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Corruption and types of innovation: evidence from post-Soviet countries

Master's thesis

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Name and signature of supervisor…….

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Abstract

In the view of a missing consensus on how corruption relates to firm innovation, this paper empirically studies the relationship between petty corruption and product, process, marketing and organizational innovations in post-Soviet region. Exploiting cross-sectional firm-level data from the fifth round of Business Environment and Enterprise Performance Survey (BEEPS V), the paper finds that bribery increases the probability of introducing all four innovation types in the overall post-Soviet region. Considering variations in institutional development levels, the paper distinguishes three clusters of countries within the region respect to the quality of institutional structures based on Worldwide Governance Indicators (WGI) data of World Bank. Results reveal that bribery "greases the wheels" of only organizational innovation in the countries with strong institutional environment. The paper suggests that while the quality of institutions are good enough to prevent using bribery as a tool to foster product, process and marketing innovations, there is still room for improving institutions concerning organizational innovation. In the countries with moderate institutions, the correlation between bribery and product innovation is positive and statistically significant. Institutions concerning product innovations ought to be strengthened in this country cluster. Similar to the overall post-Soviet region, bribery encourages all four innovation types in the countries with weak institutional structures. So, fight against corruption needs to be braced and institutions should be improved to adhere global standards in order to halt corruption's positive link to firm innovation.

Keywords: *corruption, bribery, firm innovation, product innovation, process innovation, marketing innovation, organizational innovation, institutions, post-Soviet region.*

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1. Introduction

Today's business world challenges a company's capacity to sustain competitive advantage more than ever due to constant technological advances, shorter lifecycle of products and technologies, and globalization of markets which increases the rate of rivalry (Dadfar et al., 2013). In such a globalized economic world, competition becomes more dynamic and innovation is seen as one of the key drivers of competitive advantage by small and medium sized enterprises (SMEs) which play an important role in the economy of every country at national level (Nie, 2007). In order to outperform others in the market and sustain competitive advantage, companies must take the advantage of latest technological innovations and continuously develop and improve products and processes (Hitt et al., 2001). Innovation also enables firms to effectively align resources with market opportunities and address customer needs more efficiently (Rujirawanich et al., 2011).

The environment in which a firm operates can affect its innovation capability and performance. Institutional factors constitute a subset of such influential environmental factors (Bayarçelik et al., 2014). For example, political and economic instability, lack of regulations on intellectual property (IP) rights, non-compliance with contracts are attributes of an environment with a weak institutional structure and may hinder innovation performance of firms (Volchek et al., 2013). Inefficient regulations may cause time-consuming exercises for SMEs and increase transaction costs of introducing innovation. A well-regulated business environment, on the contrary, results in economic development and prosperity. Efficient business regulations lead to less bureaucratic procedures and allow firms to operate more effectively by reducing transaction costs (Breen & Gillanders, 2012).

One of the indicators of poor institutional quality is corruption. Institutional structure can be weak because corrupt public officials may not be interested in designing good regulations in order to extract more bribes in future (Andvig & Moene, 1990). Likewise, public agents may not be interested in enforcing laws in order to have an opportunity of receiving bribes. For instance, regulators may be offered

bribes by a monopolist to prevent its competitors from entering the market by creating artificial obstacles (Breen & Gillanders, 2012).

So far, many studies have been devoted to analyzing corruption's impact on economic growth (d'Agostino et al., 2016; Del Monte & Papagni, 2001; Gyimah-Brempong, 2002; P. Mauro, 1995; Mo, 2001). However, only small attention has been given to its impact on firm innovation as an institutional manner. Moreover, conclusions of conducted studies are not uniform. In the literature, there exist two major conflicting views about the impact of corruption on innovation.

The first view is referred to as the "sand the wheel effect" of corruption on innovation and supports conventional wisdom which indicates a negative relationship between the two. According to this view, corruption is a deterrent for businesses as it creates additional expenses, leads to misallocation of resources, reduces investments in research and development (R&D) and innovation activities, and weakens trust (DiRienzo & Das, 2015; Lee et al., 2020; Mahagaonkar, 2010; P. Mauro, 1995; Waldemar, 2012). Second view, on the other hand, is known as the "grease the wheel" effect of corruption on innovation and suggests that petty corruption, bribery and/or other types of informal payments in small amounts may facilitate firm innovation by means of "getting things done". For example, bribery can help businesses to secure contracts, obtain licenses and permissions, remove small barriers to operate and so on (Krastanova, 2014; Nguyen et al., 2016; Taha, 2016; Vial & Hanoteau, 2010).

Hence, no common view about the impact of corruption on firm innovation has been established so far. Phenomena regarding understanding the underlying relationship is either studying countries particularly or conducting a cross-country study for a group of countries that have geographical, economical and/or historical ties, and hence making generalization.

Post-Soviet region is considered as one of the most corrupt regions in the world. Roots of corruption had deepened in the region over 70 years of Soviet regime. According to the Corruption Perception Index (CPI) of Transparency International, only Baltic states (Estonia, Latvia, Lithuania) and Georgia have good

rankings and are the least corrupt countries of the region. This can be reasoned by significantly different governance standards of Baltic states compared to the rest of the countries, and Georgia's more positive attitude towards integration to the European Union (EU) and Western world. While Belarus and Armenia are more corrupt, Kazakhstan, Moldova, Azerbaijan, Kyrgyzstan, Ukraine, Russia, Tajikistan and Uzbekistan are the most corrupt countries in the former communist region (Transparency International, 2019). Although governments take actions and introduce new regulations to cope with corruption, efficiency and results of such activities are different due to a high degree of heterogeneity in the former communist region (FSU). For example, while Azerbaijan falls behind Armenia and Georgia in CPI ranking (Transparency International, 2019), it scores better than the two in economic development and global competitiveness (Korganashvili et al., 2017). On the other hand, the easiest country to start and do a business among the three is Georgia followed by Azerbaijan, while Armenia scores the worst (World Bank Group, 2020).

Hence, studying the relationship between corruption and firm innovation in the FSU region is very interesting considering the legacy of a totalitarian past, strategically important geolocation and a high degree of heterogeneity in terms of labor force, natural resources, political atmosphere and institutional structures.

To the author's knowledge, however, the relationship between corruption and firm innovation has been overlooked in the FSU. Empirical studies have been conducted for wider sets of transition countries (i.e., Africa, Asia, Central and Eastern Europe) which induces a question about the extent to which the results can be generalized for the post-Soviet region. Therefore, this thesis aims to contribute to the literature by studying how bribery, defined as a form of corruption, relates to firm innovation in the post-Soviet states – Estonia, Latvia, Lithuania, Azerbaijan, Georgia, Armenia, Belarus, Moldova, Ukraine, Russia, Kazakhstan, Tajikistan, Kyrgyzstan and Uzbekistan. Turkmenistan is excluded from the scope of the FSU region, because there is no data available for this country in the used dataset. Even though various classifications of innovation exist, in this thesis, the author refers to "OSLO

Manual: Guidelines for collecting and interpreting innovation data" framework which distinguishes four types of innovation, namely product, process, marketing and organizational innovations.

Secondly, to the best of the author's knowledge, this is the first study for the region that systematically analyzes the link between bribery and all four types of innovation - product, process, marketing and organizational innovations. In this sense, this work also adds to the limited literature by covering marketing and organizational innovations besides product and process innovations.

The next chapter of the thesis reviews the relevant literature. It is followed by the "Data and Methodology" section, where the dataset used to conduct the research is described and methodology behind the econometric model is explained. Empirical analysis and results are described in Chapter 4. Eventually, Conclusion, References and Appendices are provided as separate sections.

2. Literature Review

2.1. Innovation, Firms and Economic Growth

Corruption and innovation play an important role in economic growth. Starting with innovation, it increases competition in the market which leads to higher productivity and better financial performance of firms and through them to a sustainable economic growth (Phillippe Aghion & Howitt, 1990; Grossman & Helpman, 1991; Hall et al., 2009; Pece et al., 2015; Romer, 1990).

2.2. Institutions and Corruption

2.2.1. Institutions

In the innovation-firm productivity-economic growth link, the role of institutions needs to be taken under consideration. Institutions are defined as "the formal and informal rules that organize social, political and economic relations". While formal institutions refer to the law, regulations and constitution imposed by the government, informal institutions refer to norms and values of the society (North, 1990). Studies

provide evidence to the important role of institutions in economic development and growth (Djankov et al., 2006; Gillanders & Whelan, 2010), innovation (Tebaldi & Elmslie, 2008) and higher productivity (Philippe Aghion et al., 2009; Barseghyan, 2008). Overall, while poor quality of institutions is seen as a deterrent for a firm's innovation performance (Volchek et al., 2013), an effectively regulated environment fosters innovation activities of businesses and improves the well-being of society. The latter positive effect is observed because the business environment becomes much more stable when laws are enforced constantly and effectively. In addition to that, if distributive, representative and accountability functions of institutions perform well, an efficient communication among government bodies, which design and implement the regulations, is assured. This, in turn, leads to a much more optimal business environment (Breen & Gillanders, 2012).

2.2.2. Corruption as an Institutional Problem

Corruption has several definitions. Commonly, it is referred to as "the misuse of resources or power for private gain which contravenes the rules of the game (Jain, 2001; Transparency International, n.d.). Bribery is one of the forms of corruption and is defined as "the act of dishonestly persuading someone to act in one's favor by a payment or other inducement, such as gifts, loans, fees, rewards or other advantages (e.g., taxes, services, donations). The use of bribes can lead to collusion (e.g. inspectors under-reporting offences in exchange for bribes) and/or extortion (e.g. bribes extracted against the threat of over-reporting)" (*Why Corruption Matters: Understanding Causes, Effects and How to Address Them*, n.d.-a).

Corruption can be both a symptom and a cause of a weak institutional structure. As an example of being a symptom, it can be mentioned that in an over regulated environment with a high degree of bureaucracy, corruption gives an opportunity to firms to engage in economically beneficial activities and "get things done" (Zimmermann, 2007).

On the other hand, some studies see corruption as one of the main causes of weak institutional structures. They claim that it is not always only a lack of understanding of good policies that leads to poor quality of institutional structures. In order to increase the opportunity of extracting bribes, public agents may not be interested in establishing strong institutions and enforcing regulations (Coolidge, 1999; Krueger, 1993, 2002).

Corruption reveals its impacts at both macro and micro economic levels. Despite the difficulty of measuring corruption, a considerable amount of research has considered its impacts at the macroeconomic level. Mauro was the pioneer to study the empirical impact of corruption on economic growth. Though in his first study, the underlying impact was found to be statistically insignificant (P. Mauro, 1995), he found a statistically significant negative effect of corruption on per capita income growth rate by using a larger set of data afterwards (M. P. Mauro, 1996).

While some research reports also positive impacts of corruption at macroeconomic level, in overall, studies suggest that corruption creates additional expenses to obtain services which are free of charge normally. Businesses face uncertainties emerging due to corruption and lower their investments which hinders growth (*Why Corruption Matters: Understanding Causes, Effects and How to Address Them*, n.d.-b). Supporting this view, a recent paper conducts a systematic review by analyzing 55 empirical studies devoted to macroeconomic impacts of corruption and concludes that one unit increase in CPI decreases GDP per capita growth rate by 0.12 percentage. Indirect impact of corruption, measured by public financial revenue flows and human capital level, is found to be even stronger and attributed to -0.29% (Ugur & Dasgupta, 2011).

At the microeconomic level, corruption's impacts are explained from individual and firm behavioral aspects. For instance, an individual may favor engaging in corrupt activities due to apparent benefits of them compared to fair economic activities. So that firms may be pushed to develop incompetent production models due to avoiding doing business in corrupt industries (Coolidge, 1999; Svensson, 2005).

2.2.3. Corruption in Post-Soviet Countries

In the FSU region, there is a misperception of corruption in the society. Typically, people refer to “grand corruption” which happens on large scales as the “true” corruption and denounce it. However, petty corruption which helps to “get things done” in daily life is widely tolerated by people. For example, according to (Dasgupta & Serageldin, 2000), people who do not use state services for medical treatment in Russia, the successor of the former Union of Soviet Socialist Republics (USSR), are more willingly to get private treatment in illegal ways rather than paying for it officially. Commonly, petty corruption is not perceived to be “true” corruption by the FSU societies and even considered necessary for the functioning of the system (Bowser, 2017; Habibov et al., 2017).

It is important here to distinguish Baltics from the rest of the region countries. Due to their close ties with Scandinavian countries, which rank in the top 10 respect to CPI, Estonia, Latvia and Lithuania have significant differences than the rest in terms of ethical practices. EU, NATO and OECD memberships in case of Estonia and Latvia helped Baltic states to effectively introduce institutional reforms and establish free market economies, democratic political atmosphere and strong law enforcement. Officials in the Baltic region are also less likely to take bribes rather than the rest of the FSU countries (Sanyal & Samanta, 2017).

Despite being classified as more and the most corrupt countries of the FSU (Transparency International, 2019), Georgia, Moldova and Armenia show significant efforts in fighting against corruption. In addition to local governments’ actions to cope with corruption, underlying countries benefit from The Eastern Partnership program which is a joint initiative between member states and the EU aiming to build “a common area of shared democracy, prosperity, stability and increased cooperation” (European External Action Service, 2016). As a result, institutional qualities of these countries are of moderate quality (see *section 3.1*). Policy reforms introduced by official bodies reveal positive outcomes in these countries’ business environments, as well. For example, according to the *Ease of Doing Business report* of 2019,

Georgia leaves behind even Baltic states and positions at 6th place out of 190 countries. Armenia and Moldova also position among the first 50 countries in the ranking (World Bank Group, 2020).

Azerbaijan, Ukraine, Belarus, Russia, Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan are also among more and the most corrupt countries of the region. Moreover, first three countries are also members of The Eastern European Partnership. However, despite this program and actions taken to fight against corruption, all these eight countries are attributed to weak institutional structures (see *section 3.1*). Although it relates to the efficiency of actions taken against corruption by local governments, initial levels of institutions also matter. As seen from *Figure 1*, initial level of institutions was the best for Baltic states in 1996. Uzbekistan and Tajikistan had and still have the worst institutions in the region. While institutions stood more or less at the same level for other countries at initial point, there is an impressive continuous progress by Georgia since 2002.

2.3. Corruption and Innovation

All in all, although innovation and corruption are key determinants of economic development and growth, as seen from above, the conclusion on the relationship between innovation and corruption is not consistent and splitted into two conflicting hypotheses.

2.3.1. "Sanding the Wheels of Innovation" Effect of Corruption

One of them is the "Sanding the wheels of innovation" hypothesis that sees corruption as a hindrance for innovation due to several reasons. Hierarchical structure of the bureaucracy is presented as one of those reasons. Some actors of this hierarchical structure may create artificial barriers for businesses to get bribes. Unnecessary delays in processes, for instance, granting licenses, could be an example of such barriers. In this case, businesses face a dilemma of either

undertaking the cost of bribery and accomplishing innovation activities, or avoiding the costs of bribery at all. While the first case reduces investments in innovative activities, the second case vanishes such activities at all. Hence, firm innovation gets negatively impacted in either way (Myrdal, 1968).

Supporting this argument, another study suggests that public officials sometimes can act unwillingly in controlling corruption in order not to lose their illegal incomes. In the long run, it can result in a much corrupt environment where additional expenses of businesses, in the form of bribery, are increased significantly. Innovation activities of firms would get hurt in this case, consequently (Kurer, 1993). Apart from that, corruption causes uncertainty and less predictability in the business. As bribery, informal payments are against the rule of laws of all countries, there is no corruption deal where the terms and agreements are specified in detail, and the side which terminates the agreement carries legal responsibility for its behavior. Hence, innovation as an outcome of such deals is never guaranteed (Luo, 2005).

A number of empirical studies support the “Sanding the wheels of innovation” hypothesis of corruption. Relevant to our focus region, there is a recent paper which utilizes firm-level data from BEEPS, launched in 2008, to examine the effects of transnational corruption on host country firms’ innovation behavior and performance in transition economies, where the FSU region is also partially in the scope. The study distinguishes grand corruption in government contracts and practices of petty corruption. It suggests that when the proportion of foreign firms involved in grand corruption increases, R&D investments in host countries fall down relatively and product innovation is hindered. On the other hand, foreign petty corruption is found to positively affect product innovation, however this effect also tends to decrease when the level of corruption gets higher. The research also suggests that foreign firms’ engagement in corrupt activities decreases the likelihood of the host country’s ability to introduce new products and services in the long-term (Habiyaremye & Raymond, 2018).

The negative impact of corruption on product and organizational innovations was identified in context of African firms, as well (Goedhuys et al., 2016; Mahagaonkar, 2010).

2.3.2. "Greasing the Wheels of Innovation" Effect of Corruption

"Greasing the wheels of innovation" hypothesis, on the contrary, argues that corruption can make innovation more likely to happen, particularly in case of underdeveloped and transition countries where institutional weaknesses are present. For example, using data of 7000 firms from 30 transition economies including the states of the South Caucasus, (Krammer, 2013) suggests that firms use bribery as a tool to minimize uncertainties, bypass institutional and bureaucratic barriers in order to bring innovation into the market. Moreover, the study argues that bribe efficiency is mitigated by the quality of existing institutions, being both formal (control of corruption) and informal (trust) institutions (Krammer, 2013).

Similarly, (Xie et al., 2019) finds a positive link between corruption and new product innovation by using World Bank Enterprise Survey's panel data from 27 transition countries, partially including the FSU region, collected in 2012. The positive impact is found to be statistically significant at 1%. Authors explain this impact by weak institutional structures which reveal in the forms of policy instability and uncertainty, and threats of informal competition. In such circumstances, companies use corruption to overcome the increasing informal competitive pressure, bureaucratic red tape and government inefficiency.

All in all, it appears that while there exists enough literature studying innovation and corruption as determinants of economic growth, relationship between the former two is relatively neglected and only a limited number of inconclusive studies has been conducted so far. Completed studies have yet to reach a theoretical consensus, whereas empirical results demonstrate that both "greasing" and "sanding" effects of corruption on innovation are possible, depending on the strength level of local institutions, forms of corruption and types of innovation.

Considering this in the view of limited studies which neglect process, marketing and organizational innovations for the post-Soviet region, this paper contributes to the literature by arguing on the relationship between bribery and product, process, market and organizational innovations in the mentioned geographical area.

3. Data and Methodology

3.1. Data

Cross-sectional firm-level data from the fifth round of Business Environment and Enterprise Performance Survey (BEEPS), which was implemented by European Bank for Reconstruction and Development in partnership with the World Bank, is used to conduct the study.

BEEPS is intended to capture business perceptions of biggest environmental factors which put obstacles to firm growth, importance of different constraints for increasing labor force and productivity, and the impact of a country's business environment on its global competitiveness.

BEEPS V was undertaken during the years of 2012-2016, and consists of data from 16,566 enterprises in 32 countries of Eastern Europe and Central Asia. It used stratified random sampling method and applied this structure in three levels to all subjective countries: industry, establishment size and region (*BEEPS | 2012-2016*, n.d.).

One additional reason why this dataset is suitable for the study is that the fifth round of BEEPS introduced a new concept, namely Innovation Module, which distinguishes product, process, organizational and marketing innovations. Such differentiation is compliant with the classification of innovation by the OSLO Manual.

BEEPS dataset is cleaned by excluding "Don't know", "Refused", "DOES NOT APPLY" answers from all variables of the estimation strategy. After cleaning, 5227 responses are left for the focus countries in total.

In addition to BEEPS dataset, the paper is elaborated with The Worldwide Governance Indicators (WGI) data of World Bank in order to capture institutional

qualities in the region countries. WGI is a panel dataset which consists of aggregate and individual governance indicators for more than 200 countries and territories over the world for the time period from 1996 to 2018. Considering that BEEPS V was conducted during 2012-2016, WGI dataset will also be restricted to the same time period in order to ensure data integrity. WGI reports six dimensions of governance, namely voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. Standard normal units of these governance indicators in the original WGI dataset vary in [-2.5; 2.5]. But to avoid confusion, units of all governance indicators are rescaled to vary in the range of [0; 5] with higher values corresponding to better governance. After shifting the focus to the post-Soviet region, this range becomes [1.3; 3.6]. Considering this, countries of the FSU region are grouped respect to their institutional qualities by dividing the latter interval by three. Thus, Uzbekistan, Tajikistan, Kyrgyzstan, Azerbaijan, Belarus, Ukraine, Russia and Kazakhstan are the countries with weak institutional structures in a respective order. Moldova, Armenia and Georgia are the countries with moderate institutional quality, whereas Lithuania, Latvia and Estonia have strong institutions and law enforcement. This grouping pattern will be followed in the rest of the paper.

3.2. Variables

There are four different dependent variables corresponding to four types of innovation and they are defined as follows:

Product innovation is defined as “a good or service that is new or significantly improved”. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics (*Oslo Manual*, n.d.). So, product innovation is introduced by a firm if the answer of the question “During the last three years, has this establishment introduced new or significantly improved products or services?” from BEEPS is “YES”.

Process innovation is "the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (*Oslo Manual*, n.d.). BEEPS captures process innovation with the question "During the last three years, has this establishment introduced any new or significantly improved methods for the production or supply of products or services?". If the answer is "YES", then process innovation is present.

Marketing innovation is "the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing" (*Oslo Manual*, n.d.). If the answer to the question "During the last three years, has this establishment introduced new or significantly improved marketing methods?" is "YES", then marketing innovation is relevant to the firm.

Organizational innovation is the "implementation of a new organizational method in the firm's business practices, workplace organization or external relations" (*Oslo Manual*, n.d.). Answer to the question "During the last three years, has this establishment introduced any new or significantly improved organizational or management practices or structures?" from BEEPS defines relatedness of organizational innovation to a firm.

The main explanatory variable of the model is *Bribes.* It is defined as the percentage of total annual sales paid as informal payment/gift. Such measurement of bribery is in line with previous studies (Fisman & Svensson, 2007; Mahagaonkar, 2010; Waldemar, 2012). Other independent variables of the model are *informal competition, firm size (logs), firm age (logs), foreign ownership, time tax, financial limitations, training, education, management's expertise* and *female manager.*

Detailed descriptions of both dependent and all independent variables are given in *Table 1* under *Appendices*.

Moreover, I follow the approach of (Ashyrov & Masso, 2020) and introduce a set of dummy variables for industries according to the ISIC classifications Revision 3.1: 15–37, 45, 50, 51, 52, 55, 60–64, 72 in order to capture industry-specific effects

(United Nations, 2004). A set of country dummies are also included in the model in order to capture country-fixed effects.

Table 2. Summary statistics of the variables.

Statistic	N	Mean	St. Dev.	Median	Min	Max
Dependent variables						
Product Innovation	5,227	0.219	0.414	0	0	1
Process Innovation	5,227	0.198	0.398	0	0	1
Organizational Innovation	5,227	0.214	0.410	0	0	1
Marketing Innovation	5,227	0.228	0.419	0	0	1
Independent variables						
Bribes (in percentages)	5,227	0.843	3.702	0	0	80
Informal Competition	5,227	0.152	0.360	0	0	1
Firm Age (logs)	5,227	2.251	0.736	2.303	0	4.997
Firm Size (logs)	5,227	3.002	1.196	2.773	0	9.306
Foreign Ownership	5,227	0.057	0.232	0	0	1
Time Tax	5,227	14.400	19.991	10	0	100
Financial Limitations	5,227	0.189	0.392	0	0	1
Training	5,227	0.372	0.483	0	0	1
Education	5,227	44.697	31.747	40	0	100
Management's Expertise	5,227	14.754	9.601	12	1	60
Female Manager	5,227	0.356	0.479	0	0	1

Source: Author's calculations.

Table 2 presents summary statistics of dependent and independent variables. Out of 5227 observations, 593 firms reported some percentage of bribe. While 4634 firms reported 0% bribe, maximum percentage of bribe equals to 80. The issue with very high percentages of bribes which makes a firm to seem suspicious to be in a valid business is addressed in *Robustness Checks* by removing bribery outliers. Meanwhile, the average percentage of bribe for the region is approximately 0.8. Domestic firms constitute a larger portion of the dataset. Out of 5227 companies,

only 298 are foreign-owned. 4929 enterprises are identified as domestic companies. It also reveals that almost half of the firm employees are educated. On average, 44.7% of firms' employees obtain a university degree. Companies' top managers have approximately 15 years of experience working in the underlying sector.

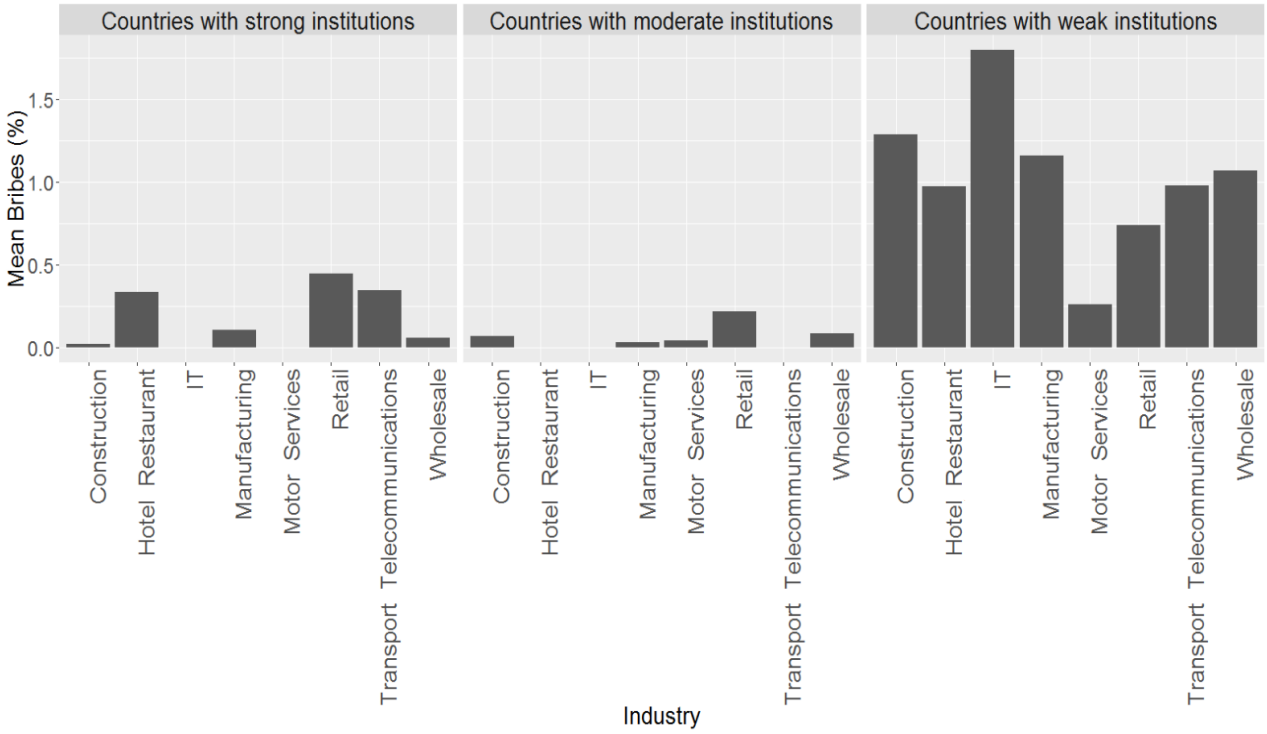

Figure 2. Mean bribes per industry in each country group.

Source: Author's calculations.

Figure 2 illustrates mean bribes per industry in each country group. Retail is the most corrupt industry in both countries with strong and moderate institutions. It is followed by transport and telecommunications, and hotel and restaurant industries in countries where institutional structures are of high quality. It can also be observed that while IT and motor services are corruption-clean industries in the latter country cluster, no bribery is reported for hotel and restaurant, IT and transport and telecommunications industries in the countries with moderate institutions. On contrary, there is no corruption-clean industry in the countries with weak institutional

structures. IT is the most corrupt industry being followed by construction, manufacturing and wholesale industries in countries in the latter group of countries. Hotel and restaurant, and transport and telecommunications industries are reported to have roughly the same average percentage of bribes, whereas motor services is the least corrupt industry in the countries with poor institutions. In overall, average bribery percentages are highest where institutions are bad.

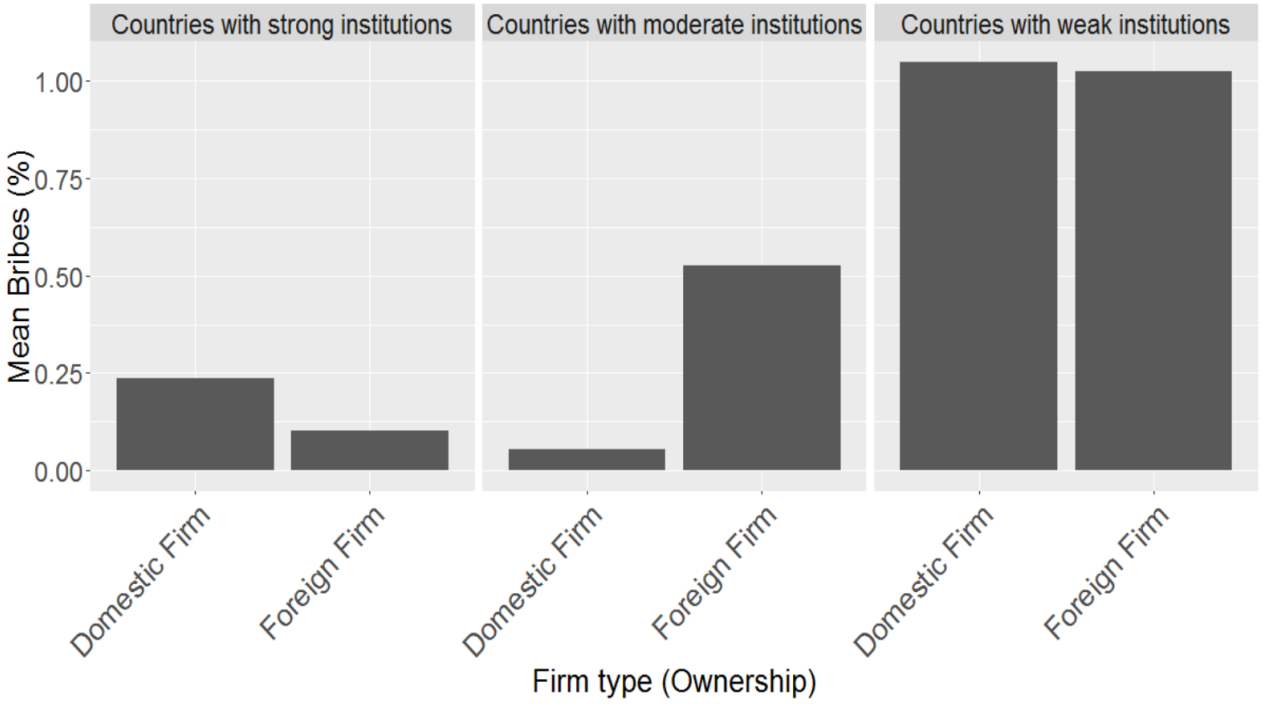

Figure 3. Mean bribes per firm ownership in each country group.
Source: Author's calculations.

Figure 3 shows that domestic firms tend to pay more bribes on average in countries of strong institutional structures. The situation is the other way around in countries with moderate institutions where foreign firms pay significantly higher percentage of bribe on average. As in *Figure 2*, firms pay higher bribes in countries with poor institutions no matter their ownership type. Average bribe paid by domestic firms is slightly higher than that of foreign-owned companies.

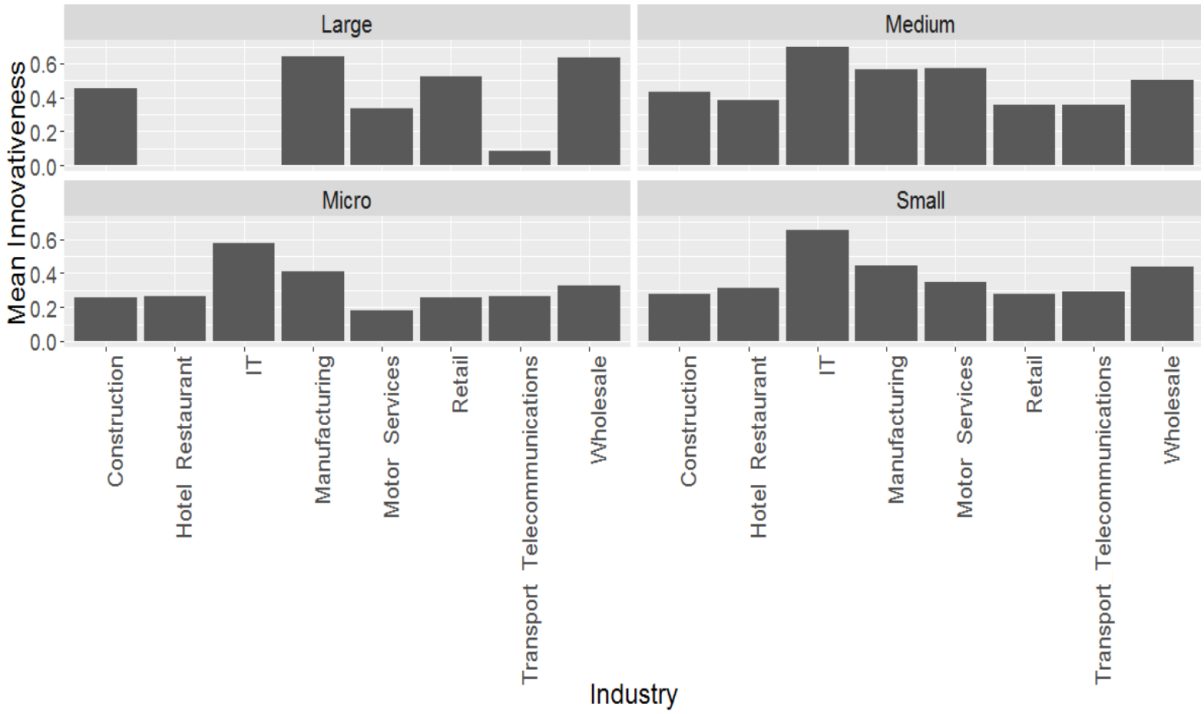

Figure 4. Innovativeness per industry and per firm size.

Source: Author's calculations.

Figure 4 is produced to illustrate mean innovativeness per industry by taking firm size into account. Following the definition of (European Commission, 2003), an enterprise is considered micro if it employs less than 10 persons, small if it employs between 10 and 50 persons, medium-sized if it employs between 50 and 250 persons and large if it employs 250 or more persons. Firm is considered to be innovative if any type of innovation is relative to it. If a firm does not relate to any innovation type out of four, then it is not considered as innovative. It reveals that, large firms are more innovative in manufacturing, wholesale, construction and retail industries in respective order. They are less innovative in motor services and transport and telecommunication industries. Interestingly, no innovation has been introduced by large firms in the IT and hotel and restaurant industries across the region. On the contrary, IT is the most innovative sector among micro, small and medium sized enterprises. It is followed by manufacturing and motor services

industries for medium sized firms, and by manufacturing and wholesale industries for small and micro sized enterprises.

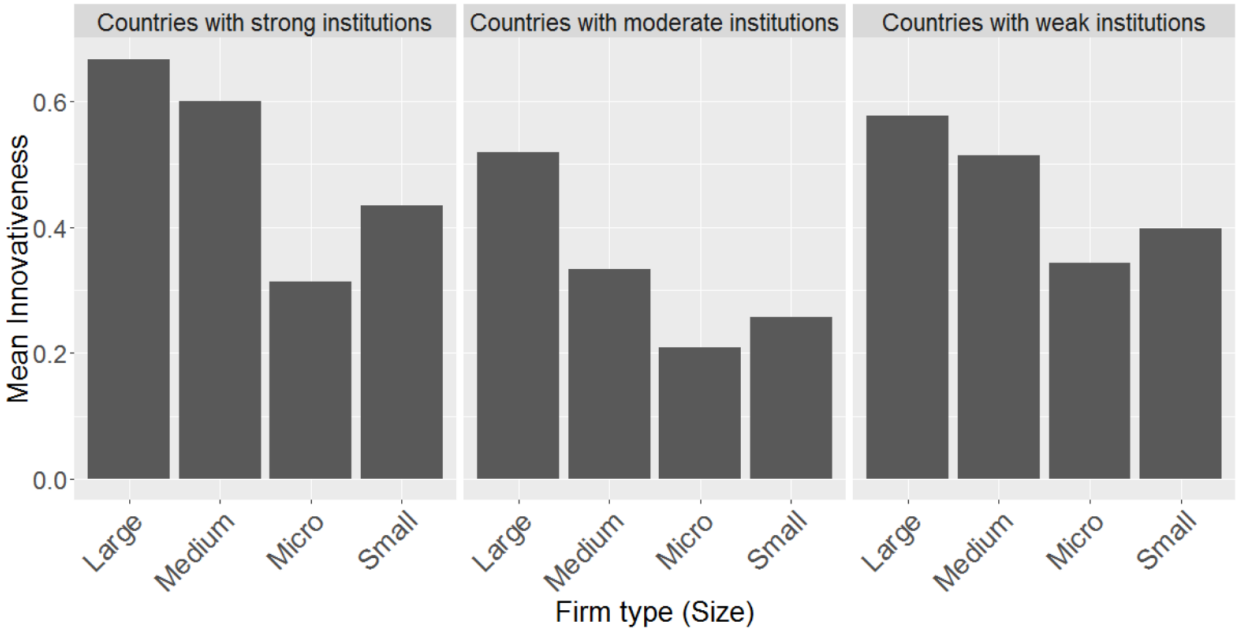

Figure 5. Mean innovativeness per firm size in each country group.

Source: Author's calculations.

Figure 5 illustrates mean innovativeness per firm size in each country cluster. Companies of large and medium sizes are the most innovative firms in all country clusters. Small enterprises are the third most innovative enterprises across the region. Micro firms are the least innovative firms in the FSU region. One possible reason could be that larger firms have more financial means to innovate and their in-house R&D centers foster innovation. Moreover, small firms have less bureaucracy rather than medium-sized firms and it would be easier for them to make changes in their business models and come up with innovation.

Table 3. Correlation matrix of the variables used in regression analysis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Product Innovation	1														
Process Innovation	0.51	1													
Marketing Innovation	0.38	0.43	1												
Organizational Innovation	0.4	0.5	0.6	1											
Bribes	0.06	0.04	0.07	0.06	1										
Informal Competition	0.06	0.08	0.05	0.06	0.1	1									
Firm Age (logs)	0.07	0.07	0.02	0.03	-0.02	0.02	1								
Firm Size (logs)	0.16	0.15	0.11	0.16	-0.03	-0.01	0.28	1							
Foreign Ownership	0.09	0.04	0.11	0.09	0	0.01	0.02	0.17	1						
Time Tax	0.03	0.06	0.08	0.07	0.07	0.05	0	0.07	0.02	1					
Financial Limitations	0.06	0.06	0.08	0.07	0.06	0.11	-0.02	-0.02	-0.02	0.04	1				
Training	0.21	0.22	0.22	0.24	0.02	0.05	0.05	0.25	0.09	0.08	0.05	1			
Education	0.04	0	0.07	0.05	0.03	-0.03	-0.17	-0.2	-0.01	0.02	0.03	0.05	1		
Management's Expertise	0.06	0.06	0.01	0.03	0.01	0.06	0.38	0.14	-0.03	-0.01	0.03	0.08	-0.08	1	
Female Manager	-0.08	-0.06	-0.04	-0.06	-0.04	-0.06	0.03	-0.02	0	0.03	-0.06	-0.03	0	-0.03	1

Source: Author's calculations.

Table 3 is produced to present the correlation matrix of the variables before conducting the econometric estimations. As all absolute values are less than 0.6, no multicollinearity is expected in the model. To give a visual representation, correlation matrix heatmap is depicted in *Figure 6.*

3.3. Methodology

Because the aim is to analyze the relationship between bribery and all types of innovation, four different equations are estimated. Since the dependent variables are binary (see *Table 1*), considering previous literature, probit model is preferred over OLS model.

Analytical expressions of the regressions are as follows:

$$\Pr(Y_{k,ij} = 1) = F(\lambda_0 + \lambda_1 Bribes_{ij} + \lambda_2 X_{ij} + \lambda_3 \mathrm{I}_j + \lambda_4 \mathrm{C}_j + \varepsilon_{ij})$$

where *F* is the cumulative distribution function of the standard normal distribution, $Y_{k,ij}$ is dependent variable where *(k=1,…,4):* Product, Process, Marketing and Organizational Innovation. $Bribes_{i,j}$ is the main explanatory variable, $X_{i,j}$ is a set of control explanatory variables, such as firm size, firm age, firm's financial limitations, firm's threat perception of informal competition, education extent of firm's employees, trainings provided to employees, firm's ownership type, firm manager's gender and experience in the sector, senior management's time spent on dealing with regulations. Indices *i and j* are read as firm *i* in country *j*. I_j and C_j denote industry and country dummies which capture industry and country fixed effects, respectively.

Regressions will be run for the FSU region firstly, then for each country group within the region particularly.

4. Empirical Analysis and Results

Results of probit model estimations for the overall FSU region are shown in *Table 4*. It can be seen that bribery, defined as a form of corruption, is positively associated with all four innovation types in the FSU region. Such positive effect is statistically significant for product and marketing innovations at 1%, for organizational innovation at 5% and for process innovation at 10%. More specifically, 1% increase in total annual sales payed as informal payment/gift, increases the probability of firms introducing product, process, marketing and/or organizational innovations. This positive relationship is not totally unexpected and can be justified by the unsatisfactory level of institutions in the overall region in which countries are in transition period. In such environments, public bodies tend to have greater control over resources which are crucial to innovate, and this fact provides an opportunity to them to extract bribes from firms. The Soviet legacy and its resulting misperception of corruption in the region leads to easily involvement of firms in corrupt activities to access the underlying resources.

Table 4. Probit model estimations for the full sample.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.016***	0.010*	0.015***	0.010**
	(0.005)	(0.005)	(0.005)	(0.005)
Informal Competition	0.148***	0.232***	0.115**	0.175***
	(0.057)	(0.058)	(0.057)	(0.058)
Financial Limitations	0.158***	0.157***	0.230***	0.202***
	(0.052)	(0.054)	(0.051)	(0.053)
Firm Age	0.032	0.070**	0.006	0.013
	(0.033)	(0.034)	(0.033)	(0.033)
Firm Size	0.128***	0.117***	0.107***	0.171***
	(0.020)	(0.020)	(0.020)	(0.020)
Foreign Ownership	0.240***	-0.020	0.401***	0.280***
	(0.086)	(0.094)	(0.087)	(0.089)
Time Tax	0.001	0.003***	0.004***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Training	0.395***	0.448***	0.445***	0.444***
	(0.045)	(0.046)	(0.044)	(0.045)
Management's Expertise	0.002	0.002	-0.003	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Female Manager	-0.218***	-0.179***	-0.131***	-0.167***
	(0.046)	(0.047)	(0.045)	(0.046)
Education	0.003***	0.001	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.627***	-1.779***	-1.557***	-1.771***
	(0.193)	(0.197)	(0.190)	(0.194)
Observations	5,227	5,227	5,227	5,227
Log Likelihood	-2,364.556	-2,197.601	-2,403.737	-2,301.415
Akaike Inf. Crit.	4,793.111	4,459.201	4,871.474	4,666.829

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's calculations.

Moreover, companies may consider only short-term benefits of corruption and favor being involved in corrupt activities. Apart from that, firms usually are eager to

bring their innovations into the market immediately, and generally moderate institutions in the FSU region increase the level of bureaucracy which lags this process. Examples could be obtaining permits, licenses, patents, monetary credits and so on. In order to avoid such delays, companies prefer to use bribery as a tool to facilitate the process. Hence, our results support the "greasing the wheels of innovation" hypothesis and confirms that for the FSU region petty corruption facilitates all types of firm innovation.

Taking discussions further and focusing on the link between bribery and firm innovation in each particular country cluster within the FSU region, *Table 5* presents results for countries of strong institutional structures.

Table 5. Probit model estimations for the sample of countries with strong institutional structures.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	-0.158	0.016	-0.124	0.075*
	(0.155)	(0.042)	(0.121)	(0.040)
Control variables	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.216**	-2.235***	-2.185***	-2.324***
	(0.557)	(0.673)	(0.685)	(0.682)
Observations	431	431	431	431
Log Likelihood	-214.577	-196.096	-186.965	-176.236
Akaike Inf. Crit.	469.155	432.192	413.930	392.472

Note: *p<0.1; **p<0.05; ***p<0.01

Table is in shortened form. Full table is presented in appendices.

Source: Author's calculations.

From *Table 5*, it can be observed that bribery has statistically significant positive relationship only with organizational innovation in the EU member post-Soviet countries. While it decreases the probability of introducing product and marketing innovations, these effects are statistically insignificant. Positive link between bribery and process innovation is also insignificant. Relationships between bribery and product, process and marketing innovations are not significant, because law enforcement is strong and government does not control critical resources for innovation unlike the overall FSU region. Possible explanation of the positive relationship with organizational innovation could again be the room for improvement in institutional structures. Although underlying cluster countries are the best in terms of institutional quality in the FSU region, they fall into countries with moderate institutions when compared to the rest of the world. So, there might be gaps in existing institutions which lead firms to use bribery as a tool to overcome those lags. For example, during the process of designing regulations public agents may face a dilemma between the best and the second best choices. As they do not always prefer the alternative that suits private agents best, the latter may favor the second best alternative through corruption as they might think that it suits them best (Mahagaonkar, 2010). This finding is inconsistent with the previous literature (Lee et al., 2020; Mahagaonkar, 2010) which report a negative link between corruption and organizational innovation. However, it should be noted that the latter studies report the negative link for countries with weak country-level governance which is not the case for the EU member post-Soviet countries. However, comprehensive analysis of the exact market conditions, legislations, national innovations systems and institutional structures of the underlying cluster countries might be conducted to reveal the insights of this conflict.

Table 6. Probit model estimations for the sample of countries with moderate institutional structures.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.113*	0.024	0.035	-0.041
	(0.063)	(0.057)	(0.054)	(0.084)
Control variables	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.696***	-2.051***	-1.875***	-2.275***
	(0.493)	(0.562)	(0.503)	(0.579)
Observations	746	746	746	746
Log Likelihood	-279.437	-232.403	-268.287	-227.563
Akaike Inf. Crit.	598.874	504.805	576.573	495.126

Note: *p<0.1; **p<0.05; ***p<0.01

Table is in shortened form. Full table is presented in appendices.

Source: Author's calculations.

Table 6 shows results of estimations for the countries where institutional structures are of moderate quality. It is seen that bribery greases the wheels of only product innovation in the underlying country cluster. It has positive relationships with process and marketing innovations and a negative relationship with organizational innovations, but these relationships are statistically insignificant. This indicates that institutions are strong enough in this country cluster to prevent the usage of bribery as a tool to "get things done" in the context of process, marketing and organizational innovations. Meanwhile, explanations for the positive links between firm innovation and petty corruption in the FSU region are valid for product innovation in the countries with moderate institutions. Firms use corruption as a tool to bypass bureaucratic procedures and take competitive advantage by bringing their products into the market as fast as possible. Moreover, uncertainty in the environment also leads to companies' involvement in bribery. To clarify, corrupt firms can be certain

that their needed resources, permissions, licenses, patents, etc. will be granted them to bring their innovations into the market (Mahagaonkar, 2010).

Table 7. Probit model estimations for countries with weak institutional structures.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.016***	0.010*	0.017***	0.010*
	(0.005)	(0.005)	(0.005)	(0.005)
Control variables	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-2.154***	-2.029***	-1.354***	-1.800***
	(0.236)	(0.237)	(0.219)	(0.229)
Observations	4,050	4,050	4,050	4,050
Log Likelihood	-1,850.245	-1,750.755	-1,932.533	-1,871.292
Akaike Inf. Crit.	3,750.489	3,551.509	3,915.066	3,792.585

Note: *p<0.1; **p<0.05; ***p<0.01

Table is in shortened form. Full table is presented in appendices.

Source: Author's calculations.

Table 7 presents results of the analysis for the countries with weak institutional structures. Like the general FSU region, bribery increases the likelihood of all innovation types in this country cluster, as well. Justifications for all positive links between bribery and firm innovation in the general FSU region and group of countries with moderate institutions are valid in this case, as well.

5. Robustness Checks

Firstly, the BEEPS V dataset used to run above given regressions included firms that reported bribes equal to and even more than 50% of their total annual

sales in a year. Such high percentages of bribes prompt a question that whether those firms are even in valid businesses. In order to address this issue, bribery outliers are removed from the dataset by filtering out firms which reported bribes higher than 20% of their total annual sales in a year. The filtered dataset includes 5199 observations and the main regressions which is for the FSU region as a whole are redone by using the filtered dataset. Results reported in *Table 8* show that bribery increases the odds of all innovation types in the FSU region. While positive relationships between bribery and product, process, marketing innovations are statistically significant at 1%, bribery's positive association with organizational innovations is significant at 10%.

Table 8. Robustness checks for the full sample by removing bribery outliers.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.029***	0.023***	0.026***	0.015*
	(0.008)	(0.008)	(0.008)	(0.008)
Control variables	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.639***	-1.786***	-1.564***	-1.775***
	(0.193)	(0.197)	(0.190)	(0.194)
Observations	5,199	5,199	5,199	5,199
Log Likelihood	-2,340.772	-2,176.192	-2,383.209	-2,281.361
Akaike Inf. Crit.	4,745.543	4,416.384	4,830.418	4,626.722

Note: *p<0.1; **p<0.05; ***p<0.01

Table is in shortened form. Full table is presented in appendices.

Source: Author's calculations.

Secondly, when corruption proxy is defined as the percentage of total annual sales paid as informal payment/gifts, reported figures by the firm managers might be inaccurate and biased, and thus not revealing the actual level of corruption in the

environment. To overcome this, another corruption proxy, namely "Corruption" is chosen from the BEEPS survey. It is obtained by considering answers of "How common is it for firms to have to pay some irregular "additional payments or gifts" to get things done with regards to customs, taxes, licenses, regulations, services etc.?". Considering the secretive nature of corruption, answers "Never" and "Seldom" are coded as "0", and answers "Sometimes", "Frequently", "Very frequently" and "Always" are coded as "1". Given that, regressions for the FSU region are redone and estimation results are presented in *Table 9*.

Table 9. Robustness checks for the full sample with a new "Corruption" proxy.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Corruption	0.169***	0.139***	0.062	0.163***
	(0.041)	(0.043)	(0.041)	(0.042)
Control variables	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.710***	-1.872***	-1.638***	-1.806***
	(0.187)	(0.192)	(0.185)	(0.189)
Observations	6,124	6,124	6,124	6,124
Log Likelihood	-2,825.792	-2,593.363	-2,823.174	-2,670.373
Akaike Inf. Crit.	5,715.584	5,250.725	5,710.348	5,404.746

Note: *p<0.1; **p<0.05; ***p<0.01

Table is in shortened form. Full table is presented in appendices.

Source: Author's calculations.

With the new proxy, corruption is still positively related to firm innovation and increases the odds of introducing product, process and organizational innovations. Underlying positive links are found to be statistically significant at 1%. The relationship between corruption and marketing innovation is also positive, but statistically insignificant.

6. Conclusion

Although considerable amount of literature has been devoted to analyzing corruption and innovation as determinants of economic growth, firm performance and productivity, the relationship between corruption and innovation has yet to reach a theoretical consensus. While the common view in the literature is that corruption hinders innovation by leading to misallocation of resources and decreasing investments in R&D and innovation activities, more and more empirical studies recently claim that it fosters innovation by being used by firms to overcome bureaucratic red tape, accelerate the processes of obtaining license and permissions, and secure contracts.

By using a cross-country firm-level data from BEEPS V, this study rejects the detrimental effect of corruption and supports the “greasing the wheels of innovation” hypothesis by confirming that bribery increases the probability of introducing innovation in the post-Soviet Region. It finds that bribery has a statistically significant positive effect on all four innovation types, namely product, process, marketing and organizational innovations, in the former Soviet region.

This study is unique in a sense of analyzing particularly the post-Soviet region which have been overlooked in the previous literature. Secondly, it also contributes to the limited literature by covering marketing and organizational innovations in addition to product and process innovations.

Thirdly, the study takes into account high heterogeneity in the region and groups post-Soviet countries considering their institutional qualities. To assess institutions of countries, the paper is elaborated with the WGI data from World Bank. As a result, it finds that in the EU member post-Soviet countries, namely Estonia, Latvia and Lithuania, bribery has a significant positive relationship only with organizational innovation. This indicates that while the level of institutions is good enough to prevent usage of bribery as a tool to facilitate product, process and marketing innovations, there still exists room for improvement of regulations to foster organizational innovation. In the countries of moderate institutional quality, namely Georgia, Armenia and Moldova, bribery greases the wheels of only product

innovation. No significant relationship is detected between bribery and process, marketing and organizational innovations in the underlying country cluster. Fight against corruption should be braced and relative institutions ought to be strengthened in this group of countries in order to eliminate bureaucratic hurdles which lead to the usage of bribery to accelerate product innovation. Eventually, bribery increases the likelihood of all four innovation types in Uzbekistan, Tajikistan, Kyrgyzstan, Azerbaijan, Belarus, Ukraine, Russia and Kazakhstan. Because quality of institutional structures in these countries is poor and law enforcement is weak. Under these circumstances, bribery becomes necessary to bring innovations into the market and accelerate this process.

The current study has several limitations. First of all, as corruption is against "the rules of the game" and corrupt behaviors are illegal, it is hard to measure corruption accurately. Political atmosphere, level of freedom of speech in the focus region might affect respondents' attitudes towards answering certain questions and they might be biased in reporting actual situation accurately. Moreover, there are many missing observations as respondents avoided to answer questions because of their sensitivity. Although BEEPS data provides some insights about the extent to which an environment is corrupt, it is not completely unbiased and there is a need for more accurate, objective and less perception-based data. In this sense, this research can be redone by using more precise and unbiased dataset afterwards.

Secondly, corruption might encourage innovation in a short term, but it might be detrimental for firm innovation in a long run. However, BEEPS consists of cross-country data and is not panel-structured. Thus, it is not possible to observe how the relationship between firm innovation and corruption evolves over the years. Further works might be focused on long term effects of corruption and firm innovation.

Thirdly, the main focus of this paper is the relationship between petty corruption and firm innovation. Further focus can be given to the relationship between grand corruption and firm innovation.

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6. Appendices

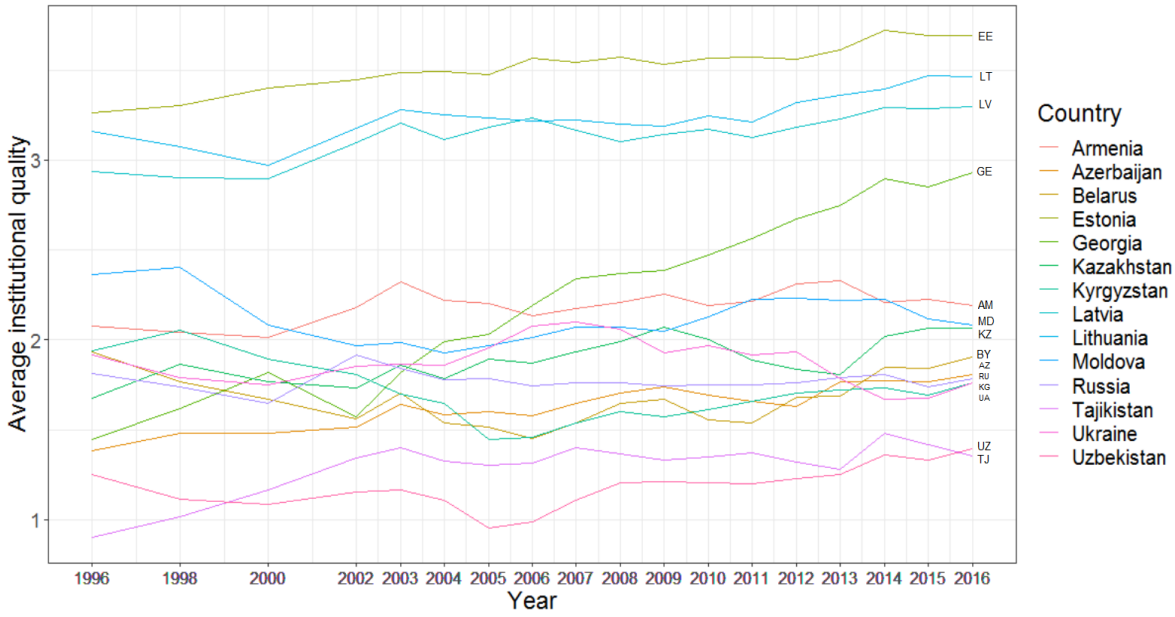

Figure 1. Average institutional quality of the region countries during 1996-2016.

Source: Author's calculations & (The World Bank, n.d.).

Table 1. Detailed description of the variables.

Variable	Description	Used in Studies
Dependent variables		
Product Innovation	Whether any new or significantly improved products or services were introduced in the last 3 years, 1 = "YES"	(Goedhuys et al., 2016; Habiyaremye & Raymond, 2018; Krastanova, 2014; Mahagaonkar, 2010; Trinh, 2019; Waldemar, 2012; Xie et al., 2019)
Process Innovation	Whether any new or significantly improved methods for the production or the supply of products/services were introduced in the last 3 years, 1 = "YES"	(Goedhuys et al., 2016; Krastanova, 2014; Mahagaonkar, 2010; Nguyen et al., 2016; Trinh, 2019)
Marketing Innovation	Whether any new or significantly improved marketing methods were introduced in the last 3 years, 1 = "YES"	(Goedhuys et al., 2016; Mahagaonkar, 2010)
Organizational Innovation	Whether any new or significantly improved organizational or management practices/structures were introduced in the last 3 years, 1 = "YES"	(Goedhuys et al., 2016; Mahagaonkar, 2010)
Independent variables		
Bribes	Percentage of total annual sales paid as informal payment/gift	(Fisman & Svensson, 2007; Krastanova, 2014; Mahagaonkar, 2010; Nguyen et al., 2016; Trinh, 2019; Waldemar, 2012)
Informal Competition	Whether practices of informal competitors in the sector are major or severe obstacles to the current operations of a firm, 1 = if the answer is either "Major obstacle" or "Very severe obstacle"	(Krastanova, 2014)
Firm Size (log)	Logarithm of the number of permanent, full time individuals working at the end of last fiscal year	(Krastanova, 2014; Stock et al., 2002; Trinh, 2019)

Table continued

Variable	Description	Used in Studies
Firm Age (log)	Logarithm of the number of years since the firm began to operate	(Coad et al., 2016; Huergo & Jaumandreu, 2004; Krastanova, 2014; Trinh, 2019)
Foreign Ownership	Foreign-owned company, if at least 10% of the company's equity shares are owned by foreign individuals	(Ashyrov & Masso, 2020; Feliciano & Doytch, 2017; Habiyaremye & Raymond, 2018; Kimura & Kiyota, 2007)
Time Tax	Percentage of senior management's time spent on dealing with regulations	(Xie et al., 2019; Zimmermann, 2007)
Financial Limitations	Whether Financial Limitations is a major or severe obstacle for firms, 1 = if the answer is either "Major obstacle" or "Very severe obstacle"	(*BEEPS* | *2012-2016*, n.d.; Krastanova, 2014; Trinh, 2019)
Training	Whether a firm had formal training programs for its permanent, full time employees over fiscal year, 1 = "YES"	(Diebolt & Hippe, 2018; Toner, 2011)
Education	Percentage of full time employees who completed a university degree	(Junge et al., 2012; Waldemar, 2012)
Management's Expertise	Top manager's number of years of experience working in this sector	(Balsmeier & Czarnitzki, 2014)
Female Manager	1 = if the main respondent's gender is female	(Christiansen et al., 2016; Dwyer et al., 2003)

Source: Author's calculations.

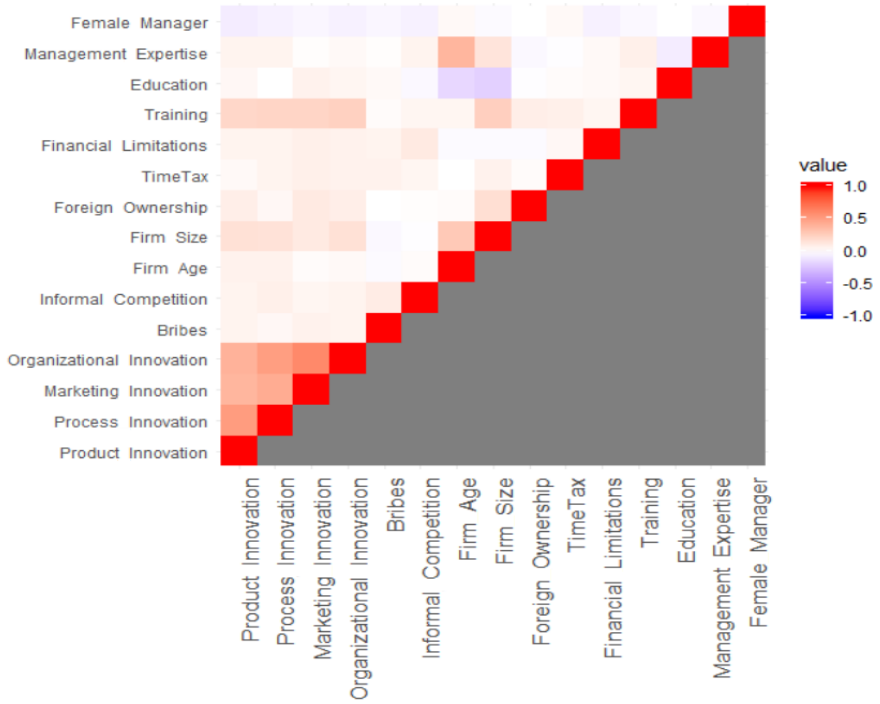

Figure 6. Correlation matrix heatmap.

Source: Author's calculations.

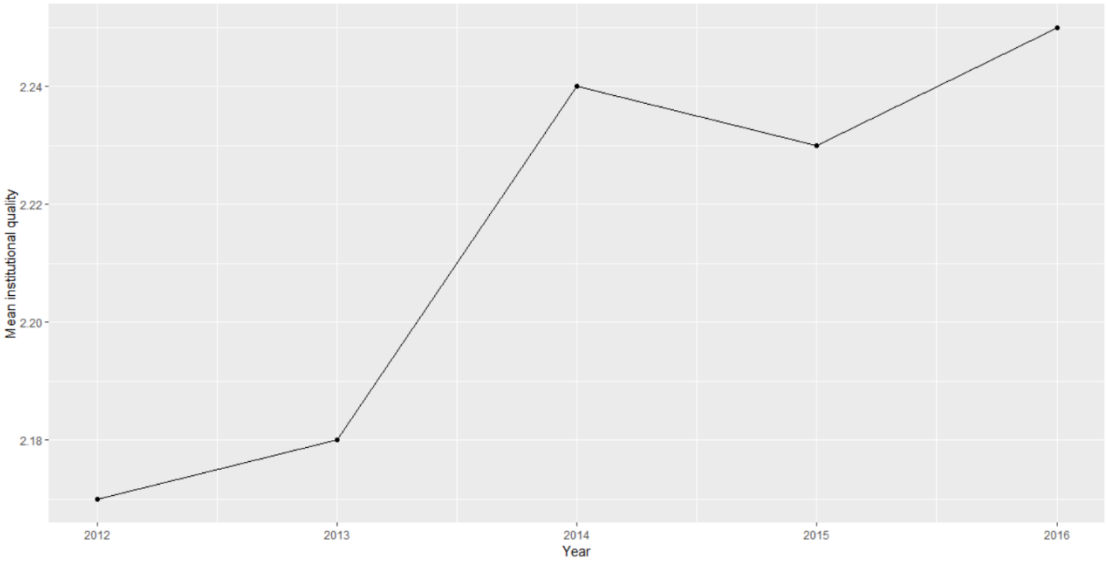

Figure 7. Average institutional quality in the FSU region during 2012-2016.

Source: Author's calculations.

Table 5. Probit model estimations for the sample of countries with strong institutional structures.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	-0.158	0.016	-0.124	0.075*
	(0.155)	(0.042)	(0.121)	(0.040)
Informal Competition	0.221	0.353*	0.524***	0.687***
	(0.188)	(0.193)	(0.195)	(0.197)
Financial Limitations	-0.272	-0.305	0.095	-0.023
	(0.227)	(0.237)	(0.226)	(0.235)
Firm Age (logs)	0.085	0.188	0.161	0.192
	(0.132)	(0.140)	(0.143)	(0.152)
Firm Size (logs)	0.103	0.157**	0.051	0.268***
	(0.070)	(0.073)	(0.076)	(0.079)
Time Tax	0.004	0.010*	0.003	0.007
	(0.006)	(0.005)	(0.006)	(0.006)
Training	0.499***	0.374**	0.342**	0.319*
	(0.153)	(0.159)	(0.163)	(0.168)
Management's Expertise	-0.017*	-0.010	-0.005	-0.038***
	(0.009)	(0.009)	(0.009)	(0.011)
Female Manager	0.009	-0.053	-0.238	0.037
	(0.149)	(0.154)	(0.161)	(0.164)
Education	0.001	0.005*	0.007**	0.005*
	(0.003)	(0.003)	(0.003)	(0.003)
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.216**	-2.235***	-2.185***	-2.324***
	(0.557)	(0.673)	(0.685)	(0.682)
Observations	431	431	431	431
Log Likelihood	-214.577	-196.096	-186.965	-176.236
Akaike Inf. Crit.	469.155	432.192	413.930	392.472

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's calculations.

Table 6. Probit model estimations for the sample of countries with moderate institutional structures.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.113*	0.024	0.035	-0.041
	(0.063)	(0.057)	(0.054)	(0.084)
Informal Competition	0.434***	0.489***	0.339**	0.311*
	(0.154)	(0.162)	(0.158)	(0.169)
Financial Limitations	0.286*	0.234	0.570***	0.314*
	(0.155)	(0.174)	(0.151)	(0.171)
Firm Age (logs)	0.097	0.230**	0.166	0.186
	(0.106)	(0.114)	(0.110)	(0.118)
Firm Size (logs)	0.075	0.038	0.152***	0.172***
	(0.055)	(0.060)	(0.055)	(0.059)
Time Tax	0.004	0.001	0.004	0.0002
	(0.004)	(0.005)	(0.004)	(0.005)
Training	0.641***	0.641***	0.843***	0.785***
	(0.143)	(0.154)	(0.142)	(0.149)
Management's Expertise	-0.002	-0.001	-0.005	0.004
	(0.007)	(0.008)	(0.007)	(0.008)
Female Manager	0.085	0.109	-0.290**	-0.056
	(0.130)	(0.140)	(0.137)	(0.143)
Education	0.003	0.0001	0.0005	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.696***	-2.051***	-1.875***	-2.275***
	(0.493)	(0.562)	(0.503)	(0.579)
Observations	746	746	746	746
Log Likelihood	-279.437	-232.403	-268.287	-227.563
Akaike Inf. Crit.	598.874	504.805	576.573	495.126

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's calculations.

Table 7. Probit model estimations for the sample of countries with weak institutional structures.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.016***	0.010*	0.017***	0.010*
	(0.005)	(0.005)	(0.005)	(0.005)
Informal Competition	0.086	0.177***	0.038	0.091
	(0.066)	(0.066)	(0.065)	(0.065)
Financial Limitations	0.172***	0.174***	0.194***	0.200***
	(0.058)	(0.059)	(0.057)	(0.057)
Firm Age (logs)	0.015	0.042	-0.025	-0.014
	(0.036)	(0.037)	(0.035)	(0.036)
Firm Size (logs)	0.150***	0.124***	0.124***	0.180***
	(0.022)	(0.023)	(0.022)	(0.022)
Time Tax	0.001	0.003***	0.004***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Training	0.364***	0.442***	0.422***	0.429***
	(0.050)	(0.051)	(0.049)	(0.049)
Management's Expertise	0.004	0.003	-0.003	-0.0002
	(0.003)	(0.003)	(0.003)	(0.003)
Female Manager	-0.292***	-0.232***	-0.098*	-0.201***
	(0.052)	(0.054)	(0.050)	(0.052)
Education	0.004***	0.001	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-2.154***	-2.029***	-1.354***	-1.800***
	(0.236)	(0.237)	(0.219)	(0.229)
Observations	4,050	4,050	4,050	4,050
Log Likelihood	-1,850.245	-1,750.755	-1,932.533	-1,871.292
Akaike Inf. Crit.	3,750.489	3,551.509	3,915.066	3,792.585

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's calculations.

Table 8. Robustness checks for the full sample by removing bribery outliers.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Bribes	0.029***	0.023***	0.026***	0.015*
	(0.008)	(0.008)	(0.008)	(0.008)
Informal Competition	0.158***	0.239***	0.113**	0.178***
	(0.057)	(0.058)	(0.058)	(0.058)
Financial Limitations	0.155***	0.157***	0.233***	0.200***
	(0.053)	(0.054)	(0.052)	(0.053)
Firm Age (logs)	0.032	0.068**	0.004	0.012
	(0.033)	(0.034)	(0.033)	(0.033)
Firm Size (logs)	0.132***	0.122***	0.111***	0.174***
	(0.020)	(0.020)	(0.020)	(0.020)
Foreign Ownership	0.241***	-0.023	0.392***	0.271***
	(0.087)	(0.094)	(0.088)	(0.089)
Time Tax	0.001	0.003***	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Training	0.391***	0.443***	0.441***	0.442***
	(0.045)	(0.046)	(0.044)	(0.045)
Management's Expertise	0.002	0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Female Manager	-0.209***	-0.177***	-0.128***	-0.161***
	(0.046)	(0.047)	(0.045)	(0.046)
Education	0.003***	0.001	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.639***	-1.786***	-1.564***	-1.775***
	(0.193)	(0.197)	(0.190)	(0.194)
Observations	5,199	5,199	5,199	5,199
Log Likelihood	-2,340.772	-2,176.192	-2,383.209	-2,281.361
Akaike Inf. Crit.	4,745.543	4,416.384	4,830.418	4,626.722

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's calculations.

Table 9. Robustness checks for the full sample with a new "Corruption" proxy.

	Dependent variable:			
	Product Innovation	Process Innovation	Marketing Innovation	Organizational Innovation
	(1)	(2)	(3)	(4)
Corruption	0.169***	0.139***	0.062	0.163***
	(0.041)	(0.043)	(0.041)	(0.042)
Informal Competition	0.130**	0.194***	0.081	0.167***
	(0.052)	(0.053)	(0.052)	(0.053)
Financial Limitations	0.144***	0.148***	0.243***	0.194***
	(0.047)	(0.049)	(0.047)	(0.048)
Firm Age (logs)	0.022	0.054*	0.014	0.008
	(0.030)	(0.031)	(0.030)	(0.031)
Firm Size (logs)	0.144***	0.128***	0.102***	0.169***
	(0.018)	(0.018)	(0.018)	(0.018)
Foreign Ownership	0.264***	0.057	0.384***	0.233***
	(0.081)	(0.087)	(0.082)	(0.084)
Time Tax	0.002	0.002**	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Training	0.378***	0.469***	0.475***	0.447***
	(0.041)	(0.042)	(0.041)	(0.041)
Management's Expertise	0.003	0.004*	-0.003	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Female Manager	-0.197***	-0.152***	-0.119***	-0.153***
	(0.042)	(0.043)	(0.041)	(0.043)
Education	0.003***	0.001*	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Countries	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Constant	-1.710***	-1.872***	-1.638***	-1.806***
	(0.187)	(0.192)	(0.185)	(0.189)
Observations	6,124	6,124	6,124	6,124
Log Likelihood	-2,825.792	-2,593.363	-2,823.174	-2,670.373
Akaike Inf. Crit.	5,715.584	5,250.725	5,710.348	5,404.746

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's calculations.

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