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An Analysis of the Production Function of Ready-Made Garments Industry in Bangladesh: A Case of Tex-Town Group Limited

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Abstract
More than 78% of Bangladesh's export earnings come from the garment industry. The ready-made garments (RMG) sector has a greater potential than any other sector in terms of employment and foreign exchange earnings to reduce poverty and make a contribution to the national economy. In this paper, we attempt an econometric estimation of Cobb-Douglas production function in Bangladesh's ready-made garments industry and also test the hypothesis that ready-made garments industry is expected to reap better economies of scale in a competitive environment. We try to resolve some econometric issues such as heteroscedasticity, autocorrelation and multicollinearity in the production function estimates by adopting different solutions and adjustment procedures with a view to obtain reliable parameter estimates. . This study has been used the annually time series data about ready-made garments production, labour wages, and capital of Tex-Town Group Limited from 2002-2013. Ordinary Least Square (OLS) method is used to estimate the model. The results show that there is a positive relationship between labour wages, capital and ready-made garments production in Bangladesh. The value of R2 is 0.687. This indicates that about 68.7% of the total variation in the ready-made garments production is explained by the labour wages and capital in Bangladesh. The results are statistically significant at 5% level of significance. This study suggests that increase in labour employment and capital to increase the production of ready-made garments in Bangladesh.
Keywords: Ready-made Garments Industry; Production Function; Wage, Capital.

1.0 Introduction

The Successful export oriented readymade garments (RMG) industry of Bangladesh has observed remarkable growth since its beginning late 1970s. Explosive growth of RMG exports is of not inimitable to Bangladesh. The annual compound growth rate of RMG export industries in Indonesia (31.2%), Mauritius (23.8%) & Dominican Republic (21.1%) compares favorably with that of Bangladesh (81.3%) over the 1980-87 periods. However, while the initial conditions were favorable for export growth in the countries noted above, this was far from the truth in case our country. This makes research into the factors responsible for the observed outstanding growth of RMG exports from Bangladesh-a persuasive case study in economic development.

In Industrial Organization, economists are investigating how productivity differences across firms are related to market structure, and more generally what causes differences in productivity across firms (Bartlesman and Doms, 2000). Many macroeconomic models assume that productivity shocks cause business cycle fluctuations. Productivity plays a central role in the recent trade literature as well. In these models, productivity is heterogeneous across firms and high productivity firms decide to enter into trade (Bernard et al. (2003), Melitz (2003)).

The main stumbling block in production function estimation has been accounting for the endogeneity of productivity. Inputs are generally correlated with productivity because a firm takes into account its productivity when making input decisions. This correlation biases production function parameters estimated using OLS, as first pointed out by Marshak and Andrews (1944). To focus on endogeneity, economists have simplified the estimated form of the production function.

2.0 Objectives of the Study:

The main objectives of this study are referring as follows:

1. To estimate the production function of ready-made garments industry of Bangladesh.
2. To give some possible solutions and recommendation based on the empirical result of this study.

3.0 Review of Literature:

An existing literature review on the area of an econometric estimation of Cobb-Douglas production function is briefly discussed in this section.

Devesh Raval (2011) found that under a Cobb-Douglas production function, the capital-labor ratio rises exactly in proportion to the rise in wages, so the factor cost ratio is constant. The slope of the relation between wages and the factor cost ratio then identifies the elasticity of substitution.

Rahman and Yusuf (2010) uses Cobb-Douglas production function to represent long run GDP (Gross Domestic Product) growth function with constant returns to scale and steady, exponential technological change over time. They found that capital's share of national income is slightly less than that of labour share.

Mahajan (2005) uses a Cobb-Douglas production function to estimate MFP (Multi Factor Productivity) by using time series data in industrial firm of Bangladesh. His calculation show that capital deepening contributed steadily and increasingly to growth process.

Salim and Kalirajan (1999) by using Cobb-Douglas production function found that input growth contributed significantly to output growth in almost all the industries, although TFP growth improved from the early to late 1980s, and in many industries input use increased at approximately the same rates as output growth.

Selim (2009) examine the significance of labour productivity and use of inputs in explaining technical efficiency of rice production in Bangladesh and found that higher labour productivity can stimulate high efficiency gains, but increased use of inputs (except land) induces negative marginal effect on technical efficiency. While more use of land, improved seeds and fertilizers contributes to the rate of labour-productivity induced marginal efficiency gain, any additional labour depresses this rate. Given the agricultural policy reform history in Bangladesh, our findings imply that rather than providing input subsidy or output price support, future reforms should put more emphasis on providing incentives to enhance labour productivity and encourage formalization of the agricultural labour market.

Moayzzem et al (2012) considers Cobb-Douglas (C-D) production function with additive error and multiplicative error term for measuring the production process of some selected manufacturing industries in Bangladesh and they estimate the parameters of the production function by using optimization subroutine.

Azizul et al (2006) investigates the technical efficiency of selected manufacturing industries of Bangladesh using a Cobb-Douglas stochastic frontier production function, which has time-varying technical inefficiency effects, was estimated. The estimated average technical efficiency for four groups of industries of Bangladesh over the reference period was 40.22% of potential output for the truncated normal distribution, whereas it was 55.57% of potential output for the half-normal distribution.

In this paper we take up the problem of specifying and estimating an econometric model of Cobb-Douglas production function for a profit maximizing firm in the readymade garments industry of Bangladesh.

4.0 Data and Model:

4.1 Data Collection:

The data source is the annual report of the selected Garments industry. In this study to estimate Cobb-Douglas production function of Bangladesh's ready-made garments industry, data about the labour wages, capital and quantity of ready-made garments production in money amount were collected from annual report of Tex-Town Group Limited which is situated at Saver in Dhaka of Bangladesh. To conduct this study annually data are collected from 2002-2013.

4.2 Data Analysis:

Apart from the conventional mathematical, statistical and econometric tools, to detect the existence of autocorrelation, we have applied Durbin-Watson test. To estimate the production function Cobb-Douglas method was used.

4.3 Production Function:

The production function is purely a technical relation, which connects factor inputs and outputs. It describes the Laws of proportion, i.e., the transformation of factor inputs into outputs at any particular time period. The production function represents the technology of a firm or an industry, or the economy as a whole, and it includes all the technically efficient methods of production.

4.4 Conceptual Framework:

Production in a manufacturing enterprise is a value adding process. A production function shows the maximum amount of output attainable from a particular set of inputs. If there are only two inputs labour and capital, the function can be expressed as:

$$Y = f(L, K)$$

Where; Y = Output,
L = Labour, and
K = Capital.

Output is typically measured as value added by manufacture in a year. In a time series analysis, it is deflated for price changes. It can also be measured as the gross value of output or the volume of output produced in a year. Inputs are measured in terms of services of the input per unit of time. But this kind of data is generally not available. So in empirical studies inputs are measured by the amount of input made available or utilized in the

production process. The number of man-days or man hours worked or wages paid or number of persons employed measures the input of labour. The capital input is measured by the amount of capital stock either gross (or) net utilized in the production process.
Production functions involve and can provide measurements for the following concepts, and one among them is the efficiency of production, which we plan to estimate in this paper:

1. The marginal productivity of the factors of production.
2. Factor intensity.
3. The returns to scale.

4.5 The Model:
Cobb-Douglas Production Function is one of the most widely used production function in Economics and Management research. This production function not only satisfies the basic economic law but also easy in its computation and interpretation of the estimated parameters. The objectives of applying Cobb- Douglas production function is to estimate the co-efficient of inputs, their marginal productivities, factor shares in total output and degree of returns to scale. It is based on unitary elasticity of substitution of inputs and this production function has been widely applied in empirical studies.

It is customary to take the output in the form of value added or output in real terms and the studied inputs are fixed capital, and labour wages. Output is measured in monetary terms; Gross fixed capital consists of book values of land, buildings, plant, machinery, transport equipment and other fixed assets such as furniture and fixture. Labour is measured in terms of number of workmen employed or wages and salaries.

The following model was applied to data on output and input for estimating the Cobb-Douglas production function:

$$Y=AL^{\alpha}K^{\beta}$$

Where, Y = output
L = wages & salaries of Employees
K = Gross Capital
A = Efficiency parameter
α = Co- efficient of Labour
β = Co- efficient of capital

The logarithm of both sides of the above model is taken to convert the equation into linear form; its log transformation is specified below:

$$\text{Log } Y = \log A + \alpha \log L + \beta \log K + Ui.$$

The efficiency parameter (A) and the co-efficients of the inputs were estimated by applying the above equation. Parameters'α', and 'β' represent individually the proportionate change in output for a proportionate change in labour, and capital. Ui is the error term. The three coefficients taken together to measure the aggregate proportionate change in output for a given proportionate change in labour, and capital. This implies that $\alpha + \beta$ shows the degree of returns to scale.

If $\alpha + \beta > 1$, it would imply that the output increase would be more than proportionate to the increase in inputs, if $\alpha + \beta < 1$, it would imply that the output increase would be less than proportionate to the increase in inputs and if $\alpha + \beta = 1$ the output would just increase proportionately to the rate of increase of inputs. Therefore there will be economies of scale, constant returns to scale or diseconomies of scale depending upon whether $\alpha + \beta$ is less than 1, equal to 1, or greater than 1.

This implies that the Cobb-Douglas production function can represent any degree of returns to scale.

Theoretically we expect that all the input coefficients shall have a positive sign and greater than zero i.e., $\alpha > 0$, $\beta > 0$.

5.0 Data of production, labour wages and capital:
In this study to estimate Cobb-Douglas production function for ready-made garments sector of Bangladesh data are collected about ready-made garment's production, labour wages and capital from Tex-Town Group Limited which are represent in the table.

Table-1: Data of production, labour wages and capital of Tex-Town Group Limited

Year	Production (in USD)	Labour Wages (in USD)	Capital (in USD)
2002	1825900	70500	4500500
2003	1828320	71250	4620500
2004	1843700	72182	4840200
2005	1820100	72280	4890100
2006	1826500	72300	4905500
2007	1830300	74200	5002340
2008	1846100	73500	5014355
2009	1853400	74300	5017420
2010	1846300	76100	5024342
2011	1842600	76300	5080500
2012	1865000	76750	5082200
2013	1875000	78750	5487500

Source: Annual Report from 2002-2013 of Tex-Town Group Limited, Saver, Dhaka, Bangladesh.

6.0 Empirical Results:

To estimate Cobb-Douglas production function econometrically in this study SPSS (Statistical Package for the Social Sciences) has been employed and the estimated results of econometric model of Cobb-Douglas production function are shown in the following table.

Table-2: Model Summery

Variable	Coefficient	Standard error	T statistics		Collinearity Statistics	
			Value	Significant		
Constant	5.177	.245	21.145	.000	Tolerance	VIF
Lobour	.793	.124	1.720	.120	.164	6.110
Capital	.039	.084	.085	.934	.164	6.110
R square	.687					
Durbin-Watson test	1.937					
Predictors: (Constant), Capital, Labour, Dependent Variable: Production						

Source: Author's estimation.

In the table-2 the R^2 given from the regression analysis is 0.687; which is approximately 68.7%. Statistically, estimated econometric model of Cobb-Douglas production function is a good fit. Economically, it means that about 68.7% of the total variation in the production of the ready-made garments of Tex-Town Group Limited is attributed to or explained by the labour wages and capital of that firm. The unexplained variation is 31.3% in the estimated econometric model. Hence it can be said that the production of a ready-made garments of a firm does not only depends on labour and capital though labour and capital are an integral part of production; it also depends on several factors such as management efficiency of production, efficient usages of raw-materials, economies of scale, etc.

From the estimated regression results in table-2, it is found that the constant term (A) value is 5.177; meaning that, without labour and capital variable in the production process of the firm; the production will be increased by 5.177%. An estimated value of the constant term (A) is statistically significant since its (t) statistic is greater than 2. Based on the t-test, value of A is also statistically significant at 5% level of significance.

Based on economic theory and experience, it is expected that there will be a positive relationship between production and labour; and production and capital. In this study an estimated econometric result in table shows that the slope of labour wages variable (α) is 0.793. This means that a 1% increase in lobour wage rate will cause ready-made garments production is increased by 0.793%. On the other hand, the slope of capital variable (β) is 0.039. This means that a 1% increase in capital in the production process of the firm will cause ready-made garments production is increased by 0.039%.

Here too, we can conclude that there is a positive relationship between ready-made garments production and labour wages; and ready-made garments production and capital in the ready-made garments sector of Bangladesh. This statement is found by the estimation of Cobb-Douglas production function in the ready-made garments sectors of Bangladesh.

The analysis and discussion of the results in section -6 all confirm the conclusion that ready-made garments production in Bangladesh is influenced significantly by labour wages and capital. This is true because Bangladesh is a labour intensive production country and therefore, labour is cheap in Bangladesh and widely used in the garments sector of Bangladesh.

7.0 Overall significance of the results:
In this study to test overall significance of the results ANOVA (Analysis Of Variance) test has been used and the result of ANOVA test is shown in below:

Table-3: ANOVA Table

F Statistics		
Calculated Value	**Critical Value**	**Significant**
9.897	2.9340	0.005

Source: Author's estimation.

In table-3, it is seen that calculated F-ratio (9.897) > F-critical (2.9340) so R^2 value is statistically significant for the estimated model.

8.0 Test of the empirical results:

8.1 DW and R^2:
The values of the DW and R^2 are 1.937 and 0.687. Here the value of the Durbin Watson is greater than the values of the R^2. This means that the regression results are sensible and the model can be accepted.

8.2 Testing for the presence of Heteroscedasticity using the Spearman's Rank Correlation Coefficient:
To test for heteroscedasticity, using spearman's rank correlation, we obtained the correlation coefficients between considering independent variable (labour wages and capital) and residual for the model are shown in below:

Table-4: Spearman's Rank Correlation between residual and independent variable

Variable	Spearman's Rank Correlation between Residual and Independent variable
Labour	0.056
Capital	0.105

Source: Author's estimation.

In this table all the values of spearman's rank correlation (r) are very low rank correlation which is lower than o.50. This indicates the absence of heteroscedasticity in the estimated econometric model of Cobb-Douglas production function.

8.3 Testing for the presence of autocorrelation using the Durbin–Watson test:
Using the Durbin –Watson test formula, we obtain d=1.937. Based on the decision rule (n =12 and k = 2, from the Durbin-Watson table, dL = 0.569 and dU= 2.315; so we accept H0 and reject H1 because d=1.937 lies within the acceptance range which means that there is no autocorrelation.

8.4 Testing for the presence of multicollinearity using the VIF (Variance Inflation Factor):
It is seen that in table-2, the VIF value of labour and capital are 6.110 and 6.110 which are less than 10. That indicates estimated result of econometric model of Cobb-Douglas production function is free from multicollinearity.

As shown from the above tests, the results shown from the ordinary least square (OLS) for econometric model of Cobb-Douglas production function is a sensible one and have no problem of heteroscedasticity, autocorrelation and multicollinearity. We therefore accept the results of the estimated econometric model of Cobb-Douglas production function.

9.0 Economic Interpretation of the empirical results:

9.1 Economies of Scale:
The sum of co-efficient indicates returns to scale and in this study from the estimated results in table-2 it is seen that ($\alpha + \beta = 0.793+0.039= 0.832$) which is less than 1 that indicates decreasing returns to scale in the ready-made garments production of Bangladesh.

9.2 Factor Shares:
In the production function, factor share meaning that factor intensity of production. In this study it is seen that the value of labor wages co-efficient (α) is 0.793 which is greater than the value of capital co-efficient (β = 0.039). From this result it is to be noted that the production in the ready-made garments sector of Bangladesh is labour intensive but not capital intensive. Its main reason is that Bangladesh is a labour intensive country and labour intensive commodity.

10.0 Conclusion and Recommendations:
In this study, we have analyzed the Cobb-Douglas production function using time series data in selected

garments industry in Bangladesh. We have observed that the estimated value of the R2 given from the regression analysis is 0.68. This indicates estimated econometric model of Cobb-Douglas production function is a good fit and the result is significant. It has been found that the slope co-efficient of labour and capital are 0.793 and 0.039 respectively; that indicates positive relationship between labour, capital and ready-made garments production in Bangladesh. Here it is also found that although the growth in technical efficiency was statistically significant over time as tested by the t-test, the rate of increase in technical efficiency has been very slow over time in Bangladesh. In this study it is found that decreasing returns to scale in the ready-made garments production of Bangladesh.

In this respect, under this study we suggest that to attain sustainable production growth in the garments sector of Bangladesh; technical efficiency of both labour and capital should be increased. Therefore, technical efficiency of labour can increase through the arrangement of effective labour training system in the garments sector of Bangladesh. And technical efficiency of capital can increase through the proper use of capital equipment by the trained labour and management. Thus when labour and capital are effectively used then decreasing return to scale can be overcome and increasing return to scale may be ensured in the ready-made garments sector's production of Bangladesh.

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