

Export Intensity and Total Factor Productivity in Kenya's Manufacturing Sector

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Abstract

Kenya has adopted an export-led manufacturing industrialization strategy as envisaged by many policy documents including the *Kenya Vision 2030* which aimed at increasing the manufacturing share in Gross Domestic Product to 15 per cent by 2022. The share of manufactured exports in all exports was targeted at 60 per cent by 2022 as per the National Exports Development and Promotion Strategy. However, manufacturing sector's productivity has been declining as demonstrated by its economic contribution which has averaged around 10 per cent from 2007 to 2022 and has persistently declined from 12.79 per cent in 2007 to 7.83 per cent in 2022 pointing towards premature deindustrialization. Besides, from 2007 to 2022, the share of total exports made up of manufactured goods averaged 33 per cent. The study aimed to estimate firms' total factor productivity (TFP) and examine the impact of export activity on firms' TFP in Kenya's manufacturing industry. Firm TFP was computed utilizing the Levinsohn and Petrin (2003) technique. The study employed Propensity Score Matching and a dynamic panel model estimated using the generalized methods of moments technique, to analyze the effect of exporting on firms TFP. Export intensity, labor productivity and management experience had positive effects on firm's TFP. However, firm size and capital intensity had negative effects on TFP. Based on the study findings, the government should emphasize on export promotion policies as well as adoption of labor intensive technologies in Kenya's manufacturing sector.

Keywords: export intensity, manufacturing sector, total factor productivity

1. Introduction

Numerous nations in the quest for economic transition have pursued export oriented manufacturing strategies. Universally, export promotion is vital since it spurs economic growth and enhances productivity and competitiveness of exporters. The manufacturing sector is very key in expanding a country's exports given that about 70 per cent of exports comprise of manufactured products (World Bank, 2023). Overall, the manufacturing sector serves substantially to economic expansion and progress by promoting and sustaining high levels of efficiency, offering employment prospects, and enhancing national competitiveness (KAM, 2022). The rise of the manufacturing sector promotes economic expansion since it creates positive spillover effects to other sectors via interlinkages (Kaldo, 1996). These include increased demand and absorption of products and services from other sectors in the economy. Kaldo (1996) argued that the manufacturing sector is a key engine for the growth of economies and its productivity and growth is positively linked to the performance of other sectors in the economy.

One of the important dimensions of firm performance in theoretical and empirical literature is productivity. Countries, sectors and firms may have the same resources but may differ in terms of their production and growth based on their levels of productivity. Sustained economic growth and development can be achieved through productivity improvements (Hall & Jones, 1999). Adam Smith and David Ricardo, laid emphasis on productivity growth arising from specialization and participation in international trade. Productivity improvement has also been linked to "creative destruction" and enterprise renewal in the sense that firms that invest in new innovations and inventions boost their productivity and improve their chances of survival in the market (Schumpeter, 1942).

Total factor productivity growth, alongside capital accumulation and growth in labor, is an important long term driver to improved standards of living based on the arguments of neoclassical and endogenous growth theories (Solow, 1956; Romer, 1994).

The linkage between firm's export performance and total factor productivity has been widely explored especially in developed countries as commenced by (Bernard, Jensen, & Lawrence, 1995). Two dimensions of export performance are explored: export propensity and export intensity. Export propensity is the export status of a firm (exporters versus non-exporters). Export intensity quantifies the percentage of a company's exports in overall sales. Empirical evidence argues that total factor productivity is a key driver of export performance by firms according to the self-selection hypothesis (SSH) (Bernard, Jensen, Redding, & Schott, 2007). The argument in favor of SSH is that productive firms can cover the sunk costs involved in entering these markets. Firm performance, especially total factor productivity, is also enhanced via firms' exports as put forth by the learning by exporting hypothesis (LBE) (Bigsten & Gebreyesus, 2009). This is because exporting firms face intense competition hence they have to get information on marketing and technological advancement so as to survive.

Endogenous growth theory also supports the LBE hypothesis (Romer, 1994). Endogenous growth theory identifies innovation, international openness and human capital formation as determinants of technological progress (TFP growth). With the imposition of firm heterogeneity, Melitz (2003) analysis supported the SSH and the LBE hypothesis. Melitz (2003) revised Krugman's (1979) new trade theory (NTT) to develop the 'new' new trade theory (NNTT). Based on NNTT, exporting leads to reallocation of resources from less productive to more productive firms. This results to self-selection into export markets by highly productive firms and productivity improvements (learning-by-exporting) for exporting firms.

The SSH is widely supported by existing literature. However, the evidence on the LBE hypothesis is mixed and inconclusive. Some studies support the LBE hypothesis (Bigsten & Gebreyesus, 2009; Camino-Mogro, Ordeñana-Rodríguez, & Vera-Gilces, 2023; Kiendrebeogo, 2020) while others report insignificant learning effects from exporting (Bernard & Jensen, 1999; Grazi, 2012; Haidar, 2012; Vu, Holmes, Tran, & Lim, 2016). A negative learning effect has also been reported (Bresnahan, Coxhead, Foltz, & Mogues, 2016). More so, there is scanty literature on this subject for Kenya and other developing countries. There are also methodological gaps in the existing literature whereby the endogeneity concerns are not properly addressed both in the estimation of TFP and the analysis of the LBE hypothesis. It is therefore imperative to explore the LBE hypothesis further for the Kenyan context, taking into account these limitations, which the current study did.

Based on these drawbacks, the current study contributed to the existing literature in several ways. First, the study utilized a rich and reliable panel data obtained from the World Bank Enterprise Surveys (WBES) for the periods 2007, 2013 and 2018. Second, total factor productivity was estimated using the Levinsohn and Petrin (LP) (2003) approach as opposed to the traditional Ordinary Least Squares (OLS) technique. This is because, several estimation concerns, including sample selectivity bias and simultaneity issues, can arise from the OLS approach (Van Beveren, 2012). In addition, the LP (2003) approach is not widely explored in the Kenyan context. Third, in order to address the endogeneity concerns in this subject, the LBE hypothesis was tested using two approaches. The first approach involved the use of a dynamic panel data model which was estimated using the Two-Step System Generalized Method of Moments technique. The second approach involved the use of Propensity Score Matching to test the LBE hypothesis while controlling for self-selection.

The study findings based on the two approaches supported the LBE hypothesis since exporting was found to be a significant and positive determinant of firm level TFP. In addition to exporting, other positive drivers of TFP were labor productivity and management experience. On the other hand, firm size and capital intensity had negative effects on TFP. Based on the study findings, the government should emphasize on export promotion policies in Kenya since exporting boosts firms' productivity.

1.1 The Manufacturing Sector's Role and Performance in Kenya

The manufacturing sector is vital in achieving economic transformation of many developing nations because it is interlinked with other sectors in the economy. In Kenya, the manufacturing sector is key towards the achievement of the *Kenya Vision 2030* (Republic of Kenya, 2007). Therefore, it is important to improve its productivity, competitiveness and performance in general since a thriving manufacturing sector translates to improved economic growth in a country. One of the key priorities in the development of a robust manufacturing sector in Kenya has been promotion of international trade. Since attaining independence, Kenya has adopted export promotion policies to promote foreign trade. Kenya also participates in a number of regional and international trade agreements in a quest to boost her export performance. Nevertheless, the set target of 60 percent share of manufacturing exports in all exports as per the National Exports Development and Promotion

Strategy (NEDPS) is yet to be achieved given that the actualized average share for the period 2007-2022 was 32.37 per cent (World Bank, 2023).

The manufacturing sector is also expected to contribute over 15 per cent to GDP according to the *Kenya Vision 2030* (Republic of Kenya, 2007). A rising proportion of manufacturing in GDP indicates a higher degree of industrialization of a country (KAM, 2019). However, this sector has experienced sluggish performance and declining levels of industrialization characterized by a stagnant share in GDP of about 10 per cent for the period 2007-2022 (World Bank, 2023). More so, its percentage has steadily decreased from 12.79 percent in 2007 to 7.83 percent in 2022, an indicator of deindustrialization (KAM, 2022). Besides, the average share of agriculture in GDP for the same period was 20 per cent while that of services was 55.26 per cent (World Bank, 2023). This implies that services sector contributes the highest share of GDP which is also an indication of premature de-industrialization (KAM, 2019). With manufacturing sector having the least share, it is imperative to boost its share in GDP if Kenya is to industrialize by the year 2030.

Given the commendable efforts by the government regarding export promotion, it is important to investigate whether exporting has significant economic benefits for proper policy guidance especially for Kenya where literature on the same is scarce. Therefore, this study estimated firm level TFP and analyzed the effect of export intensity on firms' TFP in Kenya's manufacturing sector.

1.2 Statement of the Problem

The manufacturing sector is very key for economic transformation in Kenya and many other developing countries as evidenced by the East Asian Miracle (KAM, 2022). The sector's contribution to GDP was targeted at 15 per cent by the year 2022 as per the *Kenya Vision 2030* (KAM, 2019). Additionally, manufactured exports were targeted at 60 percent of the total exports for the same period. The government has emphasized on export promotion policies for the realization of industrialization by the year 2030. Regardless, export performance in the manufacturing sector has been below the set targets with an average of 33 percent for the period 2007-2022. More so, the sector's contribution in GDP has stagnated around 10 percent and has persistently declined since 2011 with a value of 7.83 in 2022, an indicator of premature deindustrialization. Over the period 2007-2022, agriculture and services sectors have been more dominant in terms of GDP contribution at 20 per cent and 55.26 per cent, respectively. The poor performance of the manufacturing sector is a threat to the achievement of the *Kenya Vision 2030* if proper remedies are not implemented.

It is therefore important to establish whether the export promotion policies by the government are warranted for better policy direction. This can be established by analyzing how exporting affects firm performance (LBE hypothesis test) which the current study undertook. There exists limited evidence on this subject in Kenya (Okado, 2013; Bresnahan, Coxhead, Foltz, & Mogues, 2016; Matiy & Matundura, 2019; Chebor, 2020; Esaku, 2020). Most studies focus on testing SSH (Okado, 2013; Matiy & Matundura, 2019; Chebor, 2020) with very few focusing on testing the LBE hypothesis in Kenya's manufacturing sector (Bresnahan, Coxhead, Foltz, & Mogues, 2016; Esaku, 2020). Additionally, the reviewed studies suffer from methodological drawbacks since the endogeneity issues are not properly accounted for. Based on these limitations, the current study analyzed the effect of export intensity on TFP for Kenya's manufacturing firms. A dynamic panel data model was employed to obtain reliable estimates. Additionally, propensity score matching was employed as a robustness check for the LBE hypothesis.

2. Empirical Literature Review

Bresnahan et al. (2016) examined how increased trade freedom affected productivity growth in Kenya for the period 1991-2000. The Influence of export participation on TFP was estimated using fixed effect models which included output, funding, resources, additional resources, labor, foreign ownership, and export destinations as control variables. The study found no evidence of learning by exporting in Kenya. This study provided useful insights on the link between export participation and firm-level TFP. However, the use of static panel models in this subject was not appropriate given that endogeneity is a concern. As such, the current study tested the LBE hypothesis using a dynamic panel data model as opposed to the fixed effect model so as to obtain more reliable results using an updated dataset.

Kreuser and Newman (2018) analyzed the determinants of TFP for manufacturing firms in South Africa for the period 2010-2013. The analysis involved estimating TFP first using the Levinsohn and Petrin (LP) (2003) approach to account for endogeneity. The determinants of TFP were analyzed using Ordinary Least Squares (OLS). The positive determinants of TFP were: firm size; firm age; research; tax incentives; capital-labor ratio; firm exports and firm imports. The study made commendable effort on addressing the endogeneity problem in the measurement of TFP. However, estimating the determinants of TFP using OLS was not appropriate since

OLS does not address endogeneity concerns in the analysis. Therefore, the current study employed a dynamic panel model instead to control for endogeneity issues for more reliable results for Kenya.

Seleem and Zaki (2018) estimated TFP and its determinants for Middle East and North Africa region. TFP was estimated utilizing the Solow residual approach after which the OLS technique was utilized to determine the response of TFP to exporting, firm attributes and macroeconomic variables including trade openness, tax burden, lending rates and tariffs. The findings indicated that state ownership, foreign ownership, female management and formal registration positively impacted TFP at the firm level. At the macro level, TFP was negatively impacted by high taxes and increased cost of borrowing. On the other hand, high tariffs positively affected TFP. The reviewed study provided useful insights on the micro and macro determinants of TFP. However, endogeneity concerns were not addressed in the estimation of TFP as well as in analyzing the determinants of TFP. Thus the current study addressed the endogeneity issues by estimating TFP using the LP (2003) methodology as well as analyzing the determinants of TFP using the Two-Step System GMM estimator (2SYSGMM) for the case of Kenya.

Esaku (2020) examined the impact of free trade on productivity improvements in Kenya's manufacturing industry. The study utilized panel data from World Bank Surveys for the period 1992-1999. The estimation was conducted using Ordinary Least Squares, Fixed Effect and quantile regression while controlling for firm age, size and ownership status. The research findings for all the methods indicated that increased trade liberalization increased firm and industry productivity. This research offered empirical evidence on the importance of freer trade in the manufacturing sector through productivity enhancement. However, the OLS and Fixed Effect models do not control for endogeneity hence the need for the instrumental variables estimation techniques which the current study employed. More so, the dataset used was not updated (1992-1999) hence the need for the most current data set to capture recent developments which the current study implemented.

Kiendrebeogo (2020) tested the LBE hypothesis for manufacturing firms in Egypt. The analysis was conducted using propensity score matching. The results supported the LBE hypothesis whereby the study reported larger post-entry premiums for exporters. In addition, the study also established that the learning effect was more pronounced to firms exporting to highly advanced nations. The current study utilized this approach as a robustness check for the LBE hypothesis. The main estimation was conducted via a dynamic panel data approach to account for endogeneity in the Kenyan context.

Dvouletý and Blažková (2021) estimated TFP and its drivers for firms in Czech Republic for the period 2000-2019. The study first estimated TFP using the OLS estimation technique after which the determinants of TFP were explored. The regression was conducted using OLS and the generalized least squares technique. The results indicated that firm age, firm size, debt ratio were significant determinants of TFP. The study estimated TFP and analyzed its determinants without a proper methodology to address endogeneity concerns. More so, export intensity was not incorporated in the reviewed study despite its importance in literature. Therefore, the current study addressed the endogeneity issues by estimating TFP using the LP (2003) technique that controls for endogeneity. More over the determinants of TFP were estimated using a dynamic panel model which takes care of endogeneity. Additionally, export intensity was incorporated in the analysis so as to test the LBE hypothesis for Kenya.

Using panel data for Ecuador's manufacturing sector, Camino-Mogro et.al (2023) analyzed the response of TFP to exports for the period 2007-2018. The analysis was conducted using the difference-in-difference matching (DDM) estimator to address the selection bias. The study findings indicated that there were productivity and performance gains of exporters once they entered the export markets thus supporting the LBE hypothesis. The study accounted for selection bias using matching techniques. The current study employed dynamic panel models to analyze the learning effects of exporting for manufacturing firms in Kenya after which propensity score matching was employed for comparison purposes.

3. Methodology

3.1 Theoretical Framework

Total Factor Productivity (TFP) was approximated using firm theory, which describes how organizations produce output using a specific collection of resources and capabilities. The Solow Residual technique was employed based on following the production function:

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

Where: i and t are the subscripts for firm and time, respectively. Firm's output is represented by Y_{it} . Capital, labor and materials are denoted by K_{it} , L_{it} , and M_{it} , respectively with their respective output elasticities β_k , β_l

and β_m . A_{it} denotes TFP.

Linearizing the function, we have the variables in their natural logarithm form as:

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

$$\ln(A_{it}) = \beta_0 + \varepsilon_{it} \quad (3)$$

Where: β_0 is firm's efficiency. ε_{it} is the residual term decomposed into an observable (v_{it}) and unobservable (u_{it}^q) component (Van Beveren, 2012). This yields:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + v_{it} + u_{it}^q \quad (4)$$

Where: $w_{it} = \beta_0 + v_{it}$ and it measures TFP of the firm using equation (4). Equation (4) can be rewritten as:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + w_{it} + u_{it}^q \quad (5)$$

Nevertheless, OLS estimates from (4) are biased due to endogeneity issues (Van Beveren, 2012). The solution to this was proposed by Olley and Pakes (OP) (1996) and Levinsohn and Petrin (LP) (2003). They propose the use of a proxy for unobserved productivity (Levinsohn & Petrin, 2003). The proposed proxies are intermediate inputs and investment for LP (2003) and OP (1996), respectively. The LP (2003) is more practical since not all firms have non-zero investment values. For the LP (2003) approach, the material demand function is:

$$m_{it} = m(k_{it}, w_{it}) \quad (6)$$

Inverted as:

$$w_{it} = w(k_{it}, m_{it}) \quad (7)$$

Substituting (7) into (5) yields:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + w(k_{it}, m_{it}) + u_{it}^q \quad (8)$$

Given that:

$$\phi_{it}(k_{it}, m_{it}) = \beta_k k_{it} + \beta_m m_{it} + w(k_{it}, m_{it}) \quad (9)$$

Equation (8) becomes:

$$y_{it} = \beta_l l_{it} + \phi_{it}(k_{it}, m_{it}) + u_{it}^q \quad (10)$$

Equation (10) is thus estimated via OLS to yield β_l and ϕ .

w_{it} is then presented as:

$$w_{it} = E[w_{it}|w_{it-1}] + \xi_{it} \quad (11)$$

Where (ξ_{it}) denotes unexpected improvements in productivity.

For the estimation of β_m and β_k we use the moment conditions presented on (12) and (13).

$$E[(\xi_{it} + u_{it}^q)k_{it}] = 0 \quad (12)$$

$$E[(\xi_{it} + u_{it}^q)m_{it-1}] = 0 \quad (13)$$

Based on equations (9-13), we have:

$$E[y_{it+1} - \beta_l l_{it+1}] = \beta_0 + \beta_m m_{it+1} + \beta_k k_{it+1} + E[w_{it+1}|w_{it}] \quad (14)$$

Denoting $w_{it} = \beta_0 + E[w_{it+1}|w_{it}]$ and based on equation (9), equation (14) can be rewritten as:

$$y_{it+1} - \beta_l l_{it+1} = \beta_m m_{it+1} + \beta_k k_{it+1} + f(\phi_{it} - \beta_m m_{it} - \beta_k k_{it}) + \xi_{it} + u_{it}^q \quad (15)$$

Estimation of equation (15) provides reliable estimates for β_m and β_k . Lastly, firm's TFP is computed as a residual as follows:

$$TFP_{it} = y_{it} - \widehat{\beta}_k k_{it} - \widehat{\beta}_l l_{it} - \widehat{\beta}_m m_{it} \quad (16)$$

After the estimation of TFP, the effect of export intensity on TFP was analyzed. The theoretical framework was anchored on the endogenous growth theory and the LBE hypothesis as put forth by the 'New' New Trade Theory (NNTT). Endogenous growth theory is anchored on the following Cobb Douglas production function:

$$Y = AK^a L^{1-a} \quad (17)$$

Where: Y is output, K and L are capital and labor inputs, respectively, A represents TFP and a and $1 - a$ represents respective output elasticity of the inputs. Endogenous growth theory identify innovation, international openness and human capital formation as determinants of technological progress. According to Romer (1990) total factor productivity change is endogenous and can be represented as:

$$\Delta A = F(KA, HA, A) \quad (18)$$

Where: ΔA is the change in total factor productivity or technological progress, KA represents capital input necessary in the production of a new design, HA represents the number of people working on the production of a new design, and A is the existing technology for designs.

Based on the arguments of endogenous growth theory, total factor productivity (TFP_{it}) in each period is majorly influenced by new ideas or innovations from investment in Research and Development by the firm (RD_{it}), international trade participation in this case, export intensity ($XINT_{it}$), availability of skilled labor (HA_{it}) as well as the existing level of total factor productivity of the firm (TFP_{it-1}) as shown in equation (19).

$$TFP_{it} = f(RD_{it}, XINT_{it}, HA_{it}, TFP_{it-1}) \quad (19)$$

According to the LBE hypothesis based on the NNTT, exporting boosts firms' performance especially in terms of productivity improvements (Melitz, 2003). Thus, TFP is a function of export intensity just as presented on equation (19). Incorporating other firm attributes that may affect TFP other than those presented on equation (19) yields:

$$TFP_{it} = f(RD_{it}, XINT_{it}, HA_{it}, TFP_{it-1}, Z_{it}) \quad (20)$$

Where Z_{it} represents firm characteristics that may influence TFP standard in literature such as foreign ownership, firm size, firm age, human capital, research and development, capital intensity and management quality (Bernard & Jensen, 1999).

3.2 Empirical Model

The effect of exporting on TFP was analyzed by converting equation (20) into natural logarithm form to obtain a linear estimable function as follows (Bigsten & Gebreeyesus, 2009; Vogel & Wagner, 2010):

$$\ln TFP_{it} = \alpha_0 + \alpha_1 \ln TFP_{it-1} + \alpha_2 \ln XINT_{it} + \beta \ln Z_{it} + \delta D_{it} + \omega_i + \varepsilon_{it} \quad (21)$$

Where \ln denotes the natural logarithm of the corresponding variable, D_{it} represents industry, ownership and time dummies, ω_i represents the firm-specific effect, ε_{it} is the residual and Z_{it} is a vector of firm attributes influencing TFP standard in literature including foreign ownership, firm size, firm age, human capital, research and development, capital intensity and management quality. This dynamic specification followed the model by (Bigsten & Gebreeyesus, 2009).

A dynamic model violates strict exogeneity because the lagged dependent variable tends to be correlated with the residual (Anderson & Hsiao, 1981; Arellano & Bond, 1991). Due to the violation of the exogeneity assumptions, employing static panel data estimation techniques may yield inconsistent results (Anderson & Hsiao, 1981; Arellano & Bond, 1991). According to Anderson and Hsiao (1981), this endogeneity issue can be solved by utilizing instrumental variables (IV). However, Arellano and Bond (1991), Arellano-Bover (1995) and Blundell and Bond (1998) introduced the Generalized Method of Moments estimator (GMM), utilizing a comparable set of internal instruments which is more efficient compared to the Anderson and Hsiao (1981) estimator (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998). Therefore, to address the endogeneity issue, the study adopted the two-step system GMM (2SYSGMM) estimator for equation (21) following the approach by (Roodman, 2006). The effectiveness of the 2SYSGMM estimator is based on the validity and reliability of the instruments utilized. As such, two diagnostic tests were performed to ensure that the instruments used were valid and reliable as discussed in the next section.

3.3 Diagnostic Tests

3.3.1 Over Identifying Restrictions Test

Since the study employed a model that utilized instrumental variables, the validity of the instruments had to be checked for the estimates to be deemed reliable. The study employed the Sargan-Hansen test of over identifying restrictions under the following hypotheses: H_0 : Over identifying restrictions are valid (if $p > 0.05$) and H_1 : Over identifying restrictions are not valid (if $p < 0.05$) (Sargan, 1975; Hansen, 1982).

3.3.2 Serial Correlation Test

For the instruments to be deemed reliable, there should be no serial correlation of order 2 and higher. The study checked for second order serial correlation whose absence is indicated by an insignificant AR (2) statistic.

4. Results

4.1 Diagnostic Test Results

Based on the results provided on Table 1 the instruments were valid since the probability value of the Hansen Statistic was greater than 0.05.

Table 1. Hansen over identifying restrictions test results

Model	Chi-square statistic	P-value
Effect of Export Intensity on Total Factor Productivity	14.13	0.292

Source: Author's computations from study data.

After an attempt to run the second order serial correlation tests, the results could not be produced. This was because of the nature of the data used. The data had a very short time dimension ($T=3$) hence the AR (2) statistics could not be generated. Regardless, this was not a major issue since very short panels are less susceptible to serial correlation. The study relied on robust standard errors. Overall, based on the Hansen statistics and the use of robust standard errors, the instruments were deemed valid hence the results from the dynamic model were considered reliable. Moreover, propensity score matching was employed to test the LBE hypothesis as a robustness check.

4.2 Total Factor Productivity Estimation Results

Table 2 presents the TFP estimates based on the LP (2003) approach as well as the OLS approach.

Table 2. Production function estimation results

Dependent variable: Infirm revenue	Estimation Technique			
	OLS		LP (2003)	
Variable	Coefficient	P-Value	Coefficient	P-Value
lnlabor	0.7439***	0.000	0.7461***	0.006
lncapital	0.1041***	0.003	0.1197***	0.003
lnenergycost	0.4216***	0.000	0.3463***	0.000
Sum (Returns to Scale)	1.2696		1.2121	
Wald Test of Constant Returns to Scale (CRTS)	-		Chi-square statistic = 0.92	P-value = 0.3365

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. ln denotes the natural logarithm of the variable.

Source: Author's computations from WBES data (2007, 2013, 2018).

From Table 2, for both the OLS and LP estimators, the output elasticities of all the inputs were all positive and statistically significant. The OLS estimate for labor was downward biased. This suggested that labor was negatively linked with productivity shocks (Levinsohn & Petrin, 2003). For the given data set, the coefficient of capital estimated using OLS was lower than that of the LP approach. This implied that capital was inversely connected to productivity shocks. This is consistent with (Levinsohn & Petrin, 2003). The signs of all factor elasticities were positive thus economically reasonable. This implied that, ceteris paribus, an increase in any of the inputs resulted to increased output. The Wald statistic confirmed that the CRTS assumption was met. Due to the OLS bias, the study estimated TFP using the LP (2003) approach whose results are presented on Table 3.

Table 3. Average total factor productivity by year of survey

Year of Survey	Summary of Average TFP		
	Mean	Std. Dev.	Frequency
2007	8.26	0.98	99
2013	8.50	3.87	225
2018	8.34	3.38	158
Average Total	8.40	3.30	482

Source: Author's computations from WBES data (2007, 2013, 2018).

From Table 3, for the sampled firms, firm level TFP stagnated between 8.50 and 8.26 during the study period. The firms experienced slightly improved TFP between 2007 and 2013 from 8.26 to 8.50, respectively. However, TFP declined from 8.50 in 2013 to 8.34 in 2018. There is therefore need to understand why firms have not been able to realize consistent TFP improvements. One way to explore this is by first understanding the relevant determinants of TFP which the current study analyzed.

4.3 Results on the Effect of Export Intensity on Firm Level Total Factor Productivity Using a Dynamic Panel Data Model

The results based on the 2SYSGMM estimator are presented on Table 4.

Table 4. Regression results on the effect of export intensity on firm-level total factor productivity

Variables	2-Step System GMM (2SYSGMM)			
	Short-Run Coefficients		Long-Run Coefficients	
	Coefficient	P-Value	Coefficient	P-Value
First Lag of Total Factor Productivity	-0.1145*	0.055	-	-
Export Intensity	0.2608**	0.046	0.2279**	0.044
Firm Size	-0.2567**	0.040	-0.2242**	0.045
Capital Intensity	-0.2056***	0.000	-0.1796***	0.000
Firm Age	0.0309	0.918	0.0270	0.918
Labor Productivity	0.4627***	0.000	0.4043***	0.000
Management Experience	0.5104*	0.079	0.4459*	0.077
<u>Foreign Ownership Dummy (FO)</u>				
<i>Base: Domestic</i>				
Foreign	0.7727	0.298	-	-
<u>Year Dummy</u>				
<i>Base: 2007</i>				
Year=2013	-	-	-	-
Year=2018	-0.3467	0.349	-	-
<u>Industry Dummy</u>				
<i>Base: Other Manufacturing</i>				
Food	0.3616	0.419	-	-
Textiles and Garments	-0.8007	0.138	-	-
Chemical, Pharmaceutical, and Plastic	0.5397	0.302	-	-
Constant	7.033667***	0.000	-	-
No. of Observations	257	-	-	-
Hansen Statistic (P-Value)	0.292	-	-	-
Number of Instruments	30	-	-	-

*** p<0.01, ** p<0.05, * p<0.1.

Source: Authors calculations based on study data.

The coefficient of export intensity was positive and statistically significant in the short-run (SR) and in the long-run (LR) with corresponding values of 0.2608 and 0.2279. This meant that, a percentage increase in export intensity led to 0.2608 and 0.2279 percentage increase in firm level total factor productivity on average in the SR and LR, respectively, all else being equal. Hence export intensity and firm level TFP exhibit an inelastic relationship. These results support the LBE hypothesis which argues that exporting improves firms' productivity, although empirical evidence on the LBE hypothesis is mixed (Bernard & Jensen, 1999; Grazzi, 2012; Haidar, 2012; Vu, Holmes, Tran, & Lim, 2016; Love & Marez, 2019). Nevertheless, the study findings are backed by vast empirical evidence including (Bigsten & Gebreyesus, 2009; Abbey, Gyeke-Dako, & Oduro, 2017; Whang, 2019; Kiendrebeogo, 2020; Camino-Mogro, Orde ˜ana-Rodr ıguez, & Vera-Gilces, 2023).

The coefficient of firm size was negative and statistically significant in the SR and LR. Values of -0.2567 and -0.2242 implied that an expansion in the number of workers by one per cent resulted to a 0.2567 and 0.2242 percentage decrease in firm's TFP on average in the SR and LR, respectively, ceteris paribus. Thus the relationship between firm size and TFP was inelastic. The evidence on the same is inconclusive. Some studies report a positive relationship such as Kreuser et al. (2018) for South Africa, Dvoulet ıy, Bla ˙zkova (2021) for Czech Republic and Macharia et al. (2022) for Kenya. Others report a negative relationship such as (Deshmukh & Pyne, 2013; Seker & Saliola, 2018). This could be attributed to the argument that small enterprises have adaptable, non-hierarchical systems that can lead to increased efficiency. They may be able to discover dedicated employees and reward or compensate them with greater ease than larger firms, thus boosting the firm's productivity.

In the SR and LR, the coefficient for capital intensity was negative and statistically significant with values of -0.2056 and -0.1796, respectively. This implied that a percentage increase in capital intensity led to 0.2056 and 0.1796 percentage decrease in firm's TFP in the SR and LR, respectively, ceteris paribus. Therefore, TFP and capital intensity had an inelastic relationship. This was contrary to several empirical results in which capital

intensity positively affected firms' TFP such as (Yang & Mallick, 2010; Haidar, 2012; Kiendrebeogo, 2020; Dong, Kokko, & Zhou, 2022; Camino-Mogro, Ordeñana-Rodríguez, & Vera-Gilces, 2023). However, the results can be explained based on the findings of Fonchamnyo (2014) for Cameroon manufacturing firms where capital intensity negatively influenced export intensity. Because of the labor-intensive nature of Kenya's industrial sector, firms are able to hire cheap labor which cuts down their production costs and improves their efficiency. As such, the labor intensive firms are able to enjoy higher TFP compared to capital intensive firms. The findings corroborates existing evidence (Fonchamnyo, 2014; Linh, 2021).

The coefficient for labor productivity was positive and statistically significant with values of 0.4627 and 0.4043 in the SR and LR. These findings implied that, on average, a percentage increase in labor productivity led to an increase in firms' TFP by 0.4627 and 0.4043 per cent in SR and LR, respectively, holding all other factors constant. Hence labor productivity and firm's TFP exhibited an inelastic relationship. These findings supported the evidence provided by (Shen, Yue, Sun, & Guo, 2020). This could be attributed to the argument that firms with highly productive workers are more efficient and are more likely to employ highly skilled workers as well as consistently upgrade the skills of their existing workers. Consequently, the firms become more efficient and innovative thus boosting their TFP.

Both in the SR and LR, the coefficient for management experience was positive and statistically significant with estimated values of 0.5104 and 0.4459, respectively. This meant that, on average, all else being equal, a percentage increase in the top manager's years of experience increased firm's TFP by 0.5104 and 0.4459 percent in the SR and LR, respectively. Thus the relationship was inelastic. This positive relationship could be linked to the quality of decisions made by experienced managers regarding the choice of workers as well as updated and advanced production techniques. More experienced managers are able to source for more skilled workers or train the existing workers so as to enhance firm productivity. They are also aware of the latest production techniques and are able to implement them which in turn boosts firm productivity. The results are supported by existing empirical evidence such as (Linh, 2021; Macharia, Ngui, & Gathiaka, 2022).

4.4 Estimating the Learning Effect from Exporting Using Propensity Score Matching (Robustness Check)

The relationship between international trade participation and firm performance is associated with endogeneity problems which results mainly from selection bias in the sense that highly productive and large firms self-select to export markets. In addition, based on the Learning by Exporting (LBE) hypothesis, post entry performance of firms increases as firms participate in export markets. When analyzing the effect of exporting on firm performance, it is important to establish if the performance improvement is purely from participating in export markets or it is due to self-selection since exporters already exhibit superior performance characteristics before entering the export markets. Most empirical studies employ the propensity score matching to test the LBE hypothesis (Bigsten & Gebreeyesus, 2009; Yang & Mallick, 2010; Haidar, 2012; Kiendrebeogo, 2020; Camino-Mogro, Ordeñana-Rodríguez, & Vera-Gilces, 2023).

The current study adopted the 2SYSGMM estimation technique to control for endogeneity issues when analyzing the learning effects from exporting. However, the results from the 2SYSGMM are highly sensitive to the choice of instruments and their validity. The study checked the validity of the instruments based on the Hansen statistics and it was evident that the instruments employed in the analysis were valid. Nevertheless, it was impossible to conduct the second order serial correlation test due to the fact that the panel used was unbalanced and very short (T=3). However, serial correlation is not a major issue for very short panels. All the same, to clear any doubts regarding the results estimated using the 2SYSGMM technique, the analysis was extended further by employing the propensity score matching technique as a robustness check for the LBE hypothesis.

Let Δy denote change in a firm's performance measure, in this case Total Factor Productivity (TFP), $EXPdummy_{it} \in \{0,1\}$ be a dummy variable indicating whether a firm is an exporter or not in period t and $\Delta y_{i,t+s}^1$ represent the change in firm level TFP at time $t + s$ ($s \geq 0$) post entry into foreign markets. In order to analyze the TFP effect of entry in to export markets, a counterfactual is necessary. Thus for firm i , the causal effect of exporting at time $t + s$ can be presented as $\Delta y_{i,t+s}^1 - \Delta y_{i,t+s}^0$ where $\Delta y_{i,t+s}^0$ denotes the change in TFP of exporters if they had never exported before. However, $\Delta y_{i,t+s}^0$ cannot be observed. Based on the arguments of Heckman et al. (1997), the average effect of exporting on the firms that commence exporting can be expressed as:

$$E\{\Delta y_{i,t+s}^1 - \Delta y_{i,t+s}^0 | EXPdummy_{it} = 1\} = E\{\Delta y_{i,t+s}^1 | EXPdummy_{it} = 1\} - E\{\Delta y_{i,t+s}^0 | EXPdummy_{it} = 1\} \quad (22)$$

Where $E\{\Delta y_{i,t+s}^1 | EXPdummy_{it} = 1\}$ represents the expected post entry TFP change of exporters and

$E\{\Delta y_{i,t+s}^0 | EXPdummy_{it} = 1\}$ represents the expected TFP change of exporters prior to entry into foreign markets. Since $E\{\Delta y_{i,t+s}^0 | EXPdummy_{it} = 1\}$ cannot be observed, it is important to identify a counterfactual.

In order to choose an appropriate counterfactual, it is important to identify observable firm characteristics (control variables) that affect the export decisions of firms. A common choice of a counterfactual in literature is non-exporters who display relatively similar traits as exporters based on the control variables, in essence, $E\{\Delta y_{i,t+s}^0 | EXPdummy_{it} = 0\}$. Hence the study used $E\{\Delta y_{i,t+s}^0 | EXPdummy_{it} = 0\}$ as the counterfactual or control group. The idea is to match exporters (treatment group) with non-exporters (control group) that display relatively similar characteristics based on the control variables. The study adopted a propensity score which estimates the probability of a firm to export based on the control variables following the matching technique by Rosenbaum and Rubin (1983). The propensity score was estimated for all exporters and non-exporters using a logit model as follows:

$$P(EXPdummy_{it} = 1) = F(Controls_{it}) \quad (23)$$

Where $F(\cdot)$ is a logistic cumulative distribution function. The control variables ($Controls_{it}$) include firm size, firm age, capital intensity, labor productivity, management quality and dummy variables for foreign ownership, year and industry. For all the matches, the balancing property was satisfied. The next step was thus to estimate the effect of exporting on TFP on the matched sample by estimating the average treatment effect on the treated (ATET). The results are presented on Table 5.

Table 5. Propensity score matching results on the effect of exporting on firm level total factor productivity

Outcome Variable: Total Factor Productivity	Coefficient	Robust Standard Error	z	P > z
ATET	1.0523	0.5373	1.96	0.05
Export Propensity (Exporters vs Non-Exporters)				

Source: Authors Computations from study data.

The results from Table 5 indicate that the coefficient for the effect of exporting on firms' TFP (ATET) was positive and statistically significant with a value of 1.0523. The findings implied that, for the matched sample, exporters experienced significant TFP improvements compared to non-exporters. Thus just as in the 2SYSGMM case, there was evidence of the LBE hypothesis. Hence the results from both estimation techniques were consistent thus validating the study findings.

5. Summary, Conclusions and Policy Implications

5.1 Summary and Conclusions

While employing the LP (2003) approach, the study estimated firm's TFP in Kenya's manufacturing sector. By utilizing the 2SYSGMM technique, the study analyzed the response of TFP to firm's export intensity. In addition, the LBE hypothesis was tested using the propensity score matching technique. The study findings were supported by the LBE hypothesis which argues that exporting enhances firm level TFP. Other positive determinants of firm level TFP were labor productivity and management experience. However, firm size and capital intensity had negative effects on firm level TFP. All the study findings were in line with the existing literature on the subject. The study concluded that the LBE hypothesis was supported by the study findings for Kenya's manufacturing sector.

5.2 Policy Implications

Over the years, the Kenyan government has laid a lot of emphasis on an export-led industrialization strategy. The study found evidence of export-led growth at the firm level. This implies that, the Kenyan government is on the right track in terms of supporting an export-led industrialization policy. Therefore, based on the study findings, the government through the Ministry of Trade, Investments and Industry and the Kenya Association of Manufacturers (KAM) should continue implementing policies aimed at promoting exports such as the expansion of export processing zones, special economic zones and export financing among others. More so, market access can be enhanced through active involvement in regional and international trade agreements like the Tripartite Free Trade Area (TFTA), the African Continental Free Trade Area (AfCFTA), the Kenya-USA Free Trade Area (FTA), the Kenya-European Union Economic Partnership Agreement (Kenya-EU EPA) and the Kenya-United Kingdom Economic Partnership Agreement (Kenya-UK EPA) among others.

Firm size had a negative effect on TFP. As such, the government, through the Ministry of Cooperatives and

Micro, Small and Medium Enterprises (MSME) should continue supporting MSMEs to enable them overcome the constraints that they face relative to their larger counterparts. As such, they will be even more productive generating positive spill-over effects to the entire sector. Large firms should also be supported to avoid inefficiencies that lower their TFP. The study established a negative effect of capital intensity on firms' TFP. These results support the Heckscher-Ohlin (Factor Proportions) Model which argues that trade between countries is influenced by their factor-endowments. A country will produce and export more of a good that uses the abundant factor intensely and vice versa. Given that Kenya is a labor-rich country, it will be more economical for Kenya to produce more labor-intensive goods for exports compared to capital-intensive goods. Therefore, the Ministry of Trade, Investments and Industry should promote the use of labor-intensive techniques which will utilize the abundant labor resource in the country and enhance firm performance.

The Ministry of Education should work together with firm owners and KAM to pursue policies aimed at promoting labor productivity. This is supported by the positive effect of labor productivity on firm level TFP. This can be basically achieved through formal and specialized training programmes to boost the skills of the workers as well as proper remuneration and incentives to motivate the workers.

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Competing Interests

The authors declare no financial or personal interests that may have influenced the work presented in this study.

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