggest that gender diversity improves the probability of innovation, age diversity increases the intensity of innovation, and an increase in the proportion of employee directors decreases both the probability and intensity of innovation. Based on the previous literature, we can infer that innovation activities in enterprises are influenced by the characteristics and organizational configuration of its human resources.

### *2.3. The Effect of Gender on Innovation*

Among the dimensions of diversity, gender has gained the spotlight in recent years. This attention could be attributed to the ever-growing presence of female entrepreneurs in the global business environment; in 2012, more than 187 million out of 400 million entrepreneurs were women [38]. As such, there has been a growing number of studies focusing on the relationship between the participation of women and the innovation activities of a firm. However, the results seem to be mixed.

Several studies show that gender diversity is positively related to innovation. For example, Chen et al. [39] demonstrate that greater representation of women in the board of directors leads to greater innovative success for given R&D expenditure, while Galia et al. [26] show that gender diversity on the board of directors leads to a higher probability of environmental innovation. Dezso and Ross [40] also find that a greater female presence on the board leads to greater performance, especially if the firm focuses on innovative activities. Torchia et al. [41] demonstrate that gender diversity can indirectly drive organizational innovation by positively mediating the decision-making culture dimension of (1) cognitive conflict and (2) preparation and involvement in board meetings. In addition, Ruiz-Jiménez, Del Mar Fuentes-Fuentes, and Ruiz-Arroyo [42] find that the gender diversity of the top management team positively affects the relationship between the knowledge combination capability and innovation performance. Ruiz-Jiménez and Del Mar Fuentes-Fuentes [43] also find that the gender diversity of the management team positively mediates the management capabilities of the enterprise, ultimately having a positive effect on innovation performance. Gender diversity in the top management team can positively affect both innovative idea generation and the implementation of ideas into new products or services [44].

Slightly deviating from the rest, Østergaard et al. [25] look gender diversity in the employee population rather than the management, and find that moderate gender diversity, where the minority group has enough mass to contribute to a firm's innovation process, has a greater likelihood of leading to innovation compared to low or high diversity. Horbach and Jacob [45], based on the German employee database of the Institute for Employment Research, demonstrate that highly-qualified female

workers with a university education and a mixed-gender management board have a positive effect on a firm's innovation. Nielsen, Bloch, and Schiebinger [46] find that gender diversity of employees can positively influence scientific discovery and innovation by three approaches to gender diversity: (1) diversity in research teams, (2) diversity in research methods, and (3) diversity in research questions. Furthermore, in the context of new ventures, there is a positive relationship between the gender diversity of new venture firms and their innovation performance [47].

However, some studies find that a female presence has no relationship, or even a negative relationship, with innovation, depending on the culture of the country. For example, Mueller [48] finds that men have a higher risk-taking propensity than women, and explains that there is a significant positive gap in risk-taking propensity and innovation between men and women across seventeen countries of varying development. Similarly, Reuvers et al. [22] claim that followers demonstrate more frequent innovative behaviors when transformational leadership is displayed by male leaders than female leaders. These results, however, may be caused by biases, as innovative works stereotypically tend to be given to men rather than women [49]. Kushnirovich and Heilbrunn [50], after analyzing a survey of employees of 60 high-tech organizations in Israel, conclude that gender has no significant effect on innovativeness—rather, they find that culture has a greater impact on innovativeness. This idea is further supported by studies such as Schøtt and Cheraghi [51] and Schneid, et al. [52]. For example, through investigating over sixty thousand entrepreneurs in sixty-seven countries, just like Kushnirovich and Heilbrunn [50], Schøtt and Cheraghi [51] find that gender has negligible impact on innovation. Instead, culture seems to be the dominant factor in innovativeness.

Outside of studies that delve directly into the relation between gender and innovation, there are many papers that research the effect of gender on other activities of a firm. Although not directly related to the effect of gender on a firm's innovation activities, these studies can provide insight into how innovation activities could be affected by gender. Specifically, they reveal several characteristics that differentiate a female participant from a male participant that could improve or worsen innovation activities. Studies document three characteristics that female participants could improve innovation performance. First, women tend to use a 'transformational style' of leadership. Wolfram et al. [53] argue that female bosses tend to have more respect for male subordinates and have more frequent communication with them. Eckel and Grossman [54] claim that women are, on average, less selfish than men and are more likely to cooperate with others. Furthermore, female leaders of a group alleviate status conflicts within the group, facilitating information sharing within the group and promoting team creativity [55]. Considering that communication with subordinates, collaboration with colleagues, and the enhancement of team creativity are all crucial to innovation, these traits can positively contribute to a firm's explorative and exploitative innovation performance [56].

Second, women are less likely to be corrupt than men. Women take stronger stances on legal issues than men [57], and are therefore more likely to comply with the law [58]. Among the various forms of corruption, bribery is particularly concerning since it can affect the amount of funds available for innovation. For example, a firm may pay a bribe to a government agency for tangible benefits, or receive bribes from a subcontractor. Such activities worsen the firm's cash flow, making it difficult to secure funds for innovation. Since the firm now lacks the funds, it may not be able to make use of the best options during the innovation process, ultimately harming the firm's innovation performance [59]. Numerous studies find that women are either as likely as or less likely than men to receive or give bribes [27,58,60,61], which would lead to the conclusion that having women in a firm's leadership team could improve innovation performance.

Lastly, women tend to be more objective about the current business situation. Lundeberg et al. [62] and Barber and Odean [63] find that male CEOs are more likely to be overconfident than female CEOs, and thus have a higher investment volume. Similarly, Huang and Kisgen [64] argue that male CEOs tend to be more overconfident than their female counterparts, based on the findings that male CEOs tend to perform more acquisitions and borrow more funds than female CEOs, while simultaneously showing a lower future financial performance. In the same context, Glass and Cook [65], based on data

from Fortune 500 companies from 2001 to 2010, find that firms with female CEOs or gender-diverse boards have a stronger business performance than those who don't. Reguera-Alvarado, de Fuentes, and Laffarga [66] find that an increase in the female participation rate on the board of directors of 125 non-financial companies listed on the Madrid Stock Exchange from 2005 to 2009 increased the economic performance of the companies. Perryman, Fernando, and Tripathy [67] explain that gender diversity of the top management team alleviates management risk and strengthens business performance. Ionascu [68] also find that gender diversity of the boards increases the firm's performance in profit-firms and standard-tier listed companies of Romania, one of the European emerging markets. Such differences suggest that female CEOs and female participation on the board of directors may make decisions for a firm's innovation that are better suited to the current business situation than male CEOs and non-gender diversified boards of directors [69].

In contrast, some researchers argue that women tend to be more risk-averse than men, which would be detrimental to innovation given that innovation is inherently a risky procedure. Na and Hong [70] find that, unlike female CEOs, male CEOs tend to manage earnings aggressively, using both discretionary accruals and real activities. However, earnings management, especially real activities management, is risky since it can harm firm value in the long run. Cole and Salimath [71] find that female-owned firms have lower leverage than male-owned firms. Faccio et al. [72] find that, while firms run by female CEOs have a higher survival rate than male CEO firms, the former also has lower leverage and less earnings variability. Faccio et al. [72] demonstrate that female CEO companies tend to make less risky investments and financial choices than companies run by male CEOs. Changes-in-risk analysis related to CEO turnover also indicates that firms' risk exposure tends to decrease during a male-to-female transition and increase in the reverse direction. On average, women are more inclined to avoid risk in investment and financial decisions than men [73]. Dwyer et al. [74], who analyze data on 2000 mutual funds, also find that women are less risk-taking in their investment decisions than men, even when their investment knowledge is the same. In the perspective of social relationships, Whittington [75] find that men are more likely to actively engage in research collaboration using intermediary positions in human networks, while women do not because of risk-aversion characteristics. Grable and Lytton [76], and Sung and Hanna [77], who use consumer finance surveys, as well as Grable [78], who uses university member surveys, reveal that women are significantly less risk tolerant than men. Neelakantan [79] demonstrates that women tend to be less tolerant of risk than men in simulation studies on the risk tolerance of men and women, which is consistent with Lyons et al. [80], who find that women are more conservative than men.

Overall, the characteristics of female participants demonstrated by previous studies may have a positive or negative impact on a firm's innovation performance. This study intends to address this question, particularly in the setting of emerging markets.

## 3. Data and Research Method

### *3.1. Sample*

The original data for the study is collected from the combined data for Eastern Europe and Central Asia from a survey jointly conducted by the World Bank and the European Bank for Reconstruction and Development (also known as BEEPS 2013). This dataset provides information on business environments at the firm-level. Our final sample consists of 6474 manufacturing firms over 30 countries, as summarized in Panel A of Table 1. Among those countries, Russia (22.61%), Turkey (16.87%), and Ukraine (11.79%) have proportions greater than 10% and the rest have less than 3%. The sample firms are distributed over 10 sectors of the manufacturing industry. Among them, 1112 (17.18%) and 685 (10.58%) firms come from the food and non-metallic mineral products sectors, respectively, while other sectors each take up less than 10% of the sample (see Panel B of Table 1).

**Table 1.** Sample Distribution.

| **Panel A: Country.** | | |
|---|---|---|
| **Country** | **Frequency** | **%** |
| Albania | 120 | 1.85 |
| Armenia | 120 | 1.85 |
| Azerbaijan | 126 | 1.95 |
| Belarus | 120 | 1.85 |
| Bosnia-Herzegovina | 120 | 1.85 |
| Bulgaria | 97 | 1.50 |
| Croatia | 130 | 2.01 |
| Czech Republic | 102 | 1.58 |
| Estonia | 89 | 1.37 |
| Georgia | 121 | 1.87 |
| Hungary | 99 | 1.53 |
| Kazakhstan | 200 | 3.09 |
| Kosovo | 70 | 1.08 |
| Kyrgyzstan | 104 | 1.61 |
| Latvia | 110 | 1.70 |
| Lithuania | 104 | 1.61 |
| Macedonia | 120 | 1.85 |
| Moldova | 120 | 1.85 |
| Mongolia | 120 | 1.85 |
| Montenegro | 50 | 0.77 |
| Poland | 184 | 2.84 |
| Romania | 180 | 2.78 |
| Russia | 1464 | 22.61 |
| Serbia | 120 | 1.85 |
| Slovakia | 98 | 1.51 |
| Slovenia | 86 | 1.33 |
| Tajikistan | 118 | 1.82 |
| Turkey | 1092 | 16.87 |
| Ukraine | 763 | 11.79 |
| Uzbekistan | 127 | 1.96 |
| Total | 6474 | 100.00 |
| **Panel B: Industry** | | |
| **Industry** | **Frequency** | **%** |
| Food | 1112 | 17.18 |
| Textiles | 322 | 4.97 |
| Garments | 573 | 8.85 |
| Chemicals | 402 | 6.21 |
| Plastics & Rubber | 300 | 4.63 |
| Non-metallic mineral products | 685 | 10.58 |
| Basic metals | 86 | 1.33 |
| Fabricated metal products | 632 | 9.76 |
| Machinery & equipment | 539 | 8.33 |
| Electronics | 233 | 3.60 |
| Other | 1590 | 24.56 |
| Total | 6474 | 100.00 |

Note: The original data is collected from the Enterprise Survey data jointly conducted by the World Bank and the European Bank for Reconstruction and Development (BEEPS 2013). After deleting missing values, the final sample size becomes 6474 firms.

### *3.2. Research Design*

Our research design is to predict how female participation in a firm affects the firm's innovative activities. However, gender related variables can be endogenous [27]. To mitigate the endogenous concerns, we use the Heckman two-step regression model [28,29]. From Jha and Sarangi [27], we adopt

a dummy for countries whose dominant language has distinct two genders (masculine and feminine) as the instrument and construct the first stage regression model as follows.

(1) First Stage

In the first stage, the probit regression in Equation (1) is estimated in order to calculate the inverse Mills ratio (IMR). In Equation (1), each gender related variable is regressed on the instrument variable, NG_2 (a dummy variable which equals one if the number of genders in the dominant language is two, and zero otherwise), with control variables.

$$Gender = \alpha + \beta_i\ NG\_2 + \sum Control + \varepsilon_i. \quad (1)$$

**Dependent Variable**: The dependent variable of Equation (1), *Gender*, is one of the following three measures: the presence of (a) female owner(s) (one for the presence of a female owner or female owners and zero otherwise); the presence of a female top manager (one if the top manager is female and zero otherwise); and the majority share of female workers in a firm (one if the percentage of female employees of a firm is greater than 50% and zero otherwise). For the majority share of female workers in a firm, the sample is divided into three groups based on the percentage of female workers: low (below 20%), medium (between 20% and 50%), and high (over 50%) ratio of female workers. These measures are named *Female_Ownership*, *Female_Topmanager*, *Female_Workers_High*, respectively.

**Instrumental Variable**: The explanatory variable (*NG_2*) in Equation (1) is an instrumental variable which equals one if the number of genders in the dominant language is two, and zero otherwise [27].

**Control Variable**: Following Ayyagari et al. [17], Equation (1) includes control variables (*Control*) which may affect a firm's innovative activities. They are *Size_Large* (one if the number of employees is equal to or over 100 and zero otherwise), *Age_Young* (one if firm age is less than nine years and zero otherwise), *Corporation* (one if the establishment is a corporation and zero otherwise), *Multiple_Establishments* (one if a firm has multiple establishments and zero otherwise), *Capacity_High* (one if the percentage of capacity utilization is greater than 80 and zero otherwise), *External_Financing* (the percentage of external financing deflated by 100), *State_Ownership* (one if the government owns more than 50% of shares and zero otherwise), *Domestic_Ownership* (one if the domestic shareholders owns more than 50% of shares and zero otherwise), *Foreign_Ownership* (one if the domestic shareholders owns more than 50% of shares and zero otherwise), *Log_No_Competitors* (natural logarithm of total number of competitors), *Domestic_Sales* (the percentage of domestic sales deflated by 100), *Experience_High* (one if the experience of the top manager in the same sector is greater than 10 years and zero otherwise), *Educatioin_High* (one if the average number of years of education of a typical permanent full-time production worker is equal to or greater than 12 years and zero otherwise), *Industry_Dummy* (dummies for each industry), and *Country_Dummy* (dummies for each country). In particular, for *Age_Young*, the sample is divided into three groups based on the age of the firm: young (below 9 years), medium (between 9 and 17 years), and old (over 17 years).

(2) Second Stage

In the second stage, two approaches are attempted [17]. As there may be different categories of innovative activities, we examine the gender effect on each innovative activity as well as on overall innovative activities using the following logit regression model (2-1) and ordered logit regression model (2-2):

$$Innvation\_i = \alpha + \beta_i\ Gender + \sum Control + IMR + \varepsilon_i, \quad (2\text{-}1)$$

$$Innvation\_Aggregate = \alpha + \beta_i\ Gender + \sum Control + IMR + \varepsilon_i. \quad (2\text{-}2)$$

The dependent variable (*Innovation_i*) in Equation (2-1) is a dummy variable based on each of the six survey questions on firm innovation, as shown in Panel A of Table 2. Although the original questionnaire consists of eight survey questions, questions 7 and 8 are not used for all countries (they are applied to non-Russian only). Hence, we do not include questions 7 and 8, since they could distort the results due to a lack of homogeneity in the sample. Among them, *Innovation_1* and *Innovation_2* are questions on product innovation, while *Innovation_3*, *Innovation_4*, *Innovation_5*, and *Innovation_6* are on process innovation, organizational innovation, marketing innovation, and investment on R&D, respectively. Since each question requires a yes or no answer, a dummy variable is built for each question, such that it equals one if the answer is yes and zero otherwise. Since there are six dummy variables, six logit regressions are run separately.

**Table 2.** Innovation Measures.

| **Panel A: Survey Questions on Innovative Activities.** | |
|---|---|
| **Survey Question No.** | **Description** |
| *Innovation_1* (Product Innovation) | During the last three years, has this establishment introduced new or significantly improved products or services? Please exclude the simple resale of new goods purchased from others and changes of a solely aesthetic nature. |
| *Innovation_2* (Product Innovation) | Were any of the new or significantly improved products or services of this establishment new to one of this establishment's markets? |
| *Innovation_3* (Process Innovation) | During the last three years, has this establishment introduced any new or significantly improved methods for the production or supply of products or services? |
| *Innovation_4* (Organizational Innovation) | During the last three years, has this establishment introduced any new or significantly improved organizational or management practices or structures? |
| *Innovation_5* (Marketing Innovation) | During the last three years, has this establishment introduced new or significantly improved marketing methods? |
| *Innovation_6* (R&D investment) | During the last three years, did this establishment spend on research and development activities, either in-house or contracted with other companies (outsourced)? |

| **Panel B: Distribution of *Innovation_Aggregate*** | | |
|---|---|---|
| | **Frequency** | **%** |
| The value of *Innovation_ Aggregate* = 0 | 3467 | 53.55 |
| The value of *Innovation_ Aggregate* = 1 | 712 | 11.00 |
| The value of *Innovation_ Aggregate* = 2 | 749 | 11.57 |
| The value of *Innovation_ Aggregate* = 3 | 565 | 8.73 |
| The value of *Innovation_ Aggregate* = 4 | 373 | 5.76 |
| The value of *Innovation_ Aggregate* = 5 | 366 | 5.65 |
| The value of *Innovation_ Aggregate* = 6 | 242 | 3.74 |
| Total | 6474 | 100.00 |

Note: In Panel B, variable *Innovation_Aggregate* is calculated as follows. First, a dummy variable, which is one if the answer for the corresponding survey question on innovation is yes and zero otherwise, is constructed. These dummy variables are then summed into a single aggregate variable. As such, the variable ranges between 0 and 6, with a bigger value implying more innovative activities.

The dependent variable in Equation (2-2) is the sum of all six dummy variables (*Innovation_Aggregate*) as an aggregate measure of a firm's overall innovative activities. Since the dependent variable in Equation (2-2) is an ordinal variable ranging from 0 to 6, the ordered logit regression model is used. Panel B of Table 2 presents the distribution of the variable *Innovation_Aggregate*. Since this variable is a sum, higher values imply more innovative activities. In terms of the degree of innovative activities, over 53% of the total sample (equivalent 3467 firms) have no innovation while 3.74% (242 firms) of the sample firms are highly active in innovation (please see Panel B of Table 2).

The test variable is the gender-related variable, which is used as a dependent variable in the first stage, except for *Female_Ownership*. For this variable, the percentage of female ownership

(*Female_Ownership%*) is used instead of the presence of a female owner in the second stage, since the percentage of female ownership could reflect the presence as well as the magnitude of female ownership.

All control variables except for *IMR* are the same as those discussed in the first stage regression model (1), and *IMR* represents the inverse Mills ratio calculated in Equation (1). Table 3 explains the definition of each variable in the equations.

**Table 3.** Variable Definition.

| Variable | Definition |
| --- | --- |
| *Innovation_i* | Dummy variable: one if the answer to survey question *Innovation_i* (*Innovation_1* - *Innovation_6* refer to Panel A of Table 2) is yes and zero otherwise |
| *Innovation_Aggregate* | Sum of the six dummy variables based on the survey questions related to innovation (refer to Panel A of Table 2). Ranges between 0 and 6, with greater values implying more innovative activities (6 = highly innovative; 0 = no innovation) |
| *Female_Ownership* | Dummy variable: one if the percentage of female ownership is greater than 0 and zero otherwise |
| *Female_Ownership%* | The percentage of female ownership |
| *Female_Topmanager* | Dummy variable: one for a firm with a female top manager and zero otherwise |
| *Female_Worker_High* | Dummy variable: one if the percentage of female workers is over 50 and zero otherwise |
| *NG2* | Dummy variable: one if the number of gender in the dominant language is 2 and zero otherwise |
| *Size_Large* | Dummy variable: one for large size firms (the total number of employees is equal to or greater than 100) and zero otherwise |
| *Age_Young* | Dummy variable: one for young firms (the firm age is less than nine years) and zero otherwise |
| *Corporation* | Dummy variable: one if the business form of an establishment is a corporation and zero otherwise |
| *Multiple_Establishments* | Dummy variable: one for firms with multiple establishments (the number of establishments is greater than one) and zero otherwise |
| *Capacity_High* | Dummy variable: one for high capacity utilization (the percentage of capacity utilization is greater than 80) and zero otherwise |
| *External_Financing* | The percentage of external financing deflated by 100 |
| *State_Ownership* | Dummy variable: one if the government owns more than 50% of shares and zero otherwise |
| *Domestic_Ownership* | Dummy variable: one if the domestic shareholders own more than 50% of shares and zero otherwise |
| *Foreign_Ownership* | Dummy variable: one if the foreign shareholders own more than 50% of shares and zero otherwise |
| *Log_No_Competitors* | Natural logarithm of total number of competitors |
| *Domestic_Sales* | The percentage of domestic sales deflated by 100 |
| *Experience_High* | Dummy variable: one if the experience of top manager in the same sector is greater than 10 years and zero otherwise |
| *Education_High* | Dummy variable: one if the average number of years of education of a typical permanent full-time production worker is equal to or greater than 12 years and zero otherwise |
| *IMR* | Inverse Mills Ratio calculated from the first stage regression model |

## 4. Results

### *4.1. Descriptive Statistics*

Panel A of Table 4 reports the descriptive statistics of the innovation measures. The means of individual innovation measures, *Innovation_i* (*Innovation_1* - *Innovation_6*), are distributed between 0.15 and 0. Specifically, during the last three years of the sample period, 30% of sample firms have

introduced new products, while the percentage of firms whose products are new in the market is 21%. About one fourth of the total sample have attempted process innovation (25%), organizational innovation (22%), or marketing innovation (23%), whereas only 15% have invested in research and development. On the other hand, the aggregate innovation measure, *Innovation_Aggregate*, has a mean and median value of 1.34 and 0, which shows that on average the sample firms are involved in less than two out of six innovative activities.

**Table 4.** Descriptive Statistics (Total Observations = 6474).

| **Panel A: Innovation Related Variable** | | | | | |
|---|---|---|---|---|---|
| **Variable** | **Mean** | **Std Dev** | **Min** | **Median** | **Max** |
| *Innovation_1* | 0.30 | 0.46 | 0 | 0 | 1 |
| *Innovation_2* | 0.21 | 0.40 | 0 | 0 | 1 |
| *Innovation_3* | 0.25 | 0.43 | 0 | 0 | 1 |
| *Innovation_4* | 0.22 | 0.41 | 0 | 0 | 1 |
| *Innovation_5* | 0.23 | 0.42 | 0 | 0 | 1 |
| *Innovation_6* | 0.15 | 0.36 | 0 | 0 | 1 |
| *Innovation_Aggregate* | 1.34 | 1.80 | 0 | 0 | 6 |
| **Panel B: Gender Related Variable** | | | | | |
| **Variable** | **Mean** | **Std Dev** | **Min** | **Median** | **Max** |
| *Female_Ownership* | 0.32 | 0.47 | 0 | 0 | 1 |
| *Female_Ownership%* | 0.12 | 0.27 | 0 | 0 | 1 |
| *Female_Topmanager* | 0.15 | 0.36 | 0 | 0 | 1 |
| *Female_Worker_High* | 0.27 | 0.44 | 0 | 0 | 1 |
| **Panel C: Instrument Variable and Control Variable** | | | | | |
| **Variable** | **Mean** | **Std Dev** | **Min** | **Median** | **Max** |
| *NG_2* | 0.06 | 0.24 | 0 | 0 | 1 |
| *Size_Large* | 0.16 | 0.37 | 0 | 0 | 1 |
| *Age_Young* | 0.26 | 0.44 | 0 | 0 | 1 |
| *Corporation* | 0.89 | 0.31 | 0 | 1 | 1 |
| *Multiple_Establishments* | 0.09 | 0.28 | 0 | 0 | 1 |
| *Capacity_High* | 0.32 | 0.47 | 0 | 0 | 1 |
| *External_Financing* | 0.23 | 0.32 | 0 | 0 | 1 |
| *State_Ownership* | 0.01 | 0.09 | 0 | 0 | 1 |
| *Domestic_Ownership* | 0.91 | 0.28 | 0 | 1 | 1 |
| *Foreign_Ownership* | 0.05 | 0.22 | 0 | 0 | 1 |
| *Log_No_Competitors* | 2.36 | 1.91 | 0 | 1.95 | 5.02 |
| *Domestic_Sales* | 0.82 | 0.32 | 0 | 1 | 1 |
| *Experience_High* | 0.67 | 0.47 | 0 | 1 | 1 |
| *Education_High* | 0.43 | 0.49 | 0 | 0 | 1 |

Note: For variable definition, refer to Table 3.

The descriptive statistics of the four gender related variables are presented in Panel B of Table 4. Nearly one third (32%) of the sample firms has female ownership, but the average percentage of ownership by female owners is only 12%. Also, 15% of top managers are female, and firms whose female workers are over 50% make up 27% of the total sample.

Finally, the descriptive statistics of the instrumental variable and other control variables are shown in Panel C of Table 4. Only 6% of the sample firms operate in a nation in which the number of genders in the dominant language is two. Among the total sample firms, 16% have at least 100 employees, whereas 26% are less than nine years old. Most firms (89%) are corporations but only a few firms have more than one establishment (9%), while about one third of the sample firms have over 80% of capacity utilization (32%) and the average percentage of external financing is 23%. The mean values of state, domestic, and foreign ownerships are 1%, 91%, and 5%, respectively, indicating that most firms are owned by domestic shareholders. The average number of competitors (log transformed) is 2.36- and

most firms (82%) sell products to domestic customers. The experience of top managers in the same sector is over 10 years for about two thirds of the firms (67%), while 43% of the firms have full-time employees who are educated for more than 12 years on average.

### *4.2. Correlation Matrix*

Table 5 shows the Pearson correlation between the variables in the second stage, except for industry and country dummies. Innovation measures (*Innovation_1* ~ *Innovation_6*, as well as *Innovation_Aggregate*) are significantly and positively correlated with each other at the 1% level. For example, the correlation coefficient on variable *Innovation_1* and *Innovation_2* is 0.79 while that between *Innovation_1* and *Innovation_3* is 0.51.

Also, all three test variables (gender-related variables) are highly correlated. The Pearson correlation coefficients between *Female_Ownership%* and *Female_Topmanager*, *Female_Ownership%* and *Female_Worker_High*, and *Female_Topmanager* and *Female_Worker_High* are 0.52, 0.19, and 0.22, respectively, all significant at the 1% level. Of these, *Female_Ownership%* is highly and positively correlated with *Innovation_1* (0.04) and *Innovation_2* (0.03), while *Female_Topmanager* has a positive correlation with *Innovation_5* (0.03) but a negative correlation with *Innovation_6* (−0.03). *Female_Worker_High* is not correlated with any innovation measures.

Most control variables are correlated with the innovation measures. *Size_Large*, *Corporation*, *Multiple_Establishments*, *Extermal_Financing*, *Foreign_Ownership*, *Experience_High*, *and Education_High* are positively correlated with the innovation measures, whereas *Age_Young*, *Capacity_High*, *Domestic_Ownership*, *Log_No_Competitors* have negative correlations with the innovation measures.

### *4.3. Main Test Results*

Table 6 presents the results of the first stage probit regression, where the dependent variable is *Female_Ownership*, *Female_Topmanager*, and *Female_Worker_High* in Columns (1), (2), and (3), respectively. The instrumental variable NG_2 is significantly related to all three dependent variables in the negative direction. The coefficients on *Female_Ownership*, *Female_Topmanager* and *Female_Worker_High* are −0.19, −2.26, and −1.19, all significant at the 5% level or better, which is consistent with the results from Jha and Sarangi [27].

**Table 5.** Pearson correlation matrix (N = 6467).

| No. | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | *Innovation_1* | 1.00 | | | | | | | |
| 2. | *nnovation_2* | 0.79 *** | 1.00 | | | | | | |
| 3. | *Innovation_3* | 0.51 *** | 0.46 *** | 1.00 | | | | | |
| 4. | *Innovation_4* | 0.37 *** | 0.35 *** | 0.50 *** | 1.00 | | | | |
| 5. | *Innovation_5* | 0.37 *** | 0.34 *** | 0.43 *** | 0.58 *** | 1.00 | | | |
| 6. | *Innovation_6* | 0.34 *** | 0.31 *** | 0.34 *** | 0.36 *** | 0.34 *** | 1.00 | | |
| 7. | *Innovation_Aggregate* | 0.79 *** | 0.76 *** | 0.75 *** | 0.73 *** | 0.71 *** | 0.60 *** | 1.00 | |
| 8. | *Female_Ownership%* | 0.04 *** | 0.03 ** | 0.01 | 0.01 | 0.01 | −0.01 | 0.02 * | 1.00 |
| 9. | *Female_Topmanager* | 0.01 | 0.01 | 0.00 | 0.00 | 0.03 ** | −0.03 ** | 0.01 | 0.52 *** |
| 10. | *Female_Worker_High* | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 | −0.02 | 0.00 | 0.19 *** |
| 11. | *Size_Large* | 0.08 *** | 0.08 *** | 0.08 *** | 0.11 *** | 0.09 *** | 0.12 *** | 0.13 *** | −0.07 *** |
| 12. | *Age_Young* | −0.05 ** | −0.02 * | −0.03 *** | −0.03 *** | −0.02 * | −0.04 *** | −0.05 *** | −0.01 |
| 13. | *Corporation* | 0.04 *** | 0.03 ** | 0.04 *** | 0.05 *** | 0.04 *** | 0.06 *** | 0.06 *** | −0.07 *** |
| 14. | *Multiple_Establishments* | 0.02 | 0.04 *** | 0.04 *** | 0.09 *** | 0.06 *** | 0.06 *** | 0.07 *** | −0.05 *** |
| 15. | *Capacity_High* | −0.03 ** | −0.03 ** | 0.00 | −0.01 | −0.02 * | −0.02 * | −0.03 ** | −0.02 |
| 16. | *External_Financing* | 0.08 *** | 0.06 *** | 0.09 *** | 0.10 *** | 0.10 *** | 0.09 *** | 0.12 *** | 0.01 |
| 17. | *State_Ownership* | 0.01 | 0.02 * | 0.01 | 0.02 * | 0.03 ** | 0.02 | 0.02 ** | −0.02 ** |
| 18. | *Domestic_Ownership* | −0.08 *** | −0.06 *** | −0.06 *** | −0.06 *** | −0.06 *** | −0.08 *** | −0.09 *** | 0.05 *** |
| 19. | *Foreign_Ownership* | 0.08 *** | 0.05 *** | 0.05 *** | 0.06 *** | 0.05 *** | 0.06 *** | 0.08 *** | −0.04 *** |
| 20. | *Log_No_Competitors* | −0.08 *** | −0.06 *** | −0.05 *** | −0.05 *** | −0.02 | −0.07 *** | −0.07 *** | −0.01 |
| 21. | *Domestic_Sales* | −0.02 | −0.02 | −0.03 ** | −0.06 *** | −0.02 | −0.10 *** | −0.05 *** | −0.02 * |
| 22. | *Experience_High* | 0.05 *** | 0.06 *** | 0.03 *** | 0.05 *** | 0.02 * | 0.05 *** | 0.06 *** | 0.01 |
| 23. | *Education_High* | 0.14 *** | 0.09 *** | 0.11 *** | 0.09 *** | 0.08 *** | 0.07 *** | 0.14 *** | 0.02 * |

| No. | Variable | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | *Innovation_1* | | | | | | | | |
| 2. | *nnovation_2* | | | | | | | | |
| 3. | *Innovation_3* | | | | | | | | |
| 4. | *Innovation_4* | | | | | | | | |
| 5. | *Innovation_5* | | | | | | | | |
| 6. | *Innovation_6* | | | | | | | | |
| 7. | *Innovation_Aggregate* | | | | | | | | |
| 8. | *Female_Ownership%* | | | | | | | | |
| 9. | *Female_Topmanager* | 1.00 | | | | | | | |
| 10. | *Female_Worker_High* | 0.22 *** | 1.00 | | | | | | |
| 11. | *Size_Large* | −0.08 *** | 0.02 * | 1.00 | | | | | |
| 12. | *Age_Young* | 0.01 | −0.03 ** | −0.12 *** | 1.00 | | | | |

**Table 5.** *Cont.*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13. | *Corporation* | −0.03 *** | −0.04 *** | 0.11 *** | 0.02 | 1.00 | | | |
| 14. | *Multiple_Establishments* | −0.03 ** | −0.03 ** | 0.16 *** | −0.01 | 0.05 *** | 1.00 | | |
| 15. | *Capacity_High* | 0.00 | 0.03 ** | 0.05 *** | −0.04 *** | −0.01 | 0.05 *** | 1.00 | |
| 16. | *External_Financing* | −0.02 | 0.00 | 0.06 *** | −0.02 * | 0.01 | −0.02 | 0.00 | 1.00 |
| 17. | *State_Ownership* | 0.00 | 0.01 | 0.13 *** | −0.04 *** | 0.01 | 0.02 | 0.03 ** | 0.04 *** |
| 18. | *Domestic_Ownership* | 0.00 | −0.03 ** | −0.17 *** | 0.01 | −0.06 *** | −0.12 *** | −0.02 | −0.03 ** |
| 19. | *Foreign_Ownership* | 0.00 | 0.02 * | 0.14 *** | 0.00 | 0.06 *** | 0.14 *** | 0.01 | 0.01 |
| 20. | *Log_No_Competitors* | 0.00 | −0.01 | −0.10 *** | 0.06 *** | −0.05 *** | −0.04 *** | −0.06 *** | −0.01 |
| 21. | *Domestic_Sales* | 0.03 ** | −0.04 *** | −0.18 *** | 0.04 *** | −0.04 *** | −0.11 *** | −0.05 *** | −0.09 *** |
| 22. | *Experience_High* | −0.06 *** | 0.02 | 0.01 | −0.32 *** | −0.02 | 0.01 | 0.02 | 0.02 |
| 23. | *Education_High* | 0.02 * | 0.03 *** | 0.00 | −0.02 | 0.04 *** | −0.02 * | 0.07 *** | 0.01 |

| **No.** | **Variable** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | *Innovation_1* | | | | | | | | |
| 2. | *nnovation_2* | | | | | | | | |
| 3. | *Innovation_3* | | | | | | | | |
| 4. | *Innovation_4* | | | | | | | | |
| 5. | *Innovation_5* | | | | | | | | |
| 6. | *Innovation_6* | | | | | | | | |
| 7. | *Innovation_Aggregate* | | | | | | | | |
| 8. | *Female_Ownership%* | | | | | | | | |
| 9. | *Female_Topmanager* | | | | | | | | |
| 10. | *Female_Worker_High* | | | | | | | | |
| 11. | *Size_Large* | | | | | | | | |
| 12. | *Age_Young* | | | | | | | | |
| 13. | *Corporation* | | | | | | | | |
| 14. | *Multiple_Establishments* | | | | | | | | |
| 15. | *Capacity_High* | | | | | | | | |
| 16. | *External_Financing* | | | | | | | | |
| 17. | *State_Ownership* | 1.00 | | | | | | | |
| 18. | *Domestic_Ownership* | −0.30 *** | 1.00 | | | | | | |
| 19. | *Foreign_Ownership* | −0.02 * | −0.75 *** | 1.00 | | | | | |
| 20. | *Competition_High* | −0.03 ** | 0.13 *** | −0.13 *** | 1.00 | | | | |
| 21. | *Domestic_Sales* | 0.01 | 0.19 *** | −0.18 *** | 0.14 *** | 1.00 | | | |
| 22. | *Experience_High* | −0.02 * | 0.05 *** | −0.04 *** | −0.02 | −0.05 *** | 1.00 | | |
| 23. | *Education_High* | 0.02 * | 0.01 | 0.01 | −0.09 *** | 0.10 *** | −0.01 | 1.00 | |

Note: *, **, and *** indicate the significance based on *p*-value of less than the 10 percent level, 5 percent level, and 1 percent level (two-tailed), respectively. For variable definition, refer to Table 3.

**Table 6.** First Stage Probit Regression Results (Total Observations = 6474).

| **Dependent Variable** | **(1)** ***Female_Ownership*** | | **(2)** ***Female_Topmanager*** | | **(3)** ***Female_Worker_High*** | |
|---|---|---|---|---|---|---|
| | $\beta$ | **(SE)** | $\beta$ | **(SE)** | $\beta$ | **(SE)** |
| ***NG_2*** | **−0.19** | **(0.09) **** | **−2.26** | **(0.12) ***** | **−1.19** | **(0.13) ***** |
| *Size_Large* | 0.00 | (0.05) | −0.36 | (0.06) *** | 0.04 | (0.09) |
| *Age_Young* | −0.12 | (0.03) *** | −0.01 | (0.05) | 0.00 | (0.07) |
| *Corporation* | 0.18 | (0.05) *** | −0.08 | (0.07) | −0.10 | (0.06) |
| *Multiple_Establishments* | 0.02 | (0.05) | −0.02 | (0.09) | −0.15 | (0.07) ** |
| *Capacity_High* | −0.13 | (0.04) *** | −0.03 | (0.04) | 0.07 | (0.04) * |
| *External_Financing* | 0.06 | (0.05) | −0.06 | (0.07) | 0.01 | (0.06) |
| *State_Ownership* | −0.01 | (0.26) | 0.20 | (0.22) | 0.02 | (0.28) |
| *Domestic_Ownership* | −0.01 | (0.12) | −0.04 | (0.15) | −0.05 | (0.15) |
| *Foreign_Ownership* | −0.36 | (0.14) *** | −0.04 | (0.16) | −0.01 | (0.18) |
| *Log_No_Competitors* | −0.00 | (0.02) | 0.00 | (0.01) | 0.00 | (0.01) |
| *Domestic_Sales* | −0.08 | (0.07) | 0.08 | (0.15) | −0.25 | (0.09) *** |
| *Experience_ High* | −0.02 | (0.03) | −0.22 | (0.05) *** | 0.09 | (0.04) ** |
| *Education_ High* | 0.06 | (0.02) *** | −0.01 | (0.04) | 0.02 | (0.07) |
| *Industry_ Dummy* | Yes | | Yes | | Yes | |
| *Country_ Dummy* | Yes | | Yes | | Yes | |
| **Pseudo $R^2$** | 0.0902 | | 0.1512 | | 0.3138 | |

Note: *, **, and *** indicate the significance based on *p*-value of less than the 10% level, 5% level, and 1% level (two-tailed), respectively. In each column, $\beta$ and (SE) represent the coefficients and the robust standard errors, respectively. For variable definition, refer to Table 3.

The results of the second stage regression model (2-1), when the test variable was *Female_Ownership%*, *Female_Topmanager*, and *Female_Worker_High*, are reported in panels (A), (B), and (C) of Table 7, respectively. Each panel reports the results based on *Innovation_1–Innovation 6* in separate columns. From Panel A of Table 7, the percentage of female ownership is found to have a positive impact on innovative activities. With the exception of *Innovation_3*, they are all significant at the 5% level or better. In contrast, female top manager is positively associated with only marketing innovation (*Innovation_5*) from the results of Panel B of Table 7. Furthermore, a high portion of female workers has just a marginally negative impact on process innovation (*Innovation_3*), based on the results of Panel C of Table 7. For control variables, while the results are not identical across the test variables and innovation measures, *Size_Large*, *Multiple_Establishments*, *External_Financing*, *Experience_High*, and *Education_High* are usually positively associated with innovation activities, while *Capacity_High*, *Domestic_Ownership*, and *Log_No_Competitors* are in general negatively associated with innovation activities.

**Table 7.** Second Stage Logit Regression Results (Total Observations = 6474).

| **Panel A: Test Variable = Female_Ownership%.** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dependent Variable** | ***Innovation_1*** | | ***Innovation_2*** | | ***Innovation_3*** | | ***Innovation_4*** | | ***Innovation_5*** | | ***Innovation_6*** | |
| | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** |
| ***Female_Ownership%*** | **0.47** | **(0.11) ***** | **0.37** | **(0.13) ***** | **0.16** | **(0.13)** | **0.25** | **(0.13) **** | **0.25** | **(0.12) **** | **0.33** | **(0.12) ***** |
| *Size_Large* | 0.48 | (0.05) *** | 0.48 | (0.07) *** | 0.48 | (0.06) *** | 0.60 | (0.08) *** | 0.51 | (0.09) *** | 0.65 | (0.07) *** |
| *Age_Young* | −0.07 | (0.24) | 0.13 | (0.26) | −0.24 | (0.19) | −0.31 | (0.22) | 0.04 | (0.28) | 0.20 | (0.31) |
| *Corporation* | 0.04 | (0.33) | −0.07 | (0.39) | 0.25 | (0.33) | 0.50 | (0.36) | −0.03 | (0.43) | −0.20 | (0.54) |
| *Multiple_Establishments* | 0.17 | (0.10) * | 0.28 | (0.09) *** | 0.39 | (0.09) *** | 0.73 | (0.11) *** | 0.50 | (0.07) *** | 0.26 | (0.10) *** |
| *Capacity_High* | −0.15 | (0.26) | −0.08 | (0.30) | −0.16 | (0.23) | −0.31 | (0.26) | −0.04 | (0.33) | 0.11 | (0.39) |
| *External_Financing* | 0.52 | (0.17) *** | 0.39 | (0.20) * | 0.74 | (0.20) *** | 0.83 | (0.13) *** | 0.65 | (0.21) *** | 0.41 | (0.25) |
| *State_Ownership* | −0.37 | (0.38) | −0.19 | (0.37) | −0.74 | (0.37) ** | −0.15 | (0.40) | −0.14 | (0.33) | 0.02 | (0.58) |
| *Domestic_Ownership* | −0.45 | (0.19) ** | −0.45 | (0.20) ** | −0.43 | (0.16) *** | −0.33 | (0.19) * | −0.36 | (0.22) | −0.67 | (0.29) ** |
| *Foreign_Ownership* | 0.06 | (0.66) | 0.10 | (0.76) | −0.66 | (0.67) | −0.79 | (0.50) | 0.24 | (0.81) | 0.64 | (0.94) |
| *Log_No_Competitors* | −0.05 | (0.02) *** | −0.04 | (0.02) ** | −0.02 | (0.01) | −0.01 | (0.03) | 0.02 | (0.03) | −0.04 | (0.01) *** |
| *Domestic_Sales* | −0.08 | (0.25) | −0.04 | (0.24) | −0.48 | (0.16) *** | −0.59 | (0.19) *** | −0.16 | (0.23) | −0.27 | (0.27) |
| *Experience_ High* | 0.26 | (0.07) *** | 0.35 | (0.07) *** | 0.16 | (0.08) ** | 0.20 | (0.10) ** | 0.13 | (0.08) | 0.24 | (0.12) ** |
| *Education_ High* | 0.45 | (0.15) *** | 0.28 | (0.16) * | 0.44 | (0.17) *** | 0.40 | (0.15) *** | 0.22 | (0.19) | 0.34 | (0.23) |
| *IMR* | −0.42 | (2.56) | −1.32 | (2.82) | 1.49 | (2.22) | 2.55 | (2.44) | −1.39 | (3.25) | −3.95 | (3.63) |
| *Industry_ Dummy* | Included | | Included | | Included | | Included | | Included | | Included | |
| *Country_ Dummy* | Included | | Included | | Included | | Included | | Included | | Included | |
| **Pseudo $R^2$** | 0.1738 | | 0.1260 | | 0.1725 | | 0.1648 | | 0.1484 | | 0.1726 | |
| **Panel B: Test Variable = Female_Topmanager.** | | | | | | | | | | | | |
| **Dependent Variable** | ***Innovation_1*** | | ***Innovation_2*** | | ***Innovation_3*** | | ***Innovation_4*** | | ***Innovation_5*** | | ***Innovation_6*** | |
| | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** |
| ***Female_Topmanager*** | **0.04** | **(0.12)** | **0.04** | **(0.13)** | **−0.07** | **(0.07)** | **0.03** | **(0.07)** | **0.13** | **(0.06) **** | **−0.13** | **(0.13)** |
| *Size_Large* | −0.76 | (0.54) | −1.07 | (0.61) * | 0.00 | (0.42) | −0.28 | (0.49) | 0.28 | (0.57) | 0.84 | (0.76) |
| *Age_Young* | −0.12 | (0.06) * | 0.00 | (0.07) | −0.12 | (0.09) | −0.10 | (0.10) | −0.08 | (0.07) | −0.15 | (0.08) * |
| *Corporation* | −0.16 | (0.14) | −0.22 | (0.15) | −0.05 | (0.15) | −0.02 | (0.13) | 0.10 | (0.15) | 0.36 | (0.34) |
| *Multiple_Establishments* | 0.11 | (0.10) | 0.22 | (0.09) ** | 0.34 | (0.07) *** | 0.65 | (0.11) *** | 0.50 | (0.07) *** | 0.32 | (0.11) *** |
| *Capacity_High* | −0.30 | (0.07) *** | −0.34 | (0.09) *** | −0.06 | (0.10) | −0.15 | (0.07) ** | −0.19 | (0.09) ** | −0.24 | (0.13) * |
| *External_Financing* | 0.33 | (0.14) ** | 0.19 | (0.17) | 0.59 | (0.14) *** | 0.57 | (0.11) *** | 0.67 | (0.16) *** | 0.61 | (0.19) *** |
| *State_Ownership* | 0.30 | (0.46) | 0.66 | (0.40) * | −0.48 | (0.34) | 0.33 | (0.42) | −0.04 | (0.35) | −0.11 | (0.52) |
| *Domestic_Ownership* | −0.55 | (0.22) ** | −0.59 | (0.24) ** | −0.46 | (0.17) *** | −0.38 | (0.21) * | −0.38 | (0.26) | −0.67 | (0.33) ** |
| *Foreign_Ownership* | −0.16 | (0.23) | −0.37 | (0.23) * | −0.32 | (0.23) | −0.21 | (0.31) | −0.14 | (0.32) | −0.37 | (0.31) |
| *Log_No_Competitors* | −0.07 | (0.02) *** | −0.06 | (0.03) ** | −0.02 | (0.02) | −0.02 | (0.03) | 0.01 | (0.03) | −0.04 | (0.02) ** |
| *Domestic_Sales* | 0.18 | (0.15) | 0.24 | (0.19) | −0.29 | (0.15) * | −0.25 | (0.16) | −0.19 | (0.18) | −0.54 | (0.23) ** |
| *Experience_ High* | −0.49 | (0.33) | −0.61 | (0.36) * | −0.10 | (0.24) | −0.28 | (0.31) | −0.02 | (0.37) | 0.30 | (0.48) |
| *Education_ High* | 0.45 | (0.05) *** | 0.32 | (0.06) *** | 0.36 | (0.10) *** | 0.26 | (0.08) *** | 0.29 | (0.08) *** | 0.53 | (0.14) *** |
| *IMR* | 4.18 | (1.80) ** | 5.28 | (2.05) ** | 1.61 | (1.37) | 2.97 | (1.55) * | 0.75 | (1.99) | −0.74 | (2.53) |
| *Industry_ Dummy* | Included | | Included | | Included | | Included | | Included | | Included | |
| *Country_ Dummy* | Included | | Included | | Included | | Included | | Included | | Included | |
| **Pseudo $R^2$** | 0.1716 | | 0.1255 | | 0.1724 | | 0.1643 | | 0.1480 | | 0.1717 | |

**Table 7.** *Cont.*

| Panel C: Test Variable = Female_Worker_High | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dependent Variable** | ***Innovation_1*** | | ***Innovation_2*** | | ***Innovation_3*** | | ***Innovation_4*** | | ***Innovation_5*** | | ***Innovation_6*** | |
| | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** |
| ***Female_Worker_High*** | **0.01** | **(0.07)** | **−0.07** | **(0.07)** | **−0.15** | **(0.08) *** | **−0.03** | **(0.08)** | **−0.02** | **(0.07)** | **0.05** | **(0.12)** |
| *Size_Large* | 0.48 | (0.06) *** | 0.49 | (0.07) *** | 0.52 | (0.06) *** | 0.62 | (0.08) *** | 0.53 | (0.08) *** | 0.65 | (0.08) *** |
| *Age_Young* | −0.10 | (0.06) | 0.02 | (0.07) | −0.11 | (0.09) | −0.08 | (0.10) | −0.07 | (0.07) | −0.15 | (0.08) * |
| *Corporation* | 0.03 | (0.13) | 0.05 | (0.13) | −0.03 | (0.13) | 0.09 | (0.11) | 0.07 | (0.09) | 0.28 | (0.27) |
| *Multiple_Establishments* | 0.08 | (0.17) | 0.22 | (0.17) | 0.24 | (0.14) * | 0.58 | (0.13) *** | 0.40 | (0.11) *** | 0.26 | (0.21) |
| *Capacity_High* | −0.16 | (0.07) ** | −0.18 | (0.10) * | 0.03 | (0.09) | −0.03 | (0.07) | −0.12 | (0.06) * | −0.24 | (0.14) * |
| *External_Financing* | 0.54 | (0.13) *** | 0.45 | (0.17) *** | 0.68 | (0.15) *** | 0.72 | (0.11) *** | 0.71 | (0.14) *** | 0.58 | (0.19) *** |
| *State_Ownership* | −0.36 | (0.39) | −0.18 | (0.38) | −0.71 | (0.37) * | −0.13 | (0.40) | −0.13 | (0.34) | 0.01 | (0.57) |
| *Domestic_Ownership* | −0.45 | (0.20) ** | −0.46 | (0.23) ** | −0.44 | (0.16) *** | −0.32 | (0.20) * | −0.38 | (0.22) * | −0.70 | (0.31) ** |
| *Foreign_Ownership* | −0.06 | (0.21) | −0.25 | (0.21) | −0.28 | (0.22) | −0.14 | (0.29) | −0.13 | (0.30) | −0.38 | (0.28) |
| *Log_No_Competitors* | −0.05 | (0.02) *** | −0.04 | (0.02) * | −0.02 | (0.01) | −0.01 | (0.03) | 0.02 | (0.03) | −0.04 | (0.01) *** |
| *Domestic_Sales* | −0.22 | (0.37) | −0.22 | (0.39) | −0.60 | (0.25) ** | −0.62 | (0.22) *** | −0.42 | (0.18) ** | −0.58 | (0.32) * |
| *Experience_ High* | 0.30 | (0.10) *** | 0.36 | (0.10) *** | 0.26 | (0.09) *** | 0.30 | (0.10) *** | 0.17 | (0.07) ** | 0.20 | (0.09) ** |
| *Education_ High* | 0.49 | (0.07) *** | 0.36 | (0.07) *** | 0.39 | (0.10) *** | 0.30 | (0.07) *** | 0.31 | (0.08) *** | 0.53 | (0.14) *** |
| *IMR* | 0.74 | (1.31) | 0.61 | (1.31) | 1.11 | (0.85) | 0.97 | (0.59) | 1.06 | (0.56) * | 0.51 | (1.36) |
| *Industry_ Dummy* | Included | | Included | | Included | | Included | | Included | | Included | |
| *Country_ Dummy* | Included | | Included | | Included | | Included | | Included | | Included | |
| **Pseudo $R^2$** | 0.1709 | | 0.1244 | | 0.1731 | | 0.1641 | | 0.1478 | | 0.1715 | |

Note: *, **, and *** indicate the significance based on *p*-value of less than the 10% level, 5% level, and 1% level (two-tailed), respectively. In each column, ***β*** and (SE) represent the coefficients and the robust standard errors, respectively. For variable definition, refer to Table 3.

Table 8 provides the results of Equation (2-2), the effects of gender on the overall innovative activities of firms, based on the dependent variable *Innovation_Aggregate*. The results when the test variable is *Female_Ownership%*, *Female_Topmanager*, and *Female_Worker_High* are reported in columns (1), (2), and (3) of Table 8, respectively. Of the three test variables, *Female_Ownership%* is positively associated with *Innovation_aggregate* at the 1% level, with a coefficient estimate of 0.38. When we use the presence of female shareholder(s) (i.e., *Female_Ownership*) as the test variable instead *Female_Ownership%* in (2-1) or (2-2), the results remain qualitatively the same. On the other hand, neither *Female_Topmanager* nor *Female_Worker_High* are significantly related to *Innovation_aggregate*. The coefficient estimates on the control variables across the three test variables are mostly similar to those in Ayyagari et al. [17]. The dependent variable *Innovation_aggregate* is significantly positively related to *Multiple_Establishments*, *External_Financing*, and *Education_High* across the three test variables. For example, the coefficient estimates on those variables when the test variable is *Female_Ownership%* (*Female_Topmanager* and *Female_Worker_High*) are 0.45 (0.41 and 0.33), 0.65 (0.53 and 0.69), and 0.38 (0.41 and 0.45), respectively, all significant at the 5% level or better. On the other hand, the estimates on *Domestic_Ownership* are all negative and significant at the 1% level. For example, the coefficient estimates on *Domestic_Ownership* when the test variable is *Female_Ownership%* (*Female_Topmanager* and *Female_Worker_High*) is −0.56 (−0.64 and −0.58). The variance inflation factor (VIF) is less than 3 in all regressions, indicating that a multicollinearity problem is remote.

**Table 8.** Second Stage Ordered Logit Regression Results (Total Observations = 6474).

| **Dependent Variable** | ***Innovation_Aggregate*** | | | | | |
|---|---|---|---|---|---|---|
| **Test Variable** | **(1) *Female_Ownership%*** | | **(2) *Female_Topmanager*** | | **(3) *Female_Worker_High*** | |
| | ***β*** | **(SE)** | ***β*** | **(SE)** | ***β*** | **(SE)** |
| ***Female_Ownership%*** | **0.38** | **(0.09) *** ** | | | | |
| ***Female_Topmanager*** | | | **0.03** | **(0.09)** | | |
| ***Female_Worker_High*** | | | | | **−0.04** | **0.07** |
| *Size_Large* | 0.60 | (0.05) *** | −0.32 | (0.49) | 0.62 | 0.06 *** |
| *Age_Young* | −0.05 | (0.17) | −0.13 | (0.06) ** | −0.11 | 0.06 * |
| *Corporation* | 0.02 | (0.26) | −0.05 | (0.15) | 0.05 | 0.12 |
| *Multiple_Establishments* | 0.45 | (0.08) *** | 0.41 | (0.08) *** | 0.33 | 0.13 ** |
| *Capacity_High* | −0.06 | (0.22) | −0.23 | (0.06) *** | −0.10 | 0.08 |
| *External_Financing* | 0.65 | (0.18) *** | 0.53 | (0.16) *** | 0.69 | 0.15 *** |
| *State_Ownership* | −0.41 | (0.35) | 0.09 | (0.35) | −0.39 | 0.35 |
| *Domestic_Ownership* | −0.56 | (0.16) *** | −0.64 | (0.19) *** | −0.58 | 0.18 *** |
| *Foreign_Ownership* | −0.02 | (0.48) | −0.32 | (0.23) | −0.25 | 0.22 |
| *Log_No_Competitors* | −0.03 | (0.02) | −0.04 | (0.02) * | −0.03 | 0.02 |
| *Domestic_Sales* | −0.24 | (0.17) | −0.08 | (0.12) | −0.49 | 0.28 * |
| *Experience_ High* | 0.23 | (0.06) *** | −0.33 | (0.31) | 0.28 | 0.07 *** |
| *Education_ High* | 0.38 | (0.13) *** | 0.41 | (0.07) *** | 0.45 | 0.07 *** |
| *IMR* | −0.85 | (1.90) | 3.10 | (1.62) * | 1.13 | 0.96 |
| *Industry_ Dummy* | Yes | | Yes | | Yes | |
| *Country_ Dummy* | Yes | | Yes | | Yes | |
| **Pseudo $R^2$** | 0.1888 | | 0.1874 | | 0.1872 | |

Note: *, **, and *** indicate the significance based on *p*-value of less than the 10 percent level, 5 percent level and 1 percent level (two-tailed), respectively. In each column, ***β*** and (SE) represent the coefficients and the robust standard errors, respectively. For variable definition, refer to Table 3.

## 5. Discussion

This study stems from the premise that firm innovation is necessary for economic growth in emerging countries. In particular, we have focused on the role of gender diversity in promoting a firm's innovation. Using data from the BEEPS 2013 provided by the World Bank, we apply the Heckman two-stage model to measure the effect of female shareholder percentage, female CEOs, and a female majority of employees on overall firm innovation. The innovation activities of a firm are estimated by six individual innovation measures (two products-related innovations, process

innovation, organizational innovation, marketing innovation, and R&D investments), as well as the composite measure of these six innovation estimations.

The results suggest that female ownership percentage positively affects individual innovation measures, with the exception of process innovation, as well as the composite measure of innovation. This result seems to reflect the results that are found in previous research, which studies firms in developed economies [26,39–41]. Although some papers generally focus on female representation on the board of directors, the results could be comparable given that both ownership and the board of directors are the top representatives of a firm. Furthermore, this result suggests that it is important to structurally establish a governance structure for women's equity in corporate ownership and to make a voice in the board of directors for the innovation performance of the enterprise in emerging countries [81].

Meanwhile, female top managers has a positive effect on marketing innovation only. Although this is slightly different from our study of whether or not a woman is a top manager, this is in contrast to the study of the gender diversity of top management teams by Ruiz-Jiménez, Del Mar Fuentes-Fuentes, and Ruiz-Arroyo [42], and Ruiz-Jiménez and Del Mar Fuentes-Fuentes [43]. This result could be explained by the risk-taking propensity of female CEOs. Mueller [48] claims that there is a large gap in the risk-taking propensity of men and women, even in emerging countries. Other papers that look at differences in risk-taking propensity, while focusing on developed economies and usually focusing on firm performances, all seem to agree that female CEOs tend to avoid risky investments or activities [70–74]. Given that emerging markets are generally situated in more conservative and traditional cultures, the already risk-averse female CEOs would be especially careful not to take unnecessary risks—including innovation. The positive effect on marketing innovation might be that, unlike product or technological innovation, marketing could be considered less risky, since it does not require large-scale investments such as additional infrastructure. Risk averseness can also lead to stricter standards for defining innovation. Given that the data is from a survey performed on top managers, the stricter standards held by female top managers may have driven the lack of statistical significance between female top manager and innovative activities, as mentioned in Luksyte, Unsworth, and Avery [49].

Finally, a high proportion of female workers does not seem to have a significant association with innovation. This claim agrees with some of the results from the past literature. Kushnirovich and Heilbrunn [50], who use a survey from Israel, find that culture, rather than gender, has a significant impact on innovation. However, it is contrary to results of Østergaard et al. [25], Horbach and Jacob [45], Nielsen, Bloch, and Schiebinger [46], and Dai, Byun, and Ding [47]. These studies find that gender diversity improves innovation. However, given that they use firm data from developed countries, it is possible that the culture in these developed countries is what drives the innovativeness, rather than the gender diversity itself. This result also highlights the social situation in emerging countries, where the kind of work given to women is not creative but merely task-oriented, and the granting authority for women to work creatively in corporate organizations is insufficient [52].

## 6. Conclusions

This study has important results for the role of female participants on a firm's innovation in emerging countries, and provides several implications for both policymakers and firm management. First, given that female ownership is positively related to innovation in general, emerging countries should promote further market participation by women to increase female ownership. Second, emerging countries should support the innovation management of female top managers at a national level. Female top managers have more risk-averse tendencies than male top managers, especially in the conservative and traditional cultures that are prevalent in these countries. However, the sensitive nature of corruption and the ability of female top managers to objectively view business situations without overconfidence can lead to better innovation performance than male top managers. With appropriate political support, female top managers could shake off cultural shackles and

positively contribute to their firm's innovation in emerging countries. Lastly, the firms should set up innovation-related training programs for female workers and expand their work opportunities. Innovation begins by looking for exploratory or exploitative solutions from routines. However, the status of women in emerging countries is often lower than that of men, forcing women to become passive. Innovation requires an active and progressive attitude, so firms should strive to break this cultural barrier for improved innovation performance.

Of course, it is difficult to make practical changes in a company, especially in small medium enterprise (SME), because of the resistance to existing routines [82]. However, there is a need for voluntary awareness and a systemic effort from firms for female ownership, leadership, and employment [83]. To achieve this goal, companies should internally consider motivation, method, and education for innovation through the expansion of female roles. In addition, in order to create an organizational culture that focuses on this change, it is necessary to think about appropriate leadership and employee participation in the process of change [71,72]. Furthermore, cultural consensus and social policies should accompany these changes to actively support female participation in the enterprise [83].

There are several caveats to this paper. The target countries of this study are limited to emerging countries in Eastern Europe and Central Asia. It is possible that, due to cultural differences, other emerging markets could provide different results. We also focus only on manufacturing firms, which could limit the applicability of the results to other industries like finance, telecommunications, or hotels. For example, process innovation could have been unaffected by female ownership because processes in manufacturing companies generally require large investments in new infrastructure, which would be difficult regardless of ownership proportions. This might not be the case for financial industries, where the processes for creating products or services do not necessarily require large infrastructural updates. Future research should focus on addressing these limitations.

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