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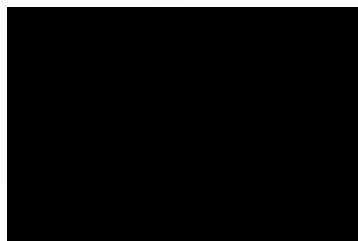
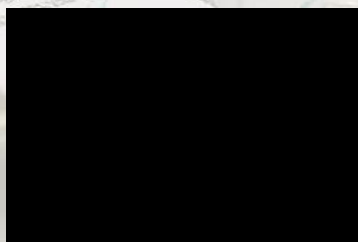
Macroeconomic Policy and Financing for Development Division

# WHAT'S GENDER GOT TO DO WITH FIRM PRODUCTIVITY? EVIDENCE FROM FIRM LEVEL DATA IN ASIA

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Steve Loris Gui-Diby , S. Selsah Pasali and  
Diana Rodriguez-Wong



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## Contents

<b>I. INTRODUCTION .....</b>	<b>2</b>
<b>II. LITERATURE REVIEW .....</b>	<b>3</b>
<b>III. ESTIMATION STRATEGY AND DATA ISSUES.....</b>	<b>5</b>
<b>A. METHODOLOGY .....</b>	<b>5</b>
<b>B. DATA ISSUES .....</b>	<b>7</b>
<b>IV. DESCRIPTIVE ANALYSES.....</b>	<b>8</b>
<b>V. EMPIRICAL RESULTS.....</b>	<b>12</b>
<b>VI. POLICY IMPLICATIONS .....</b>	<b>16</b>
<b>VII. CONCLUSION.....</b>	<b>19</b>
<b>REFERENCES.....</b>	<b>21</b>
<b>APPENDIX .....</b>	<b>23</b>

## Tables and Figures

TABLE 1: DESCRIPTIVE STATISTICS.....	9
TABLE 2: DESCRIPTIVE STATISTICS BY TYPE OF FIRMS .....	11
TABLE 3: COMPARISONS OF MEANS OF FINANCIAL CONSTRAINT MEASURE AND PRODUCTIVITY LEVEL BY GENDER VARIABLES.....	12
TABLE 4: REGRESSION ANALYSES OF SALES PER WORKER (LEVEL), GENDER VARIABLES AND OBJECTIVE MEASURE OF FINANCIAL CONSTRAINTS - OLS.....	14
TABLE 5: REGRESSION ANALYSES OF THE LEVEL OF SALES PER WORKER, GENDER VARIABLES AND THE OBJECTIVE MEASURE OF FINANCIAL CONSTRAINTS – TWO-STEP APPROACH .....	15
 FIGURE 1. GENDER GAPS BY INDUSTRY IN THE SAMPLE .....	 33
FIGURE 2. SHARE OF TIME SPENT ON PRODUCTIVE ACTIVITIES .....	33
FIGURE 3. GENDER EQUALITY IN LAWS AND REGULATIONS.....	34



**MPFD Working Papers**  
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## **What's Gender Got to Do with Firm Productivity? *Evidence from Firm Level Data in Asia\****

By  
Steve Loris Gui-Diby , S. Selsah Pasali and Diana Rodriguez-Wong

### Abstract

The views expressed in this Working Paper are those of the author(s) and should not necessarily be considered as reflecting the views or carrying the endorsement of the United Nations. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate. This publication has been issued without formal editing.

This paper attempts to shed some light on the relationship between gender, financial constraints and productivity. It uses firm-level data from 23 Asian countries, and models with correction of selection biases. On the basis of an objective measure of financial constraint, this paper finds that the provision of adequate funds by financial institutions is important for productivity but gender is not a significant explanatory factor of productivity and female-owned enterprises are not necessarily more credit-constrained than male-owned enterprises. It is concluded that the impact of gender on productivity is not direct but mostly indirect through key drivers of productivity. The paper thus stresses the need, for governments, to address challenges related to sectoral segregation, gender-based discrimination, uneven time spent on non-productive activities, and transition from informal sector to formal sector as they are related to key drivers of productivity.

**Keywords:** firm performance, gender equality, women's economic empowerment, productivity, entrepreneurship, financial constraints, fixed effects estimator.

**JEL Classification:** J16, L25, L26.

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## I. Introduction

The 2030 Agenda for Sustainable Development, with its emphasis on inclusive development, requires renewed thinking on how long-term economic expansion can be more inclusive and leave no one behind. For the Asia-Pacific region, this is an ever more important consideration as recent economic trends have seen a decline in economic growth since 2010 - which is expected to plateau during the next two years - and a decline in productivity growth (UNESCAP, 2016). Findings from UNESCAP (2016) stress the critical importance of domestic aggregate demand and the need for productivity growth. Furthermore, the role of financing to spur productivity growth in small and medium enterprises is particularly highlighted.

However, the report does not examine what role female-owned firms could play in increasing productivity growth, and if financing is a stringent constraint for female-owned enterprises. This role could be important because, according to the under-performance hypothesis for example, female-owned firms are less productive than male-owned firms (Coleman, 2000; Du Rietz & Henrekson, 2000; Sabarwal & Terrell, 2008), meaning that closing the productivity gap could add benefits to the economy. Following this argument, a critical factor to boost the performance of female-owned firms is financing. Overall, research findings suggest that female entrepreneurs are generally more credit-constrained than their male counterparts (Coleman & Robb, 2009; Tur-Pocar, Mas-Tur, & Belso, 2016; Mijid & Bernasek, 2013). However, empirical evidence on this argument is scarce in the Asia-Pacific region, as observed by the most extensive and recent literature reviews, such as the one done by (Poggesi, Mari, & De Vita, 2016). Thus, our research attempts to fill this gap by focusing on binding constraints faced by female-owned enterprises. Specifically, we investigate whether female-owned firms face larger financial constraints than male-owned firms in the Asia-Pacific region.

The contribution of our paper to the literature is threefold. First, it provides empirical evidence on the female firm underperformance hypothesis by providing a rigorous quantitative analysis on determinants of firm productivity in a panel data setup with three dimensions. Second, exploiting the World Bank's Enterprise Survey to its fullest capacity, our paper analyzes a representative sample of the wider Asia-Pacific region where a large number of female enterprises are opportunity-driven, unlike in Africa and Latin America where necessity-driven entrepreneurship abounds. Three, it uses a measure of financial constraint which is based on the economic account of the interviewee – a more objective measurement - rather than on his or her perception. The study uses firm-level data from twenty three Asian countries which represent about 86% of the total output (2010 prices) of the developing Asia-Pacific region.

For this purpose, the paper is organized as follows: Section II reviews the literature on the existence of financial constraints for female owned-firms and the potential underlying reasons, Section III presents the econometric methods used to address the research question, Section IV presents descriptive analyses of key variables of interest, Section V and VI respectively deal with empirical results, and policy issues which can explain the main results, and Section VII concludes.

## II. Literature Review

Among factors which drive the productivity growth of firms, access to financial capital can be identified as a very important one (Beck, Demirgüç-Kunt, & Maksimovic, 2005). Empirical evidence partially supports the fact that female entrepreneurs are generally more credit-constrained than their male counterparts. (Coleman & Robb, 2009; Tur-Pocar, Mas-Tur, & Belso, 2016; Mijid & Bernasek, 2013). For instance, Bellucci, Borisov, & Zazzaro (2010) find, on the basis of more than 7,800 credit lines of Italian firms in 23 industries, that female-owned firms face constraints in accessing credit. Hansen & Rand (2014) describe similar findings in the case of 16 African countries by using a perception-based credit constraint but the authors do not find differences between male- and female-owned firms on the basis of financial access data. Constraining financial conditions for female-owned firms have not also been confirmed by Watson, Newby, & Mahuka (2009) in the case of Australian firms or by Marco (2012) in the hotel industry of Spain. These mixed results can be partially explained by the existence of “supply-side” and “demand-side” factors.

On the supply side, female-owned firms may face difficulties in accessing credit because their activities are perceived to present higher risks. As a result, banks require female-owned firms to put-up higher levels of collateral; or provide loans with unfavorable interest rates (Coleman, Access to capital and terms of credit: A comparison of men- and women-owned small businesses, 2000). Coleman (2000)’s findings in the case of US firms are also corroborated by Fletshner (2009) in Paraguay in rural areas, Hansen & Rand (2014) in 16 sub-Saharan African countries on the basis of perception-based measure of credit constraints, and Muravyev, Talavera, & Schäfer (2009) in a set of 26 countries from Eastern Europe and Central Asia. This situation can be explained by the small size of female-owned firms, the recorded and potential low productivity of these firms in sectors with low profitability and growth potential, and the existence of asymmetric information between the bank and the potential borrower. For instance, given that the loan officers are generally male, the prevalence of gender norms in many societies on women’s success in business can potentially influence his professional opinion when making lending decisions.

Women generally own small sized firms; the size being measured in number of employees and level of sales (Coleman, 2007; Amin, 2010). This often means that the quality of assets that can be put forward as collaterals is adversely affected, and there is an information asymmetry between potential borrowers and banks because reporting requirements (accountancy) for small size firms are lower (Coleman, 2000). Amin (2010) suggests that women, in Burkina Faso, Cameroon, Cabo Verde, Côte d’Ivoire, Madagascar and Mauritius, are more likely to operate firms from their household’s premise because they would like to maintain a balance between their professional and family lives as women are more often than not the primary caregivers of the family.

Banks can also be reluctant to provide loans to female owned-firms because, according to the under-performance hypothesis, female-owned firms are less productive than male-owned firms (Coleman, 2000; Du Rietz & Henrekson, 2000; Sabarwal & Terrell, 2008). As a result, lenders are more likely to foresee lower profitability levels and to propose unfavorable loan conditions, or they are more likely to reject loan applications from female-owned firms.

This treatment of loan applications from female-owned firms could be related to the sector of the firm, its location, or the lack of bank records. In fact, according to Coleman (2000) and Marlow & McAdam (2013), female-owned firms are mostly concentrated in the service sector and the latter is considered to provide low returns and to require less assets that can be used as collateral. Furthermore, as female-owned firms are generally operated from home to accommodate caring responsibilities and economic activities (Marlow & McAdam, 2013), lenders could also question their capacity to efficiently run their productive unit with household duties being perceived as a barrier to women's entrepreneurship (Tur-Pocar, Mas-Tur, & Belso, 2016). Concerning bank records and the existence of the long-term relationship between the bank and the female-owned firm, Coleman (2000) stresses that firms which built a history of its transactions in a bank were more likely to borrow money and to have better credit conditions. However, Amin (2010) reports that female entrepreneurs are less likely to have bank account in several African countries, and it would then prevent them from having access to financial services.

While the supply-side discussion has yielded insights on the lending process and whether or not lending institutions are biased against female-owned enterprises, according to Poggesi, Mari, & De Vita (2016), scholars generally agree that gender-based discriminatory behavior from financing institutions is not the most important factor. In fact, studies which do not confirm the role of gender as a discriminatory factor in the access to loans also exist (Hansen & Rand, 2014; Watson, Newby, & Mahuka, 2009).

The low demand for loans from female-owned firms can also contribute to the explanation of the low usage of financial products as Watson, Newby, & Mahuka (2009) point out that SMEs can consciously or unconsciously decide not to apply for loans. To explain differences in gender-based financing outcomes, the literature turns to "demand-side" factors, in particular, "*self-discriminatory factors*".

These factors pose that women could be more risk adverse, and reluctant to apply for loans (Coleman, 2000). In addition, women may not need loans because their firms are small. They can thus finance the expansion of their firms as well as initial start-up investment by using personal resources (Coleman & Robb, 2009). To explain this pattern, Alfonso-Almeida (2013) suggests that different studies use different feminist theories such as the *liberal feminist approach* or the *social feminist approach* as starting points.

The *liberal feminist approach* states that men and women are equal in all their capacities and that observed differences are due to structural discrimination factors such as education choices, different employment opportunities, more limited social networks or less access to mentorship. On the other hand, the *social feminist approach* states that men and women are not the same because they have been shaped by different social forces and undergone different socialization processes that influence different behavioral patterns (Alfonso-Almeida, 2013). These theories, which can be considered as complementary (Fischer, Reuber, & Dyke, 1993), underpin self-limiting behaviors whereby women may perceive their chances of success differently, constraining the risks they take and the business opportunities they decide to pursue.



Thus, on one hand, the social feminism approach stresses the psychological component of the determinants of entrepreneurship can shed some light on the lower propensity of women to take risk, or their lower self-confidence (Fischer, Reuber, & Dyke, 1993). And on the other hand, on the basis of the liberal feminism approach, a lower access to training institutions<sup>1</sup>, that which help developing entrepreneurial behaviors in mathematics or business management, could affect the capacity of women to develop their activities by using financial products.

This brief literature review clearly shows that the question at hand has not yet been satisfactorily answered both theoretically and empirically. In addition, there is lack of evidence from the Asia and the Pacific region which hosts a number of sub-regions each with its unique socio-cultural predisposition toward women's role in the economy. Our paper therefore is long over-due and well positioned to provide some insights as to how female-owned enterprises are performing vis-à-vis male-owned enterprises. Are they less productive than their male-owned counterparts and if so can financial constraints explain the productivity differential? Section III and IV aims to provide as much insights as possible from the region.

### III. Estimation Strategy and Data Issues

#### A. Methodology

To answer to the research question, the empirical strategy of the paper is based on the estimation of ordinary least squares (OLS) estimators which use firm-level data from 23 countries and six main industries. Countries and industries are represented by dummy variables. The base line equation which is estimated is the below:

$$\theta_{ijk} = \alpha + \beta_1 gender_{ijk} + \beta_2 finance_{ijk} + \beta_3 gender_{ijk} \times finance_{ijk} + \beta X_{ijk} + \mu_i + \gamma_k + \varepsilon_{ijk}$$

where  $\theta_{ijk}$  represents firm productivity in country  $i$  firm  $j$  and industry  $k$  and is measured by sales per worker;  $gender$  is a dummy variable that equals 1 if largest owner is female and 0 otherwise;  $finance$  represents the measure of financial constraint and  $X$  is a matrix of standard control variables, including firm age, size, export status, share of foreign ownership in the capital of the firm and year dummies. This set of control variables has been jointly or separately used in the following studies: Dimelis & Louri (2002), Dimelis & Louri (2004), Girma (2005), Coleman (2007) and Waldkirch & Oforu (2010).

In this paper, productivity is measured as the sales per worker instead of total factor productivity. Total factor productivity could not be measured because the dataset contains cross-section data from the most recent surveys organized in the Asian region.

The gender variable is *proxied* by a dummy variable that is equal to one for firms with female

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<sup>1</sup> If such programs do not address time constraints women face on a daily basis emanating from household chores as well as childcare or ensure safety during transportation, it is unlikely they will secure strong participation from women.

ownership exceeding 50 per cent and zero otherwise. Unfortunately, for China, Lao People's Democratic Republic, the Russian Federation and Sri Lanka, the variable "percentage of female ownership" is not available, and dropping these countries from the analysis creates a significant sample selection bias. Thus, an alternative measure which is a loosened version of the above mentioned variable is considered as follows: a dummy variable that equals one if there exists at least one female owner in the firm. To summarize, three key variables are used in the below econometric analyses: the existence of at least one female owner (dummy variable), the fact to be a "female-owned firm" i.e. having the size of female ownership above 50 percent (dummy variable); and the size of female ownership (continuous variable).

For the financial constraint measure, while Fletshner (2009) and Hansen & Rand (2014) use a perception-based measure, the paper is based on an objective measure which is the share of assets purchased without support from financial institutions. In fact, the World Bank Enterprise Surveys (WBES) requests firms' managers and owners to rate the perceived level of financial constraint on a scale from zero to 4; zero being "finance not being a constraint" to four being "finance being a very severe constraint." However, we assume that their perception of finance as a financial constraint may not be reliable because they may be past loan applicants who fail to receive loans and are no longer requesting loans even though they need them, or they may not be financially literate.

The above coefficients are estimated on the basis of OLS because the time dimension is not available as in panel data. This equation is re-estimated in two sub-regions (North and Central Asia and South-South West Asia) because of their well-balanced country representation, and for each country being covered in this study. Because the OLS method is not the most efficient estimation method, different models are tested on the basis of the above mentioned gender variables (three options), robust standard errors are computed and different estimation methods are tested.

Our baseline specification and the proposed use of OLS to estimate coefficients suffer from some weaknesses related to the existence of endogeneity and selection bias issues, and the absence of a time component.

First, there are endogeneity issues. It is not easy to argue that all the independent variables are fully exogenous; excluding a variable such as "female-owned enterprises" because it is based on an arbitrary rule of 50 percent of ownership of the capital with some random component at least around the threshold. Furthermore, as foreign investors choose the most productive firms for their investment (Damijan & Knell, 2005; Guadalupe, Kuzmina, & Thomas, 2012), and some of the independent variables used in the baseline model can also explain the decision to invest (foreign investors), there is an endogeneity issue between productivity and foreign ownership as well as a selection bias. To address those issues, estimators derived from an instrumental variables (IV) approach and a two-step Heckman based approach could be used. The two-step approach aims at determining analytical weights for each observation. As in Damijan & Knell (2005) and Guadalupe, Kuzmina, & Thomas (2012), these weights are based on the probability to be chosen

by foreign investors or the probability to be a multinational enterprises (MNEs).<sup>2</sup> More research is required to find adequate instruments to perform an IV approach. Even though some variables from WBES may technically qualify as valid instruments, this paper refrains from relying only statistical tests for choosing valid instruments.

There is also a selection bias due to the unavailability of specific questions in some country questionnaires. For instance, our key variable of interest, the female size of ownership in the capital, is not available in four countries; among which China and the Russian Federation two economies which are the most important ones in their sub-regions. It is unfortunately not possible to deal with this issue.

Another selection bias may be related to the fact that women could also be more likely to invest in specific sectors or industries as pointed out by Coleman (2000) and Marlow & McAdam (2013). The correction of such issue can also on the basis of a selection model which estimates the probability of woman to invest by only the industry.<sup>3</sup>

Second, as surveys are organized at different periods in each country, it is not possible to build a panel-dataset. As firms are not observed over time, it is not possible to control for time-invariant unobservable firm characteristics. One option could have been to transform our strategy into pseudo-panel setup by collapsing firms by industries within countries. However, given the size of samples, this pseudo-panel would have potentially suffer from a low number of observations.

Third, the above mentioned methods fail to capture correlations across clusters. While we would hope to cluster standard errors two-way by industry and country, we refrain from implementing such approach as there is only a limited number of categories and it can potentially jeopardize the results if clustered. Recent techniques such as bootstrapping for two-way models can be used in the future.

## **B. Data issues**

In this paper, we make use of a variety of data sets at two different levels. First, we use firm-level data from the World Bank Enterprise Surveys in an effort to investigate productivity differentials across gender of the owner(s) of the firm and whether financial constraints have anything to do with such differentials. Second, we use country-level data from a variety of sources, including the Women, Business and the Law database in an effort to shed further light into the relationships between financial inclusion and formal as well as informal institutions that matter for women's entrepreneurship opportunities.

For the firm-level analysis, among the 32 Asia-Pacific countries having World Bank Enterprise Surveys, 23 countries have been selected because the available for a recent survey, and the

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<sup>2</sup> The selection model explains the status of “multinational enterprise (MNE)” by the belonging of the firm to a group, the existence of R&D activities, the productivity level three years ago, country and industry dummy variables. This selection model is replicated at the national level. Firms with foreign ownership below 10% are not MNEs.

<sup>3</sup> The full sample is used for this model and country dummy variables also included. This selection model is replicated at the national level.

existence of key variables in their data sets. The sample is thus made up of 29,312 firms from 23 countries including Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, China, Georgia, India, Indonesia, Kazakhstan, Kyrgyzstan, Lao PDR, Mongolia, Nepal, Pakistan, Philippines, the Russian Federation, Sri Lanka, Timor-Leste, Turkey, Vietnam and Uzbekistan. Given sub-regional categorization of UNESCAP, there is a well representation of the South and South West sub-region followed by North and Central Asia.

In terms of period coverage, our master data set spans the period between 2009 and 2015 with over 95 per cent of our data coming from 2012 and onward. There is large variation in terms of surveyed firms across the countries included in our sample with Timor-Leste providing as low as 126 firms, while India with over 9,000 firms.

The questionnaire of the 2013 Survey organized in Bangladesh is used as the reference questionnaire for the identification of questions in other 22 countries. The list of questions, from which variables are derived, is attached in Appendix 1.

For harmonization purposes, there are six major industries that are used in the analysis: manufacturing, construction, wholesale retail trade, hotel and restaurants, transportation, storage and communication and real estate. The sample has 60 per cent of the firms in the manufacturing industry and 20 per cent from hotel and restaurant industry.

#### **IV. Descriptive analyses**

Table 1 and Table 2 provide summary statistics for all variables that are used in the empirical specification. While Table 1 provides summary statistics for all firms across 23 countries, and six industries,<sup>4</sup> Table 2 reports the variables by three types of firms: (i) firms with at least one female owner, (ii) firms with majority female ownership and there can be considered as female-owned (FO) enterprises; and (iii) firms with female top manager.

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<sup>4</sup> It is implicitly assumed that the most recent survey represents an accurate picture of the country.

**Table 1. Descriptive statistics**

VARIABLES	N	Mean	Standard deviation	Min	Max
Sales per worker - Level	23,735	34,020	41,268	552.8	226,894
Sales per worker - Growth	20,777	1.715	38.05	-82.09	178.0
Existence of female shareholders*	28,991	0.291	n.a.	0	1
Female shareholder above 50% of capital *	25,266	0.0663	n.a.	0	1
Firms with female manager*	29,184	0.139	n.a.	0	1
Financial constraint - Self	28,817	0.295	0.301	0	1
Financial constraint - Objective	28,512	0.946	0.194	0	1
Firm age	28,929	16.84	13.12	0	174
Small size*	29,312	0.393	n.a.	0	1
Medium size*	29,312	0.377	n.a.	0	1
Large size*	29,312	0.222	n.a.	0	1
Foreign ownership share	29,192	3.080	15.65	0	100
VARIABLES	N	Mean	Standard deviation	Min	Max
Government share	29,194	0.698	6.825	0	99
Private domestic share	29,213	95.49	18.63	0	100
Exporting status*	29,103	0.137	n.a.	0	1
Existence of product innovation*	29,144	0.342	n.a.	0	1
Existence of process innovation*	26,462	0.339	n.a.	0	1
Performance of R&D activities*	27,655	0.221	n.a.	0	1

Full sample contains data from World Bank Enterprise Surveys for 23 countries in Asia and the Pacific region by UNESCAP definitions. There are 29,312 firms in total. Missing values affect variables to varying degree as seen above. The size of female ownership is missing for the Russian Federation, China, Sri Lanka and Lao PDR. Dependent variables are trimmed at bottom 1 percentile and top 5 percentile to remove outliers. The same set of control variables are used for each dependent variable. Innovation variables are additional dependent variables.

\* means that it is a categorical variable which is represented as a dummy variable. For this type of variable, standard deviation is not applicable (n.a.) and the mean should be interpreted as the proportion of cases which correspond to the value one.

Table 1 is divided into five panels. The first panel reports summary statistics for our two main proxies for firm productivity, namely sales per worker in level and its growth.<sup>5</sup> Note that each firm is asked about its sales in the last fiscal year and three fiscal years ago. On average, our full sample has positive growth in sales per worker at a modest level with a wide range. Focusing on levels, the average firm in UNESCAP has reach around USD 34,000 in sales per worker. Unfortunately, we lose around 3,000 firms moving from level to growth as these firms do not report sales or employees in either dates.

The second panel of Table 1 displays our gender proxy and shows important disparities in terms of female ownership, female holding the majority of the capital, and firms managed by female. Female owners, no matter how much shares they own in a firm, are not uncommon. In fact, 30 per cent of the firms report at least one female owner. If we factor in size of ownership, then we find that close to 7 per cent of the firms can be considered female-owned enterprises. Female share is a continuous version of the preceding variable. On average, women's size of ownership is less than 10 per cent. Note that there is a drop in observations from female owner to the next two proxies. The reason is because of lack of data from the China, Lao PDR, Russian Federation and Sri Lanka. Finally, on average 14 per cent of the firms report that the top manager is a woman.

<sup>5</sup> All nominal variables originally collected by respective country currency are converted into USD using IMF database on historical exchange rate for each country-year match for mid-year.

Two measures of financial constraints come next. Fortunately, a majority of firms report on all variables that contribute to the creation of these two proxies. The first proxy measures self-perception of the firm's manager or owner. The variable ranges from zero to one with increments of 0.25. Naturally, zero represents firms having no financial constraints and one representing the very severe financial constraints. The average score obtained suggests that financial constraints as self-perceived are not as high as financial constraints objectively captured. For instance, close to 40 per cent of the firms do not report any financial constraints while less than five per cent of the firms reporting very severe financial constraint. Among the remaining 55 per cent, more than half reports minor constraints. In terms of sub-regions, the share of firms which report very severe financial constraints are highest in North and Central Asia followed by South and South-West Asia, while South-East Asia has the highest share of firms that report no financial constraints. When we move to the objective financial constraint, a more uniform picture arises across sub-regions as well as countries in that majority of firms are in fact predominantly financing their assets internally without any support through banks or financial institutions.

Next, consider our set of standard control variables for which almost all countries provide information. The average firm is 17 years old in the wider region with 14 per cent exporting. In terms of size, small and medium size enterprises dominate the region with large size firms representing slightly more than 20 per cent. The majority of the firms are private owned firms with minimal representation from government-owned firms.

The last panel introduces additional dependent variables worth investigating in a study on firm productivity. To the extent that boosting sales per worker would require some kind of innovation, we make use of valuable information readily available for majority of firms on product and process innovation as well as research and development expenditure all of which are binary variables that are equal to one if firms engage in any one of such activities and zero otherwise. Around one-third of firms report having engaged in product or process innovation while just under one-quarter report positive expenditure on research and development (R&D).

**Table 2. Descriptive statistics by type of firms**

VARIABLES	Firms with female shareholders		Female-owned firms		Firms with female manager	
	mean	s.d.	mean	s.d.	mean	s.d.
Sales per worker - Level	37,323	42,363	23,513	33,771	32,363	39,610
Sales per worker - Growth	6.628	39.48	3.755	40.82	5.679	40.00
Financial constraint - Self	0.268	0.297	0.298	0.303	0.293	0.305
Financial constraint - Objective	0.935	0.209	0.955	0.184	0.951	0.183
Firm age	16.79	13.57	15.79	13.25	14.82	11.95
Small size*	0.360	n.a.	0.512	n.a.	0.450	n.a.
Medium size*	0.361	n.a.	0.346	n.a.	0.334	n.a.
Large size*	0.272	n.a.	0.124	n.a.	0.203	n.a.
Foreign ownership share	3.773	16.67	2.425	14.28	3.744	17.24
Government share	1.350	9.791	0.135	2.482	0.326	4.371
Private domestic share	93.83	21.03	95.53	19.53	94.80	20.18
Exporting status*	0.172	n.a.	0.113	n.a.	0.141	n.a.
Existence of product innovation*	0.355	n.a.	0.289	n.a.	0.358	n.a.
Existence of process innovation*	0.358	n.a.	0.293	n.a.	0.345	n.a.
Performance of R&D activities*	0.231	n.a.	0.150	n.a.	0.232	n.a.
Number of observations (N)	8433		1675		4045	

The number of observations reflect the maximum number of firms in each category. As showed in Table 1, there are observations lost to varying degree across different types of firms, particularly for dependent variables with growth rates.

\* means that it is a categorical variable which is represented as a dummy variable. For this type of variable, standard deviation is not applicable (**n.a.**) and the mean should be interpreted as the proportion of cases which correspond to the value one.

Table 2 provides summary statistics for all variables that enter our regressions by types of firms as defined earlier. We refrain to compare them with their respective male category and even between each other. This table merely serves to display various characteristics of different types of firms and comparisons are made to averages obtained in Table 1 with full sample.

Table 1 and Table 2 show that while female-owned enterprises have much lower sales per worker figures, they exhibit much higher growth. More than half are small size enterprises. Less of them are exporting and foreign ownership shares are lower. In addition, objective and subjective financial constraints are higher.

Finally, looking at firms with top female managers, we observe that they maintain higher growth performance even though similar levels in sales per worker are recorded. They are younger and exhibit lower employment growth performance in the past three years.

## V. Empirical Results

Before implementing the above empirical strategy, without controlling other factors, we test the existence of differences between financial constraints and labor productivity observed in female-owned enterprises or and enterprises with female owners, and the ones observed in other enterprises. Table 3 presents the results of these analyses. This table presents mean tests for the objective financial constraint measure ( $\varphi$ ) and the productivity level ( $\pi$ ). The hypotheses of the tests are as follows:

$H_0: \varphi(\text{other}) = \varphi(\text{women})$  vs.  $H_a: \varphi(\text{other}) \neq \varphi(\text{women})$  (Test. 1)

$H_0: \varphi(\text{other}) = \varphi(\text{women})$  vs.  $H_a: \varphi(\text{other}) < \varphi(\text{women})$  (Test. 2)

$H_0: \pi(\text{other}) = \pi(\text{women})$  vs.  $H_a: \pi(\text{other}) > \pi(\text{women})$  (Test. 3)

**Table 3: Comparisons of means of financial constraint measure and productivity level by gender variables**

Countries	Firms with women owners			Female-owned enterprises		
	Equal financial constraints (1) – Test 1	High financial constraints (2)-Test 2	Low productivity (3)-Test 3	Equal financial constraints (4)-Test 1	High financial constraints. (5)-Test 2	Low productivity (6)-Test 3
<b>Afghanistan</b>	0,061*	0,030**	0,955	0,061*	0,030**	0,497
<b>Armenia</b>	0,768	0,616	0,086*	0,542	0,271	0,328
<b>Azerbaijan</b>	0,002***	0,001***	0,053*	0,002***	0,001***	0,000***
<b>Bangladesh</b>	0,006***	0,997	0,728	0,587	0,293	0,000***
<b>Bhutan</b>	0,424	0,788	0,000***	0,099*	0,049**	0,431
<b>Cambodia</b>	0,917	0,542	0,050**	0,735	0,368	0,029**
<b>China</b>	0,975	0,513	0,000***			
<b>Georgia</b>	0,018**	0,009***	0,171	0,025**	0,012**	0,013**
<b>India</b>	0,000***	1,000	0,000***	0,792	0,604	0,000***
<b>Indonesia</b>	0,145	0,928	0,013**	0,169	0,084*	0,256
<b>Kazakhstan</b>	0,130	0,065*	0,408	0,411	0,206	0,815
<b>Kyrgyzstan</b>	0,109	0,055*	0,308	0,762	0,619	0,076*
<b>Lao PDR</b>	0,726	0,637	0,043**			
<b>Mongolia</b>	0,417	0,791	0,001***	0,872	0,436	0,069*
<b>Nepal</b>	0,489	0,756	0,000***	0,570	0,715	0,016**
<b>Pakistan</b>	0,122	0,939	0,312	0,324	0,838	0,234
<b>Philippines</b>	0,538	0,731	0,000***	0,503	0,251	0,222
<b>Russian Fed.</b>	0,800	0,400	0,309			
<b>Sri Lanka</b>	0,037**	0,981	0,869			
<b>Turkey</b>	1,000	0,500	0,597	0,978	0,511	0,486
<b>Uzbekistan</b>	0,557	0,279	0,560	0,837	0,581	0,886
<b>Viet Nam</b>	0,591	0,705	0,350	0,045**	0,023**	0,065*
<b>Full sample</b>	<b>0,000***</b>	<b>1,000</b>	<b>1,000</b>	<b>0,019**</b>	<b>0,009***</b>	<b>0,000***</b>

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



Overall, for the entire sample, stringent financial constraints and low productivity are observable in female-owned enterprises, everything being equal. But this pattern is likely to be less observable by considering only data from the same country: this result could point out to the existence of significant heterogeneity between countries in terms of productive capacities and financial products. It also points out to the necessity of integrating information or data from other developing countries to analyze this issue because of the existence of homogeneity of factors within a country. For firms with female owners, results are mixed and inconclusive when analyzing the entire sample; signaling potential weaknesses associated to the usage of this variable.

Table 4 presents results from equation (1) which are based on OLS method and the full sample. Differences emerge from the usage of different proxy variables to measure gender. Results in columns (1)-(3) are based on the existence of female owners, columns (4)-(5) present results related to the 50 percent threshold set for female ownership, and columns (7)-(9) present results which are based on the size of female ownership. In terms of gender proxies, since the last two gender proxy are based on the same original variable, number of observations do not change across these two proxies while we have more than 2,000 firms if we consider the first gender proxy, thereby keeping China, the Russian Federation, Lao People's Democratic Republic and others in the sample.<sup>6</sup>

Table 4 below provides interesting insights on the role of gender and the importance of "standard" productivity drivers which are considered in the list of control variables. First, gender does not seem to be a particular constraint for productivity levels because all the related coefficients are not significantly different from zero, including the interaction term. Second, firms that do not finance assets through banks and financial institutions are much less productive. Third, the signs of coefficients of control variables are mostly in line with the existing literature. For instance, firms that are exporting exhibit larger sales per worker. The competition they face in the international markets undoubtedly push these firms toward the limit. Larger firms are much more productive than both small and medium firms. A wide range of factors may be relevant such as economies of scale in production, access to relatively cheap credit and the extent of market outreach. Finally, the firm productivity increases also with the share of foreign ownership. One potential reason is of course technology and human resource transfer that can strengthen firm performance.

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<sup>6</sup> Results which are based on subjective financial measures exist. Between both types of analyses, the only difference is related to the magnitude of the impact of financial constraint on productivity; the magnitude is higher for the objective measure.

**Table 4. Regression analyses of sales per worker (level), gender variables and objective measure of financial constraints - OLS**

VARIABLES	Firms with female owners			Female-owned firms			Share of female ownership		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Gender variable	0.0330 (0.0733)	-0.00219 (0.0728)	-0.00107 (0.0733)	-0.256** (0.129)	-0.193 (0.132)	-0.181 (0.132)	-0.00170 (0.00131)	-0.00118 (0.00131)	-0.00109 (0.00132)
Financial constraint	-0.395*** (0.0454)	-0.309*** (0.0450)	-0.306*** (0.0452)	-0.400*** (0.0398)	-0.308*** (0.0396)	-0.305*** (0.0398)	-0.407*** (0.0425)	-0.311*** (0.0422)	-0.308*** (0.0424)
Financial constraint*Gender	0.00827 (0.0765)	0.0206 (0.0760)	0.0176 (0.0765)	0.00626 (0.135)	-0.00813 (0.137)	-0.0182 (0.138)	0.000199 (0.00137)	-7.38e-05 (0.00137)	-0.000145 (0.00137)
Firm age		0.00161** (0.000626)	0.000709 (0.000673)		0.00140** (0.000663)	0.000490 (0.000717)		0.00142** (0.000664)	0.000481 (0.000717)
Exporting		0.308*** (0.0233)	0.308*** (0.0235)		0.324*** (0.0253)	0.323*** (0.0254)		0.326*** (0.0253)	0.325*** (0.0254)
Small size		-0.248*** (0.0220)	-0.249*** (0.0222)		-0.269*** (0.0240)	-0.270*** (0.0242)		-0.273*** (0.0240)	-0.274*** (0.0242)
Medium size		-0.117*** (0.0207)	-0.119*** (0.0209)		-0.135*** (0.0228)	-0.137*** (0.0230)		-0.137*** (0.0228)	-0.139*** (0.0230)
Size of foreign ownership		0.00234*** (0.000530)	0.00259*** (0.000546)		0.00177*** (0.000581)	0.00201*** (0.000601)		0.00184*** (0.000582)	0.00208*** (0.000602)
Government share		0.00315*** (0.00106)	0.00308*** (0.00107)		-0.00129 (0.00147)	-0.00125 (0.00152)		-0.00124 (0.00147)	-0.00119 (0.00152)
Experience of manager			0.00265*** (0.000852)			0.00250*** (0.000927)			0.00260*** (0.000927)
Observations	22,843	22,578	22,277	19,901	19,706	19,466	19,901	19,706	19,466
R-squared	0.202	0.219	0.221	0.188	0.207	0.208	0.187	0.206	0.208

Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 5. Regression analyses of the level of sales per worker, gender variables and the objective measure of financial constraints – Two-step approach**

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Female owners	Female-owned	Female ownership	Female owners	Female-owned	Female ownership
Gender variable	-0.055 (0.080)	-0.152 (0.150)	-0.001 (0.001)	0.042 (0.127)	-0.112 (0.208)	-0.001 (0.002)
Financial constraint	-0.313*** (0.049)	-0.310*** (0.044)	-0.313*** (0.046)	-0.187** (0.090)	-0.192** (0.077)	-0.193** (0.082)
Gender*Financial constraint	0.018 (0.084)	-0.073 (0.156)	-0.000 (0.002)	-0.046 (0.134)	-0.094 (0.218)	-0.001 (0.002)
Firm age	0.003*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.006*** (0.001)	0.006*** (0.002)	0.006*** (0.002)
Exporting status	0.268*** (0.026)	0.274*** (0.029)	0.276*** (0.029)	0.144*** (0.042)	0.152*** (0.047)	0.154*** (0.047)
Small size	-0.213*** (0.025)	-0.255*** (0.028)	-0.259*** (0.028)	-0.337*** (0.041)	-0.330*** (0.044)	-0.333*** (0.044)
Medium size	-0.085*** (0.023)	-0.114*** (0.026)	-0.115*** (0.026)	-0.156*** (0.036)	-0.150*** (0.039)	-0.151*** (0.039)
Size of foreign ownership	0.003*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.002*** (0.001)	0.002** (0.001)
Government share	-0.003** (0.001)	-0.000 (0.002)	-0.000 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Manager	0.002** (0.001)	0.001 (0.001)	0.001 (0.001)	0.000 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Observations	22,277	19,466	19,466	18,273	16,449	16,449
R-squared	0.247	0.234	0.234	0.212	0.210	0.210
Type of bias correction	Women inv.	Women inv.	Women inv.	MNE selection	MNE selection	MNE selection

Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 5 presents the results of analyses with a correction of selection bias. Columns (1)-(3) present result with a correction of selection bias emerging from the fact that women are more likely to invest in specific sectors, and columns (4)-(5) present results with a correction of the selection bias emerging from the entry of foreign investors in the capital of the firm. Results from this table confirm the importance of financial support for productivity growth but they do not confirm the role of gender when analyzing productivity. These results are similar to the ones of Watson, Newby, & Mahuka (2009) in the case of Australian firms or by (Marco, 2012) in the hotel industry of Spain. Furthermore, while there are differences in the level of productivity and financial constraints faced by female-owned firms (without controlling other factors, Cf. Table 3), regressions performed at the country-level with the correction of selection bias do not also reveal additional insights on the existence of stringent or additional evident financial constraints for women (Cf. Appendix 7). Other variables which are consistently explaining productivity are as follows: the size of the firm, the fact to export products, the age of the firm, and foreign ownership. Selling products abroad means that the firm has a capacity to innovate, and that business skills and engineering would be critical.

From the above empirical results which stress the importance of factors such as the exporting status or financial constraints, one can thus infer that the impact of gender on productivity is not a direct impact, it is mostly an indirect impact which appears through control variables. Thus, the impact of gender on productivity would have to be analyzed by considering laws and institutions which prevent women from having business skills which can allow them to invest in sectors with less competition, being able to innovate or having access to finance. The below section attempts to present some reasons and policy issues which can help explain our conclusions.

## VI. Policy Implications

The above findings - suggesting that female ownership per se is not strongly and directly associated with differences in labor productivity and, that it does not increase the negative impact of a limited access to credit on productivity - are encouraging in supporting the general policy focus to foster female entrepreneurship, especially in a context where evidence is constantly put forward to doubt women's entrepreneurial abilities (e.g. studies suggesting that women are risk-averse and less likely to compete). Fostering female entrepreneurship is even more pressing when we consider that, in this sample, only 7% of firms are female-owned. Furthermore, it is likely that the WBES data only provides us with a picture of female business owners that have managed to survive in the formal<sup>7</sup> sector, leaving out female entrepreneurs who may be operating in the informal sector.

Thus, in looking at what targeted policy interventions can be advocated to support increased and robust female-owned enterprises, we look at the following factors, which partially reflect limitations in our sample but are also related to the main drivers of productivity: (i) sectoral segregation; (ii) the prevalence of women entrepreneurs in the informal sector; and (iii) gender-based discriminatory factors that can impact productivity and innovation. Specifically, policy makers could design policies to support women to enter sectors with higher productivity levels as our sample showed that female-owned enterprises are found predominantly in two sectors: "wholesale retail" and "hotel & restaurants." Policy interventions could also aim to support the formalization of women-owned informal production units; and address gender-based discriminatory factors that may be reflected in formal laws and regulations or social norms to lower their impact on productivity and innovation.

**Pertaining to sectoral segregation, our sample showed that female-owned enterprises are found predominantly in two sectors: "wholesale retail" and "hotel & restaurants" (See figure 1 for distribution across sectors/Appendix 8). The drivers of this segregation are complex, but social norms are an important factor.** Female entrepreneurs often start businesses

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<sup>7</sup> In Asia-Pacific, data on informal enterprises exist only for Cambodia and Myanmar. Ownership by gender can only be identified in Myanmar's Informal Enterprise Survey (2014). Across one-third of the firms surveyed, the largest owner is a female. According to Cambodia's Informal Enterprise Survey (2013), around 15 per cent of the firms surveyed have only female managers while two-thirds of the firms surveyed report at least one female manager.

with less capital, less access to credit, less experience and less education.<sup>8</sup> As these sectors often do not require substantial fixed costs to enter or to grow the business - which would partially explain our finding that financial constraints will not bind – this allows women to start businesses more easily but it also implies lower productivity and growth, suggesting that female entrepreneurship potential is not optimized. Furthermore, these sectors have more potential to offer more flexible working arrangements for women when considering their roles in the household. In fact, social norms that influence women’s socially-prescribed roles are key factors that determine women’s choices in allocating their time and labor.

**Policy interventions should be designed to recognize the unequal care burdens placed on women and to reduce and redistribute them as mechanisms to decrease time constraints and support the pursuit of capacity building through education or business skill trainings.**

Unequal burdens of unpaid care work are disproportionately impacting women and the choices they make. While systematic evidence on intra-household decision making and women’s bargaining power is lacking, evidence from time use surveys conducted in different countries show that women spend more time in care activities and less time than men in market activities - which include any type of remunerative economic activity in any type of sector and occupation. Gender gaps in time use often show large disparities all across the world, but in Asia and the Pacific region, two sub-regions with extreme disparities stand out: North and Central Asia and South and South-West Asia, (See figure 2/Appendix 8), where attaining gender parity requires substantial reversals in time use. A crucial difference between the two sub-regions is the prevalence of gender-sensitive formal institutions in the former sub-region (See figure 3 for measures of gender equality in laws and regulations by sub-region/Appendix 8). Discriminatory informal institutions enforce women’s roles as caretakers and in unpaid care work and contribute to increase women’s time poverty, challenging gender equality as well as the empowerment of women and girls. Social protection mechanisms and supportive government programs such as affordable childcare provision could lessen the burden on women and free their time to pursue additional education or further business opportunities.

**Concerning the informal sector, policy interventions could aim to address the factors hindering women entrepreneurs’ transition to the formal economy, as staying in the informal economy has negative repercussions on productivity, growth and social vulnerability.** Because few countries produce data detailing the size and composition of the informal economy, it is difficult to quantify with precision how many women entrepreneurs operate their businesses in this area. However, estimates suggest that in Asia and the Pacific, the size of the informal economy is very large, ranging from 20% of non-agricultural employment in Armenia to 42% in Thailand and estimates above 60% in Sri-Lanka, Vietnam, Indonesia, Pakistan and India.<sup>9</sup> In this context, it is observed that the share of self-employment in the informal sector is larger than wage employment and where data is disaggregated by sex, it is observed that the share of women in non-agricultural informal employment outnumbers that of men in most

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<sup>8</sup> Cirera, Xavier and Qursum Qasim. *Innovation, Technology & Entrepreneurship*. Policy Note. September 2014, No. 5. World Bank Group.

<sup>9</sup> (Vanek, Chen, Carre, Heintz, & Hussmanns, 2014).

countries.<sup>10</sup> The most recent analysis from the ILO on world employment trends for example, finds that as many as one in five women are contributing family workers in Asia and the Pacific, when only 5% of men in the region are in that category. In regions such as Southern Asia, vulnerable employment (defined as the share of own-account workers and contributing family workers in total employment) is as high as 81.7% of all employed women versus 72.4% of employed men. (ILO, 2017). The economic and social repercussions of staying in the informal economy are serious, even more so for women. Operating in the informal economy can trap entrepreneurs in a cycle of low productivity, poverty and vulnerability. Furthermore, informal entrepreneurs are less likely to have access to secure property rights, impacting access to credit and reducing their capacity to invest in their businesses. Informal enterprises also tend to lack the size necessary to reach and leverage economies of scale and, especially micro and small businesses, do not have the capacity to generate sufficient profit to invest in key drivers of economic advancement and long-term sustainability such as innovation and risk-taking.<sup>11</sup> For women entrepreneurs, who as we have seen are segregated in sectors with low-productivity and whose enterprises tend to be small in size and focused on local markets, these negative impacts are therefore even more pressing.

**Finally, concerning gender-based discrimination, while this study does not yield direct insights on their existence or impact, it is important for policy makers to recognize the indirect impact that such discrimination can have in women's entrepreneurial choices, in the investments that they chose to make and on key drivers of productivity such as capacity to innovate.** The impact of gender-based discrimination can be seen, for instance, in a qualitative study conducted across China, India, Indonesia and Malaysia, where participants indicated perceived discrimination and bias in favor of men in areas such as lending from financial institutions and service providers, and discrimination from customers or suppliers when operating a business (UNESCAP, 2013). Implicit or explicit restrictions on opening bank accounts, signing contracts, registering businesses often push female entrepreneurs into the informal sector and services industry, where productivity, capacity to grow and innovate are lower. Similarly, occupational restrictions on non-pregnant women reinforce gender norms and occupational segregation. The absence of affordable and quality childcare reduces women's daily time endowment and forces them to find work arrangements that are consistent with daily responsibilities. In other words, formal as well as informal institutions matter for female entrepreneurs' structural transformation. The Women, Business and the Law database maintained by the World Bank offers important insights. While data are available for a majority of countries in recent years, Figure 3 (Appendix 8) focuses on the historical series with a narrower set of indicators between 1960 and 2010 for countries in the region. Fourteen indicators enter the index that ranges between zero and one with the latter representing full gender equality across laws and regulations including constitutional guarantees on gender equality, absence of restrictions on women's mobility and employment and equitable inheritance and property rights as well as matrimonial property regimes.

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<sup>10</sup> (ILO, 2014)

<sup>11</sup> Ibid.

Figure 3 (Appendix 8) suggests that countries in East and North-East Asia as well as in South-East Asia have significantly improved the laws and regulations that matter for women's economic empowerment. North and Central Asia has almost reached full gender equality in formal laws and regulations with South and South-West Asia lagging behind. The rise of female own-account workers in South-East Asia is partly reflected in its strong performance in revising discriminatory laws. Formal institutions however, do not guarantee consistent implementation and strong enforcement. Consequently, reviewing constitutions and legal codes (i.e. civil, penal and labor code among others) is only the first step in enabling a level playing field for women. The prevalence of social norms that challenge women's successful participation in the labor market and entrepreneurial potential require innovative strategies and engaging men for a change.

## VII. Conclusion

The objective of this paper was to shed some light on the existence of binding financial constraint for female-owned enterprises to increase their productivity level (measured as sales per worker) in the Asian region. For this purpose, firm-level data from 23 countries has been used, and models with selection bias correction have been used. The selection bias which are corrected are the ones related to the presence or investment of firms in specific sectors and the selection of foreign investors of targeted firms. To avoid the usage of a perception-based measure, an objective financial constraint metric has been used. This metric represents the share of assets purchased without support from financial institutions.

On the basis of the above mentioned data and methods, it is found that gender is not a core variable which determines productivity level. Female ownership *per se* is not strongly and directly associated with differences in labor productivity and it does not increase the negative impact of a limited access to credit on productivity. These results are also observed when performing country-level regressions. The impact of gender on productivity can only be perceived in our analytical framework as resulting from the existence of laws and institutions which prevent them from having access to credit or to attend adequate schools which can help them developing engineer or business skills. The impact of gender on productivity is more likely to be indirect than direct.

The derived policy section suggests that there is a need for policies to foster the development of women's entrepreneurship and to further optimize female entrepreneurial talent. To do so, it is important to address fundamental challenges such as sectoral segregation because they push women into highly competitive sectors with low productivity. Furthermore, it would be key to address constraints such as: unequal burdens of unpaid care work, which shape women's choices and may encourage entrepreneurs to segregate into certain sectors and remain in the informal economy; and discrimination in informal and formal institutions because they can create barriers which have an impact on business behaviors. Finally, informal employment constitutes around 82 per cent of non-agricultural employment in South Asia and 65 per cent in South-East Asia, according to Vanek and others (2014). However, frequent, systematic and wide ranging data are not available on micro enterprises across the Asia-Pacific region, even though women are mostly found within such enterprises. It is paramount that data collection efforts shift their focus to Asia-Pacific to support rigorous analysis and evidence based policy-making.

However, the empirical analyses of this paper present some caveats because of the unavailability of time-variant data, the usage of most recent datasets, and the impossibility to use instrumental variable approach adequately. Furthermore, while the objective measure of financial constraint may implicitly reflect the usage of financial services, the study fails to account for the issue of financial inclusion. Future studies could integrate this issue in the analytical framework.



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## Appendix

### Appendix 1. List of variables

Categories and code of variables	Label	Description	Reference in the questionnaire (Bangladesh)
pdinnov	Product or service innovation	Dummy variable = 1 if firm innovates; 0 otherwise	H1
pdinnovm	Product innovation new for market	Dummy variable = 1 if firm innovates; 0 otherwise	H2
pcinnov	Process innovation	Dummy variable = 1 if firm innovates; 0 otherwise	H3
sector	Sectors Manufacturing	Five dummy variables for: 1=food; 2=textiles and garments; 3=chemicals, plastics & rubber, and non-metallic mineral products; 4=basic metals, fabricated metal products, and machinery and equipment; 5=electronics and other manufacturing	a4b
	Services	Two dummy variables for: 6=Retail; 7=Hotel and restaurants.	
size	Firm size	Two dummy variables for: 1=small (5-19), 2=medium (20-99), 3=large (100+)	a6b
emp	Permanent full-time workers end of last fiscal year	Permanent full-time workers end of last fiscal year: numeric	L.1
skproworker	Skilled production workers	Skilled production workers: numeric	L.4a
unskproworker	Unskilled production workers	Unskilled production workers: numeric	L.4b
group	Part of a larger group	Dummy variable if firms belongs to a larger group; 0 otherwise	a7
privfor	Private foreign share	Dummy variable = 1 if percentage $\geq 10\%$ , 0 otherwise OR numeric (to be treated) / Share in capital	b2b
privdom	Private domestic share	Share in capital	b2a
gov	Government share	Share in capital	b2c
age_or	Firm age	Numerical variable: computed according to first year of operation (Age of firm to be derived)	b5
qms	Quality certification	Dummy variable=1 if firms holds an internationally-recognized quality certification; 0 otherwise	b8
flic	Usage of foreign license technology	Dummy variable=1 if firm uses foreign licensed technology; 0 otherwise	e6
rdinput	R&D expenditures	Dummy variable	H7
training	Training of staff	Dummy variable	L.10
skillwork	Percentage of permanent workers who completed secondary school	Percentage	L.9b
manager	Manager's experience in the sector	Numerical	b7
market	Nature of main markets	1=Local-municipality; 2=Local-national; 3=International	E1
competitors	Number of competitors	Number of competitors: numeric	E2b

Categories and code of variables	Label	Description	Reference in the questionnaire (Bangladesh)
exports_dir	Direct Exports	Direct exports: numeric variable	d3c
exports_ind	Indirect exports	Indirect exports: numeric variable	d3b
sales_lcu	Annual sales in local currency (last year)	Annual sales in local currency	D2
inputdom	Material inputs or supplies of domestic origin	Material inputs or supplies of domestic origin: numeric	D12a
assetmach_lcu	Asset machinery, vehicles and equipment in LCU	Asset machinery, vehicles and equipment in LCU: numeric	N5a
assetland	Land and buildings in LCU	Land and buildings in LCU: numeric	N5b
borrbank	Percentage of assets financed by banks	Percentage of assets financed by banks: numeric	K5bc
borrfin	Percentage of assets financed by non-bank financial institution	Percentage of assets financed by non-bank financial institution: numeric	K5e
femaleowners	Existence of female owners	Dummy variable	b4
femalesizeown	Percentage of female ownership	Percentage	b4a
femaletop	Female as Top Manager	Dummy variable	b7a
sales_lcu3	Annual sales in local currency (three years ago)	Number in local currency	n3
capacityuse	Capacity utilization during the recent fiscal year	Percentage	f1
purchaseasset	Occurrence of the purchase of fixed assets such as machinery, vehicles, equipment, land or building	Dummy variable (Yes=1; No=0)	k4
perceptionfin	Access to finance as obstacle: Perception	Number ranging between 1 and 4	k30
attgvcontract	Attempt to secure government contract during the last year	Dummy variable (Yes=1 ; No=0)	j6a
workers_3	Full-time workers three years ago	Number	L2
femprodworkers	Female permanent full-time production workers	Number	L5a
femnprodworkers	Female permanent full-time non production workers	Number	L5b

**Appendix 2. Number of observations by industry and country**

Countries	Manufacturing	Utilities	Construction	Wholesale and Retail	Hotel and Restaurant	Transportation, Storage and Communication	Financial Intermediation	Real Estate	Education	Sub-total
Afghanistan	156	0	90	174	3	45	0	1	0	469
Armenia	111	0	27	153	35	20	0	14	0	360
Azerbaijan	122	0	40	165	31	28	0	4	0	390
Bangladesh	1179	0	2	173	80	5	0	3	0	1442
Bhutan	81	0	43	51	44	31	0	3	0	253
Cambodia	135	0	9	146	70	12	0	1	0	373
China	1693	0	133	443	150	143	0	138	0	2700
Georgia	111	0	37	162	23	24	0	3	0	360
India	7165	0	241	889	335	380	0	251	0	9261
Indonesia	1069	0	35	163	34	17	0	2	0	1320
Kazakhstan	200	0	65	294	6	28	0	7	0	600
Kyrgyzstan	104	0	42	80	20	22	0	2	0	270
Lao PDR	93	1	44	85	37	5	28	12	61	366
Mongolia	120	0	47	150	25	17	0	1	0	360
Nepal	245	0	0	145	67	24	0	4	0	485
Pakistan	1054	0	20	93	50	13	0	17	0	1247
Philippines	1037	0	21	184	43	40	0	10	0	1335
Russian Fed.	1373	0	444	1849	136	261	0	157	0	4220
Sri Lanka	362	0	3	183	45	11	0	6	0	610
Timor-Leste	60	0	12	38	14	1	0	1	0	126
Turkey	1081	0	59	170	21	12	0	1	0	1344
Uzbekistan	129	0	31	164	25	38	0	3	0	390
Viet Nam	694	0	75	180	15	28	0	4	0	996
<b>Sub-total</b>	<b>18374</b>	<b>1</b>	<b>1520</b>	<b>6134</b>	<b>1309</b>	<b>1205</b>	<b>28</b>	<b>645</b>	<b>61</b>	<b>29277</b>

Data Source: World Bank Enterprise Surveys (2009-2015). Based on ISIC Revision 3.1, we define industries using sector identifiers.

**Appendix 3. Equations underlying the estimated probabilities of investment of women – Probit models**

VARIABLES	(1) Full Sample	(2) Afghanistan	(3) Bhutan	(4) Cambodia	(5) Georgia	(6) India	(7) Indonesia	(8) Mongolia	(9) Nepal	(10) the Philippines	(11) Sri Lanka	(12) Turkey
Construction	-0.149*** (0.039)	0.138 (0.195)	0.826 (0.887)	0.543** (0.239)	0.027 (0.114)	-0.000 (0.251)	0.001 (0.100)	-0.114 (0.245)	-0.631*** (0.232)		-0.320*** (0.077)	0.378 (0.399)
Wholesale and retail	0.046** (0.022)	-0.421** (0.187)	-0.339*** (0.130)	-0.202 (0.236)	0.236*** (0.069)	0.327** (0.160)	-0.221*** (0.059)	0.755*** (0.194)	0.229 (0.154)	-0.178 (0.222)	0.112** (0.047)	0.972*** (0.281)
Hotel and restaurant	0.182*** (0.039)	0.589 (0.758)	-1.134*** (0.302)	0.569** (0.238)	0.275** (0.111)	0.923*** (0.297)	0.120 (0.080)	0.332 (0.250)	0.246 (0.277)	0.341 (0.228)	0.493*** (0.114)	1.633*** (0.530)
Transportation, Storage and Communication	0.002 (0.042)	-0.007 (0.256)		0.437 (0.267)	0.272** (0.114)	0.101 (0.293)	-0.001 (0.082)	-0.370 (0.653)	-0.834** (0.375)	0.685* (0.388)	-0.211** (0.094)	
Financial Intermediation	0.668*** (0.258)							0.935*** (0.282)				
Real Estate	-0.151*** (0.058)			0.828 (0.762)	-0.175 (0.111)		-0.207* (0.108)	0.261 (0.390)		0.699** (0.339)	-0.188 (0.116)	
Education	0.582*** (0.196)							0.849*** (0.226)				
Observations	28,968	469	1,433	253	2,700	355	9,224	351	358	1,214	4,149	124
Percentage of correct	74.64	86.78	81.51	62.06	60.63	64.23	85.13	64.96	58.94	91.76	68.57	67.74
Significance of the model	0.0000	0.0469	2.42e-06	0.0084	0.0001	0.0133	0.0008	1.01e-05	0.0001	0.0500	0.0000	0.0001

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Appendix 4. The role of gender and financial constraints in determining the level of productivity – OLS based results**

Countries	Firms with female owners	Financial constraints	Interaction term	Female-owned firms	Financial constraints	Interaction term	Share of female ownership	Financial constraint	Interaction term
Afghanistan	0.419 (0.272)	-0.298 (0.760)	0.000 (0.000)	0.326 (0.425)	-0.219 (0.777)	0.000 (0.000)	0.006 (0.005)	-0.241 (0.775)	0.000 (0.000)
Armenia	-0.174 (0.748)	-0.201 (0.682)	0.204 (0.773)	-0.404 (0.491)	-0.201 (0.467)	0.732 (0.549)	0.000 (0.008)	-0.155 (0.523)	0.003 (0.008)
Azerbaijan	-0.384* (0.219)	0.019 (0.638)	0.000 (0.000)	-0.506* (0.286)	0.018 (0.639)	0.000 (0.000)	-0.006** (0.003)	0.021 (0.637)	0.000 (0.000)
Bangladesh	0.097 (0.320)	0.031 (0.198)	0.269 (0.333)	0.092 (1.138)	0.083 (0.162)	-0.215 (1.227)	0.002 (0.011)	0.077 (0.195)	0.001 (0.011)
Bhutan	1.160** (0.497)	0.464 (0.324)	-1.402** (0.542)	0.514 (0.636)	0.053 (0.284)	-0.980 (0.686)	0.012 (0.009)	0.220 (0.295)	-0.016* (0.009)
Cambodia	-1.379 (0.829)	0.066 (0.818)	1.213 (0.865)	-1.149 (0.795)	0.019 (0.817)	1.018 (0.820)	-0.011 (0.008)	0.045 (0.817)	0.010 (0.008)
China	-0.434 (0.276)	-0.616*** (0.190)	0.280 (0.283)	0.000 (0.000)	-0.571*** (0.196)	0.000 (0.000)	0.000 (0.000)	-0.571*** (0.196)	0.000 (0.000)
Georgia	-0.084 (1.239)	-0.227 (0.276)	-0.391 (1.268)	-1.370 (2.306)	-0.401 (0.261)	1.040 (2.330)	-0.002 (0.021)	-0.279 (0.269)	-0.003 (0.021)
India	0.066 (0.116)	-0.338*** (0.064)	0.094 (0.125)	-0.195 (0.221)	-0.343*** (0.056)	0.021 (0.241)	0.001 (0.002)	-0.340*** (0.061)	0.000 (0.002)
Indonesia	-0.251 (0.683)	-0.076 (0.589)	0.167 (0.691)	-0.045 (0.722)	-0.009 (0.430)	-0.176 (0.735)	-0.005 (0.009)	-0.090 (0.521)	0.002 (0.010)
Kazakhstan	-0.742 (0.564)	-0.189 (0.461)	0.662 (0.579)	-0.691 (0.554)	-0.201 (0.458)	0.680 (0.584)	-0.008 (0.006)	-0.214 (0.461)	0.007 (0.006)
Kyrgyzstan	0.728 (1.467)	-0.648 (0.496)	-0.840 (1.486)	0.395 (1.572)	-0.646 (0.514)	-0.734 (1.622)	0.002 (0.019)	-0.632 (0.524)	-0.005 (0.019)
Lao PDR	-1.516* (0.789)	-1.047 (0.753)	1.388* (0.810)	0.000 (0.000)	-0.996 (0.785)	0.000 (0.000)	0.000 (0.000)	-0.996 (0.785)	0.000 (0.000)
Mongolia	-0.509 (0.416)	-0.548 (0.366)	0.507 (0.440)	-0.303 (0.342)	-0.266 (0.310)	0.118 (0.374)	-0.004 (0.004)	-0.321 (0.334)	0.002 (0.004)
Nepal	-0.511 (0.410)	-0.219 (0.295)	0.252 (0.442)	-0.099 (0.623)	-0.186 (0.269)	-0.572 (0.650)	-0.002 (0.006)	-0.185 (0.279)	-0.004 (0.006)
Pakistan	4.265*** (1.620)	0.386 (1.372)	-3.753** (1.695)	-0.082 (0.492)	-1.661 (1.656)	0.000 (0.000)	3.323*** (0.740)	-0.011 (1.163)	-3.321*** (0.740)
Philippines	-0.269 (0.280)	-0.649** (0.254)	0.478 (0.298)	-0.113 (0.269)	-0.382** (0.156)	-0.153 (0.290)	-0.001 (0.003)	-0.378** (0.180)	-0.001 (0.003)

Countries	Firms with female owners	Financial constraints	Interaction term	Female-owned firms	Financial constraints	Interaction term	Share of female ownership	Financial constraint	Interaction term
Russian Federation	0.116 (0.204)	-0.326*** (0.117)	-0.161 (0.211)	0.000 (0.000)	-0.362*** (0.118)	0.000 (0.000)	0.000 (0.000)	-0.362*** (0.118)	0.000 (0.000)
Sri Lanka	0.186 (0.430)	-0.319 (0.294)	-0.132 (0.459)	0.000 (0.000)	-0.339 (0.303)	0.000 (0.000)	0.000 (0.000)	-0.339 (0.303)	0.000 (0.000)
Turkey	0.526* (0.315)	0.063 (0.159)	-0.498 (0.338)	-0.253 (0.556)	-0.069 (0.146)	0.377 (0.757)	-0.001 (0.006)	-0.057 (0.155)	0.000 (0.007)
Uzbekistan	0.356 (0.869)	0.096 (0.566)	-0.365 (0.885)	-0.685 (0.763)	-0.152 (0.513)	1.028 (0.776)	-0.007 (0.008)	-0.162 (0.526)	0.010 (0.008)
Viet Nam	0.246 (0.307)	0.202 (0.267)	-0.395 (0.345)	-0.166 (0.405)	0.042 (0.192)	-0.048 (0.441)	-0.002 (0.005)	0.051 (0.215)	-0.001 (0.005)

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



**Appendix 5. The role of gender and financial constraints in determining the level of productivity – two-step approach with a correction of the selection bias for the probability of women to invest**

Countries	Firms with female owners	Financial constraints	Interaction term	Female-owned firms	Financial constraints	Interactions term	Share of female ownership	Financial constraint	Interaction term
Afghanistan	0.544* (0.290)	-0.177 (0.765)	0.000 (0.000)	0.350 (0.431)	-0.057 (0.777)	0.000 (0.000)	0.007 (0.005)	-0.094 (0.775)	0.000 (0.000)
Bhutan	1.288*** (0.495)	0.614* (0.363)	-1.500*** (0.529)	0.408 (0.550)	0.110 (0.292)	-0.834 (0.599)	0.011 (0.008)	0.289 (0.314)	-0.015* (0.009)
Cambodia	-1.514** (0.744)	-0.080 (0.737)	1.356* (0.786)	-1.315* (0.714)	-0.122 (0.735)	1.189 (0.746)	-0.013* (0.007)	-0.097 (0.735)	0.012 (0.007)
Georgia	-0.261 (1.243)	-0.284 (0.282)	-0.226 (1.275)	-1.555 (2.180)	-0.454* (0.265)	1.223 (2.207)	-0.005 (0.021)	-0.348 (0.275)	0.000 (0.021)
India	0.067 (0.115)	-0.331*** (0.064)	0.083 (0.124)	-0.189 (0.220)	-0.336*** (0.056)	0.004 (0.241)	0.001 (0.002)	-0.331*** (0.061)	0.000 (0.002)
Indonesia	-0.368 (0.687)	-0.090 (0.587)	0.275 (0.695)	0.021 (0.742)	0.032 (0.423)	-0.254 (0.755)	-0.005 (0.010)	-0.071 (0.519)	0.003 (0.010)
Mongolia	-0.456 (0.425)	-0.548 (0.372)	0.463 (0.449)	-0.330 (0.358)	-0.292 (0.318)	0.152 (0.387)	-0.003 (0.004)	-0.317 (0.345)	0.002 (0.004)
Nepal	-0.409 (0.424)	-0.122 (0.295)	0.139 (0.458)	0.041 (0.694)	-0.098 (0.266)	-0.750 (0.720)	-0.001 (0.007)	-0.094 (0.277)	-0.006 (0.007)
Philippines	-0.240 (0.282)	-0.628** (0.256)	0.452 (0.301)	-0.081 (0.282)	-0.369** (0.157)	-0.190 (0.302)	-0.001 (0.003)	-0.362** (0.181)	-0.002 (0.004)
Sri Lanka	0.253 (0.433)	-0.314 (0.295)	-0.191 (0.463)	0.000 (0.000)	-0.343 (0.306)	0.000 (0.000)	0.000 (0.000)	-0.343 (0.306)	0.000 (0.000)
Turkey	0.530* (0.313)	0.065 (0.161)	-0.498 (0.336)	-0.257 (0.560)	-0.069 (0.147)	0.386 (0.758)	-0.001 (0.006)	-0.056 (0.156)	-0.001 (0.007)

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Appendix 6. Equations underlying the estimated probabilities of selection by foreign investors – Probit models**

	(1)	(2)	(3)	(4)	(5)	(6)			
VARIABLES	Full sample	Bangladesh	Cambodia	India	Indonesia	Kazakhstan			
R&D activities	0.148*** (0.042)	0.309 (0.189)	0.178 (0.319)	0.203** (0.098)	0.692*** (0.183)				
Group	0.406*** (0.044)	0.217 (0.179)	0.732* (0.417)	0.167 (0.107)	0.609*** (0.146)	0.685* (0.407)			
Productivity (t-3)	0.070*** (0.010)	0.164*** (0.061)	0.128* (0.069)	0.108*** (0.038)	0.097*** (0.020)	0.215 (0.134)			
Medium size	-0.444*** (0.041)	-0.432** (0.189)	-1.208*** (0.281)	-0.185* (0.110)	-0.859*** (0.134)	-0.621 (0.510)			
Small size	-0.671*** (0.049)		-1.421*** (0.286)	-0.430*** (0.154)	-1.167*** (0.179)	-0.078 (0.432)			
Observations	20,470	837	310	7,984	1,279	232			
Percentage correct	95.04	96.06	90.65	99.19	91.16	94.40			
Significance of the model	0.000	0.001	9.44e-09	1.57e-09	0.000	0.001			

	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
VARIABLES	Kyrgyzstan	Nepal	Philippines	Russian Federation	Sri Lanka	Turkey	Uzbekistan	Viet Nam
R&D activities	0.114 (0.344)	1.319*** (0.425)	-0.221** (0.107)	0.252* (0.137)	0.291 (0.278)	0.093 (0.221)		0.006 (0.157)
Group	0.920*** (0.355)	-0.594 (0.685)	0.289*** (0.108)	0.536*** (0.152)	0.762*** (0.239)	0.418** (0.188)	-0.333 (0.411)	0.688*** (0.190)
Productivity (t-3)	0.168* (0.096)	-0.087 (0.148)	0.065** (0.029)	0.095*** (0.033)	-0.002 (0.067)	-0.055* (0.033)	0.148* (0.078)	-0.018 (0.045)
Medium size	-0.379 (0.356)	-1.272** (0.544)	-0.326*** (0.103)	-0.539*** (0.141)	-0.503* (0.281)	-0.754*** (0.202)	-0.285 (0.275)	-0.794*** (0.160)
Small size	-0.454 (0.371)		-0.532*** (0.119)	-0.589*** (0.144)	-0.869*** (0.323)	-1.236*** (0.310)	-0.385 (0.276)	-0.973*** (0.220)
Observations	184	185	1,053	2,245	497	625	233	878
Percentage correct	84.78	95.68	76.26	96.53	95.37	94.08	85.84	91.80
Significance of the model	0.026	0.001	0.000	3.23e-09	5.72e-06	1.88e-08	0.000	0.000

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Industry dummy variables are also included but they have not been reported.**

**Appendix 7. The role of gender and financial constraints in determining the level of productivity – two-step approach with a correction of the selection bias for the probability of selection by multinational enterprise**

Countries	Firms with female owners	Financial constraints	Interaction term	Female-owned firms	Financial constraints	Interaction term	Share of female ownership	Financial constraint	Interaction term
Armenia	-0,407 (0,744)	-0,685 (0,628)	0,387 (0,786)	-1,103** (0,495)	-0,745 (0,474)	1,362** (0,598)	-0,008 (0,008)	-0,765 (0,577)	0,010 (0,009)
Bangladesh	-0,166 (0,376)	0,230 (0,338)	0,472 (0,399)	0,120 (1,324)	0,421** (0,199)	-0,506 (1,687)	-0,008 (0,012)	0,309 (0,304)	0,008 (0,013)
Cambodia	0,265 (1,069)	1,706 (1,115)	-0,370 (1,126)	0,233 (1,079)	1,637 (1,109)	-0,267 (1,111)	0,002 (0,011)	1,657 (1,111)	-0,003 (0,011)
Georgia	1,777* (0,940)	0,642* (0,378)	-2,344** (1,010)	1,315 (1,791)	0,253 (0,433)	-1,912 (1,842)	0,025** (0,011)	0,562 (0,350)	-0,033*** (0,012)
India	-0,193 (0,146)	-0,194*** (0,075)	0,257* (0,155)	-0,534*** (0,186)	-0,164** (0,066)	0,304 (0,216)	-0,004* (0,002)	-0,188*** (0,072)	0,004 (0,003)
Indonesia	2,044 (1,684)	1,129 (1,308)	-1,936 (1,709)	0,061 (1,622)	0,576 (1,210)	-0,407 (1,654)	0,012 (0,026)	0,677 (1,342)	-0,015 (0,026)
Kazakhstan	-2,739** (1,335)	-0,247 (0,500)	2,187 (1,468)	-0,671 (1,462)	-0,189 (0,547)	-0,026 (1,763)	-0,058** (0,025)	-0,253 (0,494)	0,051* (0,027)
Kyrgyzstan	0,803 (1,405)	-1,154** (0,571)	-0,891 (1,433)	0,674 (1,529)	-1,259** (0,582)	-1,059 (1,610)	0,003 (0,021)	-1,283** (0,608)	-0,007 (0,022)
Mongolia	0,028 (0,495)	-0,088 (0,499)	-0,042 (0,533)	0,099 (0,351)	0,041 (0,321)	-0,338 (0,415)	0,003 (0,004)	0,075 (0,377)	-0,004 (0,005)
Nepal	-1,210* (0,700)	-0,677 (0,585)	0,704 (0,789)	-0,904 (0,592)	-0,777 (0,497)	0,339 (0,763)	-0,009 (0,006)	-0,749 (0,509)	0,001 (0,008)
Pakistan	5,405*** (0,933)	2,001*** (0,700)	-4,883*** (1,138)	0,493 (0,487)	0,428 (1,625)	0,000 (0,000)	5,881*** (0,898)	1,906*** (0,714)	-5,875*** (0,897)
Philippines	-0,345 (0,269)	-0,674*** (0,245)	0,442 (0,290)	-0,220 (0,260)	-0,429** (0,171)	-0,018 (0,285)	-0,003 (0,003)	-0,438** (0,189)	0,000 (0,003)

What's Gender Got to Do with Firm Productivity? Evidence from Firm Level Data in Asia

Countries	Firms with female owners	Financial constraints	Interaction term	Female-owned firms	Financial constraints	Interaction term	Share of female ownership	Financial constraint	Interaction term
Russian Federation	0,309 (0,229)	-0,298 (0,189)	-0,289 (0,241)		-0,357* (0,186)			-0,357* (0,186)	
Sri Lanka	1,088* (0,595)	0,033 (0,475)	-1,074 (0,659)		0,028 (0,437)			0,028 (0,437)	
Turkey	0,551 (0,441)	-0,349 (0,279)	-0,076 (0,498)	-1,074 (1,200)	-0,429* (0,233)	1,889 (1,395)	-0,005 (0,010)	-0,469* (0,258)	0,011 (0,012)
Uzbekistan	0,744 (0,915)	0,166 (0,371)	-0,532 (0,989)	-0,435 (0,666)	-0,304 (0,637)	1,267 (0,778)	-0,014 (0,015)	-0,377 (0,666)	0,022 (0,016)
Viet Nam	0,710 (0,501)	0,708 (0,452)	-0,767 (0,566)	-0,381 (0,660)	0,415 (0,328)	-0,063 (0,703)	0,002 (0,009)	0,478 (0,370)	-0,005 (0,009)

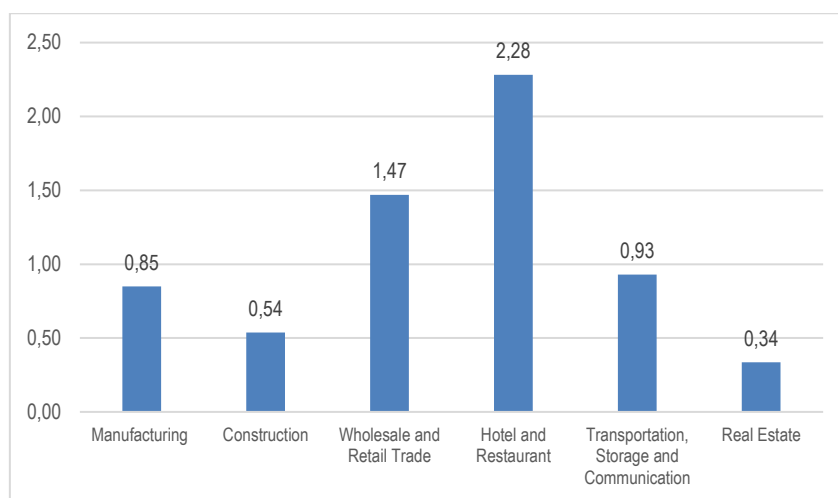
Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Industry dummy variables are also included but they have not been reported.**

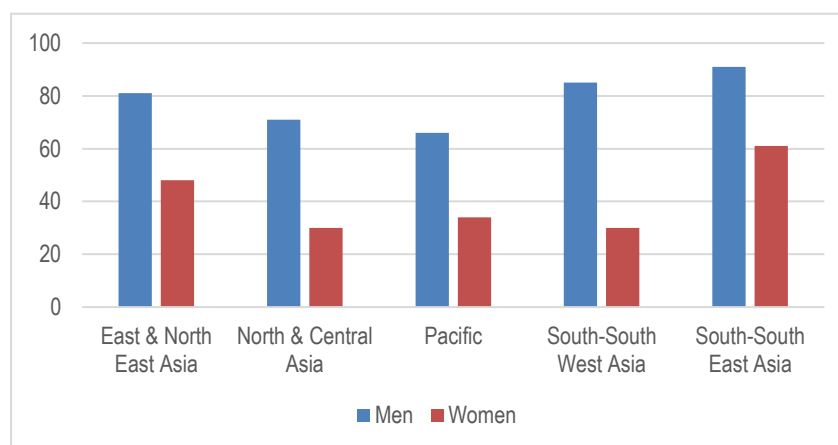
## Appendix 8. Charts to support the policy section

**Figure 1. Gender gaps by industry in the sample**



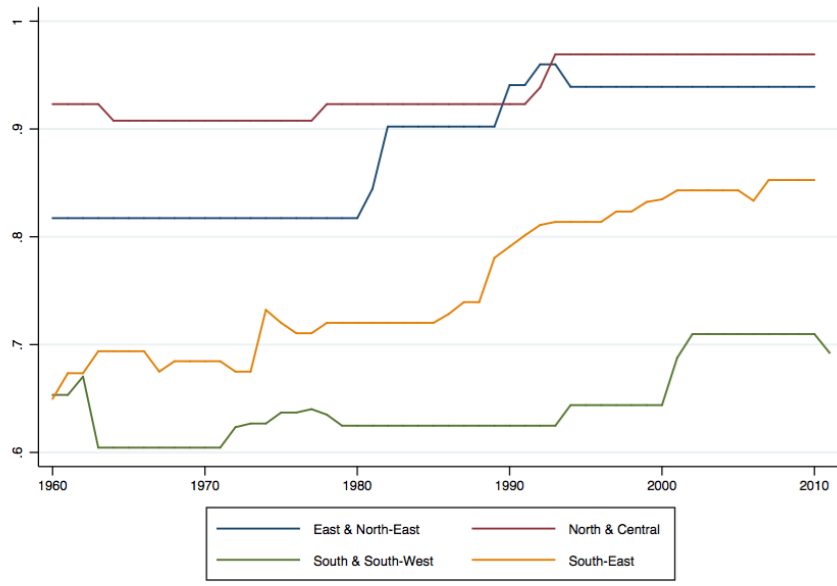
Source: Authors, based on data from the World Bank Enterprise Surveys (2009-2015)

**Figure 2. Share of time spent on productive activities**



Source: Authors, based on data from the United Nations Statistics Division (UNSD)

Figure 3. Gender Equality in Laws and Regulations



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