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Partial and Total Productivity Measurement Models for Garment Manufacturing Firms

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Abstract

The main objective of this study is to explore the productivity measures typically used in Ethiopian garment manufacturing firms and its shortcomings. A case study was carried out at NGM manufacturing firm. The analysis of existing productivity measures indicates that the firm does not have proper and systematic productivity measures to monitor its productivity performance. Garment manufacturing firms did not determine the resource (labor, material, machine, energy, etc.) utilization rate and considered productivity as an equivalent to labor productivity. Partial and total productivity measurement models are developed and applied to monitor the productivity status of the firm. The models are tested using the data of five consecutive fiscal years (2007/8 to 2011/12) collected from NGM firm. Accordingly, the partial productivity indices of the firm for current year (2011/12), as compare to base year (2009/10), for each input factor (human, material, capital, energy and miscellaneous input factors) are 2.36, 0.64, 0.51, 2.25 and 1.09, respectively. The total productivity index of the current year is 0.75. Furthermore, the partial and total productivity analysis trends of NGM firm were computed in the same fiscal years. All partial productivity indices of the company during the period of 2008/9 showed a decline as compared to the base period (2009/10) which is the lowest productivity in the specified period. The total productivity index also showed the lowest (a decline by 73%) in the same period. Therefore, the developed partial and total productivity measurement models had the scope to portray the firm's performance in a comprehensive manner.

Keywords: *Productivity Measurement Model, Partial Productivity, Total Productivity, Garment Manufacturing*.

1. Introduction

The productivity measurement has always been an important aspect in manufacturing firms. Nowadays, the issue of productivity improvement, especially in developing countries, has become important for manufacturing firms' managers, strategic planners, government policy makers and it is becoming a key factor affecting the overall performance of firms [11]. Improving organizational productivity is an issue that has been used for some time and will continue to be important. For manufacturing firms characterized by low utilization of their resources (machines/ equipments, human labor, materials, capital, energy, time and others), productivity measurement and improvement is not only desired but is also increasingly becoming a requirement for organizational survival [20].

The productivity measurement is the quantification of both the output and input resources of a production system. It is the pre-requisite for productivity improvement [18]. It shows the gap between the existing and the desired status or the level of productivity in the manufacturing firm. It has been stated that the low level of productivity in manufacturing firms implies a low growth of national as well as organizational economy [17].

Garment manufacturing is one of the labor intensive manufacturing firms that contribute to the economic growth of the country. There are about 39 garment manufacturing firms in Ethiopia. Those manufacturing firms are inadequate in their resource utilization, and low productivity is a common feature for most of them. Almost all of these firms are characterized by low profit due to the high cost of production. Firms do not clearly identify the factors influencing the productivity and the existing productivity status is not known. There is no defined and reliable productivity measurement system. Therefore, the purpose of the present study is to develop productivity measurement models for garment manufacturing firms in Ethiopia.

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2. Research Approach

The approaches of the present study include literature review, observations, discussions and a case study. A detailed literature review of productivity measurement approaches and types of productivity measurement are presented. The current productivity measurement practices in manufacturing firms are reviewed.

Researchers have made field observations to see the overall working environment of the garment manufacturing firms, to investigate work processes and procedures, and to observe the productivity tasks practiced in firms. Moreover, a couple of fruitful discussions were held with general managers, production managers and supervisors in the firms.

A case study was carried out at NGM manufacturing firm. NGM firm is selected as a case study because of the data and information availability as well as the interest of managers to do so. The objective of the case study was to study specific productivity problems, to identify the shortcomings of the current productivity measurement method, and to verify and test the proposed productivity measurement models.

3. Development of Productivity Measurement Model

The productivity measurement and analysis should commonly fulfill the criteria that it should provide both aggregate (firm-level) and detailed (operational level) productivity indices, represent the firm productivity, identify or prioritize the problem areas and determine the solutions for improving productivity in such areas, resulting in the identification of potential improvements; it should be complete (completeness refers to the thoroughness with which outputs or results delivered and all inputs or resources consumed are measured and included in the productivity ratio); it should be inclusive, including all activities of the firm; it should show which particular input resources are being utilized inefficiently and it should enable to decide how to reallocate resources; it should determine how well previously established goals were met; it should also point out which operational units are profit making and which are not. The measurement model should offer a way of not only measuring but also evaluating, planning, and improving the overall productivity of an organization as a whole as well as its operational units; it should provide valuable information to strategic planners in making decisions related to diversification and phase outs of products or services.

The development of an effective measurement system is essential for a continuous productivity improvement. What is needed, then, is a productivity measurement system that not only provides a firm-level total productivity index to indicate the productivity health of the firm, but it also points out the growth or the decline in the productivity and the profitability of its products or services. Partial productivities and total productivity were considered in the present study for measuring productivity.

3.1. Computation of Partial Productivities

A. *Partial productivities can be calculated by:*

Partial Productivity:

$$PP_G = \frac{OF}{I_G} \ (Where \ \ G = H, M, C, E, X) \quad (1)$$

B. The five basic partial productivity indices can be calculated by:

i. Human Productivity index:

$$PP_{H\text{-}index} = \frac{OP_c}{OP_b} \times \frac{IP_{Hb}}{IP_{Hc}} \quad (2)$$

ii. Material Productivity index:

$$PP_{M\text{-}index} = \frac{OP_c}{OP_b} \times \frac{IP_{Mb}}{IP_{Mc}} \quad (3)$$

iii. Capital Productivity index:

$$PP_{C\text{-}index} = \frac{OP_c}{OP_b} \times \frac{IP_{Cb}}{IP_{Cc}} \quad (4)$$

iv Energy Productivity index:

$$PP_{E\text{-}index} = \frac{OP_c}{OP_b} \times \frac{IP_{Eb}}{IP_{Ec}} \quad (5)$$

v. Miscellaneous Productivity index:

$$PP_{X\text{-}index} = \frac{OP_c}{OP_b} \times \frac{IP_{Xb}}{IP_{Xc}} \quad (6)$$

where
OF = Total output of the firm
OP_C = Output of current period
I_G = (H, M, C, E, and X inputs)
OP_b = Output of base period
IP_C = Input of current period
IP_b = Input of base period

3.2.Total Productivity of a Firm: TPF Based on Total Outputs & Inputs

A. *Total productivity of the firm for period t as a function of its total outputs and total inputs is given by:*

$$TPF_t = \frac{OF}{IF} \quad ..... \quad (7)$$

where
OF = Total output of the firm and
IF = Total input of the firm

$$TPF_t = \frac{OF}{v.\ of\ I_H + v.\ of\ I_M + v.\ of\ I_C + v.\ of\ I_E + v.\ of\ I_X} \quad (8)$$

v. : Value

B. *Total productivity index of the firm for period t as a function of its total outputs and total inputs is given by:*
Total Productivity index of a firm:

$$TPF_{Index} = \frac{OF_c}{OF_b} \times \frac{IF_{Cb}}{IF_{Cc}} \quad (9)$$

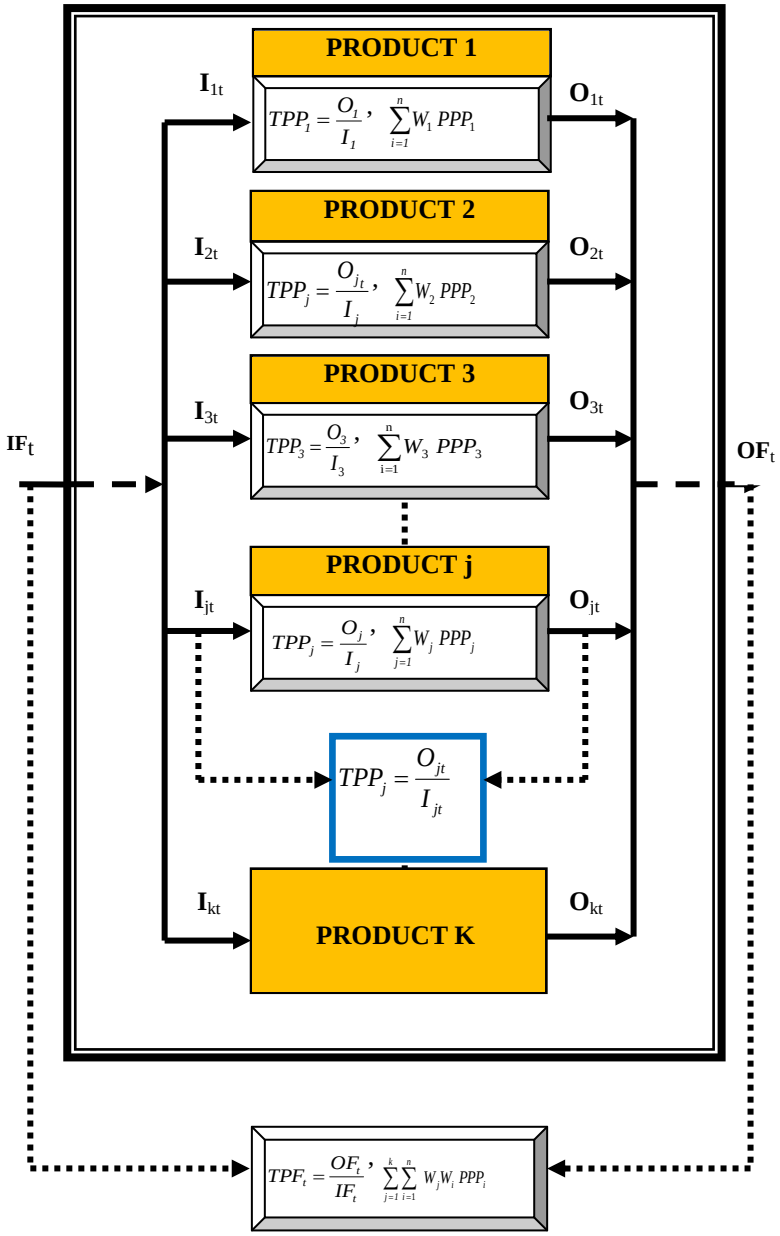

Figure 1. Product-based Productivity Measurement Model at Firm Level

TPF Computation Based on Individual Products: Total productivity of a product in a given period (PP-based):

where

TPP_j = Total productivity of a product j
PPP_{ji} = Partial Productivity of product j for input i
W_{ji} = Weight attached to input factor i & j
j = Designates a type of a product in a firm

C. *Partial productivity index of a product:*

$$PPP_{ji} = \frac{OP_c}{IP_{ic}} \Big/ \frac{OP_b}{IP_{ib}} \qquad (11)$$

PPP_{ji} = Partial Productivity of product j for input i
OP_c = Output value of a product *for* P_c
OP_b = Output value of a product for the P_b
IP_{ic} = An Input factor of a product for P_c
IP_{ib} = An Input factor of a product *for* P_b
I = Designates the type of input factor of a product.

D. *Total productivity of a firm for a given period (PB-Product Based):*

$$TPF = w_j * 1/n(w_1 PPP_1 + w_2 PPP_2 \ldots\ldots + w_j PPP_j)$$

$$= \sum_{j-1}^{K} w_j \, 1/n \left(\sum_{i=1}^{n} w_i PPP_i \right)$$

$$TPF = \sum_{j=1}^{k} w_j TPP_j = \frac{O_1 + O_2 + O_3 + \ldots O_n}{I_1 + I_2 + I_3 + \ldots I_n} \qquad (12)$$

where

TPF = Total productivity of a Firm
PPP_i = Partial Productivity of a product for input i
W_j = Weight attached to a product; & $\Sigma\, W_j = 1$
W_i = Weight attached to input factor; and
i = Designates the type of input factor of a product
j = Designates type of a product in a Firm
k = Number of products in the firm
n = Number of input factors for a product

E. *Total Productivity of a firm based on its five partial productivities (PB) is given as:*

$$TPF = \frac{1}{5}\left(\sum_j w_{jH} PPP_{jH} + \sum_j w_{jM} PPP_{jM} + \sum_j w_{jC} PPP_{jC} + \sum_j w_{jE} PPP_{jE} + \sum_j w_{jX} PPP_{jX}\right) \quad (13)$$

F. *Total Productivity index of a firm based on its five partial productivities (PB) is given as:*

$$TPF_{Index} = \sum_j w_{jH} PPP_{jH} + \sum_j w_{jM} PPP_{jM} + \sum_j w_{jC} PPP_{jC} + \sum_j w_{jE} PPP_{jE} + \sum_j w_{jX} PPP_{jX} \quad (14)$$

G. *Total Productivity of a firm based on its five partial productivities is given as:*

$$TPF = \frac{1}{5}\left(W_{iH} PP_{iH} + W_{iM} PP_{M} + W_{iC} PP_{iC} + W_{iE} PP_{iE} + W_{iX} PP_{iX}\right) \quad (15)$$

H. *Total Productivity index of a firm based on its five partial productivities is given as:*

$$TPF_{Index} = W_{iH} PP_{H\text{-}index} + W_{iM} PP_{M\text{-}index} + W_{iC} PP_{C\text{-}index} + W_{iE} PP_{E=index} + W_{iX} PP_{X=index} \quad (16)$$

4. Productivity Computation at NGM Firm

The productivity measurement is part of the diagnosis of identifying where the improvement activity should be prioritized. It is important to do measurement as a basis for analysis, and also to track the change and the progress during the improvement program. The basic objectives behind the productivity measurement are to help the practitioners understand their production processes, to ensure that decisions are based on facts, to show where improvements need to be made, to show if improvements actually happened, to identify whether the practitioners are meeting customer requirements or not.

The productivity measurement is not well exercised in NGM firm. To achieve long-term productivity improvements, the present ad-hoc or informal approach has to be replaced by a more systematic and strategic approach to measurement. In particular, it is necessary to analyze the relationship between causes and effects of garment productivity and to quantify the impacts of the different input factors for productivity.

4.1. Computation of Partial Productivities of NGM firm for 2011/2012 Fiscal Year (FY)

NGM firm produces different models of garments (such as Baseball pants, Polo-shirts, T-shirts, etc.). For measuring the partial and total productivity in NGM firm, five-year (i.e., 2007/8 to 2011/12) data were collected.

Base year selection: The base year for the calculation of the productivity growth in the company was defined to be the 2009/2010 fiscal year (FY), because this year got a relatively higher average performance and fully advocated by the interview result from the company's production manager. Implementing the measurement model requires gathering of any two of the quantities, i.e., price or value of each input and output. Accordingly, the data of output and input values of NGM firm for the fiscal years 2007/8 to 2011/12 were compiled as shown in Table 1.

The authors have defined the five partial productivities of NGM firm as follows:

1. ***Human inputs:*** these include the values of salaries and benefits of all employees of the company.
2. ***Material inputs:*** these include major raw materials, such as knitted and woven fabrics; accessories, such as buttons, sewing threads, zippers, bands, etc.
3. ***Capital inputs****:* uniform annual cost of both fixed and working capital.
4. ***Energy Inputs*****:** these include electrical power and water consumption.
5. ***Miscellaneous inputs*****:** these include taxes, professional fees, advertisement cost, insurance, travel and per diem, etc.)

A. *Five Basic Partial Productivities of NGM firm for 2011/2012 FY*

1. The partial productivities of NGM firm for 2011/2012 fiscal year are computed as follows:

$$PP_H = \frac{OF}{I_H} = \frac{12798897}{340650} = 37.57$$

$$PP_M = \frac{OF}{I_M} = \frac{12798897}{2318670} = 5.52$$

$$PP_C = \frac{OF}{I_C} = \frac{12798897}{3012873} = 4.25$$

$$PP_E = \frac{OF}{I_E} = \frac{12798897}{72845} = 175.70$$

$$PP_X = \frac{OF}{I_X} = \frac{12798897}{950236} = 13.47$$

Therefore, the partial productivities of the company for the fiscal year 2011/2012 with respect to each input factor are calculated using equation 1. Accordingly, the partial productivities for human, material, capital, energy and miscellaneous input factors of the process are 37.57, 5.52, 4.25, 175.70 and 13.47, respectively.

Table 1. Data for Computing Partial and Total Productivity. (Source: Authors' computation from NGM firm)

Item	Fiscal Year				
	2007/8	**2008/9**	**2009/10**	**2010/11**	**2011/12**
Value of Human Inputs	924,372	426,430	549,597	337,993	340,650
Value of Capital Inputs	1,937,522	1,510,843	1,048,983	4,436,026	3,012,873
Value of Material Inputs	1,709,467	1,472,118	1,015,385	3,993,236	2,318,670
Value of Energy Inputs	36,667	45,443	112,044	32,317	72,845
Value of Miscellaneous Inputs	235,777	225,462	708,185	1,181,268	950,236
Value of Total Outputs	4,856,342	2,541,355	8,745,896	11,953,628	12,798,897
Value of Total Inputs	4,843,805	3,680,296	3,434,191	9,980,840	6,695,274

B. *Five Basic Partial Productivity indices of NGM firm for 2011/2012 FY*

2. Using equations (2-6), the partial productivity indices of the different input factors of the NGM firm for fiscal year of 2011/2012 has been computed as follows:

Partial productivity index for human input factors:

$$PP_{H\text{-}index} = \frac{OP_c \times IP_{ib}}{OP_b \times IP_{ic}} = \frac{12798897 \times 549597}{8745896 \times 340650} = 2.36$$

where, $PP_{H\text{-index}}$ is the partial productivity index of the NGM firm for fiscal year of 2011/2012 for human input factor.

Partial productivity index for material input factors:

$$PP_{M\text{-}index} = \frac{OP_c \times IP_{ib}}{OP_b \times IP_{ic}} = \frac{12798897 \times 1015385}{8745896 \times 2318670} = 0.64$$

where, $PP_{M\text{-index}}$ is the partial index of the NGM firm for fiscal year of 2011/2012 for fiscal year of 2011/2012 for material input factor.

Partial productivity index for capital input factors:

$$PP_{C\text{-}index} = \frac{OP_c \times IP_{ib}}{OP_b \times IP_{ic}} = \frac{12798897 \times 1048983}{8745896 \times 3012873} = 0.51$$

where, PPC-index is the partial productivity of the NGM firm for fiscal year of 2011/2012 for capital input factor.

Partial productivity index for energy input factors:

$$PP_{E\text{-}index} = \frac{OP_c \times IP_{ib}}{OP_b \times IP_{ic}} = \frac{12798897 \times 112044}{8745896 \times 72845} = 2.25$$

where, PPE-index is the partial productivity of the NGM firm for fiscal year of 2011/2012 for energy input factor.

Partial productivity index for miscellaneous input factors:

$$PP_{x\text{-}index} = \frac{OP_c \times IP_{ib}}{OP_b \times IP_{ic}} = \frac{12798897 \times 708185}{8745896 \times 950236} = 1.09$$

where, PPx-index is the partial productivity of the NGM firm for fiscal year of 2011/2012 for miscellaneous input factor.

Therefore, the partial productivity indices for the fiscal year 2011/2012 with respect to each input factor (human, material, capital, energy and miscellaneous input factors) of the NGM firm are 2.36, 0.64, 0.51, 2.25 and 1.09, respectively.

4.2. Total Productivity Computation of NGM firm for 2011/2012 FY

In the present study, three basic approaches are developed to calculate the total productivity of the company. Those methods are: Total productivity based on total outputs and total inputs, total productivity based on five basic partial productivities and total productivity based on the individual products of the company. The first and the second approaches were implemented in the company. The third approach was not implemented in the company, because there were no organized data in the form of individual products in the company.

A. *Computation of Total Productivity Based on Total Outputs and Inputs*

The total productivity of the company for fiscal year 2011/2012 as a function of its total outputs and total inputs has computed by using equation (7) as follows:

$$TPF_{2011/2012} = \frac{OF}{IF} = \frac{12798897}{6695274} = 1.912$$

Therefore, the total productivity of NGM firm for fiscal year 2011/2012 based on the function of its total output and total input is 1.912.

B. *Computation of Total Productivity Based on Partial Productivities*

The total productivity of the NGM firm for the fiscal year 2011/2012 was also computed based on five partial productivities by using equation (15) as follows:

$$TPF = \frac{1}{5}(W_{iH}PP_{iH} + W_{iM}PP_M + W_{iC}PP_{iC} + W_{iE}PP_{iE} + W_{iX}PP_{iX})$$

First, the weight factors for each input are computed as follows:

$$W_H = \frac{I_H}{IF} = \frac{340650}{6695274} = 0.051$$

$$W_M = \frac{I_M}{IF} = \frac{2318670}{6695274} = 0.346$$

$$W_C = \frac{I_C}{IF} = \frac{3012873}{6695274} = 0.450$$

$$W_E = \frac{I_E}{IF} = \frac{72845}{6695274} = 0.011$$

$$W_X = \frac{I_X}{IF} = \frac{950236}{6695274} = 0.142$$

$$\therefore TPF = \frac{1}{5}(0.051\,x\,37.57 + 0.346\,x\,5.52 + 0.450\,x\,4.25 + 0.011\,x\,175.70 + 0.142\,x\,13.47)$$

$$= 1/5\,(1.91 + 1.910 + 1.913 + 1.933 + 1.913)$$

$$= \underline{\mathbf{1.915}}$$

The total productivity index of the company for the fiscal year 2011/2012, as a function of its total outputs and total inputs, was computed by using equation (9) as follows:

Total Productivity index of firm:

$$TPF_{Index} = \frac{OF_c}{OF_b} \times \frac{IF_{Cb}}{IF_{Cc}}$$

$$TPF_{Index} = \frac{12798897}{8745896}\,x\,\frac{3434191}{6695274} = 0.7506$$

Total Productivity index of a firm based on its five partial productivities has computed using equation (16) as:

$$TPF_{Index} = W_{iH}PP_{H\text{-}index} + W_{iM}PP_{M\text{-}index} + W_{iC}PP_{C\text{-}index} + W_{iE}PP_{E\text{-}index} + W_{iX}PP_{X\text{-}index}$$

$$= 0.051 \times 2.360 + 0.346 \times 0.64 + 0.450 \times 0.51 + 0.011 \times 2.25 + 0.142 \times 1.09$$

$$= 0.1204 + 0.2208 + 0.2295 + 0.0248 + 0.1548$$

$$= \underline{0.7504}$$

4.3. Partial & Total Productivity Analysis at NGM

A partial and total productivity analysis was done at NGM firm by comparing the current partial and total productivity with the base period. Based on the data obtained for five consecutive periods (2007/08, 2008/09, 2009/10, 2010/2011, 2011/2012), the status of the current fiscal year 2011/12 was determined with the reference to the base year 2009/10.

A. *Partial Productivities Analysis at NGM Firm*

The partial productivities of the current fiscal year (2011/12) were computed in section 4.1.A. above. Accordingly, the partial productivities of human, energy and miscellaneous inputs showed a growth with an amount of 136 %, 125%, and 9 %, respectively. But the partial productivities of capital and material inputs showed a decline with an amount of 49% and 36%, respectively. Table 2 shows the decline or growth of the partial productivities of the company in 2011/12 fiscal year:

Table 2. Comparison of Current Partial Productivities with P_b

Partial Productivities	Base period (2009/10)	Current period (2011/12)	Change (%)	Status
Human Inputs Productivity	15.91	37.57	136	Growth
Capital Inputs Productivity	8.34	4.25	-49.0	Decline
Material Inputs Productivity	8.61	5.52	-36.0	Decline
Energy Inputs Productivity	78.06	175.7	125.0	Growth
Miscellaneous Inputs Productivity	12.35	13.45	9.0	Growth

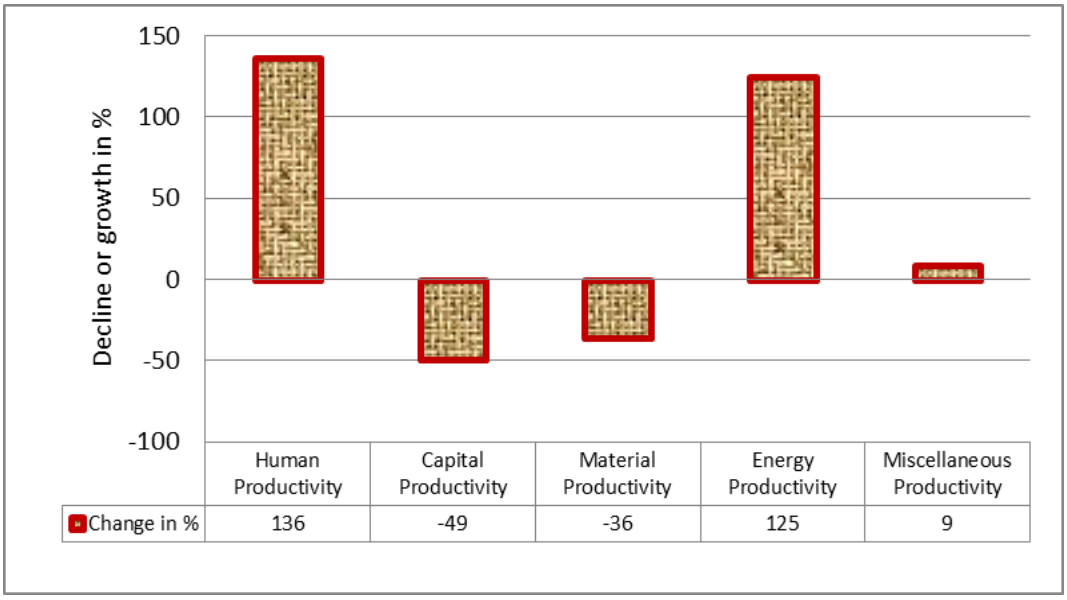

Figure 2. Decline/growth of PP for Year 2011/12 against P_b

B. *Total Productivity Analysis at NGM Firm*

The total productivity index of NGM firm for the current period (2011/12) was computed in section 5.2. and it is 0.75. This indicates that the productivity of the company declined with an amount of 25 %. Hence, it is necessary to investigate the points where primarily poor productivity growth shows and make appropriate improvement initiatives for the firm. The developed productivity measurement methodology indicates not only the productivity growth or the decline of the firm but it also enables to investigate the productivity of the company at firm level, product level, operational level, and even at process input factors or parameters level.

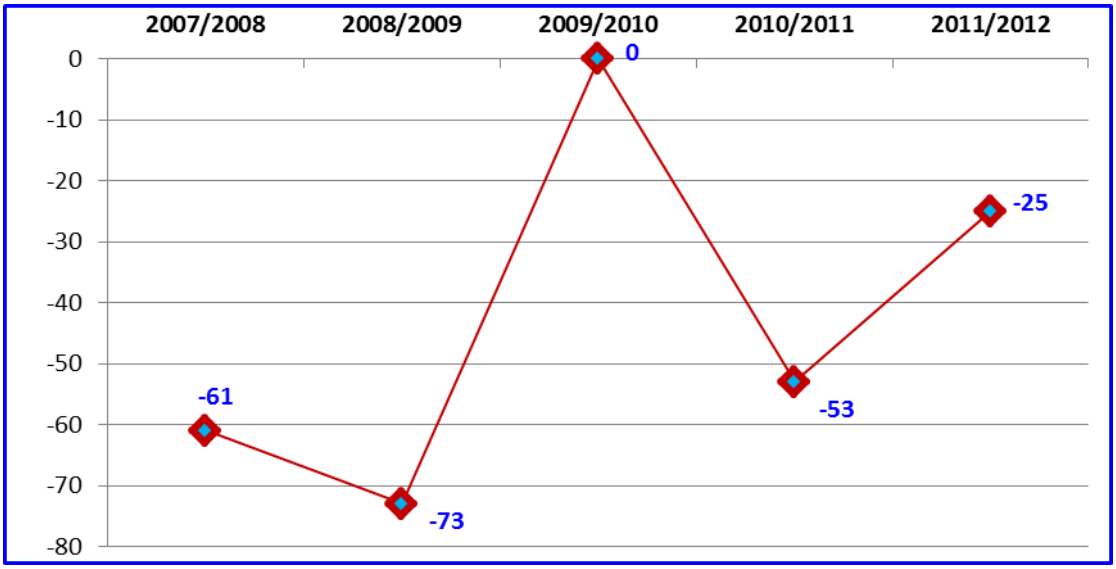

Figure 3. Total Productivity Trends: 2007/8 to 2011/12 against P_b

5. Results and Discussion

5.1. Partial and Total Productivities at NGM Firm (2007/8 – 2011/12)

So far, the partial and total productivities of NGM firm have been computed for fiscal years 2007/8 to 2011/12. The productivity measurement results are helpful for the company to know the status of its performance and to identify the potential areas for improvement. Especially, the productivity index is important to tell the relative position of the current period with respect to the base period, and links to the actual productivity story of the company. Comparison of the productivity index value with the previous productivity history of the company will enable to dig out the critical productivity problems and suggest the appropriate corrective actions that should be taken by the company. The productivity measurement and the analysis result also enable to point out the bottleneck areas where improvement actions that are to be taken at both the operational and the company levels. As stated above, the summarized partial and total productivities and its indices are shown in Table 3.

The productivity of the company for the specified periods (2007/8 to 2011/12) fluctuates from year to year. For instance, the total productivity indices of the company for the fiscal years 2007/8 to 2011/12 were 0.394, 0.271, 1.00, 0.47, and 0.75, respectively. Hence, the productivity of the current year (2011/12) is better than the other fiscal years as compared to the base year. On the other hand, it showed poor productivity during the period 2008/9. Of course there was an interruption of electrical power at a national level during the periods 2007/8 and 2008/9.

5.2. Productivity Trend Analysis at NGM firm (2007/8 – 2011/12)

The productivity trend analysis provides a wealth of information for many other purposes, such as profit planning, short and long-term productivity planning, and productivity evaluation. The productivity trend analysis is probably the most important step in the productivity-measurement stage of a firm's productivity program, because productivity figures are interpreted to trigger action-oriented management strategies. Hence, the productivity indices of NGM firm were compiled in the form of a management summary report to indicate the percent changes in total and partial productivities for the specified periods (2007/8 to 2011/12) as shown in Table 4.

Table 3. Partial and Total Productivity of NGM firm for Five Fiscal Years

Parameters	Fiscal Years					
	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	Min. value
TPF	1.003	0.691	2.547	1.198	1.912	0.691
TPF_i	0.394	0.271	1.00	0.470	0.751	0.271
PP_H	5.25	5.96	15.91	35.37	37.57	5.25
$PP_{H\text{-}i}$	0.33	0.37	1.00	2.22	2.36	0.33
PP_C	2.51	1.68	8.34	2.69	4.25	1.68
$PP_{C\text{-}i}$	0.30	0.20	1.00	0.32	0.51	0.20
PP_M	2.84	1.73	8.61	2.99	5.52	1.73
$PP_{M\text{-}i}$	0.33	0.20	1.00	0.35	0.64	0.20
PP_E	132.4	55.92	78.06	369.9	175.7	55.92
$PP_{E\text{-}i}$	1.70	0.72	1.00	4.74	2.25	0.72
PP_X	20.60	11.27	12.35	10.12	13.45	10.12
$PP_{X\text{-}i}$	1.67	0.91	1.00	0.82	1.09	0.82

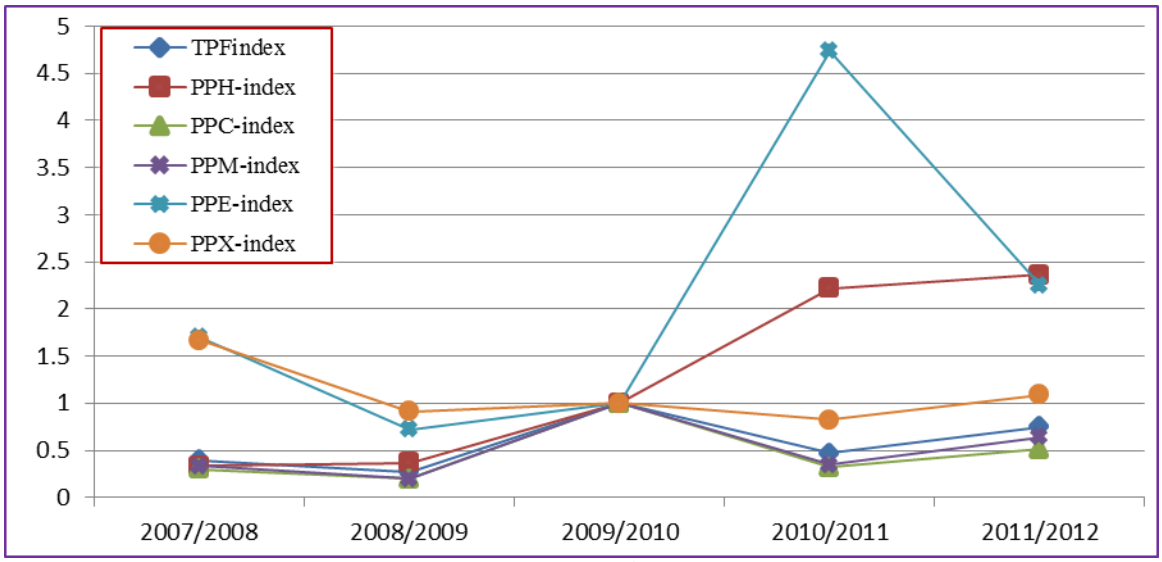

Figure 4. Partial and Total Productivity Indices for Novastar Garment PLC against Base Period

All partial productivity indices of the company during the period 2008/9 showed a decline as compared to the base period 2009/10 which is the lowest productivity in the specified period. The total productivity indices also showed the lowest (a decline by 73%). In general, one can observe the report format of the productivity trend analysis and could easily identify productivity status of the company.

5.3. Productivity Measurement and its Shortfall at NGM firm

NGM firm has been measuring and analyzing its productivity for a long period of time partially (only labor productivity). The company's labor productivity is measured as the ratio of the total number of garment to the total number of employees. It is measured to evaluate the company productivity growth and/or decline. Productivity is expressed in the form of sales volume and used to evaluate the overall performance of company. This productivity measurement model, however, has limitations as: it cannot represent the firm's productivity, it is not complete and inclusive and it does not indicate the areas of productivity problems and opportunities for improvement. The details are discussed as follows:

- *NGM firm uses inappropriate Productivity Measurement Technique*

Currently, the company measures labor productivity only. Moreover, the measurement approach for the labor productivity is inappropriate. It uses Mill's index approach. Mill's index is obtained by dividing the total product output by the total number of employees. Basically, Mill's index approach is used for measuring the productivity index at industry level, such as manufacturing industry, construction industry, service industry, etc. The measured productivity index may be used as an indication of productivity at industry level, not at firm or operational level.

- *Productivity Measurement System of NGM firm Lacks Completeness*

Completeness means the thoroughness with which outputs and all inputs, or resources consumed, are measured and included in the productivity ratio (M. A. Wazed, 2008). With this respect, the productivity measurement is not complete at NGM firm. The company did not consider all factors of production (inputs) of the firm, such as materials, energy, capital and other utilities and facilities, which are used to produce the final products of the company. These input factors have a high impact on the productivity of the organization. Ignoring these factors, while measuring the productivity of the firm, will result in an erroneous effect and will misdirect the company's improvement effort.

- *Productivity Measurement System of NGM firm Lacks Comparability*

The existing productivity measurement system (labor productivity) does not show a comparability result. The company needs to identify its productivity growth by defining a base year. The productivity index will be developed based on the base year and is used to determine whether the company is growing or declining in productivity with time. The current productivity measurement and analysis system, however, measure productivity only as the rate of garments produced per unit of labor utilized in the given period of time.

Table 4. Partial and Total Productivities Trends at NGM firm (2007/8-2011/12)

S.N	Fiscal Years	Partial Productivities Changes, %					Total Productivity Changes, %
		H	M	C	E	X	
1	2007/2008	-0.67 ↓(67%)	-0.67 ↓(67%)	-0.70 ↓(70%)	+0.70 ↑(70%)	+ 0.67 ↑(67%)	**-0.61 ↓(61%)**
2	2008/2009	-0.63 ↓(63%)	-0.80 ↓(80%)	-0.80 ↓(80%)	-0.28 ↓(28%)	- 0.09 ↓(9 %)	**-0.73 ↓(73%)**
3	2009/2010	0.00 →(0 %)	0.00 →(0 %)	0.00 →(0 %)	0.00 →(0 %)	0.00 →(0 %)	**0.00 →(0 %)**
4	2010/2011	+1.22 ↑(122%)	-0.65 ↓(65%)	-0.68 ↓(68%)	+3.74 ↑(374%)	- 0.18 ↓(18%)	**-0.53 ↓(53%)**
5	2011/2012	+1.36 ↑(136%)	-0.36 ↓(36%)	-0.49 ↓(49%)	+1.25 ↑(125%)	+ 0.09 ↑(9 %)	**-0.25 ↓(25%)**

6. Conclusion

The present study examined the garment manufacturing firms' productivity measurement and investigated how partial and total productivities could be measured. Basically, the productivity measurement is the pre-requisite for productivity improvement. The garment manufacturing firms are using only one of the partial productivities, i.e., labor productivity. This productivity measurement system, however, has limitations, such as: it could not represent the firm's productivity, or the productivity measurement system lacks completeness, productivity measurement system also lacks comparability (there is no base year selection and the status of productivity growth or decline is unknown), the productivity measurement system in garment manufacturing firms does not include all possible measurement systems (such as partial productivities, total productivity), the existing productivity measurement also has a limitation in identifying and detecting productivity problems as well as productivity improvement opportunities.

A case study was performed at NGM firm. It focused upon the shortcomings of the current productivity measures and the computation of partial and total productivities. Moreover, the proposed partial and total productivity measurement models were tested considering the data of five consecutive fiscal years (2007/8 to 2011/12). Accordingly, the partial productivity indices of the company for the current year (2011/2012) as compared to the base year (2009/10) for each input factor (human, material, capital, energy and miscellaneous input factors) were 2.36, 0.64, 0.51, 2.25 and 1.09, respectively. The total productivity index of the current year was 0.75. Furthermore, the partial and total productivities analysis trends of NGM firm were computed for the fiscal years 2007/8 - 2011/12. All partial productivity indices of the company during the period of 2008/9 showed a decline as compared to the base period (2009/10) which is the lowest productivity in the specified period. The total productivity indices also showed as the lowest (a decline by 73 %) in the same period. Therefore, the developed partial and total productivity measurement models were used for monitoring and measuring the productivity performance of the company that enhances its productivity improvement in the long run.

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