Economic Efficiency and Growth Sustainability of Indian Small Scale Industries : A Pre and Post-Liberalization Based Comparative Analysis

** Amanat Bhullar*
*** Parminder Singh*

Abstract

Economic sustainability requires the development of an industrial sector which sequentially leads to economic development. The major thrust of the present paper was to analyze the overall economic efficiencies of the Indian small scale industrial sector. The study was confined to the period from 1980-81 to 2013-14 which was further divided in two phases, that is, pre reform period (1980-1981 to 1990-1991) and post reform period (1991-1992 to 2013-2014). For the purpose of the study, data were curled from Annual Survey of Industries (ASI) statistics prepared by Small Industrial Development Organization (SIDO) and data compiled by Planning Commission. To perform the analysis, data envelopment analysis was used and the Tobit regression model was utilized to analyze the factors effecting efficiencies. The results showed that the average overall technical efficiencies and economic efficiencies were 0.61 and 0.78, respectively. We suggested that the government should implement financial reform packages that foster competition in the banking market, and that the industry should devise incentive schemes to improve managerial efficiency.

Keywords: **economic efficiencies, globalization, growth, small scale industrial sector, sustainability**

JEL Classification : C1, L6, O1, O4

Paper Submission Date : February 6, 2017 ; Paper sent back for Revision : June 20, 2017 ; Paper Acceptance Date : August 24 , 2017

Economic efficiency is not a single term ; rather, the terminology is associated with the use of frontier functions. The overall economic efficiency is calculated as the multiplicative combination of technical and allocative efficiencies (Murillo - Zamorano, 2004). After its independence in the year 1947, India has been on a mission to achieve economic development ; however, several factors such as poverty and unemployment have played adverse roles hindering the developments in the nation. With the emergence of the Indian small scale industries (SSI) along with the large scale sector, the poverty and unemployment crisis declined considerably. Furthermore, competition in the sector increased, which necessitated the measurement of economic efficiency of these SSIs (Mohandass & Subramaniyan, 2014). The economic efficiency of Indian SSIs was deemed important as the development of these industries contributes considerably to the nation's GDP (Bishnoi, 2015). However, SSIs in India require changes and improvements in their operations such as allocation of resources and adoption of technology, and should build technical competency in order to compete with the large scale sector. Furthermore, the small-scale sector is one among the important areas of employment generation wherein the number of employees working in Indian SSIs have increased over the years. According to the RBI's *Handbook of Statistics on Indian Economy* 2011, the number of laborers working in Indian SSIs increased from 4.59 million units in 1975-1976 to 62.63 million units in 2007-2008.

* *Research Scholar,* Punjab School of Economics, Guru Nanak Dev University, Amritsar, Punjab.
E-mail : gunubhullar@gmail.com
** *Former Head & Dean,* Punjab School of Economics, Guru Nanak Dev University, Amritsar, Punjab.

Analyzing the significance of Indian SSIs, the paper determines the economic efficiency of the Indian small scale sector. In this regard, the calculation of economic efficiency is further decomposed into technical and allocative efficiencies which when multiplicatively combined will result in economic efficiency. Furthermore, there is little literature available regarding the economic efficiency of Indian SSIs with no literature focusing on the comparative analysis of economic efficiency in the pre and post- liberalization period. Hence, the present study will be a comparative analysis of economic efficiency of Indian SSIs in the pre and post - liberalization periods.

Database and Methodology

The data for calculation of technical efficiency, allocative efficiency, and hence economic efficiency is collected from previous research papers. The present study is a comparative analysis of economic efficiency in Indian SSIs during the pre and post liberalization period; hence, data is collected for the period ranging from 1980-1981 to 2013 - 2014. The calculation of efficiencies requires data for two inputs (number of labour units used by the SSIs and capital invested by the SSIs) and one output (gross value added). Economic efficiency is measured by equating the benefits and costs at the margin. In order to assess economic efficiency, it is, however, necessary to determine the outputs and the weighting factors of the outputs (Weisbrod, 1968). Lovell (1993) stated productivity to be the ratio of outputs to its inputs. This is the case wherein the process of production imparts the use of a single input and a single output leading to simple calculation of productivity. In most of the cases, productivity is influenced by different factors such as differences in technology, production processes, and the differences in production environment. The calculation of productivity by isolating efficiency components is a measure to identify the contribution of a productive unit to productivity. A unit is deemed productive if the produced outputs outnumber the inputs that are employed for production (Greene, 1997).

The theory of technical efficiency was defined by Koopmans (1951) who defined the term as a vector of feasible input/output where increasing an output requires at least a reduction in another output or an increase in one input, and the reduction of an input requires an increase in another input or reduction in another output. However, Debreu (1951) and Farrell (1957) defined technical efficiency as the equiproportional reduction of all inputs associated with the production of outputs, which still reveals the outputs. In simple terms, the concept of technical efficiency is the ability of a producer to generate outputs with the allocated inputs or with the use of minimum level of inputs, which do not hinder optimal output.

In line with the technical efficiency measurement as stated by Farrell (1957), the theory was reformulated and a measurement technique to calculate technical efficiency for cases dealing with multiple inputs and outputs was put forth. The data envelopment analysis model thus originated. It is based on linear programming. Furthermore, discussed in Seiford and Thrall (1990) general the formulation of the DEA model, which calibrates on the basis of estimated discrete piece-wise frontier defined by a set of Pareto efficient decision-making units (DMUs). The DMUs which are located on the efficiency frontier which when compared with other units utilize very less inputs, provided the outputs are known as 'best practice performers' or 'best practice institutions' and these units retain the value of one. However, DMUs which do not lie on the frontier of efficiency are denoted as inefficient and their score lies elsewhere between zero and one. The score of efficiency of various DMUs can be interpreted as the distance to efficiency frontier radially. In simple terms, the DEA is in the form of a non-parametric piece-wise-linear convex isoquant surface frontier over data points to calculate the efficiency of each DMU relative to the frontier. Frontier formation is based on the assumptions of variable returns-to-scale (VRS) or constant returns-to-scale (CRS). The CRS assumption is considered when the SSI sector operates at an optimal level over the years of evaluation, and the VRS assumption prevails when the operations of production in the SSI sector are not optimum. The overall technical efficiency is the sum of pure technical efficiency and scale efficiency.

As aforementioned, DEA uses linear programming methods for the construction of piece-wise non-parametric frontier over the data. Efficiency measures are calculated relative to the frontier. Let us assume K inputs and

M outputs for the Indian SSIs on the whole. For the year designated as *'t'*, the inputs and outputs are represented by column vectors *xt* and *yt* . For all the firms in the SSIs, the $K \times T$ inputs matrix *X* and the $M \times T$ outputs matrix *Y* are represented. The LPP formulation to calculate technical efficiency is given by :

$$\min \ \theta_t^{CRS} \qquad \ldots\ldots\ldots\ldots (1)$$
$$\text{Subject to } -y_t + Y\lambda \geq 0,$$
$$\theta_t^{CRS} x_t - X\lambda \geq 0,$$
$$\lambda \geq 0$$

where, θ_t^{CRS} is the measure of technical efficiency for the *'t'* th period under the CRS assumptions and λ is the $T \times 1$ vector of constants , X_λ and outputs Y_λ, which are a linear combination of inputs and outputs of other units of the population. If the θ_t^{CRS} equals 1, then the performance of the small scale industries in the given year is efficient technically under the CRS assumptions. However, if the value of θ_t^{CRS} is less than 1, then it indicates that the small scale industry sector has suffered some technical inefficiencies in the production year.

The DEA model with CRS assumptions provides the overall technical efficiency appropriately only if the SSIs operate at an optimal scale without suffering from inefficiencies. However, such optimal scale functioning of the SSI would have been hindered by factors such as imperfect competition, finance complexities, and so on. This further leads to measure the technical efficiency which is assumed by the fact that complexities during operations, scaled-up and scaled-down versions of inputs are included. However, when the operations of all firms are not optimal, then the measure of technical efficiency should be combined with the scale efficiencies (SE). In order to neglect the effects of SE, variable returns-to-scale (VRS) can be used. The linear programming problem of CRS can be converted to VRS using a simple convexity constraint : $T1\lambda = 1$.

$$\min \theta_t^{VRS} \qquad \ldots\ldots\ldots\ldots (2)$$
$$\text{Subject to } -y_t + Y\lambda \geq 0,$$
$$\theta_t^{VRS} x_t - X\lambda \geq 0,$$
$$T1\lambda = 1.$$
$$\lambda \geq 0$$

where, θ_t^{VRS} is the measure of efficiency, also termed as pure technical efficiency *(PTE)* of the *'t'* th year under VRS assumptions with $T1$ being the $T \times 1$ vector of 1.

The present approach forms a convex hull with intersecting planes that tightly envelopes the data points rather than the conical hull of the *CRS*. Hence, the *PTE* scores of *VRS* (θ_t^{VRS}) are greater than or equals the *CRS* technical efficiency scores (θ_t^{CRS}). The convexity constraint ($T1\lambda = 1$) denotes the benchmarking of an inefficient year against similar size output years which means the point of projection of the firms on the DEA frontier will be a combination of the years of observed performance. The restriction based on convexity is not imposed in the case of *CRS*.

As aforementioned, the overall technical efficiency is divided into pure technical efficiency *(PTE)* and scale efficiency *(SE)*. Hence, *SE* is measured as follows :

$$SE_t = \frac{\theta_t^{CRS}}{\theta_t^{VRS}} \qquad \ldots\ldots\ldots\ldots (3)$$

in which if *SE* equals '1', it indicates scale efficiency or *CRS* and if *SE* <1, it indicates scale inefficiency.

However, there is a limitation in the measure of scale efficiency. The value acquired does not denote whether the DMU operates in the area of increasing returns-to-scale or decreasing returns-to-scale. Such a limitation could be overcome through the use of an additional DEA which imposes non-increasing returns-to-scale.

Changing the DEA model in equation (2) by substituting the value of $T1\ \lambda = 1$ by $T1\ \lambda \leq 1$, the model is transformed as follows :

$$\min \theta_t^{NIRS} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$
$$\text{Subject to } -y_t + Y\lambda \geq 0,$$
$$\theta_t^{NIRS} x_t - X\lambda \geq 0,$$
$$T1\lambda \leq 1,$$
$$\lambda \geq 0,$$

where the measure of efficiency of the $'t'^{th}$ year under the non-increasing returns to scale is denoted as θ_t^{NIRS} and $T1$ is a $T \times 1$ vector of ones. The nature of scale efficiencies due to increasing returns-to-scale or decreasing returns-to-scale can be determined for a DMU by equating θ_t^{NIRS} and θ_t^{VRS} . *If* θ_t^{NIRS} is not equal to θ_t^{VRS} , then decreasing returns to scale apply.

Analysis and Results

The discussion of calculating overall technical efficiency, pure technical efficiency (PTE), scale efficiency (SE), economic efficiency (EE), and allocative efficiency (AE) has been done. To compute the various scores of efficiency, one output, that is, gross value added (GVA) and two inputs (capital and labour) of SSIs have been taken into account. The Table 1 represents the overall technical efficiency for the SSI for two periods which are namely, pre-liberalization period (1980-1981 to 1990-1991) and post-liberalization period (1991-1992 to 2013-2014). It is revealed that SSIs of India operate with an average score of 0.61 during the entire period of study; whereas, the score during the pre-reform period is 0.78 and during the post-reform period, it is 0.53.

(1) Overall Technical Efficiency

↳ **Hypothesis (H_1):** Indian SSI sector's overall technical efficiency consistently increased in the pre and post reform periods.

The Table 1 shows that the overall technical efficiency increased from the year 1980-1982 to 1983-1990. When the post reform period was considered, technical inefficiency was noticed in most of the years. Especially, in the year 1994-1995, the SSI sectors attained 99% technical inefficiency. Meanwhile, overall technical efficiency was noticed in the years 2004-2005, 2005-2006, 2011-2012, 2012-2013, and 2013-2014. Also, the overall technical efficiency consistently increased during the pre-reform period compared to the post reform period. The overall technical efficiency in the post reform period experienced a set-back as the average technical efficiency score fell to 0.53 in the post-reform period as compared to 0.78 in the pre-reform period. Thus, the figure itself exhibits a significant decline in technical efficiency in the post-reform period as compared to the pre-reform period. Thus, the severe decline in technical efficiency demands the analysis of the sources of technical efficiency in the small scale industrial sector of India. Therefore, the hypothesis H1 is partially accepted.

(2) Pure Technical Efficiency

↳ **Hypothesis (H_2):** Indian SSI sector's pure technical efficiency consistently increased in the pre and post reform periods.

The Table 2 presents the pure technical efficiency of Indian SSI sectors. From the year 1980 to 1990, there was no pure technical inefficiency in SSI sectors. Especially, 100% pure technical efficiency occurred in the years 1980-1981, 1981-1982, 1985-1986, 1987-1988, and 1989-1990. When the post-reform period was considered, pure

Table 1. Overall Technical Efficiency of Indian Small Scale Industrial Sector for the Pre and Post Reform Periods

Years	Overall Technical Efficiency
1980-81	0.61
1981-82	0.67
1982-83	0.66
1983-84	0.74
1984-85	0.80
1985-86	0.86
1986-87	0.90
1987-88	0.94
1988-89	0.95
1989-90	1.00
1990-91	0.50
1991-92	0.16
1992-93	0.20
1993-94	0.13
1994-95	0.01
1995-96	0.12
1996-97	0.20
1997-98	0.28
1998-99	0.38
1999-00	0.46
2000-01	0.54
2001-02	0.58
2002-03	0.66
2003-04	0.81
2004-05	1.00
2005-06	1.00
2006-07	0.29
2007-08	0.32
2008-09	0.33
2009-10	0.84
2010-11	0.89
2011-12	1.00
2012-13	0.99
2013-14	1.00
Average efficiency for pre-reform period	**0.78**
Average efficiency for post-reform period	**0.53**
Average of entire period	**0.61**

Table 2. Pure Technical Efficiency of the Indian Small Scale Industrial Sector for the Pre and Post Reform Periods

Years	Pure Technical Efficiency
1980-81	1.00
1981-82	1.00
1982-83	0.96
1983-84	0.99
1984-85	0.99
1985-86	1.00
1986-87	0.99
1987-88	1.00
1988-89	0.98
1989-90	1.00
1990-91	0.72
1991-92	0.55
1992-93	0.54
1993-94	0.51
1994-95	0.48
1995-96	1.00
1996-97	0.98
1997-98	0.99
1998-99	1.00
1999-00	0.99
2000-01	0.99
2001-02	0.96
2002-03	0.95
2003-04	0.97
2004-05	1.00
2005-06	1.00
2006-07	0.34
2007-08	0.33
2008-09	0.34
2009-10	0.88
2010-11	1.00
2011-12	1.00
2012-13	0.99
2013-14	1.00
Average efficiency for pre-reform period	**0.97**
Average efficiency for post-reform period	**0.82**
Average efficiency of entire period	**0.86**

Table 3. Scale Efficiency of Indian Small Scale Industrial Sector for the Pre and Post Reform Periods

Years	Scale Efficiency
1980-81	0.61
1981-82	0.67
1982-83	0.69
1983-84	0.75
1984-85	0.81
1985-86	0.86
1986-87	0.91
1987-88	0.94
1988-89	0.97
1989-90	1.00
1990-91	0.69
1991-92	0.29
1992-93	0.37
1993-94	0.25
1994-95	0.02
1995-96	0.12
1996-97	0.20
1997-98	0.28
1998-99	0.38
1999-00	0.46
2000-01	0.55
2001-02	0.60
2002-03	0.69
2003-04	0.84
2004-05	1.00
2005-06	1.00
2006-07	0.85
2007-08	0.97
2008-09	0.97
2009-10	0.95
2010-11	0.89
2011-12	1.00
2012-13	1.00
2013-14	1.00
Average efficiency for pre reform period	**0.81**
Average efficiency for post reform period	**0.64**
Average scale efficiency of entire period	**0.69**

technical inefficiency was observed from the year 1991-1995. After the year 1996, SSI sectors had pure technical efficiency. This efficiency continued till the year 2006. In the years 2006-2009, the number of labourers and

capital increased, but the gross value added did not increase. Hence, pure technical inefficiency is found over the years. Meanwhile, the efficiency gradually augmented from the year 2009 to 2014. PTE declines from 0.97 in the pre-liberalization period to 0.82 in the post-liberalization period which on the calculation of the average values of both pre and post liberation period reveals a very meagre amount of pure technical inefficiency over the years. PTE is defined as the efficient utilization of resources by the decision making units (DMUs); however, with low PTE, DMUs would have allocated their resources inappropriately. Pure technical inefficiency (PTI) is evident during the first four years of the post-liberalization period and during the years 2006-2007 to 2008-2009. Managerial inefficiencies are attributable to the inefficiency that prevailed during the years. However, the average PTE calculated is found to be more than 0.8, which means the PTE during both pre and post-liberalization period is healthy. Hence, the hypothesis H2 is rejected.

(3) Scale Efficiency

↳ **Hypothesis (H_3) :** Indian SSI sector's scale efficiency consistently increased in the pre and post reform periods.

Scale efficiency of the SSI sector for the pre and post reform periods is shown in the Table 3. Magnitudes of scale efficiency of Indian SSI sector gradually increased from the year 1980 to 1990. The SSI sector did not have good scale efficiency in the majority of the post reform period. However, the scale efficiency of the SSI sector was at the peak in the years 2004 - 2005, 2005 - 2006, 2011 - 2012, 2012 - 2013, and 2013 - 2014.

From the Tables 1 to 3, it is concluded that 31% of 39% overall technical inefficiency in the Indian SSI sector is due to scale effect, while the remaining technical inefficiency is due to improper management practices. Since, scale efficiency of SSI sector consistently improved in the pre-reform period, the Tables 2 and 3 reflect a decline in PTE and SE in the post reform period as compared to the pre-reform period. The PTE declines to 0.82 in the post-reform period as compared to 0.97 in the pre-reform period. The decline is of a smaller margin, but a huge decline is seen in SE in the post reform period, that is, 17% (from 81% to 64%). Hence, the analysis shows that managerial inefficiency is relatively a meager source of overall technical efficiency in the SSI sector of India. Hence, the hypothesis H3 is partially accepted. The scale efficiency of the SSI sector consistently improved in the pre-reform period.

(4) Economic Efficiency

↳ **Hypothesis (H_4):** Indian SSI sector's economic efficiency consistently increased in the pre and post reform periods.

The Table 4 represents the economic efficiency scenario of the Indian small scale industry sector for the entire study period (1980-1981 to 2013-2014) and two sub-periods namely, pre-reform period (1980-1981 to 1990-1991) and post reform period (1991-1992 to 2013-2014). It has been found that the economic efficiency of the Indian small scale industrial sector scores an average of 0.55 during the entire study period. This means that there was 45% economic inefficiency in the SSI sector of India during the study period. The economic efficiency also increased from the years 1980-1982 and 1983-1990. Economic efficiency was poor in most of the post reform period. SSI sectors attained only 2% of economic efficiency in the year of 1994-1995. It is noticed as the least economic efficiency in the post reform period. Economic efficiency was noticed in the years 1989-1990, 2004-2005, and 2005-2006. Thus, in the entire study period, there are only three benchmark years, that is, 1989-1990, 2004-2005, and 2005-2006 where efficiency scores are equal to 1.

Further, the economic efficiency showed a decline in the post reform period of 0.43 from 0.78 in the pre-reform period. It is inferred that the small scale industry can reduce its production cost by 45% by reallocating its inputs. Thus, the analysis represents a wide variation in the entire study period and there is an immense need to reduce

Table 4. Economic Efficiency of Indian Small Scale Industrial Sector for the Pre and Post Reform Periods

Years	Economic Efficiency
1980-81	0.61
1981-82	0.67
1982-83	0.66
1983-84	0.74
1984-85	0.80
1985-86	0.86
1986-87	0.90
1987-88	0.94
1988-89	0.95
1989-90	1.00
1990-91	0.49
1991-92	0.29
1992-93	0.34
1993-94	0.20
1994-95	0.02
1995-96	0.20
1996-97	0.30
1997-98	0.36
1998-99	0.47
1999-00	0.54
2000-01	0.62
2001-02	0.64
2002-03	0.71
2003-04	0.84
2004-05	1.00
2005-06	1.00
2006-07	0.31
2007-08	0.31
2008-09	0.29
2009-10	0.28
2010-11	0.27
2011-12	0.31
2012-13	0.31
2013-14	0.31
Average efficiency for pre reform period	**0.78**
Average efficiency for post reform period	**0.43**
Average efficiency of entire period	**0.55**

Table 5. Allocative Efficiency of Indian Small Scale Industrial Sector for Pre and Post Reform Periods

Years	Efficiency
1980-81	1.00
1981-82	1.00
1982-83	1.00
1983-84	1.00
1984-85	1.00
1985-86	1.00
1986-87	1.00
1987-88	1.00
1988-89	1.00
1989-90	1.00
1990-91	0.98
1991-92	1.00
1992-93	1.00
1993-94	1.00
1994-95	1.00
1995-96	1.00
1996-97	1.00
1997-98	1.00
1998-99	1.00
1999-00	1.00
2000-01	1.00
2001-02	1.00
2002-03	1.00
2003-04	1.00
2004-05	1.00
2005-06	1.00
2006-07	1.00
2007-08	0.97
2008-09	0.85
2009-10	0.80
2010-11	0.30
2011-12	0.31
2012-13	0.31
2013-14	0.31
Average efficiency for pre reform period	**0.99**
Average efficiency for post reform period	**0.83**
Average efficiency of entire period	**0.91**

operating cost and enhance the economic efficiency again. Hence, the hypothesis H4 is rejected.

(5) Allocative Efficiency : Allocative efficiency can be calculated from technical efficiency and economic efficiency in the following manner :

*Economic Efficiency = Technical efficiency * Allocative efficiency*
Allocative Efficiency = Economic efficiency / Technical efficiency

↳ **Hypothesis (H_5):** Indian SSI sector's allocative efficiency consistently increased in the pre and post reform periods.

From the Table 5, it is observed that allocative efficiency occurs in the pre reform period (1980-1990) and in the post reform period (1991 - 2007). Meanwhile, since the year 2007, SSI sectors attained allocative inefficiency. The cause of the inefficiency may be increasing competitiveness during the period from 2007 - 2014. Further, 39% of 45% economic inefficiency of the Indian SSI sector is attributed to technical inefficiency. Therefore, the hypothesis H5 is partially accepted.

The overall conclusion that emerges from the decomposition of economic efficiency into technical efficiency and allocative efficiency is that overall, technical inefficiency is more responsible for economic inefficiency, and allocative inefficiency is a weak source of it. Improper management skills are responsible for causing more overall technical inefficiency than scale inefficiency. Thus, economic inefficiency is a cause of dominant managerial inefficiency ; whereas, scale inefficiency and allocative inefficiency are feeble sources of economic inefficiency. Scale inefficiency is more responsible for economic inefficiency than allocative inefficiency in the small scale industrial sector of India.

(6) Factors Influencing Economic Efficiency and Overall Technical Efficiency : Two factors are hypothesized to influence economic efficiency and overall technical efficiency in the Indian SSIs and are as follows :

The ratio of capital to number of labour employed in the SSIs (K/L) and return, which is the measure of profitability. Return is calculated by the ratio of difference between gross value added (GVA) and the payment made to the total fixed assets. In the present research, it is hypothesized that these factors may affect economic efficiency and overall technical efficiency. With these variables, economic inefficiency and overall technical inefficiency can be discerned for which separate regression functions are utilized. The calculation of economic inefficiency using ordinary least squares methods is deemed to be inapplicable since the value of inefficiency should lie within the range of zero to one. This further implies the need to determine the impact of the aforementioned variables (*K*/*L*) and *(Return)* on the values of technical inefficiencies in both economic and overall technical efficiency. The Tobit model is ,therefore, used to analyze the determinants or factors affecting efficiency. The regressions for both economic and overall technical efficiency are indicated by the following equations (5) and (6) :

$$EEi = \beta 1 + \beta 2\,(K/L)\,i + \beta 3\,(Return)\,i + U_i ; \qquad \ldots\ldots.(5)$$
$$OTEi = \beta 1 + \beta 2\,(K/L)\,i + \beta 3\,(Return)\,i + U_i ; \qquad \ldots\ldots..(6)$$

where, *EEi* and *OTEi* indicate the economic and overall technical efficiencies respectively ; *K/L* is the ratio of capital to labour employed ; and *Return* is the measure of profitability ; β1, β2, and β3 are the coefficients of independent variables ; *Ui* denotes the noise or error term which is uniformly distributed. Subtracting the values of *EEi* and *OTEi* reveals economic and overall technical inefficiencies.

Table 6. Determinants of Economic and Technical Inefficiency in Indian Small Scale Industrial Sector

(Parameter)	Maximum Likelihood Estimates	*Z* - value
Economic Inefficiency		
Constant (β_1)	1.169**	6.67
K/L (β_2)	-8.57E-06**	-4.21
RETURN (β_3)	-0.023	-1.91
Overall Technical Inefficiency		
Constant (β_1)	0.892**	3.40
K/L (β_2)	-4.26E-06	-1.39
RETURN (β_3)	0.008	0.43

** $p < 0.01$

The Table 6 shows the causes of economic and technical inefficiency in the Indian SSI sector. Here, K/L and Return are used as independent variables while economic and overall technical inefficiencies are used as dependent variables. The dependent variables range from 0 (inefficient) to 1 (efficient). In this case, the present research tries to find the factors affecting economic and technical inefficiencies. In order to segregate the inefficient dependent variables, the present study uses the Tobit regression model. On the basis of 1% level of significance ($p < 0.01$), economic inefficiency is dependent on the K/L. In addition, K/L has negative relationship with economic inefficiency. Hence, economic inefficiency of the SSI sector would diminish if K/L increases. However, return failed to depict a significant impact on economic inefficiency. Similarly, K/L and return did not show significant effect on technical inefficiency of the Indian SSI sector.

The values inferred from the Table 6 denote certain evidence of relationship existing between the hypothesized variables (K/L and Return) and the dependent variables (economic inefficiency and overall technical inefficiency). Considering the factors affecting economic inefficiency, it is deemed that the value of K/L is negatively and significantly affecting economic efficiency. Hence, there is a need for Indian SSIs to increase capital intensity and the number of labour significantly to improve economic efficiency of these units. Considering the factors affecting overall technical inefficiency, it is revealed that there exists a negative relationship between capital intensity and overall technical efficiency, however, the values are not significant. Hence, a generalized conclusion can be put forth meaning that in order to improve economic efficiency in Indian SSIs, improvements in capital intensity and labour should be made. However, it is seen that Indian SSIs witnessed sustainable growth in terms of labour and capital investment, which is elaborated in the next section.

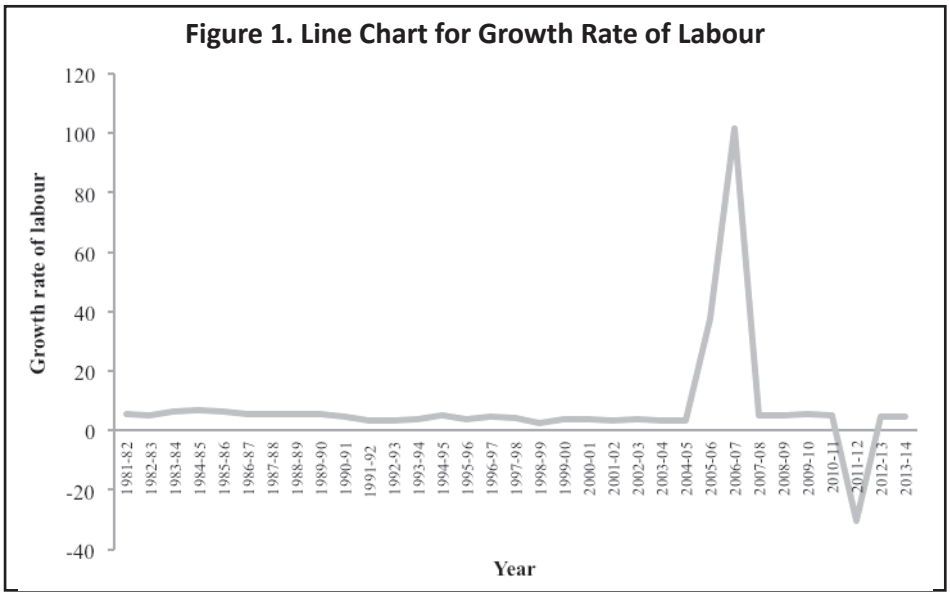
(7) Economic and Social Sustainability : Unemployment was recognized as a major problem way back in the 1950s. However, with fast economic growth, the Indian SSI industry became the most labour intensive sector of the country and was considered to possess adequate strategies to mitigate unemployment crisis during the 1950s and 1960s. The Table 7 presents the number of laborers working in the SSI sector during the pre and post reform periods. During the pre-reform periods, 5% - 7% growth was attained in the number of labour units. A slight growth in the number of laborers of SSIs was noticed from the year 1991 - 2005. As discussed by Gandhimathy (2013), societies will have positive growth in the forthcoming years, but the reduction of workers will further reduce the employment opportunity in this sector. However, there was a peak growth found in the number of labour units from the year 2006 to 2007. The average numbers of labours for the pre and post reform periods were 96.50 lakhs and 329.87 lakhs. Hence, it can be inferred that the SSI sector created more employability in the post reform period compared with the pre reform period. These inferences are similar to the estimation discerned wherein labour units grew to a considerable level during the post-reforms period. The increased number of labour

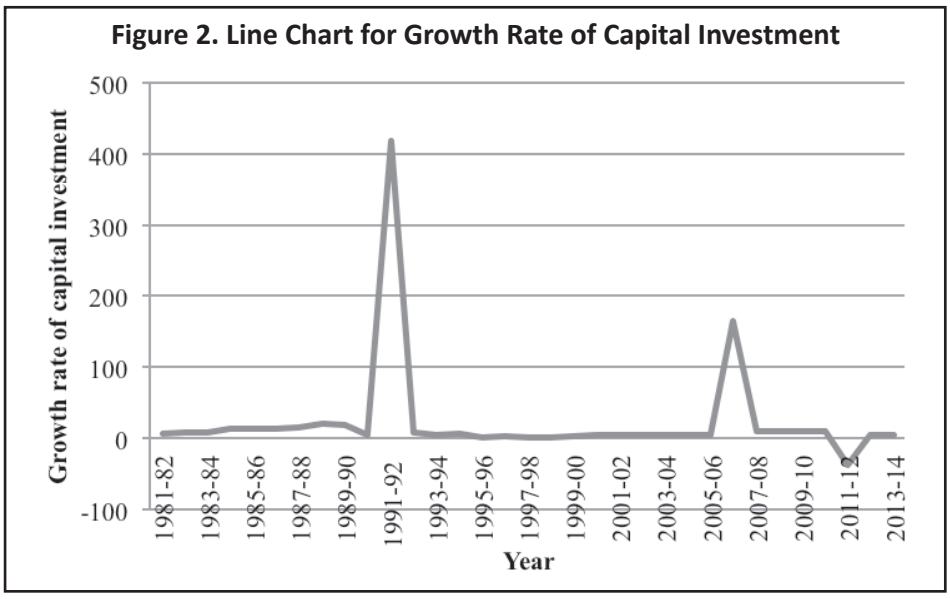
Table 7. Growth Rate of Labour and Capital of Indian Small Scale Industrial Sector

Years	Labour (in lakhs)	GR	Capital investment (in lakhs)	GR
1980-81	71		585000	
1981-82	75	5.63	628000	7.35
1982-83	79	5.33	680000	8.28
1983-84	84.2	6.58	736000	8.24
1984-85	90	6.89	838000	13.86
1985-86	96	6.67	958500	14.38
1986-87	101.4	5.63	1088100	13.52
1987-88	107	5.52	1261000	15.89
1988-89	113	5.61	1527900	21.17
1989-90	119.6	5.84	1819600	19.09
1990-91	125.3	4.77	1930200	6.08
1991-92	129.8	3.59	10035100	19.90
1992-93	134.06	3.28	10962300	9.24
1993-94	139.38	3.97	11579500	5.63
1994-95	146.56	5.15	12379000	6.90
1995-96	152.61	4.13	12575000	1.58
1996-97	160	4.84	13056000	3.83
1997-98	167.2	4.50	13324200	2.05
1998-99	171.58	2.62	13548200	1.68
1999-00	178.5	4.03	13998200	3.32
2000-01	185.6	3.98	14684500	4.90
2001-02	192.23	3.57	15434900	5.11
2002-03	199.65	3.86	16231700	5.16
2003-04	206.83	3.60	17021900	4.87
2004-05	214.28	3.60	17869900	4.98
2005-06	294.91	37.63	18811300	5.27
2006-07	595.66	10.98	50075800	16.20
2007-08	626.34	5.15	55819000	11.47
2008-09	659.35	5.27	62175300	11.39
2009-10	695.38	5.46	69383500	11.59
2010-11	732.17	5.29	77348700	11.48
2011-12	509.4015	-30.43	48643435	-37.11
2012-13	534.727	4.97	51488193	5.85
2013-14	560.7757	4.87	54393013	5.64
AAGR of pre-reform period	**96.50**	**5.85**	**1095663.64**	**12.786**
AAGR of post-reform period	**329.87**	**8.47**	**29601680**	**29.1709**

Note: AAGR stands for average annual growth rate.

GR stands for growth rate.





units in this scenario relates to the increase in the number of SSI units all over the country during the post-reform period, which was relatively low during the pre-reform period.

Social sustainability in the Indian context with respect to increase in the number of labour units in Indian SSIs during pre and post liberalization period reveals a considerable growth of labour units. In all dimensions of the Indian economy in terms of environmental, economic, and social relations, sustainability of employment has always been a complex issue, and liberalization, according to the present research, has provided better results.

Capital investment in the Indian SSI sector and its growth rate are also shown in the Table 7. The figures of capital investment clearly connote that investment gradually improved from the year 1981 to 1989. In the year 1991-1992, capital investment of the SSI sector attained abundant growth. The same was noticed in the year 2006-2007. On an average, 29% of growth of capital investment was found in the post-reform period while in the pre-reform period, only 13% growth was noticed. It is deemed that the establishment of SSIs in India take less investment ; however, it reduces the issues of employment on a large scale. However, summing up capital

investments during pre and post reform periods separately discerns the fact that Indian SSI sector became capital intensive during the post-reform period. Capital investment in the Indian SSIs peaked during 1991-1992 and sustained at a consistent pace. However, few distortions could be seen in the year 2011-2012. Comparing both the periods, the post-reform period achieved economic sustainability with a stable increase in capital investment, which is the sight of continuous development in the SSI sector during the post-reform period. One of the major reasons for the decline in capital investment growth of some years is the negative working capital gap of the Indian small scale industrial sector. As in India, the working capital gap is significantly causing sickness in the SSI, and the Government of India has framed an elaborated framework of financial infrastructure (Kumar, 2014). A graphical representation of the labour and capital growth rates is shown in the Figures 1 and 2.

Discussion and Conclusion

Liberalization and globalization are the major driving factors of a country's economy. India is a nation which is embracing globalized market view in terms of both imports and exports. No country in this world can flourish only with the local resources and the capacities to drive the growth of the nation. From 1991, Indian SSIs faced huge competition with each other which is associated with global open market trading policies. Hence, the present study intended to examine the efficiency of Indian SSIs which led the present research to analyze the following efficiency scores - overall technical efficiency, pure technical efficiency, scale efficiency, economic efficiency, and allocative efficiency.

Overall technical efficiency is calculated using two input variables (labour and capital) and one output variable (GVA) in CRS. The calculation of overall technical efficiency is performed using 'DEA solver' which is an add-on to Microsoft Excel. Data for the input and output variables were collected from various sources using physical search and the data was restricted within the time frame from 1980-1981 and 2013-2014. However, the present research segregated the time period into two: pre-liberalization and post-liberalization periods wherein the time frame for the periods is 1980-1981 to 1990-1991 and 1991-1992 to 2013-2014, respectively. Calculating the overall technical efficiency from the collected data reveals the pre-reform period to hold an average value of 0.78 ; whereas, the same in the post-reform period is 0.53. The average of both the pre and post-liberalization values reveals a 0.61 OTE value. The value of overall technical efficiency is found to be significant during the pre-reform period and even reached a value of 1.00 during the year 1989 - 1990. However, according to the results, with the liberalized economic regime, overall technical efficiency values were insignificant during the post-reform period. This could be attributed to various factors which are analyzed using Tobit regression model. The present research hypothesized two factors such as the ratio of capital to labour (K/L) and Return which is the emoluments paid. The results of the analysis reveal the existence of negative values of K/L which poses serious threat to the overall technical efficiency of Indian SSIs. This discerns the need for improvements in capital intensity in the post reforms period.

Similarly, the values of pure technical efficiency (PTE) are calculated using the collected data of two input variables (labour and capital) and one output variable (gross value added- GVA) in variable return to scale (VRS). PTE denotes the management performance towards appropriate utilization of resources which include labour, capital, and time. The results of the study reveal that PTE of Indian SSIs during the pre-reformation period is 0.97 and the same during the post-reformation period is 0.82, averaging 0.86 in both periods. Very meagre inefficiency score could be envisioned which means that DMUs would have been so crucial towards allocation of resources. However, the pre-reforms period achieved a value of 0.97 which is close to 1.00.

To calculate the scale efficiency of Indian SSIs, the present study utilized the formula :

$$\text{Scale Efficiency, } SE = \frac{\text{Over Technical Efficiency } \textit{(OTE)}}{\text{Pure Technical Efficiency } \textit{(PTE)}}$$

Using the equation, the values for SE are calculated for both pre and post-reforms period. Scale efficiency measures the suitability of a firm's size in operation which when modified leads to inefficiency. The average SE value during the pre-reforms period is 0.81, whereas the same in the post-liberalization period is 0.64. These values indicate that during the pre-reform period, Indian SSIs had the option to produce a limited number of deliverables which would suffice for a limited population. Hence, the scale of firms operating during that time would be optimal. However, with new players emerging after 1991, these SSIs were forced to expand their operations to compete with rival companies. Though the size of firms and production scale increased, the demand for delivered products may have been declining due to increased number of market participants.

In terms of identifying the value for economic efficiency in pre-liberalization and post-liberalization period, the present research identified the value of EE to be 0.78 and 0.43 during pre and post reforms periods, respectively. Economic efficiency is defined as the state of economy wherein resources are generally considered scarce and hence optimal allocation of resources without wasting them is a primary concern. In this manner, inefficiency can be mitigated. However, when an economy is economically efficient, any changes made in the allocation of resources may affect other units. Indian SSIs are a mix of various industries which include metal industries, food products, rubber and plastic industries, paper products, and so on. There is always a variation in the number of resources allocated within these industries. When a particular sector within the SSIs is growing, more investment in the form of capital and labour are devoted to the specific industry, thereby, leaving other industries to suffer. This can be one important reason for a significant efficiency value during the pre-reform period. Another reason is the existence of very limited number of companies in the pre-reforms period which would have balanced investment options.

Allocative efficiency is calculated as the ratio of economic efficiency and overall technical efficiency and it reveals certain characteristics. The AE of both pre and post- liberalization periods are 0.99 and 0.83, respectively, wherein the average value is found to be 0.91 in the overall time frame. This further indicates that the SSI achieved allocative efficiency over the years in both pre and post reforms periods. The values remained '1' during the time period 1980-1981 to 1989-1990. However, a meager inefficiency occurred in the year 1990-1991. Similarly, the allocative efficiency values remained '1' for the period from 1991-1992 to 2006-2007 and showed inefficiencies later. However, in later years and in 2013-2014, the value of allocative efficiency reached 0.31, which is not a good sign.

With the calculation of efficiencies, it is discerned that the number of labour units and capital investment increased in the post-reforms period as compared to the values of pre-reform period. This increase is attributed to the increase in the number of SSI units in the country. However, variations in sustainability could be seen in certain years when there is nil or decrease in the growth of Indian SSI. On the whole, it is discerned that during the pre-liberalization period, Indian SSIs were considerably efficient when analyzing all the different efficiency scores. However, after economic liberalization, several factors influenced efficiency scenarios which can be analyzed using Tobit analysis. The present research analyzed the impact of K/L and return on economic efficiency and overall technical efficiency. The study concludes that with improvements in capital intensity and labour, Indian SSIs may flourish, thereby confirming survival from foreign competition.

Policy Implications, Limitations of the Study, and Scope for Future Research

Though proper care was taken to successfully complete this study, it was not free from some of the limitations and constraints. We experienced data constraints in the management of secondary data. The data published by the small industry promoting agencies have not been regular. Further, the data published by different organizations on particular issues for a given period of time have not been uniform. Thus, we encountered various data gaps. Additionally, there is future scope of research on the basis of different variables chosen for analysis. The present paper includes only three variables and the results show that the efficiencies of post reform period have marked a

dent on the growth of the Indian small scale industrial sector. The whole command is held by the small scale industrial sector in the Indian market. From old grains to clothes, everything is produced with the assistance of SSI. Therefore, the SSI is like a backbone of the large scale industrial sector because it provides raw material and semi finished goods to this sector. The future prospects lie in the fact that show that these two sectors will survive side by side in the near future which will determine the future of India in the world economy.

Various policy implications are suggested for the Indian small scale industrial sector to overcome inefficiencies, which are as follows :

(1) Modern techniques of production should be used to reduce cost and improve labour productivity by retraining workers with modern skills.

(2) Modern inventory management techniques should be adopted by the SSI units.

(3) Small scale industries should associate with various financing agencies to reduce dependence of the SSI on government and to reduce delays.

(4) The small scale industry should reorient and adhere to more cost effective use of resources, marketing skills, and technological competitiveness.

(5) The Government of India should explore the possibility of setting up a central marketing corporation for distributing unbranded products of the small scale industry.

(6) Financial assistance should be provided by the government to small scale industries to provide loans at low rates of interest.

(7) Opening up of new banks in various rural areas will solve the problem of inadequacy of finance in some areas.

Thus, the process further gains momentum when sophisticated automation follows change in quality and standards in process and practices. The small scale industries of India can then afford to be obvious to these factors and from a new culture will emerge entrepreneurs who can face global competition.

References

Bishnoi, M. (2015). Indian small scale industries: An analysis in pre and post globalised period. *EPRA International Journal of Economic and business Review, 3*(4), 269 - 273.

Debreu, G. (1951). The coefficient of resource utilization. *Econometrica, 19* (3), 273 - 292. doi: 10.2307/1906814

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society, 120* (3), 253 - 290. doi: 10.2307/2343100

Gandhimathy, B. (2013). An economic analysis of production industrial cooperatives in Tamil Nadu: The stochastic production function model. *Arthshastra Indian Journal of Economics and Research, 2*(6), 40 - 46. DOI: 10.17010/aijer/2013/ v2i6/54539

Greene, W. H. (1997). Frontier production functions, in M. H. Pesaran & P. Shmidt (eds.). *Handbook of applied econometrics, Volume II: Microeconometrics*. Oxford : Blackwell Publishers Ltd.

Koopmans, T. C. (1951). *An analysis of production as an efficient combination of activities. Activity analysis of production and allocation*. New Jersey: John Wiley and Sons, Inc.

Kumar, S. (2014). Industrial sickness in small scale industrial sector of India with special refrence to financial gap. *Arthshastra Indian Journal of Economics and Research, 3*(2), 20-31. doi:10.17010/aijer/2014/v3i2/55973

Lovell, C. K. (1993). Production frontiers and productive efficiency, in A. O. Fried, A. K. Lovell, & S. S. Schmidt (eds.) *The measurement of productive efficiency* (pp. 3 - 67). Oxford: Oxford University Press.

Mohandass, S., & Subramaniyan, E. (2014). Impact of globalization on micro, small and medium enterprises in India. *Asia Pacific Journal of Research, 1*(19), 165 - 170.

Murillo-Zamorano, L. R. (2004). Economic efficiency and frontier techniques. *Journal of Economic Surveys, 18* (1), 33 - 77.

Reserve Bank of India. (2011). *Handbook of statistics on Indian economy 2010 - 2011*. Mumbai : RBI.

Seiford, L. M., & Thrall, R. M. (1990). Recent developments in DEA: The mathematical programming approach to frontier analysis. *Journal of Econometrics, 46* (1-2), 7 - 38. doi: https://doi.org/10.1016/0304-4076(90)90045-U

Weisbrod, B.A. (1968). Income redistribution effects and benefit-cost analysis of government expenditure programs, in S. B. Chase (ed.). *Problems in public expenditure analysis*. Washingdon, DC: The Brookings Institution.