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Trade Reforms and Total Factor Productivity

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Abstract

The relationship between trade reforms and industry performance has been undecided both on theoretical and empirical grounds. Amidst of this, Ethiopia has undertaken series of trade and other economic reform measures since 1992. The objective of this paper is to assess firm-level TFP heterogeneity in the Ethiopian manufacturing industry during and post-trade reform periods. Based on unbalanced panel data of 8395 manufacturing firms engaging 10 and above persons for the period (1996 and 2007), TFP was estimated using Olley and Pakes (1996) with Yasar et al. (2008) STATA application. The study found heterogeneous firm-level TFP in line with contemporary economic theories with skewed distribution with relatively high concentration of unproductive firms to the left. Import-intensive, exporting, incumbent and also smaller and large-scale firms performed more productively as compared to resource-based, non-exporting, exiting and medium sized firms, respectively, over the entire period. While the manufacturing sector has become more productive during the post-reform period, private, non-exporting, import-dependent, large-scale and incumbent firms contributed a statically significant improvement in TFP scores during this period. These results are consistent with many present-day studies. Despite being based on local-resources, exporting firms have not shown TFP improvement mainly because of the scarcity of raw materials. Overall, the findings suggest that the government may need to investigate the bottlenecks holding back the linkage between agro-processing industries and the agricultural sector to improve the performance of resource-based industries in general, and the exporting firms in particular. Medium scale industries also require an equal support as small enterprises, in terms of access to market, loans and other services so as to cope-up with the competitive push. Otherwise, further trade reform would improve the overall TFP of the manufacturing sector if the necessary precaution is put in place in terms of addressing the above and related bottlenecks.

1. Introduction

It has become common knowledge among economic scholars and policy makers that productivity growth is the key determinant of economic growth and the ability of countries to compete in the global market. Individual firms, as agents of economic activities and technological derivers, are the prime sources of productivity growth that transcends across the whole economy.

Theories and empirical evidences on the relationship between trade reforms and firm performance are mixed as also indicated in Hopenhayn (1992) in Tybout (2000). For instance, as indicated in Slaugther (2004), some scholars are in favour of sheltering 'infant industries' to have the opportunity to learn, become productive, increase profits and expand their size; and thus further exploit scale economies without competitive pressure from outside. On the contrary, others

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argue that elimination of the threat of foreign competition through protection strengthens market power of local firms, and at the same time allows relatively inefficient firms to survive and other inefficient local small firms to enter into the market (Tybout, 2000). Besides removing this source of inefficiency, free trade also facilitates technology transfer through imports of capital goods (Lee, 1995), which ultimately increases the average Total Factor Productivity Growth (TFPG) of the manufacturing sector. Melitz (2003) and Bernard et al. (2007) show in their theoretical models that the exit and entry dynamics of firms and the possible rise of industry level Total Factor Productivity (TFP) through reallocation of inputs towards more productive firms.

Empirical evidence on the reactions of firms to changes in trade regimes in terms of TFPG and exit and entry dynamics has also been mixed. For instance, Epifani (2003) finds overall decline in TFP in India; Damijan et al. (2009) finds no clear evidence in six former socialist European countries; and Muendler (2004) and Taymaz and Yilmaz (2007) find an increase in TFP in Brazil and Turkey, respectively.

Albeit this controversy, a number of countries have been pursuing trade liberalization measures partly in response to the pressure of multilateral financial institutions. Ethiopia also undertook a series of economic reform measures since 1992, which, among other things, include decontrol of prices, removal of subsidies and quotas, subsequent reduction of the rate and bands of applied tariff rates, privatization and opening up of the economy for private investment. A second wave of reforms is expected as the country is also in the process of acceding to the World Trade Organization (WTO), which restricts any attempt for further increase in tariffs unless proven harmful for economic agents to survive. Joining the Common Market for Eastern and Southern Africa (COMESA) free trade area also demands up lifting of tariff barriers.

The road ahead for further liberalization requires assessing what has already happened to firms' performance and survival as a response to previous reforms. Using firm-level industrial data, Shiferaw (2005) find an increase in TFP in the Ethiopian manufacturing sector, driven by dynamics of firm entry and exit between 1996 and 2002. Gebreeyesus (2006) also uses data between 1996 and 2003, and finds TFP differential among firms. Both studies provide a clue on the change in performance and firm dynamics as a result of operating during the transition of the directive system of management to a relatively market-friendly economic system.

Revisions of trade reforms, private investment policies and other similar measures continued to be undertaken in Ethiopia until 2003. In reality, the effect of these policy actions may not necessarily be observed instantly and require some gestation period. To our knowledge, there has not been additional recent firm-level research along this line that intends to show post-reform effects. Thus, it is important to fill this gap before the forthcoming wave of trade-related reforms is pursued. In view of this, this study uses a relatively richer panel of firm-level data set for the period between 1996 to 2007 to investigate what possible effects the first wave of trade reforms has brought on TFP and firm dynamics.

In the light of firm heterogeneity-based trade theories, this article intends to address such questions as whether TFP varies across groups of firms categorized by input source (domestic resource-dependent or imported inputs-dependent), product market orientation (exporting and non-exporting), survival conditions of firms in the market (exiting, entering and incumbent firms), ownership (private and public), and size (larger, medium and smaller ones). It also explores whether TFP has improved on average after the trade reform and has the change been similar across groups of firms.

Based on the accumulated theoretical and empirical literature, and on the basis of the Ethiopian condition, this paper has two sets of hypotheses to be tested: (a) TFP differs across different groups of firms categorized by different attributes; and (b) Total factor productivity, on average, improves after trade reforms. The validity of hypotheses will be tested using TFP differences across different groups of firms and between 'during' and 'post' trade regimes using group mean and group median comparison tests.

The overall objective of this study is to estimate and analyse TFP and assess its magnitude among different groups of firms and between trade regimes in the manufacturing sector of Ethiopia. The specific objectives are to estimate:

(a) Production functions using different estimation methods and compare empirical results thereof; and
(b) TFP using estimated coefficients of the selected production function and assess its magnitude across different groups of firms and into two different trade regimes.

This study intends to contribute to the literature and policy discourse on the area. First, apart from minor revisions, the first phase of major trade reforms in Ethiopia was brought to an end. Thus, the data set used in the study offers a wider scope of information on the performance of firms both during and after trade reforms. Second, this paper provides information on how performance is likely to vary because of heterogeneous characteristics of firms such as input and output market orientation, firm size and mode of ownership; which has not been dealt properly in previous studies on Ethiopia. Finally, the paper uses a methodological framework that addresses econometric problems associated with firm-level production functions in the context of a panel data.

The rest of the paper is organized as follows. Section two discusses the theoretical and empirical literature revolving around the performance of firms in the light of trade reforms. Section three outlines the analytical framework. Section four discusses the descriptive statistics and econometric estimates. Section five provides conclusion and policy implications.

2 Literature Review

2.1 Theoretical Literature

The literature on the effect of trade liberalization on firm performance suggests different transmission mechanisms. Trade liberalization tends to discipline

domestic firms through competition arising from increased volume of imports. Holmes and Schmitz (2001) shows how lowering of tariffs facilitates a shift from unproductive to productive activities through removal of entrepreneurial slack and avoiding misallocation of resources. Under imperfect competition, openness to trade reduces market power of domestic producers and improves efficiency (Tybout & Westbrook, 1995 in Tybout, 2000).

Some theoretical models such as Grossman and Helpman (1991) and Eaton and Kortum (1996) also show how open trade facilitates transfer of technology and embodied information about new ways of producing goods through imports of higher quality and increased variety of intermediate inputs, and thereby improves firm-level productivity. For instance, Eaton and Kortum (1996) show OECD countries derive their productivity growth from abroad through the absorption of foreign technologies. Openness also provides incentives to invest in technological innovation and to acquire modern machinery and equipment (Costantini & Melitz, 2007; Yeaple, 2005). Knowledge transmitted through outward-oriented trade also facilitates growth (Grossman & Helpman, 1991).

Recent theories on the relationship between trade openness indicate that the reaction of firms towards trade openness is not the same across firms because of their inherent heterogeneous attributes. Some firms are driven out of the market and others manage to survive; this behaviour is mainly because of the level and growth of TFP (Hopenhayn (1992) in Tybout (2000); Ericson & Pakes, 1995). Firms' decision of staying in the markets is made based on comparison of their streams of discounted profits and costs associated in remaining in operation. Melitz (2003), Yeaple (2005), Bernard, et al. (2007) and Melitz and Ottaviano (2008) developed theoretical models showing how a reduction in trade or entry costs increase aggregate productivity of the industry as resources are reallocated from exiting less productive firms to productive ones.

Exposure to trade will induce only more productive firms to enter into the export market, simultaneously force the least productive firms to exit, and raise reallocations of economic activities and aggregate industry-level productivity (Melitz , 2003). Reallocations during trade liberalization raise average firm-level output and average industry productivity (Bernard, et al., 2007). In both models, creative destruction is higher in comparative advantage industries than otherwise. Particularly, firms operating in larger and more integrated markets exhibit higher aggregate productivity (Melitz & Ottaviano, 2008).

Within the heterogeneous firms' theoretical framework, export market-oriented firms have more options to learn as they keep technical safety and standards (Damijan et al., 2009). They are more exposed to new technological innovation and ways of handling production processes, and also more efficient organizational systems partly because of customers' demands or interventions. There is, however, a bi-directional causality. Firms may self-select themselves into the export market if they attain a certain level of efficiency.

Firms could be foreign-owned or locally-owned, and also state-owned or private-owned. Damijan et al. (2009) argue that foreign-owned firms often operate at a higher level of TFP because of competence premium in terms of firm specific knowledge in technology, managerial expertise, market access, and other attributes. Konings (2000), on the other hand, argues that ownership effects may not have an impact on performance because of, for instance, lags in the transition involving the transfer of one mode of ownership to the other if acquired through privatization, or investment in new area of operation.

There are two strands of literature on state-owned enterprises (SOEs). The first is that of social view stating that SOEs strive to maximize social welfare, use the most efficient technology and operate efficiently. The second is the agency view argues that managers lack incentives to handle firms efficiently and possibly engage excess employment and inefficient technology because of information asymmetry and the contradiction between the agent (manager) and the principal (politician) (Okten & Arin, 2006).

The above theoretical literatures provide mixed predications about the relationship between trade reforms and firm performance. The empirical literature also provides mixed results.

2.2 Empirical Evidence

Epifani (2003) finds a relative decline in average firm-level TFP following trade openness in India. Valodia and Velia (2006) in Durban, South Africa, and Damijan et al. (2009) find no uniformity in firm TFP changes across firms following liberalization in six former socialist European countries. On the other end, Pavcnik (2002) found that trade liberalization led to an increase in plant productivity in import-competing sectors and facilitated the reallocation of resources and output from less efficient to efficient firms in the case of Chile. Foreign competition pressures raised industry-level TFP through reallocation of economic activities away from inefficient firms in Brazil; but imported inputs played a minor role in this respect (Muendler, 2004). Similarly, an increase in industry level productivity was observed following trade liberalization in Turkey; however, gains were found to be larger in import-competing industries as compared to export-oriented and non-traded sectors (Taymaz & Yilmaz, 2007).

Aw et al. (2001) in Taiwan, De Loecker (2007) in Slovenia, and Lileeva (2008) in Canada and USA find exporting firms to have higher productivity than non-exporting firms as a result of the learning-by-doing effect. Navaretti et al. (2006) found TFP had grown among exporters following trade liberalization, but found it difficult to trace a causal link that goes from exporting to productivity in Chad and Gabon. Bernard and Jensen (1999) in the US, and Arnold and Hussinger (2005) in Germany find that more productive firms become exporters. Van Biesebroeck (2005) and Girma et al. (2004) find that exporting firms are more efficient among African and UK manufacturing firms, respectively, regardless of the causality between learning-by-doing and exporting.

The actual effect of ownership on firm performance has also been mixed. Foreign-owned firms do not perform better than domestic firms in Bulgaria (Konings, 2000; Damijan et al. 2003), and in Hungary and Slovakia (Damijan et al., 2003). Contrary to this, foreign-owned firms performed better as in the case of Czech Republic (Damijan et al., 2003); in Poland (Konings, 2000); in Estonia and Slovenia (Damijan et al., 2003); and in Bosnia-Herzegovina, Croatia, Romania and Slovenia (Damijan et al., 2009).

Using firm-level industrial data from the Ethiopian manufacturing sector for the period 1996 to 2002, Shiferaw (2005) find industry level TFPG, which was driven by market reallocation as result of driving out inefficient firms and improving TFP among incumbent firms. Using panel level data between 1996 and 2003, Gebreeyesus (2006) finds productivity differential, firm turn-over and higher growth among small firms.

Overall, there is still no conclusive evidence about the relationship between firm performance and trade reforms. Most studies focus on certain aspects of the relationship between trade reform and firm performance in their areas.

3. Methodological Framework

This study utilizes both descriptive statistics and econometric methods, and follows a two steps procedure to estimate parameters of interest. In econometrics application, the first stage is to estimate a Cobb-Douglass production function through OLS, Fixed Effects (FE), Blundell and Bond (2000) system General Methods of Moments (system GMM), Olley Pakes (1996) and Yasar et al. (2008) and estimated coefficients are compared. Based on theoretical and econometric justifications, estimated coefficients of Olley and Pakes (1996), and the Yasar et al. (2008) method are chosen to obtain TFP values. Group mean and median equality tests are used to assess TFP differences among groups of firms, between during and post-reform performances, and also check the validity of the hypotheses.

Still not clear

3.1 Data Source and the Nature of the Survey

The data are acquired from the Ethiopian Central Statistical Agency annual surveys on large and medium-scale manufacturing and electricity industries. As the title imply, the survey contains two distinctly different sets of establishments: large and medium-scale manufacturing industries, and also electricity industries. The Central Statistical Agency (CSA) (also called the Central Statistical Authority) started conducting the survey of large and medium-scale industries since 1976 (CSA, 2005).

Units of inquiry are large and medium-scale industrial establishments. The CSA (2005: 1) noted that:

> *… the Large and Medium Scale Manufacturing survey is confined to those establishments which engage ten persons and above and use power-driven machinery and cover both public and private industries in all regions of the country.*

The CSA maintains firm-level data set in a SPSS format for each survey year since 1996. Establishments/firms have their own eight-digit invariant International Standard Industrial Classification (ISIC) code and each question/ variable has also invariant code across the years. This helps to identify each firm and variable of interest across the different years. In this study, firm-level data from 1996 to 2007 in SPSS formats acquired from the CSA is arranged in unbalanced panel of firms. The survey covers a wide range of issues including gross value of production, wages and salaries, domestic and imported inputs, number of persons, temporary and permanent workers, fixed assets, investment expenditure, electricity and other energy consumptions, export and total sales revenues, year of commencement of establishments, etc.

3.2 The Model

Estimation of production function has a fairly long history in the econometric literature. However, the techniques of estimation have gone through a lot of modification in terms of addressing econometric problems. In this paper, an econometric model of production functions estimation for the case of heterogeneous firms— as proposed by Olley and Pakes (1996) and converted in the STATA by Yasar et al. (2008)—is used because of its superiority over the other methods. Accordingly, the estimated coefficients are used to obtain TFP scores. However, production functions are estimated using OLS, fixed effects and GMM; and presented along with a chosen method for comparison purposes.

Literature provides various forms of a production function, which could characterize the production technology of firms. The most common form is the Cobb-Douglas production of the type:

$$Y_{it} = L_{it}^{\propto} M_{it}^{\beta} K_{it}^{\gamma} E_{it}^{\phi} A_{it} \qquad (3.1)$$

where $Y_{it}, K_{it,} L_{it,} M_{it}$, E_{it} and A_{it} are output, capital, labour, material, energy consumption and productivity shock facing firm i at time t.

There are four commonly cited econometric problems that potentially lead to biased production functions' parameter estimates. The first problem is associated with deflation of nominal values. Using heterogeneous physical outputs and inputs to make performance comparisons across firms is not plausible. It requires using nominal values to make aggregation possible and a need to use sectoral price indices as a proxy measure for physical inputs and outputs. These indices also have their own problems leading into biased productivity estimates as indicated in Klette and Griliches (1996), Mairesse and Jaumandreu (2005), and Konings and Vandenbussche (2008). Getting accurate and complete data on firm-level price indices is neither a remote possibility. Given this caveat, relevant sectoral prices' indices are used to deflate nominal input and output values to minimize the bias.

The second is associated with the problem of having endogenous explanatory variables. Marshak and Andrews (1944) (in Olley & Pakes, 1996) are the first to recognize the endogenous nature of inputs in the estimation of production functions. Firms are aware of their managerial capability, workers discipline and industrial peace or other similar conditions at time *t, ceteris paribus,* and they could predict the likely level ofFP_{it}. This prior knowledge of *TFP* may affect the type and amount of inputs that need to be used by a firm. Under such conditions, the use of OLS could lead to simultaneity bias; leading to biased and inconsistent coefficient estimates.

Mundlak (1961) and Hoch (1962) (in Ackerberg et al., 2006) assumed $\omega_{it}$to be time-invariant firm-specific and use fixed effects in panel data production function to address the endogeneity problem. This specification does not consider time varying firm-specific conditions affecting TFP. It is also noted that in the presence of potential measurement errors, fixed effects are likely to generate higher bias than OLS estimators; and tend to give very low capital coefficients and return to scale (Ackerberg et al., 2006).

Pavcnik (2002) obtains coefficients of production function parameters using fixed effects models, and calculates residuals. In the second step, $\omega_{it}$is modeled as a second degree polynomial growth trend of the residual in time to generate TFP estimates based on auxiliary regression. This procedure is arbitrary and unnecessarily requires many degrees of freedom (ibid., 2002).

The other option to solve the endogeneity problem is to use valid instruments such as input prices. This procedure has also its own problems. Among other things, firms do not usually report input prices (Ackerberg et al., 2006). Even if they do, there is no mechanism that permits to set standard prices accounting for different prices. In practice, individual input choices are determined by all input prices and thus independence requirement of instruments become invalid.

Blundell and Bond (2000) applies a methodology—commonly referred to as system GMM—and uses moment conditions of lagged differences of explanatory variables as instruments of 'endogenous inputs' in the US manufacturing companies; and find "… more reasonable and more precise estimates for the coefficients of capital and labour" (Baltagi, 2005: 148). One shortcoming to this model is its inability to address selection bias.

The third major issue in panel data is the problem of non-stationarity. However, as Green (2012: 970) noted, "… in small T cases of longitudinal, microeconomic data sets, the time-series properties of the data are a side issue that is usually of little interest. But when T is growing at essentially the same rate as n, for example, in the cross-country studies, these properties become a central focus of the analysis." Thus, this paper uses a data set with relatively large n dimension (an average of about 763 firms per year), with a relatively short T (12 years). This makes testing and addressing non-stationarity problem to be less meaningful.

The fourth major issue is selection bias. Survey reports usually display only surviving firms; but firms' self-select themselves to exit if they fail to operate over a certain threshold level of TFP. Considering only surviving firms, it will possibly cause selection bias and non-robust coefficient estimates. OLS, fixed effects, instrumental variables and the Blundell and Bond (2000) methods do not address this problem. Thus, this bias needs to be explicitly modelled in estimating production functions.

Olley and Pakes (1996) and Yasar et al. (2008) suggest a multi-steps semi-parametric approach to solve both simultaneity and selection bias problems. A similar procedure is suggested by Levinsohn and Petrin (2003) to use intermediate inputs as an instrumental variable to address simultaneity bias; although intermediate inputs variable has also a high likelihood of being endogenous.

The Olley and Pakes (1996) procedure is subjected to the availability of investment data. Even if firms do not make major regular investment outlays—such as expansion of the existing capacity or opening up of new branches in response to productivity shocks—they usually spend on rehabilitation, maintenance and repair activities. The following methodology is used to capture the level of investments undertaken by firms. Book value of fixed assets at $t+1(K_{it+1})$ is given by:

$$K_{it+1} = K_{it} + I_{it} - d_{it}K_{it} - \xi_{it}K_{it} = K_{it}(1 - d_{it} - \xi) + I_{it} \qquad (3.2)$$

where K_{it+1} are $K_{it}$is capital stock of firm i at time t+1 and t respectively, I_{it} is investment outlay of firm i at time t, d_{it} is depreciation rate, and $\xi_{it}K_{it}$ is the value of capital that is reported to be disposed or sold by the firm. From (3.2), it follows:

$$I_{it} - K_{it+1} + (d_{it} + \xi_{it} - 1)K_{it} \qquad (3.3)$$

However, for simplicity, (3) joined ($\delta = d_{it} + \xi_{it}$), to get:

$$I_{it} - K_{it+1} + (\delta - 1)K_{it} \qquad (3.4)$$

The steps of addressing simultaneity and endogenous exit as discussed by Olley and Pakes (1996: 1271):

> *To analyse either the selection or the simultaneity problem we need a dynamic model of firm behavior that allows for firm-specific efficiency differences that exhibit idiosyncratic changes over time. To sort out the simultaneity problem, the model must specify the information available when input decisions are made. To control for the selection induced by liquidation decisions, the model must generate exit rule.*

According to Olley and Pakes (ibid.), firms decide whether to continue or exit out of the market at the beginning of each period with a liquidation value of Φ, and never come back again. As indicated in Yasar, et al. (2008), a firm's profit is conditional on the magnitude of state variables, productivity level, capital stock and the age of a firm. The productivity and profit of a firm at time t + 1 are the

function of current productivity and capital stock. Firms decide to exit out of the market if their expected discounted return is lower than the sell-off value of their assets, which itself is a function of productivity. Thus, the exit decision of a firm depends on whether it operates higher than a certain threshold TFP level. Considering this, selection bias is addressed using the following procedures.

The optimal exit decision rule of firms is given by:

$$I_{it} = \begin{cases} 1 \text{ if } \omega_{it} \geq \overline{\omega}_{it}(K_{it}, a_{it} \\ 0 \text{ . Otherwise} \end{cases} \qquad (3.5)$$

The productivity shock (ω_{it}) evolves overtime following the first order Markov process:

$$p(\omega_{it}|INF_{it}) = p(\omega_{it}|\omega_{it-1}) \text{ or } \omega_{it} = g(\omega_{it-1}) + \varepsilon_{it} \qquad (3.6)$$

where INF_{it} is firm i's information set at time $t - 1$ incorporating the realization of ω_{it} starting from $t = 0$ to time $t - 1$

Yasar et al. (2008) also note that a firm's investment decision at time t depends on ω_{it}, k_{it}, and a_{it}, which is given by:

$$I_{it} = I\omega_{it}, \delta, K_{it}, a_{it} \qquad (3.7)$$

This equation implies that "… future productivity is increasing in the current productivity shock, so firms that experience a large positive productivity shock in period t will invest more in period t+1)" (ibid: 223).

Following Yasar et al. (ibid.) and Olley and Pakes (1996), (3.1) is restated as:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_e l_{it} + \beta_e e_{it} + \beta_k k_{it} + \beta_a a_{it} + \beta_l l_{it} + u_{it} \qquad (3.8)$$

$$u_{it} = \omega_{it} + \eta_{it} \qquad (3.9)$$

where y_{it}, l_{it}, m_{it}, e_{it} and k_{it} are log values of output, labour, materials, energy and capital stock, respectively; a_{it} is the age of a firm; ω_{it} is firm-level productivity unknown by the researcher, but anticipated by the management and affects the decision-making process; β_j are parameters to be determined; and η_{it} represents a productivity shock which is unknown to the researcher and the management of the firm, which does not affect firms' decision process.

The investment decision rule (3.7) addresses simultaneity bias arising from the bidirectional relationship between variable inputs and productivity. Yasar et al. (2008) indicated that ω_{it+1} is an increasing function of ω_{it} as firms with positive productivity shock invest more. Assuming that $I_t > 0$, (3.7) can be inverted to give:

$$\omega_{it} = I^{-1}(I_{it}, K_{it}, a_{it}) = h(I_{it}, K_{it} + a_{it} \qquad (3.10)$$

Inserting (3.9) and (3.10) into (3.8) gives

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_e l_{it} + \phi(i_e, k_{it}, a_{it}) + \eta_{it} \quad (3.11)$$

where $\phi(i_{it}, k_{it}, a_{it}) = \beta_0 + \beta_k k_{it} + \beta_a a_{it} + h(i_{it}, k_{it}, a_{it})$; and $\phi(i_e, k_{it}, a_{it})$; and is approximated through second-order polynomial series in age, capital and investment.

According to Yasar et al. (2008), OLS gives consistent coefficient estimates of the input variables explicitly shown in (3.11) because the error term, which is in $\phi(.)$is longer correlated with variable inputs. However, the coefficients of capital stock and age variables could not be identified; requiring invoking (3.5) to address selection bias. The probability of exit of a firm at time *t* depends on the level of TFP of the firm in time *t*-1. The next step is to fit a Probit model of X_{it} on lag values of I_{t-1}, K_{t-1}, and a_{it}, their squares and cross products; whose predicted values $\hat{P}_{it}$ are to be used in (3.12).

$$y_{it} = \hat{\beta}_l l_{it} + \hat{\beta}_m m_{it} + \hat{\beta}_e e_{it} = \beta_k k_{it} + \beta_a a_{it} + g(\hat{\phi}_{t-1} - \beta_k k_{it-1} - \beta_a a_{it-1}, \hat{P}_{it}) + \zeta_{it} + \eta_{it} \quad (3.12)$$

where the *g*(.) is approximated by second-order polynomial in $(\hat{\phi}_{t-1} - \beta_k k_{it-1} - \beta_a a_{it-1})$ and $\hat{P}_{it}$.

$\hat{P}_{it}$ is considered as a propensity score and Mills' ratio by Ackerberg et al. (2006) and Yasar et al. (2008). Sample selection bias depends on two unknown parameters, the actual and the threshold ω_{it}. Given the nature of the specification of (3.12), it is estimated through non-linear least squares. Once consistent estimates of parameters for β_l, β_e, β_m, β_k and β_a are obtained using the above procidures, firm-level log values of TFP estimates are generated as:

$$T\hat{F}P = y_{it} - \hat{y}_{it} \quad (3.13)$$

3.3.3 Definition and Measurement of Variables

1. ***Output*** (y_{it}): In accordance to the definition of the CSA, output is measured as the gross value of production, which is the sales value of all outputs produced, including final and semi-finished goods and services rendered by a firm to others, and similar other receipts during the reference period, adjusted by sectoral price indices.
2. ***Labour Input*** (l_{it}): Labour is heterogeneous in its very nature. Using the number of persons or workers may not give the right approximation of labour input because of the differences in the mode of employment (seasonal, temporary, family worker and permanent worker), and also the quality (in terms of education, skill, experience and dedication) of work within and across firms. The number of hours worked is another option but no data is

available about it either. Thus, total wages and salaries paid are assumed to take care of the inherent heterogeneity in the quality of labour and its contribution to output adjusted by general consumer price indices. The CSA (2005) considers all payments in cash or in kind (converted into cash) made to employees during the reference year in connection with the work done for the establishment—including allowances, commissions, bonuses, professional and hardship allowances—as wages and salaries. Measuring labour input in this way is taken with one caveat: it may underestimate the activities of unpaid family workers, owners and partners.

3. ***Materials*** (M_{it}): As per the CSA, materials include all types of materials (local and imported), and also parts and containers consumed during the reference year at the cost of the factory, including purchase price, transport charges, taxes and other incidental costs; but adjusted for over-time price changes.
4. ***Capital*** (K_{it}): Capital is the book value of all fixed assets (machinery and equipment, buildings and similar items) of a firm at the beginning of period *t*, deflated by a weighted average of machinery and equipment, import and construction sector price indices. It is calculated using (3.2).
5. ***Energy Consumption*** (E_{it}): It includes expenses on electricity, and wood and charcoal consumed during the reference period.
6. ***Investment*** (I_{it}): It is generated using (3.2) and adjusted for inflation through the deflator used for fixed assets. The survey offers data required for constructing (I_{it}), including the book value of fixed assets at the beginning and end of the year, value of new purchases, capital repair, sold and disposed fixed assets, and also the value of depreciation.
7. ***Age*** (a_{it}): It refers to the age of a firm derived by subtracting the survey period and the year of commencement of the establishment.

Firms are categorized by their different characteristics. Based on the information on the type of ownership, firms are grouped into SOEs and private firms. The information on domestic and imported materials is used to categorize into domestic resource-based firms (whose local material cost is higher than 50% of the total material cost) and import-intensive firms, otherwise. Firms, which sell part of their produce abroad, are taken as exporting firms[1] and others as non-exporting firms. The information on the source of the initial paid-up capital (private non-Ethiopian) indicates whether the firm is fully-locally owned or foreign capital affiliated. The number of permanent workers is used to classify firms in to three different sizes; small firms (with total permanent workers of less than 10), medium sized firms (with workers between 10 and 50), and large scale firms with permanent workers greater than 50.

[1]Arnold and Hussinger (2005) use a threshold level of 5% of the total sales needs to be sold aboard to consider a firm as exporting for the case of Germany, for instance. In the Ethiopian case, where below 10% of the total sales of large and medium scale industries is directed for exporting (CSA, 2007), it does not look realistic to use such thresholds.

4. Empirical Findings

Firms, which do not report data or have zero values for key variables described in the production function are excluded from estimation. Because of the entry and exit dynamics, the estimation is based on an unbalanced panel of 8395 data points.

4.1 Descriptive Statistics

Table 1 shows the shares of firms in different industrial groups from input and output values of the entire large and medium-scale industries in this study.

Table 1: Share of Industrial Groups from all Large and Medium Scale industries (%)

Industrial Group	Number of Firms	Permanent Workers	Wages and Salaries	Net Fixed Asset	Out put
Food and Beverages	28.4	27.1	34.1	35.7	37.8
Textile and Wearing Apparel	7.9	30	19.6	15.6	10.7
Tannery, Luggage and Footwear	7.1	8.2	8.5	7.1	10.5
Wood and Furniture	16.6	6	4.8	2.8	2.8
Chemical and Pharmaceuticals	5.6	4.8	5.1	7.6	6.1
Rubber and Plastic	4.6	4.5	4.5	6.5	5.1
Paper and Printing	8.3	6.8	7.8	3.1	5.1
Non-metallic	11	6.6	7.8	13.1	9.2
Metal and Metallic Products	10.4	6	7.7	8.3	12.9

Source: Own Computation based on CSA (1997 -2007).

Resource-based industries such as food, beverages, textiles and apparel, leather, wood and non-metallic industries accounted for the bulk of manufacturing output and input values. Owing to this structure, Schwab (2012) categorizes Ethiopia among the first stage of development or factor-driven economies, whose industrial bases are natural endowments such as low-skilled labour and natural resources.

Table 2 summarizes the size distribution of firms by permanent workers, capital and output.

Table 2: The Size Distribution of Firms by Permanent Workers, Capital and Output

No. of Permanent Workers	Firms			Permanent Workers		Net Fixed Assets (Capital)		Output	
	No.	*% Share*	*Cum. (%)*	*% Share*	*Cum. (%)*	*% Share*	*Cum. (%)*	*% Share*	*Cum. (%)*
Up to 10	1677	20	20	1.2	1.2	1	1	1.2	1.2
11 to 25	2420	28.8	48.8	4	5.2	3.3	4.3	2.6	3.8
26 to 49	1415	16.9	65.6	5.1	10.3	6.7	11	5.5	9.2
50 to 100	1043	12.4	78	7.5	17.8	9.3	20.3	10	19.2
More than 100	1840	21.9	100	82.2	100	79.5	100	80.8	100

Note: Cum. (%) = Cumulative (%)

Source: Own Computation based on CSA (1997 -2007).

Among firms considered in this study, around 20% employed up to 10 permanent workers; but only to account for about 1.2% of permanent workers and output, and 1% of the value of fixed assets of all large and medium scale industries. Around 78% of the firms employed about 17.8% of permanent workers, and accounted for less than 19% of the output and 20% of the value of fixed assets. On the opposite tail, firms that employed more than 100 permanent workers were only around 22% of the total number of firms, but accounted for about 82% of the permanent workers and about 80% of the output and value of fixed assets.

Table 3 summarizes the share of firms in input and output values categorized by different attributes. Around 82.3% of the medium and large-scale enterprises are privately-owned. Around 51.5% of the private enterprises are sole-proprietors. Others take the form of partnership, share-company, cooperatives or any other form, not explicitly stated in the survey (CSA, 2008). Regardless of their number, most private enterprises are comparably small and hold disproportionately low share in input usage and output contribution.

Table 3: Share of Firms in Input and Output Values by Different Attributes in (%)

Group of Firms		No. of Firms	Permanent Workers	Wages and Salaries	Net Fixed Asset	Output
Type of Ownership	SOEs	17.8	65.5	49.7	45.6	55.3
	Private	82.3	34.5	50.3	54.4	44.9
Product Market Orientation	Exporter	5.5	24.5	27.8	24.8	26.8
	Non-exporting	94.5	75.5	72.2	75.2	73.2
Input Market Orientation	Import-Intensive	34	35.1	38.7	39.9	42.7
	Domestic – based	66	64.9	61.3	60.1	57.3
Investment Orientation	Foreign Oriented	4.9	6	6.3	5.8	5.3
	Fully Domestic	95.1	94	93.7	94.2	94.7
Market Status	Exiting	6.6	1.8	1.3	1.6	1.2
	Entrant	11.7	3.7	2.7	9.3	3.7
	Incumbent	81.7	94.5	96.1	89.8	95.3

Source: Own computation.

Only 5.5% of the firms participate in the export market; perhaps because of the inability compete. Relatively, Ethiopian exporting firms are large in size; consistent with, for instance, Greenway and Yu (2004) in the UK, and Van Biesebroeck (2005) in some sub-Saharan African countries. As much as exporting firms are larger, exporting is largely concentrated in few agro-processing industries.

Import-intensive industries, firms importing 50% of their raw materials and intermediate inputs from abroad, constitute 34% of the total number of large and medium scale industries. In terms of input and output size, they are not any different from domestic resource-based industries. Table 3 also shows that FDI remained very limited in the manufacturing sector despite various incentive mechanisms for attraction.

With regard to operational status of firms, exiting firms are found to be smaller in size than incumbent and entrant firms as evidenced from the disproportionate share of inputs and outputs as compared to the share of the number of firms.[2] More firms enter into the market than those that exit. Entry-rate (the ratio of entrant firms to the total number of firms) and exit-rate (ratio of exiting firms to the total number of firms) exhibit large fluctuations over the study period. Nonetheless, on average, entry-rate has been higher than exiting rate as displayed in Fig. 1, perhaps because of the presence of favourable policy environment to the private sector investment.

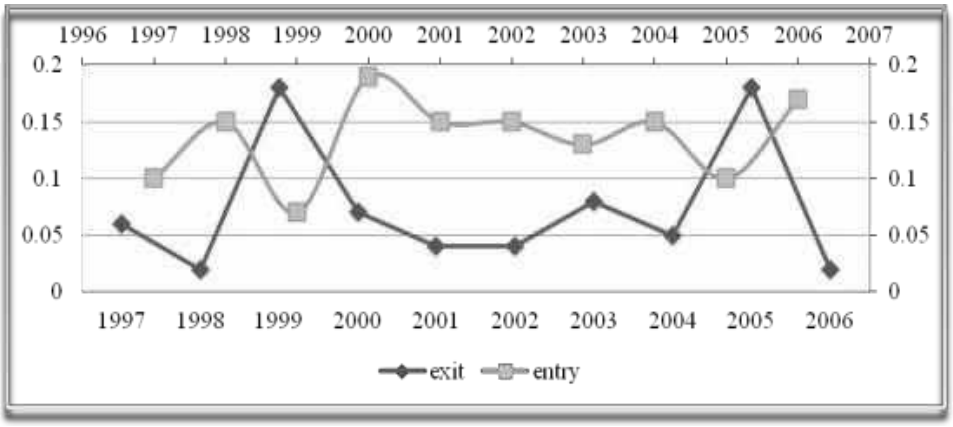

Figure 1: Entry and Exit Rates as Percentage of All Firms During the Year
Source: Own Calculation.

Table 4 summarizes the share of exiting firms from the different groups of firms. Existing firms are predominantly non-exporting and small-scale firms; albeit medium-scale firms also had a relatively sizable magnitude. Of the total firms that engaged less than 10 persons, and also that engaged between 10 and 50 persons, 12.8% and 6.9%, respectively, exit. On the contrary, only 0.9% of exporting and 2.7% of firms with more than 50 permanent workers exited between 1997 and 2006.

Within each category, the shares of exiting firms from the total number of permanent workers, wages and salaries, net fixed assets and output are lower than their share from the total number of firms; showing once again that these firms are relatively smaller in size and role in the manufacturing sector.

[2]Entrant firms in this study are those that joined the sector during the period under study. After operating for two years, they are considered as incumbent firms. Exiting firms are those industries, which left from the report either existed out of the market, downsized their operation to less than ten persons engaged (not ten permanent employees) or didn't report to CSA. Firms with the latter case are presumably very few because of the fact that it is mandatory to provide information for CSA.

Table 4: Exiting Firms' Share from Different Groups of Firms in Percentage

	No. Firms	Number of Permanent Workers	Wages and Salaries	Net Fixed Asset	Output
All Industries	**6.6**	**1.8**	**1.3**	**1.6**	**1.2**
Exporters	0.9	0.29	0.29	0.49	0.1
Non-exporting	7.0	2.3	1.7	2.0	1.6
Import-intensive	5.3	1.8	1.4	1.6	1.2
Domestic resource-based	7.3	1.9	1.9	1.6	1.2
Small	12.8	13.2	4.3	11.3	4.9
Medium	6.9	6.2	5.4	6.9	5.1
Large	2.7	1.2	0.9	0.9	0.8

Source: Own computation.

4.2 Econometric Results

The data are unbalanced panel with the shorter and longer time spans of three and twelve years; and a cross-section dimension of 397 and 920 firms respectively. Estimation results of STATA 10 are displayed on Table 5.

Table 5: Production Function Regression Results

Coefficient/ Test Parameters	OLS	Fixed effects	System GMM	Olley and Pakes
01	02	03	04	05
Labour	0.264***	0.252***	0.236***	0.252***
	(0.0056)	(0.008)	(0.034)	(0.009)
Raw materials	0.622***	0.608***	0.576***	0.620***
	(0.005)	(0.006)	(0.031)	(0.01)
Power	0.080***	0.078***	0.134***	0.073***
	(0.004)	(0.005)	(0.023)	(0.007)
Capital	0.049***	0.045***	0.035**	0.053***
	(0.004)	(0.004)	(0.0175)	(0.007)
Age	-0.003	-0.031*	-0.12	0.024
	(0.006)	(0.019)	(0.202)	(0.062)
JST for time dummies (P-value)	0.000	0.000		
JST for group effects (P-value)		0.000		
JST for all coefficients (P-value)	0.0000	0.000	0.000	0.0000
R-square	0.96	0.82		
AR(1): P-value			0.000	
AR(2): P-value			0.214	
Sargan (Chi-square (199): P-value			0.000	
Test for Constant Returns to Scale	0.03	0.058	0.343	0.000
N	**8395**	**8200**	**7166**	**8298**

Note: System GMM estimator in Column 4 used a lag length of used maximum lag length of three years for predetermined variables. Values in brackets are standard errors. *, ** and *** are level of significance of 10%, 5% and 1%, respectively.

Heteroskedasticity in the error term has been found using Breusch-Pagan/Cook-Weisberg test, and accordingly robust standard errors are taken in OLS. Lagged differences and lagged levels are used as instruments for level and difference equations, respectively, in system GMM. On the basis of the predominant

presumption that the last period TFP, which is subsumed into the error term, is likely to affect the current financial condition of a firm and its capacity to spend on inputs to be used currently, explanatory variables of the production function are not considered purely exogenous; and they are treated as predetermined in system GMM.[3] The moment conditions of system GMM are valid only if there is no autocorrelation in error terms (StataCorp, 2011). The null hypothesis of no autocorrelation is rejected in the econometric result. Because of the fact that the first difference of subsequent errors are related even if they are independently and identically distributed, rejecting the null hypothesis of no serial correlation at order one does not necessarily imply that the model is not correctly specified (ibid., 2011). The null hypothesis of no autocorrelation of order two is not rejected; implying that the model does not have a misspecification problem.

The Sargan test fails to reject the null hypothesis of over-identifying moment conditions are valid. Sargan Test has a Chi-squared distribution only when the error terms are homoskedastic, in which case system GMM does not compute this test in the presence of robust standard errors; because its asymptotic distribution is not known under such a condition (Ibid, 2011). Robust standard errors are considered to deal with heterogeneity at the expense of the information about the validity of over identified moment conditions. Similar to OLS and Fixed Effects, system GMM has inherent problems of estimating production functions using unbalanced panel data as stated before. This calls for the use of Olley and Pakes and Yasar et al (2008) estimator. The default for this model in STATA uses clustered bootstrap command that treat all observations for a single firm as one cluster and gives bootstrap standard errors[4].

In all the four estimations, joint significant tests rejected the null hypothesis that all coefficients are jointly zero. In conformity with Olley and Pakes (1996) and Levinsohn and Petrin (2003), OLS estimates are higher for all freely moving parameters; and the coefficient of capital is biased downwards than Olley and Pakes (1996) and Yasar et al. (2008); perhaps because these estimates are biased due to selection and endogenity problems as predicted in Olley and Pakes (1996).

The FE estimator controls for correlation between inputs and permanent shocks because of individual effects. In order to address simultaneity between inputs and the persistent shock that varies in individual firms and across the industry over-time, time dummy running from 1997 to 2007 was included; as it is case for OLS as well. In both FE and system GMM, the capital coefficient is also downward biased as compared to the Olley and Pakes (1996) and Yasar et al. (2008) estimator. However, there has not been any consistent trend with regard to other coefficients among the four regression results.

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[3] A variable is predetermined if $E(x_{it}\varepsilon_{it}) \neq 0$ for all $s < t$, and $E(x_{it}\varepsilon_{it}) = 0$ for all $s \geq t$, (StataCo, 2009).
[4] Of the total number of firms in the panel, 97 (1.2 percent) did not have data to generate values for investment variable and thus dropped out of the estimation.

The Olley and Pakes (1996) and Yasar et al. (2008) estimator is used to explain the relative contribution of each input to output and construct TFP scores because of its advantages over the other estimates. Results indicate that raw materials and labour account for the bulk of output variation because of the fact that most industries are natural resource-based and less technology intensive. Low level of capacity utilization among firms (49% in 1997, (CSA, 1998)) and 55.2% in 2006 (CSA, 2007)) could also be another reason for the same.

4.3 Total Factor Productivity: Entire Period

TFP is simply a residual between the actual output and weighted sum of inputs, in which the weights are elasticity or factor share estimates. Using the source of growth approach of the neoclassical model, the growth of output is decomposed into the growth of factor inputs weighted by factor shares and also the residual, often levelled as technical progress or growth in total TFP (Agénor & Montiel, 2008).

Consistent with Melitz (2003), Yeaple (2005), Bernard, et al. (2007), and Melitz and Ottaviano (2008), firms have shown a heterogeneous response to the change in the trade regime; including reduction in tariff rates. Fig. 2 shows the Kernel Density estimate. The distribution of log of TFP is skewed towards the left, with less performing firms having a relatively high concentration.

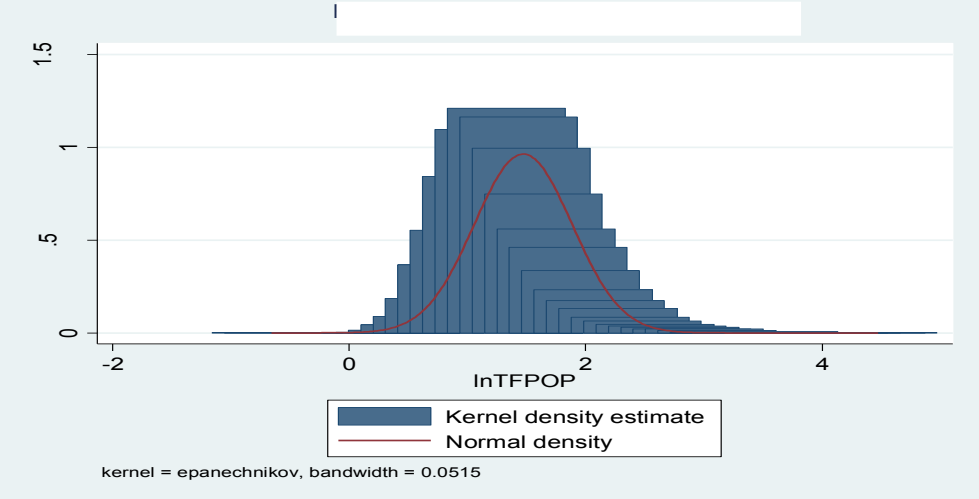

Figure 2: Kernel Density Estimate

Source: Own Calculation based on CSA (Various Years).

A similar result is shown in Table 6. The coefficient of variation shows the degree of heterogeneity in TFP among firms with each industrial group and the level of heterogeneity varies among industrial groups.

Table 6: Descriptive Statistics of TFP by Industrial Group

Industrial Groups	Min	Mean	Max	P25	P50	P75	SD	CV
Food & beverages	1.25	4.76	38.6	3.22	3.95	5.09	3.12	0.66
Textiles & wearing apparel	0.54	4.74	48.2	3.04	3.98	5.32	3.59	0.77
Tanneries, luggage & footwear	1.73	4.94	20.7	3.56	4.46	5.78	2.18	0.44
Wood & furniture	1.79	4.78	83.2	3.42	4.16	5.41	3.20	0.66
Paper & printing	1.55	4.58	22.6	3.38	4.06	4.90	2.36	0.52
Chemicals & pharmaceuticals	1.88	5.09	54.9	3.49	4.33	5.34	3.84	0.75
Rubber & plastic	1.81	4.55	21.5	3.41	4.15	5.11	2.01	0.44
Non-metallic Mineral Products	1.64	5.15	39.5	3.38	4.22	5.89	3.23	0.63
Metals & Metallic Products	1.83	5.00	62.8	3.41	4.21	5.50	3.57	0.71
Total	**0.54**	**4.84**	**83.2**	**3.33**	**4.11**	**5.32**	**3.13**	**0.65**

Source: Own Calculation based on CSA (Various Years).

Table 6 shows that tanneries, luggage and footwear, and textiles and wearing apparel are the two extreme industrial groups with the lowest and highest level of firm-level heterogeneity in TFP scores, respectively.

Table 7 compares TFP of each one the 9 industrial group with the remaining other 8 industrial groups.

Table 7: TFP Comparison among Industrial Groups

Industrial Groups (Number of Firms)	2-group Hotelling's T-squared (F)-Test		Median Comparison Test	
	Mean	*P-value*	*% Firms Over the Median TFP*	$X^2(1)$ *Test (P-Value)*
Food & beverages (2380)	4.76	0.14	45.1	0.00
Others (6015)	4.86		51.9	
Textiles & wearing apparel (667)	4.74	0.411	46.2	0.04
Others (7728)	4.85		50.3	
Tanneries, luggage & footwear (596)	4.94	0.35	57.4	0.00
Others (7739)	4.83		49.4	
Wood & furniture (1391)	4.78	0.49	51.3	0.30
Others (7004)	4.84		49.7	
Paper & printing (700)	4.59	0.03	48.1	0.31
Others (7695)	4.86		50.1	
Chemicals & pharmaceuticals (470)	5.09	0.07	57.7	0.00
Others (7925)	4.82		49.5	
Rubber & plastic (390)	4.55	0.06	50.5	0.83
Others (8005)	4.85		49.9	
Non-metallic Mineral Products (924)	5.15	0.00	53.1	0.04
Others (7471)	4.79		49.6	
Metals & Metallic Products (877)	5.00	0.10	52.9	0.06
Others (7471)	4.82		49.6	

Source: Own calculation.

Non-metallic mineral processing industries, chemicals & pharmaceuticals metals and metal products industries are found to have relatively higher level of TFP as compared to other industries in terms of group mean and median comparison

tests (at 10% of level of significance). Faster growth in the construction sector such as buildings and roads in the country might have explained the relatively higher TFP scores for non-metallic mineral and metallic industries. In terms of resource-base, however, non-metallic industries heavily depend on natural endowments whereas chemical and metal and metallic products industries rely almost entirely on imported intermediate inputs.

More than half (57%) of tanneries and leather processing firms obtained TFP scores higher than the median TFP and performed better than other industrial groups in statistically significant level; but there is statistically significant mean TFP difference between this industrial group and the remaining others. Evidently, food & beverages, and textile and wearing apparel industries operated at lower TFP compared to others at least based on median comparison test.

Table 8 compares TFP of firms categorized by source of input, output market, operational status, mode of ownership and size. The findings indicate public enterprises out-performed private enterprises in line with the social view that SOEs could become more efficient than their private counterparts.

Table 8: TFP Comparison among Groups of Firms of Different Attributes

Industrial Groups by Different Attributes		**Hotelling's T-squared (F)-Test**		**Median Comparison Test**	
		Group Mean	***P-value***	***% Firms above Median TFP***	***Pearson X^2(1) Test: (P-Value)***
	Private (6902)	4.79		49.3	0.01
Ownership	SOEs (1493)	5.06	0.00	53.0	
Output Market	Exporter (461)	5.53		62.0	0.000
Orientation	Non-exporter (7934)	4.79	0.00	49.3	
	Domestic Resource-Based (5539)	4.80		47.1	0.00
Input Market Orientation	Import-Intensive Industries (2856)	4.90	0.19	55.4	
Investment Capital	Fully Domestic (7984)	4.84		49.9	0.72
Orientation	Foreign Affiliated (411)	4.85	0.94	50.8	
	Entry (983)	4.70		51.1	0.25
	Exit (556)	4.51	0.24	48.0	
	Incumbent (6856)	4.88		50.6	0.00
	Exit (556)	4.51	0.01	41.7	
Operational Status	Incumbent (6856)	4.88		50.6	0.00
	Entry (983)	4.70	0.09	45.5	
	Exit (556)	4.51		42.4	0.00
	Entry & incumbent (7839)	4.86	0.01	50.5	
	Small (1677)	4.84		53.1	0.00
Size by Permanent	Medium (3835)	4.67	0.07	48.6	
Employment	Small (1677)	4.84		47.2	0.00
	Large (2883)	5.06	0.02	51.6	
	Medium	4.67		46.1	0.00
	Large	5.06	0.00	55.1	

Source: Own calculation.

In the Ethiopian context, importing intermediate inputs is not a matter of performance.[5] With the exception of agro-processing and non-metallic industries, almost all other industries exclusively rely heavily on imported inputs. In terms of TFP, there has not been a statistically significant difference between domestic resource-based and import-intensive industries in terms of group mean comparison test. However, around 8.5% of import-intensive firms are found to operate over the median level of TFP as compared to domestic resource-based firms.

In a least developed country such as Ethiopia, firms that have a component of FDI are expected to have superior technologies, market networks and skilled manpower; and thus likely to become more productive than fully locally-owned firms as in the case of, for instance, Haddad and Harrison (1993) in Morocco and Sinha (1993) in India. In this study, however, firms having a component of FDI do not show any statistically significant difference in TFP as compared to fully domestically-owned ones. Given that FDI has started to flow in after long years of unfavourable environment in Ethiopia, foreign-owned firms might have required some time to accustom with the local business environment and operate in a more productive way.

The empirical result of this paper does not lend conclusive evidence regarding the relationship between TFP and firm size. Medium-sized firms with permanent workers between 10 and 50 were found to be less productive as compared to both smaller firms with less than 10 permanent workers and larger firms with more than 50 permanent workers. Among other things, this result may be attributed to the policy environment that seemingly discriminate medium-sized firms.

The industrial development strategy gives special emphasis to micro and small enterprises (MSE), and accordingly provides various incentive schemes including credit, input and market networking (Zerihun, 2008). The policy document does not explicitly define what MSEs are, nonetheless, industries, with lesser than 10 permanent employees, are likely to fall under this category and benefit from the policy privilege. According to Altenburg (2010), most large-scale industries are SOEs, foreign-capital-owned, endowment-owned (affiliated to the ruling party), or owned by one billionaire in the country. The remaining others are owned by entrepreneurially weak individual Ethiopian investors in and out of the country; often complaining of unfair policy treatment in terms of unfair competition, alleging that firms owned by other categories have better access to land, credit and foreign exchange (Zerihun, 2008; Altenburg, 2010).

In line with the theoretical predictions of Melitz (2003) and Bernard et al. (2007) on heterogeneous firms, exiting firms are found to be less productive in a statistically significant way as compared to incumbent and entrant firms. This finding is consistent with extensive volumes of empirical research, including

[5]The causality between the purchase of intermediate inputs and TFP, (whether productive firms tend to import intermediate inputs or the use of intermediate input tends to improve TFP of firms) is an empirical issue in the global context.

Muendler (2004) in Brazil, Pavcnik (2002) in Chile, Fernandes (2007) in Colombia, Aw et al. (2001) in Taiwan, and Shiferaw (2005) in Ethiopia. However, there has not been a statistically significant difference between TFP levels of entrants and exiting firms. This might be perhaps because of the fact that entrants need some gestation period to get used to the business environment and benefit out of learning-by-doing as time passes.

Exporting firms are found to be more productive than non-exporting firms in a statistically significant way. This is consistent with Bigsten et al. (2002) in African countries; Greenway and Yu (2004) in the UK; Mengistae and Teal (1998) in Cameroon, Côte d'Ivoire, Kenya and Mauritius; Arnold and Hussinger (2005) in Germany; Mengistae and Pattillo (2002) in Ethiopia, Ghana and Kenya; National Bank of Belgium (2008) in 14 countries; Yasar et al. (2006), Harris and Li (2008) in the UK; and Farnńas and Marcos (2007) in Spain; Hwang (2003) in Taiwan; De Loecker (2007) in Slovakia, and others.

As Table 9 indicates, exporting firms are on average larger than non-exporting firms in terms of employment, value of fixed assets and also output. TFP variations between exporting and non-exporting firms are assessed in three different size categories. In the more than 50 permanent workers category, exporting firms are found have 10% TFP premium over non-exporting larger firms. Similarly, among firms employing 10-50 permanent workers, exporting firms performed by about 28% TFP premium over inward looking firms. However, among smaller firms, exporting and non-exporting firms do not have a statistically significant TFP difference.

Table 9: TFP Comparison between Exporting and Non-exporting Firms by Size and Industrial Group

Industries with different attributes			**Hotelling's T-squared (F)-Test**	
			Group Mean	***P-value***
Size	Large	Exporting	5.49	0.00
		Non-exporting	4.99	
	Medium	Exporting	5.96	0.01
		Non-exporting	4.65	
	Small	Exporting	4.70	0.89
		Non-exporting	4.84	
Industrial	Food & Beverage	Exporting	6.63	0.00
		Non-exporting	4.65	
	Textile & wearing apparel	Exporting	4.39	0.26
		Non-exporting	4.81	
	Tanneries, luggage and footwear	Exporting	5.40	0.00
		Non-exporting	4.73	

Source: Own Calculation based on CSA (Various Years).

More than 90% of exporting firms operate in food and beverages (28%), textile and wearing apparel (24%) and tanneries, footwear and other leather processing industries (39%). In particular, about 93% of tanneries export their final or semi-

processed hides and skins to the rest of the world. This indicates that exporting in Ethiopia is predominantly driven by natural resource-base or comparative advantage.

Within the food and beverages, as well as in tanneries, footwear and leather products industrial groups, exporting firms had 43% and 14% TFP premium over and above non-exporting firms, respectively. However, no statistically significant mean TFP difference was observed between exporting and non-exporting firms in the textile and wearing apparel industrial groups.

Overall, entering into exporting markets requires satisfying basic requirements such as competitiveness in price, quality, timelines and regularity in supply although the causality between exporting and TFP is still an empirical issue by its own merit. High transaction costs emanating from logistics could make penetrating foreign markets harsher than operating in the domestic market with, among other things, a privilege of a weighted average of 17.5% tariff shield. Apparently, therefore, it tends to imply that exporting requires being more productive.

4.4 TFP During and Post-Trade Reform Periods

The entire study period is divided into two trade regimes. The first period is between 1996 and 2002 during which tariff rates were continuously reduced. Assuming that firms do not instantly respond to tariff changes through their performance, the year 2003 was also considered as part of the first trade regime. After 2003, the country has not made visible tariff adjustment measures and the trade regime is more or less the same.

Table 10 shows TFP during and after trade reforms by different industrial groups. The overall TFP gain following trade reforms has not been observed at every individual industrial group.

Table 11 shows TFP levels during and after trade reforms by different attributes of firms. Besides product-based classification, disaggregation of firms by different attributes gives a more appealing result. Private firms, non-exporting, import-intensive and incumbent firms became more productive after the reform in a statistically significant manner.

Albeit exporters are also affected through the effect of tariff changes on relative prices of inputs and overall resource reallocation in the economy following trade regime change, the effect of trade liberalization directly targets non-exporting firms. In line with Melitz (2003) and Bernard et al. (2007), and consistent with empirical findings documented in Tybout (2000) and Dijkstra (2000), the removal of inward trade barriers might have bought what Muendler (2004) called 'competitive push' and improved TFP of non-exporting firms. Non-exporting firms might have removed different sources of inefficiency in the light of the existing policy condition. Pavcnik (2002) also finds within plant productivity improvements in the import-competing sector attributable to a liberalized trade.

Table 10: TFP Difference Between, During and After Trade Reforms by Industrial Group

Industrial Groups		2-group Hotelling's T-squared (F)-Test		Median Comparison Test	
		Mean	*P-value*	*% Firms Over the Median TFP*	*Pearson $X^2(1)$ Test (P-Value)*
Food & beverages	Up to 2003 (967)	4.74	0.89	50.1	0.90
	After 2003 (1413)	4.76		49.8	
Textiles & wearing apparel	Up to 2003 (428)	4.62	0.23	40.8	0.00
	After 2003 (238)	4.97		66.4	
Tanneries, luggage & footwear	Up to 2003 (377)	4.8	0.05	45.6	0.00
	After 2003 (219)	5.17		57.5	
Wood & furniture	Up to 2003 (844)	4.73	0.41	44.1	0.00
	After 2003 (547)	4.87		58.1	
Paper & printing	Up to 2003 (404)	4.21	0.00	34.4	0.00
	After 2003 (296)	5.11		71.3	
Chemicals & pharmaceuticals	Up to 2003 (294)	5.22	0.34	48.6	0.45
	After 2003 (176)	4.87		52.3	
Rubber & plastic	Up to 2003 (216)	4.46	0.32	45.8	0.00
	After 2003 (174)	4.66		55.2	
Non-metallic Mineral Products	Up to 2003 (542)	4.92	0.34	51.3	0.35
	After 2003 (382)	4.73		48.2	
Metals & Metallic Products	Up to 2003 (479)	5.23	0.34	40.3	0.00
	After 2003 (398)	5.03		61.6	
Total	Up to 2003 4999)	4.77	0.02	46.9	0.00
	After 2003 (3396)	4.94		56.0	

Source: Own Calculation based on CSA (Various Years).

Import-intensive firms improved their average TFP by about 10% after 2003, but resource-based industries operated at almost a similar level of TFP in both trade regimes. This result is consistent with the positive effect of the use of (high quality) imported intermediate inputs on plant level TFP as in the case of Kasahara and Rodrigue (2008) in Chile, and Fernandes (2007) in Colombia. The underlying cause for this difference in Ethiopia may be explained by shortages of raw materials in the local market. For instance, in the CSA (2008), most industries that suffered from scarcity of raw materials were those that depend on domestic resources. Of the firms that reported causes of below capacity operation—around 32% of food and beverages, around 67% of textile and wearing apparel, 32% of wood and furniture and 33% of non-metallic minerals firms—all attributed it to acute shortages of raw materials (ibid.). This is a manifestation of weak backward linkage between industry and the agricultural sector.

There has not been a statistically significant difference in TFP both among exiting and entering firms between the two trade regimes. Incumbent firms improved their average TFP level by about 4% after 2003. The trade reform has not also brought similar effects on different sizes of firms.

Table 11: TFP Difference Between, During and Post-Trade Reforms by Different Attributes of Firms

Industrial Groups		Trade Regime	Hotelling's T-Square Test		Median Comparison Test	
			2-group Mean	*P-value*	*% Firms above Median TFP*	*Pearson $X^2(1)$ Test (P-value)*
Ownership	Private	Up to 2003 (3981)	4.71		45.4	0.00
		After 2003 (2921)	4.90	0.01	56.3	
	State-Owned	Up to 2003 (1017)	5.00		47.5	0.03
		After 2003 (476)	5.16	0.80	54.0	
Output Market Orientation	Exporter	Up to 2003 (261)	5.34		44.8	0.01
		After 2003 (200)	5.77	0.12	56.5	
	Non-exporting	Up to 2003 (4737)	4.74		45.9	0.00
		After 2003 (3197)	4.88	0.04	56.1	
Input Market Orientation	Domestic Resource-Based	Up to 2003 (3385)	4.80		48.0	0.00
		After 2003 (2154)	4.81	0.97	53.2	
	Import-Intensive	Up to 2003 (1614)	4.69		41.9	0.00
		After 2003 (1242)	5.16	0.00	60.5	
Operational Status	Exit	Up to 2003 (328)	4.54		45.1	0.01
		After 2003 (228	4.46	0.74	57.0	
	Entry	Up to 2003 (609)	4.71		47.5	0.05
		After 2003 (374)	4.69	0.93	54.0	
	Incumbent	Up to 2003 (4062)	4.80		45.5	0.00
		After 2003 (2794)	5.01	0.01	56.6	
Size by Permanent Employment	Small	Up to 2003 (1069)	4.84		48.5	0.10
		After 2003 (608)	4.82	0.89	52.6	
	Medium	Up to 2003 (2269)	4.63		45.5	
		After 2003 (1566)	4.72	0.41	56.5	0.00
	Large	Up to 2003 (1661)	4.91		45.1	0.00
		After 2003 (1222)	5.27	0.00	56.6	

Source: Own calculation based on CSA (Various Years).

Smaller and medium firms operated in almost a similar pace after the reform as they were doing up to 2003. Firms with more than 50 permanent workers improved their TFP on average by about 7% after the reform. On the other hand, the median test showed a statistically significant difference between the two trade regimes among the different industrial groups except for smaller industries. Larger number of firms in almost all groups operated in higher level of TFP in post-reform period as compared to the transition period.

5. Conclusion

Theories and empirical evidences on the relationship between trade reforms and firm performance are mixed. Infant industry argument suggests the need for protection for local firms to have adequate period of learning and expansion before they are exposed to external competitive pressure. On the contrary, recent trade theories postulate that following trade reforms, unproductive firms exit out of the market and give way for new and more productive entrants; the reallocation of resources thereof towards more productive firms will raise industry-level productivity. Amidst of this controversy, Ethiopia undertook

several economic policy reforms since 1991 aimed at transforming the economic management from a socialist economy into market-oriented economy. These reforms include the reduction of tariff rates, removal of quotas, uplifting price caps and opening up the economy for private investment. The country is still waiting to undertake a second way of trade reform in its endeavour to join the WTO and the COMESA free trade area.

The main objectives of this paper was, therefore, to assess the change in TFP of manufacturing firms between the period of trade reform and afterwards. Based on data obtained from the CSA for the period between 1996 and 2007 on medium and large-scale industries engaging 10 persons or more, Cobb-Douglass production function was estimated using OLS, fixed effects, GMM and Olley and Pakes (1996) and Yasar et al. (2008) econometric techniques on a panel of 8395 firms. Essential econometric tests were carried out, and all estimates of the input variables' coefficients show signs consistent with the production theory. Slight differences in the magnitudes of coefficients have been observed across the different estimation techniques. The Olley and Pakes (1996) and Yasar et al. (2008) estimation was chosen to obtain TFP scores because of its inbuilt mechanisms of addressing simultaneity and selection bias.

TFP has heterogeneous magnitude across firms. Its distribution is skewed towards the left; showing high concentration of unproductive firms. Over the study period, chemicals and pharmaceuticals, metals and metallic products, and also non-metallic mineral products: all scored higher TFP scores as compared to other industrial groups in both median and mean difference tests, at least at 10% level of significance. On average, exporting firms were more productive than non-exporting firms, which is consistent with the recent theory; while incumbent firms performed better than exiting firms in a statistically significant level. Both smaller and large-scale firms performed better than medium-scale firms; perhaps partly because of the ownership structure and policy environment favouring mainly smaller firms.

The industrial sector became more productive in the post-reform period in both mean and median group difference tests, although improvement in TFP has not been uniformly seen across all industrial groups. In 6 of the 9 industrial groups, more than 50% of the firms scored higher than the median TFP level in statistically significant level. Most reform performance of tanneries, luggage and footwear, and paper and printing industries has been better in statistically significant level in terms of both mean and median tests.

Private firms, import-substituting and import-intensive industries have become more productive in the post-reform period than before. As against the predictions of dominant contemporary trade theories, exporting firms have not shown a statistically significant TFP improvement during the post-reform period. Despite that almost all exporters are local resource-based industries, the scarcity of raw materials has been the main constraint for their stagnant performance.

Thus, the causes for weak linkages between industry and agriculture sectors should be investigated and duly addressed to improve the performance of domestic resource-based industries in general, and exporting firms in particular. Despite better achievements during the entire period, the performances of smaller firms also become equally stagnant as medium-sized firms in the post-reform period. This calls for addressing underlying causes for low performance of these firms, including the scarcity of raw materials, lack of access to finance and also market-related problems. By so doing, it is possible to minimize the number of firms exiting out of the market without compromising the overall productivity improvement of the sector.

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