Addis Ababa University, Ethiopian Journal of Business and Economics, EJBE Vol.8, No. 2
Doi: http://dx.doi.org/10.4314/ejbe.v8i2.2 p-**ISSN**: **2311-9772** **e-ISSN: 2410-2393**
Available online: http://ejol.aau.edu.et/index.php/ejbe and https://www.ajol.info/index.php/ejbe

The Quest for Firms' Productivity in Strategic Industries in Ethiopia: Evidences from Growth and Transformation Plan

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Abstract

The Ethiopian government has launched and implemented a five-year Growth and Transformation Plan (GTP) in two waves in 2010 and 2015 with the primary objective of enhancing economic transformation through strategic gear shifter industries. However, there is no due attention to productivity and rigorous examination, despite the massive financial injection. This study, therefore, aims to examine the driving forces of firms' productivity using different methods, including panel data modeling, Levinsohn & Petrin, difference GMM, and system GMM estimation techniques. The study finds that operational labor exhibited negative and insignificant relations with firms' productivity. Capital shows a positive influence on firms' productivity, with a higher production coefficient. Moreover, the difference in GMM results between local and imported materials shows a positive influence on firms' productivity. Imported materials, on the other hand, show higher output, putting upward pressure on firm productivity. In contrast, fuel has a positive impact on firm productivity. It draws due attention to some key areas in which policy promotes industrial linkage and manufacturing competitive products and that promotes electric infrastructural development.

Keywords: Manufacturing, TFP, simultaneity Bias, GMM Estimator, LP Model

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Introduction

The overall economic advancement that maintains its structural balance and growth performance has remarkably been exhibited in the developed world. Yet, it has been incoherently increased in developing nations. In particular, the African continent exhibits inconsistent economic structure and economic growth performance since the nations' economies rely heavily on non-industrial and manufacturing sectors (World Bank, 2015a). The average manufacturing GDP share of Sub-Saharan Africa for the years of 2000 and 2015 was 11%, which is smaller than the same years' global average of 17% (World Bank, 2017) and engaged only 6.6% of the region's employed labor force (World Bank, 2010) Hence, this creates wide permanent income level differences among the industrialized and non-industrialized nations.

The level of productivity of value-added sectors can be considered as a cause for this significant variation, and hence it affects the overall enhancement of the economies in the region (Arrow K., 1962). Moreover, production inputs, technical efficiency, total factor productivity, technology, human capital, and a stock of knowledge are indispensable sources of productivity but are still fully inaccessible for catching up in developing nations (Smolny, 1996a). Ethiopia is among the developing nations found in the sub-Saharan region, which have experienced depressed economic performance in general and in the manufacturing sector in particular. As a result, the nation has inherited instability, inconsistent growth, and slow economic transformation, which has become the global agenda (Rahmato, 2004; Chole, 1992; Zerayehu & Peter, 2014).

Prebisch and Singer (1950) proved that the manufacturing sector has long been considered as the vital engine for economic growth and structural transformation. To realize this, the Ethiopian manufacturing firm has been promoted since the imperial period to date by adopting variable and unsustainable economic policies (MoFED, 2002). For the last 15 years, the current regime has promoted export-led industrial development in order to achieve structural transformation and economic transition. However, the reality has shown that the manufacturing sector has passed decades with its infancy and limited share, with a 4.8% share in GDP on average (NPC, 2016; Zerayehu & Peter, 2014). The sector has existed with poor performance and low productivity; consequently, it has lost the power of competition with global export-oriented firms and imported production commodities (NPC, 2016; AACCSA, 2015). The entire economy is not able to make competitive technological innovation and has a limit in knowledge together with technology transfer from abroad (Chole, 1992; Rahmato, 2004). This study is thus expected to find out how these determinants vigorously influence the productivity of Ethiopian manufacturing firms, specifically for export-oriented import substitution firms, which have been strategically incorporated into the growth and transformation plan.

Theoretical Literature Review

The associated literature is somewhat compatible with low-developed economies, which exploited the determinants of manufacturing firm productivity, largely existing and explained in developed economies (Bartelsman, 2004; Siegfried & Evans, 1994; Smolny, 1995a; Kim & Kwon, 1977; Berndt & Khaled, 1979; Jorgenson & Grilliches, 1967). Hence, related literature for this firm-level TFP study is consistently integrated as follows. The Neoclassical Solow (1956 and then 1957) growth models examined economic growth and the change in firm-level productivity. In particular, Solow's 1957 seminal paper originated the analysis on total factor productivity (TFP) and measured its effect on manufacturing firms' productivity using the growth accounting approach as a standard (Solow R., 1957). The standard growth theory has manifested the related firm-level production function with the neoclassical Solow growth model, indicating the firms' output productivity growth through the combination of physical capital and labor inputs only, assuming the technology is employed by the two-factor inputs of Solow (1957). It also considered an exogenous dynamic increase in the technical efficiency of capital and labor and assumed a constant return to scale of the given inputs (Solow R., 1957). The factor inputs in the given theory determine the output growth elasticity and technical efficiencies or residuals calculated from the share of factors' income.

Mankiw et al. (1992) exhibited the quality change in the two-factor inputs using Lucas's (1988) model or Solow's augmented growth model with human capital, capturing cross-section nations' economies data, and achieved more success than the standard model in the firm-level output productivity and ensured the prominent influence of using human capital as the third production factor and hence investing in its return through firm productivity. Augmenting the traditional slow growth theory with human capital, Romer (1986) and Lucas (1988) explained the substantiality of investment in human and physical capital to accelerate the change in technology. Mankiw et al.

(1992) extended as an investment for firm labor force qualification in developed economies a threshold that exceeded that of investing in physical capital.

However, the standard growth accounting theory, even though it could be augmented with human capital, left other observed variable inputs that exerted influential power in total factor productivity unexplained and collided with estimation crises (Smolny, 1995ab and 1996ab; Olley & Pakes, 1996). Prior to the emergence of traditional OLS, Marschak and Andrews (1944) applied an intuitive measurement model for estimating the relationships between input levels and unobserved firm-specific productivity shocks in the production function parameters. This estimation approach indicated that as more input was consumed, firms positively responded to a large productivity shock. Olley & Pakes (1996) discriminated against the traditional Solow ordinary least square total factor productivity estimator within the production function framework as it created biased parameter estimates on firm productivity. The chosen factor inputs and firm productivity through the effect on total factor productivity are more likely to be correlated. As a consequence, endogeneity bias occurred when estimating with the production function at the firm level, and Olley & Pakes (1996) demonstrated that using a balanced panel given no sufficient room for firm entry and exit, the estimation underwent selection bias (Olley & Pakes, 1996) Leaving this incident common, Katayama (2009) challenged the practical proxying for a firm-level price by taking the deflators at the industry level. Yet, a tremendously balanced panel of firm-level research is displayed as measuring total factor productivity using the traditional residual approach becomes apparent. Subsequently, Olley & Pakes (1996) proposed an improved total factor productivity measure using firm-specific input-output deflators controlling industry, location, and time.

Using Ericson and Pakes' (1995) explained total factor productivity estimation techniques, Olley and Pakes (1996) developed a dynamic model in firm behavior that allowed for characteristic shocks on productivity, including firm entry and exit models within the framework of the Cobb-Douglas production function. This model is formulated with a consistent semiparametric estimator of firms' productivity, solving simultaneity bias using firms' investment decisions as a proxy for unobserved production shocks. An integrated firms' exit rule serves to minimize selection bias in the estimation techniques of Van Beveren (2010). Comprehensively, Olley and Pakes examined the productivity of manufacturing firms by adding firm size and age, human capital, research and development or innovation, and market integration, together with power supply and crime or corruption, as an input into the production function, Levinsohn & Petrin (2000) and Van Beveren (2010). Levinsohn & Petrin (2003) developed a more compatible model of measuring firms' productivity through total factor productivity by extending the semiparametric and dynamic theories of Olley & Pakes (1996) to include intermediate input as a proxy instead of an investment. The theory refuted the monotonic nature of the previous model, which only observed and estimated the positive aspects of investment on firm productivity. Taking the strict productivity-increasing aspects of investment by a dynamic model resulted in a significant loss in efficiency, as the theory demonstrated. Furthermore, the validity might be dependent on the availability of firms' data.

Fernandes (2008) deployed the modified model of Olley & Pakes (1996) by Ackerberg et al. (2007) or the ACF production function estimation approach The ACF alteration focused mainly on labor input choice timing. Labor and its share of skilled workers lack freedom of variability in the Olley & Pakes (1996) estimation technique. To them, labor input is assumed to be selected at a sub-period after the firms' capital has moved towards existence but before the investment is chosen. Expected productivity might also limit labor input.

Empirical Evidence

Discerning the traditional Solow's Standard growth accounting model and then developing their dynamic approach, Olley & Pakes (1996) measured the determinants of firm productivity through total factor productivity, collecting firm-level input and output deflators and making industry, location, and year-fixed effects as the control variables, Levinsohn & Petrin (2003) The finding indicated that as firm size is negatively correlated with total factor productivity, inverse-U shaped correlation has been exhibited with firm age and total factor productivity, human capital, and research and development, creating a positive relationship with firms' total factor productivity and qualitatively increasing the firms' productivity growth. Moreover, global integration enhanced total factor productivity within the existence of firms' absorptive capacity; this finding resulted as technological advancement increased total factor productivity, scarcity in the supplies of power, and committing more crimes exhibited a loss in total factor productivity. Contrary to Levinsohn & Petrin (2003), Smolny (1995a) found the positive effect of firm size (i.e., large firms) on firm productivity growth using an augmented growth accounting approach within a production function framework for a firm-level panel of manufacturing firms in West Germany.

Using a firm-level unbalanced panel and estimating with the semi-parametric approach, Canfei & Rudai (2013) exhibited that government subsidies, as well as bank loans, created an unclear correlation with firms' total factor productivity. However, the authors reported that key industrial support by the government together with firm-specific subsidies and bank loans is shown to be more productive in Chinese manufacturing firms. Following the firm-level econometric model of Evans (1987a), using annual census-based data from 1996 to 2003, Bigsten & Gebreeyesus (2007) analyzed the relationship between firm growth and firm attributes, which included firm size, age, as well as firm productivity in Ethiopian manufacturing firms. The analysis used pooled OLS for estimating firm growth models and the system GMM estimation method developed by Blundell & Bond (1998) for controlling unobserved heterogeneity and endogeneity effects in firm growth and size association. Moreover, the authors explored whether the firm growth rate of Ethiopian manufacturing is consistent with the law of proportionate effects (LPE), as defined by Mansfield (1962).

This longer panel data set resulted in the smaller firms growing faster than relatively larger firms, in divergent with Gibrat's law, and this side effect is somewhat similar to the empirical result of Levinsohn & Petrin (2003). It indicates the significance of the learning effect and is in contrast with the empirical result of Canfei & Rudai (2013) 'firm dynamics in China estimated through Olley & Pakes' (1996) model, that younger firms exhibit less productive than the older ones, i.e., competition effect dominated the learning effect for Chinese manufacturing so far in Ethiopian firms. Although the dissimilarity of models they used existed, Levin & Petrin (2003) exhibited similar results with Canfei & Rudai (2013), contrary to Bigsten & Gebreeyesus (2007) for Ethiopian manufacturing. Moreover, the study also found that labor productivity and capital intensity positively affected the growth of Ethiopian manufacturing firms.

Rama and Simon (2015) investigated the determinant of Ethiopian manufacturing firm performance, taking labor productivity as a dependent variable, using two years of panel data, estimating within the framework of the Cobb-Douglas production function, and using fixed effect regression. The empirical findings under fixed effect regression indicated that firm size, capital intensity, as well as human capital brought significant effects on firm performance through labor productivity, and this showed agreement with Bigsten & Gebreeyesus (2008) firm growth effect. The positive relationship between firm size and labor productivity raised a negative argument with the empirical result of Bigsten & Gebreeyesus (2007) as well as Levinsohn & Petrin (2003) and Fernandes (2008)' firm growth correlation. However, both Rama & Simon (2015) and Bigsten & Gebreeyesus (2007) originated similar consequences for the shock of human capital and capital intensity on firm productivity and growth respectively.

Fernandes (2008) discovered that there are more factors besides business size, age, and experienced managers that have an impact on firm productivity. Total factor productivity was higher for exporting businesses than for domestic businesses, and it showed positive productivity for businesses with quality certification and businesses with overdraft facilities. Research and development, bank loans other than overdrafts, differences from Canfei & Rudai (2013) for Chinese state-owned enterprises, problems with the power supply, the presence of corruption, and location, on the other hand, adversely linked with total factor productivity. Fernandes (2008) used panel data from Bangladesh manufacturing firms to investigate production function estimate model using conventional OLS and fixed effect methods. State-owned businesses and locally held businesses' poorer productivity

Wodajo & Senbet (2013) probed the level of productivity and regional concentration of large and medium-scale firms in Ethiopian manufacturing, disaggregated as public and private, using a firm-level panel over the period 2003 to 2005. The investigation deployed the Cobb-Douglas production function framework, estimating through traditional OLS, fixed effect (FE), and generalized method of moments (GMM). The authors found regional variations of firms and significant effects of capital intensity and production capacity across the region's firms. They also indicated that public firms accessed more indirect and material inputs than private firms while increasing their output. However, GMM estimation exhibited a statistically insignificant effect of productivity between the two entities. As Fernandes (2008) strongly promoted, firm total factor productivity together with injected capital exhibited an irrelevant correlation with public firms' productivity, contrary to private firms. Moreover, physical capital and intermediate inputs created a positive effect on the productivity of private firms, and the correlated result of intermediate input pointed out similar inference with the positive link of imported intermediate inputs explored by Girma (2014) for Ethiopian manufacturing firms' productivity. He used a firm-level panel undergrowth accounting model in the framework of production function and with the estimation of dynamic and static effects independently. However, this finding indicated a small number of firm productivity gains and limited absorptive economic capacity since the import-to-GDP ratio exhibited an extremely high level. The ratio of imported intermediate input to local input is weighted incredibly far above the ground.

Thanapol (2015) investigated firm productivity through total factor productivity determinants in Thai manufacturing industries using firm-level panel data. The author measured the Cobb-Douglas production function using different estimation techniques which built-in traditional ordinary least square (OLS), fixed effect (FE), and random effect (RE) together with the Levinsohn & Petrin, 2003 approach for comparison. Similar to Bigsten & Gebreeyesus (2007), the discovery revealed that small firms related positively to total factor productivity and exhibited higher productivity than the larger firms in Thailand. Firm age was exposed to negative effects with total factor productivity, skilled labor, and productivity exhibited significantly positive relationships. Productivity indicated a positive link with private and head branch types of firms on average. Wodajo and Senbet (2013) established agreeable results in the effect of experienced labor and private firms on Ethiopian manufacturing using the same estimation method. Findings further exhibited a negative effect of firms in the central region on total factor productivity due to less competition in its total sales, as Agarwal (1998) and Agarwal & Audretsch (2001) confirmed the less promoted link between market size and market structure on Chinese firm productivity across the region.

Unlike Olley & Pakes' (1996) semi-parametric estimation model of proxy investment, Thanapol (2015) captured intermediate inputs as a proxy using the developed Levinsohn & Petrin (2003) estimating techniques. Thanapol (2015) used the Levin and Petrin (2003) model and obtained smooth productivity shock greater than the response from unobserved shock in investment proxy, competing with the Olley and Pakes (1996) production function estimation and sharing the Arnold (2003) idea. This research deals with the Levinsohn & Petrin model and other techniques used by Thanapol (2015) for Thai firms to estimate the TFP and its determents for Ethiopian firms empirically and systematically using parametric and semiparametric estimators of production function and through the examination of determinants in total factor productivity. The ordinary least square, fixed effect, and random effect provide the robustness estimation needed proviso Levinsohn & Petrins (2003) theory performs as expected using the firm-level panel data over the period from 2006 to 2015.

Theoretical Model Specification to Estimate Productivity

Measuring Productivity:

The study uses the developed version of Solow's (1957) residual growth accounting approach by Levinsohn & Petrin (2003). Consider the establishment level of productivity measured by firms' output using deflated sales or value-added at basic price, creating a functional relationship with its correspondent inputs, i.e., $Y = f(A, K.L.M, P)$ where **Y** denotes firms' output, **K** indicates firm-level capital stock, **L** stands for labor, **I** denote firms' intermediate input, P denotes power, and **A** stands for the firms' TFP/residuals not explained by the firms' inputs. This functional relationship can be expressed in the form of the Cobb-Douglas production function as follows.

$$Y_{it} = A_{it}K_{it}^{\beta k}L_{it}^{\beta l}M_{it}^{\beta m}P_{it}^{\beta p} \quad \ldots (1)$$

Labour (L) is decomposed as operational labor (l), managerial and technical labor (sl), and material (M) is also decomposed into local material (lm) and imported material (im). Finally, the power energy indicator (P) decomposes to electric power (ep) and fuel (fuel), in which inputs other than labor and capital are characterized as intermediate inputs of the given firm. Hence, the natural log derivation of Equation (1) gives a linear production function as

$$lnY_{it} = \beta_0 + \beta_l lnl_{it} + \beta_{sl} lnsl_{it} + \beta_k lnk_{it} + \beta_{lm} lnlm_{it} + \beta_{im} lnim_{it} + \beta_{ep} lnep_{it} + \beta_f lnf_{it} + \varepsilon_{ijt} \quad \ldots (2)$$

Levinsohn & Petrin (2003) computed the Solow (1957) $residual$ $\ln A_{it}$ as

$$lnA_{it} = \beta_0 + \varepsilon_{it} \quad \ldots (3)$$

Where β_0 is to measure the mean efficiency level across the firm over time, ε_{it} shows the time and producer specific deviation from the mean and they further decomposed ε_{it} into unobservable and observable components of v_{ijt} and μ_{ijt}^{q} respectively. Where $\boldsymbol{\beta_{0+}v_{it} = \omega_{it}}$, represents firm-level productivity /Solow residual or technical efficiency which is not directly observable and μ_{it}^{q} indicates unexpected deviations from the mean due to measurement error. Van Beveren (2010) has empirically approved this by measuring unobservable productivity shock. Therefore, the TFP estimation models of production function serve as the initials to the whole next steps are given as;

$$lnY_{it} = \beta_0 + \beta_l lnl_{it} + \beta_{sl} lnsl_{it} + \beta_k lnk_{it} + \beta_{lm} lnlm_{it} + \beta_{im} lnim_{it} + \beta_{ep} lnep_{it} + \beta_f lnf_{it} + \upsilon_{it} + \mu_{it}^q. \quad (4)$$

The expected firm-level productivity $\widehat{\omega}_{it}$ could then be computed as;

$$\widehat{\omega}_{it} = \hat{\upsilon}_{it} + \hat{\beta}_0 = \hat{Y}_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_{sl} sl_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_{lm} lm_{it} - \hat{\beta}_{im} lm_{it} - \hat{\beta}_{ep} ep_{it} - \hat{\beta}_f f_{it} \quad .... \quad (5)$$

The firms' productivity in levels can then be calculated as the exponential of $\widehat{\omega}_{ijt}$ which is indicated by $\widehat{\Omega}_{ijt}$ and hence derived as $\widehat{\Omega}_{ijt} = \exp(\widehat{\omega}_{ijt})$ and the productivity measure resulting from equation (5) uses for evaluating the influence and impacts of various policy variables at the firm level and aggregated firm-level TFP computes an industry level total factor productivity through the summation of (Olley & Pakes, 1996) firm-level output shared weighted average $\widehat{\Omega}_{ijt}$.

Estimating productivity:

The study adopted the developed theory of Olley & Pakes (1996) to estimate firm-level total factor productivity and compared the results with the estimating results of pooled OLS, Fixed Effect, and Blundell-Bond GMM estimators. This recent version of the TFP measure approach serves mainly to capture the intermediate input variables that retard productivity in Ethiopian manufacturing firms (AACCSA, 2015).

This Solow (1957) residual approach is a foundation for other productivity estimating techniques both at the macro level, industry level, and firm level. That is, to calculate firms' productivity as a residual, the estimated output is deducted from the actual output. However, estimating equation (2) using OLS leads to biased productivity estimates caused by endogeneity and simultaneity of input choices and selection bias. As first detected by Marschak and Andrews (1944), the ordinary least square technique considered inputs exogenously in the production function instead of within the firms' characteristics, including firms' efficiency. Following the traditional OLS, various other methods have been invented to solve the recognized biases. Fixed and random effects, instrumental variables (Griliches & Mairesse, 1995; Levinson & Petrin , 2003), as well as the "difference" GMM of Arellano & Bond (1991), and the extended "system" GMM of Blundell & Bond (1998), are among the invented estimating approaches adopted in this study for comparison. To minimize this, Pavcnik (2002) and Levinsohn & Petrin (2003) estimated Equation (4) using fixed-effect techniques, considering plant-specific and time-invariant as follows.

$$Y_{it} = \beta_0 + \beta_l l_{it} + \beta_{sl} sl_{it} + \beta_k k_{it} + \beta_{lm} lm_{it} + \beta_{im} im_{it} + \beta_{ep} ep_{it} + \beta_f f_{it} + \omega_{it} + \mu_{it}^{q} \quad \ldots.(6)$$

Starting from its introduction through the empirical works of Mundlak (1961) and Hoch (1962), the fixed effect model overcomes simultaneity bias by using only the within-firm variation in the sample and eliminates selection bias caused by the endogenous exit. However, the estimation of equation (6) leads to low capital coefficient estimates and creates enormous variation between balanced and unbalanced sample coefficients (Olley & Pakes, 1996). It is also not able to choose inputs in reaction to a productivity shock since it imposes strict homogeneity in heterogeneous firms (Wooldridge, 2009).

Following the estimator works of Arellano & Bond (1991); Arellano & Bover (1995) and Blundell & Bond (1998), slows down the time-invariant nature through the decomposition of firms' productivity into fixed and autoregressive AR (1) components, achieving the coefficient more consistently by cleansing the inherent endogeneity bias of the estimated firms' TFP. This consistency has been maintained through instruments of independent variables and lagged dependent variables, which face the endogeneity bias. Arellano and Bond (1991) specified the "difference" GMM for estimating the small-time series and large cross-section panels with linear functional relationships as;

$$Y_{it} = \beta_0 + Y_{it-1} + \beta_l l_{it} + \beta_{sl} sl_{it} + \beta_k k_{it} + \beta_{lm} lm_{it} + \beta_{im} im_{it} + \beta_{ep} ep_{it} + \beta_f f_{it} + \omega_{it} + \mu_{it}^{q} \quad ..(7)$$

Equation (7) estimates the current and twice the lag of dependent variables and capital, all labor variables with the inclusion of electric power and fuel energy. Moreover, it also adds the current and their lags of local and imported materials, and it is with the "GMM"-style and "IV"-style to all variables. Blundell & Bond (1998) developed the "system GMM" estimating model, extending the AB estimator and mitigating the model weaknesses detected earlier by Arellano & Bover (1995). That was, the lag levels in the AB estimator resulted in poor instruments for the first differenced variables. Blundell and Bond re-estimate equation (7) as follows to avoid the detected poorness:

$$Y_{it} = \beta_0 + Y_{it-1} + \beta_l l_{it} + \beta_{sl} sl_{it} + \beta_k k_{it} + \beta_{lm} lm_{it} + \beta_{im} im_{it} + \beta_{ep} ep_{it} + \beta_f f_{it} + \omega_{it} + \mu_{it}^{q} \quad \ldots(8)$$

Finally, the study considered the Levinsohn & Petrin (2003) estimating model deployed in this study relied on intermediate inputs as a proxy for unobserved productivity of the firm because of its monotonic nature, which has been made as an alternative to the investment proxy in Olley & Pakes (1996):

$$Y_{it} = \beta_0 + \beta_l l_{it} + \beta_{sl} sl_{it} + \beta_k k_{it} + \beta_{lm} lm_{it} + \beta_{im} im_{it} + \beta_{ep} eP_{it} + \beta_f f_{it} + \omega_{it} + \mu_{it}^q \quad \ldots \ (9)$$

Where Y_{it} is for indicating the log of value-added in year t and $lm + im + ep + fuel$ are intermediate inputs (I). In this study, these inputs can easily be expressed as a function of capital and productivity as, $I_t = I_t(k_t, \omega_t)$ and this can be inverted to express unobserved productivity into an observable function;$\omega_{it} = s_t(k_{ijt}, m_{it}, P_{it})$ where, $s_t(.) = m_t^{-1}(.), P_{ijt}^{-1}(.)$.Hence, rewriting equation(7) can be done taking material and energy as a proxy as follows;

$$Y_{it} = \beta_l l_{it} + \beta_{sl} sl_{it} + \beta_k k_{it} + \beta_{lm} lm_{it} + \beta_{im} im_{it} + \beta_{ep} ep_{it} + \beta_f f_{ijt} + s_t(k_{it}, lm_{it}, ep_{it}) + \mu_{ijt}^q \ (10)$$

Then $s_t(m_{it}, k_{it}) = \beta_0 + \beta_m m_{it} + \beta_k k_{it} + \omega_{it}(m_{it}, k_{it})$ and equation (8) can also be estimated by substituting third order polynomial in $m_{it} and\ k_{it}$ in place of $s_t(m_{it}, k_{it})$ using OLS to make consistent parameter estimation of the firm value-added as

$$Y_{it} = \delta_0 + \beta_l l_{it} + \beta_{sl} sl_{it} + \beta_{im} im_{it} + \beta_f f_{ijt} + \sum_{i=0}^{3} \sum_{j=0}^{3-i} \delta_{ij} k_i^t lm_j^t ep_i^t + \mu_{ijt}^q \quad \ldots\ldots\ldots \ (11)$$

Extended Model Specification on the Driving Forces of Productivity

The study defines industry- and firm-specific TFP determinants based on the aforementioned assumptions. These determinants are largely inherited from factor inputs and the technical efficacy of the businesses' inputs (Fernandes, 2008; Canfei & Rudai (2013); Smolny, 1995a).

$\boldsymbol{Y_{it}}$=**f**$(Technical\ efficiency, factor\ inputs)$.. (12)

The study bases its definition of the industry- and firm-specific TFP determinants on the presumptions described above. These factors are generally passed down through factor inputs and the technological efficacy of the inputs used by the enterprises (Fernandes, 2008; Canfei & Rudai (2013); Smolny, 1995a).

$\boldsymbol{\omega_{it}}$=**f**$(factor\ inputs)$.. (13)

The firms' factor inputs, which are transformed into output through the level of knowledge and technology, provide more productivity, and the traditional approach decomposes these inputs like labor and capital together with their technical efficiency (Solow R. , 1957) .

$\boldsymbol{\omega_{it}}$=**f**$(labor, capital)$.. (14)

The importation of capital goods increased the firms' capital stock. However, the foreign exchange deficit of an individual nation always constrained this import and this weakened the firms' technological efficiency. Thus, the model equation is modified as follows:

$\boldsymbol{\omega_{it}}$=**f**$(labor, capital\ stock)$.. (15)

The capacity in knowledge and experience make a separation among the workforce of manufacturing firms (Van Beveren, 2010). Hence, the equation is expanded as

$\boldsymbol{\omega_{it}}$=**f**$(\ unskilled\ labor, skilled\ labor, capital\ stock)$.. (16)

The recent theories on the estimate of the firm's production function shown as an intermediate input raised the firms' TFP and serves as a proxy for unobserved productivity shock. Consequently, it helps to reduce or avoid the potential correlation between input levels and this unexplained firm-specific productivity (Levihnsohn & Petrin, 2000; Levinsohn & Petrin, 2003; Fernandes, 2008; Van Beveren (2010) As a result, the equation is extended as;

$\boldsymbol{\omega_{it}}$=**f**$(\ unskilled\ labor, skilled\ labor, capital\ stock, intermediate\ input)$............ (17)

Manufacturing firms need material and energy inputs which incorporated with intermediate input are the major sources for productivity (Levinsohn & Petrin, 2003) and it could further decompose as;

$\boldsymbol{\omega_{it}}$=**f**$(\ unskilled\ labor, skilled\ labor, capital\ stock, material, energy)$.................. (18)

Since limited availability always existed in domestically manufactured material inputs, heavy reliance on imported material input has put behind the productivity of Ethiopian manufacturing firms (Girma, 2014) As a result, the above equation is expanded as

ω_{it}=f($unskilled\ labor, skilled\ labor, capital\ stock, local, \&imported\ materials. energy$)

---------(19)

The sources of energy that affect firms' productivity through TFP are derived from electric power and fuel energy and hence, the above equation is written as;

ω_{it}=f($unskilled, skilled\ lab, capital\ stock, local, \&imported\ materials, electricity, fuel$) ………. (20)

Equation (4) in the study's estimation of the given model was used to base the other model results on the standard OLS. Equations (6), (7), (8), (9) and equation (10) come next (10). Equation (5) has produced an expected estimation for the analysis of the TFP performance of enterprises.

Table 1

Variable Definition and Relationship with Firms' TFP

Variable	Definition	Expected Sign
Ln_l	Natural log of the Firm's operational labor in the production process, direct labor force to the firm Groups.	+ ve
ln_sl	Natural log of managerial and technical labor proxies by skilled labor (Fernandes, 2008).	+ve
Ln_k	Natural log of capital stock i.e., the average values of firms' fixed assets fewer Depreciation values at the beginning plus end of each year to measure capital.	+ve
Ln_lm	Natural log of locally produced raw material input	+ve
Ln_ln	Natural log of imported raw material input	+ve
Ln_ep	Natural log of the firms' electric power consumption. It is a bill amount paid by firms.	+ve
Ln_fuel	Natural log of fuel costs consumed by the firms to gain energy including Charcoal and others.	+ve

Source: Own compilation based on literature

Econometric Results, Discussion, and Analysis

The descriptive statistics summary of central tendency aids in determining the degree of variability for each variable both generally and between and within the model. The mean value displays the average value of each variable, with managerial and technical labor having a lower mean value and businesses' value-added having a higher mean value. The standard deviation, which depicts how close the data are to the mean value, can also convey the distribution of data around the average value. Moreover, by measuring the fluctuation between the minimum and maximum values, the range also offers some indication regarding the dispersion of data. The ln-va, which represents the value-added of Ethiopian enterprises, underwent with overall increased heterogeneity and within lower variation in this condensed analysis. Additionally, businesses use the most fuel overall.

Table 2

Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
ln_va	overall	14.17612	1.694188	7.146772	18.04817	N = 268
	between		1.43101	11.01689	16.86826	n = 28
	within		.9614211	9.240872	16.88015	T-bar = 9.57143
ln_l	overall	7.369738	1.628326	3.218876	11.56172	N = 268
	between		1.626899	4.240783	10.46268	n = 28
	within		.5492006	5.196032	9.27644	T-bar = 9.57143
ln_sl	overall	5.896983	1.591145	2.079442	9.55393	N = 268
	between		1.585968	3.064525	9.298898	n = 28
	within		.5451652	3.82483	7.678122	T-bar = 9.57143
ln_k	overall	14.49083	1.891053	1.733424	18.3809	N = 268
	between		1.585617	11.73244	17.38693	n = 28
	within		1.093648	4.26154	17.08072	T-bar = 9.57143
ln_lm	overall	13.38866	2.543637	.7080358	17.9697	N = 268
	between		2.31195	6.445014	17.3882	n = 28
	within		1.608611	2.115166	17.84106	T-bar = 9.57143
ln_im	overall	14.08854	2.079982	3.678829	17.6699	N = 268
	between		1.733714	10.07453	16.56741	n = 28
	within		1.224165	4.566408	17.4593	T-bar = 9.57143
ln_ep	overall	10.1746	2.796373	.0198026	15.13192	N = 268
	between		2.003658	4.978633	13.40719	n = 28
	within		2.168213	1.35587	14.4551	T-bar = 9.57143
ln_fuel	overall	10.67643	3.074491	.2851789	15.71911	N = 268
	between		2.332388	5.165298	14.78317	n = 28
	within		2.268616	-.3925372	14.56832	T-bar = 9.57143

Source: Stata Output

Comparative analysis on the Econometric Results of Estimators

The traditional ordinary least square model result serves as a point of reference for comparing other previously stated models implemented to this estimate of firms' TFP and all of the estimators reported in table 3 below.

Table 3

Production Function Estimate Results

Variable inputs	Coefficient and Robust SD Results of Models				
	OLS	FE	Difference-GMM	System-GMM	LP
L_1 ln-va			-0.171* (.087)	0.321***(0.083)	
Ln_l	-0.280* (0.160)	0.143 (0.172)	0.125 (0.138)	-0.123 (0.158)	-0.354**(0.172)
Ln_sl	0.390**(0.162)	0.256(0.208)	0.439**(0.181)	0.332**(0.155)	0.409**(0.202)
ln-k	0.405***(0.108)	0.208***(0.075)	0.120** (0.051)	0.240** (0.087)	0.392***(0.117)
L_1.ln-k			-0.104* (0.051)	-0.111*(0.058)	
ln_lm	0.055 (0.042)	0.005 (0.026)	0.071* (0.035)	0.014 (0.035)	0.019 (0.064)
ln_im	0.223*** (0.057)	0.272*** (0.075)	0.233** (0.085)	0.267** (0.086)	0.194** (0.086)
ln_ep	-0.093* (0.048)	-0.027 (0.038)	-0.047 (0.049)	-0.012 (0.046)	-0.046 (0.048)
ln_fuel	0.106** (0.040)	0.003 (0.039)	0.029 (0.056)	-0.002 (0.054)	0.091** (0.043)
L_1.ln_fuel			-0.114* (0.062)		
Wald test		437.43			8.69
X^2 Statistics	71%		248.38	172.24	
Hausman P-Value			8.2	13.11	
Observation	268	268	180	238	268
Adjusted R^2	69%	68%			

Source; Author's computation based on regression results of estimators

*Note: *** and** as well as * represent 1%,5%, and 10% levels of significance respectively and the total values of TFP used in this table are found in the appendix section.*

In the short run, a fixed effect estimator produces constant estimates of the labor, capital, and intermediate input coefficients and is used to correct simultaneity bias, according to theoretical literature (Levihnsohn & Petrin, 2000; 2010; Van Beveren (2010). However, the capital coefficient is anticipated to be larger and the labor and material coefficients to be lower, respectively.

Unfortunately, the inside estimator did not yield any significant explanatory variable coefficients for this manufacturing TFP in 71% of the cases. The results of Thai Manufacturing Firms' TFP were shared by the significant coefficients, nevertheless (Thanapol, 2015) The capital and imported material coefficients have received substantial results from the fixed effect estimator, allowing for the measurement and analysis of the TFP of the enterprises. Every scenario will typically indicate an increase in the estimated parameter coefficients.

As the result shows the p-value (Prob > F) in the fixed effect model indicated 100% sufficiency of the model for measuring the firms 'total factor productivity and R^2 shows 38% within, 75% between as well as 64% overall effects. As the within effects of this estimator is the lowest among the R^2 effects, it entails fewer benefits of individual and short-run effects to firms' TFP than the overall effect. The corr (u_i, Xb) = -0.0224 proves the assumption of within the estimator model since it negatively correlates the error term with explanatory variables. Only capital and imported raw materials in which both are significant at a 99% confidence level and at a 5% level of significance respectively and are less adequate to explain the firm's TFP.

Strong "difference By establishing 138 instruments (IV-style instruments), 9 of which coincide with the given explanatory factors aside from the lagged dependent variables, the GMM model is sufficient to measure the given data with prob> F= 0.0000. The lagged value-added instrument, which has been designated as the "GMM style" instrument, has a coefficient (L1=0.171, L2=0.010) that is within the acceptable bounds for dynamic stability. The model also creates 117 over-identifying constraints, where the number of constraints corresponds to Hansen J degree of freedom and the test's P-value is considered as Hansen-p. A dependent variable's (ln va) defined lag duration, which influences its lag coefficient, displays a maximum of two periods. The second, value-added and capital lag as well as the lags for domestic and imported raw materials.

The one-step "System GMM" estimator result in annex 8 also exhibited "GMM-type" instruments for both first differences and level equation separately, with 202 instruments. The model shows sufficient to estimate the given TFP data that its prob > F = 0.0000 and F(14 27) = 172.24. Moreover, the model generates 187 over-identifying restrictions in which number of over-identifying restrictions also represents Hansen J degree of freedom. The lags of managerial and technical labor (sl), as well as imported raw materials, local materials, operational labor, electricity power, and fuel, were demonstrated to be insignificant in this model.

In the Levinsohn-Petrin (2003) Model, as it has been discussed, this semi-parametric estimator of TFP assumes the invariability conditions of intermediate proxies. In other words, material inputs, electric power, and fuel in this study should strictly be increasing in total factor productivity (TFP). Furthermore, the model has been used to address the simultaneity and selection bias of unobserved productivity. Levinsohn & Petrin **(**1999; 2003**)** Material inputs, which are divided as local and imported, energy inputs such as electricity and fuel, are under intermediate input categories and are included in this model as explanatory variables. Hence, these inputs can be possible proxies for this firm. Levinsohn & Petrin **(**2003**)** put selection criteria among the given proxies as the more monotonic through the intermediate input's demand function, i.e., is chosen as a valid proxy. Moreover, less than one zero value in the entire observation among the given inputs could be selected as the qualified proxy. Considering these criteria, local material input and electric power have been taken as the best proxies. The study infers with bootstrapping 102 from the given observation for this estimator, which requires explaining and calculating the variance and covariance (the possible standard errors) variables.

The LP model with local material proxy results shows that all free variables apart from electric power and fuel are statistically significant at 5%. Furthermore, the capital (state) variable exhibits statistical significance at 1%. When electric power serves as a proxy, the regressed free variables, including state variables except for local material, have a 5% level of significance. To indicate model sufficiency, the p-value in both proxy measures is 0.0032 and 0.0204, respectively. The Wald test results of 8.69 and 5.38, respectively, measure the firm TFP's return to scale, which is indicated by the sum of coefficients equaling one. The coefficient on operational labor gives a negative result and negatively affects the firms' TFP. As well as managerial and technical labor coefficients, the coefficient on capital appears to be the next highest in this estimator, and these are similar to Fernandes's results for the case of Bangladesh manufacturing (Fernandes, 2008).

Estimates of TFP

The estimated coefficients of the whole observations using panel data indicate that they capture the results of four different models. These are robust fixed and random effect models; "difference" and "system" GMMs with robust (Levinsohn & Petrin, 2003) models. Indeed, the study obtained TFP as residuals from the estimated production function through the given models. Hence, it adds the predicted "ln_LP, omega" result based on equation (5) of the specified model to analyze the performance of Ethiopian manufacturing firms' TFP.

This analysis is carried out based on the expected equation (5) of TFP designed for Ethio-manufacturing firms throughout the given period (2006–2015) using the predicted result LP model in the Stata 13.0 version. The predicted "TFP_LP, omega" result, which has been calculated after TFP estimating through the "levpet" command, is described in the tables below across each firm group with their comprised number of firms. This predicted TFP amount is measured with Ethiopian Birr and the analysis is similar to the empirical result of Van Beveren (2010) for food and beverage firms' TFP.

As the firms' TFP in the underneath tables exhibited, the state-owned ISIC (10, 11) and ISIC (23) firms produced higher average TFP than private firms. However, the number of private firms in these groups has surpassed. This explains why state-owned firms have more support and subsidies divergent from private firms' promotion strategies (NPC, 2016). The TFP performance of each firm group across the years is explained by inconsistent incremental series. It shows high fluctuations and contradictions in its incremental performance as the years become recent.

As details of the tables indicate, state-owned food and beverage manufacturing TFP performance has shown oscillation across the years, between 381 in 2012 and 6,819 in 2015. Indeed, not exceeding the TFP of a state-owned firm group, food and beverage manufacturing for private-owned firms exhibited a fluctuating performance from the TFP amount of 410 in the year 2010 up to 2,890 in 2015. Government-owned textile manufacturing has executed a lower 100 TFP amount in 2011 after achieving a higher (1,854 TFP amount) for the year 2010. It is lower than the state-owned private textile manufacturing has exhibited the TFP amount of between 1,361 and 86 predicted for the years 2009 and 2012, respectively.

Wearing apparel except fur apparel manufacturing with government hand-produced lower performance swing with the boundary of the year 2006 TFP result (9.9) and the TFP (1,309) of the year 2013 as compared with the private hand (265 in 2013 and 1,331 in 2014). Tanning and dressing of leather and leather products manufactured in state-owned firms have still exhibited non-consistent TFP value with a lower amount in the year 2007 (8.1) and a higher (2,089) for the year 2013. However, the private portions of this firm achieved higher TFP than state-owned between TFP amounts of 280 for the year 2006 and 1,762 in the year 2014.

The state-owned wood and cork products except furniture have shown somewhat better TFP performance than their private hand, with a lower TFP value of 90 for 2011 and a higher value of 599 for 2015. That is, the TFP performance of this firm in private ownership has shown a range between a higher value of 517 in the year 2008 and a lower value of 28 in the year 2014. State-owned firms in the manufacture of paper, paper products, and printing generated higher TFP as compared with privately owned. It starts with the lower frontier of 865 in the year 2010 and shows a higher TFP of 1,293 for the year 2014. Nevertheless, the private hand oscillated between the lower TFP value of 115 in the year 2012 and 614 in the year 2015. Chemical and chemical products together with pharmaceutical manufacturing of state-owned firms generated a higher TFP value of 1,350 for the year 2013 and a lower TFP amount of 124 for the year 2015, while the private-owned firms in this firm group produced a lower TFP amount of 18.3 in 2006 and a higher value of 1,131 for the year 2010. The government-owned firm shows higher TFP than private firms. The manufacture of rubber and plastic products for the state-owned firms showed a higher TFP of 2,537 in 2014 and a lower amount of 118 in 2015.

Moreover, the private manufacture of rubber and plastic products indicated lower performance than government-owned. A lower TFP value of 334 is reflected for the year 2008, and its higher value of 868 is shown for the year 2014. The TFP amount in state-owned manufacturing of other non-metallic mineral products has indicated better performance by generating a higher value of 2,843 in 2008 throughout the given years apart from the lowest TFP value of 169 for the year 2010. It has also performed more consistently with its private one through a lower TFP value of 118 for 2011 and the highest value of 1,465 for the year 2014. Public-owned manufacturing of basic iron and steel has shown inconsistent and limiting hundred values and exhibited the highest TFP of 1,127 in the year 2014 and a lower amount of 76 for the year 2013. Equally, the privately-owned manufacturing of this firm has indicated somewhat unwavering performance with a higher TFP value of 463 in 2013 after showing a lower TFP of 117 for the year 2007.

The state-owned manufacture of fabricated metal products, except machinery and equipment, has shown a disjointed increment, with a lower TFP of 138 in 2009 and a higher TFP value of 895 in the year 2014. After displaying a lower TFP value of 251 in 2006, however, private firms within the mentioned group generated a higher TFP amount of 1,081 in the year 2015. On the other hand, the manufacture of machinery and equipment in state-owned firms has done nothing except for the years 2014 and 2015, with TFP amounts of 281 and 1,228 respectively. Conversely, private firms exhibited a lower TFP of 37 in 2012 after showing a higher TFP amount of 313 for the year 2013. Governmental motor vehicle, trailer, and semi-trailer manufacturing posted an exceptional TFP performance value of 2,622 in 2015, up from 86 at the end of 2014. Private firms of this manufacturing have appeared with a lower TFP of 90 in 2009 and the highest TFP amount of 811 for the year 2012. Moreover, state-owned furniture manufacturing has indicated an exceptional TFP value of 2,806 in the year 2010 and then the TFP value has gone down to 29 for the year 2015, and the privately owned by this firm group demonstrated a higher TFP performance of 866 following a lower TFP value of 448 in 2006.

The operational labor of the firms' group which has an insignificant coefficient value in the fixed effect estimate exhibits a higher negative value of the coefficient in the LP model than that of the OLS estimate, as well as managerial and technical labor coefficient amounts are higher in the OLS estimate result and lower than the estimated result of the LP model. Difference GMM estimator and system GMM have shown statistically insignificant results for operational labor, and Difference GMM exhibits 0.439 in managerial and technical labor, in which this coefficient result is higher than system GMM and LP model results, while system GMM shows a lower coefficient than OLS. Indeed, the LP estimate has been ranked second with 0.393 results. This GMM estimator removes simultaneity bias and gives a consistent coefficient (Arellano & Bond). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, 1991), whereas the LP estimator also corrects both simultaneity and selection biases (Levinsohn & Petrin, 2003). As a result, the lower system GMM than OLS in this coefficient is due to error correction, and the higher results for difference GMM are unexpected. LP estimators indicated the model efficiency for TFP measuring with less expected simultaneity and selection biases (Levinsohn & Petrin, 1999; Fernandes, 2008).

Leaving the fixed effect estimation result as the lowest next to the difference GMM, the LP model exhibited a higher coefficient amount (0.392) in the capital variable, while it showed a lower result than the OLS estimate. Moreover, system GMM generates more or less good results than difference GMM, as well as their first lag value, show negative coefficient results in which the firms are negatively affected by these lags. The local material coefficient shows no significant value in all estimates other than the difference in GMM. Conversely, imported material input is strongly significant across all models and has exhibited a higher coefficient amount within the estimator (0.272) than OLS, and the LP estimate generates a lower amount (0.182) in which it ranked behind OLS. System GMM produced a higher imported material coefficient next to the fixed effect and the difference between the GMM estimator results also puts the following fixed effect estimator.

The strong model results in TFP generation for imported materials, as Ethiopian manufacturing firms are dependent on imported raw materials input and this input is also dependent on foreign exchange. As evidence shows, foreign currency deterioration is a common disease in Ethiopia (Zerayehu & Peter, 2014). Hence, the firms' TFP faces a discrepancy. An electric power variable produced negative results in each model and was insignificant in all estimators apart from OLS. However, fuel energy has exhibited a higher positive coefficient in OLS and the lagged difference GMM estimator adds the negative coefficient amount to these variables. Unfortunately, all the rest of the estimators produced irrelevant results for this input.

Table 4

Comparison of TFP Estimates Obtained from Different Models

TFP Estimates	N	Mean	SD	Min	Max
OLS	268	7.21	0.94	-3.91	2.52
FE	268	14.18	1.34	8.99	17.02
Difference-GMM	208	2.25	1.71	0.42	10.06
System –GMM	238	14.23	1.43	8.56	17.39
LP Model	268	657.77	667.00	8.11	6819.20

Source: Stata Result

This predicted TFP is calculated by equation (5) of the model, and different results are predicted for each estimator. The mean estimation results in each model apart from the LP estimator ranged between 2.25 and 14.23, inclusively, similar to (Van Beveren, 2010) for Belgium manufacturing, while the mean result in the LP estimator exhibits higher than them. This higher result in the LP model continues across the standard deviation, minimum and maximum amounts of TFP.

The determinant of firms' Total Factor Productivity

The study has identified different determinants of TFP for Ethio-manufacturing firms, explained through various literature together with their possible influences (Wodajo & Senbet, 2013; Bigsten & Gebreeyesus, 2007). However, all of the specified determinants were not able to be estimated through these models due to data inaccessibility, and some others were dropped from these estimates since they were fitted insignificantly to the models. Indeed, the study focuses on, estimates, and recapitulates the empirical results of intermediate input-driven determinants, as well as labor and capital variables, which are critical for the Levinsohn and Petrin (2003) and Blundell & Bond (1998) models.

As explained, 71% of the coefficients of each estimated independent variable influence the firms' TFP corresponding to the beforehand given hypothesis of this study. In contrast to the given hypothesis and the results of Fernandes (2008) and Thanapol (2015) in Bangladesh and Thai manufacturing firms' TFP respectively, operational labor affects the TFP of Ethiopian manufacturing negatively. However, managerial and technical labor have increased firms' TFP, providing the same estimate with Fernandes (2008) It can be perceived in other ways that an operational labor force is a liability for Ethiopian firms. The GMM estimate revealed a positive influence. Furthermore, imported raw materials input for Ethiopian manufacturing increased TFP the most across all specified estimation logarithms than local material input. This result is similar to that of Levin & Petrin (2003) for Chilean manufacturing and Van Beveren (2010) for Belgian food firms' TFP As OLS results show, electric power has negatively influenced Ethiopian firms' TFP, similar to Bangladesh firms' TFP (Fernandes, 2008) However, fuel energy input positively pressured the firms' TFP, similar to Chilean firms' TFP (Levinsohn & Petrin, 2003).

The correlations among the TFP measures of expressed models are strong. When the correlation between the estimated TFP is compared, it shows a small difference. This TFP measure correlation result gives some clues for evaluating the effects of policy changes on Ethio-manufacturing firms as measured by Van Beveren (2010) for Belgian food and beverage manufacturing. The correlation obtained between the fixed effect TFP model and the correlation of TFP results in GMM indicated a difference of more than 95%. However, the correlation, among other things, is less than 0.95.

Diagnostic Tests

Heteroscedasticity and autocorrelation tests are used to confirm the regression findings for all models. As a result, their sufficiency has been discovered and their strengths and weaknesses have been determined. Additionally, this work analyzes the fixed, random, robust, and clustered OLS models.

GMM Test

Since the dynamic panel data estimators are instrumental variable models, they are fundamental for evaluating the Sargan-Hansen test results. The BB GMM results show a p-value greater than Chi2 = 0.008 and a Hansen test score of 1.000. Moreover, these tests for system GMM exhibited 0.366 and 1.000, respectively. GMM-style instruments, considering the logic of Arellano and Bond (1991), allow using multiple lags, and IV-style instruments are included in the matrix of Roodman (2009) xtabond2 routine. For the estimator of system GMM, the default in xtabond2 instruments is specified as for applying to the differenced equations as well as level equations or both. Furthermore, the Autoregression (AR) test has been taken to check the autocorrelation of the residuals. The p-value of AR (2) in annex 7 shows significance, i.e., Pr > z =0.049, and it exhibited insignificance (0.621) in a difference GMM. Hence, the second lag of firms' value-added in system GMM estimate is appropriate for serving as an instrument to its current value. As referred to in annexes 8 and 9, Roodman's (2009) xtabond2 routine could specify the lag limits of GMM-style instruments. As a result, it limits the lags to be 1-2 in constructing GMM instruments.

Tests for LP Model

As was stated in the works of Levinsohn & Petrin (2003), the specification tests for this estimating model hold with Levin & Petrin (1999; 2003), working with the test of the two best alternative proxies (local raw material followed by electric power in the case of this study) and getting similar estimate results as indicated in the following table.

Table 5

Specification Tests for The Chosen Proxies of Local Material and Electric Power

Variables	**Local material proxy Estimates**	**Electric power proxy estimates**	**Difference**
Ln_l	-0.354 (0.173)	-0.354 (0.176)	0.00 (0.003)
Ln_sl	0.393 (0.178)	0.409 (0.202)	-0.016 (0.024)
Ln_im	0.182 (0.082)	0.0194 (0.086)	0.016 (0.018)
Ln_fuel	0.057 (0.044)	0.091 (0.044)	-0.03 (0.00)
Ln_k	0.392 (0.117)	0.330 (0.142)	0.062 (-0.02)
The P-value in each proxy			
Local Material	0.0032		
Electric power	0.0204		-0.0172

Source; Author's calculation based on LP Model proxies

Note: the difference in the bootstrap errors is displayed in parentheses and statistical significances in both proxies are indicated at 5% confidence levels as well as their difference show approximately zero.

Hence, the LP model is sufficient to estimate this firm TFP as it is tested through the test specification made by Levinsohn & Petrin (2003) and practiced by Van Beveren (2010).

Conclusion and Policy Implications

The economic growth in Ethiopia has demonstrated an improved performance rate with a sluggish change in output structure over the included period from 2006-2015 in this study. However, the growth performance relied heavily on non-industrial and manufacturing sectors (World Bank, 2015a) and this characterized the structure of GDP as having a stagnant 4.8% average share of the manufacturing sector, which has been expected to drive productivity and sustain economic performance (Zerayehu & Peter, 2014). As a result of this, the permanent income of the nation has been erratic and has been lower-level among Sub-Saharan African counties (World Bank, 2017) This overall economic inconsistency has been caused by the lack of formulating feasible policies for the value-added sector to be vibrant. The erratic determinants in the TFP of Ethiopian manufacturing firms over the reference period are the one and decisive sector that lacks feasible policy focus (Prebisch, 1950; Arrow K., 1962). Hence, as the firm TFP is capable of curing this erratic problem, the study identified the key variables of TFP for Ethio-manufacturing firms that are compatible with the specified estimation models (Levinsohn & Petrin, 2003). The estimated data has been found from large and medium-scale manufacturing firm data sets of CSA over the period 2006-2015 with two digits (ISIC) classification. The study used dynamic panel data models in addition to OLS and fixed effects to control the correlation between input levels and unobserved productivity shock of the given firm. Moreover, the LP model together with the "difference" GMM and "system" GMM estimators of the dynamic section has reduced the simultaneity bias and yields error-free coefficient parameters. The study found using these estimators for the available firm panel data, as across firm groups' performance results with predicted TFP_LP, omega estimation within the reference period has exhibited highly oscillated and inconsistent incremental performance. Within this practice, state-owned food and beverage manufacturing and non-metallic minerals registered the highest scores of TFP performance among other manufacturing firms.

As the TFP estimates entail, operational labor has negatively affected the firms' TFP and its coefficient in the LP estimator result is higher than the traditional OLS result, while other models show statistically insignificant. This shows larger falls in firms' TFP and is explained as operational labor for most firms is a liability. Conversely, managerial and technical labor show a positive shock to TFP with a higher coefficient in all models apart from the fixed effect result. As it was theoretically supported, the OLS coefficient result was displayed higher than other models (Levinsohn & Petrin, 1999) Moreover, capital has affected positively this firm's TFP across the given estimators, and the LP model shows a higher coefficient next to OLS.

Furthermore, local material has indicated its significance in GMM and generates a lower amount of positive coefficient, which does not contribute sufficiently to TFP. However, imported material has increased firms' TFP across all models significantly and shows a higher coefficient in fixed effect than in system and difference GMM. On the other hand, electricity power exhibited statistically insignificant results through the estimators apart from OLS, and this OLS result negatively pressured the firms' TFP with little coefficient value. This occurred due to the frequent power interruptions in most firms in the production processing period (AACCSA, 2015). Ethio-firms used fuel energy as an alternative and this showed positive pressure on TFP with statistical significance only in OLS and LP results. Its lag result in GMM signified a higher negative coefficient than the current coefficient results in OLS and LP models. Moreover, the first lag in value-added in the difference GMM affected itself negatively and positively in system GMM results. Similarly, the first lag in capital exhibited negative pressure on firms' TFP.

Based on these findings, the study draws suitable policies at the manufacturing firm level in the face of achieving astonishing real sector-driven economic growth. For increasing the local material inputs that help to raise firms' TFP, there should be a feasible policy that favors modern and technology-intensive farms. Moreover, there should be a strong policy that promotes inter and intra-linkages between manufacturing firms and other industries in the country. For keeping and raising imported material inputs, there should be a consistent foreign currency generating policy that creates a more sufficient current account balance and there should be a policy of manufacturing competitive products in the global market from such firms while dominating export share and raising the country's export volume.

Correspondingly, a practicable industrial linkage policy that enables the substitution of imported material inputs should be developed. Energy inputs are highly associated with the TFP gains in Ethio-manufacturing firms. Hence, there must be developed infrastructure in electric power together with a non-crashed power production policy from different sources. The managerial and technical parts of labor exhibited gains to firms' TFP and necessitated crafting a policy that creates knowledge transformation from abroad. However, further research would be needed on the aggregate firm-level labor input with more established data for crafting more relevant policy. Moreover, there should be a responsive policy that replaces outdated production inputs with updated capital goods to generate more proceeds for firms' TFP associated with capital stock.

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