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Abstract

The private sector is deemed as an engine of growth. As such, many developing countries including Ghana have sought to develop the private sector to propel the growth of their economies. This notwithstanding, much has not been done to examine the effects of such efforts on the productivity of firms in relation to trade reforms in the context of the private sector. This paper contributes to the trade literature by examining how tariffs affect the productivity of manufacturing firms in Ghana's private sector using firm-level data from 1991 to 2001. In the first step, productivity is estimated via the Levisohn-Petrin approach in order to correct for the well-known simultaneity and selection biases. In the second step, the effect of tariffs on the derived productivity is analysed. The findings suggest that lower tariffs are associated with a decline in the productivity of Ghanaian private firms in the manufacturing sector.

Keywords: tariffs; productivity; trade liberalization; private sector; manufacturing

Subject classification codes: D24, F1, F13, F14, F23, O14

Introduction

In Africa, the private sector contributes over 80% to total production and employs about 90% of the working age population (AfDB 2011). It is therefore essential in fighting poverty and ensuring inclusive growth (DFID 2008; OECD 2007). Hence, a well-developed private sector plays an important role in the development process of developing countries through job creation, public revenue generation, better wages, poverty reduction and improving living conditions. In spite of its contributions, the private sector was neglected by several African countries at independence including Ghana.

In the early post-independent Ghana, a centrally planned economy was adopted coupled with State-Owned Enterprises (SOEs) that were backed by import substitution strategies. In this regard, higher tariffs were imposed on imports as well as quotas that restricted the quantities of imports. However, this has not been very successful as such strategies proved to be unsustainable (AfDB 2011) in most African countries. As a result, an attempt has been made in Ghana through reforms sponsored by the World Bank and International Monetary Fund (IMF) to make the private sector a key partner in the development of the country.

The reforms sought to promote manufacturing industries and an outward looking economy backed by the private sector. Trade liberalization was part of such reforms in Ghana and meant to open up the once protected and inward-looking economy. In this respect, import controls were abolished, exchange rates deregulated, and state enterprises privatized. The country has maintained a credible commitment to trade reforms over the years. However, much is not known about how such trade reforms has impacted on the performance of the private sector in Ghana. According to Buffie (2001), trade policy research in developing countries abound on advocacy but very short on empirical evidence. For this reason, this paper examines the impact of trade liberalization on the productivity of private firms in Ghana's manufacturing sector using firm-level data. Specifically, the paper investigates the extent to which tariff

reductions have contributed either to a rise or decline in the productivity of private manufacturing firms between 1991 and 2001. Also, it investigates performance differences between importers vs. non-importers and exporters vs. non-exporters. Finally, it analyses whether firm ownership type that is foreign or domestic play a role in delivering superior firm performance.

Even though studies on trade and firm productivity abound, several of them have not focused on the private sector and a few others have been either at the industry (Fatou and Choi 2013; Bigsten and Gebreeyesus 2009; Amiti and Konnings 2007) or cross-country level (Bresnahan et al. 2016; Foster-Mcgregor et al. 2013; Söderbom et al. 2006). Furthermore, several studies have used macro data, which is not sufficiently informative as trade is said to be undertaken by firms but not countries (Hallak and Levinsohn 2008). Hence, "country level data are not granular enough to capture how trade impacts firms and households around the globe" (Hallak and Levinsohn 2008,217). Such aggregate data according to Kasahara and Rodrigue (2008) does not capture heterogeneity across different firms in an economy. It is therefore necessary to first examine changes at the firm-level as done in the present paper in order to have a better understanding of the changes on the aggregate level.

Amid the continuous calls for liberalization in the developing world, this paper is useful to policy makers in their trade policies especially with regards to either increasing or decreasing tariffs. The paper therefore contributes to knowledge in the framework of developing country studies in the area of trade and firm efficiency. The rest of the paper is structured as follows: The next section provides a brief background on the economic performance of Ghana over the period. Section 3 presents the empirical literature on trade and productivity. The data employed and the empirical models are outlined in section 4. In section 5, the empirical results are reported and section 6 presents the conclusions.

Background

The economic performance of Ghana since independence can be categorized into three phases: Immediate post-colonial period / Independence (1957 – 1966), post-Nkrumah/Era of coup d'états (1966 -1982) and 1983 to present (era of economic restoration and development). The first period had an average economic growth of about 4.5% per annum coupled with relatively low inflation rates (Anaman and Osei-Amponsah, 2009). This period witnessed the establishment of several state industries across the country: the setting up of the Ghana Industrial Holding Corporation (GIHOC) and the development of the Akosombo hydroelectric dam and the new township and industrial city around the Tema port. Hence, Anaman and Osei-Amponsah (2009) opine that Nkrumah's regime made the initial attempts to industrialize Ghana. The immediate post-colonial period was therefore characterized by inward-looking policies of import substitution industrialization and the dominance of state enterprises.

The second phase was home to political instability with the frequent change of governments via coup d'états. In fact, there were 4 coup d'états and 7 Heads of State within this period Therefore, the industrialization efforts of the previous period were largely abandoned. Furthermore, frequent changes in policies brought about a lack of policy direction.

The third phase is a period marked by political stability, moderate economic growth of about 4.8% per annum alongside moderate inflation rates and trade liberalization. This period witnessed the major stages of Ghana's outward-oriented economy. That is, the transition to import liberalization in 1983 and the liberalized trade regime since 1990. A major feature of this phase was the shift to the private sector as the backbone of the Ghanaian economy, which resulted in the privatization of state enterprises. Therefore, improving the attractiveness of the private sector and stimulating private investments were key at this stage. To that end, corporate income tax rate applicable to manufacturing firms was reduced from 45% to 35% in 1991. Also, corporate tax rebate on exports was raised from 25% to 30%.

With regards to trade, import duty on semi-processed intermediate goods was reduced to 10% from 15% in 1991 whilst all quantitative restrictions on imported raw materials for export manufacturers were eliminated. A 100% duty drawback on imported inputs was introduced and custom duty on textile imports was reduced to 10% from 40% (World Bank, 1991). In terms of strides in the political arena of Ghana, this period witnessed the conduct of democratic election in 1992 that returned the country to multiparty system and bringing about participatory governance/decision making.

By this time, the import licensing system had been abolished and the once highly controlled exchange rate deregulated. Documentation requirements for both imports and exports were also simplified. Hence, it is argued that Ghana's trade policy began at this point "to reflect a strong belief in international competitiveness, and the recognition that protectionism and import controls can only prevent the levels of economic growth associated internationally with competition-induced structural Change" (GATT 1992,13). A policy objective of government during this period was to lower average tariffs to below 10%. Until January 2000, Ghana had a four-tier tariff structure with rates of zero, 5%, 10% and 20%. Mostly, raw materials and capital goods attracted rates of zero and 5% whilst intermediate and consumer goods mostly had rates of 10% and 20% respectively. The simple average Most Favoured Nation (MFN) tariff fell to 13% by January 2000 from 17% in 1992 (WTO, 2001). It is in this vein that this paper seeks to assess the effect of tariffs on the productivity of private firms in Ghana.

Empirical Literature on the Productivity Effects of Trade

It has been argued that the existing literature on opening up, either through reductions in tariffs or quota points to associated productivity gains (De Loecker 2011). For example, Bigsten et al. (2009) found large positive effects of tariff reductions on productivity from their study of manufacturing firms in Ethiopia covering 1997 – 2005. In particular, they indicate that

excessive tariff levels may be distortionary. Still on Ethiopia, Abreha, (2014) found productivity gains from importing using data of manufacturing firms from 1996 to 2011. His findings reveal that importers perform better and also provide evidence that supports learning-by-importing. Furthermore, the results of Bigsten et al. (2016) using firm-level manufacturing data from Ethiopia confirm that tariff reductions on intermediate inputs result in higher productivity gains.

Similarly, a study of manufacturing firms in Ghana by Ackah et al. (2012) found a large positive effect of tariff reductions on total factor productivity. Likewise, Nyantakyi and Munemo (2014) concluded from their study of manufacturing firms in three Sub-Saharan countries (Ghana, Kenya and Tanzania) that firm performance will improve if tariffs on imported capital goods are eliminated. Using firm and industry level data, their results suggest that further improvements in access to foreign technology via trade liberalization could result in significant productivity improvements of technically incompetent firms.

Studies on the tariff-productivity nexus in other countries aside Africa also point to similar conclusions. For instance, Amiti and Konings (2007) found from their study of Indonesian firms that a 10-percentage point decrease in input tariffs leads to a 12 percent productivity gain for firms that import inputs. They also indicate that the gains from input tariff reductions are at least twice as high as any gains from reducing output tariffs. Similarly, a study by Topalova and Khandelwal (2011) on the effect of trade liberalization on productivity suggest that both lower tariffs on inputs and final goods did increase firm-level productivity in India with input tariffs having the larger impacts. In a similar way, Hansen (2010a) revealed that a 10-percentage point fall in tariff rates resulted in up to 2 percent total factor productivity gains in his analysis of the impact of tariff cuts within the Eastern European enlargement on German and Austrian firm productivity. He concludes that tariff reductions significantly raised the productivity of parent firms.

Additionally, Pavnick (2002) found that trade liberalization led to within plant productivity improvements in Chile for plants in the import-competing sector. Another study using firm-level Chilean manufacturing longitudinal data by Kashara and Rodrigue (2008) revealed positive impact of imported intermediates on plant level productivity using four different estimators of With-in Group estimator, the system GMM estimator and the Olley-Pakes (1996) and Levinsohn and Petrin (2003) estimators. They suggest that productivity is improved with foreign intermediate imports. These results conform to the findings of Fernandes (2007) that tariff liberalization has a strong positive impact on plant productivity although stronger for larger plants and those in less competitive industries.

Ge et al. (2011) also found from their study of Chinese firms covering 2000 - 2006, that a 1% decrease in input tariff resulted in an increase in total import value by 3.1%, an increase in intermediate inputs by 2.6% and a 4.3% increase in the value of imported capital goods. On the link between intermediate imports and productivity, they reveal that a 10% increase in imported intermediate value led to an increase in total factor productivity of 0.5% whilst a 10% increase in capital goods imports resulted in an increase of 0.2% in productivity. In a similar way, Yu (2014) suggests that input and output tariff reductions impact positively on productivity and are said to contribute 14.5% to economy-wide productivity growth. He concludes from his study of large Chinese firms that a 10-percentage point decrease in input tariffs resulted to a 5.1% productivity gain.

On the exports-productivity nexus, Bigsten et al. (1998) discovered from both random effects and time-variant productivity models that exporters are more efficient than non-exporters. Mengistae and Pattillo (2002) corroborate their results with the findings that exporting manufacturers' have a total factor productivity premium of 11- 28 percent in their study of three Sub-Saharan African Countries using firm level panel data. Similarly, studies of (Bigsten and Gebreeyesus 2009; Fatou and Choi 2013) have suggested a positive

relationship between exporting and productivity in African manufacturing industries. A study of manufacturing firms in nine African countries revealed that exporters in those countries were more productive and increased their productivity advantage after entry into the export market (Van Biesebroeck 2005).

In a similar way, Bresnahan et al. (2016) found a positive association between export intensity and productivity using manufacturing firm-level panel data from four African countries (Ghana, Kenya, Tanzania and Nigeria). The results showed that exporting firms were in most cases significantly productive than firms selling in the domestic markets. Likewise, Hansen (2010b) found that firms that export are 40% more productive than non-exporters. Furthermore, Wagner (2005) using firm-level data from 33 countries covering the period 1995 -2004 found that exporters have higher productivity and are more productive than non-exporters. In like manner, a study of Japanese firms revealed that firms that export have high productivity and those who maintain their foreign presence through exports have even higher productivity (Kimura and Kiyota, 2006). In the same way, the results of Aw et al. (2011) in their study of Taiwanese firms show that exports have a positive effect on a plant's future productivity.

In terms of the import status and productivity of firms, Halpern et al. (2015) posit that firms that import all input varieties record about 22 percent increase in their revenue productivity as shown in their study of Hungarian firms from 1993 to 2002. They also indicate that productivity gains from tariff cuts are larger in an economy that has lots of importers and foreign firms. They concluded that about one-quarter of productivity growth in Hungarian firms during this period was attributed to imported inputs. Likewise, Foster-Mcgregor et al. (2013) employing manufacturing firm-level data of 19 Sub-Saharan African countries found that on the average, importers were more productive than non-importers. They therefore concluded that the costs of importing in the form of import quotas and duties should be reduced

to enable less productive firms have access to foreign resources. Similarly, Fan et al. (2015) strongly suggest that access to imported intermediate inputs can substantially increase the ability of firms to deliver high-quality goods to foreign markets. On the other hand, high import tariffs have been found to discourage capital accumulation by raising the price of imported capital goods (Irwin, 2001). This implies that high tariffs and stringent trade barriers are detrimental to firm productivity and economic growth in general.

Empirical Model

Following Van Beveeren (2012), a two-stage approach is applied in the productivity analysis. First, firm-level total factor productivity is estimated based on a production function using the Levinsohn-Petrin (2003) methodology. After which the effects of tariffs on total factor productivity is examined. For a start, a Cobb-Douglas production function of the form given below is considered:

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m} \qquad (1)$$

Where Y_{it} is the real gross output in firm *i* at time *t*; (L_{it}), (K_{it}), (M_{it}) represent labour, capital, and materials respectively for firm *i* in time *t*; A_{it} is the Hicksian neutral efficiency level of the firm *i* in time *t* and said to be unobservable to the researcher. τ is the key trade policy variable (tariff) used in determining whether trade policy is a function of a firm's productivity. The gross output approach is used because the use of intermediate inputs makes it possible to capture the complete picture of the production process (Sichel, 2001). Also, unlike the value-added method which is observed to have higher estimated coefficients and could thus overestimate productivity, the gross output approach does not have such a challenge (Gandhi et al., 2017). Hence, it serves as "a better indicator of the full extent of disembodied technological change" (Cobbold, 2003:2). Taking the natural logarithm of equation (1), the following log-linear equation is obtained:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \varepsilon_{it} \quad (2)$$

Where the natural log of the Hicksian neutral efficiency is given as $ln\ (A_{it}) = \beta_0 + \varepsilon_{it}$. The subscripts *i* and *t* denote firm and time (in years) respectively and ε_{it} is the time varying error. The dependent and input variables are in natural logarithm (the small letters denote that variables are in natural logarithm); hence the input coefficients represent input elasticities. β_0 represents a measure of the mean efficiency level across firms and over time and $\beta_l, \beta_k,$ $and\ \beta_m$ are the coefficients for labour, capital, and materials respectively. The time varying error component, ε_{it}, can be decomposed into two components as observable and unobservable. As a result, equation (2) can be rewritten as follows:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + v_{it} + u_{it}^q \quad (3)$$

where $\omega_{it} = \beta_0 + v_{it}$ represents firm level productivity, β are the coefficients to be estimated and u_{it}^q is an i.i.d. component that refers to the unexpected deviations from the mean resulting from measurement errors and other external factors. It is thus seen as the true error, which can contain both unobserved, and measurement errors (Arnold, 2005). Estimating equation (3) allows for ω_{it} to be solved, such that TFP (i.e. the estimated productivity), measured as the difference between actual output and the predicted output is obtained as the residual of the production function as shown in the following equation:

$$\widehat{\omega}_{it} = \hat{v}_{it} + \hat{\beta}_0 = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_m m_{it} \quad (4)$$

Where: $\widehat{\omega}_{it} = \text{TFP}_{\text{it}}$

$\hat{\beta}_l,\ \hat{\beta}_k\ and\ \hat{\beta}_m$, are the estimated factor elasticities for labour, capital and materials respectively.

The estimated TFP equation allows for the evaluation of the impacts of various policy variables at the firm level (Van Beveeren 2012). Therefore, to determine the influence of tariffs as a trade policy instrument on firm productivity, the following equation is estimated:

$$\ln \text{TFP}_{ijt} = \alpha_0 + \alpha_1(tariff) + \beta' X_{ijt} + \alpha_i + \alpha_t + \varepsilon_{ijt} \quad (5)$$

Where: ln TFP_{ijt} is determined from equation (4) and refers to the log total factor productivity at the firm level. Tariff is given as the average bilateral tariff at the International Standard Industrial Classification (ISIC) at the 3-digit level (See Table A.1 for the categorization of firms as per the ISIC). X_{ijt} = vector of firm characteristics (firm ownership type, size), α_t =time specific effect; α_i = firm specific effect such as management quality; ε_{ijt} = unobserved productivity; α and β' = parameters to be estimated. The year effect has been included to absorb shocks in the economy such as technological changes that might affect productivity.

In line with trade stylized facts in the literature and the objectives of this paper, the effects of other trade variables such as import, or export status of firms have been assessed with the equation below:

$$\ln\text{TFP}_{ijt} = \alpha_0 + \alpha_1(tariff) + \alpha_2(\, export\_share\,) + \alpha_3(tariff \times import\_share) + +\alpha_5(import\_share) + \beta' X_{ijt} + \alpha_i + \alpha_t + \varepsilon_{ijt} \quad (6)$$

Where export_share = share of a firm's export to output; import_share = share of raw materials imported; tariff * import_share is the interaction of tariff and import_share and all other variables are as previously defined in equation (5).

Equations 5 and 6 are estimated by means of fixed effects (FE) and system GMM. The use of the FE estimator solves any possible endogeneity issues relating to tariffs and productivity. The fixed effects estimation assumes that unobserved productivity is plant-

specific but time-invariant. In other words, unobserved productivity is assumed to be constant over time. A Hausman test was performed to choose between fixed and random effects model; the test results showed that fixed effects was consistent. According to Ackerberg et al. (2007), the use of only the within-firm variation in the sample allows the fixed effect estimator to overcome the usual simultaneity bias. Consequently, the possibility of trade policy endogeneity in the data was taken care of since input endogeneity problems are completely addressed by the fixed effects estimator (Ackerberg et al., 2007). The fixed effects estimator is further preferred because it controls for any omitted variables bias unlike the random effects, which only reduces standard errors, but not bias.

The system GMM is used to avoid any possible serial correlation in the TFP estimation (Fernandes, 2007). It also solves the simultaneity and selection biases associated with the OLS estimator (Van Beveren, 2012). The system GMM estimates are obtained with *xtabond2*, a user-written command by Roodman (2009) because of its "ability to 'collapse' instruments to limit instrument proliferation" (Roodman, 2009:87). Also, it is preferred in the current paper because our dataset consists of short periods and larger observations (that is, small T, large N) and *xtabond2* is said to be the best choice when the panel has a short period of time.

Data and Descriptive Statistics

For the empirical analysis, we use secondary firm-level data of private manufacturing firms in Ghana from 1991 to 2001. The data was sourced from the Ghana Manufacturing Enterprises Survey (GMES) dataset. The dataset has information on output, intermediate inputs, employment, capital, wages, trade status (i.e., imports and exports), firm ownership (Ghanaian, foreign, and mixed) at the firm-level. The firms are located in four cities of Ghana: Accra, Cape Coast, Kumasi and Takoradi. For our measure of trade liberalization, we use average annual tariffs from the Center for Prospective Studies and International Information (CEPII) Tradeprod dataset for the periods 1991 to 2001 (See Table A.2 in appendix). In the end, we

employ an unbalanced panel comprised of 145 firms and 1,173 observations in four subsectors covering a minimum of three and a maximum of eleven years (see Table A.3 in appendix for the data composition). In view of the fact that an unbalanced panel is used, we implicitly take care of firm entry and exit, therefore dealing with selection bias.

To avoid estimating any spurious relationship between tariffs and firm productivity, a unit root test was carried out. Our dataset contains gaps; hence we use the Fisher-type test based on Phillips–Perron unit-root test as it is suitable for unbalanced datasets with gaps and also robust to both serial correlation and heteroscedasticity. The null hypothesis of the Fisher-type Phillips–Perron unit root test (H_0) is: All panels contain unit roots, while the alternative hypothesis (H_a) is: At least one panel is stationary. From the results obtained as shown in Table A.4 in the appendix, we can reject the null hypothesis (since a p-value < 0.05 was obtained) and conclude that the dataset is stationary. Hence, each variable used follows a stationary process.

The summary statistics of the key variables employed are presented in Table 1. Over the period, the average total factor productivity of all firms (lnTFP_firms) was approximately 3.2% and that of fully owned Ghanaian firms (lnTFP_Ghanaian) was about 1.5%. On firm ownership, as high as 83% of firms were fully owned by Ghanaians. About 42% of firms import raw materials and an average of only 10% were engaged in exports during the periods considered, a characteristic of most developing countries. With respect to location, most firms are found in urban areas as about 56% of the firms constituting the majority were located in Accra, the capital of Ghana and another 35% were found in Kumasi, the second largest city in Ghana. The remaining 9% were in Cape Coast and Takoradi. On average, about 3% of firms exited the market within the 1991 to 2001 period.

In terms of performance differences among firms with varying trade orientation, the descriptive statistics in Table 1 show that the average productivity of local exporting firms (i.e.

lnTFP_Ghanaian_exporters) is about 3% compared to 1% for their non-exporting counterpart (i.e. lnTFP_Ghanaian_non-exporters) . This falls in line with the general thinking that exporters are more productive than non-exporters (Mengistae and Pattillo, 2002; Bigsten et al., 1998). On the other hand, indigenous firms (i.e. lnTFP_Ghanaian_importers) engaged in importing have an average productivity of about 0.9% as against 3% for non-importing firms (i.e lnTFP_Ghanaian_non-importers). This could probably be due to the cost of engaging in international markets such as transportation cost, and tariffs that non-importing firms do not incur.

Table 1: Summary Statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
lnTFP_firms	1,173	3.22	8.23	-17.87	12.46
lnTFP_Ghanaian	971	1.57	6.92	-10.26	11.80
lnTFP_GH_importers	378	0.91	6.68	-10.26	11.80
lnTFP_GH_exporters	85	3.05	5.91	-9.63	11.79
Imports	1,173	0.42	0.49	0	1
Exports	1,173	0.11	0.31	0	1
Ghanaian	1,173	0.83	0.38	0	1
Foreign	1,173	0.02	0.15	0	1
Mixed	1,173	0.15	0.36	0	1
Any Foreign	1,157	0.17	0.38	0	1
Exit	1,173	0.04	0.19	0	1
ln firm size	1,173	3.06	1.26	0	6.24
Accra	1,173	0.56	0.50	0	1
Cape Coast	1,173	0.03	0.18	0	1
Kumasi	1,173	0.35	0.48	0	1
Takoradi	1,173	0.05	0.23	0	1

Note: Foreign + Mixed = Any foreign. Hence, either Ghanaian + Any foreign = 1 or Ghanaian + Foreign + Mixed = 1.

Possible Measurement Issues

A direct estimation of equation 3 via ordinary least squares (OLS) is problematic since it ignores fixed effects, as well as input and output endogeneity and selection bias arising from firm entry and exit (Harris & Moffat, 2015). The OLS estimator assumes that the independent variables must not correlate with the error term, an assumption often known as "the orthogonality of the error term with the regressor" (Antonakis et al. 2010, 1089). In other words, to estimate equation (3) using OLS, the inputs of the production function must be exogenous. That is, they must be determined independently from the efficiency levels of the firm. However, this is often not the case in practice because the choice of the quantity of a firm's inputs is dependent on a firm's knowledge of its characteristics or on the amount of profit a firm envisage (Marschak and Andrews Jr. 1944). This implies that the independent variables are endogenous, that is they correlate with the error term, leading to the problem of endogeneity. Hence, estimating equation (3) by means of OLS gives rise to the well-known simultaneity bias.

Simultaneity bias or endogeneity of input choice is said to be the correlation between the level of inputs chosen and unobserved productivity shock (De Loecker, 2007). This bias stems from the fact that ω_{it} is unobserved by the econometrician but known to the individual firms. For instance, more productive firms could employ more labour and/or invest in capital based on either higher current or anticipated future profits. This could result in the input coefficients of the OLS estimation of the production function to be higher than their true values (Pavnick 2002). In other words, the OLS estimates can be biased (Van Beveren 2012) either upwards or downwards and inconsistent in this case. This can lead to incorrect inferences and may result in conclusions that are misleading as well as providing theoretical interpretations that are inappropriate (Ullah et al. 2018).

Also, a firm may choose to stay or exit the market based on its knowledge of its productivity, ω_{it}. Such knowledge also affects its decisions with respect to hiring of labour, purchase of materials, and investment in new capital (Pavnick 2002). In other words, selection bias also known as endogeneity of attrition results in a negative correlation between ε_{it} and K_{it}, leading to a downward bias of the capital coefficient (Van Beveren 2012). Consequently, TFP estimates are biased upwards if the exit rule of a firm is ignored (Van Beveren 2012). By employing an unbalanced panel in the current paper, we implicitly account for selection bias. Additionally, we control for the exit of firms in our productivity analysis, explicitly dealing with the endogeneity of attrition problem.

Another methodological problem associated with the estimation of TFP is the omitted output price bias. Such a price bias emanates from the use of deflated sales in place of quantities of output in empirical studies. The standard practice in the literature has often been the use of deflated firm level revenues as proxy for physical quantity, which is mostly not observed (De Loecker 2011). As such, to eliminate price effects, firm level sales or revenue are often deflated using industry level price index, rather than firm-level prices (De Loecker 2011). However, this introduces an omitted price bias. This is because if inputs are correlated with prices, then the coefficients of the production function will be biased. For instance, TFP estimates are biased upwards, due to an under-estimation of firm input use, as a result of using industry levels prices if firms negotiate lower prices for a given input (Van Beveren 2012). At the moment however, Van Beveren (2012) notes that there is no formal solution to such a bias in the absence of firm-level price data. Thankfully, the dataset employed in this study contains firm-specific prices, thereby eliminating the omitted price bias.

The most popular solutions proffered over the years to solve the problem of endogeneity have been instrumental variables (IV) and proxy variables approach (Galvao et el. 2017). The use of the IV method in practice has however been very limited due to the extreme difficulty

in obtaining appropriate instruments. Hence, Ackerberg et al. (2007) assert that the IV method has performed poorly in practice. Therefore, semi-parametric methods, that is the proxy variables approach developed by Olley-Pakes (1996) and Levinsohn-Petrin (2003) have been considered to offer better solutions to the simultaneity and selection biases inherent in the OLS estimator. In both methods, input variables are used as proxies to control for unobserved productivity but differ in the type of proxy employed. Whereas the Olley-Pakes (OP) uses investment as a proxy, the Levinsohn-Petrin (LP) uses intermediate inputs (materials, energy or both) instead.

Until now, the OP has been the only method accounting explicitly for the exit decisions of firms and completely resolving the selection bias that arises from ignoring such decisions (Van Beveren, 2012). Nonetheless, practically, the LP estimator has been widely used since most firms often report periodic data for intermediate inputs, hence allowing for a greater number of observations to be examined with this approach. Following this, the paper employs the LP estimator[1] to correct for the simultaneity bias.

Although the OP method has the capability of resolving both the simultaneity and selection biases inherent in the TFP estimations (Van Beveren 2012), the usage of only non-zero investments per period, however, limits the sample size as a lot of firms neither invest nor have positive investments annually. In other words, missing or zero investments are common trends in real data. The absence of strictly positive periodic investments implies that the zero investments must be dropped in order to meet the strictly monotonous relationship between the proxy (investment) and output, a key condition of the approach. The resulting effect is a huge drop in the number of observations. The demerits of the method are rightly captured in the words of (Levinsohn and Petrin 2003, 321) that, "firms that make only intermittent investments

[1] For an overview of the method, see Levinsohn and Petrin (2004).

will have their zero-investment observations truncated from the estimation routine (the monotonicity condition does not hold for these observations). For manufacturing censuses, this can be a large portion of the data".

Discussion of Results

Table 2 displays the baseline results of the tariff-productivity nexus based on equation (5) using fixed effects estimation. For the entire dataset, the tariff variable is negative and insignificant across the four models, implying that tariff reductions are not accompanied by significant changes in firm productivity. The results suggest that larger firms perform better than smaller ones as the firm size variable is positive and significant as expected. For instance, larger firms are about 28% relatively productive in comparison to smaller firms at the highest significance level. This supports the evidence by Francis and Honorati (2016) and Bausch and Krist (2007) that larger firms are more productive than their smaller counterparts. The baseline findings also suggest that firms that exited were about 29% less productive in comparison to firms that survived.

Table 2: Tariffs and Firm-Level Productivity (Baseline Results) – Fixed Effects Estimation.

Dependent Variable: ln TFP				
	(1)	(2)	(3)	(4)
ln Tariff	-0.1285	-0.1119	-0.1177	-0.1016
	(0.1619)	(0.1576)	(0.1631)	(0.1587)
ln firm size		0.2828***		0.2806***
		(0.0736)		(0.0735)
exit			-0.3029**	-0.2939**
			(0.1273)	(0.1233)
constant	3.4744***	2.5756***	3.4335***	2.5430***
	(0.5142)	(0.4756)	(0.5171)	(0.4773)
year effect	Yes	Yes	Yes	Yes
Observations	1173	1173	1173	1173
No. of firms	145	145	145	145
R^2 (within)	0.03	0.06	0.04	0.04

Notes: All estimations contain firm fixed effects and sector effects. Robust standard errors that are clustered at the firm level are in parentheses. Significance at * 10%, ** 5%, *** 1%.

In Table 3, the results as per equation (6) are reported. Across the four model specifications for firms that are fully or partially foreign owned, the tariff variable is negative as expected and statistically significant. This means that for non-indigenous private firms, decreasing tariffs are accompanied by an improvement in productivity. For example, model 1 shows that a 10-percentage point reduction in tariff is associated with a 5.7% improvement in productivity at a high significance level for firms with any foreign ownership. This is probably because foreign firms responded more positively to decreases in tariffs. Perhaps also, the managerial skills of the management, extent of technology, and the type of labour foreign owned firms employ could be some reasons for the differences in firm performance between foreign and Ghanaian owned firms. The differences in productivity does support the assertion

that foreign owned firms are more productive than their local counterparts as found by Amiti and Konnings (2007).

On the other hand, the tariff variable is unexpectedly positive for fully owned Ghanaian firms, an indication that higher tariffs are positively related to firm improvement for such firms. Nonetheless, such results are not statistically significant in all the four models. Hence, there is no concrete significant evidence on the tariff-productivity relationship for local private firms. A similar conclusion was drawn by Razzaque et al. (2003) where no significant relationship was observed between nominal tariffs and productivity in Bangladesh. The variables on the trade status of firms were not significant statistically. In general, the outcome lends credence to the assertion that foreign firms benefit the most from trade liberalization (Ferdows, 1997).

Table 3: Tariffs and Firm-Level Productivity (All Firms) – Fixed Effects Estimation.

Dependent Variable: ln TFP								
	Full/Partial Foreign Owned Firms				Fully Owned Ghanaian Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Tariff	-0.5678***	-0.4771***	-0.4100**	-0.4344**	0.1645	0.1731	0.2486	0.2415
	(0.1843)	(0.1673)	(0.1818)	(0.1771)	(0.2014)	(0.1985)	(0.1968)	(0.2012)
ln firm size		0.3277**	0.3096**	0.3009**		0.2349***	0.2312***	0.2361***
		(0.1359)	(0.1391)	(0.1369)		(0.0814)	(0.0788)	(0.0789)
exit		-0.0970	-0.1123	-0.0996		-0.1694	-0.1622	-0.1708
		(0.1220)	(0.1220)	(0.1228)		(0.1473)	(0.1440)	(0.1452)
ln Ex_share			0.0166				0.0146	
			(0.0410)				(0.0319)	
ln Tariffs*Ims			-0.0322				-0.0355	
			(0.0436)				(0.0235)	
ln Im_share			0.1294				0.0759	
			(0.1424)				(0.0589)	
imports				0.4729				0.2432
				(0.6046)				(0.2333)
ln Tariffs*Imd				-0.1167				-0.1207
				(0.1950)				(0.0936)
exports				0.0936				-0.0475
				(0.1147)				(0.0851)
constant	0.8052	-0.7877	-1.0238	-0.9102	0.8774	0.1930	-0.0188	-0.0054
	(0.5670)	(0.6485)	(0.7315)	(0.7097)	(0.6662)	(0.6377)	(0.6190)	(0.6346)
year effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	202	202	202	202	971	971	971	971
No. of firms	27	27	27	27	118	118	118	118
R^2 (within)	0.13	0.17	0.19	0.19	0.05	0.08	0.08	0.08

Notes: All estimations contain firm fixed effects and sector effects. Robust standard errors that are clustered at the firm level are in parentheses. ln Tariffs*Imd is an interaction term between log tariffs and the import dummy variable and ln Tariffs*Ims is an interaction term between log tariffs and log import share. Models 1 – 4 apply to full/partial ownership of firms by foreigners whilst models 5 – 8 relate to fully owned Ghanaian firms. Significance at * 10%, ** 5%, *** 1%.

Tariff-Productivity Nexus Based on Firm Characteristics

Table 4 present results of the impact of tariffs on firm productivity based on ownership. The results show that a 10-percentage point reduction in tariffs is significantly accompanied by a 5.7% and 4.7% increase in productivity for firms with partial or full foreign ownership, and mixed owned firms respectively. On the contrary, the tariff variable though negative for fully owned Ghanaian firms is not statistically significant. This outcome runs counter to the argument that exposure to international trade leads to an increase in the efficiency of domestic producers that were previously or initially protected (De Loecker and Goldberg, 2014).

Table 4: Tariffs and Firm-Level Productivity Based on Firm Ownership

Dependent Variable: lnTFP			
	Ghanaian	**Foreign**	**Mixed**
	(1)	**(2)**	**(3)**
ln Tariff	-0.0164	-0.5678***	-0.4676**
	(0.2011)	(0.1843)	(0.1888)
constant	3.9502***	0.8052	-0.3473
	(0.6427)	(0.5670)	(0.5639)
year effect	Yes	Yes	Yes
Observations	971	202	175
No. of Firms	118	27	23
R^2 (within)	0.03	0.13	0.20

Notes: Robust standard errors that are clustered at the firm-level are in parentheses. Ghanaian refers to firms fully owned by Ghanaians, foreign represents the share of foreign investment in a firm and Mixed applies to firms with both foreign and Ghanaian owners. Significance at * 10%, ** 5%, *** 1%.

It appears therefore from Table 4 that tariff reductions in Ghana have been more beneficial to foreign firms in comparison to domestic ones. Probably, private indigenous firms did not respond adequately to tariff changes in comparison to their foreign counterparts. Indeed, the World Bank (1994,78) asserts that manufacturing growth in Ghana was slow in the cause

of the economic recovery program due to "lagging private investments". This could be due to supply side constraints such as inadequate access to capital, high cost of borrowing, high cost of fuel and inputs, inadequate supply of inputs and inadequate technology. In fact, Aryeetey and Tarp (2000) opined that much attention was not paid to identifying what the private sector really needed in order to adequately respond to liberalization incentives. Rather, "It was assumed that the private sector would respond quickly and smoothly to revised incentive structures" targeted at it because of the belief that the public sector crowding out the private sector was the major problem (Aryeetey and Tarp 2000,349).

Since the relationship between tariffs and productivity of Ghanaian firms is inconclusive as per the results of Tables 3 and 4, we conduct further analysis focusing only on Ghanaian importing firms. This is because importing firms are presumed to benefit the most from falling tariffs. Therefore, in Table 5, the tariff-TFP analysis for Ghanaian firms engaged in importing is reported. The tariff variable is negative as expected across all models but insignificant, indicating that the results are not robust enough to conclude that tariff changes positively impact on the productivity of local importing firms. As a result, the paper does not provide strong evidence that declining tariffs are associated with higher productivity for local firms that import. Hence, a learning by importing effect for fully owned Ghanaian firms cannot be confirmed.

Table 5: Tariffs and Firm-Level Productivity of Ghanaian Importing Firms

Dependent Variable: ln TFP (Ghanaian firms)			
	(1)	**(2)**	**(3)**
ln TFP $_{t-1}$	1.0450***	1.0302***	1.0385***
	(0.0458)	(0.0369)	(0.0358)
ln Tariff $_{t-1}$	-0.6819	-0.4930	-0.6851
	(0.5182)	(0.4436)	(0.4192)
firm size	0.0039	0.0015	0.0023
	(0.0049)	(0.0040)	(0.0025)
exit	-0.0536	0.0454	0.0087
	(0.1491)	(0.1317)	(0.1352)
year effect	Yes	Yes	Yes
N	322	322	322
No. Firms	82	82	82
Instruments	17	20	23
AB 1(p-value)	0.00	0.00	0.00
AB 2 (p-value)	0.21	0.20	0.22
Hansen test (p-value)	0.90	0.37	0.61

Notes: The instruments for specifications for all columns are differenced equation, ln Tariff and ln TFP lagged 1 period, differenced year dummies; levels equation, first difference of the first lags of ln Tariff and ln TFP. Lag limits are (1 1) for model 1; (1 2) for model 2; (1 3) for model 3. Robust standard errors in parentheses. AB 1 and 2 are tests for first- and second- order serial correlation. Significance at * 10%, ** 5%, and *** 1%.

An analysis of the tariff-productivity nexus of Ghanaian firms based on firm size, measured by the number of employees in each firm is reported in Table 6. Firms are grouped into four categories: micro, small, medium, and large enterprises[2]. Micro firms are defined as firms with less than six employees; small firms are firms with an employee size of 6 to 19; firms with 20 to 75 employees are termed as medium; and large firms are defined as those with more than 75 employees.

[2] The definitions are in line with, they are part of the team that compiled the RPED GMES dataset.

For micro, small and medium enterprises (MSMEs) that are fully owned by Ghanaians, the tariff variable is positive, meaning that higher tariffs are associated with higher productivity whilst lower tariffs are associated with lower productivity. The results are however statistically significant only for micro firms. For example, a 10-percentage point decrease in tariffs is associated with 11.7% decline in firm productivity of micro Ghanaian firms. In effect, Ghanaian micro firms are more productive with rising tariffs. In other words, indigenous micro firms are unable to perform well in terms of their productivity with increased competition due to trade. Subsequently, this outcome conforms to the infant industry argument that indigenous firms must be protected from foreign competition by way of imposing higher tariffs until they are able to grow, expand and can compete or withstand foreign competition. Nonetheless, the results point to the lack of competitiveness of local firms.

Table 6: Tariffs and Firm-Level Productivity of Ghanaian Firms Based on Size

Dependent Variable: lnTFP (Ghanaian Firms)				
	Micro	Small	Medium	Large
	(1)	(2)	(3)	(4)
ln Tariff	1.2057***	0.1551	0.2140	-0.1413
	(0.3665)	(0.3577)	(0.2522)	(0.6222)
exit	-0.1275	-0.3322*	-0.0907	0.3303
	(0.3703)	(0.1790)	(0.0953)	(0.6579)
constant	0.5311	0.6993	0.0512	-0.2487
	(1.2323)	(1.2091)	(0.8229)	(2.0381)
year effect	Yes	Yes	Yes	Yes
Observations	158	382	333	98
No. of firms	38	74	64	19
R^2 (within)	0.10	0.10	0.10	0.12

Notes: Robust standard errors that are clustered at the firm level are in parentheses. Ghanaian firms refer to firms fully owned by Ghanaians. Significance at * 10%, ** 5%, *** 1%.

In Table 7, results on the relationship between tariffs and firm level productivity using the system GMM estimation as per equation (6) are presented. Tariffs, the variable is negative and statistically significant in the first model only for the entire dataset. The significant model

implies that declining tariff rates result in increases in firm productivity. Particularly, a 10-percentage point reduction in tariffs is seen to cause an improvement in firm productivity of about 13% at the 10% significance as depicted in model 1. Nevertheless, the effect is weak especially that the results of the other three models are insignificant.

For fully owned Ghanaian firms, the tariff variable is positive across the four models and significant only for model 3 at the 10% level. That is, for local firms, a reduction in tariffs is accompanied by a decline in productivity of around 7.4%. Nonetheless, the results are not strong enough to conclude that lower tariffs indeed do induce lower firm productivity in locally owned firms because of the statistical insignificance of the other model results. In terms of firm size and productivity, a positive but insignificant relationship is observed. The import dummy and import share variables of fully owned Ghanaian firms are observed to be negative, indicating that firms that import or have a higher share of imports are not better performing in terms of their productivity than non-importers. However, these conclusions are rather weak since the results obtained are not significant statistically.

The p-values of the Hansen test for the null hypothesis of the validity of the overidentifying restrictions reported at the bottom of Table 7 are greater than 0.1 in all specifications. Hence, across all the model specifications, we do not reject the null hypothesis. In addition, we present the p-values for the AR (1) and AR (2), which are the test for first- and second- order autocorrelation respectively. The p-values of the AR (1) are significant across all specifications, indicating a high first order autocorrelation as expected. Lastly, there is no evidence of a significant second order autocorrelation in all specifications as per the p-values of the AR (2) reported in Table 7. Therefore, we can conclude that the test statistics reported hint at a proper specification.

In a nutshell, the System GMM estimations reveal a weak positive relationship between tariffs and firm productivity of local firms whereas the FE estimations did not depict any significant impact. Therefore, the empirical evidence does not show any significant relationship between tariffs and firm productivity in the Ghanaian private manufacturing sector. Probably, the private sector in Ghana is either not well developed or too small to take advantage of trade incentives. It is also possible that the private sector did not react much to trade incentives because they felt they were not adequately consulted during the period of the economic reforms (Tangri, 1992). Indeed, Tangri (1992:110) reports that a former president of the Ghana Employers' Association mentioned that "For private investors, their supply response will be affected by the extent of opportunities made available for consultation and participation" by the state.

Table 7: Tariffs and Firm-Level Productivity - System GMM Estimation.

Dependent Variable: ln TFP								
	All Firms				Fully Owned Ghanaian Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln TFP $_{t-1}$	0.8096***	0.9313***	0.8840***	0.9085***	0.9241***	0.9262***	0.9275***	0.9441***
	(0.0885)	(0.0577)	(0.0835)	(0.0847)	(0.0365)	(0.0381)	(0.0363)	(0.0320)
ln Tariff $_{t-1}$	-1.3725*	-0.5168	-0.9071	-0.7029	0.7453	0.7575	0.7411*	0.4970
	(0.8245)	(0.5802)	(0.7713)	(0.6477)	(0.4622)	(0.4605)	(0.4451)	(0.3922)
ln firm size		0.1251	0.1138	0.0356		0.0657	0.0660	0.0998
		(0.1882)	(0.1837)	(0.1854)		(0.1451)	(0.1411)	(0.1238)
exit		-0.0460	0.0529	-0.0220		-0.0061	0.0053	0.0079
		(0.2162)	(0.1784)	(0.1523)		(0.1356)	(0.1332)	(0.1289)
imports			0.0971				-0.1054	
			(0.1109)				(0.1094)	
ln Im_share				0.0914				-0.1454
				(0.1209)				(0.0898)
ln Tariffs*Ims				-0.0193				0.0441
				(0.0412)				(0.0313)
ln Ex_share				-0.0539				-0.0095
				(0.0538)				(0.0379)
year effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	969	969	969	969	795	795	795	795
No. of Firms	145	145	145	145	118	118	118	118
Instruments	0 16	0 26	0 23	0 23	0 14	0 17	0 19	0 23
AB 1 (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AB 2 (p-value)	0.33	0.69	0.49	0.55	0.52	0.54	0.55	0.51
Hansen test (p-value)	0.35	0.15	0.28	0.10	0.67	0.22	0.34	0.46

Notes: The instruments for specifications for all columns are: differenced equation, ln Tariff lagged 1 period, lnTFP lagged 1 period, imports, ln Im_share, ln Ex_share, ln Tariffs*Ims, ln firm size and exit, differenced year dummies; levels equation, first difference of first lag of Tariffs, first lag of TFP, imports, ln Im_share, ln Ex_share, ln Tariffs*Ims, ln firm size and exit. Lag limits for model 1 and 3 are (1 2); model 2 (1 4) and (1 1) for models 4 to 8. Robust standard errors in parentheses. Models 1 to 4 apply to the entire dataset whilst models 5 – 8 relate to only fully owned Ghanaian firms. AB 1 and 2 are tests for first- and second- order serial correlation. Significance at * 10%, ** 5%, and *** 1%.

Conclusion

In this paper, we try to investigate the relationship between tariff reductions and firm productivity of the manufacturing sector in Ghana. The findings suggest that tariff reductions do not result in productivity improvement for Ghanaian owned private whereas the productivity of partial or foreign owned firms improved due to declining tariffs. The empirical findings fall short of supporting the evidence that trade liberalization can increase firm-level productivity of local firms via tariff reductions. It however confirms the significance of firm ownership on firm productivity.

For policy makers who are concerned about the potential drawbacks of trade liberalization on domestic firms in the developing world, this paper provides great insights. First of all, the results reveal that all firms are not affected in the same way as a result of opening up via declining tariffs. The extent of effect varies with the size of the firm (that is whether micro, small, medium or large) such that the larger the firm, the lesser the negative effect and the smaller the firm, the higher the negative impact. In other words, micro and small enterprises were negatively affected due to lower tariffs with micro firms being the worst affected as per the findings. So, from a policy point of view, rather than implementing wholesale policies, policy makers must tailor public policies to the needs of firms based on their characteristics such as size and their ability to cope or adjust to increasing competition.

Also, the current findings raise serious concerns about the impact of liberalizing trade on the performance of indigenous owned private firms. On the one hand, it questions the significance of trade reforms in stimulating the productivity of private indigenous firms, thereby downplaying the calls for further reforms in the form of declining tariffs in developing countries like Ghana. More importantly, the negative impact of declining tariffs on the productivity of privately-owned Ghanaian manufacturing firms cast doubts on the ability of the private sector, particularly in manufacturing to serve as the engine of growth in Ghana. It is

therefore necessary that policy makers rethink the idea of ultimately getting rid of tariffs as a means to spur growth.

The results draw attention to strengthening the capabilities of indigenous firms to be competitive amid foreign competition. Indeed, the findings point to indigenous firms being harmed in terms of their productivity as a result of increased import competition due to falling tariffs. This calls for competitive strategies, both at the firm and policy making (government) levels to improve the competitiveness of local firms. At the firm-level, Ghanaian firms could focus on meeting local demands of consumers, especially that about 90 percent of firms studied served only the domestic market. By adapting their products to local preferences such that the products appeal to local taste, they could be able to build a market niche and wade off the competition from foreign firms. As part of focusing on domestic consumers, indigenous firms must improve their customer services by becoming more customer oriented.

Furthermore, Ghanaian owned firms could improve upon their competitiveness by improving the quality of their products. Relative to products of local firms, foreign firms are said to produce superior products (Dawar and Frost, 1999). Therefore, to compete with foreign firms, products of indigenous firms must possess some quality that is comparative to the products of their foreign counterparts. Linked with improving quality is innovation, the absence of which slows firm growth. Indeed, the Bank of Ghana (2007) asserts that the lack of innovation in the Ghanaian manufacturing sector is a major factor accounting for the weak performance of the sector. This is not surprising as R&D investments in Ghana is very little as revealed by the World Bank. The latest available data indicates that the country's R&D expenditure as percentage of GDP was 0.4% in 2010, which compares unfavorably to 2.4 % in East Asia and Pacific, and 2.7% in North America (World Bank, 2019). Clearly, the spending on research and development is woefully inadequate and the private sector must commit more resources to such activities if they want to be competitive enough in a global environment.

To conclude, encouraging joint ventures or partnerships between foreigners and Ghanaians could allow for more domestic firms to stay more productive and thus benefit from trade liberalization especially as the key targets of trade reforms. In addition, investment in education, technology and quality of labour force by domestic firms could better position them to respond adequately to trade reforms and thus accrue the expected gains from such reforms.

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Appendix

Table A.1: Firm Classification into Subsectors Based on ISIC (Rev. 2).

ISIC Code	Description	Abbreviation
312	Food products	Food
313	Alcohol	Beverages
322	Wearing apparel	Garment
332	Furniture except metal	Furniture
381	Fabricated metal products	Metal
382	Machinery except electrical	Machines

Table A.2: Average Tariffs

Year	Food	Garments	Furniture	Metal	Beverages	Machines
1991	20.45	33.3	23.64	22.19	18.63	13.00
1992	21.42	27.27	20.53	18.8	50.00	11.98
1993	14.26	22.15	14.93	14.78	23.67	8.51
1994	23.71	30.35	21.8	21.5	38.97	14.11
1995	17.33	22.4	13.45	12.12	55.74	5.75
1996	12.54	14.36	6.82	6.95	21.94	3.52
1997	20.13	25.14	17.76	16.69	31.52	8.34
1998	14.71	18.48	13.49	12.17	31.97	7.17
1999	14.16	16.81	11.39	11.15	24.34	6.32
2000	14.48	18.46	11.1	10.5	21.65	4.46
2001	12.38	25.87	15.75	13.55	44.51	5.45

Source: De Soussa et al. (2012).

Table A.3: Data Composition by Sector.

Sector	No. of firms	No. of Observations	Percent (%) of Obs.
Food & Beverages	26	201	17.14
Garments	39	315	26.85
Furniture	37	305	26.00
Metal & Machines	43	352	30.01
Total	145	1,173	100.00

Table A.4: Unit Root Test of Key Variables.

Variable	Z statistic		Z statistic(demeaned)	
	Level	***First Difference***	***Level***	***First Difference***
ln TFP	-6.8616***	-7.0102***	-5.6422***	-6.6672***
ln Tariff	-16.0511***	-17.5250***	-9.8705***	-10.3637***
ln gross output	-3.3880***	-4.2293***	-5.7610***	-6.1368***
ln Materials	-3.3286***	-3.6346***	-5.9405***	-6.5877***
ln Capital	-11.7847***	-12.4234***	-9.5913***	-10.0297***
ln Labour	-4.0250***	-4.5662***	-8.8761***	-8.9297***
ln Indirect cost	-9.3004***	-9.5937***	-9.5437 ***	-9.9421 ***
ln Firm size	-1.6891**	-2.3995***	-6.3952***	-6.8751***
import share	-1.6567**	-1.6565**	-13.3830***	-13.5891***
T*import share	-3.2833***	-3.3002***	-7.8523***	-8.7714***