The Labor Productivity Gap between Female and Male-Managed Firms in the Formal Private Sector

Asif Islam

Isis Gaddis

Amparo Palacios Lopez

Mohammad Amin

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Abstract

This study analyzes gender differences in labor productivity in the formal private sector, using data from 128 mostly developing economies. The results reveal a sizable unconditional gap, with labor productivity being approximately 11 percent lower among female- than male-managed firms. The analyses are based on female management, which is more strongly associated with labor productivity than female participation in ownership, which has been the focus

of most previous studies. Decomposition techniques reveal several factors that contribute to lower labor productivity of female-managed firms relative to male-managed firms: fewer female- than male-managed firms protect themselves from crime and power outages, have their own websites, and are (co-) owned by foreigners. In addition, in the manufacturing sector, female-managed firms are less capitalized and have lower labor cost than male-managed firms.

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Asif Islam
Isis Gaddis
Amparo Palacios Lopez
Mohammad Amin¹

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¹ Enterprise Analysis Unit, DECIG, World Bank; Gender Group, World Bank; Living Standards Measurement Study (LSMS), Development Data Group, World Bank; Enterprise Analysis Unit, DECIG, World Bank

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1. Introduction

There is burgeoning interest in measuring productivity gaps along gender lines in developing countries and understanding the forces that explain such inequalities. In the agricultural sector, a number of recent country-level studies, mostly from Sub-Saharan Africa, document gender gaps in land and labor productivity in favor of men, which often remain significant even when the analysis controls for the use of productive inputs (Peterman et al. 2011; Kilic et al. 2014; Aguilar et al. 2015; Guirkingner et al. 2015; Palacios-Lopez and Lopez 2015; Ali et al. 2016). The empirical evidence on whether there is a similar gap outside agriculture, particularly in the formal private sector, is more nuanced. Using firm-level data from the early 2000s, Bardasi et al. (2011) find that female-owned enterprises are less productive than male-owned enterprises in Latin America and the Caribbean and in Europe and Central Asia, but not in Sub-Saharan Africa, controlling for country and sector fixed effects. Analysis in Bruhn et al. (2009) for Latin America, Hallward-Driemeier (2013) for Sub-Saharan Africa and Gui-Diby et al. (2017) for Asia suggests that unconditional differences in productivity between male and female entrepreneurs in the formal sector disappear once the analysis controls for firm characteristics (particularly firm size and sector). However, methodological differences between these studies in terms of the productivity concept (labor or total factor productivity), measurement of productivity (sales or value added per worker), and economic specification (number and choice of control variables, estimation method) most likely explain some of the observed differences in results and impede comparability across regions.

This study is, to the best of our knowledge, the first global assessment of gender gaps in labor productivity in the formal private sector, covering 128 (mostly developing) economies and using a consistent methodology and recent data sources. It is based on data for over 46,000 firms collected between 2009 and 2016 under the World Bank's Enterprise Survey program. Female-managed firms are defined as firms where the top manager is female, and, vice versa, male-managed firms are defined as firms where the top manager is male. The Enterprise Surveys are nationally representative and employ the same basic

questionnaire and methodology across countries. This feature is important given that most studies on gender gaps in labor productivity are either country-specific (especially in agriculture) or region-specific.

Our results reveal a sizable gender gap in labor productivity, with female-managed firms being about 11 percent less productive than male-managed firms. Unlike in other studies in this field, the gender gap does not decrease when controlling for a broad range of firm characteristics, suggesting that gender gaps in labor productivity are not driven primarily by those differences in observable enterprise characteristics, at least not those that we can control for with the available data. Using decomposition techniques, we find that female-managed firms are younger than male-managed firms, and less likely to be under foreign ownership, own a website, pay for security or use a power generator. These factors contribute to the gender gap in labor productivity. On the other hand, female-managed firms are smaller than male-managed firms and overrepresented in the service sectors, where they furthermore generate above-average returns, and these factors narrow gender differences in labor productivity. The latter results challenge the widely held notion that female-managed firms are less productive because of the small size of their operations and because they are disproportionately represented in service sectors. However, there is a large residual difference in productivity that cannot be explained by differences in observable enterprise characteristics, or by returns to these characteristics. Finally, we confirm results in Aterido and Hallward-Driemeier (2011) that women's participation in decision-making (i.e. whether the firm has a female top manager) is more strongly related to labor productivity than women's participation in ownership (i.e. whether the firm has a female owner), which suggests that some of the existing studies (based on ownership) may not reveal the full extent of gender differences in productivity.

The contribution of this study to the literature can be summarized as follows: (i) it shows that there is a labor productivity gap in the formal private sector between female-managed and male-managed firms at the global level and quantifies this gap; (ii) it decomposes the labor productivity gap into several elements to inform policy makers on the factors that contribute to this gap; and (iii) it conducts the analysis using

firm-level, nationally representative data, which also allows for comparisons across firm size, sector and region.

The remainder of the paper is structured as follows. Section 2 reviews the existing literature on gender differences in labor productivity and sets the stage for the empirical analysis. Section 3 describes the data and presents the base regression results. The decomposition methodology is detailed in section 4, while its results are presented in section 5. Section 6 presents additional robustness checks and section 7 concludes with policy recommendations.

2. Literature Review

Gender equality is an important policy objective and there are both efficiency and human rights arguments for advancing equality between men and women (Duflo 2010). A large literature points to the interrelationships between gender inequalities and economic development. This includes, for instance, the association between economic development and women's labor force participation (Goldin 1994; Tam 2011; Gaddis and Klasen 2014), the impact of gender gaps in education on economic growth (Hill and King 1995; Dollar and Gatti 1999; Klasen 2002), and implications of gender disparities in wages and earnings (Tzannatos 1999; Seguino 2000).

Most research on gender differences in entrepreneurship was initially focused on industrialized countries. A prominent finding that emerged from (especially early) studies in this field is that male entrepreneurs outperform female entrepreneurs on a range of quantifiable performance measures, such as sales or turnover, profits, productivity, etc. (for the US: Loscocco and Robinson 1991; Chaganti and Parasuraman 1997; for the UK: Rosa et al. 1994; for Germany: Gottschalk and Niefert 2011). These gender gaps in enterprise performance often appeared to be mediated by differences in enterprise characteristics, with women-owned or -managed enterprises often being smaller, less capitalized and more strongly concentrated in low productivity sectors than enterprises owned or managed by men (see Klapper and Parker 2010; Minniti and Naudé 2010; OECD 2012). Empirical evidence, however, remains more mixed, about whether

gender gaps persist when comparing firms within the same sector and of similar size and capital intensity. On these grounds, several authors have challenged the ‘female underperformance hypothesis’ (Du Rietz and Henrekson 2000; Zolin and Watson 2013).¹

In the development economics literature, research on gender differences in entrepreneurship gained momentum only more recently. Over the last decade, an increasing policy focus on female entrepreneurship and improved data availability have prompted a growing literature to assess gender-specific constraints to entrepreneurship and evaluate the effectiveness of various interventions in tackling these constraints. In a recent review for Sub-Saharan Africa, Campos and Gassier (2017) develop a conceptual framework that illustrates how gender-specific constraints – including contextual factors (legal discrimination, social norms, etc.), endowments (skills, capital and assets, etc.) and preferences (risk, time, etc.) – affect strategic choices (capital and labor inputs, etc.) of male and female entrepreneurs and ultimately outcomes (e.g. gender differences in firm performance).

More closely related to this paper is a strand of the development economics literature that quantifies gender gaps in firm productivity at the country or regional level using household and firm survey data. These studies, which are summarized in Table 1, focus on differences in labor or total factor productivity between firms owned or managed by men vs. women. This literature reveals several interesting patterns. First, in most countries, unconditional gender differences in labor productivity favor men (e.g. Bardasi et al. 2011 for Europe and Central Asia and Latin America; Rijkers and Costa 2012 for Bangladesh, Ethiopia and Sri Lanka; Hallward-Driemeier 2013 for Sub-Saharan Africa; Gui-Diby et al. 2017 for Asia). Second, similar to industrialized countries, gender gaps in productivity typically narrow – and sometimes even close – if the analysis controls for key enterprise characteristics, most notably sector and firm size (e.g. Hallward-Driemeier 2013; Rijkers and Costa 2012; Gui-Diby et al. 2017). Third, though comparison across studies is hampered by differences in the underlying methodology, there is some evidence that gender gaps are

¹ More recently, fueled by legislative strides to improve gender equality in executive positions, several studies have investigated the relationship between the share of women in top management (such as CEOs and boards of directors) and firm performance. These studies have often find that *gender diversity* in top management positively impacts firm performance (Smith et al 2006; Martín-Ugedo and Minguez-Vera 2014; Christansen et al 2016; Flabbi et al 2016).

smaller in the formal than in the informal sector. For example, Hallward-Driemeier (2013) estimates that female-owned enterprises are 6 percent less productive than male-owned enterprises in the formal sector, compared with a gender gap of 50 percent in the informal sector. Similarly, Bruhn (2009), using data from Latin America and controlling for enterprise characteristics, finds gender differences in productivity for micro- and small enterprises, but not for medium-sized and large firms.

The present study builds on this literature to assess gender gaps in enterprise performance in the formal private sector. It improves on the existing literature in the following ways. First, to the best of our knowledge, this is the first global assessment of gender gaps in labor productivity in the formal private sector in developing and emerging economies. We use nationally representative data for 128 countries, which cover 46,000 firms in total. This not only increases the geographic scope of the analysis compared to earlier studies at the country or regional level, but also gives us more statistical power to detect gender differences in labor productivity. In addition, our data are more recent (2009-2016) than those used by previous studies, which often relied on Enterprise Survey data from the early 2000s (e.g. Bruhn 2009; Bardasi et al. 2011). Second, we use decomposition techniques to disentangle the various factors that explain gender differences in labor productivity and provide guidance to policy makers on how to reduce gender gaps in enterprise performance. And finally, in using comparable data and a consistent approach, the study allows for comparison across firm sizes, sectors and regions. The analysis in this paper complements other recent studies that have used global firm-level data to explore the factors and policies associated with women's participation in firm management (Islam 2013; Islam and Amin 2016; Sekkat et al. 2015).

3. Data and Base Regressions

Data source

The data source for the analysis is based on the World Bank Enterprise Surveys (ES). The data set covers a cross-section of about 46,000 firms across 128 mostly developing countries, surveyed between 2009 and 2016 (list of economies presented in Table A1). The ES are nationally representative surveys of formal

(registered) firms with 5 or more employees. The surveys cover manufacturing and services firms excluding extractive industries and agriculture. The survey is implemented using stratified random sampling with location (within country), sector, and size as the strata. Respondents of the surveys are for the most part owners or top managers of the firms. The use of a standardized survey instrument and methodology allows for comparisons across economies. The surveys cover a range of topics including corruption, access to finance, infrastructure, competition, crime, labor, business environment obstacles and firm performance.² A female-managed firm is defined as a firm where the top manager is female.³ We focus on female management, rather than ownership, because it is a well-defined concept even for firms with multiple owners or shareholders, and because previous studies have argued that female decision-making is more strongly associated with productivity than female participation in ownership (e.g. Aterido and Hallward-Driemeier 2011; Hallward-Driemeier 2013).

Table A1 provides the percentage of female-managed firms by country in the sample. The economies in the sample with the highest percentage of firms with top female managers are Thailand (67 percent) and Cambodia (60 percent), followed by the República Bolivariana de Venezuela (50 percent). On the other end of the spectrum are the Republic of Congo, Guinea, and Madagascar, which have no firms with female top managers in the sample. The average for the whole sample including all countries is 18 percent.

Mean differences between female-managed and male-managed firms

Table 2 provides descriptive statistics and means tests of several variables between female-managed and male-managed firms. The outcome variable for the analysis is labor productivity, defined as sales per worker. There is a statistically significant (at 5 percent) unconditional gender productivity gap, with labor productivity being approximately 11 percent lower among female-managed firms than among male-managed firms.⁴ This is higher than the gender gap found by Hallward-Driemeier for the formal sector

² Details of the methodology can be accessed through the following link:
<http://www.enterprisesurveys.org/methodology>.

³ The survey question is “Is the Top Manager female?” and an affirmative response classifies the firm as female-managed.

⁴ The US dollar equivalent in average log sales per worker is 17,500 (9.77 in logs) for female-managed firms and 19,732 (9.89 in logs) for male-managed firms.

based on ES for Sub-Saharan Africa (6 percent) but lower than what many studies have found for the informal private sector (e.g. Hallward-Driemeier 2013; Rijkers and Costa, 2012). The unconditional gender gap is also shown in the kernel density estimates of female-managed and male-managed firms in Figure 1.

We next turn to differences in the characteristics of female- and male-managed enterprises. Female-managed firms are less likely to have investment (37 vs 44 percent), slightly younger (16 vs 17 years) and much smaller in size (26 vs 45 employees) than male-managed firms. All differences are statistically significant at the 1 percent level. This is line with earlier studies that have found enterprises owned by women to be smaller and less capitalized than enterprises owned by men (Klapper and Parker 2010). Female managers also have about 2 years less experience on average than male managers, statistically significant at the 1 percent level. Female-managed firms tend to have a lower degree of outward orientation than male-managed firms. About 9 percent of female-managed firms export 10 percent or more of their sales, and only 9 percent of female-managed firms have foreign ownership. In contrast, 12 percent of male-managed firms export, and 12 percent have foreign ownership. These differences are statistically significant at the 1 percent level.

Female-managed firms are more likely to face losses due to crime than male-managed firms (21 vs 19 percent), statistically significant at the 10 percent level. Female-managed firms are also less likely to pay for security than male-managed firms (52 vs 55 percent), statistically significant at the 5 percent level. In addition, female-managed firms are less likely to own a website than male-managed firms (40 vs 43 percent). The difference is statistically significant at the 5 percent level. Female-managed firms, however, report a lower degree of power outages than male-managed firms (12.6 vs 25.7 hours), statistically significant at the 1 percent level. Also, a significantly lower proportion of female-managed firms have power generators than male-managed firms (26 vs 34 percent). Thus female-managed firms are less likely to buffer the high levels of power outages faced by both male and female-managed firms. The difference is statistically significant at the 1 percent level.

There is no significant difference between female-managed and male-managed firms in the following indicators: whether the firm offers formal training, whether the firm has a loan or line of credit, the expectation of providing gifts to public officials (to get things done), whether the firm was formally registered when it started operations, and senior management time spent in dealing with regulations. About 21 percent of all firms are expected to give gifts to public officials. About 33 percent of all firms offer formal training. Around 36 percent of firms have a loan or line of credit. And on average, management spends 10 percent of their time dealing with government regulations. Around 89 percent of firms were formally registered when they started operations.

Female-managed firms are more likely to be in the retail sector than male-managed firms. About 31 percent of female-managed firms are in the retail sector in contrast to 20 percent of male-managed firms and the difference is statistically significant at the 1 percent level. Conversely, fewer female-managed firms than male-managed firms are in the manufacturing sector (22 vs 31 percent), also statistically significant at the 1 percent level. There is no significant difference between the proportion of female-managed and male-managed firms in service sectors other than retail (47 vs 49 percent). These findings are consistent with earlier studies that have found female entrepreneurs to be engaged disproportionately in the service sectors, particularly retail (Klapper and Parker 2010; Bardasi et al. 2011; Hallward-Driemeier 2013; Amin and Islam 2014).

Figure 1: Density estimates of the log of labor productivity for female- and male-managed firms

Regressions

Firm-level regressions of the determinants of the log of labor productivity are presented in Table 3. We employ a specification that includes common control variables referenced in the literature. We account for the age and size of the firm, which have been shown to be related to labor productivity (Harris and Robinson 2004; Huergo and Jaumandreu 2004; Biesebroeck 2005; Bigsten and Gebreyesus 2007; Haltiwanger et al. 2013). In addition, we proxy for physical capital by capturing whether or not the firm purchased fixed assets in the last fiscal year. In terms of human capital, we include the years of experience of the top manager and whether the firm offers formal training. We also capture the outward orientation of the firm with variables such as exporter status and foreign ownership that have been found to play a role in firm productivity (Lopez 2005; Bernard et al. 2007). Access to finance is controlled for by a dummy variable that takes on a value of one if a firm has a loan or line of credit, and zero otherwise. We capture whether a firm has its own website. We also include several elements of the business environment. These are factors such as the total duration of power outages experienced by a firm, whether a firm owns a generator, faced crime, paid for security, expected a request for a bribe, and the amount of time spent by management in dealing with government regulations, which has been found to be important in the literature (Kinda et al. 2015; Seker and Yang 2014). The regressions control for location (within country) fixed effects.

The regression results for the pooled (male and female) sample are provided in column 1 of Table 3. The sample is subsequently divided into female-managed firms (column 2) and male-managed firms (column 3). The coefficient of the female top manager variable in column 1 is negative and statistically significant at the 1 percent level. This implies that firms with a female top manager have lower levels of labor productivity than firms with a male top manager. Somewhat surprisingly, the conditional gender gap (13 percent), is similar in magnitude to the unconditional gender gap (11 percent) shown in Table 2.⁵

⁵ The coefficient estimate is -0.143. Since the dependent variable is log-transformed, we follow Halvorsen and Palmquist (1980) in calculating the percentage difference in labor productivity as $(\exp(-0.143)-1)*100$. For control variables (which are not the focus of the study) we report the approximate effect (i.e. the coefficient estimate).

The purchase of fixed assets is found to be positively related to labor productivity for both the pooled sample of firms and the subsamples of female- and male-managed firms. However, the coefficient is statistically significant only for the pooled sample and the male-managed firm sample (1 percent level of significance). The age of the firm is positively correlated with labor productivity and the coefficients are statistically significant at the 1 percent level for the pooled and male-managed firm subsample, and at the 5 percent level for the female-managed firm subsample. Firms that offer formal training tend to have higher labor productivity in all three subsamples. The coefficient is statistically significant at the 1 percent level for the pooled and male-managed firm subsample, and at 5 percent for the female-managed firm sample. The size of the firm has a negative relationship with labor productivity. The coefficient of firm size is statistically significant at the 1 percent level for both the pooled and male-managed subsample, and at 10 percent for the female-managed firm subsample. The expectation of bribes and the percent of senior management time spent dealing with government regulations have no statistically significant relationship with labor productivity for the pooled sample as well as both subsamples.

Outward orientation of the firm is an important factor of labor productivity. For firms in the pooled sample and male-managed firms, exporting has a positive effect on labor productivity with a coefficient that is statistically significant at the 1 percent level. The coefficient for exporter status is statistically insignificant for the female-managed sample. However, the coefficient for foreign ownership is positive and statistically significant at the 1 percent level for the pooled sample and both subsamples. Firms that have a loan or a line of credit tend to be more productive. The coefficient is statistically significant at the 1 percent level for all three subsamples. Similarly, firms that have their own websites tend to be more productive, with the coefficient being statistically significant at the 1 percent level in all cases.

There is no statistically significant relationship between whether firms experienced crime-related losses and labor productivity. However, the coefficient of the dummy variable capturing whether or not firms paid for security is positive and statistically significant at the 1 percent level for the pooled and male-managed firm subsamples and at the 5 percent level for the female-managed firm subsample. The total duration of

power outages has a negative effect on the productivity of firms in the pooled sample and the male-managed firm subsample (statistically significant at the 1 percent level). However, the coefficient is negative but statistically insignificant for the female-managed firm subsample. The firm's use of a generator is positively related to labor productivity. The coefficient is statistically significant at the 1 percent level for the pooled sample and male-managed firms, and at 10 percent for female-managed firms. The implication may be that the capacity of firms to buffer or protect against criminal activity and power outages are important determinants of the labor productivity levels of firms.

Heterogeneity

We also check if the gender gap in labor productivity varies by firm size, sector and region. In Table 4 we report the results by size. The coefficient of whether a firm has a female top manager is statistically significant across all three size groups, at least at the 10 percent level of significance, though the gender gap in labor productivity is largest for large firms with 100+ employees. In Table 5 we report the results by sector. While the coefficient for female top manager is negative in all cases, it is only statistically significant for the manufacturing and other services sectors. The relationship between female top manager and labor productivity is insignificant in the retail sector.

Table 6 reports the results by region. While in all regions, the point estimate of the coefficient for female top manager is negative, the effect is statistically significant only in Europe and Central Asia (ECA) (at 1 percent) and in Sub-Saharan Africa (SSA) (at 10 percent). In these two regions, female-managed firms are approximately 20 percent less productive than male-managed firms, conditional on observable characteristics. In other regions, we find gender gaps that are smaller, and not significant.

4. Labor Productivity Decomposition Methodology

The literature has utilized Oaxaca-Blinder decompositions to explore contributors to gender wage gaps, wage inequality and productivity (Oaxaca 1973; Blinder 1973, Fortin 2008, 2011; O'Neill and O'Neill 2006; Kilic et al. 2015). Palacios-Lopez and Lopez (2015) use an Oaxaca-Blinder decomposition to explain

the gender gap in agricultural labor productivity using household-level data. We apply the same methodology to explain the labor productivity gap between female-managed and male-managed firms. A decomposition analysis allows us to illuminate the contributions of various factors to the gender gap in firm-level productivity. However, the decomposition, just like the underlying regression analysis, cannot establish whether the relationships are causal.

We estimate the log of labor productivity of female-managed firms as follows:

$$Y_F = \beta_{F0} + \sum_{j=1}^J \beta_{Fj} X_{Fj} + \epsilon_F \quad (1)$$

Where Y_F is the log of sales per worker for female-managed firms, and X is a vector of j observable factors that encompass firm-level characteristics as well as business environment elements that can influence the productivity of firms. Regional characteristics are captured by location (within country) fixed effects included in the estimations. ϵ_F is the error term. The counterpart of equation (1) for male-managed firms is presented below in equation (2), where the subscripts F are replaced by M to connote male-managed firms. It is assumed that $E(\epsilon_F) = E(\epsilon_M) = 0$.

$$Y_M = \beta_{M0} + \sum_{j=1}^J \beta_{Mj} X_{Mj} + \epsilon_M \quad (2)$$

Taking the expectation of the log labor productivity of female-managed firms, equation (1) can be written as:

$$\begin{aligned} E(Y_F) &= E\left(\beta_{F0} + \sum_{j=1}^J \beta_{Fj} X_{Fj} + \epsilon_F\right) \\ &= \beta_{F0} + \sum_{j=1}^J \beta_{Fj} E(X_{Fj}) \end{aligned} \quad (3)$$

Along similar lines, taking the expectation of male-managed firms, equation (2) can be written as:

$$\begin{aligned}
E(Y_M) &= E\left(\beta_{M0} + \sum_{j=1}^J \beta_{Mj} X_{Mj} + \epsilon_M\right) \\
&= \beta_{M0} + \sum_{j=1}^J \beta_{Mj} E(X_{Mj})
\end{aligned} \tag{4}$$

The labor productivity gap (D) can be expressed as $D = E(Y_F) - E(Y_M)$. Thus, the labor productivity gap can be obtained by equation (3) minus equation (4) and expressed as equation (5) below.

$$D = \beta_{F0} + \sum_{j=1}^J \beta_{Fj} E(X_{Fj}) - \beta_{M0} - \sum_{j=1}^J \beta_{Mj} E(X_{Mj}) \tag{5}$$

Rearranging equation (5) by adding and subtracting $\sum_{j=1}^J \beta_{Fj} E(X_{Mj})$, we obtain:

$$D = \underbrace{\sum_{j=1}^J [E(X_{Fj}) - E(X_{Mj})] \beta_{Fj}}_{\text{Endowment Effect}} + \underbrace{\beta_{F0} - \beta_{M0} + \sum_{j=1}^J [(\beta_{Fj} - \beta_{Mj}) E(X_{Mj})]}_{\text{Structural Effect}} \tag{6}$$

Where $\sum_{j=1}^J [E(X_{Fj}) - E(X_{Mj})] \beta_{Fj}$ is the endowment effect and $\beta_{F0} - \beta_{M0} + \sum_{j=1}^J [(\beta_{Fj} - \beta_{Mj}) E(X_{Mj})]$ is the structural effect. Within the structural component, the first part ($\beta_{F0} - \beta_{M0}$) reflects differential regression intercepts for male- and female-managed firms (i.e. unexplained differences across the two groups due to unobservables) while the second part ($\sum_{j=1}^J [(\beta_{Fj} - \beta_{Mj}) E(X_{Mj})]$) reflects differences in slope coefficients, i.e. the combined effect of returns to all the covariates. In practice, equations (1) and (2) are estimated as outlined in the previous section (and as shown in Table 3, columns 2 and 3). The parameter estimates and sample means of each covariate are then used to compute equation (6). We can further disaggregate the endowment and structural effect by means of a detailed decomposition to explore the contribution of each covariate.

There are two important assumptions needed for the decomposition in equation (6) to be valid (see also Fortin et al. 2011). First is the assumption of overlapping support and second is the assumption of ignorability. Under the assumption of overlapping support, there is overlap in the distribution of observables and unobservables between male- and female-managed firm subpopulations. That is, the covariates X cannot attain a single value $X = x$ or $\epsilon = e$ such that female-managed (or male-managed) firms are identified. Ignorability assumes that, conditional on controls, the assignment of female-managed firms is random. In other words, we assume that the status of being a female-managed firm is random after accounting for various factors, which rules out, for example, self-selection based on unobservables. In addition, for the detailed decomposition we have to assume additive linearity (which is implicit in the linear functions of log labor productivity shown above) and zero conditional mean (as specified above).

5. Results

Table 7 presents the decomposition results. As discussed in the previous section, labor productivity among female-managed firms is on average 11 percent lower than among male-managed firms. This unconditional labor productivity gap is decomposed into an endowment effect and a structural effect. The endowment effect refers to the attributes or incidence of certain factors experienced by the firm, whereas the structural effect refers to the returns to these attributes or factors. Take, for instance, the age of a firm. Female-managed firms are on average younger than male-managed firms and this contributes to the labor productivity gap as an endowment effect. Furthermore, the returns of an additional year in the age of the firm may have differential effects for female-managed and male-managed firms, and this would be captured as a structural effect. Below we present the results decomposed into endowment effects and structural effects.

Endowment effects

Recall that male-managed firms are more productive than female-managed firms. Thus, any factors that narrow the gender gap favor female-managed firms over male-managed firms. The findings for the endowment effects are presented in column 2 of Table 7. The age of the firm widens the labor productivity gap between female-managed and male-managed firms by 8 percent. Recall that female-managed firms are

about 2 years younger than male-managed firms. This confers an advantage to male-managed firms. This is in line with studies that show that the age of the firm is positively related to its performance (Majumdar 1997; Osunsan et al. 2015; Rossi 2016). Female-managed firms are much smaller than male-managed firms size (26 versus 45 employees). Regressions in Table 3 indicate that firm size is inversely related to labor productivity. This smaller size of female-managed firms contributes to a 22 percent narrowing of the gap between female-managed and male-managed firms.

Foreign ownership has a positive relationship with labor productivity. On average, 9 percent of female-managed firms have foreign ownership in contrast to 12 percent of male-managed firms. The lower foreign ownership in female-managed firms contributes to a 12 percent widening of the labor productivity gap between female-managed and male-managed firms. This is the second biggest contributor in terms of endowments that increase the gap. Similarly, the proportion of female-managed firms with their own website is slightly lower than the corresponding proportion of male-managed firms. This contributes to an 8 percent widening of the labor productivity gap between female-managed and male-managed firms.

The ability of a firm to protect itself against crime and to buffer the effects of power outages are important ways to safeguard firm productivity. Female-managed firms are less likely to pay for security and less likely to use power generators than male-managed firms. The lower proportion of female-managed firms paying for security than male-managed firms contributes to a 6 percent widening of the labor productivity gap. In addition, the lower adoption of power generators by female-managed firms leads to a 13 percent increase in the labor productivity gap between female-managed and male-managed firms. This is the largest contributor in terms of endowments that increases the labor productivity gap.

Female-managed firms are more likely to be in the retail sector than male-managed firms. This was shown in Table 2 and is also consistent with what has been found in the literature (Amin and Islam, 2014). As shown further in Table 3, firms in the retail sector tend to be more productive than firms in the manufacturing sector. The higher percentage of female- than male-managed firms in the retail sector (31

percent vs 20 percent) hence narrows the labor productivity gap by 55 percent. The favorable sectoral distribution of female-managed firms is the biggest contributor towards narrowing the gender gap in labor productivity. These countervailing forces, with some endowment effects narrowing and others widening the gender gap, also explain why the overall endowment effect is statistically insignificant.

It is worth highlighting that the two endowment effects that are identified here to narrow gender differences in labor productivity – the smaller size of female-managed firms and their concentration in the retail sector – are usually portrayed as forces that widen gender gaps in enterprise performance (e.g. Klapper and Parker 2010). There is indeed some evidence that controlling for firm size and sector fixed effects in labor productivity regressions can reduce the size of the gender dummy, which suggests that these factors may in some contexts explain some of the productivity disadvantage of female entrepreneurs (e.g. Aterido and Hallward-Driemeier 2011; Hallward-Driemeier 2013). However, most of the studies emphasizing firm size and distribution across industries as factors contributing to the gap between male and female entrepreneurs use performance measures that (unlike the labor productivity measure here) are not normalized on the number of workers (e.g. profitability/sales as in Loscocco et al 1991) or model total factor productivity (as in Rijkers and Costa 2012) and this most likely explains some of the differences between the results here and the other studies

Structural effects

Structural effects refer to the role of the returns to production factors or attributes of firms that lead to the widening or narrowing of the labor productivity gap between female-managed and male-managed firms. The only statistically significant structural contribution to the gender gap is the sector of the firm.⁶ Female-managed firms achieve higher returns in the retail sector than male-managed firms, and this leads to a 34 percent narrowing of the gap. Female-managed firms are hence not only disproportionately represented in the retail sector but also achieve above-average returns, which suggests that some of the observed sectoral

⁶ In the detailed decomposition, the identification of the relative contributions of the regression intercept vs categorical variables with 3+ categories to the total structural effect depends on the choice of omitted category (Fortin et al. 2011). We omit the sector with the lowest labor productivity (manufacturing) to mimic the case of a continuous variable.

concentration of female-managed firms reflects comparative advantages (rather than entry barriers). Female-managed firms are also able to take advantage of being in service sectors (other than retail), which contributes to a 72 percent narrowing of the labor productivity gap between female-managed and male-managed firms. However, these effects are overcompensated by counteracting differences in location fixed effects (gender gap increasing) and regression intercepts (gender gap reducing), which illustrates that much of the differences in labor productivity between female- and male-managed firms cannot be explained by our model. Thus, the overall structural difference between male-managed and female-managed firms leads to a 125 percent increase in the labor productivity gap between female-managed and male-managed firms.

6. Robustness

The regressions in Table 3 use information on whether a firm purchased fixed assets in the last fiscal year to proxy for physical capital, which is the only variable related to capital use that is available for the full sample of firms. However, such binary data do not provide any information on the value of the firm's capital stock. In addition, the regressions in Table 3 do not control for the firm's labor cost (that is, spending on wages and benefits), because this information is not available for the full sample. However, the World Bank's Enterprise Surveys do collect data on the hypothetical repurchase value of machinery and the cost of labor for manufacturing firms, and these factors may explain some of the differences in labor productivity between male- and female-managed firms. For example, there is evidence from prior studies that female entrepreneurs face disproportionate constraints in access to capital (Klapper and Parker 2010) and that controlling for capital intensity significantly reduces the size of the gender gap in labor productivity (Hallward-Driemeier 2013).

The first robustness check explores what happens to the gender gap in labor productivity if we control for the repurchase cost of machinery and labor cost. Because this type of financial data is only available for a subset of manufacturing firms, this comes at the cost of a significant decline in sample size, from 46,876 in Table 3, column 1, to 18,358 in Table 8, column 2. To separate the effect of the additional control variables from that of sample composition, Table 8 column 1 re-estimates the base specification on the subsample of manufacturing firms with financial data. For this sample, female-managed firms are 20 percent less

productive than male-managed firms, which is a larger gender gap than in the full sample (Table 3, column 1). It is similar in magnitude to what was shown in Table 5 for the manufacturing sector as a whole. Controlling for the repurchase cost of machinery and labor cost (Table 8, column 2), both of which are positively correlated to labor productivity, reduces the gender gap to 13 percent. These results suggest that some of the gender gap in labor productivity in the manufacturing sector is related to differences in capitalization and spending on wages and benefits between male- and female-managed firms.

Our second robustness check investigates how the gender gap in labor productivity changes if we classify firms based on whether they have a female owner, instead of whether they have a female top manager. In the case of firms under sole proprietorship, this variable indicates if the firm is owned by a woman. For firms with multiple owners, it reflects if at least one of the owners is female. As highlighted in section 3, most of the existing studies in this literature strand classify firms based on male vs female ownership, not management, though there is evidence that firms classified as female-owned per the above definition may include firms where women are only partial owners and not strongly engaged in decision-making (e.g. Aterido and Hallward-Driemeier 2011; Hallward-Driemeier 2013). Our results (Table 8, column 3) support this notion, as we do not find a significant gender gap in labor productivity if we classify firms based on whether the firm has a female owner. Likewise, if we include both female management and female ownership (Table 8, column 4), only the parameter estimate for female top manager is significant and similar in size as the base specification in Table 3. These results caution that some of the existing studies based on ownership may not reveal the full extent of the gender gap in labor productivity.

7. Conclusion and Policy Recommendations

In this study, we conducted a global assessment of gender differences in labor productivity in the formal private sector. Our results reveal a sizable unconditional gap, with labor productivity being approximately 11 percent lower among female-managed firms than among male-managed firms. Contrary to several other studies in this field, our results suggest that gender gaps in labor productivity are not driven primarily by differences in observable enterprise characteristics, and the conditional gender gap, at 13 percent, is of similar magnitude as the unconditional gap. One reason for this difference in results may be that our

analyses are based on female management, which is more strongly associated with labor productivity than female participation in ownership, which has been the focus of most previous studies.

Enabling female-managed firms to protect themselves from business environment issues such as crime and power outages narrows the labor productivity gap. Similarly, increasing outward orientation in terms of foreign ownership and connectivity to communication technology for female-managed firms are other pathways to narrow the gap between female-managed and male-managed firms. In the manufacturing sector, we find some evidence that the lower capital-intensity of female-managed firms also contributes to the gender gap.

One striking finding is the role of the sector firms operate in. Female-managed firms tend to be concentrated in the retail sector (Islam and Amin 2014). However, contrary to other studies in this field, our results suggest that the sectoral distribution of female-managed firms lowers (rather than widens) the labor productivity gap between female- and male-managed firms. In addition, restricting the sample to just retail firms shows no statistically significant difference between the labor productivity of male-managed and female-managed firms. This suggests that the disproportionate representation of female entrepreneurs in the service sectors is not necessarily a disadvantage. The policy implication is twofold. First, improvements in the business environment in the retail sector would infer direct benefits to female-managed businesses. Second, specific interventions might be taken to improve the lagging productivity of female-managed firms in the manufacturing sector.

While this study is a first step towards exploring gender gaps in labor productivity in the formal private sector in developing and emerging countries, we hope it encourages further studies along several dimensions. First, the decomposition analysis revealed a large residual gender gap in productivity that could not be explained by gender differences in observable characteristics, or by returns to these characteristics. Further country-level analyses into what factors may explain the gap, building on the conceptual framework developed by Campos and Gassier (2017), would provide important additional information. Second, labor

productivity is just one dimension of enterprise performance and decompositions of other measures would enrich our understanding of gender gaps. Third, additional analyses of gender gaps among informal and micro firms in developing countries would be important, given that the results from the formal sector cannot necessarily be extended to the informal sector. Finally, this study is cross-sectional in nature, which is a feature of most gender gap decomposition analysis. For future research, exploring how the gender productivity gap in the formal private sector evolves over time would provide important insights.

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Main Tables

Table 1: Studies estimating gender gaps in labor productivity in the formal and informal private sector (excl. agriculture) for developing countries

Author(s) (year)	Country(ies)	Main data source(s)	Sector(s)	Productivity measure(s)	Gender measure(s)	Estimation	Disaggregation	Control variables	Unconditional gender gaps	What changes with controls?
Bardasi et al (2011)***	27 countries in ECA, 13 countries in LAC and 22 countries in SSA	Business and Environment and Enterprise Performance Surveys, ES	Mostly formal	(1) Labor productivity - value added per worker; (2) TFP (Cobb-Douglas p.f.)	Female principal or sole owner (binary)	OLS	Region-level estimates	Country and sector fixed effects; Cobb-Douglas p.f. also controls for input use	Female-owned enterprises have lower labor productivity than male-owned enterprises in ECA and LAC, but not in SSA. Relationship is weaker for TFP.	Unconditional relationship holds with control variables.
Bruhn (2009)*	9 countries in LAC	ES, micro and small enterprise surveys	Formal and informal	TFP (Cobb-Douglas p.f.)	Female principal or sole owner (binary)	OLS, quantile regressions	Micro and small enterprise surveys: country-level estimates ES: Pooled estimates	Country (or region, city) and sector fixed effects; input use		With controls, female-owned micro and small enterprises are less productive than male-owned enterprises in Mexico (9 percent) and Peru (16 percent). No significant gender gaps in the Bolivia survey and the ES.
Gui-Diby et al (2017)*	23 countries in Asia	ES	Mostly formal	Labor productivity - sales per worker	(1) At least one female owner (binary); (2) female ownership >50 percent (binary); (3) female ownership (continuous)	OLS, selection correction model	Pooled and country-level estimates	Enterprise characteristics, owner's experience	In the pooled sample, (majority) female-owned enterprises have lower labor productivity than (majority) male-owned enterprises, but the relationship differs across countries and does not hold if firms are differentiated based on having at least one female owner.	With controls, female ownership is not significantly related to productivity.
Hallward-Driemeier (2013)**	37 countries in SSA	ES	Mostly formal	Labor productivity - value added per worker	(1) At least one female owner (binary); (2) at least one female decision-maker (binary); (3) principal decision-maker is female (binary)		Pooled estimates	Enterprise characteristics	Female-owned enterprises are 6 percent less productive than male-owned enterprises.	With controls for firm characteristics (sector, size), gender gaps disappear.
Hallward-Driemeier (2013)**	19 countries in SSA	Enterprise modules of various household surveys	Household enterprises (mostly informal)	Labor productivity - value added per worker	Female owner (binary)			Enterprise characteristics	Female-owned enterprises are 50 percent less productive than male-owned enterprises.	Gender gaps narrow (but remain significant) with controls for enterprise characteristics (registration, sector, size, month of operation).
Nagler and Naude (2017)***	4 countries in SSA	Enterprise modules of household surveys (LSMS-ISA)	Household enterprises (mostly informal)	Labor productivity - sales (or gross revenues) per worker	Female owner (binary)	selection correction model	Country-level estimates	Enterprise, owner's and household characteristics		With controls, female-owned enterprises are less productive than male-owned enterprises in Ethiopia, Malawi and Nigeria. No gender gap in Uganda
Nordman and Vaillant (2014)*	Madagascar	Informal enterprise surveys	Informal	TFP (Cobb-Douglas p.f.)	Female owner (binary)	OLS, fixed effects, selection correction model	<i>n.a.</i>	Year and sector fixed effects, owner's characteristics (human capital, marital status), input use		With controls, female-owned enterprises are 28 percent less productive than male-owned enterprises.
Rijkers and Costa (2012)***	Bangladesh, Ethiopia, Indonesia and Sri Lanka	Various matched household-enterprise-community surveys	Mostly informal	TFP (Cobb-Douglas p.f.)	Female manager (binary)		Country-level estimates	Enterprise (size, sector), owner's and community characteristics, input use	Female-managed enterprises achieve 12%/35%/50% of labor productivity of male-managed enterprises in Bangladesh/Ethiopia/Sri Lanka. No significant gender gap in Indonesia.	With controls, gender gaps half in Ethiopia, and disappear in Bangladesh and Sri Lanka.

Notes: ECA denotes East and Central Asia. LAC denotes Latin America and the Caribbean. SSA denotes Sub-Saharan Africa. ES denotes (World Bank) Enterprise Surveys. LSMS-ISA denotes Living Standard Measurement Study - Integrated Surveys on Agriculture. TFP denotes total factor productivity. p.f. denotes production function. *n.a.* denotes not applicable. Blank field denotes no further information. *** Published in peer-reviewed journal. ** Book publication. * Working paper.

Table 2: Descriptive Statistics and Test of Mean Difference by Gender of Top Manager

	ALL	Female Top Manager	Male Top Manager	
Log of labor Productivity (deflated, USD)	9.87	9.77	9.89	**
Firm purchased fixed assets in the last fiscal year Y/N	0.43	0.37	0.44	***
Log of age of firm	2.54	2.48	2.55	***
Log of size	2.79	2.54	2.85	***
Expected to give gifts to public officials (to get things done) Y/N	0.21	0.21	0.21	
Senior management time spent in dealing with requirements of government regulations	9.79	10.03	9.73	
Firm offers formal training Y/N	0.33	0.33	0.34	
Top manager experience in sector (years)	17.26	15.55	17.65	***
Direct exports 10% or more of sales Y/N	0.12	0.09	0.12	***
Foreign ownership Y/N	0.11	0.09	0.12	***
Establishment has a line of credit or loan Y/N	0.36	0.35	0.37	
Establishment has its own website Y/N	0.43	0.4	0.43	**
Firm experienced losses due to crime Y/N	0.19	0.21	0.19	*
Firm paid for security Y/N	0.54	0.51	0.55	**
Average total time of power outages per month	23.22	12.62	25.66	***
Firm uses power generator Y/N	0.32	0.26	0.34	***
Firm formally registered when started operations Y/N	0.89	0.89	0.89	
Manufacturing	0.29	0.22	0.31	***
Retail	0.22	0.31	0.2	***
Other Services	0.48	0.47	0.49	

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Base OLS Regressions

Dependent Variable	Log of Labor Productivity (Sales per Worker)		
	ALL	Female Top Manager	Male Top Manager
	coef/se	coef/se	coef/se
Female top manager Y/N	-0.143*** (0.041)		
Firm purchased fixed assets in the last fiscal year Y/N	0.097*** (0.032)	0.055 (0.085)	0.096*** (0.035)
Log of age of firm	0.109*** (0.022)	0.141** (0.059)	0.105*** (0.025)
Log of size	-0.053*** (0.016)	-0.082* (0.045)	-0.050*** (0.018)
Expected to give gifts to public officials (to get things done) Y/N	0.055 (0.046)	0.041 (0.119)	0.061 (0.049)
Senior management time spent in dealing with requirements of government regulations	0.0004 (0.001)	0.004 (0.003)	0.001 (0.001)
Firm offers formal training Y/N	0.181*** (0.037)	0.189** (0.095)	0.167*** (0.042)
Top manager experience in sector (years)	-0.000 (0.002)	-0.005 (0.004)	0.001 (0.002)
Direct exports 10% or more of sales Y/N	0.119*** (0.044)	-0.002 (0.149)	0.135*** (0.047)
Foreign ownership Y/N	0.419*** (0.052)	0.535*** (0.149)	0.401*** (0.058)
Establishment has a line of credit or loan Y/N	0.217*** (0.031)	0.227** (0.092)	0.227*** (0.034)
Establishment has its own website Y/N	0.277*** (0.034)	0.236*** (0.085)	0.267*** (0.038)
Firm experienced losses due to crime Y/N	0.055 (0.039)	0.076 (0.106)	0.025 (0.043)
Firm paid for security Y/N	0.215*** (0.033)	0.177** (0.090)	0.239*** (0.036)
Average total time of power outages per month	-0.001*** (0.000)	-0.0002 (0.001)	-0.001*** (0.000)
Firm uses power generator Y/N	0.182*** (0.036)	0.193* (0.101)	0.192*** (0.039)
Firm formally registered when started operations Y/N	0.156***	0.066	0.149**

	(0.055)	(0.126)	(0.062)
Retail Sector	0.446***	0.599***	0.403***
	(0.039)	(0.096)	(0.044)
Other Services Sector	0.231***	0.381***	0.207***
	(0.032)	(0.092)	(0.035)
Constant	9.102***	9.429***	9.037***
	(0.173)	(0.442)	(0.200)
Location (within country) Fixed Effects	YES	YES	YES
Number of observations	46,876	6,770	40,106
R2	0.452	0.578	0.446

note: *** p<0.01, ** p<0.05, * p<0.1, Omitted sector: Manufacturing

Table 4: Main Estimations by Size

Dependent Variable	Log of Labor Productivity (Sales per Worker)		
	Small (5-19)	Medium (20-99)	Large (100+)
Firm Size	coef/se	coef/se	coef/se
Female top manager Y/N	-0.133** (0.052)	-0.160* (0.088)	-0.333*** (0.126)
Firm purchased fixed assets in the last fiscal year Y/N	0.084* (0.044)	0.098* (0.057)	0.180** (0.090)
Log of age of firm	0.095*** (0.031)	0.126*** (0.039)	0.176*** (0.057)
Log of size	-0.040 (0.047)	0.015 (0.056)	-0.095 (0.060)
Expected to give gifts to public officials (to get things done) Y/N	0.093 (0.066)	-0.042 (0.076)	0.056 (0.115)
Senior management time spent in dealing with requirements of government regulations	0.0004 (0.002)	-0.0004 (0.002)	0.002 (0.003)
Firm offers formal training Y/N	0.224*** (0.055)	0.172*** (0.057)	-0.019 (0.100)
Top manager experience in sector (years)	0.0003 (0.002)	0.0001 (0.003)	-0.006 (0.004)
Direct exports 10% or more of sales Y/N	0.064 (0.076)	0.133* (0.070)	0.224** (0.087)
Foreign ownership Y/N	0.429*** (0.085)	0.472*** (0.083)	0.300*** (0.114)
Establishment has a line of credit or loan Y/N	0.231*** (0.045)	0.229*** (0.054)	0.176* (0.096)
Establishment has its own website Y/N	0.266*** (0.048)	0.202*** (0.055)	0.333*** (0.111)
Firm experienced losses due to crime Y/N	0.042 (0.055)	0.085 (0.066)	0.140 (0.105)
Firm paid for security Y/N	0.231*** (0.044)	0.192*** (0.056)	0.155 (0.112)
Average total time of power outages per month	-0.001** (0.000)	-0.001** (0.000)	0.001 (0.001)
Firm uses power generator Y/N	0.173*** (0.055)	0.116** (0.055)	0.301*** (0.103)
Firm formally registered when started operations Y/N	0.177*** (0.063)	0.090 (0.093)	0.260 (0.191)
Retail	0.458*** (0.050)	0.495*** (0.073)	0.157 (0.130)
Other Services	0.249***	0.252***	-0.040

	(0.045)	(0.052)	(0.094)
Constant	9.028***	8.985***	9.489***
	(0.235)	(0.384)	(0.450)
Location (within country) Fixed Effects	YES	YES	YES
Number of observations	20,983	16,802	9,091
R2	0.503	0.449	0.478

note: *** p<0.01, ** p<0.05, * p<0.1

Table 5: Main Estimations by Sector

Dependent Variable	Log of Labor Productivity (Sales per Worker)		
	Manufacturing	Retail	Other Services
	coef/se	coef/se	coef/se
Female top manager Y/N	-0.235*** (0.061)	-0.070 (0.075)	-0.148** (0.071)
Firm purchased fixed assets in the last fiscal year Y/N	0.084** (0.037)	0.154** (0.072)	0.079 (0.057)
Log of age of firm	0.043 (0.027)	0.099* (0.051)	0.112*** (0.040)
Log of size	-0.033* (0.019)	-0.006 (0.038)	-0.057* (0.031)
Expected to give gifts to public officials (to get things done) Y/N	-0.008 (0.057)	0.004 (0.095)	0.149* (0.077)
Senior management time spent in dealing with requirements of government regulations	0.001 (0.002)	0.001 (0.003)	-0.001 (0.002)
Firm offers formal training Y/N	0.207*** (0.043)	0.174** (0.074)	0.123* (0.064)
Top manager experience in sector (years)	-0.001 (0.002)	0.003 (0.004)	0.000 (0.003)
Direct exports 10% or more of sales Y/N	0.065 (0.054)	0.034 (0.166)	0.170** (0.080)
Foreign ownership Y/N	0.384*** (0.075)	0.289*** (0.109)	0.490*** (0.089)
Establishment has a line of credit or loan Y/N	0.257*** (0.039)	0.094 (0.077)	0.240*** (0.055)
Establishment has its own website Y/N	0.328*** (0.045)	0.260*** (0.077)	0.239*** (0.061)
Firm experienced losses due to crime Y/N	0.109** (0.052)	0.021 (0.082)	0.047 (0.067)
Firm paid for security Y/N	0.230*** (0.042)	0.164** (0.074)	0.205*** (0.057)
Average total time of power outages per month	-0.000 (0.000)	-0.000 (0.000)	-0.001** (0.000)
Firm uses power generator Y/N	0.220*** (0.044)	0.252*** (0.089)	0.161** (0.067)
Firm formally registered when started operations Y/N	0.110* (0.063)	0.030 (0.098)	0.144 (0.104)
Constant	7.559*** (0.956)	8.080*** (0.238)	6.343*** (0.218)
Location (within country) Fixed Effects	YES	YES	YES
Number of observations	27,257	6,748	12,871
R2	0.504	0.566	0.467

note: *** p<0.01, ** p<0.05, * p<0.1

Table 6: Main Estimations by Region

Dependent Variable	Log of Labor Productivity (Sales per Worker)					
Region	EAP	ECA	LAC	MNA	SA	SSA
	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Female top manager Y/N	-0.039 (0.093)	-0.217*** (0.076)	-0.090 (0.066)	-0.096 (0.158)	-0.097 (0.152)	-0.209* (0.124)
Firm purchased fixed assets in the last fiscal year Y/N	-0.000 (0.097)	0.110* (0.064)	0.012 (0.050)	0.308** (0.123)	0.033 (0.102)	0.172** (0.084)
Log of age of firm	0.159** (0.066)	0.003 (0.054)	0.089** (0.036)	0.084 (0.060)	0.073 (0.068)	0.174*** (0.058)
Log of size	-0.084* (0.044)	-0.129*** (0.031)	0.008 (0.026)	-0.112* (0.057)	-0.011 (0.036)	-0.047 (0.046)
Expected to give gifts to public officials (to get things done) Y/N	0.171* (0.101)	0.067 (0.087)	-0.036 (0.111)	0.091 (0.153)	0.207*** (0.080)	0.048 (0.105)
Senior management time spent in dealing with requirements of government regulations	-0.001 (0.003)	0.001 (0.002)	-0.002 (0.003)	0.002 (0.002)	-0.003 (0.004)	0.004 (0.003)
Firm offers formal training Y/N	0.084 (0.100)	0.243*** (0.067)	0.243*** (0.058)	0.039 (0.225)	-0.043 (0.098)	0.113 (0.094)
Top manager experience in sector (years)	0.001 (0.005)	-0.004 (0.003)	-0.004* (0.002)	0.007 (0.005)	0.007 (0.005)	0.005 (0.004)
Direct exports 10% or more of sales Y/N	0.182 (0.146)	0.204** (0.094)	0.040 (0.070)	0.182 (0.116)	0.184 (0.124)	0.209 (0.140)
Foreign ownership Y/N	0.021 (0.147)	0.615*** (0.130)	0.307*** (0.086)	0.148 (0.198)	0.241 (0.276)	0.512*** (0.101)
Establishment has a line of credit or loan Y/N	0.142 (0.097)	0.213*** (0.065)	0.157*** (0.050)	0.163* (0.089)	0.227** (0.092)	0.334*** (0.091)
Establishment has its own website Y/N	0.290*** (0.096)	0.283*** (0.064)	0.276*** (0.060)	0.225** (0.103)	0.229** (0.092)	0.308*** (0.094)
Firm experienced losses due to crime Y/N	0.163 (0.124)	0.143* (0.086)	0.052 (0.054)	0.253 (0.178)	-0.017 (0.130)	-0.051 (0.098)
Firm paid for security Y/N	0.104 (0.093)	0.193*** (0.063)	0.225*** (0.059)	0.242* (0.128)	0.331*** (0.084)	0.198** (0.084)
Average total time of power outages per month	-0.001 (0.001)	0.001 (0.001)	-0.000 (0.001)	-0.001* (0.000)	-0.001** (0.001)	-0.001*** (0.000)
Firm uses power generator Y/N	0.284*** (0.109)	0.128 (0.084)	0.072 (0.056)	-0.028 (0.153)	0.066 (0.079)	0.346*** (0.086)
Firm formally registered when started operations Y/N	-0.068 (0.116)	-0.262 (0.416)	0.089 (0.079)	-0.070 (0.241)	0.245** (0.123)	0.374*** (0.114)
Retail	0.221*** (0.080)	0.278*** (0.067)	0.344*** (0.055)	0.142 (0.105)	-0.225*** (0.085)	0.228*** (0.087)
Other Services	0.189* (0.107)	0.517*** (0.095)	0.540*** (0.065)	0.316*** (0.104)	0.269** (0.107)	0.615*** (0.101)
Constant	9.598*** (0.370)	9.352*** (0.469)	10.567*** (0.248)	8.112*** (0.256)	8.175*** (0.305)	8.511*** (0.257)
Location (within country) Fixed Effects	YES	YES	YES	YES	YES	YES

Number of observations	6,831	7,615	9,973	4,078	10,199	7,071
R2	0.393	0.425	0.414	0.480	0.226	0.339

note: *** p<0.01, ** p<0.05, * p<0.1

Table 7: Decomposition Results

	Differential	Endowment effects	Structural effects
	coef/se	coef/se	coef/se
Female-managed firms log of labor productivity	9.770*** (0.043)		
Male-managed firms log of labor productivity	9.888*** (0.017)		
Difference	-0.117** (0.049)		
Firm purchased fixed assets in the last fiscal year Y/N		-0.004 (0.005)	-0.018 (0.034)
Log of age of firm		-0.010** (0.005)	0.092 (0.138)
Log of size		0.025** (0.012)	-0.091 (0.119)
Expected to give gifts to public officials (to get things done) Y/N		0.000 (0.001)	-0.004 (0.025)
Senior management time spent in dealing with requirements of government regulations		0.001 (0.002)	0.028 (0.027)
Firm offers formal training Y/N		-0.001 (0.003)	0.007 (0.029)
Top manager experience in sector (years)		0.011 (0.008)	-0.107 (0.071)
Direct exports 10% or more of sales Y/N		0.000 (0.004)	-0.017 (0.016)
Foreign ownership Y/N		-0.014** (0.006)	0.016 (0.016)
Establishment has a line of credit or loan Y/N		-0.004 (0.004)	-0.0001 (0.030)
Establishment has its own website Y/N		-0.009* (0.005)	-0.014 (0.036)
Firm experienced losses due to crime Y/N		0.002 (0.002)	0.009 (0.018)
Firm paid for security Y/N		-0.007* (0.004)	-0.034 (0.045)
Average total time of power outages per month		0.003 (0.009)	0.019 (0.019)
Firm uses power generator Y/N		-0.016** (0.008)	0.001 (0.034)
Firm formally registered when started operations Y/N		-0.000 (0.001)	-0.074 (0.107)
Location		-0.007 (0.043)	-0.817 (2.066)

Retail	0.064*** (0.012)	0.039** (0.019)
Other Services	-0.006 (0.006)	0.085** (0.042)
Constant		0.732 (2.082)
Total	0.029 (0.045)	-0.147*** (0.040)
<hr/>		
Number of observations	46,876	
<hr/>		
note: *** p<0.01, ** p<0.05, * p<0.1, Omitted sector: Manufacturing		

Table 8: Robustness Checks

Dependent Variable	Log of Labor Productivity (Sales per Worker)			
	coef/se	coef/se	coef/se	coef/se
Female top manager Y/N	-0.221*** (0.065)	-0.135** (0.053)		-0.146*** (0.047)
Log of Cost For Establishment To Re-Purchase All Of Its Machinery in USD		0.081*** (0.013)		
Log of Total Labor Cost in USD		0.556*** (0.028)		
Firm has a Female Owner Y/N			-0.047 (0.032)	0.004 (0.037)
Firm purchased fixed assets in the last fiscal year Y/N	0.130*** (0.043)	0.095** (0.038)	0.100*** (0.031)	0.095*** (0.031)
Log of age of firm	0.060** (0.030)	0.029 (0.027)	0.119*** (0.022)	0.118*** (0.022)
Log of size	0.005 (0.021)	-0.592*** (0.032)	-0.053*** (0.017)	-0.056*** (0.016)
Expected to give gifts to public officials (to get things done) Y/N	0.044 (0.057)	0.006 (0.047)	0.041 (0.046)	0.041 (0.046)
Senior management time spent in dealing with requirements of government regulations	0.000 (0.002)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Firm offers formal training Y/N	0.182*** (0.049)	0.089** (0.042)	0.182*** (0.037)	0.182*** (0.037)
Top manager experience in sector (years)	-0.002 (0.002)	-0.003 (0.002)	0.000 (0.002)	-0.000 (0.002)
Direct exports 10% or more of sales Y/N	0.023 (0.060)	-0.015 (0.051)	0.118*** (0.044)	0.116*** (0.044)
Foreign ownership Y/N	0.288*** (0.087)	0.161** (0.067)	0.400*** (0.053)	0.399*** (0.053)
Establishment has a line of credit or loan Y/N	0.263*** (0.043)	0.164*** (0.037)	0.225*** (0.031)	0.226*** (0.031)
Establishment has its own website Y/N	0.309*** (0.050)	0.212*** (0.042)	0.274*** (0.034)	0.275*** (0.034)
Firm experienced losses due to crime Y/N	0.030 (0.058)	0.026 (0.052)	0.070* (0.038)	0.074* (0.038)
Firm paid for security Y/N	0.204*** (0.049)	0.075* (0.041)	0.219*** (0.033)	0.218*** (0.032)
Average total time of power outages per month	-0.001* (0.000)	-0.001** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Firm uses power generator Y/N	0.183*** (0.051)	0.131*** (0.045)	0.178*** (0.036)	0.175*** (0.036)
Firm formally registered when started operations Y/N	0.112* (0.067)	0.084 (0.056)	0.156*** (0.056)	0.158*** (0.055)
Retail			0.230*** (0.032)	0.443*** (0.039)

Other Services			0.436***	0.232***
			(0.039)	(0.032)
Constant	9.513***	4.290***	9.072***	9.089***
	(0.153)	(0.234)	(0.187)	(0.186)
Location (within country) Fixed Effects	YES	YES	YES	YES
Number of observations	18,358	18,358	46,359	46,359
R2	0.539	0.660	0.455	0.455

note: *** p<0.01, ** p<0.05, * p<0.1

Appendix

Table A1: Country composition and female manager (%) in sample

Country	Year	Firms with Female Top Manager (%)
Afghanistan	2014	11.75%
Albania	2013	10.29%
Angola	2010	12.78%
Antigua and Barbuda	2010	14.85%
Argentina	2010	7.89%
Armenia	2013	17.27%
Azerbaijan	2013	2.85%
Bahamas, The	2010	33.11%
Bangladesh	2013	4.09%
Barbados	2010	23.93%
Belarus	2013	30.35%
Belize	2010	28.67%
Benin	2016	17.59%
Bhutan	2015	26.46%
Bolivia	2010	12.07%
Bosnia and Herzegovina	2013	28.32%
Botswana	2010	14.47%
Brazil	2009	18.95%
Bulgaria	2013	24.04%
Burkina Faso	2009	27.80%
Burundi	2014	16.36%
Cabo Verde	2009	9.59%
Cambodia	2016	59.57%
Cameroon	2016	21.32%
Central African Republic	2011	10.02%
Chad	2009	7.41%
Chile	2010	4.30%
China	2012	19.14%
Colombia	2010	14.54%
Congo, Dem. Rep.	2013	10.37%
Congo, Rep.	2009	0.00%
Costa Rica	2010	18.04%
Côte d'Ivoire	2016	12.26%
Croatia	2013	19.24%
Czech Republic	2013	12.46%
Djibouti	2013	14.96%
Dominica	2010	23.78%
Dominican Republic	2016	26.02%
Ecuador	2010	18.15%
Egypt, Arab Rep.	2016	5.54%
El Salvador	2016	26.22%
Eritrea	2009	14.37%
Estonia	2013	26.70%
Ethiopia	2015	4.46%
Gabon	2009	3.04%
Georgia	2013	30.52%
Ghana	2013	15.01%
Grenada	2010	22.60%
Guatemala	2010	16.16%
Guinea	2016	0.00%
Guyana	2010	16.62%
Honduras	2010	27.58%
Hungary	2013	18.36%
India	2014	7.27%
Indonesia	2015	23.52%
Iraq	2011	3.92%
Israel	2013	10.23%
Jamaica	2010	20.12%
Jordan	2013	3.40%
Kazakhstan	2013	19.06%
Kenya	2013	12.43%
Kosovo	2013	4.51%

Kyrgyz Republic	2013	31.64%
Lao PDR	2016	43.18%
Latvia	2013	29.71%
Lebanon	2013	2.97%
Lesotho	2016	30.58%
Liberia	2009	41.08%
Lithuania	2013	22.23%
Macedonia, FYR	2013	28.31%
Madagascar	2013	0.00%
Malawi	2014	17.11%
Malaysia	2015	27.45%
Mali	2016	17.16%
Mauritania	2014	6.47%
Mexico	2010	16.89%
Moldova	2013	28.41%
Mongolia	2013	35.72%
Montenegro	2013	16.19%
Morocco	2013	6.05%
Myanmar	2016	41.20%
Namibia	2014	22.94%
Nepal	2013	17.30%
Nicaragua	2016	29.15%
Niger	2017	9.81%
Nigeria	2014	8.67%
Pakistan	2013	4.17%
Panama	2010	21.94%
Papua New Guinea	2015	12.01%
Paraguay	2010	20.31%
Peru	2010	12.89%
Philippines	2015	28.72%
Poland	2013	19.35%
Romania	2013	19.56%
Russian Federation	2012	19.81%
Rwanda	2011	17.54%
Senegal	2014	16.23%
Serbia	2013	12.19%
Sierra Leone	2009	3.16%
Slovak Republic	2013	10.99%
Slovenia	2013	17.69%
Solomon Islands	2015	22.37%
South Sudan	2014	8.72%
Sri Lanka	2011	8.07%
St. Kitts and Nevis	2010	24.78%
St. Lucia	2010	24.87%
St. Vincent and the Grenadines	2010	36.23%
Sudan	2014	3.92%
Suriname	2010	14.83%
Swaziland	2016	31.38%
Tajikistan	2013	10.12%
Tanzania	2013	12.33%
Thailand	2016	67.18%
Timor-Leste	2015	21.62%
Togo	2016	12.96%
Trinidad and Tobago	2010	14.34%
Tunisia	2013	6.48%
Turkey	2013	3.22%
Uganda	2013	21.59%
Ukraine	2013	26.76%
Uruguay	2010	18.02%
Uzbekistan	2013	12.17%
Venezuela, RB	2010	49.86%
Vietnam	2015	21.89%
West Bank and Gaza	2013	1.47%
Yemen, Rep.	2013	1.68%
Zambia	2013	23.87%
Zimbabwe	2016	19.74%