Effect of Borrowing on the Growth of Manufacturing Industries in India

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Abstract

This study explored the effect of borrowing on the growth of manufacturing industries. For examining the growth of the industries, real output was used as the proxy. A panel data set was prepared on manufacturing industries over the period from 2001 to 2010. The focus of the study is confined to the growth of the manufacturing sector ; thus, the manufacturing industries were used as the cross sections units for the panel. For the estimation of the output elasticity of capital and labor, the Cobb Douglas production function was estimated ; while estimating the technical inefficiency, the stochastic frontier model was specified based on the Cobb Douglas production function. The estimation of the regression equations revealed that borrowing from banks and capital has a significant and positive effect on the output; whereas, the technical inefficiency has a negative effect on the output and decreasing returns to scale were found.

Keywords: **manufacturing industries, borrowing, output, Cobb Douglas production function, stochastic frontier model**

JEL Classification: E51, L6, N1

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In the last two decades, empirical research on financial development and growth of manufacturing industries has attracted a considerable attention of academics, researchers, and practitioners. Obembe, Adebisi, and Adesina (2011) highlighted that the financial services have a positive effect on the growth of the firms. Moreover, numerous studies have been published on the financial development and industrial growth that include, for example, Medyawati and Yunanto (2011), Tang (2003), and Tootell, Kopcke, and Triest (2001), who, among others, examined the effect of financial support on the growth and performance of the manufacturing industries. Moreover, Virmani and Hashim (2009) conducted a study to identify the determinants of employment generation, sources, and sustainability of output growth of the manufacturing industries. Obembe et al. (2011) conducted a study to examine the effect of bank loan and owner structure on the output of manufacturing industries.

Despite a number of studies conducted in this context, a gap was identified in the recent work on financial support and growth of the manufacturing industries operating in India. In particular, there is a lack of recent empirical studies that could have analyzed the effect of borrowing from banks and other resources on the growth of the manufacturing industries. The borrowing from other sources include the borrowing from the government, borrowing from financial institutions, borrowing from foreign institutions, and inter-corporate borrowing. It may be an important analysis, which could make a distinction between the resources of borrowing available with industries in the Indian financial market. Moreover, for examining the proportionate effect of the inputs on the output, the log-transformed Cobb Douglas production function was used. Koo and Kim (1999) revealed that the financial services had a negative effect on the technical inefficiency of Korean manufacturing industries ; thus, I

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also attempted to examine the effect of technical inefficiency on the output of manufacturing industries in India by estimating the stochastic frontier production model.

For examining the output growth of manufacturing industries, data were sourced from various sources such as the Annual Survey of Industries, Reserve Bank of India, and Ministry of Industries. Variables used as the indicators of growth and financial support were summarized based on theoretical concepts. Moreover, the correlation matrix was generated for, prima facie, examining the correlation among the variables. For testing the hypothesis in this study, first panel data sets were prepared with the industries as the cross section units, and period ranging from 2001 to 2010 as the time units. Thereafter, the regression models were estimated by using the panel data regression analysis approach.

Review of Literature

Literature in support of linkage between the growth of manufacturing industries and financial support revealed that some of the studies have explored the effect of borrowing on the growth of manufacturing industries. These studies differ from each other at various levels, such as, database, methodologies, temporal coverage, and regions of studies. Most of these studies have been conducted with the perspective of exploring the linkage between the financial crises and performance of the manufacturing sector, and financial deepening, growth, & technical efficiency of the manufacturing sector.

➩ **Financial Crises and Manufacturing Sector Growth :** This section reviews the past studies (Klingebiel, Kroszner, & Laeven, 2007 ; Kondo, 2006 ; Laeven, Klingebiel, & Kroszner, 2002 ; Rand, 2007) that investigated the effect of financial crises on the performance of manufacturing industries. In this perspective, Klingebiel et al. (2007) conducted a study to investigate the effect of financial crises on the growth of industries which are financially reliant on external financing for a period from the year 1981 to 2000. For examining the growth of industries, value added was used as the indicator of growth. The ordinary least square (OLS) and instrumental variable (IV) techniques were used for data analysis. The study revealed that the countries with a deeper financial system showed an upward growth during the normal period (when there were no crises), and the converse was also noticed during the crises. On the other hand, in the financially shallow countries, the growth of the externally reliant industries was not affected as much.

➩ **Financial Deepening, Growth, and Technical Efficiency of the Manufacturing Sector :** This section of the literature reviews those studies (Nneka 2012; Okura 2009 ; Obembe et al., 2011) which examined the relationship between financial deepening and growth of the manufacturing sector ; the effect of financial deepening, size, and ownership on the performance of firms. In this context, Obembe et al. (2011) conducted a study to investigate the effect of bank loans and ownership structure on performance of manufacturing industries in Nigeria. The study was conducted based on the data for 76 non-financial firms, sourced from the Nigerian Stock Exchange for a period from the year 1997 and 2007. Real output growth was used as an indicator of performance of manufacturing industries, and explanatory variables such as labor growth, capital growth, bank loan, ownership concentration, market structure, business cycle, debt ratio, and others were used in the regression model. For the analysis of the data, the Cobb-Douglas Production function was log transformed and furthermore, the function was estimated by using the OLS method, fixed effect, and generalized method of moments. The authors concluded that director's ownership had a significant and negative effect ; whereas, the impact of bank loan was found to be positive, but not significant to the performance of firms.

Nneka (2012) examined the effect of performance of monetary policy on the manufacturing index of Nigerian manufacturing industries. The study was conducted based on the data sourced from Central Bank of Nigeria (CBN) 2010 bulletin for a period from the year 1980 to 2009.Variables like company lending rate, company income tax rate, money supply, inflation rate, and exchange rate were used to proxy the monetary policy. The study revealed that monetary policy had a significantly positive effect on the manufacturing index. Furthermore, the author also added that an expansionary monetary policy was imperative for the growth of the manufacturing sector, as it channelized the economic growth of the country.

Okura (2009) examined the relationship between firm characteristics and use of bank loans in China. The study was conducted by using the data sourced from World Bank's Enterprise Survey for the year 2003. A probit model analysis technique was used. For examining the characteristics of firms, which had availed the bank loan for financing the investment capital and working capital, the author used dummy = 1 in case when the industry had availed the loan for the working capital and export, and dummy = 0 was used when the industry had not availed the loan for the working capital and export. The variables such as: size of firms, location of firms, and ownership status of firms were used as the explanatory variables. The study highlighted that the smaller firms and firms situated in the less developed financial environments suffered more with the constraints of bank loans. Moreover, the firms which had an availability of accounting, export rights, legal services, and government assistance availed more financial support from the banks.

Koo and Kim (1999) conducted a study to examine the linkage between finance, production efficiency, and growth of the Korean manufacturing industries. They used the data for the regional manufacturing industries, and stochastic frontier production model was constructed. Assuming the Cobb Douglas Production function, they specified the stochastic frontier model. For the estimation of technical inefficiency, they used a two-step procedure ; first, they estimated the technical inefficiency, and secondly, on the log, they transformed technical inefficiency, and the output was regressed on the estimated technical inefficiency, and the study disclosed that production efficiency improved in a certain region where more financial services had been supplied. Moreover, Ahmadi and Ahmadi (2012) examined the technical efficiency level of manufacturing industries in Iran during 2005 to 2007. They identified the three principal manufacturing industries as the best performers, namely tobacco, transport equipment, and coal coke.

Descriptive Statistics

While providing the overview of the data, the compound growth rate for some of the industrial characteristics was calculated over the period ranging from the year 2001 to 2010, and the same is presented in the Table 1. The Table 1 reveals that the borrowing from the banks registered the highest growth across the industries involved in the manufacturing of paper and paper products. While discussing broadly, it was observed that the lowest compound growth rate of total assets was recorded at around 7% for the industry involved in the manufacturing of basic iron & steel and man made textiles. Net sale grew maximally for the industries involved in the manufacturing of basic iron and steel ; whereas, the maximum real output of 10.35% was recorded for the industries involved in the manufacture of basic iron and steel. Industries involved in the manufacturing of leather products and man made

Table 1. Compound Growth Rate of the Characteristics of Industries from 2001 to 2010

Manufacturing Industries	Borrowing From Banks	Other Borrowing	Total Assets	Net Sale	Real Output	Capital
Chemical Products	8.618	-4.481	4.880	3.660	4.339	6.005
Food and Beverage	5.291	1.162	4.455	4.666	2.138	1.290
Machines	-0.890	0.011	4.230	6.760	5.015	4.359
Manufacture of Basic Iron and Steel	10.502	-0.594	7.551	13.581	8.767	-2.461
Manufacture of Other Nonmetallic Mineral Products	10.603	20.561	5.057	6.196	3.822	2.387
Manufacturing of Leather Products	15.188	-0.890	2.551	2.528	1.441	7.271
Manufacturing of Man Made Textiles	6.091	-28.859	7.719	4.868	3.701	7.726
Rubber and Plastics	8.636	6.577	6.169	3.084	4.985	6.751
Manufacturing of Paper and Paper Products	15.495	0.532	6.800	3.908	3.131	3.363

Table 2. Correlation Matrix

	Borrowing from banks	Other borrowing	Total assets	Net sale	Real output	Capital	Wage Rate
Borrowing from banks	1.0000						
Other borrowing	0.6357* (0.0000)	1.0000					
Total assets	0.4907* (0.0000)	0.5148* (0.0000)	1.0000				
Net sale	0.3946* (0.0000)	0.4881* (0.0000)	0.9522* (0.0000)	1.0000			
Real output	0.3191* (0.0001)	0.4413* (0.0000)	0.9247* (0.0000)	0.9747*	1.0000		
Capital	0.1648 (0.1014)	0.3307* (0.0008)	0.7927* (0.0000)	0.8780* (0.0000)	0.9190* (0.0000)	1.0000	
Wage Rate	0.0773 (0.4468)	0.3324* (0.0005)	0.2482* (0.0133)	0.2391* (0.0171)	0.2666* (0.0077)	0.2799* (0.0050)	1.0000

Note : * indicates the 5% level of significance, ** indicates 10% level of significance

Note: Figures in round brackets are *P* values

textiles showed the maximum growth rate of capital of around 7.0% . The maximum compound growth rate in the employment generation was recorded for the food and beverage industries.

Moreover, to understand the correlation among the variables, a correlation matrix was generated, and the same is presented in the Table 2. The Table 2 discloses that there exists a positive and significant correlation coefficient (0.3191) between the borrowing from the banks and the output of industries ; and a correlation coefficient (0.4413) exists between borrowing from others and output of the industries. Moreover, the Table 2 also illustrates that a correlation coefficient (0.9190) exists between the output and capital, and the correlation coefficient (0.2799) between output and wage rate is also positive and significant.

Methodology and Data

➯ **Data Details :** This study was conducted for common listed large [1] public limited manufacturing industries. In this study, for testing the hypothesis, a panel data set, which includes variables like wage of workers and number of workers, was collected from the Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation. Moreover, this data set also includes the variables like net sale, investment [2], total borrowing [3], and borrowing from banks, the data for which were sourced from the Reserve Bank of India. The data for WPI of the manufacturing industries were selected from price statistics, which were supplied by the Office of Economic Adviser, Ministry of Commerce & Industry. Some of the variables were constructed - like real output was worked out by dividing the net sale by WPI; capital was worked out by dividing the investment by WPI; and wage rate was worked out by dividing real wages of a worker by number of workers ; whereas, the real wages of workers were worked out by dividing the wages of workers with WPI.

[1] Companies with paid up capital of ₹ 10 million and above.

[2] Investments include foreign securities, government and semi government bodies, public sector undertakings, Indian financial institutions, and shares and debentures.

[3] Total borrowing comprises of borrowing from the banks, borrowing from the government, borrowing from the financial institution, borrowing from the foreign institutions, and inter-corporate borrowing, which includes inter-corporate borrowings comprised of Indian companies, foreign companies, mortgages and other long term securities, other securities and un-secured loans.

➺ **Methodology :** While estimating the regression model, some of the past studies were taken into consideration, especially for the purpose of choosing the suitable indicators of growth of industries. In this regards, a study conducted by Medyawati and Yunanto (2011) used banking development indicators that included saving deposits, demand deposits, time deposit, and credits as the explanatory variables ; whereas, GDP growth per capita, the contribution of the agriculture sector to GDP, and the contribution of the manufacturing industry to GDP (all variables at constant price 2000) were considered as the indicator of output.

The most relevant studies in this regard were conducted by Obembe et al. (2011) and Koo and Kim (1999). These studies inspired me to examine the impact of bank borrowing on the output of the industries. Obembe et al. (2011) used labor services as the indicator of labor and capital stock as the indicator of capital. They used bank loan, labor growth, capital growth, ownership structure, market structure, business cycle, and debt ratio as the explanatory variables ; whereas, real output was considered as the indicator of growth of the industries. For capturing the effect of financial services on output production, Koo and Kim (1999) used loan outstanding as an indicator.

Moreover, Virmani and Hashim (2009) conducted a study on the Indian manufacturing industries to identify factor employment, sources, and sustainability of output growth. They highlighted that wage of workers, technology, labor law simplification, and job security were pretty relevant determinants of employment generation. Moreover, they also highlighted that capital contributes 82% to the output ; whereas, the contribution of labor was recorded at 12%. By keeping in view this set of past studies, the present study was conducted to examine the effect of borrowing on the growth of industries. In this regard, a model set has been estimated to understand the effect of borrowing from the banks and borrowing from others on the growth of industries.

While estimating the regression models, panel data regression analysis approach was used (especially for testing the put forth hypothesis - that the industries were availing financial support from the banks and other sources for improving their growth of output). Under the panel data estimation technique, two types of models have been estimated. First is known as the fixed effect model and the other one is called as the random effect model. The null hypothesis of the fixed effect model is that there does not exit any panel effect ; whereas, the random effect model hypothesized that there exits the panel effect and time effect. The choice of choosing an appropriate model was made based on the Hausman test. The null hypothesis of the Hausman test is that the panel and time effect exit. Moreover, while estimating the regression equations, the collinearity among the explanatory variable was checked by using the variance inflation factor (VIF) test, and heterogeneity in the error terms was controlled by using robust command.

In the estimation procedure, with the variables used in the regression equations, the subscript $i = 1, 2, \dots\dots\dots \dots..., 9$ is used to indicate the cross section units and $t = 2001$ to 2000 represents the time units. For estimating the effect of borrowing from banks on the real output, Equation 1 was estimated. Thereafter, to understand the effect of borrowing from other sources, Equation 2 was estimated.

$$Realoutput_{it} = \alpha + \beta_1\, RealBB_{it} + \beta_2 Realwr_{it} + \beta_3\, Cap_{it} + \mu_{it} \dots\dots\dots\dots\dots \text{(1)}$$
$$Realoutput_{it} = \alpha + \gamma_1\, RealOB_{it} + \beta_2 Realwr_{it} + \beta_3\, Cap_{it} + \mu_{it} \dots\dots\dots\dots\dots \text{(2)}$$

where,

$$\mu_{it} = \vartheta_{it} + \theta_i$$

In Equation 1, the notation *Realoutput* indicates the output of the industries and is used as the dependent variable ; the notation *RealBB* represents the real borrowing from the banks ; the notation *RealWR* indicates the real wage rate, and it has been used as the proxy of labor. For indicating the capital, *Cap* has been used, and these variables have been used as the independent variables. The error term is indicated by μ, and for indicating the coefficient of the parameters, the β's and γ's have been used, whereas, α indicates the intercept term.

Furthermore, to understand the proportionate change in the output with respect to the proportionate change in inputs, the Cobb Douglas (CD) production function was used. A large number of past studies have attempted to examine technical inefficiency by using parametric and non-parametric methods. In this study, I have limited myself to the estimation of technical inefficiency by using the parametric approach ; thus, the estimation of the stochastic frontier production model was undertaken. For the estimation of technical inefficiency, Baccouche and Kouki (2003) defined that the stochastic frontier model adds a one sided distributed random variable to the usual stochastic disturbance error term, this error term is the measure of technical inefficiency. This parametric method of stochastic frontier considers the production frontier as a random shock ; the stochastic frontier allows for deviation from the frontier to represent both inefficiency and an inevitable static noise.

Baccouche and Kouki (2003) defined a log linear form of the stochastic frontier model as follows :

$$y_{it} = \alpha + \beta x_{it} + \varepsilon_{it} \dots\dots\dots\dots\dots (3)$$
$$\varepsilon_{it} = \vartheta_{it} - \mu_i \dots\dots\dots\dots\dots\dots\dots (4)$$

where,

y_{it} and x_{it} denote, respectively, the logarithms of observed output and of a row vector of inputs for i^{th} industry in the t^{th} time period; α and β are unknown parameters to be estimated. The disturbance $\vartheta_{it} \sim N(0, \sigma^2)$ and the random variable μ_i are assumed to be non-negative, *i.i.d* and independent of ϑ_{it}. Itis highlighted that μ_i can follow various density functions, but they have specified the truncated normal, the generalized half-normal, and the exponential distribution. Furthermore, Koo and Kim (1999) conducted a study to examine the effect of the financial services on the production efficiency and they argued that financial services should not be regarded as the input factor; it has an indirect effect on production. Thus, they used the two step procedure to estimate the technical inefficiency ; first, the inefficiency was estimated by using the stochastic frontier production function ; and secondly, they regressed the estimated production inefficiency level on the financial services to investigate whether an increase in the financial services improved the production efficiency.

In this study, I first estimated the Cobb Douglas production function to understand the production elasticity with respect to labor, capital, and financial services. The Cobb Douglas production function was estimated by using the panel data estimation approach. Thereafter, for understanding the effect of the inefficiency level on the production of the manufacturing industries, the stochastic production frontier function was estimated by using the time invariant approach. The borrowing from banks, borrowing from other resources, capital, and wage rate have been used as the inputs in the Cobb Douglas (CD) production function. The mathematical formulation of CD function is mentioned below :

$$y = \alpha\, RealBB^{\beta 1} Realwr^{\beta 2}\, Cap^{\beta 3} \dots\dots\dots\dots\dots (5)$$

where,

β's indicate the coefficient of the borrowing from the banks, wage rate, and capital.

Thereafter, to estimate the coefficient of the parameters, Equation 5 has been log transformed and is presented in the Equation 6.The subscript $i = 1, 2 \dots\dots\dots 9$ indicates the cross section units and $t = 2001$ to 2009 represents the time period.

$$\log(Realoutput_{it}) = \alpha + \beta_1 \log(RealBB_{it}) + \beta_2 \log(Realwr_{it}) + \beta_3 \log(Cap_{it}) + \mu_{it} \dots\dots\dots\dots\dots (6)$$

Moreover, for examining the effect of borrowing from other resources *(RealOB)*, as well as for examining the wage rate and capital on the output, the CD function was used and its mathematical formulation is mentioned in the Equation 6.

$$Realoutput = \alpha RealOB^{\gamma 1} Realwr^{\beta 2}\, Cap^{\beta 3} \dots\dots\dots\dots\dots (7)$$

Further, Equation 8, presents the logarithmic transformation of the CD function.

$$\log(Realoutput_{it}) = \alpha + \beta_1 \log(RealOB_{it}) + \beta_2 \log(Realwr_{it}) + \beta_3 \log(Cap_{it}) + \mu_{it} \dots\dots\dots\dots\dots (8)$$

Table 3. Real Output as the Dependent Variable

Independent variables	Model 1		Model 2	
	Fixed Effect Model	Random Effect Model	Fixed Effect Model	Random Effect Model
Real borrowing from banks	0.4152*	0.4114*	-	-
	(0.083)	(0.068)		
Real borrowing from other sources	-	-	-1.0571	0.3409
			(0.459)	(0.587)
Real wage Rate	-63.1408	-16.405	-12.819	-27.11
	(0.22)	(0.688)	(0.886)	(0.656)
Capital	5.9961*	6.6874*	6.5258*	7.17080*
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	108338.3*	78902.9*	158363.7*	97719.91*
	(0.015)	(0.022)	(0.019)	(0.041)
Hausman Test	Chi-Square statistics =2.62, where *P* value= 0.457		Chi-Square statistics = 7.69, where *P* value= 0.0529	

Note : *Indicates the 5% level of significance, ** indicates the 10% level of significance, Note: figures in the brackets are *P* - values.

For the estimation of the technical inefficiency, the past studies suggested the stochastic frontier production function, as is presented in the Equation (9).

$$y_{it} = \beta_0 + \sum_{k=1}^{k} \beta_k x_k + \vartheta_{it} - \mu_i \ldots\ldots\ldots\ldots\ldots (9)$$

Results and Discussion

The models have been identified based on the Hausman test, and it is observed that the model 1 is a random effect model, and the model 2 is the fixed effect model, respectively, presented in Equation1 and Equation 2. The results of the regression models are presented in the Table 3. The Table 3 reveals that the borrowing from the banks and capital have a significant and positive effect on the output of industries ; whereas, wage rate has a statistical insignificant effect on the output of the industries. It reveals that one-unit increase in the borrowing from banks

Table 4. Estimation of Cobb Douglas Production Function

Independent Variables	Model 3		Model 4	
	Fixed Effect Model	Random Effect Model	Fixed Effect Model	Random Effect Model
Real borrowing from banks	0.2613*	0.2598*	-	-
	(0.014)	(0.000)		
Real borrowing from other sources	-	-	0.0552*	0.0755*
			(0.041)	(0.000)
Real wage rate	0.02515	0.00841	0.03748	0.03752
	(0.715)	(0.892)	(0.729)	(0.716)
Real capital	0.2374*	0.3888*	0.4653*	0.4951*
	(0.002)	(0.002)	(0.001)	(0.000)
Constant	3.0773*	2.4074*	3.1155*	2.9129*
	(0.000)	(0.000)	(0.000)	(0.000)
Hausman Test	Chi-Square statistics =10.18, where *P* value= 0.017		Chi-Square statistics =5.19, where *P* value=0.1587	

Note : * Indicates the 5% level of significance, ** Indicates the 10 % level of significance Note: figures in the brackets are *P*- values.

Table 5. Estimation of Technical Inefficiency (Stochastic Frontier Time Invariant Model) (A)

Independent Variables	Coefficient	95% Confidence Interval	
		Lower Interval	Upper Interval
Real borrowing from other sources	0.05358* (0.037)	0.00334	0.10382
Real wage rate	0.03131 (0.590)	-0.08509	0.14772
Real capital	0.49731* (0.000)	0.3862	0.60839
Constant	3.2402 (0.000)	2.74084	3.7396
μ	-1.58 (0.855)	-18.5921	15.4304
in (σ_s^2)	-0.72055 (0.864)	-8.9355	7.4944
$\frac{1}{\gamma}$	3.8087 (0.374)	-4.5932	12.2107
σ_s^2	0.4864	0.00013	1798.04
γ	0.9783	0.01001	0.9999
σ_u^2	0.4759	-3.5205	4.4723
σ_v^2	0.01055	0.00725	0.01385

Note : * Indicates the 5% level of significance and figures in the brackets are *P* - values.

Where mu (μ) is the measure of the technical inefficiency and the logarithm of sigma square, that is,

In $(\sigma_s^2) = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma_s^2$. The optimization is parameterized in terms of the inverse logit of γ. The variance of the error terms u and v are indicated by σ_u^2 and σ_v^2.

causes 0.41 unit change in the output, and one unit increase in capital causes a 6.68 unit increase in the output of the manufacturing industries. Moreover, the borrowing from other sources has an insignificant effect on the output of the industries.

Thereafter, while examining the proportionate effect of the inputs on the output, the CD function has been estimated in its log-transformed form as presented in the Equation 6 and Equation 8. The results of the estimation have been presented in the Table 4. The Hausman test suggests that the model 3 is a fixed effect model. The results of the regression models reveal that borrowing from banks and capital has a significant and positive effect on the output growth of the industries. This reveals that a 1% increase in the borrowing from the banks causes a 0.26 % increase in the output, while a 1% increase in the capital causes a 0.23% increase in the output of the manufacturing industries. Moreover, while examining the effect of borrowing from other resources on the output growth, the Hausman test suggests that the random effect model is more suitable. The results of estimation of this model indicate that borrowing from other resources has a positive and significant effect on output growth of the industries and furthermore, it is revealed that a 1% increase in the borrowing from other sources causes a 0.075% increase in the other sources output. For the estimation of technical inefficiency, by assuming the Cobb-Douglas production, the Stochastic Frontier Production Function is specified in the Equation (9).

For the estimation of the stochastic frontier production model, the maximum likelihood estimation approach was applied. The results of the estimation have been presented in the Table 5 and Table 6. The results of the regression models reveal that the technical inefficiency exits in the models and causes a negative effect on the output of the manufacturing industries. It reveals that an increase in the technical efficiency causes a positive effect on the output of the manufacturing industries. Thereafter, it has been found that the return to scale is not constant, and it has been found as the decreasing return to scale.

Table 6. Estimation of Technical Inefficiency (Stochastic Frontier Time Invariant Model) (B)

Independent Variables	Coefficient	95% Confidence Interval	
		Lower Interval	Upper Interval
Real borrowing from banks	0.23308* (0.000)	0.14161	0.32456
Real wage rate	0.01851 (0.714)	- -0.08053	0.11756
Real capital	0.29865* (0.000)	0. 15240	0. 44491
Constant	3.3298* (0.00)	2.82183	3.8377
μ	-2.6151 (0.836)	-27.3062	22.0758
ln (σ_s^2)	0.47668 (0.895)	-6.6275	7.5809
$\frac{1}{\gamma}$	5.3565 (0.141)	- 1.78205	12.4951
σ_s^2	1.61072	0.00132	1960.439
γ	0.99530	0.144049	0.9999
σ_u^2	1.6031	-9.8397	13.04612
σ_v^2	0.00756	0.005192	0.00993

Note : * Indicates the 5% level of significance and figures in the brackets are *P* - values.

Where *mu* (μ) is the measure of the technical inefficiency and the logarithm of sigma square, that is,

ln $(\sigma_s^2) = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma_s^2$. The optimization is parameterized in terms of the inverse logit of γ. The variance of the error terms *u* and *v* are indicated by σ_u^2 and σ_v^2.

Conclusion

The empirical results represent that capital and borrowing from the banks have a significant and positive effect on the output of the industries. These results are consistent with the study conducted by Obembe et al. (2011), which highlighted that borrowing from the banks has a positive effect on the real output. Thereafter, from the estimation of regression models, it was found that capital also has a positive and significant effect on the output growth of the industries. This results are also aligned with the results obtained by Virmani and Hashim (2009), who highlighted that capital contributed substantially ; whereas, the lower level of contribution was being made by the labor in the output of manufacturing industries. Moreover, the present study reveals that there exists technical inefficiency that has been detected by the estimation of the stochastic frontier production model and has a negative effect on the output of the manufacturing industries, and a decreasing return to scale has been found.

Implications

This study highlights that borrowing from the banks and other sources support the industrial output performance, but the decreasing return to scale indicates that the output in not equally increasing with the proportional change in the inputs. Furthermore, it has been highlighted in the study that the labor has a statistically insignificant effect on the output performance. The policy makers may take some necessary initiatives to optimize the contribution of the labor in the output performance of the industries. With the point of research implication, this study contributes to the literature by examining the effect of the borrowing from the banks and other sources separately.

Limitations of the Study and Scope for Further Research

This study has not incorporated the effect of skilled and unskilled labor on the output performance of the industries. Moreover, the effect of the inputs on the output performance was examined by using the parametric methods only; especially, the estimation of the technical efficiency was examined by the parametric methods. This study can be enhanced to examine the effect of skilled and unskilled labor on the output performance of the industries. Moreover, the study can be enhanced by carrying out an analysis by using the non-parametric methods, especially to examine the technical efficiency. The study can also be extended to include the factory level for the different states of the country.

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