Corruption and innovation in private firms: Does gender matter?

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Abstract

In this study, we examine whether bribery impairs gender-based asymmetries in product/process innovation in developing economies. Based on firm-level data from Latin American countries, we reject the proposition that women behave differently with respect to bribing on the grounds of higher ethical/moral standards. After controlling for endogeneity and non-random treatment effects, we find that, in line with the Differential association and opportunity (DAO) theory, women in positions of influence (i.e., firm ownership and top management) are equally associated with firm-level bribing. Furthermore, the results indicate that women receive, on average, a greater payoff from bribing compared to male counterparts. At a practical level for firms wishing to innovate, the question of how to gain maximum advantage from each peso paid in bribes becomes an interesting amoral exercise. Our study reveals that promoting women into high-level positions on the basis of their superior morality is an ill-conceived presumption, which is not supported empirically.

Keywords: Women, Bribes, Innovation, Developing countries, Latin America, Extended probit regression

JEL Classifications: D73, J16, O3, N26, L25

1. Introduction

The debate on the effects of corruption on firm growth and development is the subject of much attention in recent decades (Apergis & Apergis, 2019; Boudreaux, Nikolaev, & Holcombe, 2018; Hewa Wellalage, Locke, & Samujh, 2019). Following the seminal papers of Swamy, Knack, Lee, and Azfar (2001), and Dollar, Fisman, and Gatti (2001), a gender dimension has emerged in research on corruption. Twenty years of subsequent debate and research has provided no definitive answers — the literature on the relationship between gender and corruption relationship is still growing (See Breen, Gillanders, McNulty, & Suzuki, 2017; Esarey & Chirillo, 2013). However, the interaction between corruption and gender impact on firm-level innovation is completely missing. This paper complements the existing literature on the effects of corruption on firm level innovation by analysing the relationship between firm level innovation and corruption by gender in Latin American countries.

In privately held firms, top-level corporate executives have the power to affect corruption (Collins, Uhlenbruck, & Rodriguez, 2009) and corporate decisions. Indeed, the decision to engage in bribes is most likely determined by owners and managers (Hanousek, Shamshur, & Tresl, 2019). Literature reports evidence that the demographic factors of firm manager have a significant relationship with the channels of bribery (Apergis & Apergis, 2017). As illustrated by Apergis and Apergis (2017), Anglo-Saxon firms' owners are eager to accept bribes than other ethnicities such as Indian, Chinese and Hispanic. Gender similarly is no free from corruption with other groups like race, class and ethnicity. Gender differences in preferences, behaviours, cultures and social norms may impact the relationship between corruption and innovation level of the firm (Alatas, Cameron, Chaudhuri, Erkal, & Gangadharan, 2009; Croson & Gneezy, 2009). If female business owners are less likely to engage in bribes or limited opportunity to participate in bribes to get things done than male business owners, then this behaviour may impose a detrimental effect on firm level

innovation (Xia, Tan, & Bai, 2018). Not paying bribes might be seen as threatening to the leading regime and aggravate retaliation (Breen et al., 2017). Consequently, these female-owned firms cannot obtain the resources that are required for innovation. On the other hand, bribe payments may avoid ideological discrimination for female-owned firms (Wellalage, Locke, & Samujh, 2018). In that case, the incentive to use bribes may be higher for female-owned firms to firm level innovation than for their male counterparts. Overall, we can argue that there will be significant implications for firm innovations when the men pay the bribe instead of women due to personal factors, behaviours, beliefs and norms (Fuentes, 2018). Therefore, investigating the gender of owners and top managers and ascertaining a correlation with bribery patterns and firm-level innovation represents an important step towards anti-corruption reforms and policy implications.

Some researchers have even argued that women are less corrupt than men (See Dollar et al., 2001; Swamy et al., 2001), although this notion has been recently criticised (Boehm, 2015; C. K. Jha & Sarangi, 2018). In particular, experimental studies have presented mixed evidence, arguing that the gender- corruption nexus is dependent on institutional and cultural contexts (Armantier & Boly, 2011; Frank, Lambsdorff, & Boehm, 2011). That is, in a strong institutional setting, women may be less inclined to engage in bribery (Boehm, 2015). Nevertheless, in a weak institutional environment where corruption is the norm, not paying bribes might be a risky strategy. Most importantly, debt-laden countries, such as most of the Latin American economies, may force their population into a culture of corruption out of necessity (Apergis & Apergis, 2019). Our research focuses on business owners as they are a unique subgroup (van Praag & Cramer, 2001). Well-established propositions that women have fewer opportunities to engage in corruption, due in part to their social status (Swamy et al., 2001) and risk aversion, may be less relevant for female business owners/managers.

The major criticism aimed at research on the gender-corruption nexus is that it lacks a precise theoretical explanation of gender and corruption (See Breen et al., 2017). The literature on the cognitive psychology of corruption discusses the psychological influence of power, personal gain and self-control, loss aversion and risk acceptance, rationalisation, and emotion on one's propensity to act unscrupulously (Dupuy & Neset, 2018). Although risk aversion (Croson & Gneezy, 2009; Eckel & Grossman, 2008) and upper echelon theory (C. K. Jha & Sarangi, 2018) is the most popular theoretical explanation in the literature, some recent experimental studies report that these theories fail to explain the precise mechanism linking gender and corruption (Frank et al., 2011). Moreover, no single recognised measure exists to capture the absolute level of corruption in any given setting (Kaufmann, Kraay, & Mastruzzi, 2011). The majority of studies use perception-based proxies of corruption, which have been criticised in the literature for perception biases (Reinikka & Svensson, 2005; Svensson, 2003). Thus far, only limited studies investigating the gender effect on corruption have focused on micro-level data, as opposed to aggregate corruption indices (Bauhr, Charron, & Wängnerud, 2019). What it is more, the literature reports several empirical weaknesses in the gender-corruption relationship due to spurious correlation and/or reverse causality (Breen et al., 2017).

We seek to integrate the female integrity argument (See Hietikko, 2016), risk aversion (See Croson & Gneezy, 2009) and Differential Association and Opportunity (DAO) theory (See Surtherland & Cressey, 1977) to understand more fully the gender-bribery channel on firm- level innovation. To that end, we use the World Bank Enterprise Surveys, which report on bribery behaviours among firm owners. More specifically, our examination uses firm-level data for 6,091 private, unlisted firms in eleven Latin American countries. The region shows a high level of corruption, a low level of innovation (Lederman, Messina, Pienknagura, & Rigolini, 2013), and mid-range scores in the Global Gender Gap Index,

behind Eastern Europe and Central Asia ("The Global Gender Gap Report 2017," 2017). Our descriptive statistics indicate that both male and female business owners pay bribes. In fact, an average 14% of firms with female owners pay bribes, while 13% of the firms in the full sample (both male and female owners) pay bribes. After controlling for endogeneity and non-random treatment effects, typically linked to innovation decisions, we find that not paying bribes impede firm- level innovation. Furthermore, we find that the higher the bribe paid, the greater the grease effect on the product innovations of firms owned or managed by females. In particular, in firms with female owners (female top managers), this effect ranges from a 59.61% (61.10%) probability of product innovation when *Bribes%* is reported at 0, to a 68.77% (66.14%) one when *Bribes%* is at 100. Nevertheless, the results indicate that bribe payments have mixed effects on the process innovations of firms that are owned or managed by females. The overall result supports the view that women are no less corrupt than men if given the opportunity.

A key contribution of this study is exploring the effect of gender on the corruption-innovation nexus. Although corruption is a long-established field of research (See Apergis & Apergis, 2017; Apergis & Apergis, 2019; Belitski, Chowdhury, & Desai, 2016; Boudreaux et al., 2018; Hewa Wellalage et al., 2019), there is scant literature on the gendered aspects of corruption. However, few studies focus on gender biases within organisational contexts[1], so that the socio-psychological mechanism responsible for biases in the context of business ownership has yet to be properly examined. The only exception is Hanousek et al. (2019), who investigated the effect of corruption on the efficiency of 14 private firms led by female CEOs. To the best of our knowledge, our article is one of the first to investigate the role of female ownership and/or female leadership in paying bribes and its effect on firm-level innovation.

[1] See (Dollar et al., 2001; C. K. Jha & Sarangi, 2018; Swamy et al., 2001).

Moreover, our methodology advances previous corruption studies. Indeed, earlier empirical approaches pose two critical challenges for corruption research. The first is the need to ameliorate the endogeneity involved in corruption measures. Following recent studies, we use instrumental variables to control for simultaneity and measurement errors in an endogenous relationship (Fisman & Svensson, 2007; Qi & Ongena, 2019; Wellalage et al., 2018). Secondly, while some firms pay bribes and others do not, it is unclear whether bribery is random. Indeed, bribe seekers may selectively target certain firms (Svensson, 2003), such as innovative ones. To overcome this challenge, we control for non-random treatment effects. To our knowledge, this is the first article to control for both endogeneity and non-random treatment assignment in corruption-gender and innovation studies, which can otherwise lead to severely biased results.

The remainder of this article is organised into six sections. Section 2 reviews the theoretical evidence while Section 3 discusses the data and methods of analysis employed. Section 4 in turn presents the empirical results, while Section 5 focuses on a robustness check. Lastly, the conclusions drawn from the results are presented in Section 6.

2. Literature review and theoretical background

Corruption is likely to have detrimental effects on macro-level (Krammer, 2017) and reduce firm growth (Fisman & Svensson, 2007) and innovation (See Luo, 2005; Paunov, 2016) in micro-level. Corruption undermines the foundations of institutional trust, which is necessary to develop innovative activities (Habiyaremye & Raymond, 2013). It has been argued that corruption increases transaction costs (Luo, 2005) and uncertainty (Andrei Shleifer & Vishny, 1993), which makes innovative opportunities much less attractive. However, the impact of corruption and extortion depends on the institutional settings

(Apergis & Apergis, 2019; Wellalage et al., 2018) as corruption appears on unproductive and overregulated business climates and ineffective national governments.

The grease the wheel concept claims highlighted that in developing and emerging countries, the corruption is likely to have beneficial effects (See Belitski et al., 2016) for firms suffering from obstructive private monopolies and government practices (Voskanyan, 2000). Méon and Sekkat (2005) report that corruption can be innovation-enhancing in three ways. The first, and the well-known argument is corruption can speed up the slow-moving permit queue (Luo, 2005), thereby reducing the transaction costs associated with the new product or process development. Second, corruption enhances the quality of civil services (Leys, 1965), which may support innovative firms. Third, bribes lead to an efficient process for allocating resources since the most efficient firms will be able to afford to pay the highest bribes (Lui, 1985). Therefore, innovative firms may have a higher possibility to get licenses and resources than their non-innovative counterparts. Overall, corruption is less damaging and sometimes it is beneficial within a weak institutions structure (Méon & Sekkat, 2005).

There is no proven, unified theory on the relationship or causation between gender and corruption (Hietikko, 2016). However, previous findings in business ethics indicate that females are less prone to corruption than males (See Dollar et al., 2001; Hanousek et al., 2019; Swamy et al., 2001). Some research suggests that males are more determined, competitive and strive more for material success than females (Hofstede, 2011; Niederle & Vesterlund, 2007). This competitiveness may lead to high levels of innovation but it may also elicit unethical behaviour such as corruption (Andrei Shleifer, 2004).

This article draws on three main theoretical arguments that explain gender differences in corruption levels and their effect on innovation—(i) the greater female integrity argument,

(ii) differential association and opportunity theory and (iii) risk-aversion theory[2]. These are sumarized as follow.

(i) *The greater female integrity argument*: This argument centers on the tendency of women to abide by rules more so than men (Sung, 2003). Research supporting this argument contends that "*women may have higher standards of ethical behaviour and be more concerned with the common good*" (Dollar et al., 2001, p. 427). Women are deemed to have higher ethical standards than men; therefore, they are inclined to view corruption more negatively (Swamy et al., 2001). Studies have found that women in general see corruption as a more harmful and acute problem than do men (Carasciuc, 2001). Furthermore, the extant literature provides evidence that women are more trustworthy than men and engage less in corrupt transactions (Dollar et al., 2001). As such, some researchers have suggested that greater female representation in parliament leads to less corruption (Dollar et al., 2001). This contention is supported by Swamy et al. (2001), who found that greater female participation in parliament, government bureaucracy and the workforce led to less corruption. Other studies supporting the female integrity argument find that women are more strict with themselves compared to men (Buchan, Croson, & Solnick, 2008), and exhibit higher levels of honesty than men (Feingold, 1994). Given that corruption involves obtaining private benefits through a breach of rules, the above argument and findings could be applied to assert that women engage less than men in corruption.

ii) Differential association and opportunity (DAO) theory: The DAO theory holds that an individual's engagement in crime is based on his/her opportunities and network (Surtherland & Cressey, 1977). Adler (1977, p. 156) reports that increases in white-collar offences by women will occur as they compete with men in the "*upper echelons*

[2] Other popular perspectives include the resource dependency theory, the agency theory, and the upper echelon and feminist theory.

of the American economic system who thrive […] *in the rarefied atmosphere of high finance, high living and, alas, high skulduggery*". Based on the DAO theory, Alhassan Alolo (2007) contends, that regardless of gender, it is the availability of opportunities that leads individuals to engage in corrupt behaviour. Indeed, in a study of male and female officials, who were exposed to similar corrupt practices and activities, Alhassan-Alolo op cit. found that women are as inclined as men to engage in corruption. Studies by Goetz (2007) and (Alatas et al., 2009) drew similar conclusions. The latter study, conducted in Australia (Melbourne), India (Delhi), Indonesia (Jakarta), and Singapore, revealed that the behavioural differences between genders in relation to corruption is not universal across the countries (Alatas et al., 2009). In particular, while no gender differences were seen in India, Indonesia and Singapore, women in Australia appeared to be less tolerant to corruption than their male counterparts. In line with the DAO theory, higher levels of tolerance to corruption in highly corrupt countries stem from higher levels of exposure to corruption in daily life. Furthermore, recent studies have found that there is no gender difference in relation to corruption if men and women have similar opportunities in society (Truex, 2011; Vijayalakshmi, 2008). However, a study by Lan and Hong (2017) found that men typically give larger bribes in private contexts than in public contexts while women give smaller bribes in both private and public contexts.

(iii) *Risk-aversion theory*: Risk preference is significantly related to actual reported corruption in the public sphere (Lee & Guven, 2013). According to this theory, in an environment where corruption is punished, women may be less willing to engage in it (Paternoster & Simpson, 1996). Compared with men, women are more averse to risk and competition in the vast majority of tasks (Buchan et al., 2008; Croson & Gneezy, 2009). Similar to other risky behaviours (e.g., crime, drinking, gambling or

investing), women tend to engage differently in corruption ("Why corruption matters: understanding causes, effects and how to address them," 2015). Experimental studies provide evidence that women are less likely to offer or accept bribes because they are more risk averse and are more afraid of punishment (Dreber & Johannesson, 2008; Schulze & Frank, 2003). That said, a recent experimental study reports that no gender difference is evident in relation to bribing behaviour in non-risk situations (Menocal et al., 2015). However, in a risky situation, women are less willing to accept bribes.

Gender differences in preferences, behaviours, cultures and social norms may impact the relationship between corruption and firm-innovation level (Alatas et al., 2009; Croson & Gneezy, 2009). Situational factors and personal factors may influence bribe-giving behaviours (Rabl, 2011). Traditional hierarchies and male-dominated networks can impact the level of corruption (C. K. Jha & Sarangi, 2018; Swamy et al., 2001), which ultimately impacts firm-level innovation by increasing power discrepancies within society.

The social and cultural values embedded within institutions play a vital role in the gender gap in corruption (Alatas et al., 2009). The difference in political culture between democracies and autocracies also explains the gender gap seen at different levels of corruption in societies. Extant research indicates that “women are less susceptible to corruption in democracies but equally susceptible in autocratic systems” (Esarey & Chirillo, 2013, p. 362). In some countries, female representation in the upper echelon is limited. In such cases, the lower levels of female participation in corruption is due to their minority representation in positions of power (Echazu, 2010). An increase in female representation would decrease corruption because, as a minority group, corruption poses a higher risk for women and thus, they cannot afford to be corrupt. Societal expectations also have an impact on corruption levels (Alhassan Alolo, 2007). In particular, nepotism is the moral obligation of a collectivist culture, regardless of the gender of public officials (Alhassan Alolo, 2007).

3. Data and methodology

3.1 Data

The data are assembled from the World Bank Enterprise Surveys in Latin American countries[3]. In particular, the most recent Enterprise surveys (2016, 2017)[4] provide data for eleven Latin American countries (Argentina, Bolivia, Colombia, Ecuador, El Salvador, Paraguay, Peru, Guatemala, Honduras, Nicaragua and Uruguay), which are all included in the analysis. An Enterprise Survey employs stratified random sampling techniques with identical questionnaires across all countries. Such stratified random sampling ensures a representative sample, which minimises sample selection biases. The strata for the Enterprise Surveys are firm size, business sector and geographic region within a country. The above countries involve a sample of 6,091 firm-level observations. Within the sampled firms, 43% are small (5-19 employees), 34% are medium (20-99 employees), and the remaining 23% are large (more than 100 employees).

On the other hand, the average percentage of firms engaged in product innovation is 60%, while only 41% of the firms are engaged in process innovation. These high average product and process innovation figures are due to the Enterprise Surveys' allowing to capture the rate of firm innovation in a broader sense[5]. As Table 1 shows, Ecuador is the most innovative country, followed by Uruguay. Table 1 also reports the bribery percentage of total sales and the average bribe paying firms in each country. Peru and Ecuador payed more bribes than any other sampled country. In addition, Table 1 shows the Corruption Perception Index (CPI) 2017 and the Global Gender Gap Index 2017 for each country. The CPI index indicates that, except for Uruguay, the score for all the sampled countries was below 39, which in turn is

[3] The American continent can be subdivided into several sub-regions based on geography, politics, demographics and culture. The basic geographical sub-regions are North America, Central America, the Caribbean and South America (García, González, Romero, & Luis Reza, 2011).

[4] See the World Bank Enterprise Survey website for details as to how the surveys are conducted. (http://www.enterprisesurveys.org)

[5] In their paper, Ayyagari et al. (2011) explain why a broader definition of innovation is required in developing economies.

less than the average world score of 43 in 2017. That is to say, most Latin American countries exhibited high corruption levels in 2017. On the other hand, among the sampled countries Nicaragua presented the highest value of the Global Gender Gap Index, which seeks to measure relative gaps between women and men across four key areas: health, education, economics and politics.

<< INSERT Table 1 in here>>

Dependent variables

We use the following two variables as our innovation proxies

1. Product innovation *(Product):* This takes the value of 1 if a firm has introduced a new product or significantly improved a product or service during the last three years (Ayyagari et al. 2014; S. M. S. Krammer 2017).
2. Process innovation *(Process)*: This takes the value of 1 if a firm has introduced a new or has significantly improved a process during the last three years.

The stream of literature in developing markets has recently shifted towards direct measures of innovation for several reasons (Ayyagari, Demirgüç-Kunt, & Maksimovic, 2014; Gorodnichenko & Schnitzer, 2013). First, the traditional measures of innovations (e.g., R&D expenditure and patents) are less likely to be observable in privately owned firms (Acemoglu, Aghion, & Zilibotti, 2006) and in developing markets (Gorodnichenko & Schnitzer, 2013). Also, not all innovations are generated by R&D disbursement (Gorodnichenko & Schnitzer, 2013), formal R&D measures are favourable for large listed firms (Archibugi & Sirilli, 2001), and R&D is an input-oriented proxy of innovation rather than an output-oriented one, and not all R&D necessarily leads to innovation. Also, capturing the catching-up process of innovation is vital for firms in developing economies (Ayyagari, Demirgüç-Kunt, & Maksimovic, 2011). Therefore, our proxies for innovations (*Product* and *Process*) adequately capture firm-level innovations in developing markets.

Independent variables

Our primary independent variable is *Bribes%* which is derived from the following interview question in the Enterprise Survey:

"It is said that establishments are sometimes required to make gifts or informal payments to public officials to 'get things done' about customs, taxes, licenses, regulations, services, etc. On average, what percentage of total annual sales, or estimated total annual value, do establishments like this one pay in informal payments or gifts to public officials for this purpose?"

From this question, the bribe variable (*Bribes%)* measures the bribes as a percentage of total annual sales. In cases of firms reporting an annual value of bribes, this was converted to percentage terms using their total sales figure. The main advantage of our bribes proxy is that our *Bribes%* variable can measure the prevalence of corruption and indicate the scale of the bribes of which the firm has had direct experience[6]. Furthermore, the monitory value of corruption improves its accuracy (Méndez & Sepúlveda, 2009; O'Toole & Tarp, 2014). Nonetheless, similar to other illegal activities, corruption is often underreported (Banerjee et al., 2012), and it is difficult to find a paper trail for corrupt actions (Paunov, 2016).

The World Bank takes several precautions in its surveys to reduce measurement errors in the *Bribes%* variable. First, the question refers to *'establishments like this'* to help elicit truthful responses from survey participants (Billon & Gillanders, 2016). This indirect formulation of the question suggests that respondents are not asked to admit that their firm has paid bribes but to measure the behaviour of similar types of firms. Although seemingly less precise, this approach reduces self-censorship biases in socially sensitive research (Fisher, 1993). Second, data collection is carried out by independent agencies without government officials. Third, the World Bank ensures the anonymity of participants. While there might still be some under-reporting, computing an aggregate measure of corruption as

6 Country level studies often measure bribery as a proxy of corruption indices (C. K. Jha & Sarangi, 2018), and fail, to capture the firm exposure of bribes adequately (Hewa Wellalage et al., 2019).

industry-location (instrument variable) may reduce measurement errors compared to using a firm-level measure (Paunov, 2016). Therefore, our Bribes% proxy represents the best available proxy of bribes[7] for this study.

This study uses two main explanatory variables to explain gender effect in innovation (i) *Female* captures an owner's gender, a dummy variable equal to 1 if any of the firm's owners are female; otherwise 0. (ii) *Female_Top* takes value 1 if the firm's top manager is female, otherwise 0.

Following prior studies, other factors that might affect firm level innovation are added to the model as control variables; (i) Firm characteristics variables: Firm size (*Small, Medium, Large*) and Firm age (*Firm_Age*), Bank finance percentage (*Bank_Fin%*), export percentage (*Export%*), R & D expenses (*R&D*), (ii) Firm ownership and management variables: Foreign ownership percentage (*Foreign_Own*), Manager experience (*Mgr_Exp*), (iii) Institutional environment: The level at which corruption places an obstacle to the current operations of the firm (Obs_Corruption), the level at which finance poses an obstacle to the current operations of the firm (Fin_Obs). We also included industry and country dummies. The appendix reports the definition and measurement of variables included in the models.

Descriptive statistics in Table 2 show the mean value of the *Product* and *Process* variables are 58.89%t and 41.72%, respectively, for the full sample. This high percentage of *innovation* values indicate the importance of domestic firms' catching up with and developing the market (Gorodnichenko & Schnitzer, 2013). Compared to the full sample, firms with female owners show a high percentage of product and process innovation. Approximately 13% of the firms paid bribes to public officers. In this regard, using data from Latin American and Caribbean firms from the 2010 World Bank's Enterprise Surveys, Şeker and Yang (2014) reported that 10% of firms needed to pay bribes to get things done. The

[7] Following (Ayyagari et al., 2014; Hewa Wellalage et al., 2019; Wellalage et al., 2018), we use a dichotomous variable of bribes in the robustness section.

increase in bribes paid by firms between 2010 and 2016-2017 indicates an overall rise in regional corruption[8].

Table 2 also shows that there are no substantial differences in paying bribes in the full sample (13%) compared with the sample of firms owned by females (14%) and firms led by females (13%). This aligns with the recent argument that gender does not predict differences in ethical perceptions of bribery (McCabe, Ingram, & Dato-On, 2006). This is also supported by prior studies which have found that when there is similar access to positions of influence, no gender difference is apparent in relation to corruption (Truex, 2011). The sample indicates that 56% of the firms have at least one female owner and 17% of the firms have top female managers. Other firm characteristics and control variables show that there are no substantial differences between the full sample and female-owned and female-led firms. For all three groups, nearly half the firms in the sample are manufacturing firms; the remainder involves retail and other service providers.

<< INSERT Table 2 in here>>

3.2 Econometric specification

We estimate the following baseline probit regression to analyse the corruption and gender effect on firm-level innovation:

(1)

Here is a binary variable set equal to 1 if the firm reported an innovation activity (product- or process-related), and 0 otherwise. indicates the percentage of bribes payment to total sales; *Corrup_Obs* in turn is a dummy variable that indicates whether corruption is a major or very severe obstacle to the current operation of the firm. In addition to firm characteristics, industry- and country- fixed effects () are also included.

[8] Corruption is on the rise in Latin America and about one-third of people using public services paid a bribe in 2016. Close to two-thirds (62%) of those surveyed said that corruption had increased in 2017 (source; Transparency International, www.transparency.org)

Endogenous covariates- The empirical findings relating to innovation and bribes are mixed, and this may be attributable to endogeneity (Xie, Qi, & Zhu, 2018). A covariate is endogenous if it is correlated with the error term. Notably, this correlation in innovation and bribes can arise in many ways. An omitted variable bias may influence innovation and bribes regressions[9]. Measurement errors also commonly give rise to an endogeneity issue. When bribes are jointly determined with the innovation, there is a simultaneity problem, which leads to a spurious relationship between innovation and bribes. Accordingly, bribe payments may contribute to a reduction in firm-level innovation due to increasing costs, as a bribe amounts to an additional tax and, hence, an obstacle to innovation. Conversely, highly innovative firms may use a high level of corruption to overcome bureaucratic processes and complex regulations in accessing limited resources. We used a Smith and Blundell (1986) test of weak exogeneity of the limited dependent variable model and the test rejects the hypothesis that the *Bribes%* variable is exogenous at a significance level of 1%. To address endogeneity biases, we use two instrumental variables. The first is the locality-industry sector average of bribery (*Avg_Bribe*). The second variable is the locality-industry sector average of the total time spent by senior management on dealing with requirements forced by government regulations in a typical week (*Avg_Mgr_time*). Managers may spend more time in an environment with a high level of corruption.

Corruption obstacles tend to be more common in markets where business owners report a high locality-industry sector average of bribes, namely, weak institutions. Locality-industry sector average of bribes is likely to determine by the underlying technologies of the industry and rent extraction preferences of bureaucrats, which are exogenous to the firm (Wellalage et al., 2018). As an example, some industries are export-reliant than others, and the bribery may differ across the localities because some bureaucratise are more efficient than

[9] Following Boudreaux et al. (2018), we mitigate this problem by including various covariates related to bribes and innovation.

others (Qi & Ongena, 2018). That suggests, locality- industry sector average of bribery may pose an influence on firm level bribery but have an indirect impact on innovative activities of firms. Based on prior studies, locality-industry sector average instrument variable found to be highly positively correlated with bribes while there is little reason to believe that, locality-industry sector average has a direct effect on innovation (Xia et al., 2018). The other advantage of a locality-sector average instrument variable(s) is that this eliminates the unobservable biases at the firm level (Qi & Ongena, 2019).

Further, we test the validity of the instrument by using a transformed F-test. The F-test for instrument relevance for our instrument variables is greater than 10, enhancing confidence that the instrument is appropriate [10]. Nonetheless, Paunov (2016) argues that firm performance (in here innovation) may affect location-specific corruption. In that case, one can argue that in more corrupt regions, more innovative firms can be located. In order to avoid this challenge, prior studies adopt an alternative framework where corruption is measured at the country level in their research (Paunov, 2016). However, these country-level perception-based measures are less appropriate in analysing the effect of corruption at the firm-level (Cooray & Schneider, 2018). This may be aggregate, country-level, views on the extent of bribery does not captures the non-uniform distribution of bribe payments within a country. In given circumstances, firm specific effects of corruption, are instrumented using locality industry measures of corruption is appropriate for this study.

Non-random treatment effects-The direct comparison of firms that indicates corruption as a major obstacle and those that do not leads to an identification problem. The payment of bribes may be correlated with both observable and unobservable factors of firms. In this study, we compare the innovation of firms exposed to no treatment $T=0$ (no corruption

[10] The transformed F-test for the joint significance of identifying instruments in the first stage regression exceeds 10, thus the selected instruments are valid (Stock & Yogo, 2002).

obstacle) and the innovation of firms exposed to treatment *T=1* (corruption obstacle). Since only one of these outcomes is observed for each firm, we estimate the average treatment on the treated (ATT), that is, the difference in innovation between those treated and those with the same probability of being treated (Cox-Edwards & Rodríguez-Oreggia, 2009).

Selection biases- Sample selection biases arise when a researcher is limited to information in a non-random subsample of the population of participants (Bushway, Johnson, & Slocum, 2007). In our sample, we include all firms, regardless of their bribe payment status, so that sample selection biases are minimised.

Given the above discussion, we formulate the following extended probit (eprobit) regression for product and process innovation:

(2)

In expression (2), the main (outcome) equation refers to I (product/process innovation) as a function of various regressors, among which is Bribes%, an endogeneous variable modelled in turn as a function of and . The endogeneous treatment equation (*end.treat*), modelled in terms of financial obstacles (*Fin_Obs*), takes account of the fact that countries may or may not see corruption as a major or severe obstacle (*Corrup_Obs*).

4. Results

Columns 1 and 2 of Table 3 present eprobit regression results for product and process innovations, bribes and female owners. Columns 3 and 4 in turn present eprobit results for top female managers.

At the bottom of the table, the correlation estimates indicate the endogeneity in the model. Specifically, the error correlation *corr (e.bribes,e.I*) is an estimate of the correlation

between the error from the endogenous covariates equations and the error term from the outcome equation. The estimate is significant, enabling us to reject the hypothesis that there are no endogenous covariates. When looking at the other correlations, our suspicion of endogenous treatment is likewise confirmed (*e.obs_corruption,e.I*). This indicates that we reject the null hypotheses of no endogenous covariates and no endogenous treatment assignments.

The ***Innovation*** equation provides the coefficient estimates for the main model, after controlling for endogeneous covariates and treatment biases. The ***Corrup_Obs*** and ***Bribes%*** equations provide the coefficient estimates for the auxiliary treatment assignment and endogenous covariate equations, respectively.

<<INSERT Table 3 in here>>

As can be seen, the coefficients of the *Innovation* equation indicate that *Bribes%* has a statistically significant and negative impact on firm-level innovation in the group of female-owned firms (β of product innovation =–.0311 and β of process innovation =–.0211) and in the group of firms where women occupy top management positions (β of product innovation =–.0322 and β of process innovation =–.0217). That is to say, corruption is detrimental to the likelihood of innovation after controlling for gender and other covariates. Our main focus, however, is the interaction between gender and bribes (Female#bribes). To the extent that such an interaction is positive, female bribing may counteract the negative effect of corruption on innovation. Hence, we use margins (probabilities) to obtain interpretable effects, as the relationship between the owner/top manager gender and product/process innovation may vary according to the bribery level. Moreover, such margins capture all of the non-linearities involved in expression (2).

Table 4 and Figure 1 shows the predicted probabilities of product/process innovation and female ownership/female leadership at different levels of bribery. More specifically:

(i) *Product innovation and female owners:* Figure 1 A shows that, regardless of the owner's gender, the probability of product innovation increases for firms that pay higher bribes. However, the impact is greater for firms with female owners. For such firms, Table 4 shows that the probability of product innovation ranges from 59.61%, when *Bribes%* is reported at its minimum level, to 68.77%, when *Bribes%* is at its maximum level. In turn for firms with no female owners, such probability ranges from 57.48% to 61.89%. Moreover, Column 1 of Table 4 shows that the gender effect is significant for the full range of *Bribes%* (0- 100%).

(ii)Process innovation and female owners: Similar to product innovation, Figure 1A shows, that regardless of the owner's gender, the probability of process innovation increases for firms that pay higher bribes. However, unlike product innovation, Column 2 of Table 4 shows that when *Bribes%* value is greater than 80%, the gender effect is statistically insignificant. In particular, for female-owned firms, the probability of process innovation ranges from 42.04%, when *Bribes%* is reported at its minimum level, to 59.07%, when *Bribes%* is at its maximum level (80%). In turn for firms with no female owners, the probability of process innovation ranges from 40.05% to 44.38%.

(iii) Product innovation and female top managers: Similarly to Figure 1 A, Figure 1B shows that, regardless of the gender of the firm's top manager, the probability of product innovation increases for firm that pay higher bribes. However, the impact of gender is decreasing in *Bribes%*. In particular, as Table 4 shows, for firms with top female managers, the probability of product innovation ranges from 61.10%, when *Bribes%* is reported at its minimum level, to 66.14%, when *Bribes%* is at its maximum level. Similarly, for firms with no top female managers, such probability

ranges from 58.34% to 65.39%. Column 3 of Table 4 shows that the top manager's gender t-statistic is significant for the full range of *Bribes%* (0- 100%).

(iv) Process innovations and female top managers: Table 4 column 4 shows that top female managers have a significant impact on firm-level process innovation up to *Bribes%* at 70%. Nevertheless, the effect of the top manager's gender is insignificant on process innovation once a higher level of *Bribes%* is reached (after 70% of bribes). For firms with top female managers, the probability of process innovation ranges from 39.93%, when *Bribes%* is reported at its minimum level, to 48.44% when *Bribes%* is at its maximum significant level (70%). For firms with no top female managers, such probability ranges from 41.78% to 47%.

In sum, our results lend support to the argument that bribes play a 'grease-the-wheel' role in a weak institutional environment (Xie et al., 2018). The demand side argument shows that bribery increase access to bank credit to private firms. Subsequently, making significant bribes may dilute the strict regulations on lending institutions (Chen, Liu, & Su, 2013) and disruptive private monopolies and government practices (Voskanyan, 2000), which increase access to credit and other resources for firm product and process innovation. On the other hand, if the marginal bribe rate is below the official marginal tax rate, then bribery reduces effective tax rates of the firm. Subsequently, this reduced tax liabilities will increase firm profitability, thus have a high level of innovation.

The interaction effect between the *Bribes%* and *Female_Own* variables indicates that the probability of innovation is bribe-increasing. This impact is higher for female owners than for male owners. This indicates that bribe payments have a greater greasing effect for female-owned firms than for male-owned firms. Similarly, Trentini and Koparanova (2013) find that bribing has a positive impact on firm growth in female-owned ones. We can rationalise the above findings in two ways. Firstly, in a weak institutional environment, women tend to be

disadvantaged. When the business environment is unwelcoming for female business owners, they may see bribery as a way to get things done. For female-owned firms with weak networks in bureaucracy, bribes may represent a means of overcoming barriers in innovation. In line with Trentini and Koparanova (2013), our study finds that bribe payments potentially represent a means to smooth management and improve performance. Secondly, our study supports the DAO theory, which establishes that both males and females engage in corruption equally when they have similar opportunities and networks to engage in corrupt practices. This echoes the findings of Alatas et al. (2009) and Alhassan Alolo (2007).

<<INSERT Table 4 and Figure 1 in here>>

5. Robustness analysis

5.1 Measuring bribes as a dummy variable

Prior corruption studies report several drawbacks of measuring bribes as a percentage of total sales. In particular, it is a possibility that firm managers overestimate bribes when measured as a percentage of total sales (Clarke, 2011). Also, nonresponsive and measurement errors are visible in the bribe amount variables (Ayyagari et al., 2014). Therefore, we reanalyse our data using a dichotomous variable for bribes instead of *Bribes%.*

Panel A and B in Table 5A estimates the probability of innovation and treatment (paying bribes) based on the gender of firm owners. Intergroup analysis shows that bribe-paying female owners (Group 4) display the highest predictive average product innovation (.6635) and process innovation (.5076). The average predictive innovation of bribe-paying male owners (Group 3) is .6337 for product innovation and .4793 for process innovation. Therefore, the marginal effects of paying bribes and being a female business owner for product and process innovations are higher than being male and paying bribes. In other words, when female-owned firms pay bribes, they are approximately 3% more innovative

than male-owned firms that also pay bribes. Interestingly, in the groups that do not pay bribes (1 and 2), female-owned firms are more innovative than male-owned ones.

Panel A and B in Table 5B estimates the probability of innovation and treatment (paying bribes) based on the gender of the firm managers. Intergroup analysis shows that bribe-paying top male managers (Group 3) display the highest predictive average of product innovation and process innovation. In contrast with the results for owners, in the groups that do not pay bribes, firms with top female managers are less innovative than firms with top male managers.

Overall, these results are in line with our main findings, which suggest that not paying bribes may impede firm-level innovation in the Latin American region. Female-owned firms are the most benefited from paying bribes, and firms with top female managers are at a disadvantage by not bribing. These results are aligned with main findings. Our results also support the argument that female and male may be equally corrupt if opportunities arise.

<<INSERT Table 5 here>>

5.2 Institutional context analysis

In here we add a specification that controls for country-level variables, such as GDP per capita, a measure of culture and institutions and reruns the eprobit regression. Culture and institutions both have been found to impact both gender representation and corruption (Alatas et al., 2009; Apergis & Apergis, 2019; C. Jha & Panda, 2017). Following C. Jha and Panda (2017), we use the individualism index as a proxy of cultural differences across countries. Also, following Paunov (2016), we include political rights, the rule of law and property rights to capture institutional heterogeneity across countries. The results reported in Table 6 A shows that all coefficients of institutional and cultural variables are statistically significant to

firm level innovation. Even after control institutional and cultural variations, marginal effect results (Table 6B) are aligned with main findings.

<<INSERT Table 6A and Table 6B inhere>>

5.3 Heterogeneity in an institutional context

The effects of corruption and gender interaction on innovation may differ in a subsample of countries defined by the GDP (high GDP per capita group (above 20,000) and low GDP per capita group (below 10,000) and cultural differences (high individualism groups (score above 30) and low individualism group (score below 10) and rerun eprobit regression. Align with our main findings, Table 7 panel A report that the marginal effects of paying bribes and being a female business owner for product innovation are higher than being male and paying bribes in all subgroups. Nonetheless, this effect is high in low GDP per capita and low individualism country compared to their counterparts. Our results confirm (i) the greasing effect of corruption is strong in a weak institutional environment. (ii) both female and male are equally corrupt if opportunities arise.

<<INSERT Table 7 here>>

6.Conclusion

In this study, we look at two questions: (1) does corruption matter in firm level innovation? and (2) can gender be an explanatory factor for the relationship between corruption and firm level innovation? Extant research has shown that women engage in corruption less often than men, and that increasing gender equality will lead to lower corruption levels. However, the question of how female business owners/top managers deal with corruption and firm level innovation in developing economies was unanswered until now.

Based on firm-level data from 11 Latin American Countries, our study finds that a weak institutional environment leads to corruption, which becomes a second-best solution for innovative firms. In particular, the probability of product innovation increases for firms that pay higher bribes. However, the impact is highest for firms with female owners and top female managers. Nevertheless, gender is an insignificant factor when a high amount of bribes are at hand. For firms with female business owners, bureaucracy may appear to be a heavy burden in general and bribe payments could represent a means to speed up their access to resources and contribute to firm innovation. So, we can posit that the gender effect is more pronounced in weak institutional environments. Such an obstacle can be overcome by having strong regulatory and governance mechanisms, since corruption seems more beneficial only in weak institutional structures. Further work is needed to understand the disparities in gender differences in perceptions of corruption across countries. Countries with different cultural and institutional backgrounds may display gender differences in the corruption-innovation nexus.

Another important implication of this study is that policies which promote women into higher positions on the basis that women have inherently superior moral qualities are misguided if both men and women are equally exposed to a corrupt environment. However, promoting gender equality in society and empowering women is beneficial even when the reasons for doing so may be tenuous. Although a solid theoretical framework exists in corruption studies, a theoretical grounding for gender and corruption research is absent. Additional gender- oriented studies are required to understand the full mechanisms in play.

Our study has limitations, some of which may be possible avenues for future research. In this paper, we contribute to firm-level corruption and firm innovation. Future studies can consider macro-level cross country analysis on the incidence and depth of bribery and its relationship to levels of innovation. Also, one key concern with studying the effect of gender

is the issue of endogeneity. Due to the limitation of data, we are unable to find the firm level instrumental variable that sufficiently correlated with female ownership in the firms once other independent variables are controlled. Prior studies use country-level instrumental variables, such as dummy for countries whose dominant language has distinct two genders (masculine and feminine), percentage of women in parliament, country-level gender development Index. However, the above macro-level variables do not show significant variances in our limited cross-country study. Therefore, future studies can consider controlling possible endogeneity in gender variable using instruments.

Appendix

Definition and measurement of variables included in the models

Variables	Definition	Measurement
Product	Product innovation denotes that a firm has introduced new or has significantly improved products or services during the last three years.	1 = yes; 0 = otherwise
Process	Process innovation denotes that a firm has introduced new or has significantly improved processes during the last three years.	1 = yes; 0 = otherwise
Bribes%	Bribes as a percentage of total annual sales	Percentage
Bribes_firms	Denotes the firm's payment of a bribe, or not.	1 = yes; 0 = otherwise
Female	At least one female owner among the owners of the firm.	1 = yes; 0 = otherwise
Female_Top	Firm's top manager is female.	1 = yes; 0 = otherwise
Small	Between 0 and 19 employees	1 = yes; 0 = otherwise
Medium	Between 20 and 99 employees	1 = yes; 0 = otherwise
Large	More than 100 employees	
Foreign_Own	Percentage of firms owned by foreign individuals, companies or organisations	Percentage
Firm_Age	Number of years from the date of establishment.	Years
Mgr_Exp	Manager"s experience in sector	Years
Export%	Percentage of firm sales were directly or indirectly exports	Percentage
R&D	Firm allocated expenditures of R&D	1 = yes; 0 = otherwise
Bank_Fin%	The proportion of the firm's working capital financed by banks	Percentage
Fin_Obs	Access to finance is a major or very severe obstacle to the current operation of the firm	1 = yes; 0 = otherwise
Corrup_Obs	Corruption is a major or very severe obstacle to the current operation of the firm	1 = yes; 0 = otherwise
Manufacturing	Firm from manufacturing sector	1 = yes; 0 = otherwise
Retail	Firm from retail sector	1 = yes; 0 = otherwise
Other	Firm from sectors other than manufacturing or retail	1 = yes; 0 = otherwise
Variables for auxiliary treatment assignment		
Instrument variables *Avg_Bribes*	Locality sector average percentage of bribe payments over the last year	Average
Avg_Mgr_Time	Locality sector average percentage of total senior management's time spent on dealing with requirements imposed by government regulations in a typical week over the last year	Average

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Table 1 Sampled countries

Country	Small	Medium	Large	Product Inno %	Process Inno %	Bribes % of total sales	Bribes paying firms	2017 CPI score*	2017 Global Gender Gap Index**
Argentina	387	337	254	48.64	35.62	3.60	12.35	39	0.732
Bolivia	183	98	82	62.91	43.13	7.52	22.67	33	0.758
Colombia	396	369	214	69.49	52.26	6.59	15.02	37	0.731
Ecuador	146	133	78	76.45	55.12	7.51	15.78	32	0.724
El Salvador	375	200	144	37.41	19.89	5.98	8.91	33	0.705
Guatemala	144	108	93	60.29	46.09	5.28	11.34	28	0.667
Honduras	199	95	38	45.78	23.19	5.77	11.21	29	0.711
Nicaragua	123	151	59	62.46	36.93	2.67	11.28	26	0.814
Paraguay	113	130	115	56.59	33.52	3.88	10.48	29	0.678
Peru	453	300	232	64.51	50.55	7.02	18.00	37	0.719
Uruguay	126	136	80	73.78	59.94	1.37	4.97	70	0.710
Total	**2,645**	**2,057**	**1,389**						

**Corruption Perception Index ranks 180 countries and territories by their perceived levels of public sector corruption according to experts and businesspeople, uses a scale of 0 to 100, where 0 is highly corrupt and 100 is very clean. https://www.transparency.org/*

***Global Gender Gap Index: the highest score is 1, which indicates equality or better for women. The lowest score is 0. https://www.weforum.org/reports/the-global-gender-gap-report-2017*

Table 2 Descriptive statistics

	Full sample					Firms with female owners					Firms with female top managers				
Variable	obs	Mean	Std.Dev	Min	Max	obs	Mean	Std.Dev	Min	Max	obs	Mean	Std.Dev	Min	Max
Product	6091	.5889	.4921	0	1	3375	.6041	.4891	0	1	1093	.5837	.4932	0	1
Process	6091	.4172	.4931	0	1	3375	.4308	.4953	0	1	1093	.3651	.4817	0	1
Bribes%	5962	5.428	17.93	0	100	3276	5.531	18.04	0	100	1060	5.904	19.51	0	100
Bribes_firms	5951	.1338	.3404	0	1	3271	.1409	.3480	0	1	1056	.1307	.3372	0	1
Female_own	6065	55.65	.4968	0	1	-					1083	.8587	.3484	0	1
Female_Top	6090	.1717	.3822	0	1	3375	.2756	.4469	0	1	-				
Small	6091	.4299	.4952	0	1	3375	.4338	.4957	0	1	1093	.5709	.4952	0	1
Medium	6091	.3343	.4718	0	1	3375	.3384	.4732	0	1	1093	.3056	.4609	0	1
Large	6091	.2258	.4181	0	1	3375	.2169	.4122	0	1	1093	.1134	.3173	0	1
Foreign_Own	6091	8.460	26.33	0	100	3373	3.855	17.34	0	100	1092	5.478	21.34	0	100
Firm_Age	6091	25.90	19.16	1	187	3360	26.961	20.02	1	187	1088	23.03	17.24	2	127
Mgr_Exp	6091	24.07	12.48	1	70	3352	24.30	12.40	1	70	1089	20.97	11.42	1	66
Export%	6091	8.07	22.47	0	100	3375	6.334	19.35	0	100	1093	6.082	20.17	0	100
R&D	5913	.2322	.4227	0	1	3176	.2387	.4263	0	1	1040	.1865	.3897	0	1
Bank_Fin%	6091	18.05	25.89	0	100	3351	18.36	25.97	0	100	1081	16.60	25.66	0	100
Fin_Obs	6090	.4663	.4989	0	1	3347	.4768	.4995	0	1	1080	.4417	.4968	0	1
Corrup_Obs	6058	.6666	.4714	0	1	3324	.6691	.4706	0	1	1074	.6452	.4787	0	1
Manufacturing	6091	.4831	.4997	0	1	3375	.4839	.4998	0	1	1093	.4382	.4964	0	1
Retail	6091	.1999	.3999	0	1	3375	.2107	.4078	0	1	1093	.2900	.4540	0	1
Other_Service	6091	.3169	.4653	0	1	3375	.3055	.4607	0	1	1093	.2717	.4451	0	1

Table 3 Probit regression results of innovation, bribes and gender

	Product inno	Process inno.	Product inno	Process inno
Variables	eprobit (Endogenous covariates and non-random treatment assignment)- Female owners		eprobit (Endogenous covariates and non-random treatment assignment)- Female top managers	
Innovation eq.	1	2	3	4
Bribes	-.0311***	-.0211*	-.0322***	-.0217**
	(.0090)	(.0126)	(.0087)	(.0122)
Female	.0506	.0406	.0649	-.0484
	(.0339)	(.0367)	(.0404)	(.0456)
Female#bribes	.0012	.0034*	.0005	.0014
	(.0018)	(.0020)	(.0022)	(.0025)
Small	-.0935	.0506	-.0902	.0520
	(.1552)	(.1705)	(.1518)	(.1681)
Medium	.0720	.2151	.0738	.2080
	(.1559)	(.1726)	(.1525)	(.1703)
Large	.1460	.3743**	.1569	.3676**
	(1592)	(.1778)	(1560)	(.1758)
Foreign_Own	.0020*	-.0001	0019***	-.0004
	(.0007)	(.0007)	(.0006)	(.0001)
Firm_Age	-.0002	-.0014	-.0001	-.0010
	(.0009)	(.0009)	(.0008)	(.0009)
Mgr_Exp	-.0006	0031**	-.0002	.0024*
	(.0012)	(.0014)	(.0012)	(.0014)
Export%	.0007	.0015**	.0006	.0015*
	(.0007)	(.0008)	(.0007)	(.0007)
R&D	.5327***	.5543***	.5212***	.5440***
	(.0740)	(.0656)	(.0744)	(.0677)
Bank_Fin%	.0017**	.0002	.0016**	.0002
	(.0006)	(.0006)	(.0006)	(.0006)
Corrup_Obs	.0161	-.0877	.0182	-.1224
	(.1721)	(.2302)	(.1680)	(.2243)
Cons	-.0532	-.7110**	-.0524	-.6353**
	(.2197)	(.2883)	(.2144)	(.2824)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Corrup_Obs eq.				
Fin_Obs	.4031***	.4036***	.4046***	.4052***
	(.0038)	(.0338)	(.0336)	(.0336)
Cons	.2545***	.2543***	.2504***	.2501***
	(.0225)	(.0225)	(.0223)	(.0223)
Bribes% eq.				

Avg_bribes	.9788***	.9764***	.9669***	.9634***
	(.1379)	(.1397)	(.1357)	(.1378)
Avg_Mgr_Time	-.0399	-.0153	-.0305	-.0026
	(.0763)	(.0797)	(.0748)	(.0785)
Cons	.0655	-.3194	-.0421	-.4755
	(1.269)	(1.251)	(1.261)	(1.238)
var(bribes)	280.17	280.15	278.95	278.92
	(14.29)	(14.29)	(14.18)	(14.17)
Summary statistics				
Observations	5,470	5,470	5,530	5,530
Wald chi2	1033.1***	842.14***	1114.14***	896.85***
Log pseudolikelihood	-29846	-29833	-30158	-30155
corr(e.corru_obs,e.I)	.2434**	.1892**	.2546**	.2249*
	(.1161)	(.1600)	(.1123)	(.1537)
corr(e.bribes,e.I)	.5470***	.3799**	.5743***	.4145**
	(.1491)	(.2091)	(.1414)	(.2013)
corr(e.bribes,e.corru_obs)	.3723***	.3715***	.3731***	.3720***
	(.0289)	(.0286)	(.0285)	(.0283)

*Note: Column 1 and 2 report eprobit results with endogenous covariate and non-random treatment effects for female owners. Column 3 and 4 report eprobit results with endogenous covariate and non-random treatment effects for female top managers. Standard errors are in parentheses. * Significant at 10% level, **Significant at 5% level, ***Significant at 1% level.*

Table 4: Predictive margins for innovation, bribes and gender

	Female Owners		Female top managers	
	Product Margin	Process Margin	Product Margin	Process Margin
at#female	1	2	3	4
1 0	.5747*** (.0151)	.4050*** (.0309)	.4178*** (.0294)	.5834*** (.0119)
1 1	.5960*** (.0126)	.4204*** (.0297)	.3993*** (.0339)	.6111*** (.0166)
2 0	.5786*** (.0285)	.4082*** (.0203)	.4257*** (.0199)	.5900*** (.0286)
2 1	.6049*** (.0305)	.4366*** (.0221)	.4127*** (.0233)	.6156*** (.0332)

3 0	.5826*** (.0657)	.4116*** (.0661)	.4338*** (.0666)	.5967*** (.0650)
3 1	.6139*** (.0677)	.4531*** (.0702)	.4263*** (.0677)	.6202*** (.0684)
4 0	.5867*** (.1034)	.4150*** (.1133)	.4421*** (.1143)	.6035*** (.1015)
4 1	.6230*** (.1049)	.4699*** (.1197)	.4403*** (.1159)	.6250*** (.1046)
5 0	.5910*** (.1411)	.4188*** (.1610)	.4508*** (.1624)	.6105*** (.1377)
5 1	.6322*** (.1416)	.4868*** (.1694)	.4547*** (.1650)	.6299*** (.1407)
6 0	.5954*** (.1786)	.4226** (.2089)	.4597** (.2107)	.6175*** (.1735)
6 1	.6414*** (.1716)	.5040** (.2191)	.4694** (.2144)	.6350*** (.1766)
7 0	.6000*** (.2159)	.4266* (.2571)	.4689* (.2591)	.62473*** (.2087)
7 1	.6507*** (.2129)	.5213* (.2683)	.4843* (.2639)	.6401*** (.2121)
8 0	.6046*** (.2529)	.4308 (.3054)	.4783 (.3075)	.6319*** (.2435)
8 1	.6599*** (.2479)	.5387* (.3168)	.4995 (.3131)	.6453*** (.2472)
9 0	.6093** (.2896)	.4351 (.3538)	.4879 (.3559)	.6392** (.2777)

9 1	.6692** (.2808)	.5561 (.3642)	.5148 (.3619)	.6506** (.2819)
10 0	.6141** (.3260)	.4394 (.4024)	.4975 (.4041)	.6465** (.3113)
10 1	.6785** (.3133)	.5736 (.4104)	.5302 (.4100)	.6560** (.3161)
11 0	.6189* (.3620)	.4438 (.4512)	.5073 (.4521)	.6538* (.3442)
11 1	.6876* (.3448)	.5909 (.4550)	.5457 (.4572)	.6613* (.3497)

*Note: N=5,470 obs. for process inno; N=5,530 obs. for product inno. *1.at: bribes=0, 2. at bribes= 10, 3. at bribes= 20, 4. at bribes= 30, 5. at bribes= 40, 6. at bribes= 50, 7. at bribes= 60, 8. at bribes= 70, 9. at bribes= 80, 10. at bribes= 90, 11. at bribes= 100. Female =1 if female and 0 otherwise Standard errors are in parentheses. * Significant at 10% level, **Significant at 5% level, ***Significant at 1% level.*

Table 5A: Predictive margins: Bribes and female ownership as dummy variables

Panel A: Expression: Pr(Product=1)							
		Margins	Std. Err.	z	p>|z|	95% Conf. Interval	
Group	Bribes# Female						
1	0 0	.5599	.0213	26.28	0.000	.5181	.6016
2	0 1	.5996	.0185	32.35	0.000	.5633	.6360
3	1 0	.6337	.1737	3.65	0.000	.2933	.9742
4	1 1	.6635	.1734	3.83	0.000	.3235	1.003
Panel B: Expression: Pr(Process=1)							
		Margins	Std. Err.	z	p>|z|	95% Conf. Interval	
Group	Bribes# Female						
1	0 0	.3857	.0357	10.81	0.000	.3157	.4556
2	0 1	.4261	.0356	11.97	0.000	.3563	.4959
3	1 0	.4793	.2009	2.39	0.017	.0854	.8731
4	1 1	.5076	.2067	2.46	0.014	.1025	.9127

Table 5B: Predictive margins: Bribes and female top management as dummy variables

Panel A: Expression: Pr(Product=1),						
		Margins	Std. Err.	z	p>|z|	95% Conf. Interval

Group	Bribes# Female						
1	0 0	.5850	.0180	32.56	0.000	.5498	.6202
2	0 1	.5771	.0221	26.14	0.000	.5338	.6203
3	1 0	.6541	.1688	3.87	0.000	.3231	9850
4	1 1	.6379	.1771	3.60	0.000	.2909	.9850
Panel B: Expression: Pr(Process=1)							
		Margins	Std. Err.	z	p>|z|	95% Conf. Interval	
Group	Bribes# Female						
1	0 0	.4193	.0346	12.11	0.000	.3514	.4872
2	0 1	.3610	.0387	9.33	0.000	.2852	.4369
3	1 0	.5072	.2020	2.51	0.012	.1112	.9032
4	1 1	.4306	.1985	2.17	0.030	.0415	.8196

Note to Tables 5A and B: In Group 1, Bribes# Female = 0 0 indicates male who does not pay bribes. The other groups are defined similarly. N=5,462 obs. for process inno; N=5,522 obs. for product inno.

Table 6A Probit regression results of innovation, bribes and gender controlled institutional environment

	Product inno	Process inno.	Product inno	Process inno
Variables	eprobit (Endogenous covariates and non-random treatment assignment)- Female owners		eprobit (Endogenous covariates and non-random treatment assignment)- Female top managers	
Innovation eq.	1	2	3	4
Bribes	-.0221** (.0107)	-.0034 (.0135)	-.0243** (.0105)	-.0045 (.0137)
Female	.0642* (.0386)	.0550 (.0420)	.0605 (.0475)	.0049 (.0542)
Female#bribes	.0018 (.0020)	.0026 (.0022)	-.0001 (.0026)	.0006 (.0030)
Small	-.1914 (.1822)	.1335 (.1931)	-.1851 (.1774)	.1331 (.1925)
Medium	-.0264 (.1822)	.2952 (.1942)	-.0220 (.1772)	.2913 (.1925)
Large	.0176 (.1854)	.4457** (.1975)	.0327 (.1803)	.4431** (.1972)
Foreign_Own	.0026*** (.0008)	-4.69e-06 (.0008)	.0023*** (.0007)	-.0006 (.0007)
Firm_Age	-.0007 (.0010)	-.0023** (.0011)	-.0004 (.0009)	-.0017 (.0011)
Mgr_Exp	-.0005 (.0014)	.0031** (.0016)	-.0001 (.0014)	.0027* (.0016)
Export%	.0011 (.0008)	.0020** (.0009)	.0009 (.0008)	.0021*** (.0009)
R&D	.6104*** (.0745)	.5905*** (.0509)	.5910*** (.0780)	.5887*** (.0523)
Bank_Fin%	.0019*** (.0007)	.0007 (.0007)	.0018*** (.0007)	.0006 (.0523)
Corrup_Obs	-.2247 (.1950)	-.3364 (.2497)	-.2145 (.1886)	-.3334 (.2438)
Cons	-2.035*** (.6290)	-3.077*** (.6457)	-1.833*** (.6097)	-2.888*** (.6428)
Rule_Law	6.053*** (1.652)	7.097*** (.1.671)	5.5808** (1.608)	6.779*** (1.657)
GDP	.0002* (.0001)	.0002** (0001)	.00028* (.0001)	.0003*** (.0001)
Political_Rights	.2402*** (.0550)	.2509*** (.0536)	.2273*** (.0545)	.2440*** (.0537)

Property_Rights	-.2018** (.0819)	-,2316*** (.0892)	-.2007** (.0798)	-.2654*** (.0885)
Individualism	-.0257*** (.0040)	-.0307*** (.0038)	-.0251*** (.0040)	-.0311*** (.0038)
Industry dummies	Yes	Yes	Yes	Yes
Corrup_Obs eq.				
Fin_Obs	.4174*** (.0374)	.4193*** (.0373)	.4199*** (.0372)	,4217*** (.0372)
Cons	.2906*** (.0250)	.2899*** (.0250)	.2838*** (.0249)	.2831*** (.0249)
Bribes% eq.				
Avg_bribes	1.228*** (.2098)	1.236*** (.2107)	1.184*** (.2049)	1.193*** (.2056)
Avg_Mgr_Time	-.2385** (.1116)	-.2074** (.1150)	-.2225** (.1079)	-.1854** (.1123)
Cons	2.110 (1.619)	1.554 (.1.557)	2.046 (1.607)	1.385 (1.536)
var(bribes)	295.80 (16.11)	295.81 (.16.11)	293.33 (15.97)	293.34 (15.97)
Summary statistics				
Observations	4513	4513	4564	4564
Wald chi2	728.81***	584.26***	801.65***	600.78
Log pseudolikelihood	-24676	-24687	-24939	-24955
corr(e.corru_obs,e.I)	.3489*** (.1266)	.2276* (.1766)	.2546** (.1123)	.2249* (.1537)
corr(e.bribes,e.I)	.4214*** (.1818)	1164* (.2343)	.5743*** (.1414)	.4145** (.2013)
corr(e.bribes,e.corru_obs)	.3814*** (.0313)	.3783*** (.0313)	.3731*** (.0285)	.3720*** (.0283)

Note: Column 1 and 2 report eprobit results with endogenous covariate and non-random treatment effects for female owners. Column 3 and 4 report eprobit results with endogenous covariate and non-random treatment effects for female top managers. Following institutional variables include in all regressions.

Rule of law (Rule_Law): This is a continuous variable, Scores range from 0 to 1, with 1 indicating the strongest adherence to the rule of law https://worldjusticeproject.org/our-work/research-and-data/wjp-rule-law-index-2017%E2%80%932018

GDP per capita (GDP) are in current international dollars, and rounded up or down to the nearest whole number. Higher GDP means more economic power of economy https://www.thebalance.com/gdp-per-capita-formula-u-s-compared-to-highest-and-lowest-3305848

Political rights index (Political_Rigths)- Political rights index, 7 (weak) - 1 (strong), 2017 https://www.theglobaleconomy.com/rankings/political_rights/

Property rights index- (Property)Rights)- The property rights index measures the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. Higher scores are more desirable, i.e. property rights are better protected (https://www.theglobaleconomy.com/rankings/herit_property_rights/)

Individualism Index (Individualism)- Scores range from 0 to 100. Higher score means high individualism https://www.hofstede-insights.com/product/compare-countries/

*Standard errors are in parentheses. * Significant at 10% level, **Significant at 5% level, ***Significant at 1% level.*

Table 6B: Predictive margins for innovation, bribes and gender

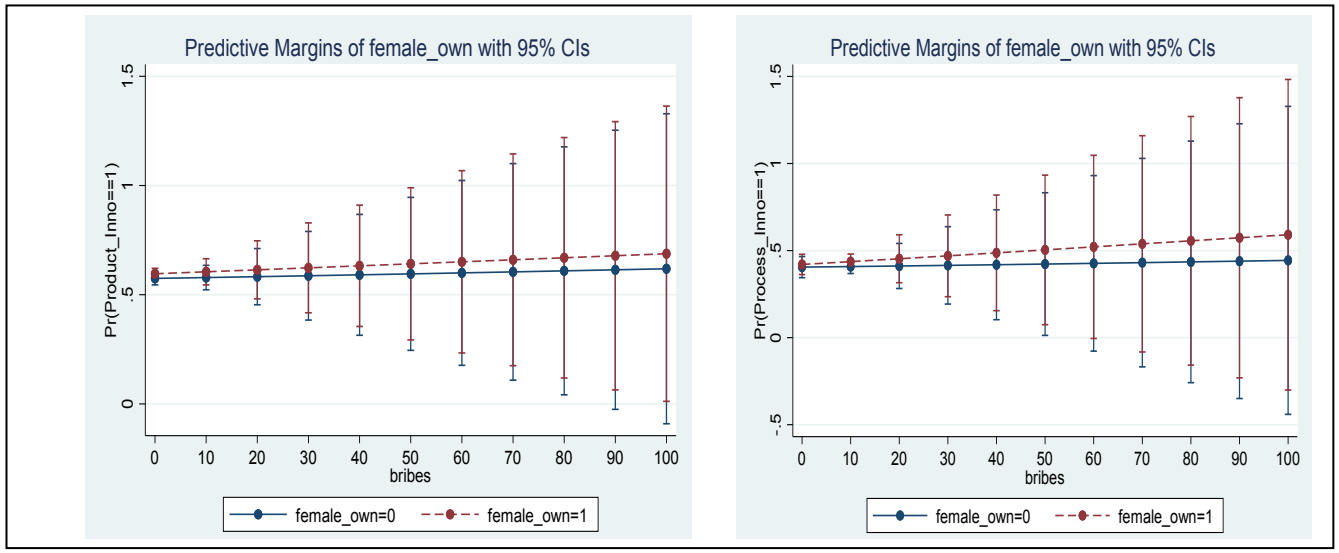
	Female Owners		Female top managers	
	Product Margin	Process Margin	Product Margin	Process Margin
at#female	1	2	3	4
1 0	.5698*** (.0193)	.4118*** (.0279)	.5812*** (.0159)	.4220*** (.0274)
1 1	.5951*** (.0169)	.4308*** (.0275)	.6054*** (.0207)	.4237*** (.0332)
2 0	.5681*** (.0283)	.4135*** (.0247)	.5827*** (.0294)	.4280*** (.0242)
2 1	.6006*** (.0302)	.4425*** (.0252)	.6067*** (.0341)	.4319*** (.0286)
3 0	.5670*** (.0696)	.4164*** (.0713)	.5849*** (.0709)	.4346*** (.0730)
3 1	.6068*** (.0716)	4548*** (.0734)	.6086*** (.0740)	.4407*** (.0752)
4 0	.5665*** (.1117)	.4199*** (.1194)	.5877*** (.1127)	.4418*** (.1227)

4 1	.6136*** (.1130)	.4678*** (.1229)	.6111*** (.1153)	.4502*** (.1251)
5 0	.5668*** (.1538)	.4241** (.1678)	.5912*** (.1542)	.4497*** (1727)
5 1	.6210*** (.1540)	.4815*** (.1727)	.6143*** (.1566)	.4603*** (1757)
6 0	.5678*** (.1956)	.4289** (.2164)	.5959*** (1542)	.4582** (2228)
6 1	.6290*** (.1941)	.4958** (.2224)	.6143*** (.1566)	.4710** (2265)
7 0	.5694** (.2372)	.4343* (.2652)	.6001** (.2359)	.4673* (.2730)
7 1	.6375*** (.2339)	.5106** (.2717)	.6225** (.2379)	.4823** (.2772)
8 0	.5715** (.2783)	.4402 (3141)	.6052** (.2758)	.468 (.3231)
8 1	.6463** (.2715)	.5259 (.3204)	.6273** (.2777)	.4941 (.3278)
9 0	.5740** (.3191)	.4464 (.3630)	.608** (.3151)	.4868 (.3730)
9 1	.6554** (.3084)	.5415 (.3682)	.6325** (.3167)	.5063 (.3780)
10 0	.5767 (.3593)	.4529 (.4118)	.6165** (.3535)	.4970 (.4226)
10 1	.6646** (.3439)	.5572 (.4148)	.6378** (.3548)	.5187 (.4275)
11 0	.5796 (.3989)	.4597 (.4605)	.6223 (.3911)	.5074 (4715)
11 1	.6737* (.3781)	.5730 (.4599)	.6432 (.3921)	.5312 (.4762)

Table 7: Predictive margins

Panel A	High GDP		Low GDP		High individualism		Low individualism	
	Product Margin	Process Margin	Product Margin	Process Margin	Product Margin	Process Margin	Product Margin	Process Margin
Bribes# Female owners								
0 0	.5971*** (.0664)	.4500*** (.0399)	.4895*** (.0827)	(not estimable)	.5697*** (.0919)	.4230*** (.0548)	.6533*** (.0616)	.4703*** (.0677)
0 1	.6085*** (.0679)	.4459*** (.0344)	.5103*** (.0833)	(not estimable)	.5336*** (.0766)	.4017*** (.0441)	.7106*** (.0842)	.5332*** (.0794)
1 0	.5971** (.2407)	.5417* (.3010)	.5186** (.2629)	(not estimable)	.5202 (.5310)	.5210 (.5421)	.6897** (.3061)	.5124** (.2368)
1 1	.6710*** (.2099)	.5670** (.2971)	.6971*** (.2330)	(not estimable)	.5754 (.5074)	.4466 (.5636)	.8286*** (.2168)	.6518*** (.2188)

*Note: Bribes= 1 if paying bribes 0 otherwise. Female =1 if female and 0 otherwise. Standard errors are in parentheses. * Significant at 10% level, **Significant at 5% level, ***Significant at 1% level. N=288 observations.*


Predictive Margins of female_own with 95% CIs
Pr(Product_Inno==1)
0
.5
1
1.5
0
10
20
30
40
50
60
70
80
90
100
bribes
female_own=0
female_own=1
Predictive Margins of female_own with 95% CIs
Pr(Process_Inno==1)
-.5
0
.5
1
1.5
0
10
20
30
40
50
60
70
80
90
100
bribes
female_own=0
female_own=1

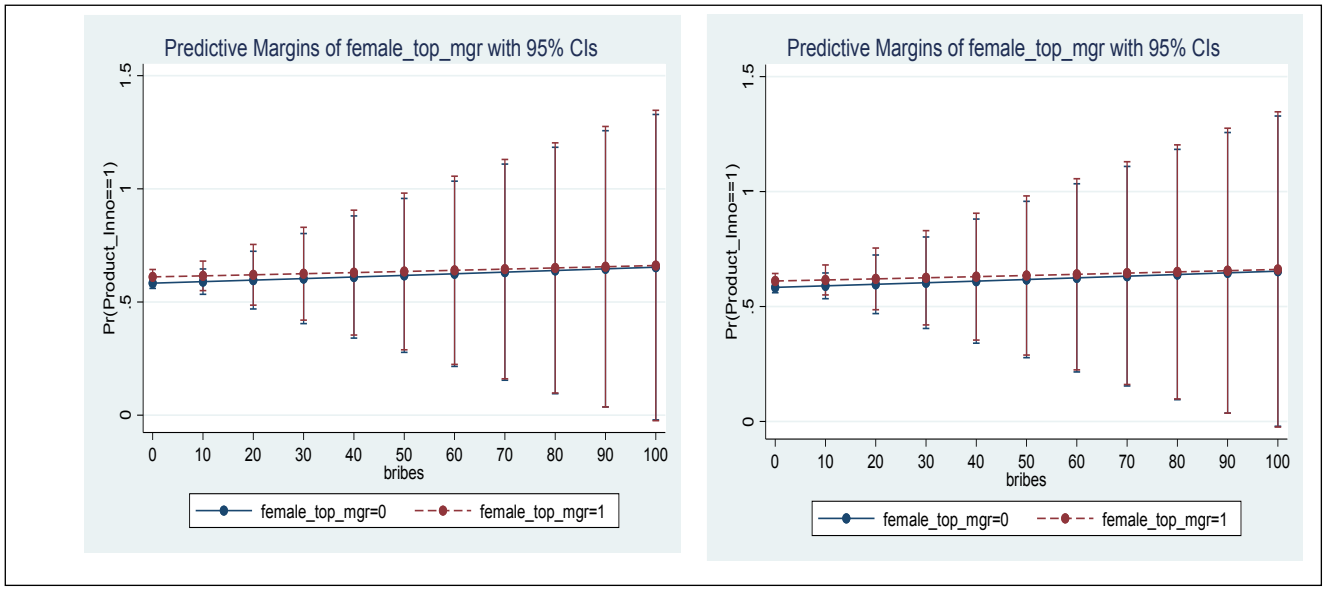

Predictive Margins of female_top_mgr with 95% CIs
Pr(Product_Inno==1)
0
.5
1
1.5
0
10
20
30
40
50
60
70
80
90
100
bribes
female_top_mgr=0
female_top_mgr=1
Predictive Margins of female_top_mgr with 95% CIs
Pr(Product_Inno==1)
0
.5
1
1.5
0
10
20
30
40
50
60
70
80
90
100
bribes
female_top_mgr=0
female_top_mgr=1

Figure 1A

Figure 1B

Figure 1: Firm-level innovation, gender and percentage of bribes payment to total sales