Exports, Foreign Ownership and Firm-level Efficiency in Ethiopia and Kenya: An Application of Stochastic Frontier Model

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Abstract

Using the World Bank Enterprise Surveys data for Ethiopia (2006 and 2011) and Kenya (2007 and 2013), this study empirically investigates the significance of exports and foreign ownership in influencing firm-level efficiency. We estimate a standard Cobb-Douglas production function using Stochastic Frontier Analysis. In addition to the two variables of interest, we control for firm characteristics, including firm size, type of industry, innovation activity, and employees' characteristics in our efficiency analysis. The results of the study show that, in both Ethiopia and Kenya, exporting helps firms lower technical inefficiency, whereas higher share of foreign ownership has the expected sign but not statistically significant. The results also confirm that, in both countries, smaller firms and firms that employ temporary workers for a longer periods of time tend to be less efficient. For Kenyan firms, experience of managers of a firm helps to lower technical inefficiency, however, innovation activities within a firm tends to raise inefficiency; whereas for the case of Ethiopian firms experience of managers lowers efficiency, albeit weakly, and innovation activities do not appear to affect firm efficiency. Our robustness analysis on the nexus between exporting and productivity confirms that one-size-fits-all causal relationship is not valid. We conclude that policy-makers in Ethiopia and Kenya should look into these key variables in designing appropriate policy to improve firm efficiency in their endeavor for industrialization.

Key Words: Efficiency, Exports, Foreign ownership, Ethiopia, Kenya
JEL Codes: F14, F21, D24

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I. Introduction

Policy-makers in developing countries in general and in Africa in particular are in search of the best policy tools to support local firms at least since late 1980s. Many countries have experimented with different policy tools and several have failed. Among the culprits for the failure of some of these experiments is the implementation of some of the policy tools before undertaking rigorous and exhaustive study on their effectiveness. What policy tools to use is often an issue of debate. To select the best policy tools, policy-makers consult their economic policy advisors for the tools that have been tested elsewhere and that have track record of success. That is where rigorous statistical analysis comes in to provide such important policy insight. The extent to which some of these policy tools, including support for export, innovation and attracting foreign firms, helps to improve firm's performance is an empirical question that this study attempts to tackle. The significance of such a study can't be overestimated given the growing interest in African economics as the region is becoming highly interconnected with the rest of the world, hence the label the 'last frontier'.

Until mid-1990s, academicians and policy-makers had relied on country/industry level analysis to provide insights for policy-makers before turning to firm-level analysis for richer results (for surveys of results of previous studies, see Wagner 2007 & 2012; Bigsten and Soderbom 2006; Martins and Yang 2009. Beginning late 1990s (a bit earlier for some countries) several factors have changed including openness of the economics, increased participation in the export market, increased inflow of foreign firms and, to some extent, increased spending of local firms in research and development (R&D). Given anecdotal evidence about the role that these factors play in affecting firm's performance, and the increased interconnection of markets, the number of studies that attempt to empirically investigate the economic significance of this phenomenon has started to grow, albeit slowly. This is despite the high real (and predicted) return from investment in firms in Africa (Gunning and Mengistae, 2001).

The aim of this study, therefore, is to empirically investigate the role that exports, foreign ownership, and innovation play in influencing the level of efficiency of firms in Ethiopia and Kenya. This study brings together relatively new activities of firms (in the African context) that have become increasingly relevant in Ethiopia and Kenya to analyze their impact on firms' performance. Specifically, this study will focus on identifying key efficiency determinants of a firm in the two countries and on investigating simultaneity issues between exporting and firm productivity.

The location proximity of Ethiopia and Kenya may seem to suggest similarity in economic structure. However, the two countries vary in several economic aspects ranging from the degree of openness, significance of manufacturing sector, and sophistication of their financial and banking sectors. Kenya is a relatively more open, financially sophisticated country with manufacturing sector accounting for a little over

a tenth of the economy (11.3% in 2013), while the Ethiopian economy is less open, with agricultural sector the dominant sector of the economy and single digit share of the manufacturing sector in overall GDP (4% in 2013). In both Ethiopia and Kenya, the share of the service sector is larger (43% for Ethiopia, and 51% in Kenya) than manufacturing sector in 2013 (the World Bank, 2015). The two sectors – manufacturing and service – contribute over 47% to the GDP in both Ethiopia and Kenya. The two sectors are very important in both countries in terms of attracting foreign investors and innovation activities. In Kenya, the manufacturing sector also contribute significantly in terms of export earning (36%), but less so in Ethiopia (10%) in 2012. In both countries the share of export earning of the service sector is less than 5% in 2012 (WTO, 2015). It is also important to note that Kenyan firms have much more experience in penetrating regional markets and have dominated several businesses in East African Community.[1] The present study uses data that took sample firms from these two sectors, manufacturing and service, to empirically investigate the determinants of firm's performance (i.e. technical efficiency).

Given the differences in the economic structure and the degree of openness between Ethiopia and Kenya, comparing the differential roles of exports, innovation, and foreign ownership in influencing efficiency of firms in the two countries is, therefore, warranted. The results of this study will provide important insight for policy-makers in the two countries to design appropriate industrial policies that take into account relevant factors based on the findings of the study. We anticipate that the results from this study provide insight for policy makers not only in Ethiopia and Kenya but also in other countries in the region with comparable economic structure.

The remaining part of this paper is organized as follows. The next section presents literature review with a focus on case studies from African countries. Section three discusses methodological issues and description of the data. Section four presents findings from of the efficiency analysis and the simultaneity tests. Section five concludes the paper.

II. Previous Studies

Most of the literature on productivity and efficiency focuses on the relationship between exporting and productivity. Whether exporting improves productivity or vise versa, the debate is still on going. Some argue that there is a positive role that exporting plays in improving productivity and efficiency of firms in developed countries. However, whether this is due to highly productive firms selecting themselves into the exporters group (Melitz, 2003; Melitz, & Ottaviano, 2008) or due to learning-by-exporting is not yet clear (Wagner, 2007 and 2012; Martins and Yang, 2009). The later studies summarize findings of previous case studies of firms mostly from advanced

[1] The East African Community (EAC) is the regional intergovernmental organization of the Republics of Burundi, Kenya, Rwanda, the United Republic of Tanzania, and the Republic of Uganda, with its headquarters in Arusha, Tanzania.

countries. The recent empirical works follow Melitz's (2003) theoretical work that supports the idea that highly productive and large firms select themselves to become exporters. Bigsten and Soderbom (2006) summarize empirical findings from firm-level studies from Africa and confirm that exporting improve productivity through learning-by-exporting. These findings are insightful despite lack of similar evidence from other developing countries. It is also important to note that these results may not apply to all African countries in the same way; for instance, the market structure and the degree of government involvement for Ethiopia and Kenya are different, and it is natural to expect that firms in the two countries may behave differently as our findings reveal in section four. In addition to estimating the frontier, the present study addresses this issue by estimating a system of equation in which we allow simultaneity between productivity and exporting to see if productive firms self select into the exporting market or vise versa.

Although there are several studies that seek to answer the role that exports, and size of foreign ownership play in affecting efficiency in other parts of the world (Yasar & Paul, 2009; Kinda, 2012; Khalifah, 2013; Greenaway, Gullstrand, & Kneller, 2005; Girma, Greenaway, & Kneller, 2004), similar studies for the case of African countries, to the best of our knowledge, are very limited. The exceptions are those studies that looked at the impact of export orientation (Mengistae and Pattillo, 2004; and Van Biesebroeck, 2005, for Sub-Saharan Africa; Soderbom, 2004, for Kenya; Bigsten, et. al., 2004 for four African countries), size (Soderbom, and Teal, 2004, for Ghana; Mengistae, 2004 for Ethiopia), and turnover (Gebreeyesus, 2008, for Ethiopia) on productivity and/or efficiency.

Mengistae and Pattillo's (2004) findings show positive effect of exporting on productivity but couldn't distinguish between selection by highly productive firms or learning-by-exporting. Van Biesebroeck's (2005) results also show positive effects of exports but supports the selection line of argument, that is highly productive firms in African tend to export compared to less productive firms. Bigsten, et. al. (2004), on the other hand, found that the positive efficiency gain from exporting is due to learning-by-exporting. The mixed results in African may have to do with the diverse structure and difference in the level of development of African countries themselves. In a country where firms are well-established and operate in a contested markets, exporting may come naturally (productivity leads to exporting), where as for firms in a country where competition is less fierce and exposure to even regional markets is limited, exporting may be a way to improve efficiency (learning-by-exporting). Our case study on Ethiopia and Kenya helps us to flush out the impact of differences in business settings and country characteristics.

Soderbom and Teal's (2004) results highlight the role of firm size and foreign ownership. Their findings show no conclusive evidence on the role of firm size, but highlight that in Ghana technical efficiency of firms with foreign ownership is not any better than other firms. While other related studies confirm positive impact of firm size

on efficiency. For instance, Lundvall & Battese's (2000) study on the effect of size on technical efficiency of 235 Kenyan firms found that firm size affect efficiency positively. Soderbom (2004) also finds support for the positive effect of size on efficiency. In both cases the reasoning is that exporting required large sunk costs and that only large firms can enter the exporting market as a result.

Coming back to the issue of foreign ownership, Figueira, et. al. (2006) looks at the effect of ownership structure on efficiency of banks in African countries. Their results indicate that privately owned firms with some share of foreign ownership performed better (in terms of efficiency) compared to private firms and state-owned firms, which often don't involve foreign ownership. Rasiah and Gachino (2005) conducted similar study for the case of Kenyan firms and found that foreign firms performed better. A related study from Ghana found that foreign presence negatively affects the performance of private local firms' but improve the performance of foreign-owned firms (Waldkirch and Ofosu, 2010). These two studies are not directly comparable, but the mixed findings are something that the present study investigates further for the case of Ethiopia and Kenya for clearer results on the role that foreign ownership plays in affecting firm performance. For more advanced countries, the role that foreign ownership plays is often positive; for instance, Gorg and Stobl (2005) highlight spillover effects from foreign firms through workers experience and mobility across firms. Halkos and Tzeremes (2010) also point to the positive effect of foreign equity on efficiency for the case of Greece.

The aforementioned studies are scattered in a sense that most use incomparable and individually collected data to investigate these issues, and only few of them have attempted to analyze effects of more than one factor that are expected to determine efficiency and productivity of firms in Africa. The datasets used in most of these studies are from early 2000s and several economic aspects have changed since then. Although cross-country analysis on the role of exports has been growing, studies that investigate the importance of foreign-ownership and innovations as determinants of firm-level efficiency and productivity are scanty at best. For policy makers, it is important to have empirical evidence of the three major policy instruments in one place so as to make choices from among comparable alternatives. The purpose of this study is to fill this void for the two African countries. In this study, we specifically ask the following questions:

1. To what extent do these new activities (i.e. exporting, and increased share of foreign ownership) contribute to improvements in firms' efficiency in Ethiopia and Kenya?
2. Do other firm characteristics (i.e. firm size, sector, age of a firm, location, and employee education, among others) affect firm-level efficiency in Ethiopia and Kenya?
3. Are there differences in the results for Ethiopia and Kenya? If so, which factors are important in each country and why.

4. Does exporting improve productivity of firms? Do only highly productive firms self-select themselves into exporting?

Identifying key determinants of firm efficiency (or inefficiency) is believed to provide richer insight for policy-makers to design targeted policy tools to improve performance of firms in Ethiopia and Kenya. For other African countries, the answer to the question 'what factor works in each country and why?' provide important lesson as they weigh different policy tools in their endeavor to improve efficiency of firms. We expect that the answer to the last question is believed to contribute to the ongoing debate on the nexus between exporting and productivity (see for instance, Harrison (1994) for theory and evidence), at least, in the context of the two African countries.

III. Methodological Issues and Data

One of the reasons for the near absence of similar studies on African countries may be due to lack of firm-level data. As the role of these activities get traction and international institutions recognize the need to empirically document the significance of these factors, several data collection initiatives were launched beginning in early 2000s. More importantly data collection was shifted to firm level through funding from various development agencies. The World Bank's Enterprise Surveys (World Bank, 2011) are one of the initiatives that conduct firm-level surveys to gather information ranging from business constraints to ownership structure to gender composition of the leadership of firms. Country level enterprise census data have also been used to investigate performance constraints and determinants of firm growth (for instance, see Soderbom, 2012; Bigsten and Gebresyesus, 2007 for the case of Ethiopia). These studies focus only on one or two aspects of firm performance determinants as their data allow only such analysis. The World Bank data is much more richer with several modules and detailed information that helps to address issues of liberalization and the role of gender in firm performance. The present study fills the void in the literature in terms of the role that these recent firm level activities play in influencing firm performance, more specifically efficiency of firms.

The economy wide liberalization in the last two decades in most African countries brought the role of foreign ownership and exporting to light only recently. Ethiopia and Kenya are two of the countries that embark on economic liberation in the last couple of decades (a bit earlier for Kenya). Despite their proximity to each other and the intent to encourage local firms through different policy initiatives, the two countries are different in terms of the sectors they liberalized, the role of the government, the extent to which local firms engage in international markets, and the number of sectors open for foreign investors. This study compares the two countries in terms of the key factors that influence efficiency of firms.

We use firm-level datasets from the World Bank's Enterprise Surveys for Ethiopia (2006 and 2011) and Kenya (2007 and 2013). For the case of Ethiopia, the enterprise survey

data has over 400 firms in 2006 and 640 firms in 2011, where as for Kenya the enterprise survey data has 780 firms in 2007 and 710 firms in 2013. However, the number of firms with the variables of interest for our estimation is not this large. Due to missing observations for some variables we end up with smaller sample sizes after we pooled the two surveys for the respective countries.. To the best of our knowledge these datasets have the largest number of sample firms surveyed, and yet have not been used for any major analysis, partly due to the need to prepare the datasets for rigorous analysis. In all of these surveys, firms were asked about their input use, ownership composition, research and development (R&D) activities, composition and skill levels of employees, and gender composition of their management team, among others. As such the data has a unique advantage to look into the contributions of not only exporting and ownership structure, but also R&D as well as gender composition of the labor force and management team to the overall performance of the firms in general and to the technical efficiency in particular.

Previous influential studies devote significant time and space on methods that help to identify the determinants of the productivity differences between exporters and non-exports. The methods range from the simple average comparison to calculating exporter productivity premia to estimations that use matched control/treated firms (Heckman et. al, 1999 and Girma, et. al, 2004). Other studies adopt the Kolmogorov- Smirnov test that compares the means of exporters and non-exporters taking into account all moments of the productivity distribution (Girma, Gorg and Strobl, 2004; Girma et al., 2005; Wagner, 2006; and Arnold and Hussinger, 2005). In this study, we compare efficiency of firms and go beyond just reporting differences in efficiencies by zooming in to see the key factors for the differences in efficiencies across firms. Stochastic Frontier Analysis (SFA) is the primary technique used in this study.

III.1. Stochastic Frontier Model

The present study estimates a Cobb-Douglas production function along with several factors that influence efficiency. SFA is designed to generate technical inefficiency or efficiency measures for each firm. What determines variation in technical inefficiency is the main question that will be addressed in this study. We hypothesize that, at least, two key factors- exporting, and the larger share of foreign ownership – play a significant role in determining the level of efficiency of each firm. Several studies have used SFA to determine the factors that influence efficiencies in other developing countries [see for instance, Khalifah (2013) for Malaysia, Yasar and Paul (2009) for Turkey, Halkos and Tzeremes (2010) for Greece]. For the case of African countries we came across two studies (Soderbom and Teal, 2004 for Ghana; Lundvall and Battese, 2000 for Kenya) that used SFA in both cases to investigate the link between efficiency and firm size. It is important to note here that we haven't come across studies in the African context that attempts to explain inefficiencies using any of the two key factors discussed above. Given the changing business environment and the claim that Africa is the "next frontier" for entrepreneurs, we believe that the focus on these aspects of

liberalization as key players in performance of firms in Africa is warranted. Below we will give a brief description on the background of SFA and examine how it relates to the present study.

The parametric stochastic frontier literature models a production function (or cost function) while accounting for inefficiency in the sample. Aigner, Lovell and Schmidt (1977) specified the total error component ε=v-u into two parts where v ϵ (-∞, ∞) represents random fluctuations in the production frontier such as good or bad weather, and u≥0 represents inefficiency for example damaged goods, as such any shortfall in output is attributed to inefficiency. The standard Cobb-Douglas production function[2] for a cross section of firms is given by:

$$y_i = \Pi_{i=1}^{n} x_i^{\alpha} e_i^{\varepsilon}, where\ \ \alpha = \Sigma_{i=1}^{n} \alpha_i = 1\ for\ i = 1, \ldots . n \qquad (1)$$

Taking logarithm of the production function will yield a linear model in which the parameters are interpreted as elasticities, as such we get:

$y_i = x_i'\alpha + \varepsilon_i$ and $\varepsilon_i = v_i - u_i$. (2)

Where y_i is a single output for firm *i*, α is a kx1 vector of unknown technological parameters to be estimated and x_i is kx1 vector of inputs. In the survey data, labor, capital and land are the three major inputs that we will utilize in the production function. The model can easily generalize to a panel structure where we examine the behavior of the same cross section unit of firms overtime for both Ethiopia and Kenya see Schmidt and Sickles (1984) and Battese and Coelli (1988). However, the survey datasets from the World Bank do not qualify as a panel data, at least for Ethiopia, since different firms were surveyed during the two survey years. Therefore, we will be treating the data as a pooling cross-section of firms and the production function in equation 2 above will be estimated.

Notice that in equation 2 the error component is confounded with noise and inefficiency, which will be decomposed post-estimation using the conditional mean function (see Jondrow, Lovell, Materov and Schmidt, 1982), which we will discuss below. For a cross-section of firms SFA imposes the following assumptions; the v_i (i=1,..,n) are independent and identically distributed (i.i.d), the u_i (i=1,..,n) are (i.i.d) and v_i and u_i are independent of each other as well as they are independent of the regressors. This paper relaxes the assumption that the u_i(i=1,..,n) are identically distributed but still maintain the independent assumption.

Several parametric assumptions are imposed on u in order to identify the parameters of the model – v is generally specified to be Normally distributed ($N(0,\sigma^2_v)$), typically it

[2] The assumption that production technology exhibits constant returns to scale will be tested for the sample firms in each country for each specification.

means that the random noise or (measurement error) averages to zero. Aigner, Lovell and Schmidt (1977) specified a Half Normal and Exponential on u. Stevenson (1980) specified a Truncated Normal distribution with a non-zero homogeneous pre-truncated mean and the Gamma distribution. These specifications generalize the half normal and the exponential, respectively. Greene (1990) shows how the Gamma specification on *u* can be estimated using Maximum Likelihood. More recently Almanidis, Qian and Sickle (2014) assumed a Doubly truncated Normal in which this generalizes the truncated normal. Accordingly firms cannot be grossly inefficient and, as such, they specified an upper bound on the distribution of u that is beyond a certain threshold of inefficiency a firm will have to exit the market. This is a much broader class of model and one major advantage of this specification is that it can accommodate the "wrong skew" which we will discuss below.[3]

In empirical applications the skew of the OLS is an important issue since it provides useful information to empiricist as to how to proceed. The total error component ε=v-u is asymmetrical unless u is equal to zero. Since v is normally distributed, skewness will occur only thorough u, therefore theoretically the skew of the total error component (ε) should be negative for a production function,[4] see Olson, J.A., Schmidt and Waldman (1980), Waldman (1982) and Almanidis, Qian and Sickle (2014). Estimation begins by first examining if OLS[5] has the "correct skew" (negative), if this is the case, the model is estimated using Maximum Likelihood technique because it is more efficient relative to Ordinary Least Square (OLS), however if the "wrong skew" (positive) occurs it poses severe problems for Maximum Likelihood Estimates (MLEs) and the models reduce to OLS, see Waldman (1982) and Wright (2015). In our estimation we proceed by first estimating OLS and examine the sign of the skew and then use this information to proceed in estimating the frontier.

Post estimation the conditional mean function $E(u|\varepsilon)$, i.e. the inefficiency term is conditioned on the total error component that is used to produce an estimate for u_i for each firm in the sample (Jondrow, Lovell, Materov and Schmidt, 1982). SFA assumes that true parameters are equal to their estimates $\beta = \hat{\beta}$ and the residuals e_i for each firm *i* is equal to the true error (that is $e_i=\varepsilon_i$) and are substituted into the conditional mean function which provides an estimate for inefficiency $\hat{u}_i= \hat{E}\ (u_i|e_i=\varepsilon_i)$. For this paper, the technology used in the production function is assumed to be the same across firms, however to control for heterogeneity we allow the pre-truncated mean to vary across firms, see Greene (2005). This is important since the main interest of this study is to explain the determinants of the inefficiency or efficiency across firms in the manufacturing and service sectors in both Ethiopia and Kenya.

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[3] Conventional specifications on u assume an infinite bound on the distribution, the Doubly truncated specification assumes a finite upper bound B and if B<2* μ (μ is the pre-truncated mean, that is the mean prior to truncation) then the distribution of u is negatively skew.

[4] Most of the specification on u has a positive skew.

[5] OLS consistently estimates all the parameters except the intercept because $E(\varepsilon)=-E(u)\neq 0$, also MLEs are more efficient because the distribution of ε is asymmetric.

From equation 2, we assume that v~ $N(0, \sigma^2_V)$ and the u_i is truncated below at 0 from a $N(\mu_i, \sigma^2_u)$, where μ_i is as defined below in equation (3). The pre-truncated mean is modeled as a function of the key variables, which are expected to influence the level of inefficiency of the firms in Ethiopia and Kenya.

$$\mu_i = \alpha + \beta(exports_i) + \theta(share\ of\ foreign\ ownership_i) + \phi'(other\ factors_i) \qquad (3)$$

$\phi' and\ other\ factors$ are a vector of parameters and variables, respectively, which influence mean inefficiency.

Maximum Likelihood is used to estimate equations (2) and (3) jointly to determine the statistically and economically significant factors in the production function (equation 2) and in the (mean) inefficiency function (equation 3). Once the predicted values of inefficiency (u_i) are determined, these values are substituted into exp $(-u_i)$, which is then used to compute values for technical efficiencies for each firm within the given sample.[6] Therefore if exp $(-u_k)$ is greater than exp $(-u_j)$, for firm k and firm j, respectively, then firm k is more efficient than firm j, that is the firms are ranked based on the values of technical efficiencies. The paper proposes that the difference between firm k's and firm j's efficiency is due to two key factors as stated above (i.e. exports, and proportion of foreign ownership share of each firm). Other control variables are also included in the mean inefficiency specification including firm size, experience of the manager of a firm, a dummy to indicate introduction of new or improved product to the market, average length of temporary workers, and percentage of female employees in each firm. Firm size and manager's experience (level of education in some cases) are the standard control variables in most previous studies. The reason for including a dummy for an improved product is to capture the degree of innovation undertakings of a firm in the recent past.

III.2. Model Variables:

As stated above, in addition to the traditional production function variables, we have used factors that we believe are observable key determinants of inefficiency differences across firms. In the production function (OUTPOUT), use of machinery (CAPITAL), size of land that each firm uses for the location of the actual production and location of sales (LAND), the number of employees hired in each firm (LABOR), and the amount of electricity used in the production process (ELECTRIC). The first two variables are considered as fixed or sunk costs of production, while the later two are variable costs of each firm. We hypothesize that exporting (EXPORTS), measured by the value of a firm's export, and share of foreign ownership (FOREIGN SHARE) in the ownership structure

[6] Note that Technical efficiency (TE_i) for firm *i* is: $TE_i = \frac{f(xi;\beta)\exp(vi - ui),}{f(xi;\beta)\exp(vi)} = \exp(-u_i)$, where realized output is $f(x_i;\beta)\exp(v_i - u_i)$ and $f(x_i;\beta)\exp(v_i)$ is the maximum theoretical output. Note $f(x_i;\beta)$ is a function of inputs and exp represents exponential.

of firms are key determinants of efficiency of firms. In addition, we have included experience of the manager of a firm (EXPERIENCE), measured by the number of years experience of top manager in the same sector, innovation activities within a firm (INNOVATION – proxied by an indicator that shows whether a firm introduced a new or improved product into the market), firm size[7] (FIRM SIZE), the average length of employment of temporary workers (TEMPORARY WORKERS) is included to capture the inefficiency associated with temporary workers due to the difficulty in managing the work force and time inconsistences associated with hiring and firing temporary workers. To control for the role of gender composition of employees, we have included the percentage of female employees (FEMALE) in each firm across countries

As stated in the theory of production and firms, we expect that all four inputs in the production function to have positive coefficients in the estimation. As to the determinants of inefficiency, as is often hypothesized in the literature, we expect that exports and higher share of foreign ownership lowers firm's inefficiency. Similarly, we expect that managers' experience and innovation activities promote efficiency of a firm as established in empirical works for the case of developed countries. On the other hand, we expect that longer average length of employment of temporary workers will lower efficiency of firms; this is because as temporary workers stay longer it is a signal that the firm faces difficulties to plan for a longer term and may operate sub-optimally. We don't have *apriori* expectations on the impacts of the proportion of female employees and firm size on efficiency. For the firm size, although theoretical models predict that larger firms are more productive (and hence efficient) than smaller firms, this may not be the case for firms in our sample countries given the level of development.

We have estimated two specifications of the stochastic frontier model. For our initial specification, we have used the same variables for both Ethiopia and Kenya. However, some of the results did not support the theoretically nor the empirically hypothesis; as a result we have estimated alternative specifications with similar, but not the same, variables for the two countries. The alternative variables are for labor and land, where for labor we have included non-production workers (NON-PRODUCTION) and seasonal workers (SEASONAL), whereas for land we have created additional land variable that includes proportion of land that a firm owns (LAND1), and a cost variable that included costs that a firm incurs in addition to what are already included in the production function (OTHER COSTS).

Table 1 below reports descriptive statistics of the model variables both for Ethiopia and Kenya. Variables reported in values (OUTPUT, MACHINES, LAND, LAND1, OTHER COSTS, ELECTRIC, and EXPORTS) are in local currency units, for Ethiopia in Birr and

[7] We followed the conventional definition to create firm size variable using the number of permanent employees that a firm hired, where firms are categorized as follows: *small*, less than 50; *medium* between 50 and 250, and *large* more than 250 employees.

for Kenya in Shillings[8]. Comparing the mean values for all firms in each country, Kenyan firms tend to be larger, used more capital, employs more seasonal and female workers, firm managers have more years of experience, exports more and have larger foreign ownership shares than their Ethiopian counterparts. Ethiopian firms employ more permanent and non-production workers, and engage slightly more in innovation activities. Average firm sizes and proportion of privately owned firms are similar in both countries.

Table 1: Descriptive Statistics of Model Variables

	Ethiopia			Kenya		
	Count	Mean	Standard Deviation	Count	Mean	Standard Deviation
Output	1002	85229.64	448380.6	1388	5580269	42500000
Capital	692	5712.291	25171.29	684	1039360	24700000
Labor	1119	100.8114	326.0091	1472	51.27242	213.6964
Electricity	931	378.2168	2778.658	1351	53687.2	314150.4
Land	617	222129.7	1908659	662	4358667	54900000
Non-Production Workers	617	29.33063	73.23335	752	25.34973	52.1177
Seasonal Workers	1109	27.71235	147.0921	1338	30.88864	152.3603
Experience	1118	13.24564	9.606276	1483	14.7532	10.4126
Exports	1010	6.119307	21.30304	1472	40.08696	40.94857
Private Ownership (%)	1041	89.50336	29.7389	1487	89.39132	28.27499
Foreign Ownership (%)	1041	5.237272	20.72704	1484	8.217722	25.35449
Employment Length of Temp. Workers	522	4.727069	8.244226	839	4.353993	3.187589
Percentage of Female Employee	639	24.32358	44.05041	846	26.49043	71.02468
Firm Size	1124	1.619217	0.7637286	723	1.598893	0.7155564
Innovation	1120	1.613393	0.4871899	1103	1.314597	0.4645656
Observation	1128			1494		

Once we estimate the model using SFA, we turn to the question about the nexus between exporting and productivity, as stated in question 4 in the introduction. In this context, we like to make sure that productivity and efficiency can't be used interchangeably. This is because efficiency can be broadly defined as the absence of waste; and according to Fried, Lovell and Schmidt (2008), efficiency is comparing observed output to maximum potential output obtainable from the inputs. Whereas productivity is the ratio of a firm's output to its input. A firm may be efficient but not necessarily productive or productive but not necessarily efficient. For example a productive firm may not internalize a negative externality hence it will be operating inefficiently. In this paper, we argue that as a firm becomes more efficient its productivity improves, but not the other way around. As such we can safely expect that

[8] At current rate (June 2015), USD $1 = 20.7 Ethiopian Birr and USD $1 = 101 Kenyan Shilling.

in explaining productivity, the estimates of efficiency that was computed from SFA can be used as an exogenous determinant in explaining productivity. In estimating the export and productivity equations simultaneously, we will use efficiency as one of the exogenous variables (see Equations 4 and 5 below).

Unlike our arguments for simultaneity of exports and productivity above, we do not suspect that there is simultaneity between exporting and foreign ownership. There are studies that support the view that exporting is not the driving factor for foreign firms to locate in most African countries. For instance, Asiedu (2002) indicates that the role openness plays in attracting foreign investors to Africa is less than that of non-African countries. Location decisions for foreign firms are driven mainly by other factors, including the availability of resources, market potential, and institutional capacity (Lemi and Asefa, 2009, Anyanwu, 2012; Kaplinsky and Morris, 2009). Another evidence to this end is the role that the US-Africa initiative - Africa Growth Opportunity Act (AGOA) - plays in attracting foreign investors to African countries. Due to limited number of (exporting) domestic firms that can take advantage of this initiative in most African countries, foreign investors (mostly Asian firms) moved to several African countries to manufacture and export to the US market (Lall, 2005). This supports the idea that it is in fact lack of exporting that attracts foreign investors into Africa not the other way around. Once these foreign firms establish a foothold in each country, they start to export. Our estimation below is, therefore to test direction of causal effects between productivity and exporting.

In our empirical application we investigate to see if productive firms in Ethiopia and Kenya are self-selecting in exporting as in Meltiz's (2003) framework or if exporting improves productivity (learning-by-exporting). In this paper we define productivity as the ratio of total output to labor. Equation 5 and 6 represents two structural equations for each firm, overtime across countries. The two random components, ε_{ic} and δ_{ic}, are assumed to be i.i.d, across firm and time.

$$EXPORTS_{ic} = \alpha_{oc} + \alpha_{1c} productivity_{ic} + \alpha_{2c}{}'\chi + \mathcal{E}_{ic} \quad (4)$$

$$Productivity_{ic} = \beta_{oc} + \beta_{1c} exports_{ic} + \beta_{2c}{}'\Psi + \delta_{ic} \quad (5)$$

for i=1,…,n and c= Ethiopia, Kenya

Where χ and Ψ are vectors of exogenous variables in the system which consist of,[INNOVATION, FOREIGN SHARE, FIRM SIZE, technical efficiency, international product certification, NON-PRODUCTION WORKERS, EXPERIENCE, TEMPORARY WORKERS, SKILLED WORKERS, SEASONAL WORKERS].

In the above simultaneous equation set-up it is difficult to determine whether exporting is driving productivity or productivity is driving exporting, hence we have simultaneity bias. We estimate the above using Three Stage Least Square (3SLS) to exploit any

contemporaneous correlation that might exist between ε_{ic} and δ_{ic} within each county and across firms. If there is contemporaneous correlation or over-identification then 3SLS is more efficient, that is the estimates are more precise when compared to 2SLS. If, however, the model is exactly identified or there is no contemporaneous dependence, then 2SLS is identical to 3SLS (see Davidson and Mackinnon (1993)). In Kenya, because it is relatively more developed, open and possesses better infrastructure, we posit that the more productive firms will more likely engage in exporting, i.e. they will self-select into the export market in support of Melitz's framework.

In equation 5 the exogenous variables that are used to explain export are innovation activities (INNOVATION), technical efficiency, share of foreign ownership (FOREIGN SHARE), manager's experience (EXPERIENCE) number of non-production (NON-PRODUCTION) and seasonal (SEASONAL) workers, as well as firm size (FIRM SIZE). In equation 6, in addition to some of these variables, we used technical efficiency, international product certification, and average length of employment of temporary workers (TEMPORARY WORKERS) as explanatory variables for productivity. We have estimated similar simultaneous equations for Ethiopia using combinations of some of these variables as determinants of exports and productivity. We expect that all the exogenous variables, with the exception of the number of seasonal workers, contribute positively to exports and productivity in both countries. As will be discussed in detail later, both equations are exactly identified, but we still report 3SLS results since we observed a slight difference in the standard errors, which might be driven by some contemporaneous dependence.

IV – Results and Discussion

Before estimating the stochastic frontier model, we estimated the production function using OLS and it confirms that the residuals are negatively skewed. In each country we run two different specifications (one with same variables for each country and the other with similar, but not the same, variables), for each specification we obtained negative skewness, which is a confirmation that the stochastic frontier model is the right estimation model for the data in each country. Right after the estimation of the OLS coefficients, we also tested whether firms exhibit constant returns to scale. In each country, in one of the specifications, firms exhibit constant returns to scale, but in the other specification decreasing returns to scale. These results are expected for firms in developing countries where infrastructure, market, and regulatory constraints inhibit firms from taking advantage of economies of scale.[9]

[9] Results for the skewness and returns to scale tests are not reported in the paper, but are available upon request from the authors.

IV. 1. Determinants of Efficiency

Tables 2 and 3 present results of the SFA for Ethiopia and Kenya, respectively. For each country, results from two specifications are reported. As expected the coefficients (i.e. elasticities) of the input variables have the expected signs in both countries for both specifications except for the negative signs on the labor variable for Kenya and land variable for Ethiopia in one of the specifications in each country. That is why we have estimated alternative production function specifications in each country with similar variables. The elasticity of output is the highest for use of electricity (0.39 and 0.37) in Kenya, and labor (0.36 and 0.35) in Ethiopia followed by the use of land (0.25 in the first specification) in Kenya and electricity (0.22 and 0.34) in Ethiopia. As expected, there is no surprise here, the elasticities are positive and less than one. As stated above, in our first specification, for Kenya, the coefficient for labor is negative but insignificant, whereas for Ethiopia the coefficient for land is negative and significant at the 10% level. On face value, these results imply that an increase in labor employment in Kenya and acquisition of land in Ethiopia lowers total output in Kenya and Ethiopia, respectively. It is not clear why this is happening for these two inputs; one explanation is that firms in both countries may substitute for these inputs as they expand production[10]. However, in our second specifications, all the coefficients have the expected positive signs, although some of them are not statistically insignificant.

[10] One can justify these results if one assumes that land (in Ethiopia) and labor (in Kenya) are inferior inputs. Although this is theoretically possible, there are limited empirical supports for this possibility.

Table 2: Stochastic Frontier Model Estimates for Ethiopia with Heterogeneous Mean in the Inefficiency Term

	A		B	
	Output	Inefficiency	Output	Inefficiency
CAPITAL	0.060		0.067	
	(1.05)		(1.23)	
LABOR	0.356**		0.345**	
	(2.43)		(2.54)	
ELECTRIC	0.221**		0.338***	
	(2.73)		(4.38)	
LAND	-0.018*			
	(-1.83)			
LAND1			0.104	
			(1.40)	
OTHER COSTS			0.139	
			(1.49)	
EXPORTS		-0.016***		-0.012**
		(-3.55)		(-2.89)
FOREIGN SHARE		-0.005		-0.000
		(-0.95)		(-0.05)
EXPERIENCE		0.238*		-0.139
		(1.75)		(-1.10)
TEMPORARY WORKERS		0.316*		0.051
		(1.74)		(0.41)
FEMALE		0.001		-0.006
		(0.09)		(-1.16)
Year dummy - 2011		-5.630***		-1.978**
		(-7.40)		(-2.32)
Innovation activity		0.359		-0.244
		(1.31)		(-1.02)
FIRM SIZE - Medium		-1.414***		-0.510
		(-3.62)		(-1.46)
FIRM SIZE - Large		-2.396***		-0.833*
		(-4.66)		(-1.66)
Observations	61		93	
chi2	5830597.11		102.783	
Sigma-u^2 estimate	0.787		0.861	
Sigma-v^2 estimate	0.001		0.001	

* p<.10, ** p<.05, *** p<.001

The two variables of interest for this study are included in the specification for the pre-truncated mean of the inefficiency equation. The two variables – exports (EXPORTS) and foreign ownership (FOREIGN SHARE)– have the expected negative signs both in Ethiopia and Kenya. That is, as firms' export and share of foreign ownership increase, the conditional mean of inefficiency decreases. Our results, however, show that only the export variable is statistically significant in both countries. These results are consistent with previous studies from developing countries. The mechanism through which export affects efficiency of firms is not clear from these results; as discussed above further analysis is necessary to investigate the channel through which this works (more on this later).

Table 3: Stochastic Frontier Model Estimates for Kenya with Heterogeneous Mean in the Inefficiency Term

	A		B	
	Output	**Inefficiency**	**Output**	**Inefficiency**
CAPITAL	0.218***		0.122**	
	(3.31)		(1.98)	
LABOR	-0.081			
	(-1.34)			
ELECTRIC	0.389***		0.365***	
	(10.23)		(9.04)	
LAND	0.248***		0.167**	
	(3.87)		(2.84)	
SEASONAL WORKERS			0.015	
			(0.23)	
NON-PRODUCTION WORKERS			0.238**	
			(3.02)	
EXPORTS		-0.011*		-0.016*
		(-1.70)		(-1.95)
FOREIGN SHARE		-0.009		-0.017
		(-0.99)		(-1.24)
EXPERIENCE		-0.837**		-1.189**
		(-2.29)		(-2.79)
TEMPORARY WORKER		0.692**		0.738**
		(2.10)		(2.24)
FEMALE		0.008*		0.008
		(1.77)		(1.57)
Year Dummy - 2013		8.939***		7.162***
		(5.35)		(4.98)
FIRM SIZE - Medium		-2.082**		-1.795*
		(-2.18)		(-1.89)
FIRM SIZE- Large		-3.286**		-2.915**
		(-3.24)		(-2.82)
Innovation		1.296**		1.443**
		(2.64)		(2.62)
Observations	236		235	
chi2	275.861		330.710	
Sigma-u^2_estimates	0.779		0.862	
Sigma-v^2 estimates	0.657		0.639	

* p<.10, ** p<.05, *** p<.001

With respect to the control variables, the results indicate that, compared to smaller firms, medium and large size firms are more efficient in both Ethiopia and Kenya. This is consistent with findings from previous studies that support the view that larger firms are more efficient. In terms of the size of the coefficients, larger firms (FIRM SIZE 3) are in a better position to lower inefficiency more than medium size firms in both countries.

Average length of employment of temporary workers (TEMPORARY WORKERS) increase inefficiency, the coefficient is positive and statistically significant for both countries. Keeping temporary workers on a payroll for longer time creates a challenge to put in place a plan for future operation of a firm in general and for improvement of efficiency in particular.

The two countries differ in terms of the role that the experience of a manager of a firm (EXPERIENCE) and innovation activities (INNOVATION) play in affecting efficiency of firms. For Kenya, as expected, firms with more experienced managers tend to be more efficient. In other words, firms with highly experienced managers manage to cut inefficiency compared to their peers. For firms in Ethiopia, managers' experience tends to be positively correlated with the mean inefficiency, implying that experience does affect efficiency negatively. This may well be measurement error in Ethiopia but may also be the fact that the experience reported in the data may not be relevant for the production process of these firms. Regarding innovation activities (INNOVATION), the surprising result is that for Kenyan firms the variable has positive and significant coefficient. This result implies that Kenyan firms that had introduced new or improved products (or processes) tend to be less efficient. Similarly, firms with higher percentage of female employees (FEMALE) are less efficient (at least in one specification). It is not that obvious through which channels these factors work to influence efficiency of firms, but we argue that firms that attempt to introduce new products into the market may do so at the expense of efficiency of the overall operation or that firms focus on the new product promotion and may lose efficiency at least for the first couple of years. The mechanics through which higher share of female employee affects efficiency negatively is not clear; one need to analyze this variable further to get to the bottom of the mechanics. For Ethiopia, both coefficients are statistically insignificant and have mixed signs.

The positive and significant coefficient of the average length of employment of temporary workers (TEMPORARY WORKERS) for both countries may give some hint as to why higher share of female employees is detrimental to efficiency of firms. If majority of these temporary employees are females, the variable may be picking the negative impact of temporary workers on efficiency. However, the data is not detailed enough to know what percent of the female employees are temporary workers and what is the average length of employment for female temporary workers.

Figures 1E and 1K report the kernel density of the efficiency estimates for Kenya and Ethiopia, respectively. The figures confirm that most firms in Kenya are relatively more efficient while for Ethiopia majority are highly inefficient during the two survey years in the sample. This is expected given the experience of firms in the two countries and the degree of exposure that the firms have been subjected to for the last couple of decades. However, as can be seen in Table 4 below, there is variation overtime in terms of efficiency between the two countries. Technical efficiency of Ethiopian firms improved significantly between 2006 and 2011, where as for Kenyan firms technical

efficiency declined between 2007 and 2013. This result is true for technical efficiency numbers from both specifications (i.e. technical efficiency 1 and technical efficiency 2). Although efficiency is expected to improve overtime in both countries, for Kenya the year 2013 defies expectations, partly due to unexpected security issues in the country. In 2013, Kenya's economy grew less than expected as tourism slumped on security concerns amid deadly attacks by Islamist militants including a raid by al-Shabab gunmen on a shopping mall in the capital. We anticipate that this may be one of the reasons for the deteriorating firm efficiency in 2013 compared to 2007. For Ethiopia, at least since 2007, it seems that the government have been pushing for the "big push" approach, pumping significant support for the business community to make them more competitive.

IV.2. Simultaneity of Productivity and Export

Table 4 presents comparison of mean values of some key variables for the top 25% and bottom 25% of firms in terms of technical efficiency. In both countries the top efficient firms tends to export more, are more productive, and larger in size. However, in Ethiopia the top 25% most efficient firms have larger share of private ownership but smaller share of foreign ownership. For Kenya, it is just the opposite, that is, the bottom 25% firms have larger share of private ownership but smaller share of foreign ownership. Perhaps it may be due to this mixed ownership structure that we obtained insignificant efficiency effect for foreign ownership variable in the frontier estimation for both countries.

Table 4: Comparison of top 25% and bottom 25% efficient firms: Mean value of variables

	Ethiopia				Kenya			
	Top 25%	Bottom 25%	2006	2011	Top 25%	Bottom 25%	2007	2013
Exports	5.75	2.42	6.44	5.94	39.36	36.98	44.93	23.05
Productivity	1885.1	0.39	0.67	3104.4	247282	69036.5	206102	150527.8
Firm Size	1.61	1.29	1.54	1.72	1.62	1.55	1.68	2.44
Private Ownership (%)	91.15	85.42	81.4	95.98	83.69	95.71	85.52	95.27
Foreign Ownership (%)	3.94	4.62	4.65	4.02	12.08	4.29	13.57	2.72
Technical Efficiency 1	0.24	0.01	0.01	0.35	0.84	0.22	0.65	0.01
Technical Efficiency 2	0.74	0.01	0.05	0.22	0.84	0.28	0.68	0.05

In both countries, the top efficient firms are both highly productive and export more. However, due to the issues of simultaneity, as discussed above, it is difficult to establish causal relationship between the two variables. To figure out whether highly efficient firms self-select themselves to join the export market or whether the firms efficiency improve after joining the export market, one needs to look at the issue from dynamic perspective or consider both variables as endogenous in system of equations. Given the limitations of our data, we have opted for the later approach as discussed above. Results of the estimation of the system of equations are reported in Table 5 with two

different specifications in each country. The results in Table 5 are robust to alternative specifications.

The results confirm that in Ethiopia exporting helps firms improve productivity in line with the learning-by-exporting argument. This is consistent with the findings from Chinese (Hu and Liu, 2014) and Indian (Topalova and Khandelwal, 2011) firms. Given the limited experience of Ethiopian firms, we argue that recent exposure to the export markets helps these firms to learn from the outside world and in the process of adopting to the new competitive market environment they become more productive. For Kenyan firms, there is no evidence of learning-by-exporting, in fact in one of the specifications the export variable have negative sign and statistically significant, which implies that exporting hurts productivity. On the other hand, for Kenya, the productivity coefficient is positive and statistically significant, that is highly productive firms tend to export more in line with Melitz's (2003) work.

Table 5. The nexus between productivity and exports: Estimates from Three Stage Least Square (3SLS)

	A		B	
Ethiopia	**Productivity**	**Exports**	**Productivity**	**Exports**
EXPORTS	0.133*		0.106*	
	(1.90)		(1.65)	
TEMPORARY WORKER	-0.400		-0.735**	
	(-1.60)		(-2.63)	
SKILLED WORKERS	-0.690***			-3.180
	(-3.53)			(-1.03)
FOREIGN SHARE		0.072*		0.116
		(1.68)		(1.39)
NON-PRODUCTION WORKERS		1.400*	-0.235	
		(1.95)	(-1.12)	
EXPERIENCE		1.317		2.458
		(1.12)		(1.39)
FIRM SIZE- Medium	1.705**		1.048	14.554
	(2.66)		(1.45)	(1.64)
FIRM SIZE- Large	3.695***		2.301**	30.919*
	(3.35)		(2.12)	(1.69)
Productivity		0.898		-4.559
		(0.87)		(-1.21)
INNOVATION		-6.841**		-11.849*
		(-2.25)		(-1.66)
Observations	259		259	
chi2	46.799	22.811	38.782	15.386
Kenya				
EXPORTS	-0.044		-0.030**	
	(-0.60)		(-2.17)	
Technical Efficiency 1	3.956			
	(1.46)			
INNOVATION	0.166		0.114	
	(0.24)		(0.40)	
FIRM SIZE - Medium	-0.725	-19.761**	-0.347	9.564
	(-0.54)	(-2.57)	(-1.04)	(1.01)
FIRM SIZE -Large	0.357	13.542	0.104	69.863***
	(0.39)	(1.46)	(0.28)	(3.90)
Technical Efficiency 2			3.991***	
			(5.64)	
International Certificate			-0.861**	
			(-2.91)	
Productivity		16.184**		14.746***
		(2.74)		(3.42)
INNOVATION		11.750		6.909
		(1.54)		(0.99)
FOREIGN SHARE		-0.099		-0.101
		(-0.96)		(-1.07)
NON-PRODUCTION WORKERS				-10.336**
				(-2.74)
SEASONAL WORKERS				-8.785**
				(-2.28)
Observations	236		234	
chi2	23.988	16.023	56.768	26.695

* p<.10, ** p<.05, *** p<.001

As we alluded to it above, we argue that the difference between firms in Ethiopia and Kenya are the level of development of domestic market, the level of exposure to outside market, and the regulatory environment that firms face in each country. Kenyan firms

are already tested in the local market due to the competitive nature and relatively saturated market compared to Ethiopia. On top of that Kenyan firms have a track record of dominating neighboring countries' markets as they penetrated the East African Community markets. As such, for a firm (new or existing) to start to export its products, it needs to be productive to survive such competitive domestic and export markets.

Based on our results, we conclude that one-fits-all line of argument, as to whether exporting affects productivity and vise versa, doesn't fit the narrative for each African countries. The level of development and the degree of exposure of each country matter to determine the direction of the relationship between exporting and productivity. One needs to look into the settings in each country before jumping to the one-fits-all conclusion.

V- Conclusions

In this study we empirically analyze the role that exporting, and share of foreign ownership play in influencing the efficiency of firms in Ethiopia and Kenya. We use SFA to estimate the production function in which we account for mean heterogeneity in explaining firm level efficiency. After controlling for firm size, firm's manager's experience, innovation activity of firms, share of female employment in the mean inefficiency specification, we carefully looked into the role that exporting and foreign ownership of a firm play in lowering (or raising) firm inefficiency. To make the comparison of results for the two countries insightful, in at least one of our specifications, we have used the same variables for both countries in the specification of the production function and the mean inefficiency equations. This was possible since we have used the enterprise survey data that the World Bank collected from both countries in the 2000s.

The results of the study show that in both countries, exporting help firms lower technical inefficiency, whereas higher share of foreign ownership of a firm has the expected sign but not statistically significant. The results also confirm that in both countries, smaller firms and firms that employ temporary workers for a long periods of time tend to be less efficient. For Kenyan firms, experience of managers of a firm help lower technical inefficiency, however, innovation activities within a firm tend to raise inefficiency. For the case of Ethiopian firms the results with respect to innovation and firm manager's experience are just the opposite. Our analysis also looks into the nexus between exporting and productivity of firms in both countries; our findings reject the one-fits-all framework of either learning-by-exporting or productive firms self-selecting into exporting. Our result shows that it all depends on the setting in which a firm operates. As such Ethiopian firms seem to become more productive by exporting (learning-by-exporting) where as in Kenya only highly productive firms self-select themselves into exporting.

These results provide important insights for policy-makers in both countries to design not only appropriate industrial policies that work, but also policies that take into account relevant factors based on the findings of the study. We anticipate that the results from this study provide insight for policy makers not only in Ethiopia and Kenya but also other countries in the regions with comparable economic structure.

The unexpected elasticity coefficients we obtained in the production function may be due to measurement error, however, we suggest that future studies look into the particularly unexpected role of land in Ethiopia and labor in Kenya; the detrimental effect of female employment on efficiency also needs further analysis. A more refined data may also be needed to address these remaining issues in greater detail.

References

Aigner, D., Lovell, C. A. A., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. Journal of Econometrics, 6(1), 21-37.

Almanidis, P., Qian, J., & Sickles, R. C. (2014). Stochastic frontier models with bounded inefficiency. In Festschrift in Honor of Peter Schmidt (pp. 47-81). Springer New York.

Anyanwu, J. C. (2012). Why does foreign direct investment go where it goes?: new evidence from African countries. Annals of Economics and Finance, 13(2), 425-462.

Arnold, J. M., & Hussinger, K. (2005). Export behavior and firm productivity in German manufacturing: a firm-level analysis. Review of World Economics, 141(2), 219-243.

Asiedu, E. (2002). On the determinants of foreign direct investment to developing countries: is Africa different?. World development, 30(1), 107-119.

Battese, G.E., Coelli, T.J. , (1988). Prediction of firm-level technical efficiencies with a generalised frontier production function and panel data. Journal of Econometrics 38, 387-399.

Bigsten, A., & Gebreeyesus, 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.

Bigsten, A., & Söderbom, M. (2006). What have we learned from a decade of manufacturing enterprise surveys in Africa?. The World Bank Research Observer, 21(2), 241-265.

Bigsten, A., Collier, P., Dercon, S., Fafchamps, M., Gauthier, B., Willem Gunning, J., ... & Zeufack, A. (2004). Do African manufacturing firms learn from exporting?. Journal of Development Studies, 40(3), 115-141.

Davidson, R., and J. G. MacKinnon. (1993). Estimation and Inference in Econometrics. New York: Oxford University Press.

Figueira, C., Nellis, J., & Parker, D. (2006). Does Ownership Affect the Efficiency of African Banks?. Journal of Developing Areas, 40(1), 37-63.

Fried, H. O., Lovell, C. K., & Schmidt, S. S. (Eds.). (2008). The measurement of productive efficiency and productivity growth. Oxford University Press.

Gebreeyesus, M. (2008). Firm turnover and productivity differentials in Ethiopian manufacturing. Journal of Productivity Analysis, 29(2), 113-129.

Girma, S., Görg, H., & Strobl, E. (2004). Exports, international investment, and plant performance: evidence from a non-parametric test. Economics Letters, 83(3), 317-324.

Girma, S., Greenaway, A., & Kneller, R. (2004). Does exporting increase productivity? A microeconometric analysis of matched firms. Review of International Economics, 12(5), 855-866.

Girma, S., Kneller, R., & Pisu, M. (2005). Exports versus FDI: an empirical test. Review of World Economics, 141(2), 193-218.

Görg, H., & Strobl, E. (2005). Spillovers from Foreign Firms through Worker Mobility: An Empirical Investigation. The Scandinavian journal of economics, 107(4), 693-709.

Greenaway, D., Gullstrand, J., & Kneller, R. (2005). Exporting may not always boost firm productivity. Review of World Economics, 141(4), 561-582.

Greene, W.H., 2005. " Reconsidering Heterogeneity in panel data estimators of the stochastic frontier model."Journal of Econometrics, 126:269-303.

Greene, W.H., 1990. A GAMMA-Distributed Stochastic Frontier Model. Journal of Econometrics, 46:141-163.

Gunning, J. W., & Mengistae, T. (2001). Determinants of African manufacturing investment: the microeconomic evidence. Journal of African Economies, 10(suppl 2), 48-80.

Halkos, G. E., & Tzeremes, N. G. (2010). The Effect of Foreign Ownership on SMEs Performance: An Efficiency Analysis Perspective. Journal Of Productivity Analysis, 34(2), 167-180. doi:http://dx.doi.org/10.1007/s11123-010-0174-2

Harrison, A. E. (1994). Productivity, imperfect competition and trade reform: Theory and evidence. Journal of International Economics, 36(1), 53-73.

Heckman, J. J., LaLonde, R. J., & Smith, J. A. (1999). The economics and econometrics of active labor market programs. Handbook of labor economics, 3, 1865-2097.

Hu, A. G., & Liu, Z. (2014). Trade liberalization and firm productivity: Evidence from Chinese manufacturing industries. Review of International Economics. In press.

Jondrow, J., Knox Lovell, C. A., Materov, I. S., & Schmidt, P. (1982). On the estimation of technical inefficiency in the stochastic frontier production function model. Journal of econometrics, 19(2), 233-238.

Kaplinsky, R., & Morris, M. (2009). Chinese FDI in Sub-Saharan Africa: engaging with large dragons. European Journal of Development Research, 21(4), 551-569.

Khalifah, N. A. (2013). Ownership and Technical Efficiency in Malaysia's Automotive Industry: A Stochastic Frontier Production Function Analysis. Journal Of International Trade And Economic Development, 22(3-4), 509-535.

Kinda, T. (2012). Foreign Ownership, Sales to Multinationals and Firm Efficiency: The Case of Brazil, Morocco, Pakistan, South Africa and Vietnam. Applied Economics Letters, 19(4-6), 551-555.

Lall†, S. (2005). FDI, AGOA and manufactured exports by a landlocked, least developed African economy: Lesotho. *Journal of Development Studies*, 41(6), 998-1022.

Lemi, A., & Asefa, S. (2009). Differential impacts of economic volatility and governance on manufacturing and non-manufacturing foreign direct investments: The case of US multinationals in Africa. *Eastern Economic Journal*, *35*(3), 367-395.

Lundvall, K., & Battese, G. E. (2000). Firm size, age and efficiency: evidence from Kenyan manufacturing firms. The journal of development studies, 36(3), 146-163.
Martins, P. S., & Yang, Y. (2009). The impact of exporting on firm productivity: a meta-analysis of the learning-by-exporting hypothesis. Review of World Economics, 145(3), 431-445.
Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica, 71(6), 1695-1725.
Melitz, M. J., & Ottaviano, G. I. (2008). Market size, trade, and productivity. The review of economic studies, 75(1), 295-316.
Mengistae, T. (1998). Age-Size Effects in Firm Growth and Productive Efficiency: The Case of Manufacturing Establishments in Ethiopia. manuscript, World Bank, Washington, DC, Aug.
Mengistae, T., & Pattillo, C. (2004). Export orientation and productivity in sub-Saharan Africa. IMF Staff papers, 327-353.
Olson, J.A., P. Schmidt and D. Waldman, 1980. "A Monte Carlo Study of Estimators of Stochastic Frontier Production Functions." Journal of Econometrics 13: 67-82.

Rasiah, R., & Gachino, G. (2005). Are foreign firms more productive and export-and technology-intensive than local firms in Kenyan manufacturing?. Oxford Development Studies, 33(2), 211-227.
Schmidt, P., & Sickles, R. C. (1984). Production frontiers and panel data. Journal of Business & Economic Statistics, 2(4), 367-374.
Söderbom, M. (2004). Productivity, exports and firm dynamics in Kenya 1999-2002. CSAE paper. Oxford: Centre for the Study of African Economies, Department of Economics, University of Oxford.
Söderbom, M. (2012). Firm size and structural change: A case study of Ethiopia. Journal of African Economies, 21(suppl 2), ii126-ii151.
Söderbom, M., & Teal, F. (2004). Size and efficiency in African manufacturing firms: evidence from firm-level panel data. Journal of Development Economics, 73(1), 369-394.
Stevenson, R. E. (1980). Likelihood functions for generalized stochastic frontier estimation. Journal of econometrics, 13(1), 57-66.
Topalova, P., & Khandelwal, A. (2011). Trade liberalization and firm productivity: The case of india. Review of economics and statistics, 93(3), 995-1009.
Van Biesebroeck, J. (2005). Exporting raises productivity in sub-Saharan African manufacturing firms. Journal of International economics, 67(2), 373-391.
Wagner, J. (2006). Exports, foreign direct investment, and productivity: Evidence from German firm level data. Applied Economics Letters, 13(6), 347-349.
Wagner, J. (2007). Exports and productivity: A survey of the evidence from firm-level data. The World Economy, 30(1), 60-82.
Wagner, J. (2012). International trade and firm performance: a survey of empirical studies since 2006. Review of World Economics, 148(2), 235-267.
Waldkirch, A., & Ofosu, A. (2010). Foreign presence, spillovers, and productivity: Evidence from Ghana. World Development, 38(8), 1114-1126.

Waldman, D. M. (1982). A stationary point for the stochastic frontier likelihood. Journal of Econometrics, 18(2), 275-279.
World Bank (2015). World Development Indicators. http://data.worldbank.org (accessed on Feb. 14, 2015).
World Bank, 2011. The World Bank Enterprise Surveys (http://www.enterprisesurveys.org), The World Bank.
World Trade Organization (WTO). (2015). International Trade and Market Access Data. http://www.wto.org/english/res_e/statis_e/statis_bis_e.htm?solution=WTO&path=/Dashboards/MAPS&file=Map.wcdf&bookmarkState={%22impl%22:%22client%22,%22params%22:{%22langParam%22:%22en%22}}, (accessed on Feb. 14, 2015)
Wright, I. (2015). Stationary Points for Parametric Stochastic Frontier Models. Department of Economics, Syracuse University, unpublished manuscript.
Yasar, M., & Paul, C. M. (2009). Size and Foreign Ownership Effects on Productivity and Efficiency: An Analysis of Turkish Motor Vehicle and Parts Plants. Review Of Development Economics, 13(4), 576-591.

Figure 1E: Kernel Density of the Efficiency of Firms in Ethiopia

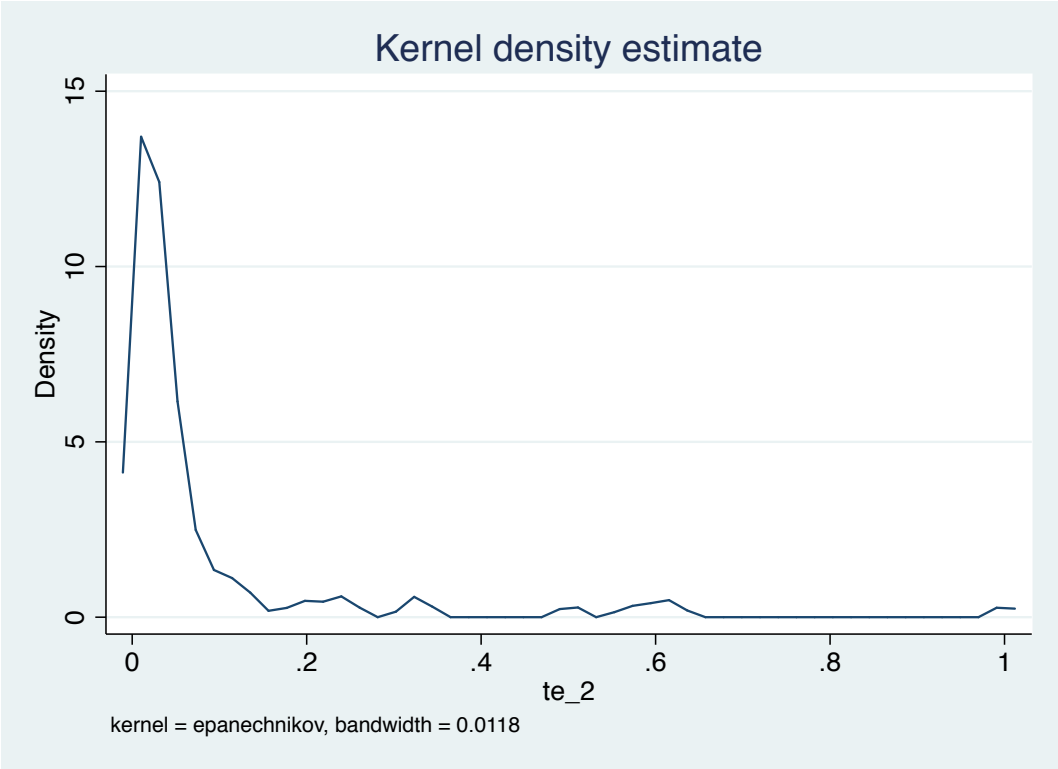

Figure 1K: Kernel Density of Efficiency of Firm in Kenya