Estimation of Production Function for Furniture and Pharmaceutical Industries in Nepal

Hom Nath Gaire*

Abstract

With the application of Robust Regression Method, this paper attempts to estimate the production function for manufacturing industries of Nepal. In this endeavour, the production function for Furniture and Pharmaceutical industries have been estimated using cross-section data of the Census of Manufacturing Establishment (CME) 2011/2012. The coefficients of log-linear form of Cobb-Douglas (C-D) production function reveal that the selected manufacturing industries are operating with decreasing returns to scales. The labour coefficients of both industries are found to be statistically insignificant. Negative labour coefficient of Pharmaceutical Industry indicates capital intensive nature of the production and minimal contribution of labour inputs. Although positive and significant, capital coefficients indicate both industries were running with decreasing returns to capital inputs. Total Factor Productivity (TFP) representing the state of technology and factors other than labour and capital found to be instrumental and significant for both the industries.

Keywords: Manufacturing Industry, C-D Production Function, Returns to Scale, TFP

JEL Classification: D21 and D24

* Ph.D. Candidate in Economics at Tribhuvan University Nepal. The author is grateful to the Editorial Board and anonymous referees for their valuable comments that helped greatly in the improvement of this paper.

I. INTRODUCTION

1.1 Background

The production function is one of the fundamental building blocks of economic theory in general and the theory of production in particular. A production function establishes the technical relationships between the inputs and outputs in a production process. It also explains the relative productivity of inputs being used in the production process, which in turn helps to measure the efficiency (returns to scales) of the industry as a whole. Thus, study and analysis of a production function helps in making varieties of decisions related to production of goods and services of the industry. Accordingly, empirical analysis of production function has implications to the economy as a whole.

Economists have given more concern about the empirical study of production function since innovations and improvements in productivity drive economic growth (Marshak & Andrews, 1944). Similarly, as a firm's decision about technology and inputs depends on the relative productivity of inputs in question, industrialists and businessmen since long have been very much inclined of the test of production function. In advanced industrial countries, economists have long been investigating how productivity differences across firms are related to market structure, and more generally what causes differences in productivity across the firms (Bartlesman & Doms, 2000). This is obvious since all correct decisions regarding what to produce, how much and how to produce have direct cost implications and related with the market situations where the industry operates.

1.2 Cobb-Douglas (C-D) Production Function

In economics, the C-D production function is widely used to represent the relationship of inputs to output. It was proposed by 19th century economist Knut Wicksell (1851-1926) and tested against statistical evidence by Charles Cobb and Paul Douglas in 1928. In 1928 Charles Cobb and Paul Douglas published a study in which they modelled the growth of the American economy during the period 1899-1922. They considered a simplified view of the economy in which output is determined by the units of labor and the amount of capital invested. Assuming other factors affecting economic performance constant, their model proved to be remarkably accurate (Berndt & Christensen, 1973).

Originally C-D production function was applied not to the production process of an individual firm but to the whole of the manufacturing industry. Output in this production function is thus manufacturing production (Ahuja, 2006). The fundamental C-D production function which has two inputs, labour and capital, takes the following mathematical form:

$$Q = AL^{\alpha} K^{\beta} \ \ldots\ldots\ldots.(1)$$

Where, Q = Manufacturing Output

L = Labour Inputs

K = Capital Inputs

A = Positive Constant Representing Production Technology

α *and* β are output elasticities with respect to labour and capital respectively

Marginal Productivity of Inputs

The first important feature of C-D production function is that the marginal productivity of inputs depends on the ratio of inputs being combined in the production process rather than the absolute quantities of the factors used.

Marginal Product of Labour is Given as:

$$\mathrm{MP_L} = \frac{\partial Q}{\partial L} = \alpha\left(\frac{\mathrm{Q}}{\mathrm{L}}\right) = \alpha(\mathrm{AP_L}) \ \ldots\ldots\ldots.(1.1)$$

Marginal Product of Capital is Given as:

$$MP_K = \frac{\partial Q}{\partial K} = \beta\left(\frac{Q}{K}\right) = \beta(AP_K) \ldots\ldots\ldots.(1.2)$$

Expressions (1.1) and (1.2) indicate that the marginal productivity of both labour and capital are inversely related to the quantities of them being used in the production process. Assuming other things remaining the same, the marginal productivity of inputs goes on diminishing with the increase in its inputs being used. Thus, the marginal products of labour and capital will be in line with the theory according to which, if the variable input labour or capital is successively employed in the operation of production, all else equal, the marginal product of that variable input goes on diminishing.

Measures of Returns to Scale

The second important feature of C-D production function is that the sum of its exponents (α *and* β) measures returns to scale of the industry in question. Multiplying each inputs labour (L) and capital (K) in (1) by a constant g we get:

$$Q' = A(gL)^{\alpha}(gK)^{\beta}$$

$$\mathrm{Q}' = \mathrm{g}^{\alpha}\mathrm{g}^{\beta}\left(\mathrm{AL}^{\alpha}\mathrm{K}^{\beta}\right)$$

$$\mathrm{Q}' = \mathrm{g}^{\alpha+\beta}\left(\mathrm{AL}^{\alpha}\mathrm{K}^{\beta}\right)$$

$$Q' = g^{\alpha+\beta}\, Q \ldots\ldots\ldots\ldots (2) \quad [\text{Since, } Q = AL^{\alpha}K^{\beta}]$$

Expression (2) says when each input of labour and capital in the production process increases by a constant factor g then output Q increases by $g^{\alpha+\beta}$. This means that if $\alpha + \beta = 1$, output Q also increases by the same factor g by which both inputs increased. Therefore, $\alpha + \beta$ measures the returns to scale of the industry as follows:

If $\alpha + \beta = 1$, returns to scale are constant
If $\alpha + \beta > 1$, returns to scale are increasing
If $\alpha + \beta < 1$, returns to scale are decreasing

Output Elasticities of Inputs

Another important feature of C-D production function is that again the exponents of labour and capital (α *and* β) respectively measure the output elasticities with respect to labour (L) and capital (K). Output elasticity of a factor refers to the relative percentage change in output caused by a given percentage change in a variable factor, keeping other factors and inputs constant.

The common output elasticity of labour (Q_E^L) is given as:

$$Q_E^L = \frac{\partial Q}{\partial L} . \frac{L}{Q} \ldots\ldots\ldots\ldots (2.1)$$

Here $\frac{\partial Q}{\partial L}$ is marginal product of labour (MP_L) which can be substituted by $\alpha \frac{Q}{L}$ in (2.1).

$$Q_E^L = \alpha \frac{Q}{L} . \frac{L}{Q} = \alpha \ldots\ldots\ldots (2.2)$$

Thus, it is proved that the labour exponent α in C-D production function is equal to the output elasticity of labour. Similarly, we can obtain the output elasticity of capital (Q_E^K)as:

$$Q_E^K = \frac{\partial Q}{\partial K} . \frac{K}{Q} = \beta \frac{Q}{K} . \frac{K}{Q} = \beta \ldots\ldots\ldots\ldots (2.3)$$

The interpretation of the values of α *and* β would be as follows:

- If the value of α and β is less than unity, the proportionate change in output will be lower than the proportionate change in the respective inputs.
- If the value of α *and* β is more than unity, then the proportionate change in output will be higher than the proportionate change in the respective inputs.

- If the value of $\alpha \ and\ \beta$ is unity, then the proportionate change in the output will be equal to the proportionate change in the respective inputs.

1.3 Objective and Significance

Nepal continues to be a predominantly agricultural economy with around one third contribution to the country's Gross Domestic Product (GDP). Although the share of manufacturing sector is small, it's role in Nepal's development during the coming decades cannot be ignored as the mass production of consumer goods is getting momentum in the recent years (Sharma, 1980). Expansion of manufacturing sector, both in terms of size and productivity helps generate employment, accelerate growth, reduce poverty and bring prosperity as it has been observed in other developing countries (CBS, 2014). However, without empirical evidence from scientific studies, it is hard to say which industry is more attractive in terms of factor productivity and can contribute relatively better to the economy.

In this backdrop, this paper aims to empirically estimate and test whether the C-D production function may be useful in analyzing the manufacturing industries of Nepal. Besides, in order to draw some specific conclusions, it aims to estimate the returns to scale and relative productivity of inputs used in Furniture and Pharmaceutical industries of Nepal. The results obtained would be useful to the planners and policymakers in formulating plans and policies so as to promote and/or regulate the respective manufacturing industries. In the meantime, private sectors, and those interested in the manufacturing industries of Nepal will be able to gauge the relative factor productivities of the selected industries, which will help them making investment decisions.

The remaining organization of the paper is such that the second section covers the review of literatures followed by research methodology. The third section presents the estimation of models and analysis of results. The final section presents the summary, findings and suggestions.

II. REVIEW OF LITERATURE

2.1 General Scenario

Cobb-Douglas (C-D) Production Function is being widely used in economics and productivity studies across many sectors (Hassani, 2012). The function’s quantitative modelling of factor inputs and output is appealing to the research domain of manufacturing industries. Using C-D production function, one can discuss pattern and trend of change in performance of the industry concerned on the basis of the observed simultaneous developments in the quantity of labor, capital and total factor productivity (Dana & Hurnik, 2007).

The C-D production function has been popular because of its enormous economic importance in making different policies and decisions in economic field at corporate as well as government level (Bhashin & Seth, 1980).The authors used the production functions for estimating the levels of technical efficiency (TE) and variations in TE in small-scale industrial units of Indian manufacturing sector. Bhatti and Ali (2004) estimated the parameters of the C-D production function for 21 manufacturing industries of Bangladesh and found economies of scale in the manufacturing of drugs & pharmaceuticals, Furniture & fixtures, Iron &basic steel, Leather footwear, Fabricated metal products, Plastic products, Printing & publications and Tobacco. There were diseconomies of scale in the Beverage, Chemical, Glass & glass products, Leather & leather products, Paper & paper products, Textile, Wood & crock products industries and Transport equipment.

Mohammad and Said (2010) looked into an analytical justification for using C-D production function in order to estimate and test the coefficients of inputs for each of the selected manufacturing industries of Oman. The results indicate that for most of the selected industries the C-D function fits the data very well in terms of labor and capital elasticities, returns to scale and economies of the industries. Estimates suggest seven out of nine manufacturing industries of Oman were enjoying increasing returns to scale and the rest found to be decreasing return to scale and no industry with constant return to scale.

Shaiara Hussain and Islam (2016) reported that the C-D production function is the most suitable for manufacturing industries of Bangladesh, where some increasing returns to scale was observed. They said it was a very much optimistic result for future investment decisions both for the government and private sector which might be helpful for employment generation and sustainable economic development. Kehindi and Awoyen (2009) found an improving economic efficiency in sawn wood industries of Ondo and Osun states, southwest Nigeria using stochastic frontier approach to estimate a self-dual C-D production function. The results show that, on an average, sawmills in Ondo and Osun states have high technical, allocative and economic efficiencies.

Sharma (2008) estimated a C-D production function along with a time trend to capture the effect of technological progress after the 1978 reforms in China using the cointegration and error-correction framework for the period of 1952-1998. The results revealed that the error correction mechanism was the most appropriate model for the estimation of the production function indicating that capital had been the most important source of growth in China since capital contributed about

62 percent of output growth. TFP accounted for about 28 percent of output growth and the rest was contributed by labour.

2.2 Nepalese Context

In Nepali context Wagle (2016), examined the C-D production function in agricultural production to investigate the logical relationship of production with capital expenditure and labour inputs. The estimates of elasticity of substitution on national agricultural panel data from economic survey (1983/84–2013/14) revealed that the sum of regression coefficients was less than unity (0.976) indicating that the system was less efficient or there was diminishing returns to scale.

Thapa (2007) examined the farm size and productivity relationship using the household data from Nepali mid hills collected by conducting a survey and analysed using models both: allowing for and not allowing for village dummies (as cluster controls); the ratio of irrigated land (as proxy for land quality); and other socio-economic variables such as caste of householdsand family size (as proxy for access to resources). Thapa further investigated returns to scale in Nepalese agriculture, by testing the C-D production function and found constant returns to scale. Labor input seems more influential in farm production of the mid hills Nepal, which is perhaps due to the effects of other inputs used by small farms rather than diseconomies of scale.

CBS (2014) estimated the C-D production function for all manufacturing industries as a whole and found that there was a continuous decline in TFP. The largest decline was between census year 2001/02 and 2006/07 meaning the manufacturing sector underwent turbulence situation and the given amount of labour and capital produced less value added. Bajracharya and Sapkota (2017) used the C-D function to assess the level of technical efficiency in certified maize seed production in Palpa District. The results revealed that increase in the amount of seed and labor by one percent would increase the yield of certified maize seed by 0.29 and 0.34 percent respectively.

The literatures available at global level suggest C-D production function is instrumental for analysis of the factor productivity and performance of manufacturing industries. Although few studies have used C-D production in agriculture sector of Nepal and CBS used C-D function to estimate the TFP of whole manufacturing industry in aggregate, the scope of estimating production function for individual manufacturing industries found to be unexplored.

III. RESEARCH METHODOLOGY

This paper employs quantitative methods so that the analysis of secondary data and the results obtained would be easier for interpretation. The coefficients of C-D production function were first estimated with Ordinary Least Square (OLS) method of regression. Since the model is suspected to suffer from the problem of heteroscedasticity, Robust Regression Method was used so as to have the BLUE (best, linear and unbiased estimator) result.

3.1 Data and Variables

To estimate the C-D production function cross section data of furniture and pharmaceutical industries were taken from the Census of Manufacturing Establishment (CME) 2011/2012, which is the latest available data set with Central Bureau of Statistics (CBS). The CME 2012 reports that pharmaceutical industry has 51 observations (manufacturing establishments), and furniture industry has 390 observations. Since, one establishment of furniture industry was found to have zero output, 389 observations have been included.

Manufacturing is the process of converting raw materials, components, or parts into finished goods that meet a customer's expectations or specifications. The conversion of inputs into outputs may be either physical or mechanical. The Furniture industry involves relatively more physical process in converting inputs into outputs whereas Pharmaceutical industry based on more chemical and mechanical transformation. Thus, in order to capture the features of pure manufacturing process these two industries are chosen.

In the production function, total value of sales reported for the census year has been considered as output (Q). Total man hour used in the production process has been taken as the measure of labour inputs (L) and total expenditure incurred (except salary and wages) is taken as capital (K). A brief definition and specification of variables is given below:

Output (Q): This is the product of total quantity sold and market price of the products. This is simply the total sales reported for the census year excluding stock. It does not include the receipts from other industrial services, which is the income generated from ancillary services (other than the core production process) by the establishment or its owners or associates.

$$Q = q * p \dots\dots (3.1)$$

$$Where, q\ is\ total\ quantity\ produced\ in\ a\ year\ and\ p\ is\ per\ unit\ price$$

Labour Inputs (Man Hour): This is the total number of hours used in production process in a year. This includes the time (hour) spent by operating (technical) employees, administrative (including support staffs) people and management (including board of directors) of the manufacturing establishment.

$$H = N * 300\ (days) * 8\ (hours) \ldots\ldots.(3.2)$$

$$Where, \quad H\ is\ total\ man\ hours\ and\ N\ is\ number\ of\ people\ engaged$$

Capital Inputs (K): This is the summation of all expenses incurred in the production process for machine, fuel, raw materials, repairs and maintenance, industrial services including insurance and interest. However, it does not include the expenses incurred in all kind of labour forces (persons) being engaged in the production process, support activities and management.

3.3 Specification of Model

The C-D production function, to be estimated with econometric models, can be specified either in log-linear form or the original power function form. Whichever form is used the regression method can be applied to estimate the coefficients. Here, the log-linear form of C-D production function has been used since it's coefficients directly give the output elasticities of labour and capital inputs. The log-linear regression model of fundamental C-D production function expressed in equation (1) is given below.

$$lnQ = ln\beta_0 + \beta_1 lnH + \beta_2 lnK + \epsilon \ldots\ldots\ldots\ldots.(3.3)$$

Where,

lnQ =Natural log of output (total sales in thousand)
$ln\beta_0$ = Natural log of constant A (total factor productivity)
lnH = Natural log of labour inputs (man hour)
lnK =Natural log of capital inputs (total expenditure in thousand)
ϵ_i =Random Disturbances (error term)
β_1 & β_2 are output elasticities of labour and capital respectively

Robust Estimator

Robust regression provides an alternative to OLS regression that works with less restrictive assumptions. It estimates much better regression coefficients when outliers are present in the data. Outliers violate the assumption of normally distributed residuals in OLS regression as it gives more weight to the outlying observations than they deserve. Robust regression down-weights the influence of outliers making residuals of outlying observations larger and easier to spot.

Robust regression through an iterative procedure seeks to identify outliers and minimize their impact on the coefficient estimates. The weights assigned to each observation in robust regression is controlled by a special function called an influence function. Although several families of robust estimators are available the family of M-estimators generalized by (Huber, 1964) has been used here. Huber defines the β estimators, which minimize the sum of a function $\rho(\cdot)$ of the residuals.

$$\hat{\beta}_M = Min \sum_{i=1}^{N} \rho\left(\frac{e_i}{\sigma}\right) \ldots\ldots (3.4)$$

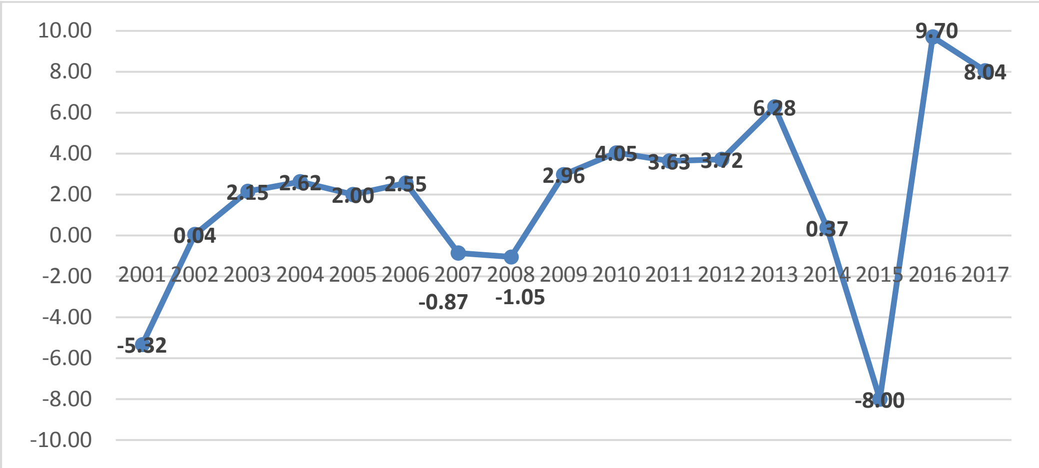
Where, $\rho(\cdot)$ is a response (loss) function of M-estimator which is non-zero decreasing function for positive values and less-increasing than the square function. In practice M-estimators uses an iteratively reweighted least squares algorithm. To simplify, suppose that σ is known and define weights $\omega_i = \rho \frac{\left(\frac{e_i}{\sigma}\right)}{e_i^2}$ then equation (3.4) can be rewritten as (which is an equivalent to weighted least square (WLS) estimator).

$$\hat{\beta}_M = Min \sum_{i=1}^{N} \omega_i e_i^2 \ldots\ldots (3.5)$$

IV. RESULTS AND ANALYSIS

The development of the manufacturing sector is crucial to attain prosperity, generate employment, reduce poverty, promote trade and spur national income growth. However, Nepal's manufacturing sector has not been able to achieve these objectives to the desired extend (CBS, 2014). The sector has had uneven growth over the years due to longstanding weaknesses in the adoption of new technology, poor infrastructure and shortage of power among others. As a result, the ratio of manufacturing output to GDP has gradually declined from 9.0 percent in 2001 to 5.5 percent in 2017and the growth of this sector is highly unstable (CBS, 2018).

Table 1: Annual Growth Rate of Manufacturing GDP (base =2000)



Source: National Income Accounts of Nepal 2018 (CBS)

4.1 Descriptive Statistics

Descriptive statistics help to understand the nature and pattern of dataset being analysed and is a crucial for further empirical analyses. Here descriptive statistics of all variables for both Pharmaceutical and Furniture industries is presented.

Table 2: Furniture Industry (Total Numbers of Observations 389)

Variables	Mean	Std. Dev.	Minimum	Maximum
Output (lnQ)	8.23	0.89	5.21	12.21
Labour Inputs (lnH)	8.33	0.45	6.84	11.49
Capital Inputs (lnK)	7.78	1.02	4.73	11.68

Table 3: Pharmaceutical Industry (Total Numbers of Observations 51)

Variable	Mean	Std. Dev.	Minimum	Maximum
Output (lnQ)	10.6567	1.6375	6.5820	13.2177
Labour Inputs (lnH)	12.0368	1.0285	10.1346	14.0058
Capital Inputs (lnK)	10.3966	1.6104	5.0998	12.8103

Source: CBS and Author's calculation

The tables above show that the average output of furniture manufacturing units is relatively lower than that of the average output of pharmaceutical manufacturing units of Nepal. The average employment of labour (L) and capital (K)is also better in pharmaceutical industry in comparison to the furniture industry. The value standard deviation, which measures the variation in the distribution (production), is relatively less for Furniture industry indicating the output of this industry is less volatile than that of pharmaceutical industry.

4.2 Estimation of Production Function

In this section, the log linear form of C-D production function is estimated for both industries. Estimation coefficients (elasticities of output with respect to inputs) have been used to gauge the returns to scale of the respective industries. The result of the estimated production function is presented below.

Furniture Industry

The OLS results presented (table 4) below show that the production function of furniture industry is well fitted as indicated by the significant F-statistics and high R squared values. However, it is just opposite of the theory and expectation of this study, the elasticity coefficient of labour input (lnH) appeared to be negative and statistically insignificant giving space for some diagnostic tests. Since this is a cross-section study the models are assumed to be free from the problem of autocorrelation. Similarly, the model does not suffer from multicollinearity as the value of Variance Inflation Factor (VIF) is less than 2 (1.95). Here what makes us suspicious is possibility of heteroscedasticity, which is tested and the results are presented in the table 4.

Table 4: OLS Estimation of Furniture Industry

Dependent Variable: Output (lnQ)				**Summary Statistics**
Independent Variables	Coefficients	S.E	t-value/ P>|t|	R^2= 0.8243 Adj. R^2 = 0.8234 F-value (2,286) =905 P>|F|= 0.000* Root MSE = 0.37468
Labour Input (lnH)	-0.0248	0.0426	-0.58/0.561	
Capital Input (lnK)	0.8002	0.0188	42.43/0.00*	
Constant (lnA)	2.2026	0.3927	5.61/0.00*	

Heteroskedasticity Tests: H_0:- Constant variance of Stochastic Disturbance

Tests	$\boldsymbol{Chi^2(\chi^2)}$ **stats**	**Prob >$\boldsymbol{Chi^2(\chi^2)}$***
Breusch-Pagan -Godfrey (BPG)	31.99	0.00
White's General (IM)	39.37	0.00

** Indicates null hypotheses are rejected at 1 percent level of significance.*

As the null hypothesis of constant variance has been rejected by BPG and IM tests, the heteroscedasticity is detected in the model. To correct heteroscedasticity, the method of Robust Regression has been used and result is presented below (table 5).

Table 5: Estimated Result from Robust Regression Method

Dependent Variable: Output (lnQ)				**Summary Statistics**
Independent Variables	Coefficients	S.E	t value/ P>t	F(2, 386) = 1360.65 Prob > F = 0.0000* R^2= 0.8243 Adj. R^2 = 0.8234 Root MSE= 0.37468
Labour Input (lnH)	0.0020	0.0346	0.06/0.95	
Capital Input (lnK)	0.7975	0.0153	52.08/0.00*	
Constant (lnA)	2.0600	0.2276	5.23/0.00*	

** Indicates null hypotheses are rejected at 1 percent level of significance.*

Now the labour coefficient turned to be positive after robust estimation, although statistically insignificant. The results reveal that technology (TFP) and the capital input have been positively contributing the output of furniture industry. The output elasticity coefficient of capital (lnk) shows that one percent increase in capital input would lead 0.8 percent increase in the output indicating decreasing returns of capital in furniture industry of Nepal. Similarly, the coefficient of TFP (lnA) shows one percent improvement in the technology and the factors other than labour and capital would contribute to rise the output by two percent. Finally, as the summation of β_1 and β_2 (0.7975+0.0020=0.7995) is less than unity, it says that there is decreasing returns to scale in the furniture industry of Nepal.

Pharmaceutical Industry

Although the production of Pharmaceutical Industry is well fitted, again the elasticity coefficient of labour input (lnH) appeared to be negative and statistically insignificant. Here TFP also found to be statistically insignificant since the null hypothesis is accepted.

Table 6: OLS Estimation of Pharmaceutical Industry (Total Observations-51)

Dependent Variable: Annual Output (lnQ)				**Summary Statistics**
Independent Variables	Coefficients	S.E	t-value/ P>|t|	R^2= 0.7972 Adj. R^2 = 0.7888 F-value (2,48) =94.4 P>|F|= 0.000* Root MSE = 0.7525
Labour Input (lnH)	-0.0705	0.1046	-0.67/0.504	
Capital Input (lnK)	0.8999	0.0668	13.46/0.00*	
$Constant$ (lnA)	2.1489	1.5309	1.40/0.167	

Heteroskedasticity Tests: H_0:- Constant variance of Stochastic Disturbance

Tests	$Chi^2(\chi^2)$ stats	Prob >$Chi^2(\chi^2)$
Breusch-Pagan -Godfrey (BPG)	0.25	0.6174
White's General(IM)	0.80	0.9770

** Indicates null hypotheses rejected at 1 percent level of significance.*

It is already confirmed that there is no autocorrelation and also the model does not suffer from multicollinearity since the values of variance inflation factor (VIF)is less than 10. The diagnostic tests given above suggested that there is very less probability of heteroskedasticity since the null hypotheses of constant variance is accepted. However, the estimation of robust regression resulted with quite higher F-statistics and statistically significant TFP coefficient, although the coefficient of labour inputs (lnH) is still negative and insignificant. The result is presented in the below (table 7).

Table 7: Estimated Result with Robust Regression Method

Dependent Variable: Output (lnQ)				**Summary Statistics**
Independent Variables	Coefficients	S.E	t value/ P>t	$F(2, 48) = 311.81$ Prob > F = 0.0000* R^2= 0.7972 Adj. R^2 = 0.7888 Root MSE= 0.7525
Labour Input (lnH)	-0.0395	0.0584	-0.68/0.502	
Capital Input (lnK)	0.9167	0.0373	24.58/0.00*	
Constant (lnA)	1.7247	0.8543	2.02/0.049*	

** Indicates null hypotheses are rejected at 5 percent level of significance.*

The results of pharmaceutical industry are also in line of furniture industry. The output of this industry is also heavily dependent on technology (TFP) and the capital input, which is obvious since the pharmaceutical industry is more techno-savvy and capital intensive. The output elasticity of capital (lnK) shows that one percent increase in capital input would lead to 0.92 percent increase in the output, still it indicates decreasing returns to capital. The coefficient of TFP (lnA) shows one percent improvements in the technology and factors other than labour and capital would contribute to raise the output by 1.72 percent. Finally, it is confirmed that the pharmaceutical industry also operating under decreasing returns to scale since the summation of β_1 and β_2 (0.9167-0.0395=0.8852) is less than unity.

V. FINDINGS AND CONCLUSIONS

It has been found, from this study, that furniture and pharmaceutical industries of Nepal were operating under decreasing returns to scale. This means, a given percent increase in the inputs would result lesser percent increase in total output and thus industrialists may not be motivated to expand the scale of outputs. In the meantime, it has been found that the labour input has not been able to play significant role in contributing to the output of the selected manufacturing industries. This may be due to the rampant labour unrest and deteriorating industrial relations during the census year 2011/2012 and lack of sufficient technical as well as skilled labour force in the domestic manufacturing industry.

Although the furniture and pharmaceutical industries of Nepal are found to be capital intensive, these have not enjoyed increasing returns to capital, meaning one percent increase in capital inputs could generate less than one percent additional output. However, it can be concluded that the TFP (technology and factors other than labour and capital) has been the key contributor to the selected manufacturing industry. It is found that one percent increase in TFP would increase total output by 1.72 to 2.15 percent in a year. Based on this, it is suggested that the government, policymakers and concerned private sector stakeholders should focus to ensure availability of skilled labour force, appropriate infrastructure and encourage technological innovation so as to promote the manufacturing industries to achieve higher economic growth in Nepal.

References

Ahuja, H. 2006. *Advanced Economic Theory: Microeconomic Analysis* (изд. 15). New delhi: S. Chand and Company Ltd.

Bajracharya, M., & M. Sapkota. 2017. "Technical efficiency of certified maize seed in Palpa district, Nepal: A stochastic frontier production approach". *Journal of Maize research and Development, 3*(1), 45-52.

Bartlesman, E., & M. Doms. 2000. "Understanding Productivity: Lesson from Longitudinal Microdata". *Journal of Economic Literature*(38(3)), 79-89.

Berndt, E. R., & L.R. Christensen. 03 1973 г. "The Translog Function and the Substitution of Equipment, structures, and Labor in U.S Manufacturing 1929-68". *Journal of Econometrics*, 81-113. Получено 06 2018 г., из https://doi.org/10.1016/0304-4076(73)90007-9

Bhashin, V., & V. Seth 1980. "Estimation of Production Function for Indian Manufacturing Industries". *Indian Journal of Industrial relations, 15*(3), 395-405.

Bhatti, H., & M.Z. Ali. 2004. "Econometric Analysis of Some Major Manufacturing Industries: A Case Study". *Managerial Auditing Journal, 19*(6), 790-795.

CBS. 2014. *Development of Manufacturing Industries in Nepal: Current State and Future Challenge.* Kathmandu: Government of Nepal, National Planning Commission.

CBS. 2018. *National Accounts of Nepal 2017/18*. Kathmandu; Government of Nepal, National Planning Commission.

Cobb, C., & P. Douglas. 1928. "A Theory of Production". *American Economic Review, 18*(Suppliment), 139-165. Получено 25 06 2018 г.

Dana, H., & J. Hurnik. 2007. "Cobb-Douglas Production Function: The Case of a Converging Economy". *Czech Journal of Economics and Finance, 57*(9-10), 465-476.

Hassani, A. 2012. *Application of Cobb-Douglas Production Function in Construction Time-Cost Analysis.* Lincoln: University of Nebraska-Lincoln.

Huber, P. 1964. "Robust Estimation of a Location Parameter". *Annals of Mathematical Statistics*, *35*(1), 73-101.

Kehindi, A. L., & T. Awoyen. 2009. "Analysis of Economic Efficiency in Swan Wood Production in Southwest Nigeria". *Journal of Human Ecology, 26*(3), 175-183.

Marshak, J., & W. Andrews. 1944. "Random Simultaneous Equations and the Theory of Production". *Econometrics, 12*(3-4), 143-205.

Mohammad, H. A., & K. Said. 2010. "Use of Cobb-Douglas Production Model on some selected Manufacturing Industries in Oman". *Education, Business and Society: Contemporary Middle Eastern Issues, 3*(2), 78-85. doi:https://doi.org/10.1108/17537981

Shaiara Hussain, & S. Islam. 2016. "A Test for Cobb-Douglas Production Function in Manufacturing Sector: A Case of Bangladesh". *International Journal of Business and Economics Research, 5*(5), 149-154. doi:10.11648/j.ijber.20160505.13

Sharma, S. P. 1980. *Estimation of the Production Function of Nepalese Manufacturing Industry.* Kathmandu, Nepal: Centre for Economic Development and Administration, Tribhuvan University.

Sharma., H. 2008. "Sources of Economic Growth in China 1952-1998". *Issues in Political Economy, 17*, 1-10. doi:http://org.elon.edu/ipe/f2%20hari% 20sharma% 20final.pdf

Thapa, S. 2007. *The relationship between farmsize and productivity: empirical evidencefromthe Nepalese mid-hills.* Italy: Faculty of Economics, University of Trento.

Wagle, T. P. 2016. "Spatial Analysis of Cobb-Douglas Production Function in Agriculture Sector of Nepal: An Empirical Analysis". *Journal of Advanced Academic Research, 3*(II), 101-114. doi: eISSN: 2362-1311(Online)