ACCOUNTING FOR PRODUCT STANDARDS IN PRODUCTIVITY MEASUREMENT A STUDY ON GHANAIAN APPAREL INDUSTRY

Donatus Ayitey[1]*and Daniel Agbeko[2]

Article History: **Received: 25.02.2023** **Revised: 17.06.2023** **Accepted: 18.08.2023**

Abstract

This paper presents an assessment of Ghanaian apparel sub-sector particularly small and medium-sized businesses by gauging productivity growth (catching-up) along two lines. The first is on growth due to output quantity expansion and the second one is growth due to output standards improvement. This is because the answer to industrial competitiveness depends largely on meeting not only local but also international product standards. Competitiveness likewise depends not only on a firm's success in obtaining an optimal output from a given set of inputs but also on its success in meeting the various local and international market standards required for the business to thrive. Timely enough, new technologies have provided some opportunity for industrial upgrading. Using a multi-stage data envelopment analysis (DEA) and an output-oriented mathematical linear programming technique, the paper computed standards-corrected and non-standards corrected total factor productivity growth coefficients. A key finding was that, growth was due to output quantity expansion and not output standards improvement as non-standards corrected growth coefficients indicate 13 per cent growth compared to standard corrected ones that indicate no change at 95% level of significance. The speed of operation and the quality of products have been among the core drivers of technological choice and adoption by producers in the apparel industry. This evidence corroborated and actually lent credence to the long standing notion that small businesses in the Ghanaian apparel sub-sector are losing competitiveness through slow product quantity expansion and low level of product standards.

Keywords: Product Standards, Productivity Growth, Firm Competitiveness, Ghana

[1]*Senior Lecturer, Department of Multidisciplinary Studies Ho Technical University, Ho Volta Region, Ghana, E-mail: dayitey@htu.edu.gh

[2]Senior Lecturer, Department of Multidisciplinary Studies Ho Technical University, Ho Volta Region, Ghana

***Corresponding Author: -** Donatus Ayitey

*Senior Lecturer, Department of Multidisciplinary Studies Ho Technical University, Ho Volta Region, Ghana, E-mail: dayitey@htu.edu.gh

DOI: 10.48047/ecb/2023.12.1.574

1.1 Introduction

In this paper, we sought to ascertain the state of competitiveness of small businesses in the apparel industry by gauging their performance in productivity growth. It also attempts to isolate product standards improvement from quantity expansion. This is to have an idea of the state of growth due simply to producing more apparel at given standards or growth due to improvement of standards. It is likely that some firms can experience growth on two fronts, expanding quantity and raising product standards whereas some of them can experience a decline in both or in one aspect.

All these are done using non-parametric techniques and estimating two models viz. standard-constant model where productivity growth is computed based only on input-output quantities and the second model which is standard-corrected where observed product standards are accounted for by a measurable indicator. Thus, issues such as, the degree to which small businesses are getting optimal output from a given set of inputs and the extent to which they are meeting both local and international standards so as to remain competitive are addressed.

Specifically, this paper tackled the following questions:

1. Are small and medium-sized businesses (SMEs) in the apparel industry building competitiveness through total factor productivity (TFP) growth?
2. What changes when we account for product standards in TFP growth?
3. Based on the answers of 1 and 2, has the apparel sub-sector built or lost competitiveness between 2002 and 2007 since over 90 per cent of firms in the sub-sector are small businesses?

Correspondingly, the research hypotheses are:

1. SMEs in the apparel sector are losing competitiveness due to low total factor productivity growth, not significant to keep them in operation.
2. Accounting for product standards (quality and non-quality) may not provide any improvement in TFP growth of SMEs
3. The apparel sub-sector as a whole is losing its competitive edge in both domestic and international markets resulting from low growth and low product standards which are not significant enough to keep them in operation.

Why accounting for standards important?

Competitiveness of firms in the apparel market in the era of globalization has become much more exacting than it was in the era of protected markets. Competitiveness which can be examined in the context of increasing productivity growth does not only comprise of output quantity expansion but must be associated with efforts in meeting standards which are usually technical specifications that must be met for products to be acceptable. For small and medium sized firms which want to be competitive internationally and continue to export their products, meeting the standards of international markets is just as important as expanding product quantity. There is also a negative side to standards as they have become indirect instruments for regulating markets, as tariffs are rather unpopular alternatives. These put extra burden on the producers of apparel products to meet these requirements.

To get the essence of how not meeting the standards can make a producer less competitive, lessons can be drawn from African Growth and Opportunity Act (AGOA), a trade Agreement signed into law in 2000 which has presented a market opening to Ghanaian exporters as well as many other countries in sub-Saharan Africa to do business with the United States of America (USA) in some selected items including apparel products. However, to export to the USA market, certain conditions such as tight stitching and carefully finished products including proper labeling and pre-packaging of individual items so that they can readily be put on the shelves must be met (Salinger and Greenwood, 2001). Products would not even be allowed onto the markets if these basic standards are not met. This means that in the competitiveness assessment, these product characteristics can no longer be overlooked. The issue of standards became prominent during our interviews with apparel producers in Ghana as some have complained that these technical requirements are actually making it more difficult to export not only to the USA market but to other markets as well.

A typical success case is one Mr. Gbortsyo located in Ho, a town in Ghana who produces beautiful *Kete* products for niches of domestic and international markets. So far the demand for his products has far exceeded his capacity of production and currently meeting only 30 percent of the domestic market whilst demand from USA and Europe are still not being met. One thing that sets Mr. Gbortsyo apart is zero tolerance for shoddy *Kente* products. Whilst his *Kente* products, are made of 79 warps per strip, the shoddy one has only 50 warps, thus not up to the exact technical specifications to last for a certain period of time and be competitive in the market because of lower standards. In addition to that, various niches of markets both home and abroad require their own specifications including honoring of contracts and meeting of delivery times and taste of the clients among others. To capture the real competitive situation of the two products implies that product standards be accounted for. Using the market value of the product may not present a very accurate picture as transportation cost and other taxes could inflate the real value of the product. It is therefore important that in our measurements and assessment of performance especially at the firm level, these characteristics known as standards or specifications need to be incorporated. That is why this study attempts to measure standards and apply them in the assessment of the productivity and competitiveness performance of some small and medium sized businesses in apparel manufacturing firms in Ghana.

2.0 The Theoretical framework

Generally, the conditions under which firms from developed countries build competitiveness are different from those of the developing countries, and more so small businesses. The targets of firms from developed countries appear also to be different from those of the firms from developing economies. It is evident that most models of technical change emphasized the conditions and the targets of firms from developed countries. Demand and supply forces driving technical change in developed countries include mainly relative prices of the factors of production and the level of factor endowments. Thus, the aim of firms from developed countries is to build competitiveness based on some factors including cost advantages. The reality is that if it costs US $100 per unit of labour to produce one unit of output in developing countries and it costs US $2000 per unit to produce the same unit of output in developed countries, there are serious cost disadvantages producing that product in developed countries. The rate and direction of technical change should be towards employing technologies which reduce greater reliance on relatively expensive factor. The cost cuts are important for firms in developing countries but priorities will have to be established in order to properly address the firms especially small businesses within the developing countries. To this, the study refers to Kennedy and Thirlwall (1972):

'*Technical progress in all its aspects is impossible to measure precisely but its essential quantitative characteristic is to shift the production function (embodying all the previously known techniques) enabling greater output to be produced with the same volume of inputs, or the same output with lesser inputs.'*

What is being emphasized here is output holding standards constant but varying the techniques of production. This is just one perspective capturing the essence of technical change. Whilst the concept of production possibility frontier which is the maximum obtainable amount of one commodity for any given amount of another commodity, given the availability of factors of production and the society's technology and management skills is used to capture the extent to which any change in technology, or factors of production or management skills, can shift outwards or inwards this curve (technical change), the idea can be captured within the context of firms from developing countries, and especially small businesses trying to survive. This is because their targets are different.

The question is: what are the targets of small businesses from developing countries if they must be competitive internationally? The answer is simple and of course it is neither increasing output nor maximizing profit alone but to first meet some minimum local and international product standards. If this is the case for these businesses, then, in using the production possibility frontiers (PPF), in assessing their competitiveness, product standards should be accounted for. This implies that, this study employs *standards-corrected production possibility frontier approach which defines as the maximum amount of output possible with a given technology, factors of production and managerial skills at given product standards.*

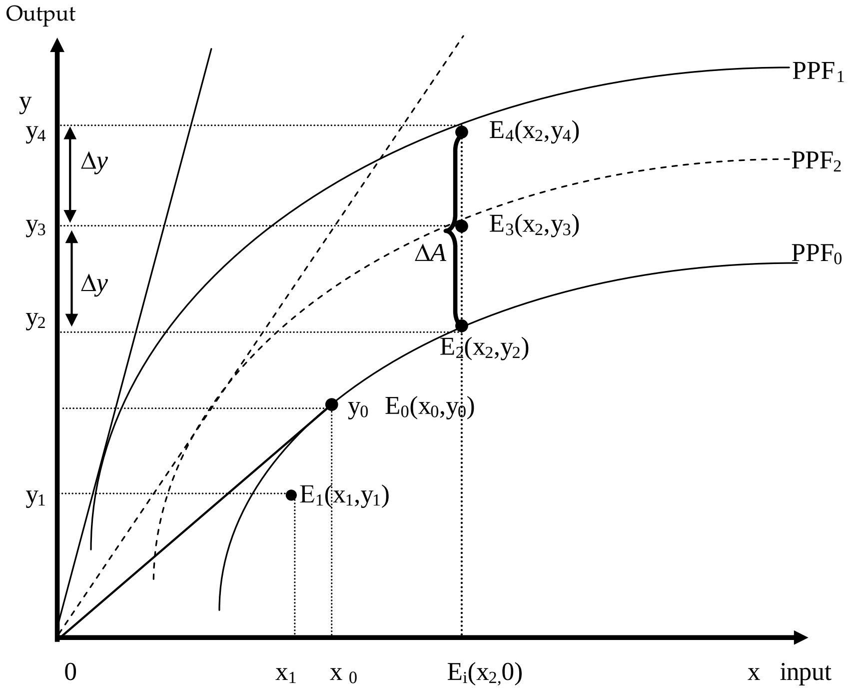
2.1 The Standards-corrected Production Possibility Approach

Firms make decisions with the aim of maximizing product quantity and standards. Then, apparel output/standards depend on some exogenous factor inputs, managerial skills and some technology characteristics. Technical change is therefore not only induced by the relative factor prices and factor endowments but by standards improvement as well. For textile or apparel industry, we will assume that technical change is not localized, in that a change of technique at one stage of production spills over into all other stages and this is reflected in the output/standards of the product. In order to ensure that there is no technological lock-in, we have to assume that variable returns to scale but focus on non-increasing returns to every technique so that at one stage of the production process, there will be the need to switch to better technologies, techniques and skills. Assume that we have the ith level of output/standard y to depend on some input x: and technology. In the case of a single firm switching from one technique to the other (see Figure 1), we have:

1.1 $\Delta y = f(\Delta A)$

An increase in output (Δy) in equation 1.1 captured by the distance between point E_2 and point E_4 could be viewed as a shift or ΔA shown in Figure 1. This shift in PPF or ΔA could result from technical change, shifting from old to new products or standards improvements (quality or non-quality improvement). In Figure 1, a firm producing at E_1 is operating inefficiently because it is not on the production frontier. The firm operating at E_0 on the other hand is both technically efficient and scale efficient because it is on the production frontier PPF_0 at the same time located at the intersection where the ray from the origin which depicts constant returns meets PPF_0. The portion of PPF_0 curve to the left of E_0 indicates increasing returns to scale and that to the right reflects decreasing returns to scale. Any firm operating at E_1 would be seeking to move towards the frontier at E_0 and E_2 would also be seeking to be more scale efficient by moving towards E_0.

Figure 1: Shift of Production Possibility Frontier



3.0 The Methodology

3.1 Accounting for Standards in Productivity Measurement

Productivity measures that 1) account for quantity expansion and 2) incorporate quality performance have appeared in the works of Fixler and Zieschang (1992), and Färe, Grosskopf and Roos (1995). They recognized that quality improvement is equally as important a component of productivity growth as quantity expansion but it is difficult to measure accurately. In fact, productivity measures can be misleading if product standards measures are not incorporated. Fixler and Zieschang noted that it is proper to expand the concept of output beyond output quantities and that it is justifiable to measure productivity growth overtime even when products quantities are held constant with a given set of inputs. Atkinson (2005) even proposed that in the national account data, it is possible to measure quality change based on these technique[1]:

[1] For details, refer to a Paper by UK Department of Health on ' Healthcare Output and Productivity: Accounting for Quality Change published Dec 2005,

- Using a volume measure based on the level of activity, with a quality adjustment which is 'marked up or down' by a percentage reflecting indicators or success and contribution of the service to that success.

In productivity assessment, standards, especially international ones are requirements which if met make a product or service suitable for worldwide use and very important in performance analysis and competitiveness building. Thus the surest way to make businesses competitive is to meet these requirements be they safety, sanitary, quality, or cultural among others. Standards can be put into two components namely quality and non-quality categories with both defining the nature, type and general acceptability of the product or service and form integral part of performance and competitiveness measure of any economic unit.

3.1.1 Non-separability of a product from its standards

Interestingly, the question we raise is how should standards be introduced in productivity assessment?

1) Should they appear as separate vectors? Or

2) Should they be part of the inputs and outputs?

The answer to this question, we believe lies specifically with what the study is focused on. Clearly in accounting for quality in the productivity measurement, Fixler and Zieschang (1992), and Färe, Grosskopf and Roos (1995), define (x, a, y) where x refers to a vector of inputs, a denotes a vector of output attributes appearing separately and y is the output set. In the product market, dissociating products from their attributes becomes more tricky, which prompt this study to device a simple approach to account for the standards of the product by using standards indicator *SIP* (standards intensities of the product) which captures the observed apparel output standards (quality + non-quality) of each firm measured in percentage of nature of fabric, design and patronization percentage among others. The *SIP* is used to mark-up or down the products as it captures their 'standards intensities'. In line with (*x, a, y*), this study specifies (*x, y/a*) because of its output oriented nature and instead of 'a' uses '*SIP*' with different meaning to give (*x, y/SIP*). As illustrated in figure A, a firm's competitiveness defined by its level and rate of productivity performance, tends to reflect clearly when standards are accounted for. It is therefore obvious that for a given *y* and tend to mark-up and down *y* resulting in the shifting upwards and downwards shift of PPF. For example a firm that meets 80% of a set of standards is marked up by the 20 % left not met.

3.2 Measuring Standards Intensities of the Product (SIP)

This part proceeds from the notion that before a business is set up, producers know whatever products or services they want to supply in whatever quantities and levels of standards to match or exceed. With this information in mind, inputs and technological choices are made. The producers are also supposed to be able to know whether what they succeed in producing is actually up to the output standards aimed at. Dealing with quantities is relatively easier as treated in the traditional framework. This is because in the apparel industry for example, quantities produced are measurable in terms of figures. But the true nature of a product actually depends on its quantities and some other characteristics such as standards, among others. This means that, the ability to meet these other characteristics too must be accounted for in order to have more accurate picture of the state of business in terms of its relative competitiveness on the local and international front.

With standards of products known to producers and apart from meeting the minimum requirements to stay in business, they have to make a choice of how much to add to the required minimum. These standards which give details of various aspects of the products sometimes number in the thousands are expressed in measurable units referred to in this study and denoted by s . The s actually measures the difference between the minimum standards that must be met for the product to be acceptable locally and the actual standards attained by the producer. In the apparel sector, s is defined and measured along the lines of idea of Atkinson (2005), Dawson et al. (2005) and Kelly (2004) thus:

Standards (quality and non-quality) of apparel is defined as the value attached by producers and users alike to the characteristics of each of its components from fiber to fabric to the very last finishing detail and change in this standards refers to the rate of change of these characteristics (captured in %) .

3.3 Models

Different models have been used in the past to capture technical change, efficiency change and productivity change in general. They are the non-parametric and parametric/ econometric models. The non-parametric approach can be used to decompose productivity into its components namely technical efficiency (i.e. how rapid is the catching-up process?) and technical change (the degree of upgrading or innovation). The parametric method which was used by, Griliches (1961) Jorgenson (1966), Hulten (1992 and 2000) and Nishimuzu and Page (1982) among others make *a priori assumption* about the distribution of the data. The non-parametric method as proposed in this study is based on Malmquist (1953) productivity index. This is supported by the theoretical efficiency argument advanced by Farrell (1957). The issue that the study is trying to address is finding out whether small businesses in the apparel sector are experiencing technological change and building competitiveness. If this is happening, applying say 2007 technologies to 2002 inputs should result in higher output compared to applying 2002 technology to 2002 inputs. It is a non-parametric technique and does not make any prior assumption about the distribution from which the data is drawn. The Malmquist index can be estimated using Shephard's (1953, 1970) distance functions.

3.4 The Non-parametric Method based on Malmquist Index

Assuming that technologies are employed in apparel manufacturing over different periods in time , the Malmquist index can be computed with multi-outputs and multi-inputs using either input distance function which rescales all inputs towards the frontier technology or output distance function which rescales all outputs towards the frontier technology (Chavas and Cox, 1999). This study prefers the latter because of the aim of trying to find out the extent to which output can be rescaled towards the frontier with a given set of inputs. The assumption here is that both inputs and outputs are disposable and the frontier is attainable with efficient use of available factors.

As the study seeks to establish change between 2002 and 2007 represented by t-5 and t respectively for say firm s, for k level of apparel output , $y \in R_+^k$ and l amount of inputs, $x \in R_+^l$, and input-output set (x, y), t period production set for firm s can be defined as:

1.2.1 $$P^{t,s} = \left\{ (x^{t,s}, y^{t,s}) \in R_+^{k+l} \mid x^{t,s} \ can \ produce \, y^{t,s} \right\}$$

Using an output oriented set define for all $y \in P^{t,s}$, we have:

1.2.2 $$Q(x^{t,s}) = \left\{ y^{t,s} \in R_+^k \mid (x^{t,s}, y^{t,s} \in P^{t,s} \right\}$$

The output oriented Malmquist indexes and distance functions defined for the two periods follow $M_o^{t-5,s}$, $M_o^{t,s}$ and $D_o^{t-5,s}$, $D_o^{t,s}$ in that order. The subscript '*o*' defines the output oriented function. $D_o^{t,s}(x^{t,s}, y^{t,s}) = \min\{\phi : (y^{t,s}/\phi) \in Q(x^{t,s})\}$. This implies that with some given inputs, isoquant $Q(x^{t,s})$ is attainable and the rescaling is done towards it. Specifications of the index follow:

1.2.3
$$M_o^{t,s}(x^{t-5,s}, y^{t-5,s}, x^{t,s}, y^{t,s}) = \frac{D_o^{t-5,s}(x^{t,s}, y^{t,s})}{D_o^{t-5,s}(x^{t-5,s}, y^{t-5,s})}$$

Where the index is expressed with technology occurring in initial period as the reference point. The numerator is expressed as an adjacent period output distance function because of the application of the second period observations to the first period technology. The denominator is within period output distance function because it represents the feasible output with a given set of inputs based on technology occurring at that time.

1.2.4
$$M_o^{t,s}(x^{t-5,s}, y^{t-5,s}, x^{t,s}, y^{t,s}) = \frac{D_o^{t,s}(x^{t,s}, y^{t,s})}{D_o^{t,s}(x^{t-5,s}, y^{t-5,s})}$$

Similarly, technology occurring in the second period can be used as the reference point as in equation 1.2.4. However, in order to avoid arbitrary choice of technology as the reference point, the geometric mean of equations 1.2.3 and 1.2.4 as appears in equation 1.2.5 is preferred for the sake of consistency (Caves, Christiansen and Diewert 1982; Färe, Grosskopf, Norris and Zhang 1994; and Griffel-Tatjé and Lovell 1997).

--- *Non-standards corrected TFP change between t and t-5 follows:*

1.2.5
$$M_o^{t-5,s,t,s}(x^{t-5,s}, y^{t-5,s}, x^{t,s}, y^{t,s}) = \left[\frac{D_o^{t-5,s}(x^{t,s}, y^{t,s}) D_o^{t,s}(x^{t,s}, y^{t,s})}{D_o^{t-5,s}(x^{t-5,s}, y^{t-5,s}) D_o^{t,s}(x^{t-5,s}, y^{t-5,s})} \right]^{\frac{1}{2}}$$

Standards difference at a point in time and standards difference overtime for a given output is measured as a ratio of a standards-corrected output distance function to output constant distance function. The argument here lies in the non-separability of the product and its standards which appear as relative weight in output measure defined as ($\hat{y}$). These follow:

1.2.6

$\hat{D}_o^{t,s}(x^{t,s}, \hat{y}^{t,s}) \qquad D_o^{t,s}(x^{t,s}, y^{t,s})$

$\Rightarrow standard \;\; difference \;\; at \;\; a \;\; point \;\; in \;\; time \;\; (t)$

$$Simple \quad Index \quad = \frac{\hat{D}_o^{t,s}(x^{t,s}, \hat{y}^{t,s})}{D_o^{t,s}(x^{t,s}, y^{t,s})}$$

1.2.7

$\hat{D}_o^{t-5,s}(x^{t-5,s}, \hat{y}^{t-5,s}) \qquad D_o^{t-5,s}(x^{t-5,s}, y^{t-5,s})$

$standard \;\; difference \;\; at \, a \;\; point \;\; in \;\; time \;\; (t-5)$

$$Simple \quad Index \quad = \frac{\hat{D}_o^{t-5,s}(x^{t-5,s}, \hat{y}^{t-5,s})}{D_o^{t-5,s}(x^{t-5,s}, y^{t-5,s})}$$

1.2.8 *Standards corrected TFP change (Δ STAND) between t and t-5 follows:*

$$\Delta STAND^{t-5,t,s}(x^{t-5,s}, \hat{y}^{t-5,s}, x^{t,s}, \hat{y}^{t,s}) = \left[\frac{\hat{D}_o^{t-5,s}(x^{t,s}, \hat{y}^{t,s})}{\hat{D}_o^{t-5,s}(x^{t-5,s}, \hat{y}^{t-5,s})} \frac{\hat{D}_o^{t,s}(x^{t,s}, \hat{y}^{t,s})}{\hat{D}_o^{t,s}(x^{t-5,s}, \hat{y}^{t-5,s})} \right]^{\frac{1}{2}}$$

3.6 Summary of Expected Estimations

$$\left[M_o^{t-5,s,t,s}\right] \;\; \begin{matrix} > \\ = \\ < \end{matrix} \; 1 \begin{cases} productivity \;\; growth(catchning - up) \\ No \, growth \, (stagnating) \\ productivity \, decline \; (\, falling \;\; behind) \end{cases}$$

Δ Overall productivity growth

Table 1: Estimation Procedure

$\left[\hat{D}_o^{t-5,s}(x^{t,s}, \hat{y}^{t,s})\right]^{-1} = Max\phi_s$ $Subject \quad to$ $\phi_s \hat{y}_h^{t,s} - \sum_{s=1}^{m} \lambda_s \hat{y}_h^{t-5,s} \le 0 \quad h = 1,.........., r$ $x_i^{t,s} - \sum_{j=1}^{m} \lambda_s x_i^{t-5,s} \ge 0 \quad i = 1,..........., n$ $\lambda_s \ge 0 \quad \forall \quad s = 1,......., m$ A	$\left[\hat{D}_o^{t,s}(x^{t,s}, \hat{y}^{t,s})\right]^{-1} = Max\phi_s$ $Subject \;\; to$ $\phi_s \hat{y}_h^{t,s} - \sum_{s=1}^{m} \lambda_s \hat{y}_h^{t,s} \le 0 \quad h = 1,.........., r$ $x_i^{t,s} - \sum_{s=1}^{m} \lambda_s x_i^{t,s} \ge 0 \quad i = 1,..........., n$ $\lambda_s \ge 0 \quad \forall \quad s = 1,......., m$ B
$\left[\hat{D}_o^{t,s}(x^{t-5,s}, \hat{y}^{t-5,s})\right]^{-1} = Max\phi_s$ $Subject \quad to$ $\phi_s \hat{y}_h^{t-5,s} - \sum_{s=1}^{m} \lambda_s \hat{y}_h^{t,s} \le 0 \quad h = 1,.........., r$ $x_i^{t-5,s} - \sum_{s=1}^{m} \lambda_s x_i^{t,s} \ge 0 \quad i = 1,..........., n$ $\lambda_s \ge 0 \quad \forall \quad s = 1,......., m$ C	$\left[\hat{D}_o^{t-5,s}(x^{t-5,s}, \hat{y}^{t-5,s})\right]^{-1} = Max \; \phi_s$ $Subject \quad to$ $\phi_s \hat{y}_h^{t-5,s} - \sum_{s=1}^{m} \lambda_s \hat{y}_h^{t-5,s} \le 0 \quad h = 1,.........., r$ $x_i^{t-5,s} - \sum_{s=1}^{m} \lambda_s x_i^{t-5,s} \ge 0 \quad i = 1,..........., n$ $\lambda_s \ge 0 \quad \forall \quad s = 1,......., m$ D

In the top cells is standards corrected mode. In cell 3, changes in standards are shown. Cells label A, B, C and D shows the computation of the parts of models 2 using distance functions and data envelopment analysis.

3.7 Calculation of the TFP scores

With the aid of multi-stage data envelopment analysis (DEA) and an output-oriented mathematical linear programming technique, calculation of the TFP scores is possible (Table 1, cells A, B, C and D). Charnes, Cooper and Rhodes' (CCR) publications in 1978 and 1981 established the foundation for DEA which involves the use of mathematical linear programming system to construct a non-parametric production frontier in order to calculate efficiencies in production. Following CCR, the output oriented mathematical linear programming specification for s^{th} firm with i^{th} amount of inputs (x) and h^{th} amount of output $(\hat{y})$ between two time periods (t-5, t) with λ s as the weight are as follows in the table:

The efficiency level of output denoted by ϕ_s measures the extent to which output of each apparel manufacturing firm can be scaled up by employing factors of production in an efficient manner. This expansion is that of radial nature because it is done with a given set of inputs. Thus, if ϕ_s value is calculated to be equal to 1.0, efficient position is attained, greater than 1.0 implies inefficiency. The value of 1.50 means that with efficient employment of factors of production, output can be expanded by 50% and so the current state of efficiency of this firm is 0.50 (50%). The weights ($\lambda_s s$) relate to the firm or firms operating on the frontier against which other firms are being measured and compared. In this expression, this is based on estimating the inverse of the distance functions, constant returns to scale is specified. The software used in this study is Frontier Efficiency Analysis in R (FEAR) created by Wilson (2007).

3.8Outliers and Choice of bandwidth

It is a well-known fact that DEA tends to envelop the entire data associated with the decision making units, in this study, the firms under investigation. Inability to account for firms that are doing extremely well due to some other factors might render all other firms looking rather too inefficient in comparism. The same is true for the firms performing very poorly, in which case, all other firms will appear to be extremely efficient. In dealing with outliers that might be present in our data, the study employed Wilson (1993) log-ratio plot and Grubbs (1969) test for outlier detection. The impact of one or two outliers did not make any difference in our results. This was realized even when we dropped the outliers. Our choice of the bandwidth or smoothing parameter h and the type of kernel estimation follows (Silverman 1986) data-driven automatic selection procedure which is less controversial because it is based on widely used algorithm(see density plots in Figure 2).

The observed apparel output (y) for 2002 and 2007 was captured in a single survey as the value of total products at factory-gate prices. The intention is to get the true value of the product without any transportation cost and other market charges. The total value was obtained from the sum of the values of children's wear, men's wear and women's wear produced by a firm. However some firms specialized in only one or two of the three items. For both years the values were measured based on 2002 prices in old Ghana cedis to ensure that both years are comparable. Aggregating the various values for a single firm produces one apparel output indicator for 2002 and one for 2007 respectively.

The study uses three inputs namely labor (l), capital (k) and amount of fabric and material (m) used in the production of apparel. Annual labour input for 2002 and 2007 was measured in hours and derived from the average number of workers who go to work per day, average of actual number of days worked in a week and average of actual number of hours spent working in a day. This is then computed for the entire year to get a single labour indicator for each for both years. Capital on the other hand is measured by summing the values in cedis of fixed assets and variable assets. In this study, the fixed assets comprise the values of equipment, machinery and workspace or office among others. Variable capital consists of value in cedis of inventory, semi-finished or finished products and working capital commonly referred to as money for day to day running of the business. The third input which is the fabric or material for apparel manufacturing is measured in value of yards or meters used per year in cedis for the two years based of course on 2002 prices.

Observed product standards (s) comprising both quality and non-quality standards of each firm which for some firms vary between 2002 and 2007 is also obtained. The indicator has some element of subjectivity in that even though derived from objective fabric characteristics such as durability, smoothness, weaving style, comfort, colour, heat conduction, speed of shrinkage, extent of wrinkling and bagging measures among others, the use of fabric hand based on external appearance cannot always be objective. Apparel producers provided their candid assessment of their own products based on the quality, style and types of fabric inputs based on the degree of patronization of the finished apparel products. Interviewers also through the external appearance and fabric hand are also able to confirm the extent of the local and even international standards of the products. The indicator obtained captures in percentages the degree of international standard being met in 2002 and 2007. Year 2002 coincided with an era dubbed the 'Golden Age of Business' and start of African Growth and Opportunity Act (AGOA) and Presidential Special Initiative (PSI) for textile and garments, making the data reliable as respondents checked the data.

3.9 Data and Description of Variables

Variable	description
Output	
y	Observed annual apparel output of each firm (y1,….,y140) measured in cedis
Inputs	
l	Amount of labour (l1,…,l140) measured in person hours/year
k	Amount of capital (k1,…,k140) measured as the value of fixed assets plus cash spent on daily operations in cedis
m	Amount of material used (m1,…,m140) measured in value of yards or meters/year in cedis
Other	
$\hat{y}$	Observed apparel output standards (quality + non-quality) of each firm (v1,…,v140) measured in % of nature of fabric, design and patronization

Descriptive Statistics (N=140)

2002	Mean	Max	Min	Median	2007	Mean	Max	Min	Median
yt-5	2156.88	25200	70.5	1075	yt	3678.01	25000	100	2200
vt-5	0.34	0.8	0.1	0.25	vt	0.44	0.9	0.1	0.39
k-5	1321.1	6000	60	900	k	2706.22	16000	70	1600
l-5	1213.6	14080	320	960	l	1581.2	5440	320	1360
m-5	862.15	7400	30	420	m	1636.43	9500	80	900

NB: Value of output (y), capital (k) and material (m) are measured in ‘0000 old Ghana cedi whilst labour (I) is measured in person hour/year and output standards (v) measured in %

4.0 The Presentation and Analysis of Results

4.1 Incidence of Productivity Growth among small apparel businesses

This section seeks to present and analyze the results of the two models namely the non-standard corrected (Model 1.2.5) and standard-corrected (Model 1.2.8) which were estimated to establish the performance of the firms with respect to productivity growth. The main idea is to find out whether these firms are losing their competitiveness as a result of the occurrence of low or no productivity growth among them, and whether firms are even reducing output just to survive in which case output growth over the period would be negative.

Table 1.3.1 shows the results of firms which experience productivity growth between 2002 and 2007. In the first column are units of firms categorized according to their size and regional representations. The alphabet ‘n’ represents the number of firms in each category. As discussed in the previous sections, the performance of the firms is gauged using model 1.2.5 which does not account for output standards and Model 1.2.8 which accounts for output standards. For the entire sample, our results established that 69 per cent of 140 firms recorded some growth of 1 per cent and above (Model 1.2.5). The number of firms experiencing growth in standards corrected (model 1.2.8) was far less constituting only 52 per cent and just 37 per cent of the 140 firms in the entire sample.

The differences in performance among these firms with respect to non-standards corrected and standards corrected output reflects various strategies being adopted by each firm in order to survive. The apparel industry is basically demand-driven and therefore standards improvements are necessary to be competitive. The number of firms experiencing negative productivity growth is many, constituting 31 per cent for non-standards corrected and 63 per cent standards corrected. This is an indication that the sub sector is actually in difficulty with respect to growth.

Growth performance by firm size, in this case micro firms compared with small and medium sized firms revealed an interesting situation where 69 per cent of the latter registered positive growth compared to 68 per cent of the former in non-standards corrected model (Model 1.2.5). However, the variation between the two size categories in Model 1.2.8 indicated more micro firms improved their product standards relative to their small and medium counterparts. This implies that there are some efforts by many micro firms to survive the rather liberalized market environment through higher standards products. Many of the small and medium sized firms on the other hand appear to be more focused on output expansion by increasing fabric use rather than the quality and non- quality standards that could increase the cost of production.

At the regional level, the best performing region of the three appears to be the Eastern which is known for its good entrepreneurial skills and management styles. The 73 per cent of the firms in the Eastern Region (Model 1.2.5) that have recorded some growth over the 2002 to 2007 period cannot make up for the 27 per cent of them that are actually coming to terms with negative growth and therefore are on their way to exiting the business altogether. Measures that can guarantee their continuous stay in the business include laying-off people and cutting back on the amount of output produced. It is therefore of no surprise that people in the apparel related activities continued to lose their jobs with each passing season.

In Table 1.3.2, clearer information is presented by capturing the counts of firms in categories of total factor productivity (TFP) growth among the entire sample, micro-sized firms, small and medium sized firms, Greater Accra, Eastern and Volta Regions. The results of the non-standards corrected model and standard corrected model 1.2.8 are shown by the figures without the brackets and those within the brackets respectively. From the entire sample of 140 firms, 11 of them comprising of 7.9 per cent experienced TFP growth by 40 per cent and above in non-standards corrected model (model 1.2.5). Of the number of firms with phenomenal growth of 40 per cent and over in non-standards corrected model, most are from micro firms compared to small and medium sized ones whereas at the regional level they appear to be evenly spread. This is an indication that best performers can be found among different size and regional groups.

The number of firms recording what can be said to be excellent growth of 20 to 39 per cent are understandably more than those with phenomenal growth forming 17 and 2 per cent respectively in models 1.2.5 and 1.2.8. Again they are fairly common among different size and regional groups. Consistent with Table 1.3.1, the upper half section of Table 1.3.2 establishes that for the entire sample 69 per cent of firms are doing well with growth of 1 per cent and above in model 1.2.5 and 37 per cent of them are experiencing same in model 1.2.8. That positive picture painted by the upper half of Table 1.3.2 is quickly countered by the gloomy one exposed at the bottom half of Table 1.3.2 which conveys the information that all has not been well with some firms over the 2002 and 2007 period in which various initiatives including the PSI on garments was lunched by the government.

For the entire sample, the results indicate that at least 31 per cent of the firms (model 1.2.5) and 55 per cent (model 1.2.8) did not only fail to improve upon their product performance but actually faced some slump in output growth. Even if 10 per cent of the firms in a sub-sector are cutting back on production, the consequences on employment, household income and welfare become very grave. To talk of 31 and 55 per cent of firms in our sample confronted with negative growth with respect to non-standards corrected and standards corrected output respectively can best be seen as a sub-sector in crisis which needs immediate attention.

Table 1.3.1: Incidence of Positive TFP Growth among Apparel Manufacturing Firms

Unit	n	Model 1.2.5: + Non standards Corrected	Model 1.2.8: + Standards Corrected
Entire Sample	140	96(69%)	52 (37%)
Micro-Firms	85	58(68%)	32 (38%)
Small & Medium Firms	55	38(69%)	20 (24%)
Greater Accra Region	58	39(67%)	24 (41%)
Eastern Region	37	27(73%)	11 (30%)
Volta Region	45	30(67%)	17 (38%)

Δ defines change in non-standards corrected and standards corrected rate of productivity growth

In Figure 1.2, the situation is confirmed as many firms found themselves located to the left half of the distribution characterized by negative growth. In Tables 1 and 2 in Appendix, only 17 firms from Volta region, out of a total of 45 recorded positive growth in standards corrected TFP growth model compared to 30 for non-standards corrected TFP growth model. The rest either maintained their standards or adjusted downwards. Of the 37 firms sampled from the Eastern region, only 11 of them namely firm 46, 47, 49, 51, 62, 64, 66, 67, 70, 78 and 79 appear to have experienced some positive standards corrected TFP growth in compared to 27 of them in non-standards corrected TFP growth

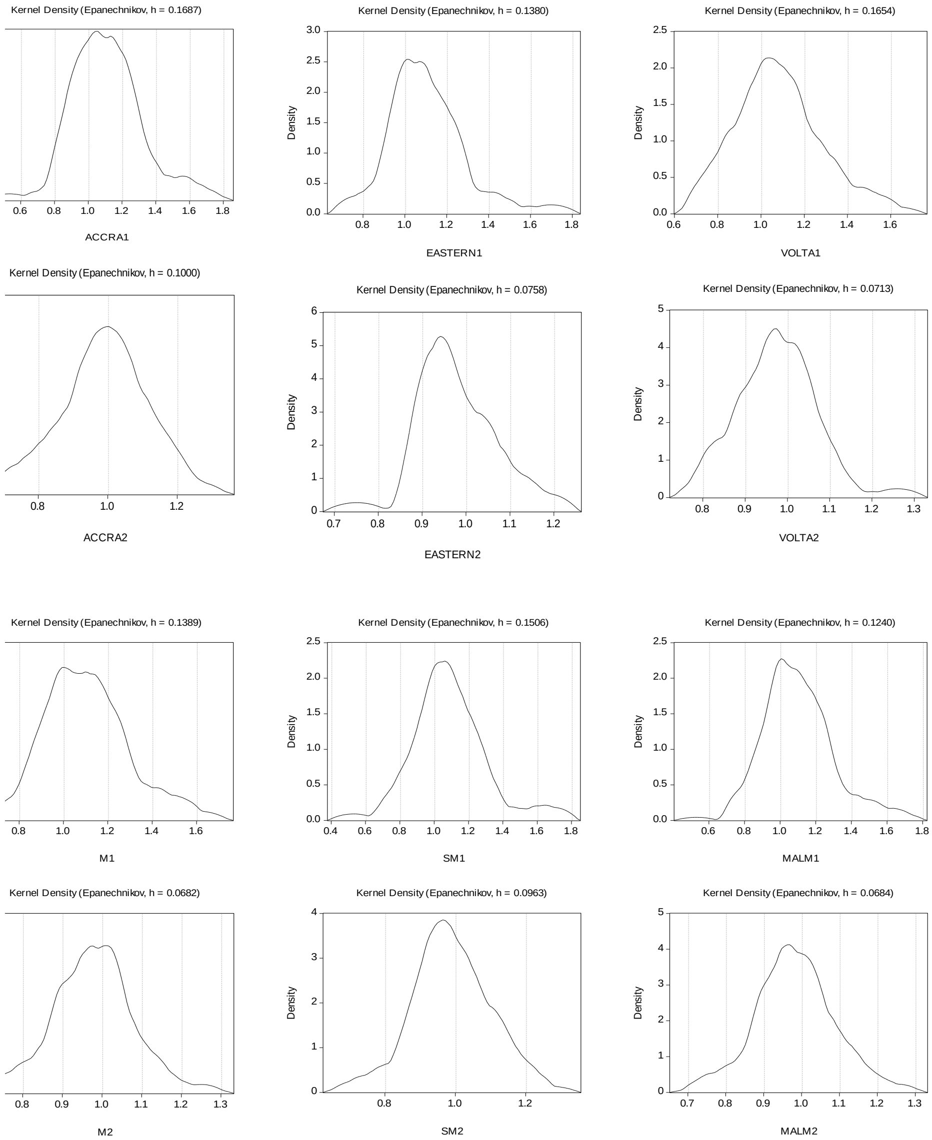
Table 1.3.2: Counts of Firms in categories of TFP Growth between 2002 and 2007

% Δ Malmquist	Entire Sample	Micro-sized Firms	Small & Medium Firms	G. Accra Region	Eastern Region	Volta Region
Positive Growth						
40%+	11[0]	7[0]	4[0]	5[0]	3[0]	3[0]
20-39%	24[3]	16[2]	8[1]	11[2]	4[0]	9[1]
10-19%	26[15]	16[8]	10[7]	13[9]	9[4]	4[2]
1-9%	35[34]	19[22]	16[12]	10[13]	11[7]	14[14]
0% Growth	0[11]	0[7]	0[4]	0[4]	0[5]	0[2]
Sub-total	96[63]	58[39]	38[24]	39[28]	27[16]	30[19]
Negative Growth						
1-9%	30[53]	21[29]	9[24]	15[17]	7[18]	8[18]
10-19%	6[17]	3[13]	3[4]	1[8]	1[2]	4[7]
20-39%	7[7]	3[4]	4[3]	2[5]	2[1]	3[1]
40% -	1[0]	0[0]	1[0]	1[0]	0[0]	0[0]
Sub-total	44[77]	27[46]	17[31]	19[30]	10[21]	15[26]
Total	140[140]	85[85]	55[55]	58[58]	37[37]	45[45]

Figures in the brackets capture counts of firms with standards corrected TFP growth and those outside the bracket capture counts of firms with non-standards corrected TFP growth.

Apart from firms 53,56,60,70 and 80 which registered zero no changes in non-standards corrected TFP growth, the rest had to contend with negative non-standards corrected TFP growth (Appendix). About 56.8 per cent of all the firms in the Eastern region did improve their standards corrected TFP growth compared to 27 per cent that did not improve non-standards corrected TFP growth (Appendix). Whist it may be true that most of the firms are

Figure 1.2: Growth Distribution by Region, Firms Size and Entire Sample for Models 1 & 2b



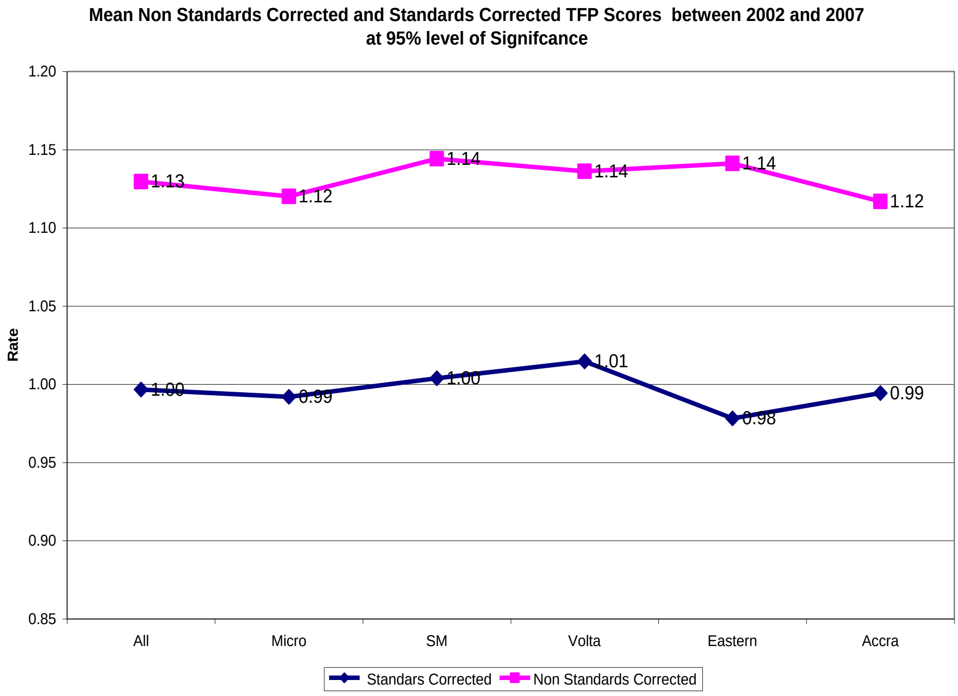
Note: Distributions are based on non-standards corrected model (1) and standards corrected model (2) respectively

producing at low standards and trying to balance their survival strategies with the choice of the level of product standards, others might not have any need to improve given their circumstances.

4.2 Research Hypothesis: Firms are losing competitiveness due to slow TFP Growth

The question we seek to answer here is whether SMEs in the apparel manufacturing business are building competitiveness through significant TFP growth. We therefore progressed with non-standards corrected TFP scores and standards corrected TFP scores. Since the estimated TFP scores derived from the data envelopment analysis (DEA) procedure alone is not enough to establish the level of statistical significance, we based our statistical inference on the construction of confidence intervals at 95% level of significance using the homogeneous bootstrap procedure with 2000 replications for three inputs and one output(Simar and Wilson, 1998). Results for non standard corrected and standards corrected TFP scores are presented in Figure 1.3.

Figure 1.3: TFP growth by Firm Size and Region



Subtracting unity from the scores provide the answer to our question as to the direction of TFP growth. Scores equal to unity indicate no change in TFP growth.

The results for non-standards corrected TFP scores indicate 13 per cent growth compared to standard corrected TFP scores that indicate no change at 95% level of significance (See All in Figure 1.3). Small and medium sized firms(SM) appear to have performed better than micro firms (see Micro). In all size and location groups, non-standards corrected TFP scores are higher than the standards corrected TFP scores revealing that these firms are losing competitiveness through low standards corrected TFP growth.

1.5 Summary and conclusion

In this Paper, the performance of SMEs in the apparel industry is assessed using both non-standards corrected and standards corrected TFP growth measures. Both non-standards corrected and standards corrected TFP measures are necessary to compare how well the firms have performed with either of them and which one needs emphasizing. The results revealed that more firms experienced TFP growth with non-standards corrected measure compared to that of the standards corrected measure. At the regional level, there were differences in the distribution of non-standards corrected TFP growth and standards corrected TFP growth. Eastern region was established as having performed best in increasing the non-standards corrected TFP growth but worst with standards corrected TFP growth. Greater Accra region was the best performer in non-standards corrected TFP growth. Regardless of size and location, these businesses have been characterized by low non-standards corrected TFP growth and low standards corrected TFP growth which implies that more has to be done so as not to lose competitiveness due to low overall TFP. The apparel sub-sector as a whole has therefore been losing its competitive edge over the 2002 and 2007 period in both domestic and international markets resulting from low TFP growth.

The findings lent credence to the long standing notion that these firms are performing poorly. In the standards corrected TFP growth measures, the revelation that SMEs are performing poorly is worrying as the market is so liberalized that the competition is felt from both domestic and international producers.

References:

1. Agresti, A. (2002). Categorical Data Analysis (2nd ed.). Wiley.
2. Caves, D. W., Christiansen, L. R., & Diewert, W. E. (1982). The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity. Econometrica, 50(6), 1393-1414.
3. Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2, 429–444.

4. Charnes, A., Cooper, W. W., & Rhodes, E. (1981). Evaluating program and managerial efficiency: Applications of data envelopment analysis to program follow through. Management Science, 27(6), 668-697.
5. Crawley, J. (2005). Statistics: An Introduction using R. John Wiley & Sons Ltd.
6. Dawson, D., Gravelle, H., et al. (2005). Developing new approaches to measuring NHS outputs and productivity Final Report. Centre for Health Economics, University of York, Research Paper 6.
7. Färe, R., Grosskopf, S., Norris, M., & Zhang, Z. (1994). Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries. American Economic Review, 84(1), 66-84.
8. Färe, R., Grosskopf, S., & Roos, P. (1995). Productivity and quality changes in Swedish Pharmacies. International Journal of Production Economics, 39, 137-147.
9. Fixler, D., & Zieschang, K. (1992). Incorporating Ancillary Measures of Processes and Quality Change into a Superlative Productivity Index. Journal of Productivity Analysis, 2, 45-267.
10. Grifell–Tatje, E., & Lovell, C. A. K. (1997). The sources of productivity change in Spanish banking. European Journal of Operational Research, 98, 364-380.
11. Griliches, Z. (1963). The Sources and Measured Productivity Growth: United States Agriculture, 1940-60. The Journal of Political Economy, 71(4), 331-346.
12. Grubbs, F. (1969). Procedures for detecting outlying observations in samples. Technometrics, 11(1), 1.
13. Hulten, C. R. (1992). Growth Accounting When Technical Change is Embodied in Capital. The American Economic Review, 82(4), 964-980.
14. Hulten, C. R. (2000). Total Factor Productivity: A Short Biography. In Hulten, Dean, & Harper (Eds.), New Directions in Productivity Analysis. University of Chicago Press for National Bureau of Economic Research.
15. Jean-Paul, C., & Cox, T. L. (1999). A Generalized Distance Function and the Analysis of Production Efficiency. Wisconsin-Madison Agricultural and Applied Economics Staff Papers, 422.
16. Jorgenson, D. W. (1966). The Embodiment Hypothesis. The Journal of Political Economy, 74(1), 1-17.
17. Kelley, N. (2004). Fabric Properties and Distinctions Quality in Apparel: EVALUATING QUALITY IN APPAREL. Textiles, Merchandising, and Design Middle Tennessee State University, Fabrics.net TM Spokane, WA.
18. Kennedy, C., & Thirlwall, A. P. (1972). Technical Progress: A Survey. Economic Journal, 82(325), 11-72.
19. Maindonald, J., & Braun, J. (2003). Data Analysis and Graphics Using R: An Example-Based Approach. Cambridge University Press.
20. Malmquist, S. (1953). Index Numbers and Indifference Surfaces. Trabajos de Estadistica, 4, 209-224.
21. Nishimizu, M., & Page Jr., J. M. (1982). Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965–1978. Economic Journal, 92, 920–936.
22. Salinger, B. L., & Greenwood, A. (2001). AGOA Textile and Garments: What Future for Uganda's Exports? Report prepared for the Nathan-MSI Group's Uganda Private Sector Trade Policy Capacity Building Project. Available at www.aird.com/Publications/UgandaTextiles.pdf.
23. Shephard, R. W. (1953). Cost and Production Functions. Princeton University Press.
24. Shephard, R. W. (1970). Theory of Cost and Production Functions. Princeton University Press.
25. Silverman, B. W. (1986). Density Estimation for Statistics and Data Analysis. Chapman and Hall.
26. UK Department of Health (2005). Healthcare Output and Productivity: Accounting for Quality Change, Gateway Ref: 5886 271610 1p 0.5k Dec05 (CWP).
27. Venables, W., & Ripley, B. (2002). Modern Applied Statistics with S (4th ed.). New York.
28. Wilson, P. W. (1993). Detecting outliers in deterministic nonparametric frontier models with multiple outputs. Journal of Business and Economic Statistics, 11, 319-323.
29. Wilson, P. W. (2007). FEAR: A Software Package for Frontier Efficiency Analysis with R. Socio-Economic Planning Sciences. Advance online publication

Appendix

Table 5.1: Mean TFP Changes(Non Standards Corrected) between 2002-2007 period

Firm	Index	Firm	Index	Firm	Index	Firm	Index	Firm	Index
1	1.0704	29	1.6006	57	1.6989	85	1.3464	113	1.0940
2	1.2101	30	1.0709	58	1.1155	86	1.1264	114	0.9271
3	0.7652	31	1.4834	59	0.8978	87	1.0124	115	0.7990
4	0.9652	32	0.9156	60	0.9503	88	0.9305	116	1.0643
5	1.0407	33	1.3488	61	1.2127	89	1.1516	117	1.0241
6	1.0826	34	1.0493	62	1.2613	90	1.0873	118	1.1819
7	1.0911	35	1.1492	63	1.1764	91	1.2599	119	1.1193
8	1.2834	36	1.2234	64	0.9963	92	1.1714	120	0.9063
9	1.2480	37	0.7982	65	1.2305	93	0.8725	121	1.1853
10	1.0639	38	0.9422	66	0.9863	94	1.2242	122	0.9119
11	1.0486	39	1.0413	67	0.7692	95	0.9103	123	0.9077
12	1.2584	40	0.9662	68	1.1906	96	1.4614	124	1.2830
13	0.8750	41	0.9036	69	1.1953	97	1.1886	125	1.6254
14	0.7718	42	1.1485	70	1.0278	98	1.1700	126	0.7845
15	1.2469	43	1.1960	71	1.0805	99	0.9870	127	1.2023
16	0.9811	44	1.3836	72	1.0838	100	0.9314	128	1.5448
17	0.9500	45	1.4772	73	1.1804	101	1.1610	129	0.5303
18	0.9719	46	1.1861	74	1.0137	102	1.2702	130	0.9967
19	0.8174	47	0.9351	75	1.0372	103	0.9545	131	0.9879
20	1.2604	48	1.4140	76	1.4906	104	1.6890	132	1.2844
21	1.0443	49	1.0021	77	0.9773	105	1.2057	133	0.9241
22	1.0500	50	0.9957	78	1.0446	106	1.1457	134	1.1024
23	0.8048	51	1.0032	79	1.1582	107	1.0199	135	0.9491
24	1.0345	52	0.7836	80	1.1854	108	1.4809	136	1.0252
25	1.1257	53	1.0777	81	1.3415	109	0.9477	137	1.2305
26	1.0954	54	0.9841	82	1.0113	110	0.9139	138	1.1650
27	1.0721	55	1.0406	83	1.0247	111	1.0347	139	1.0704
28	0.8040	56	1.1913	84	1.3352	112	1.2734	140	1.1655

Table 5.2: Mean TFP Changes(Standards Corrected) between 2002-2007 period

Firm	Standards	Firm	Standards	Firm	Standards	Firm	Standards	Firm	Standards
1	1.0000	29	1.0278	57	0.9050	85	1.0016	113	0.8948
2	0.8932	30	0.9937	58	0.9107	86	1.0736	114	0.9598
3	0.9204	31	1.0724	59	0.9243	87	1.1346	115	0.9355
4	0.9688	32	1.0613	60	1.0000	88	0.9477	116	1.2634
5	0.9189	33	0.9790	61	0.9209	89	0.8829	117	0.9865
6	0.9713	34	0.9261	62	1.1022	90	0.9985	118	0.8868
7	0.8433	35	1.0298	63	0.9449	91	0.9790	119	1.1020
8	0.9093	36	1.0013	64	1.0490	92	1.0507	120	1.0256
9	0.9352	37	0.8080	65	0.9289	93	0.7615	121	0.7849
10	0.9865	38	0.9207	66	1.0558	94	1.1632	122	0.9858
11	1.0082	39	0.9495	67	1.0932	95	0.8407	123	1.1822
12	1.0560	40	1.0131	68	0.9127	96	1.1146	124	0.9932
13	1.1434	41	1.0373	69	0.9293	97	1.0498	125	1.0000
14	0.9996	42	1.1068	70	1.0235	98	1.0000	126	1.0371
15	1.0000	43	0.8382	71	0.9194	99	0.9826	127	1.1622
16	1.0217	44	1.0572	72	0.9264	100	1.1496	128	0.7213
17	0.8315	45	1.0102	73	1.0000	101	1.0251	129	0.7458
18	0.9357	46	1.0318	74	0.9450	102	0.7547	130	0.9907
19	0.9255	47	1.1158	75	0.9062	103	0.8430	131	0.9838
20	0.8596	48	0.9804	76	0.9696	104	1.0732	132	1.0000
21	1.2593	49	1.1814	77	0.8996	105	0.9128	133	0.9145
22	0.7937	50	0.8878	78	1.1859	106	0.9155	134	0.8746
23	1.0815	51	1.0749	79	1.0430	107	0.9227	135	1.1448
24	1.0994	52	0.9108	80	1.0000	108	1.1305	136	0.9884
25	0.9719	53	1.0000	81	0.9442	109	0.8706	137	1.0570
26	0.8624	54	0.7511	82	0.9498	110	0.8419	138	1.2367
27	0.9239	55	0.9386	83	0.9589	111	1.0000	139	1.0946
28	0.9323	56	1.0000	84	1.0424	112	1.0278	140	1.0906