

Gender Gaps in Total Factor Productivity: The Case of Manufacturing SMEs in Ghana

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Abstract

This paper provides evidence on the relative productivity differences between female-owned and male-owned firms in a developing country. We rely on data from a survey of small and medium manufacturing firms in the main industrial hubs of Ghana. We apply quantile regression and decomposition techniques to estimate the productivity gap and identify the mechanism behind the gap at the mean and selected percentiles. Our preferred estimation shows that female-owned firms are more productive at the lower tail of productivity distribution, but less productive at the mean and upper tails. Compositional effects explain the productivity gaps at the lower end of the distribution whilst structural effects are the primary sources of gaps at the upper tail of firm productivity. Finally, we do not find evidence of productivity gaps in female-dominated sectors, though these sectors tend to have lower average productivity.

Keywords: Productivity distribution; manufacturing firms; gender gaps, Ghana.

Introduction

Wide gender inequalities exert substantial cost on aggregate output and economic growth (Klasen & Lamanna, 2009; Cavalcanti & Tavares, 2016). To ensure accelerated and inclusive growth, bridging gender-based differences in outcomes has become a prominent feature of global development efforts in the past three decades. The period of the Millennium Development Goals (MDGs) saw considerable progress towards reducing gender inequalities in education, access to health and labour force participation especially in non-agricultural employment. The Sustainable Development Goals (SDGs) that replaced the MDGs reaffirms the global commitment to reduce gender inequalities and promote the share of women in decision making and owners of economic resources. In developing countries where gender inequalities are pervasive and persistent (Duflo, 2012; Jayachandran, 2015), substantial investments as well institutional, legal and policy reforms are required to reduce gender-based differences in outcomes and achieve the SDG target by 2030.

Despite the introduction of a range of policy initiatives, women's participation in productive activities in the off-farm sector is limited by the complex interplay of social and cultural norms, discriminatory practices, and institutional and legal constraints. Such constraints may inhibit the entrepreneurial capabilities and performance of women (Field, Jayachandran & Pande, 2010, Islam, Muzi & Amin, 2019). As a result, women in most developing countries are disproportionately self-employed in low productivity activities in the informal sector. Improving the productive capacity of women is also essential for women's empowerment, poverty reduction and the intergenerational transmission of human capital. Understanding the factors that account for the gender gaps in outcomes is complex, but relevant for the design of effective policies essentially to reduce the negative consequences on economic development. Improving firm-level productivity is also crucial to increasing the share of manufacturing sector employment in Sub Saharan Africa (Bigsten & Gebreeyesus, 2007; Shiferwaw, 2009; Li & Rama, 2015) as well as international trade competitiveness (Fukunishi, 2009). In addition, manufacturing firms in developing countries are characterised by low productivity (Bloom et al, 2010). Addressing within country gender-related gaps in firm productivity therefore has positive effects on aggregate productivity and job creation.

The role of gender in labour market outcomes and credit markets has received substantial attention in literature in recent times. For example, Nix et al (2016) examines gender gaps in self-employment earnings and find that women receive lower returns to their characteristics. Hardy and Kagy (2018) opines that gender profit gaps may be the results of entrepreneurial motivations between men and women; as women are more likely to pursue micro-entrepreneurship out of necessity than opportunity. In credit markets, De Mel et al, (2008; 2009) provides evidence from a field experiment to show that grants to female enterprises are

captured by other household members resulting in lower returns to capital for female-owned firms. One area of concern in such studies is the definition of female-owned firms. Aterido and Hallward-Dreimeier (2011) and Presbitero et al (2014) shows that for large firms, a definition of female firms based on the role played by women in management and control, rather than ownership, reveals female disadvantage in credit markets and productivity.

Though there has been interest in understanding gender gaps in firm productivity, very few studies have examined the situation in Sub Saharan Africa (SSA) owing to the lack of good quality firm-level data. In SSA, two strands of literature have emerged. One strand of the studies has focused on gender gaps in agricultural productivity whilst the second group of studies has concentrated on nonfarm enterprises. Following the first strand of empirical studies, Udry (1996) finds gender differences in input intensities and yield. Oseni et al (2015) find gender gaps in agricultural production in northern Nigeria, while no significant gender differences are found in the South. Slavchevska (2015) also find evidence of lower female agricultural productivity in Tanzania conditional on manager's and plot characteristics, inputs and crop choice. The presence of lower female agricultural productivity is confirmed by Aguilar et al (2015) in Ethiopia. Karamba and Winters (2015) finds that provision of subsidised farm inputs has little effect on reducing gender gaps in agricultural productivity in Malawi, suggesting the influence of other underlying factors driving the lower productivity of female farmers.

Available evidence from nonfarm enterprises in Ethiopia (Rijkers & Costa, 2012; Essers et al, 2019) and Madagascar (Nordman and Vaillant, 2014) find that female-owned firms are less productive compared to male-owned firms. In Ghana, Jones (2012) estimates the gender differences in firm productivity using a panel of manufacturing firms. Jones (2012) finds that female-owned firms are less productive than male-owned firms. Such gender productivity gaps in part account for differences in firm exit between male and female-owned firms. However, Jones (2012) does not examine the effect of ownership on firm productivity beyond the mean as well as the sources of gender productivity gaps in Ghana. The evidence on gender differences in firm exit however remain inconclusive, as Shiferaw (2009) finds females-owned enterprises to have better chances of survival in Ethiopia. Bardasi, Sabarwal and Terrell (2011) explains that the gender gaps arise from female concentration in less efficient sectors and smaller firm sizes. Aterido and Hallward-Dreimeier (2011) on the other hand shows that women are disadvantaged in skills and traits that are linked to firm productivity. Conversely, Nix et al (2016) and Hardy and Kagy (2018) finds that gender performance gaps are unexplained by industry, firm and owner characteristics.

This paper contributes to the literature on gender gaps in firm productivity using a panel of small and medium manufacturing firms in Ghana. The objective of this paper is two-fold. First, we estimate the relative gender productivity gaps by comparing the productivity of female-owned firms to male-owned firms. We estimate the relative gender productivity gaps at the mean and specified percentiles. We test the robustness of our estimates of the relative gender productive gaps to different definitions of female ownership of a firm. The second objective assesses the sources of the gender gaps in productivity by decomposing the overall gap into two parts. One part of the gap arises due to differences in observed firm characteristics (compositional effects) and the other part is attributed to differences in the returns to the observed characteristics (structural effects). This study differs from previous ones such as Jones (2012) as we examine the sensitivity of productivity gaps, and sources of the gaps to the definition of female ownership of a firm. To this end, we adopt three definitions of female ownership: (i) any female among owners, (ii) at least 50 percent ownership and (iii) 100 percent female ownership of the firm. Further, we examine relative gender gaps in female dominated sectors to access the possibility productivity driven gender selection into sectors.

The case of small and medium manufacturing firms in Ghana is interesting and relevant for a number of reasons. Ghana has witnessed stable economic growth in the last two decades. The stable economic performance in part propelled the country to achieve the MDG target of halving poverty. The period also saw a structural transformation of the economy, with the

services sector emerging as the largest contributor to gross domestic product (GDP). The manufacturing sector in Ghana is dominated by small and medium sized enterprises that account for about 85 percent of manufacturing sector employment (Abeberese, et al, 2019). Despite recent progress, considerable gender gaps remain in the Ghanaian labour market. Gender differences in firm productivity may have severe implications for efforts to promote the full participation of women in economic activities through the promotion of female entrepreneurship. In addition, the structure of the Ghanaian economy is like other SSA countries and firms across the region face similar challenges.

Our results show a female productivity disadvantage at the mean. However, gender gaps differ along the distribution of firm productivity. We find a female advantage at the lower tail of the distribution (10th percentile) whilst a female disadvantage is observed at the upper tail (90th percentile). The magnitudes of the relative gender productivity gaps remain relatively stable to the definition of female ownership adopted. Further, we find that while the compositional effect is the main contributor to gender gaps at the mean and lower percentile, the gap at the upper tail of the distribution is dominated by the structural effect. The proportion of the gap explained by the compositional and structural effects varies considerably depending on the definition of female ownership adopted. Finally, we test whether relative gender productivity gaps exist in sectors where female-owned firms are concentrated. The results indicate that gender productivity gaps do not exist in sectors where female-owned firms are concentrated.

The rest of the paper is structured as follows. Section II provides a description of the dataset. Section III the empirical strategy adopted to estimate the relative gender productive gaps and assess the sources of the gender productivity gaps. The results are presented and discussed in Section IV. The paper concludes with a summary of the key findings in Section V.

Data

The data we use in this paper is from a survey of small and medium-sized manufacturing firms in Ghana. The survey was conducted in August and September of 2016 by the Institute of Statistical, Social and Economic Research with funding from the International Growth Centre. Firm-level information collected during the survey included outputs and inputs, production processes, assets and investments, employment and labour, cost of operations, type and structure of ownership, forms of operations and location. Data was collected for the five consecutive years between 2011 and 2015.

The sampling frame for the survey was drawn from the first phase of the Ghana Integrated Business Establishments Survey (IBES), an economic census of all non-household business establishments, conducted by the Ghana Statistical Service in 2014-2015. From the IBES frame, the survey selected all manufacturing SMEs operating in the four main industrial hubs of Ghana; Accra, Tema, Kumasi and Sekondi-Takoradi. The IBES defines firm sized similar to the World Bank Enterprise Surveys. A small firm is one with 6 to 30 employees whilst a medium-sized firm has with 31 to 100 employees. In total, 1224 small and medium-sized firms were identified in the four cities from IBES. 73 firms refused to participate in the survey, 55 had folded up, and 231 could not be located using the contact information obtained from GSS. In the end however, 885 firms completed the survey. The sampled firms operated in 20 different 2-digit manufacturing industries of the ISIC Rev. 4 classification. The sectors of operations included food and beverage products, textiles and wearing apparel, chemicals, metal, machinery and equipment, wood and wood products and other manufacturing. Abeberese et al (2019) provides further details on the survey and dataset.

For the analysis, we deflate all monetary values to 2006 Ghana Cedis using producer price indices from the Ghana Statistical Service. Specifically, firm output is deflated using industry-specific producer price indices whilst machinery is deflated with the producer price index for machinery. All other variables are deflated by the overall producer price index. Firm-level variables are trimmed at the 1 percent tails to minimize the influence of outliers. Thus, values below the 1st percentile were set to the value of the 1st percentile and values above the 99th

percentile were set to the value of the 99th percentile. The sample for the final analysis includes 747 firms and 3579 observations. Table 1 shows the distribution of the observations over the period and the share of female-owned firms by the three definitions of female ownership. About 39% of the firms have at least female owner whilst 37.6% of the firms have at least 50 percent of the ownership held by females. Finally, 35.5% of the firms are wholly owned by women.

[INSERT TABLE 1 HERE]

Methodology

Estimating total factor productivity

The primary objective of this paper is to examine gender differences in total factor productivity (TFP) of small and medium manufacturing enterprises in Ghana. We measure TFP using the method proposed by Levinsohn and Petrin (2003) (see Van Beveren, (2012) and Del Gatto, Di Liberto and Petraglia (2011) for overviews of TFP estimation techniques). Firms are assumed to follow a Cobb-Douglas production function characterised by equation (1).

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \beta_e e_{it} + \omega_{it} + \eta_{it} \quad \text{Eqn. (1)}$$

where y_{it} , k_{it} , l_{it} , m_{it} and e_{it} are the logarithms of output, capital (including machinery, buildings and land), intermediate inputs and electricity of firm i at time t . ω and η are firm-specific productivity shocks. ω is unobserved by the econometrician but observed by the firm in making its production decision. Levinsohn and Petrin (2003) accounts for biases that may arise from simultaneity between input choices and the unobserved firm specific productivity shock, ω . Levinsohn and Petrin (2003) proxy unobserved productivity with the demand for intermediate inputs. Intermediate inputs are therefore expressed as a function of capital and firm productivity, i.e. $m_{it} = m_t(k_{it}; \omega_{it})$. Assuming a firm's demand for intermediate inputs is monotonic and increasing in ω_{it} , Levinsohn and Petrin (2003) obtain an expression for the unobserved productivity as a function of observables by inverting the firm's demand for immediate inputs.

To address the simultaneity bias, a proxy for ω is constructed as a third-order polynomial in the firm's intermediate inputs and capital in the first stage. In the second stage, the proxy is included in a regression of the log of output on the logs of labour and electricity as follows;

$$y_{it} = \beta_l l_{it} + \beta_e e_{it} + \sigma_{it} + \eta_{it} \quad \text{Eqn. (2)}$$

where

$$\sigma_{it} = \beta_0 + \beta_k k_{it} + \beta_m m_{it} + f(m_{it}, k_{it}) \quad \text{Eqn. (3)}$$

and $f(m_{it}, k_{it})$ is a third order polynomial in the log of intermediate inputs, m_{it} , and the log of capital k_{it} .

Finally, log of TFP (φ_{it}) is obtained from Equation 4 as follows;

$$\varphi_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \beta_e e_{it} \quad \text{Eqn. (4)}$$

where $\hat{\beta}_k$, $\hat{\beta}_l$, $\hat{\beta}_m$ and β_e are the estimated coefficients of the logs of capital, labour, intermediate inputs and electricity respectively. We estimate the TFP separately for each 2-digit industry. A full list of the industries is available in the appendix of the paper.

Estimating the relative gender gap in total factor productivity

We evaluate the relative productivity gaps between female-owned and male-owned enterprises by estimating regressions of the form

$$\varphi_{ijct} = \alpha + \gamma female_{ijc} + \delta' X_{ijct} + \lambda_c + \phi_t + \rho_{ct} + \psi_{jt} + \varepsilon_{ijct} \quad \text{Eqn. (5)}$$

φ_{ijct} is the log of TFP of firm i in industry j in city c at time t . *female*, our primary variable of interest is a dummy that identifies female ownership. We adopt the three definitions of female ownership. First, our definition identifies a firm to be female owned if there is any female among the owners of the firm. The second definition identifies female-owned firms as firms with at least 50 percent female share of ownership. The final and most restrictive definition of female ownership is based on full female ownership of the enterprise (100 percent female ownership). Changes in the composition of female ownership are rare over the period of the data. As a result, we do not estimate the causal effect of a change in the gender composition of the ownership structure of a firm on productivity. Our results are therefore descriptive, and not causal.

X_{ijct} is a vector of firm-level characteristics that are likely to affect productivity. These include firm size, defined as the number of production and other (administrative, managerial and supervisory) employees and apprentices, firm age and capital intensity defined as the log of the ratio of the fixed assets of the firm (land, buildings and machinery) to total employees. In addition, we include a set of dummies to capture legal structure (sole proprietorship or otherwise), importing inputs, exporting output, shift operations, ownership of bank account and insurance policy by the firm. Table 2 presents summary statistics of the variables. We include city fixed effects λ_c to capture any time-invariant city characteristics that may affect firm productivity. ϕ_t captures time trends in productivity. City-year fixed effects (ρ_{ct}) are included to control for shocks that affect all firms in a particular city. ψ_{jt} captures industry-year fixed effects to control for shocks that affect all firms in a particular industry. ε_{ijct} is the error term. Standard errors are clustered at the firm level to account for serial correlation with firms.

[INSERT TABLE 2 HERE]

We estimate Equation 5 by ordinary least squares (OLS) and unconditional quantile regression (UQR) proposed by Firpo, Fortin and Lemieux (2009). The OLS regression enables us to estimate the relative gender productivity gap (and the effects of the covariates) at the mean of TFP. However, it is possible that the gender gap in firm productivity may differ along the distribution of firm productivity. To this end, the quantile regression technique is therefore adopted to understand gender productivity gaps at different percentiles along the distribution.

The unconditional quantile estimator is based on the re-centered influence functions. For some distributional statistics, $v(F)$, the influence function; $IF(\varphi, v, F)$ represents the influence of a change in the distribution of the covariates on the distribution statistic. (F is a class of distribution functions, in this case, the kernel density function.) Firpo et al. (2009) consider the τ th quantile, q_τ , as the distributional statistic $v(F)$ and show that the unconditional expectation of the influence function is zero, that is $E[IF(\varphi, v, F)] = 0$. Firpo et al. (2009) define the distributional recentered influence function as $RIF(\varphi, v, F) = IF(\varphi, v, F) + v(F)$. For any statistic of interest, defined as the τ th quantile, the RIF at the given q_τ is commuted as

$$RIF(\varphi, q_\tau) = q_\tau + \frac{\tau - I(\varphi \leq q_\tau)}{f_\varphi(q_\tau)} \quad \text{Eqn. (6)}$$

where q_τ is the τ th quantile of the unconditional distribution of the outcome variable φ ; $f_\varphi(q_\tau)$ captures the probability density of φ evaluated at the τ th quantile estimated using the kernel density method; $I(\varphi \leq q_\tau)$ is an indicator function determining whether the variable outcome lies below the τ th quantile or not. The expectation of the RIF at the τ th quantile is equal to the τ th quantile; that is $E[RIF(\varphi, v, F)] = v(F)$.

The Firpo et al. (2009) approach first estimates the RIF of the outcome variable. A key feature of this method is to run an OLS regression with the estimated RIF as the dependent variable on a set of explanatory variables. This approach allows for the estimation of the partial effects of the covariates at specified percentiles across the distribution. If the statistic of interest is the

mean, then the estimation of the RIF regression becomes exactly the OLS. For the purposes of our analysis and discussions, we present results at the 10th, 50th and 90th percentiles.

Decomposing gender gaps in productivity

We proceed to examine the sources of the variations in productivity by decomposing the gender productivity gap into two components. One part of the decomposition, compositional effects, measure the productivity gap that is explained by differences in the covariates, X . The other part, the structural effect estimates the differences in the productivity between male and female firms due to differences in the coefficients, δ .

At the mean, the gender gap in productivity is decomposed using the traditional Oaxaca-Blinder (1973) technique (OB). The OB decomposition approach depends crucially on the creation of a counterfactual distribution of productivity. First, we estimate Equation 5 by OLS separately for male and female owned firms to obtain consistent estimates of δ . The mean difference in productivity is expressed as

$$D_\varphi = E[\varphi_m] - E[\varphi_f] \quad \text{Eqn. (7)}$$

where m is the subsample of male-owned firms and f is the subsample of female-owned firms.

Decomposing the difference into structural and compositional effects allows the mean difference to be rewritten as

$$D_\varphi = \underbrace{(\hat{\alpha}_m - \hat{\alpha}_f) + \sum_{k=1}^K E[X_{k,m}](\hat{\delta}_m - \hat{\delta}_f)}_{\hat{D}_S} + \underbrace{\sum_{k=1}^K (E[X_{k,m}] - E[X_{k,f}])\hat{\delta}_f}_{\hat{D}_C} \quad \text{Eqn. (8)}$$

where \hat{D}_S is the aggregate structural component of the productivity gap and \hat{D}_C indicates the proportion of the gender productivity gap that arises from differences in the covariates, the compositional effect. The method also allows for the estimation of each covariate to the aggregated structural and compositional effects to be estimated.

The Oaxaca-Blinder technique does not work for the quantile decompositions. As such, we employ the approach proposed by Fortin, Lemieux and Firpo (2011). The quantile decomposition approach of Fortin et al (2011) relies crucially on the re-centred influenced functions. The approach also assumes ignorability and overlapping support. The ignorability assumption rules out selection into a particular group based on observables whilst overlapping support requires overlap of observable group characteristics. To decompose the gap, the productivity distribution of male-owned firms is reweighted to control for the compositional effects. Let φ_c be defined as the reweighted distribution. Similar to the mean decomposition, the Fortin et al (2011) approach involves estimating the unconditional quantile partial effects of the covariates based on the RIF for the male, female and reweighted distributions. Applying the Oaxaca-Blinder decomposition to the RIF regressions, the gender productivity gap at the τ th quantile is obtained as

$$\hat{q}_\tau(\varphi_m) - \hat{q}_\tau(\varphi_f) = \underbrace{\sum_{k=1}^K E[X_{k,m}](\hat{\delta}_m - \hat{\delta}_c) + \hat{R}_\tau^S}_{\hat{D}_S} + \underbrace{\sum_{k=1}^K E[X_{k,m}]\hat{\delta}_c - \sum_{k=1}^K E[X_{k,f}]\hat{\delta}_f + \hat{R}_\tau^C}_{\hat{D}_C} \quad \text{Eqn. (9)}$$

where \hat{R}_τ^S and \hat{R}_τ^C represent the approximation errors due to the structural and compositional effects respectively. Equation 9 also estimates the contribution of each covariate to the

aggregated structural (\hat{D}_s) and compositional effects (\hat{D}_c) . Further details of the methodology can be found in Fortin et al (2011). Nix et al (2016) and Essers et al (2019) have applied the methodology in similar contexts to our study.

Results

In this section, we present and discuss the results of the relative gender productivity gaps as well as the sources of the gender productivity gaps at the mean and specified quantiles. We estimate several models of Equation 5. We estimate *baseline* models where the explanatory variable is an indicator of female ownership without other controls, accounting for various fixed effects and the *extended* equation with controls and fixed effects. Our discussions, however, are restricted to the models with city, year, city-year and industry-year fixed effects.

Distribution of total factor productivity

First, we present estimates of average total factor productivity of firms in our sample over the period of the data. The results are further disaggregated by 2-digit ISIC Rev. 4 classification to explore sectoral differences in average total factor productivity. We estimate the average total factor productivity of firms in our sample to be 3.84. We also find average total factor productivity to have declined over the period. In 2011, average firm productivity was measured at 4.02, declining to 3.72 by 2015. The period of our study 2011-2015 witnessed substantial electricity shortages in Ghana that led to a national load shedding program. Previous studies based on the same data source such as Abeberese, et al., (2019) have estimated significant productivity losses due to the electricity shortages whilst Ackah et al (2018) found significant resource misallocations during the period. In addition, we found sectoral differences in average total factor productivity over the period. For example, average total factor productivity in the computer, electronic and optical products sector is estimated to be 9.95 whilst average productivity in the wood and wood products sector is 8.92. However, we estimate average productivity in the coke and refined petroleum products sector to be -3.77, suggesting that firms in the sector may be unproductive or inefficient compared to other sectors.

[INSERT TABLE 3 HERE]

Figure 1 presents the distribution of firm productivity for male- and female-owned firms. The density distribution of log TFP are estimated using Epanechnikov kernel function and a bandwidth that minimizes the mean integrated squared error under Gaussian assumptions. The distributions of productivity are identical across the definitions of female-ownership. The figures depict the presence of a group of high performing male-owned firms at the upper tail of the distribution of firm productivity.

[INSERT FIGURE 1 HERE]

Relative gender productivity gaps

This section summarizes the results of the relative gender gaps in firm productivity. The results from our *baseline* estimations based on the definition of female-owned firms as firms with a female among the owners, show a female disadvantage in firm productivity at the mean. The productivity of female-owned firms is estimated to be 15.5 percent lower compared to male-owned firms. The relative productive gaps vary along the distribution of firm productivity. At the low tail of the distribution (10th percentile), we observed a female advantage, with productivity of female-owned firms estimated to be 65.4 percent higher than male-owned firms. At the upper tail however, we find female-owned firms to be 52.9 percent less productive compared to male-owned enterprises.

[INSERT TABLE 4 HERE]

The direction of the relative productive gaps remains stable to the definition of female ownership, though the extent of the relative productive gaps changes marginally. Based on

the definition of female-owned firms as firms with at least 50 percent of ownership held by women, we estimate a 17.6 percent female productive disadvantage at the mean. Further, female-owned firms are estimated to be 64.9 percent more productive at the 10th percentile and 55.6 percent less productive at the 90th percentile compared to the male-owned firms. The definition of female-ownership, based on the most restrictive definition of full female ownership, shows a relative productive gap of 18.9 percent against female-owned firms at the mean. The relative gender gap is estimated to be 60.2 percent at the 10th percentile in favour of female-owned firms based on the restrictive definition of ownership whilst a 55.1 percent productive gap against women is observed at the 90th percentile.

Having estimated the gender productivity gaps from the *baseline* models, we proceed to examine the effect of firm-level characteristics on the relative gender productivity gaps from the *extended* model. The existence of gender productivity gaps is again confirmed from the extended models and the magnitude of the gap remain stable across the various definitions of ownership. The inclusion of the firm-specific characteristics increases the extent of the gender gaps at mean and the 90th percentile whilst the size reduces at the 10th percentile. The results show significant relationships between firm characteristics and productivity at the mean and along the distribution. Particularly, we find negative effects of the number of production employees and apprentices, and capital intensity on firm productivity. Our findings are contrary to the provisions of the heterogenous firm models (Helpman et al, 2004) and the findings of Essers et al (2019) in a study of Ethiopian manufacturing firms. The negative relationship between the firm size and productivity is not surprising. De and Nagaraj (2014) found smaller manufacturing firms to be more productive than larger ones in India. In the case of this paper, the period of our survey (2011 to 2015) coincides with a period of an electricity rationing program in Ghana. Abeberese et al (2019) suggests that firms increased their stock of machinery, particularly generators during the period, to mitigate the negative effects of the power outages on firm operations rather than as a productivity-enhancing measures.

[INSERT TABLE 5 HERE]

From the extended model, we estimate a relative female disadvantage of 20.5 percent at the mean of firm productivity based on the definition that identifies female-owned firms as firms with a female among the owners. We estimate a female productivity advantage of 54.3 percent at the lower tail of the distribution whilst we observe a 58.4 percent female disadvantage at the 90th percentile compared to firms that do not include a female among the owners. We estimate similar magnitude of the productivity gap between female and male-owned firms when we identify female firms as those with at least 50 percent female ownership. Based on the definition of at least 50 percent ownership, we estimate a female-owned firms are 21.7 percent less productive than male-owned firms at the mean. At the 10th percentile, firms with at least 50 percent female ownership are 52.7 percent more productive compared to male-owned firms. However, male owned firms exhibit 59.9 percent more productivity compared to female-owned firms at the 90th percentile. Finally, we estimate a mean female productivity disadvantage of 21.1 percent using the restrictive definition of full female ownership. At the 10th percentile, we estimate a productivity differential of 48.9 percent in favour of female-owned firms. However, we observe at the 90th percentile female-owned firms are 57.7 percent less productive compared to male-owned firms.

Our estimates of the relative gender productivity gaps appear to be large compared to the findings of Essers et al (2019) for large formal manufacturing firms in Ethiopia and Aterido and Hallward-Dreimeier (2011) using a sample of firms from six SSA countries. On the other hand, the extent of the mean gender productivity gap is closer to the magnitude estimated by Jones (2012) using a sample a of 200 manufacturing firms in Ghana between 1991 and 2002 and Nordman and Vaillant (2014) based on data for informal entrepreneurs in Madagascar. Further, Aterido and Hallward-Dreimeier (2011), Presbitero et al (2014) and Essers et al (2019) show that the gender-based gaps in firm outcomes are sensitive to the definition of female firms, distinguishing between ownership and management. In this study, we identify

the gender status of firms based on ownership structure. However, for small and medium firms as those included in our sample, de Mel et (2009) and Bernhardt et al (2019) argue that the distinction between female-owned and female-managed firms is less meaningful as ownership and management tend to coincide. We therefore do not expect our results to be sensitive to an alternative definition based on the gender composition of management of firms.

[INSERT TABLE 6 HERE]

Accounting for the sources of gender productivity gaps

Having estimated the relative differences in the productivity of male and female-owned firms, we proceed to examine the sources of the gender productivity differences by decomposing the gap into compositional and structural effects at the mean and selected percentiles respectively. A summary of the results of the mean and quantile decompositions are presented in Table 6. Unlike the relative productivity gaps, the magnitude of the contributions of the structural and compositional effects to the overall gender productive gap is sensitive to the definition of female firm ownership. The share of the productivity due to the structural effects varies substantially across the definitions of ownership. Overall, we find that the contributions of compositional effects dominate at the lower tail of productivity distribution whilst structural effects are the primary source of the gender productivity gap at the upper tail of the distribution. These findings suggest that while the female productivity advantage at the low tail of the distribution is due to differences in observed firm characteristics, the male productivity advantage at the upper tail of the distribution is accounted for by higher returns to the characteristics of male-owned firms.

Based on the least restrictive definition of female-owned firms (any female among owners), the results show that about 29 percent of the mean gender productive gap is explained by the structural effects. A similar result is found at the mean decomposition using the most restrictive definition of full female ownership of the firm. The contributions of the structural effects of the mean gender productive gap based on the definition of at least 50 percent female ownership is marginally higher, accounting for about 33 percent of the overall mean gap.

Along the distribution of firm productivity, we find that the proportion of the productivity gap between firms with females and those without a female among the owners attributable to differences in the returns to firm characteristics increase from 24 percent at the 10th percentile to two-thirds (67 percent) of the gap at the 90th percentile. The proportion of the gap that arises from the structural effects declines at the lower tail of firm productivity distribution as we adopt stricter definitions of female ownership. At the 10th percentile, we estimate that the structural effect accounts for 19 percent of the gender productivity when we defined female-owned firms by at least 50 percent ownership. The contribution of the structural effects drops to 14 percent at the 10th percentile when full female ownership of the firm is adopted. Structural effects dominate the productivity gap at the upper tail of firm productivity, accounting for 66 percent of the gap based on at least 50 percent of female ownership and 63 percent when the definition of full female ownership is applied.

[INSERT TABLE 7 HERE]

Our results contrast with Essers et al (2016) who finds that the contribution of compositional effect to the gender gap dominates at the upper tail of firm productivity in Ethiopia. On the other hand, Nordman and Vaillant (2014) finds that the share of the gender gap attributed to the structural effect increase along the distribution of firm value addition in Madagascar. This suggests that the sources of gender gaps in firm productivity may be driven by country-specific conditions and systems, and therefore requires further country-specific studies to understand the factors accounting for such gender differentials. The dominance of structural effects to gender productivity gaps at the upper tail of the distribution suggests that differences in the returns to the characteristics of firms may constitute a penalty to female entrepreneurship into high productive manufacturing sectors.

We further examine the contribution of the individual firm characteristics (covariates) to the compositional and structural effects. The results of the detailed decomposition are attached as appendices to this paper. Across the definitions of female ownership adopted, we find that capital intensity of the firm exerts a negative effect on the compositional component of the gap at the mean and selected percentiles. Observed differences in the number of production workers is a significant contributor to the compositional effect at mean and 10th percentile across ownership specifications whilst the number of other employees contributes positively to the compositional effect at the upper tail. The returns to shift operations also contributes negatively to the structural effects at the upper tails of firm productivity distribution across all three definitions of ownership. Finally, the number of apprentices increases the structural effects at the upper tail across definitions of firm ownership, whilst contributing negatively to the compositional effect at the 90th percentile based on the definition of full female ownership.

Do gender gaps exist in female dominated sectors?

Our results so far have shown varying gender differences in total factor productivity. There exists evidence in literature that suggest gender selection into sectors. Thus, it is possible female-owned firms may self-select into sectors where they have a productivity advantage. As such, we proceed to examine the presence of gender productivity gaps in female dominated sectors. If male productivity advantages persist in female dominated sectors, it may suggest that gender selection into sectors may not be driven by productivity gains but rather cultural and social factors that define female selection into sectors.

In Table 8, we present the distribution of firms in our sample across 2-digit ISIC Rev. 4 classifications. We find that 61 percent of firms in our sample operate in the textiles and wearing apparel sector, with 13 percent and 9 percent operating within the food and beverages, and furniture sectors respectively. Disaggregated by the gender composition of ownership, we find that female-owned firms (any female among owners) are predominantly concentrated in two sectors – food and beverages, and textiles and wearing apparel. These two sectors account for over 95 percent of female-owned firms in our sample with the textiles and wearing apparel sector accounting for 77 percent of the firms and 20 percent in the food and beverages sector. Within the food and beverage sector, firms with a woman among the owners accounted for 57.4 percent of the sample whilst those with at least 50 percent female ownership make up 54.7 percent of firms. Wholly female-owned firms on the other hand make up 47.8 percent of firms in the food and beverage sector. Firms with female ownership accounted for 49.0 percent in the textile and wearing sector with 48.1 percent of firms in the sector having at least 50 percent female ownership. 46.6 percent of firms in the textiles and wearing apparel sector are wholly owned by females.

[INSERT TABLE 8 HERE]

Figure 2 (Panels A and B) depicts the kernel density distribution of total factor productivity of male and female-owned firms operating the food and beverages, and textiles and wearing apparel sectors respectively. The diagrams show that irrespective of the definition of gender composition of ownership, the total factor productivity distributions of male and female-owned firms are identical in the two sectors. These provide *a priori* evidence that gender gaps in productivity may be absent in sectors where female-owned firms are concentrated.

We proceed further to measure the extent of relative gender gaps in total factor productivity by re-estimating the extended Equation 5 for the food and beverage, and textiles and wearing apparel sectors separately. The results are presented in Tables 9 and 10 respectively. Our findings do not show significant gender differences in total factor productivity in the two sectors, controlling for other firm-level characteristics and various fixed effects. This suggests that female-owned firms may select into sectors where they do not face a productive disadvantage. However, the sectors may be associated with lower average productivity. Indeed, it can be observed that average productivity in food and beverage, and textiles and wearing apparel sectors is lower compared to sectors such as basic metals, wood and wood

products, and computer, electronic and optical products where firms are predominantly male-owned. Thus, the overall gender productivity gaps may be driven by gender selection to sectors. It will be therefore important to understand the factors that account for gender-based selection into sectors of operations in Ghana to address the consequent productivity gaps.

[INSERT TABLE 9 HERE]

[INSERT TABLE 10 HERE]

Concluding remarks

In this paper, we measure the extent of relative productivity differences between male and female-owned firms. We proceed to untangle the gender productivity gap into a part that arises from differences in firm characteristics and another part that is attributable to gender differences in the returns to observed firm characteristics. Using data from a survey of small and medium manufacturing firms, we show that female-owned firms are less productive than male-owned firms. We also find that the magnitude of this gender productivity gap is robust to various definitions of female ownership of a firm. Further, we show that estimates of mean gender productivity gaps in Ghana may hide varying differences in the productivity of male and female-owned firms along the entire distribution of firm productivity.

Indeed, it is very remarkable that we find the presence of female productivity advantages at the lower tail of firm productivity the productivity distribution, whilst male-owned firms are more productive at the mean and upper percentiles of the distribution. Also, compositional effects are important to explaining the gender productivity gaps at the lower end of the distribution whilst structural effects are the primary sources of the gender gaps at the upper tail of firm productivity. The dominant contributions of structural effects to gender gaps at the upper tail of firm productivity suggest discrimination against firms owned by women. Such *pure* gender effects may deter women entrepreneurs from venturing into high productive manufacturing activities.

References

- Abeberese, A. B., Ackah, C. G., & Asuming, P. O. (2019). Productivity losses and firm responses to electricity shortages: Evidence from Ghana. *The World Bank Economic Review*.
- Ackah, C., Asuming, P., & Abudu, D. Misallocation of resources and productivity: the case of Ghana. *Paper presented at the 2018 CSAE Conference, University of Oxford, 18- 20 March*.
- Aguilar, A., Carranza, E., Goldstein, M., Kilic, T., & Oseni, G. (2015). Decomposition of gender differentials in agricultural productivity in Ethiopia. *Agricultural Economics*, 46(3), 311-334.
- Aterido, R. & Hallward-Driemeier, M. (2011). Whose business is it anyway? Closing the gender gap in entrepreneurship in Sub-Saharan Africa. *Small Business Economics* 37(4): 443-64
- Bardasi, E., Sabarwal, S. & Terrell, K. (2011). How do female entrepreneurs perform? Evidence from three developing regions. *Small Business Economics* 37(4): 417-41
- Bernhardt, A., Field, E., Pande, R., & Rigol, N. (2019). Household matters: Revisiting the returns to capital among female microentrepreneurs. *American Economic Review: Insights*, 1(2), 141-60.
- Bigsten, A., & Gebreyesus, M. (2007). The small, the young, and the productive: Determinants of manufacturing firm growth in Ethiopia. *Economic Development and Cultural Change*, 55(4), 813-840.
- Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. *Journal of Human Resources*, 436-455.
- Bloom, N., Mahajan, A., McKenzie, D., & Roberts, J. (2010). Why do firms in developing countries have low productivity?. *American Economic Review*, 100(2), 619-23.
- Cavalcanti, T., & Tavares, J. (2016). The Output Cost of Gender Discrimination: A Model-based Macroeconomics Estimate. *The Economic Journal*, 126(590), 109-134.

- De, P. K., & Nagaraj, P. (2014). Productivity and firm size in India. *Small Business Economics*, 42(4), 891-907.
- de Mel, S., McKenzie, D. & Woodruff, C. (2008). Returns to capital in microenterprises: Evidence from a field experiment. *Quarterly Journal of Economics* 123(4): 1329-72.
- de Mel, S., McKenzie, D. & Woodruff, C. (2009). Are Women more Credit Constrained? Experimental Evidence on Gender and Microenterprise Returns. *American Economic Journal: Applied Economics* 1(3): 1–32.
- Del Gatto, M., Di Liberto, A. & C. Petraglia, C. (2011). Measuring productivity. *Journal of Economic Surveys* 25(5): 952-1008.
- Duflo, E. (2012). Women empowerment and economic development. *Journal of Economic Literature*, 50(4), 1051-79.
- Essers, D., Megersa, K., & Sanfilippo, M. (2018). The Productivity Gaps of Female-Owned Firms: Evidence from Ethiopian Census Data. *Economic Development and Cultural Change*
- Field, E., Jayachandran, S., & Pande, R. (2010). Do traditional institutions constrain female entrepreneurship? A field experiment on business training in India. *American Economic Review*, 100(2), 125-29.
- Firpo, S., Fortin, N. M., & Lemieux, T. (2009). Unconditional quantile regressions. *Econometrica*, 77(3), 953-973.
- Fortin, N., Lemieux, T., & Firpo, S. (2011). Decomposition methods in economics. In *Handbook of Labor Economics* (Vol. 4, pp. 1-102). Elsevier.
- Fukunishi, T. (2009). Has low productivity constrained the competitiveness of African firms? A comparison of Kenyan and Bangladeshi garment firms. *The Developing Economies*, 47(3), 307-339.
- Hardy, M., & Kagy, G. (2018). Mind the (profit) gap: Why are female enterprise owners earning less than men?. In *AEA Papers and Proceedings* (Vol. 108, pp. 252-55).
- Helpman, E., Melitz, M. J., & Yeaple, S. R. (2004). Export versus FDI with heterogeneous firms. *American Economic Review*, 94(1), 300-316.
- Islam, A., Muzi, S., & Amin, M. (2019). Unequal Laws and the Disempowerment of Women in the Labour Market: Evidence from Firm-Level Data. *The Journal of Development Studies*, 55(5), 822-844.
- Jayachandran, S. (2015). The roots of gender inequality in developing countries. *Annual Review of Economics*, 7(1), 63-88.
- Jones, P. (2012). Identifying the effects of female ownership on firm performance: Evidence from Ghana." Paper presented at the 2012 CSAE Conference, University of Oxford, 18-20 March.
- Karamba, R. W., & Winters, P. C. (2015). Gender and agricultural productivity: implications of the Farm Input Subsidy Program in Malawi. *Agricultural Economics*, 46(3), 357-374.
- Klasen, S., & Lamanna, F. (2009). The impact of gender inequality in education and employment on economic growth: new evidence for a panel of countries. *Feminist Economics*, 15(3), 91-132.
- Levinsohn, J., & Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *The Review of Economic Studies*, 70(2), 317-341.
- Li, Y., & Rama, M. (2015). Firm dynamics, productivity growth, and job creation in developing countries: The role of micro-and small enterprises. *The World Bank Research Observer*, 30(1), 3-38.
- Nix, E., Gamberoni, E., & Heath, R. (2016). Bridging the gender gap: Identifying what is holding self-employed women back in Ghana, Rwanda, Tanzania, and the Republic of Congo. *The World Bank Economic Review*, 30(3), 501-521.
- Nordman, C. J. & Vaillant, J. (2014). Inputs, gender roles or sharing norms? Assessing the gender performance gap among informal entrepreneurs in Madagascar. IZA Discussion Paper No. 8046.
- Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. *International Economic Review*, 693-709.

- Oseni, G., Corral, P., Goldstein, M., & Winters, P. (2015). Explaining gender differentials in agricultural production in Nigeria. *Agricultural Economics*, 3(46), 285-310.
- Presbitero, A. F., Rabellotti, R. & Piras, C. (2014). Barking up the wrong tree? Measuring gender gaps in firm's access to finance. *Journal of Development Studies* 50(10): 1430-44.
- Rijkers, B. & Costa, R. (2012). Gender and rural non-farm entrepreneurship. *World Development* 40(12): 2411-26.
- Slavchevska, V. (2015). Gender differences in agricultural productivity: the case of Tanzania. *Agricultural Economics*, 46(3), 335-355.
- Shiferaw, A. (2009). Survival of private sector manufacturing establishments in Africa: The role of productivity and ownership. *World Development*, 37(3), 572-584.
- Udry, C. (1996). Gender, agricultural production, and the theory of the household. *Journal of Political Economy*, 104(5), 1010-1046.
- Van Beveren, I. (2012). Total factor productivity estimation: A practical review. *Journal of Economic Surveys*, 26(1), 98-128.

Figures

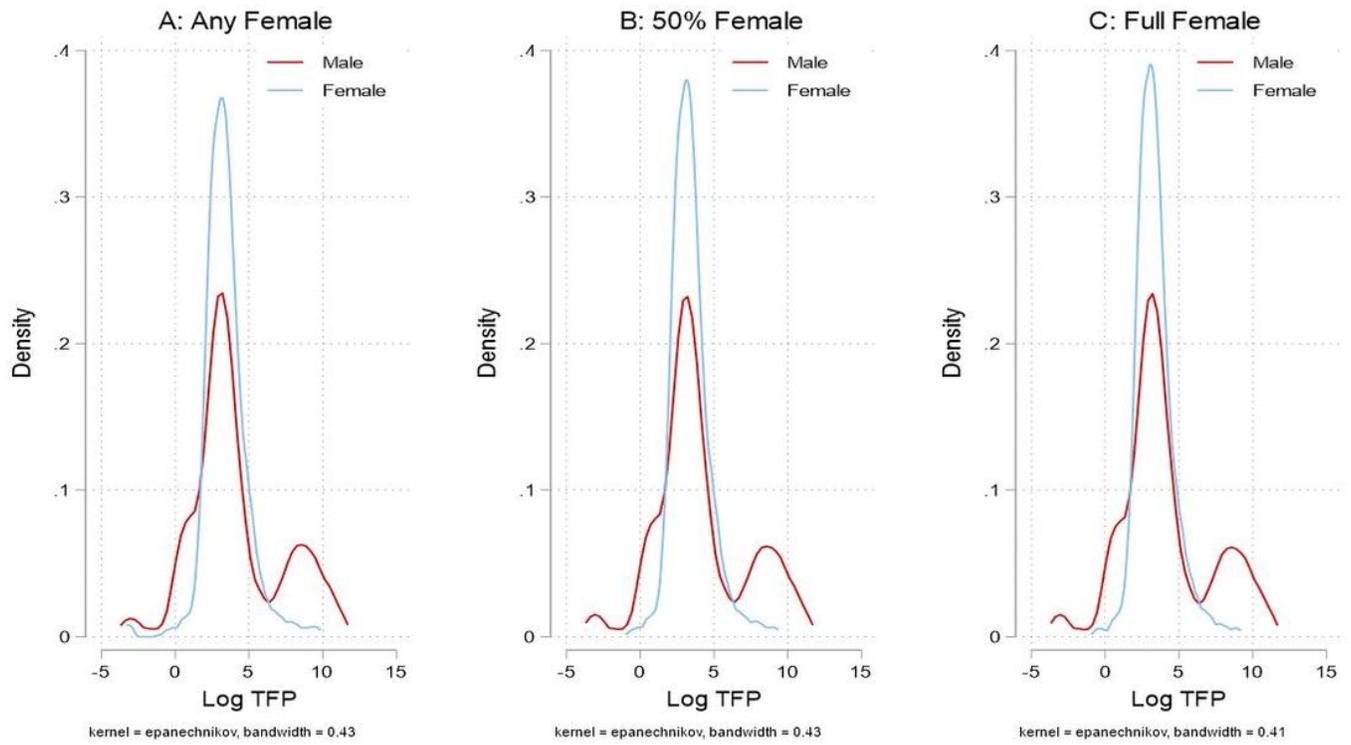
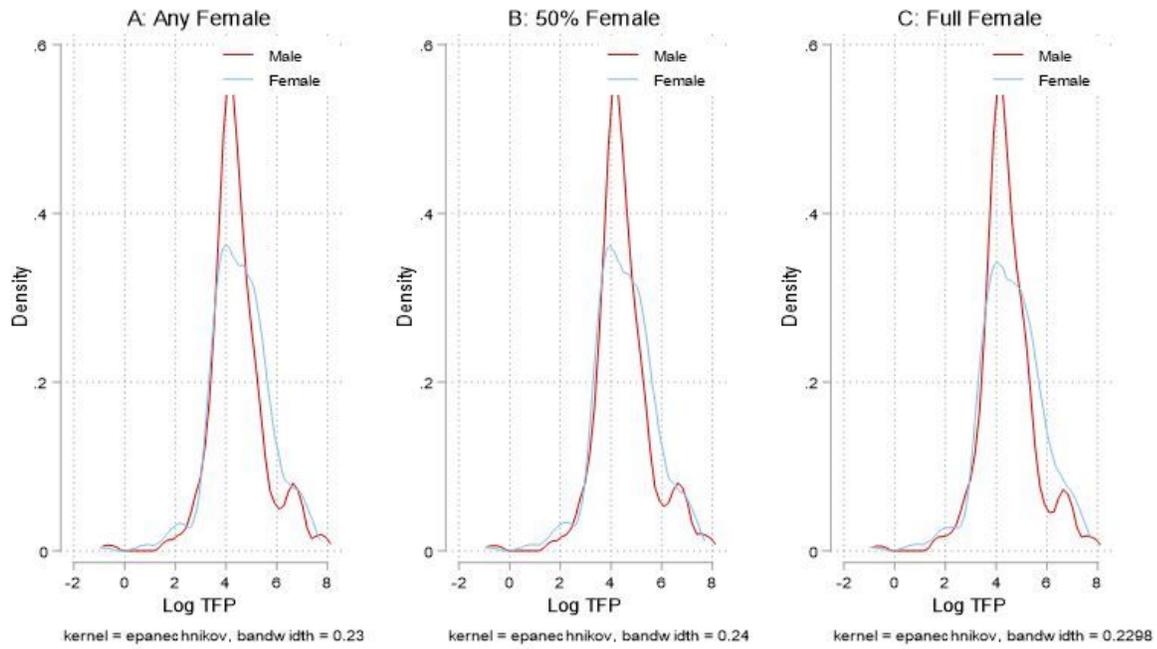


Figure 1

Distribution of TFP by ownership, all firms

A. Food and beverages



B. Textiles and wearing apparel

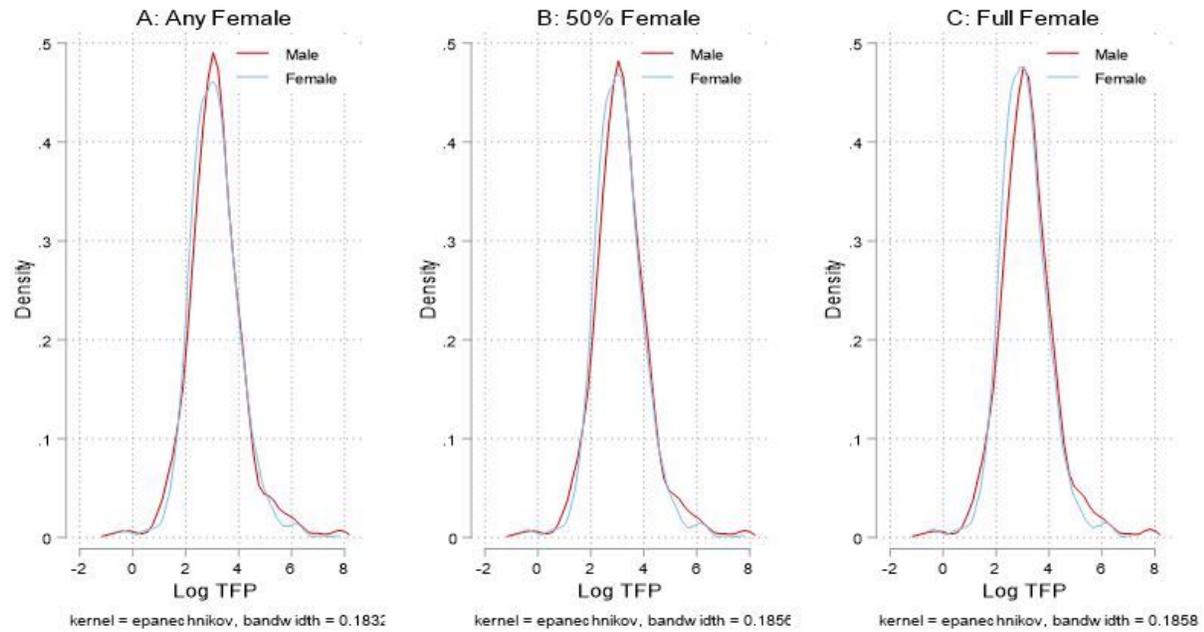


Figure 2

Distribution of total factor productivity with sectors

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