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Measuring the Efficiency of Energy Consumption of Major Indian Manufacturing Sector: A DEA-Based Malmquist Productivity Analysis

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The study spans the years 1998 to 2018 and focuses on a group of 23 manufacturing decision-making units. The required data was obtained from India's Annual Industrial Survey. Industrial Coal consumption (ICC), Industrial Electricity consumption (IEC), Industrial Petroleum consumption (IPC), Industrial Other oil consumption (IOC), and industrial value added (IVA) were among the variables studied (IVA). For undertaking the analysis at distinct manufacturing sectors a disaggregated analysis is undertaken at the level of individual manufacturing units and manufacturing groups. The input output table has been worked out for each decision making unit based on the energy data used and gross industrial value added for the various variables stated above. As a corollary, there is just one output table and four input tables. The Deap-xp2 computer application was used to run this input-output table.

For the measurement of the productivity of energy consumption in Indian manufacturing sectors the DEA based Malmquist productivity Index (MPI) has been used in this study. The study reveals aboutten decision making units, such as manufacturing of basic metal, beverages, manufacturing of furniture, leather related products, machinery and equipments, other non metallic mineral products, wearing apparels, wood and wood products, other manufacturing and printing and reproducing sectors have by and large increased productivity in most of the time periods under study.

Keywords: Measuring, Manufacturing Sector, Efficiency, Productivity.

Introduction

In formulating its growth strategy, India has placed a strong emphasis on developing its industrial sector. The goal is to generate faster growth in the industrial sector (particularly manufacturing) to boost the industry's share of GDP and India's share of global industrial production. This 'industry-led growth' can only be accomplished by making extensive use of energy. The Indian industrial sector consumes a significant amount of primary energy, accounting for 41 percent of global industrial energy use. As the economy grows, this percentage is expected to rise even more. As a result, India has become the third-largest energy consumer globally after the USA and China.

Furthermore, due to modernization, rapid economic growth, expansion of industry, population growth, and urbanisation that has occurred in the previous few decades, energy consumption has rapidly expanded. From 1990 to 2020, India's primary energy demand tripled, amounted to about 916 million tonnes of oil equivalent. Coal is the most common energy source, accounting for over 45 percent of total energy consumption, followed by petroleum and other liquids, biomass wastes, and other renewable energy sources.Manufacturing industries (which are divided into 23 groups) are among the most energy-intensive businesses in India.[1] Even though this sector provides 15 to 17 percent of GDP, it consumes up to 60 percent of all commercial energy.

As one of the world's largest and fastest-growing developing countries, India faces the risk of an imminent energy crisis, necessitating prompt action. In such circumstances, the concepts of energy efficiency and energy intensity are brought into sharp focus to maintain energy security while remaining environmentally friendly. India's manufacturing industry have one of the highest energy intensity levels in the world, implying massive energy use. As a result, one of the difficulties is to reduce the energy intensity of Indian manufacturing industries. Thehigher the energy intensity, i.e., the more energy used per unit of output, the lower the energy efficiency. Energy supply is insufficient, energy demand is excessive, and energy demand is price elastic. Therefore introducing efficiency to the industrial sector is almost unavoidable nowadays. Furthermore, industrial energy consumption is expected to increase at a quicker rate than total final energy consumption. In such a situation, significant effort must be made to improve the industrial sector's energy consumption efficiency to meet tremendous demand.

With this background, the present study attempts to estimate energy use efficiency in the Indian manufacturing industry, the highest energy-intensive sector among all other sectors in India.Energy efficiency is understood to mean using energy most cost-effectively to carry out the manufacturing process or provide a service, whereby wastage of energy is minimized. The overall consumption of primary energy resources isreduced. In other words, energy-efficient practices or systems seek to use less energy while conducting any energy-dependent activity and at the same time minimize the corresponding (negative) environmental impacts of energy consumption. In short, energy efficiency indicates the productivity of the input used.

Productivity can be the ratio of industrial output to total energy input. Generally, total factor productivity, which is described as an index of all the output to all the input, has been used to measure production efficiency. Similar to this,theMalmquist productivity index used, which is part of a data envelopment model based on a non-parametric, linear programming method of distance functions that are often employed to estimate the total factor productivity changes. Choosingthe data envelopment model is that it does not require any prior assumption to perform. The MPI decomposes changes in technical efficiency and efficient production frontier shifts. Thus the DEA-based MPI is best suitable for measuring the productivity of energy consumption in the Indian manufacturing sector.
The rest of the study is presented in five sections. The second section deals with a literature review purely containing the topic-centric past studies. The third section presents the organized Data Source and Methodology. The fourth section discusses the outcome of the result of the Data analysis. Finally, the Conclusion part summarizes the fundamental research in a nutshell with policy recommendations.

Literature Review

Several studies have conducted in the that have utilized DEA-based Malmquist productivity index to measure the level of efficiency in many industries, such as in banking, insurance, coal mining and in many manufacturing industries.It was Farrell (1957)[1] who first floated the idea of measurement of productive efficiency. LaterCaves at el(1982)[2] generated index number procedures for comparing Malmquist input output and productivity for structures of production with return to scale, productivity changes and substitution possibilities. Another study was conducted by R. Fare, S. Grosskopf, B. Lingren(1992)[3] for Swedish manufacturing of pharmacies.the total factor productivity measured for a Swedish regional pharmacies for the sample period from 1980 to 1989,for which the malquist productivity index has been utilized. The result reveal number of efficient pharmacies to inefficient firms. Z.M. Huang (1997)[4]conducted research of 16 large banks in Texas for the period of 1984 to 1985. The objective was to identify their risk coverage as well as efficiency. Against these 16 government banks five efficient non-Texas banks were introduced. And the result of the Texas banks were compared with efficient Non-Texas banks. The work was conducted through Data Envelopment Analysis.
J. Odeck (2000)[5]analyzed efficiency and productivity growth of Norwegian motor vehicle for the period of 1989-91 where he measured the efficiency through a non-parametric approach called DEA and productivity he measured through Malmquist index.The results reveal that there is, on an average, input saving potential of 21–29% for the sector as a whole. The individual units are found to be non consistent with respect to efficiency scores across various years of observation. On the other side the efficiency scores are not affected by the size of the firm.

G.A.Boyd and Joseph.X.Pang (2000)[6] examined, energy efficiency in two segments of the glass industries in the USA, using data envelopment analysis. At first they conducted a regression analysis to find out if there was any plant level electricity and fossil fuel intensity then applied efficiency test DEA. The results revealed that a 1% increase in productivity, increased the energy efficiency by more than 1%.

K.Mukherjee, S.C.Ray, and S. M. Miller (2001)[7]explored productivity growth for a cluster of 201 large US commercial banks at the beginning of post-deregulation period from 1984 to 1990, for the analysis they used Malmquist productivity index based data envelopment analysis (DEA). After isolating the contributions of technical change, technical efficiency change, and scale change to productivity growth. They got overall productivity growth of 4.5% per year on an average, but subsequently productivity declined by 7.61% between 1984 and 1985 and by 0.33% between 1988 and 1989. Their second-stage panel regressions showed that larger asset size and specialization of product mix associate with higher productivity growth while higher equity to assets associates with lower productivity growth.

J. K. Parikh and M. Kulshreshtha (2002)[8]studied the efficiency and productivity of coal mining in the Indian coal sector using detailed input and output data for underground and opencast coal mining for the period between 1985 and 1997. They adopted data envelopment analysis (DEA) Total factor productivity was analysed using the Malmquist index by decomposing productivity change into efficiency and technical change. Results go aginst the understanding that the opencast (OC) mining chennalises more productivity growth than the underground mining in India. An increasing percentage of Opencast mining regions witnessed a decline in efficiency over the period of investigation. Closer to 58%, 59% and 67% of the mining regions showed reduction in productivity during 1985 and 1990, 1990 and 1995 and 1995 and 1997, respectively. The change in the technical progress seems to have been the major driving factor behind productivity growth in opencast mining, while efficiency growth has been the most important factor in growth of underground mine productivity. Underground mines seem to have fitted a more efficient practice of functioning to equate for the lag in technical change. On the other hand, operational efficiency of opencast mines seems to have been undermined in the process of increasing production through technological progress in opencast mining.

The investigation of the above empirical setup discloses the importance and the usage of data envelopment model in testing of the energy efficiency in the manufacturing sector.

Objective of the Study

To measure energy efficiency for various industrial manufacturing sectors of the Indian economy
To estimate the energy efficiency difference across various manufacturing sectors

Data Source and Methodology

The study spans the years 1998 to 2018 and focuses on a group of 23 manufacturing decision-making units. The required data was obtained from India's Annual Industrial Survey. Coal consumption (ICC), electricity consumption (IEC), petroleum consumption (IPC), other oil consumption (IOC), and industrial value added (IVA) were among the variables studied (IVA). For undertaking the analysis at distinct manufacturing sectors a disaggregated analysis is undertaken at the level of individual manufacturing units and manufacturing groups. The input output table has been worked out for each decision making unit based on the energy data used and gross industrial value added for the various variables stated above. As a corollary, there is just one output table and four input tables. The Deap-xp2 computer application was used to run this input-output table.
For the measurement of the productivity of energy consumption in Indian manufacturing sectors the DEA based Malmquist productivity Index (MPI) has been used in this study. The MPI is a distance function that enables to analysis multi-input and multi output systems without any assumption of the production behavior, here four inputs and one output is worked out. Here it is to be noted that the distance function can be defined as either input basedor output based. In this paper, we focus on the input based distance function to measure the MPIs for calculating the energy consumption performance of different Manufacturing sectors in India and the distance to the efficient production frontier (EPF) for the inefficient Decision Making Units.
Suppose $x$and $y$are the input and output vectors, respectively. $S^t(y)$ is the efficient production frontier. θ is the ratio of input reduction for moving to the EPF. Hence the distance function can be defined as below:

$$D^t(x^t, y^t) = \max\{\theta \mid \frac{x^t}{\theta} \in S^t(y)\} \quad (1)$$

The MPIs in time periods can be defined as

$$\text{MPI} = \frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)} \quad (2)$$

Where is the distance function for measuring the distance from the position in the input and output space of the time period t to the EPF at time t. . is the distance function for measuring the distance from the position at time period t+1 to the EPF at time t.
The MPIs in time period*+1* can be defined as:

$$\text{MPI} = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t+1}(x^t, y^t)} \quad (3)$$

Where is the distance function for calculating the distance from the position in the input and output space at time period t+1 to the EPF at time t+1. is the distance function for estimating the distance from the position at time period t to the EPF at time t+1.
Farrell(1989) denoted the Malmquist productivity index as

$$MPI_0 = \left[\frac{D_0^t(x_0^t, y_0^t)}{D_0^t(x_0^{t+1}, y_0^{t+1})} \frac{D_0^{t+1}(x_0^{t+1}, y_0^t)}{D_0^{t+1}(x_0^{t+1}, y_0^{t+1})} \right] 1/2 \quad (4)$$

In this paper, the MPI can be used to estimate the change of energy consumption of different manufacturing units in India for the time period between t and t+1. If MPI_0>1, progress in efficiency; If MPI_0 =1, then efficiency remains constant, and efficiency decreases if MPI_0 <1.
In order to find out reasons for MPI change, we follow Fare et al[1] and disaggregate the MPI into two components. Along with that we use the similar method to check efficiency change and technical change, namely;

$$MPI_0 = \frac{D_0^t(x_0^t, y_0^t)}{D_0^{t+1}(x_0^{t+1}, y_0^{t+1})} \left[\frac{D_0^{t+1}(x_0^{t+1}, y_0^{t+1})}{D_0^t(x_0^{t+1}, y_0^{t+1})} \frac{D_0^{t+1}(x_0^t, y_0^t)}{D_0^{t+1}(x_0^t, y_0^t)} \right] 1/2 \quad (5)$$

Among the two components the first component calculates the degree of technical efficiency change (TEC) from the time period t and t+1, namely:

$$TEC_0 = \frac{D_0^t(x_0^t, y_0^t)}{D_0^{t+1}(x_0^{t+1}, y_0^{t+1})} \quad (6)$$

TEC estimates the catch-up effect, which indicates the energy consumption performance in the indicated period. Whereas the second component measures the efficiency production frontier shift (EPF) between the time period t and t+1 namely,

$$EPFS_0 = \left[\frac{D_0^{t+1}(x_0^{t+1}, y_0^{t+1})}{D_0^t(x_0^{t+1}, y_0^{t+1})} \frac{D_0^{t+1}(x_0^t, y_0^t)}{D_0^{t+1}(x_0^t, y_0^t)} \right] 1/2 \quad (7)$$

EPFS calculates the frontier-shift effect, which shows the shift in the production technology of an industry. If $EPFS_0$>1, then it means a positive shift of EPF or technical progress.$EPFS_0$<1 indicates a negative shift of EPF or technical regression. If $EPFS_0$= 1, then the EPF is constant.As per the above theoretical background, MPI can be constructed as follows:

$$MPI_0 = TEC_0 . EPFS_0 \quad (8)$$

At first we estimate the MPI of a decision making unit to measure the distance to EPF. To perform this, we will employ DEA model to estimate the distance function. The aim ofusing this approach is to calculate the energy consumptionefficiency and the ratio of input reduction for reachingthe EPF. The following model can be used to measure theperformance in a time period and the distance can also becalculated. Suppose we have nDMUs, each DMU$_j$(j=1, 2, 3, . . . , n) produces a vector of outputs by using a vectorof inputs at each time period t, t = 1, . . . ,T. The DEAmodelat time period$t$can be expressed as follows:

$$\begin{aligned} & D_0^t\left(x_0^t, y_0^t\right) = Min\theta_{0,} \\ & s.t \sum_{j=1}^{n} \lambda_j x_j^t \leq \theta_0 x_0^t, \\ & \sum_{j=1}^{n} \lambda_j y_j^t \geq y_0^t \\ & \lambda_j \geq 0, \quad j = 1, ..., n, \end{aligned} \quad (9)$$

Where $x_0^t = \left(x_{10}^t, ..., x_{m0}^t\right) and\ y_0^t = \left(y_{10}^t, ..., y_{s0}^t\right)$ is the input and output vectors of DMU_0 among others. Here we need to understand that DEA models used in the Malmquist productivity index can be either input oriented or output oriented. Hence in this research input oriented model has been employed. So this model considers possible radial reductions of inputs when the outputs are kept constant at current level, this is nothing but shows the amount of energy consumption reduction when industrial value added is fixed. Model (1), $\theta_0^*(\theta_0^* = D_0^t\left(x_0^t, y_0^t\right))$ is the efficiency of DMU_0at time period$t$which determines the amount by which given inputs can be proportionally reduced. Supposing, if DMU_0's energy

consumption performance is efficient in time period t andfurther in that DMU_0 if the amount of energy already used cannot be reduced with the given value added, then that $DMU_0$is said to be on the efficient production frontier (EPF). If its energy consumption performance is inefficient and can still produce the given value added after reducing the proper amount of energy, which means $DMU_0$is operating below the EPF[1], then it can reach the EPF after input reduction.Suppose we have a production function in time period $t$as well as period $t + 1$; the Malmquist productivity index calculation requires two single period and two mixed period measures (Charnes et al. 1978). From the time period $t$to $t + 1$, DMU_0's technical efficiency and the EPF may shift.We adopt the algorithm developed by Fare et al.[2]to calculate the Malmquist production index by considering energy consumption. It can be calculated via the following steps.

(i) Comparing to EPF at time t, by estimating model(1).

(ii) Comparing to EPF at time $t + 1$ by estimating via the following linear program model:

Model (II)

$$D_0^{t+1}\left(x_0^{t+1}, y_0^{t+1}\right) = Min\theta_{0,}$$

$$\text{s.t} \sum_{j=1}^{n} \lambda_j x_j^{t+1} \leq \theta_0 x_0^{t+1}, \qquad (10)$$

$$\sum_{j=1}^{n} \lambda_j y_j^{t+1} \geq y_0^{t+1},$$

$$\lambda_j \geq 0, \quad j = 1, ..., n,$$

(iii) Comparing to EPF at time t+1, by calculating through the following linear program model:

Model:III

$$D_0^{t+1}\left(x_0^{t}, y_0^{t}\right) = Min\theta_{0,}$$

$$s.t \sum_{j=1}^{n} \lambda_j x_j^{t+1} \leq \theta_0 x_0^{t},$$

$$\sum_{j=1}^{n} \lambda_j y_j^{t+1} \geq y_0^{t},$$

$$\lambda_j \geq 0, \quad j = 1, ..., n, \qquad (11)$$

(iv) Comparing to EPF at time t, by calculating through the following linear program model:

Model:IV

$$D_0^{t}\left(x_0^{t+1}, y_0^{t+1}\right) = Min\theta_{0,}$$

$$s.t \sum_{j=1}^{n} \lambda_j x_j^{t} \leq \theta_0 x_0^{t+1},$$

$$\sum_{j=1}^{n} \lambda_j y_j^{t} \geq y_0^{t+1},$$

$$\lambda_j \geq 0, \quad j = 1, ..., n, \qquad (12)$$

The above stated variables and Models have been followed to arrive at the below given result outcomes. The results have been formulated in five different tabular formats. And values of the results have been discussed in the next section.

Results and Discussion

Appendix 1-Table 1, shows the energy consumption efficiency of the 23 manufacturing sectors from 1999 to 2018. The results show that, there are 6 out of 23 sectors that experienced effective energy consumption in the reference period, which means the value of $D_0^{t}\left(x_0^{t}, y_0^{t}\right)$ is nearer or equal to 1. It also shows that these sectors mostly lie on the efficiency frontier of energy consumption as benchmarks.Basic metal is effective for the years 2002, 2004 to 2006, 2009, 2011, 2014, and 2017-18. The Manufacture Of Beverages sector

is effective for the periods 2002, 2004-05, 2009, 2011, 2013-14 and 2017-18. The manufacture of food product sector is effective for the years 2003,2006 to 2011& 2016-17. The manufacturing of publishing activities sector is effective for the years 1999, 2001-02, 2007, 2010, 2015 to 2017. The manufacturing of crop, animal production and hunting related sector is energy efficient for the years 2001, 2005, 2007, 2009 to 2013 & 2016-17. Other than the above mentioned six industrial sectors, rest seventeen industries such as chemical, coke and refined petroleum products, computer and electronic optical products, electrical equipments, fabricated metal products, furniture, leather related, machinery and equipments, other metallic mineral products, paper & paper products, pharmaceutical medical, rubber plastic products, manufacturing of textiles, tobacco, wearing apparels, wood products and other production are found to be energy inefficient for about 15 years in the last two decades of time periods. Very seldom in some years these industries have achieved energy efficiency, but no consistency in their energy efficient output performance. Similarly, the value of $D_0^{t+1}($ $x_0^t,\ y_0^t)$ and $D_0^t(x_0^{t+1},\ y_0^{t+1})$ measured from the models (3) and (4), respectively.

On the basis of these two calculated values for formula (8) the Malmquist productivity index for India's major industries was computed in table (Appendix-2 Table-2). Because MPI can be disaggregated into two components, TEC and EPFS (as shown in tables 3 and 4), which mean technical change and frontier shift.

In order toanalyze the productivity of energy consumption substantially, we employ ($1/MPI_0$-1), ($1/TEC_0$-1) and ($1-EPFS_0$-1) to represent the change of Malmquist productivity Index, TEC and EPFS, respectively. Tables 5(a), 5 (b), and 5 (c)show the value of ($1/MPI_0$-1),($1/TEC_0$-1) and ($1/EPFS_0$-1).

Appendix-5-Table 5(a) gives the value change of MPL, these results of MPI change indicated that in the last two decades that is from 1999 to 2018, there is no single industrial sector maintainedenergy consumption productivity throughout the whole time period. All the industries at different point of research period experienced productivity decline. The sector productivity of manufacture of basic metal declined 8.35%, 5.17%, 4.24%, 3.9%, 7.49%, 7.50%, 8.37% and 1.92% in the time period 2001-02, 2005-06,2007-08, 2009-10, 2010-11, 2012-13, 2015-16 and 2016-17, respectively. In the time period 2001-02 the TEC increased to 2% from negative 7.13% in 2000-01, but for the time period 2001-02 the EPFS was negative, decreased by 8.63%.The reason behindthe fall in MPI in the year 01-02 is purely due to the downward change in TEC of the same period.

Regarding the manufacturing of beverages, the productivity declined to 8.23% in 200-02, mainly due to EPF shift of negative 8.54%.whereas in the same year the TEC remained positive with 2.15%. in the later yearsthe productivity fall in this industry is not as much as in year 2001-02. The fall has been recorded less,Such as 4.66% in 2005-06, still less in2007-08 by 3.92%. however productivity decline was greater in the time period 2010-11 to 8.46% then gradually the decline reduced to 7.56%, 1.69% and 1.88% respectively in the time period of 2015-16, 16-17 & 2017-18.

For manufacturing of chemical and chemical products, the productivity declined 4.38% in 1999-00, because the technical efficiency declined 9.7% and the EPF declined 3.78%. Its productivity went on to greatly decline by 8.02% in 2001-02, because of huge negative shift in EPF by 8.52% in the same year although Technical efficiency was positive with 3.35%.however decline in MPI was recorded for seven time period in the last one and half decades, notably 2005-06, 07-08,09-10, 10-11, 12-13, 15-16, & 17-18, with 1.20%, 5.39%, 2.24%, 7.65%, 5.00% 8.28% & 5.05%.

Moreover the manufacturing of coke and refined petroleum products experienced a productivity decline in 12 different time periods. Notably in 1999-00, 2000-01,2001-02, 2002-03, 2005-06,2006-07,2007-2008,2009-10,2010-11,2012-13,2015-16,& 2016-17 years with 1.90%,6.8%, 7.80%, 1.21%, 1.50%, 2.66%,5.54%, 3.99%,6.9%, 8.11% 7.66%, 4.0% respectively. Decline by great percentage in the year 01-02, 12-13 & 15-16 majorly due to negative shift in EPF by 8.45% 8.69%, 6.93% whereas technical efficiency change was positive with 3.95% in 2001-02, but declined in 2012-13 & 2015-16 by 2.36% &2.37% respectively.

That of computer and electronic optical products witnessed a productivity decline for 10 different time periods. this reduction can be noted in the following years 1999-00, 2001-02, 2002-03, 2005-06, 2007-2008, 2009-10, 2010-11, 2012-13, 2015-16,& 2016-17 with recorded productivity decline of 1.74% 1.2% 8.13% 4.47% 5.40% 2.97% 1.7% 6.48% 8.37% & 1.11%.

In the year 1999-00 the productivity decline was purely due to fall in the technical efficiency by 2.26% whereas in the same year the EPF shift was positive. However fall in productivity in 2000-01 was mostly due to high negative shift in EPF by 3.97%. Later low productivity in 2002-03 was the function of negative shift in technical efficiency by 4.56%, another worst

performance year has been 2015-16, the cause of this is mainly due to high negative shift in EPF (7.89%) and lighter decline in technical efficiency by 2.29%.However in 2018 there was a positive productivity in this sector notably 2.62%.

For about eleven years in two decades electrical equipments sector recorded performance decline. Which can be identified in the following years 1999-00, 2001-02, 2002-03, 2005-06, 2007-2008, 2009-10, 2010-11, 2012-13, 2015-16,& 2016-17. The decline in these years has been 5.20% 5.04% 7.61% 4.26% 5.50% 2.73% 1.83% 7.26% 2.34%. Low productivity in 1999-00 is merely due to negative TEC and EPF shift by 2.95% & 3.19% respectively.Similarly productivity decline in 2001-02 was mainly because of negative shift in EPF with 6.81%, at the same time technical efficiency in the same year reflected positive by 5.55%. subsequent years too experienced productivity decline but major MPI decline happens in 2015-16, the reason being EPF making a negative shift by 6.52% along with little decline in technical efficiency of 3.16%.

At eleven different years since 1999 the MPI of fabricated metal products except machinery and equipments has seen a decline, very specifically in the following years 1999-00, 2001-02, 2002-03, 2005-06, 2006-07, 2007-2008, 2009-10, 2010-11, 2012-13, 2015-16,& 2016-17. The productivity decline in the above mentioned years can be recorded as ; 4.54% 4.35% 8.52% 3.39% 2.48% 4.81% 3.16% 3.8% 6.27% 7.51% &3.60%. Substantial decline has been seen in 2002-03, 2012-13, 2015-16. The decrease in these years can be accounted to drastic decline in technical efficiency and a negative shift in EPF. Specifically in the year 2002-03 TEC declined to 6.89% & that of EPF to 5.26%, similarly in 2012-13 the cause of decline in MPI was due to fall in TEC by 4.34% and of EPF negative shift by 8.61% hence major factor responsible was EPF shift. Whereas another poor performance was in the year 2015-16, in this period too we can find that 6.52% of EPF shift responsible for the decline in MPI alone with smaller downward shift in TEC by 3.48%.

Next if we watch the energy enabled productivity of manufacturing of machinery and equipment, we find that out of 20 reference period in eight years this industry faced with productivity decline. Notably in the year 1999-00, 2001-02, 2005-06, 2007-08, 2009-10, 2012-13, 2015-16, & 2016-17 respectively. The decline in these years can be listed as 4.39%, 5.36%, 8.21%, and 3.83% 7.53%, 8.95% 5.13% & 5.55%. Here the MPI decline has been more in 2005-06,2007-08, and 2009-10 time periods. The reason for higher fall in MPI in these years can be understood by negative influence of TEC & EPF shift. In the year 2005-06 the industry witnessed a MPI decline of 8.95% thishas been mostly because of negative fall of 8.71% of TEC and 5.3% negative shift in efficient production frontier.

For the manufacturing of other non-metallic mineral products, its productivity decreased in the following reference periods, notably in 1999-00, 2000-01, 2001-02, 2005-06, 2007-08, 2009-10, 2015-16 & 2016-17 by 5.11%, 1.66%,5.44%, 7.79% 3.98%, 7.48% 3.89% &6.48% respectively. The responsible factors for the decline have been variation and shift in the TEC and EPF. In the year 1999-00 productivity decrease of 5.11% has been mainly due to 9.8% downward trend in technical efficiency. Moreover about 4.57% of negative shift of EPF was also the cause of this decline in MPI. Subsequent drastic decline has been identified in 2005-06, 2008-09 and 2016-17. Again the cause of reduction in 2005-06 has been due to negative technical efficiency with 6.80% and a small negative shift in EPF.Similarly we find a major fall of MPI in 2009-10 by 7.48% its purely due to higher downward twist in technical efficiency of 9.10% along with a miner negative shift in 1.95% in EPF.

That of manufacturing of paper and paper products, its productivity saw improvements in ten different time periods in a stretch of two decades. The positive productivity has been seen in 2002-03 to 2004-05 namely 4.39%, 2.79%, and 7.54% respectively. Later in the reference period of 2008-09 to 2011-12 with figures of highest in 2008-09 by 49.00%, then 3.48% 1.16% and 1.12%. Similarly in 2013-14, 2015-16& 2017-18 also this industry saw improvement in the productivity of 7.76% 9.8%& 1.56%. The credit to this improvement has been realized through positive changes in the technical efficiency and a positive shift in the efficient production frontiers.

The manufacturing of pharmaceutical medical, chemical & botanical products experienced poor performance in 2000-01, 2001-02, 2002-03, 2005-06, 2008-09, 2009-10, 2012-13, 2014-15, 2015-16 & 2016-17. The declining results can be recorded as 3.11%, 5.94% 2.5% 7.96%, 1.36% 1.42% 8.89% 3.01% 3.09% and 6.38% respectively. Hence in two decades about ten different time periods have faced with declining productivity. This dual cause of TEC & EPF shifts. If we notice for 2000-01, the negative figure of 7.15% technical inefficiency caused productivity, although there was a positive efficient production frontier shifts. Moreover we can realize the major decline in productivity in 2005-06, 2012-13 & 2016-17. The cause of decrease in these three periods is basically because of negative 6.71% of TEC combined with negative shift of 3.78% of EPF in 2005-06, negative 5.66% of TEC together with negative shift of 7.44% of EPF in 2012-13 and a downward shift of 5.03% of TEC combined with a negative shift of 2.72% of EPF in 2016-17.

The manufacturing of textiles experienced productivity decline for about ten time period of two decade reference period. The years of decline has been seen in 1999-00, 2000-01, 2001-02, 2002-03, later in 2005-06, 2008-09, 2009-10, 2012-13, 2014-15, 2016-17 & 2017-18. The rate of decline can be placed 5.04%, 7.17%, 6.61%, 7.9% 8.55%,1.53% 3.41% 7.53% 8.17%, 5.19% and 2.5%.If we notice the figures we realize that the major declines are in 2000-01, 2002-03, 2005-06, 2012-13& 2014-15. Productivity decline in 2000-01 by 7.17% is mainly as a result of negative trend in TEC 9.35%. Whereas we found in the same year the behavior of EPF is positive. Similarly in 2002-03 the negative fall in productivity by 7.9% is purely due to a small negative change in technical efficiency of 3.46% with a positive EPF of 4.09%. Later in the year 2005-06 poor performance experienced due to a combined negative shift in TEC and EPF by 7.63% & 3.87% respectively. After an improved performance from 2010 to 2012, once again productivity slipped by7.53%, such results are blamed for dual negative shift in the TEC and EPF by 6.09% & 8.18% respectively. Another major productivity decline was seen in 2014-15 by 8.17% this too was due to the combined negative effect of TEC & EPF shift to the extent of 5.49% and 5.93%. However in the later years the industry witnessed a positive productivity with a positive change in TEC & EPF shift.

On one hand above we presented the productivity decline rates for number of Decision making units. However it's worth mentioning the time period that saw huge productivity improvement among number of decision making units. Very specifically in the report period of 1999-2018, we find in 2003-04,2004-05, 2006-07, 2008-09, 2010 to 2012, 2013-14 & 2017-18 almost all the decision making units have experienced improved productivity due to positive change in TEC and EPF. Another noteworthy thing is that in all decided base year experienced positive productivity change. The decision making units such as 1 to 13 DMU's experienced as high as two digit productivity change.Also the above analysis shows that the productivity change has not been constant in these 23 decision making units, which greatly changed in the report period.

Analyzing DEA efficiency is to evaluate whether DMU is on the efficient frontier or not. For this we use the projection on the EPF to measure the distance for an inefficient DMU to the EPF. After that the direction for DMU control and the amount of energy input minimization can to set when the industrial gross value added is fixed at current level. Moreover,we can estimate the projection on the EPF, which will give solutions for the inefficient DMU. Based on this the DMUs and policy makers promote development on these sectors.

Conclusion

In this chapter, input-oriented data envelopment model has been employed to measure the energy consumption productivity change over the reported period of 1999-2018 for 23 manufacturing sectors in India. Here Malmquist productivity index is used and presented in decomposed form: TEC & EPFS. TEC is employed to measure the technical change, and EPFS shows the shift in the efficient production frontier. Both TEC and EPF show the value of MPI. Hence the change of productivity is determined by change in technical efficiency and the shift of the EPF.

The results suggest that there are ten manufacturing sectors, namely manufacturing of basic metal, beverages, manufacturing of furniture, leather related products, machinery and equipments, other non metallic mineral products, wearing apparels, wood and wood products, other manufacturing and printing and reproducing that experienced moderate effective energy consumption. It also suggests that these units lie very close to the efficiency frontier of energy consumption as benchmarks. About thirteen sectors out of twenty years of time period, for about ten to eleven different period of time experienced bottom performance, namely, chemical and chemical products, coke and refined petroleum products, computer and electronic optical products, Electrical equipments, fabricated Metal products except machinery and equipments, and manufacturing of food products. On one hand the value of changes of Malmquist Productivity Index in the negative side indicates that these above mentioned thirteen industries face a situation of increased energy consumption productivity throughout most of the reported time periods. On the other hand the positive value of changes in Malmquist Productivity Index shows that the ten most efficient DMUs face a situation of declining energy consumption of productivity for most of the reported years.

To conclude, ten decision making units, such as manufacturing of basic metal, beverages, manufacturing of furniture, leather related products, machinery and equipments, other non metallic mineral products, wearing apparels, wood and wood products, other manufacturing and printing and reproducing sectors have by and large increased productivity in most of the time periods, very specifically basic metal sector improved productivity 1999 to2001, 2002-2004, 2006-07, 2008-09, 2011-12, 2013-15 & 2017-18, beverages sector enhanced energy efficient productivity for the reference period 1999 to 2001, 2002-2004, 2006-07, 2008-09,2009-10 & 2011 to 2015, furniture sector saw positive productivity in the following time period 2000-01,2002 to 2005,2006-07, 2008 to 2012, 2013 to 2015 & 2017-18, leather related products in 2000-01,2002 to 2005,2006-07, 2008-09,2010-12, 2013-15 & 2017-18,

machinery and equipments realized productivityin the time period of 2000-01,2002 to 2005, 2006-07, 2008-09, 2010 to 2012, 2013 to 2015 & 2017-18, that of non-metallic mineral products saw positive change in the productivity in the time period of 2002 to 2005, 2006-07,2008-09, a consistency of productivity improvement from 2010 to 2015, later in 2017-18, whereas manufacturing of wearing apparels maintained productivity in the following years 2001-02, a consistency of productivity improvement from 2003 to 2008, 2009 to 2012, 2013-14 & 2017-18, that of wood and wood products experienced productivity in the following years 2000 to 2002, 2004 to 2005, 2006 to 2008, 2013 to 2016 & 2017 to 2018, similarly other-manufacturing sector contained productivity improvement in these reported time periods 1999-2000, a constant energy enabled productivity growth from 2001 to 2005, 2007-08,2010 to 2012, 2013-14, 2015-16, & 2017-18, & finally the manufacturing of printing and reproduction witnessed maintaining productivity growth in the years such as 1999-2000, a consistent improvement from 2001 to 2005, 2007-08, 2010 to 2012, 2013-14. Further, the increase in the productivity of these ten sectors was caused by either positive in both EPF&TEC, or positive change in either of them.

Hence to enhance and promote the improvement in the productivity of energy consumption of major industry sectors in India, it is necessary for the Indian government to make policies to strengthen industrial energy management, distinctively in those manufacturing sectors which consumes huge amount of energy inputs with low level of output and generation of gross industrial value added.

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Appendix 1-Table-1: Input-oriented CRS efficiency of sectors from 1999-2018

DMU	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	0.721	0.602	0.137	1	0.656	0.934	1	1	0.525	0.673	0.916	0.343	1.000	0.357	0.883	1.000	0.193	0.888	0.942	1.000
2	0.696	0.521	0.146	1.000	0.614	0.912	1	0.727	0.579	0.710	1.000	0.202	1.000	0.195	0.922	1.000	0.253	0.853	0.942	1.000
3	0.429	0.690	0.148	1.000	0.683	1.000	1	0.663	0.496	0.776	0.741	0.371	1.000	0.150	0.882	0.778	0.226	1.000	0.441	1.000
4	0.472	0.476	0.150	0.966	0.802	0.986	0.597	0.413	0.637	1.000	0.749	0.463	0.995	0.109	0.837	1.000	0.287	0.934	0.705	0.387
5	0.655	0.614	0.149	0.247	0.720	1.000	0.538	0.579	0.653	1.000	0.833	0.467	0.416	0.129	0.889	1.000	0.187	0.885	0.592	0.178
6	0.681	1.000	0.172	0.540	1.000	0.486	0.564	0.512	0.612	0.903	0.749	0.346	0.595	0.117	0.825	0.950	0.348	1.000	1.000	0.198
7	0.796	1.000	0.154	0.474	1.000	0.473	0.507	0.478	0.744	0.852	0.893	0.483	0.588	0.109	0.785	0.776	0.382	1.000	1.000	0.231
8	0.513	0.851	0.175	0.804	1.000	0.442	0.474	0.903	1.000	1.000	0.888	1.000	0.966	0.114	0.788	0.850	0.400	1.000	1.000	0.147
9	0.554	0.658	0.120	1.000	0.432	0.421	0.426	0.617	0.701	0.880	1.000	1.000	0.516	0.132	1.000	1.000	0.445	1.000	0.793	0.217
10	0.727	0.725	0.135	0.723	0.408	0.414	0.451	0.736	0.804	0.866	0.966	0.773	0.608	0.149	0.494	0.901	0.473	1.000	0.543	0.355
11	0.585	0.962	0.186	0.567	0.400	0.510	0.497	1.000	1.000	0.982	0.830	1.000	0.604	0.156	0.856	0.955	0.443	0.596	0.752	0.279
12	0.523	0.965	0.338	1.000	0.372	0.538	0.553	0.802	0.901	1.000	0.689	0.857	0.369	0.145	0.836	0.944	0.466	0.535	0.720	0.110
13	0.537	0.839	0.348	1.000	0.377	0.685	0.487	0.476	0.985	1.000	1.000	0.893	0.434	0.168	0.811	1.000	0.872	0.376	0.829	0.443
14	0.625	0.564	0.233	0.771	0.446	0.743	0.527	0.846	0.890	0.110	0.824	0.858	0.586	0.186	0.725	0.972	1.000	0.618	0.848	0.270
15	0.428	1.000	0.184	0.969	0.456	0.759	0.536	0.655	1.000	0.102	0.855	0.885	0.770	0.164	0.799	1.000	0.754	0.627	1.000	1.000
16	0.610	1.000	0.231	0.878	0.624	0.763	0.541	0.881	1.000	0.111	0.878	0.928	0.520	0.182	1.000	0.403	0.990	0.620	0.756	0.905
17	0.595	1.000	0.341	0.842	0.222	0.950	0.547	1.000	1.000	0.110	0.841	0.987	0.649	0.194	0.865	0.401	0.885	0.686	0.684	0.404
18	0.519	0.652	0.491	0.631	0.697	0.860	0.479	1.000	1.000	0.100	0.952	1.000	0.488	0.219	1.000	0.322	0.862	0.683	1.000	0.602
19	0.563	0.500	1.000	0.826	0.570	0.766	0.441	0.866	0.887	0.099	1.000	0.960	0.475	0.260	1.000	0.252	1.000	0.611	0.999	0.618

20	0.616	0.302	1.000	0.889	0.378	0.712	0.425	0.901	0.999	0.136	1.000	1.000	0.533	0.272	0.877	0.318	0.870	0.592	1.000	0.735
21	1.000	0.398	0.804	1.000	0.458	0.544	0.453	0.623	0.871	0.135	1.000	1.000	0.571	0.261	0.739	0.276	0.947	0.971	0.997	0.672
22	1.000	0.397	1.000	1.000	0.493	0.607	0.547	0.441	0.911	0.174	0.810	0.922	0.767	0.784	0.602	0.203	1.000	1.000	1.000	0.438
23	0.606	0.401	1.000	0.761	0.448	0.549	1.000	0.392	0.982	0.222	0.982	1.000	0.966	1.000	1.000	0.350	0.720	0.984	1.000	0.502

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical, chemical & botanical products, 15. Rubber plastic product, 16. Manufacturing of textiles, 17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.

Appendix 2-Table-2: Value of MPI

DMU	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
1	0.984	0.797	6.063	0.484	0.52	0.431	2.069	0.435	1.736	0.068	1.041	3.989	0.597	4.000	0.620	0.281	6.128	1.238	0.622
2	0.921	0.88	5.652	0.518	0.625	0.458	1.874	0.81	1.645	0.077	0.624	6.473	0.244	0.488	0.530	0.354	4.103	1.203	1.231
3	1.78	0.706	5.056	0.762	0.497	0.496	1.136	0.606	2.171	0.049	1.289	4.264	0.19	2.001	0.292	0.398	5.806	0.734	2.02
4	1.235	1.073	4.613	1.138	0.238	0.238	1.176	1.363	2.244	0.036	1.663	3.291	0.165	5.278	0.600	0.375	4.273	1.004	0.565
5	1.21	0.801	1.012	5.349	0.149	0.11	1.807	0.973	2.172	0.039	1.423	1.214	0.405	2.838	0.313	0.254	6.140	1.125	0.276
6	2.082	0.542	2.017	4.186	0.039	0.842	1.742	0.909	2.224	0.041	1.376	2.028	0.264	1.224	0.421	0.499	4.195	1.306	0.087

7	1.833	0.473	1.769	6.777	0.058	0.819	1.512	1.329	1.925	0.034	1.461	1.614	0.255	2.684	0.305	0.672	4.014	1.563	0.251
8	2.289	0.665	2.635	4.677	0.045	0.767	4.13	0.846	1.275	0.034	9.155	1.018	0.162	2.669	0.289	0.640	3.709	1.703	0.115
9	1.697	0.567	5.17	0.689	0.426	0.765	3.434	0.662	2.174	0.036	0.112	0.475	0.341	4.688	0.322	0.604	3.272	1.122	0.206
10	1.232	0.655	3.835	0.624	0.441	0.845	5.351	0.472	1.697	0.04	7.635	0.735	0.304	6.386	0.603	0.714	3.761	1.292	0.597
11	1.783	0.674	2.156	0.842	0.558	0.82	5.592	0.221	1.62	0.02	4.05	0.539	0.319	9.531	0.440	0.633	2.053	2.248	0.297
12	2.043	1.199	2.193	0.816	0.634	0.832	4.53	0.547	1.661	0.021	3.965	0.434	0.481	0.029	0.472	0.666	1.636	2.839	0.131
13	1.591	1.448	2.214	0.695	0.782	0.57	1.849	2.025	2.095	0.02	0.742	0.463	0.471	9.893	0.563	1.174	0.524	2.917	0.39
14	0.992	1.451	2.464	1.026	0.731	0.588	4.892	0.527	0.168	1.157	1.166	0.642	0.386	9.009	0.577	1.431	1.447	2.764	0.259
15	2.806	1.296	3.754	0.794	0.729	0.585	4.393	0.635	0.138	1.316	1.235	0.781	0.259	1.073	0.465	1.126	1.959	2.732	0.807
16	2.016	3.535	2.953	1.086	0.535	0.619	6.879	0.39	0.156	1.18	1.518	0.538	0.425	4.054	0.123	5.450	0.868	2.078	1.026
17	2.055	5.03	1.882	0.92	1.448	0.495	6.066	0.398	0.166	1.206	3.332	0.698	0.404	0.687	0.107	5.933	2.874	1.78	0.511
18	1.481	3.182	0.904	1.583	0.541	0.421	0.321	0.253	0.166	1.602	0.188	0.488	0.588	2.884	0.104	3.688	1.080	4.833	0.602
19	1.017	0.678	0.495	1.054	0.589	0.445	6.693	0.38	0.172	1.814	6.624	0.475	0.667	6.095	0.073	0.473	0.755	3.035	0.544
20	0.712	7.575	0.632	0.763	0.906	0.462	5.721	1.018	0.244	1.394	8.213	0.567	0.621	3.202	0.171	4.452	0.814	2.605	0.576

21	0.438	2.889	0.862	0.801	0.52	0.643	3.254	1.177	0.272	1.501	9.455	0.61	0.558	1.47	0.224	4.980	7.870	1.367	0.611
22	0.419	6.263	2.008	0.714	0.539	0.626	1.984	1.808	0.33	0.915	0.688	0.855	2.287	2.086	0.219	0.109	8.722	1.497	0.359
23	0.772	3.505	0.572	0.902	0.537	1.192	0.661	2.028	0.4	0.891	9.538	1.118	3.716	2.588	0.254	2.773	3.389	2.221	0.461

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical, chemical & botanical products, 15. Rubber plastic product, 16. Manufacturing of textiles, 17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.

Appendix 3,Table-3: Value of TEC

DMU	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
1	1.178	3.49	0.833	0.738	0.366	0.402	2.069	0.829	1.352	0.05	2.777	1.37	1.673	1.618	0.547	1.461	1.329	1.167	0.586
2	1.23	3.148	0.823	0.843	0.421	0.418	2.579	1.017	1.341	0.055	3.091	1.307	1.251	2.22	0.488	1.399	1.216	1.089	1.16
3	1.107	3.289	0.749	1.115	0.34	0.496	1.713	0.811	1.387	0.051	2.58	1.58	1.265	2.041	0.33	1.369	1.314	1.665	0.89
4	1.222	3.406	0.717	1.371	0.193	0.392	1.7	0.885	1.429	0.047	2.691	1.532	1.504	1.996	0.502	1.309	1.311	1.33	1.029
5	1.292	3.296	0.611	1.839	0.107	0.204	1.68	0.862	1.418	0.047	2.536	1.364	1.305	1.866	0.278	1.36	1.297	1.681	0.917
6	1.418	3.15	0.643	2.261	0.081	0.726	1.917	0.761	1.507	0.049	2.974	1.18	1.339	1.592	0.366	1.36	1.461	1.306	0.442
7	1.459	3.066	0.576	3.211	0.123	0.764	1.604	0.854	1.68	0.033	2.701	1.327	1.371	1.767	0.309	1.363	1.533	1.563	1.087
8	1.381	3.228	0.574	3.763	0.102	0.716	2.169	0.764	1.275	0.038	8.129	1.054	1.378	1.825	0.268	1.359	1.484	1.703	0.783
9	1.427	3.099	0.623	1.594	0.438	0.756	2.371	0.583	1.73	0.032	10.112	0.92	1.336	1.933	0.322	1.356	1.457	1.415	0.753

10	1.237	3.507	0.717	1.108	0.434	0.775	3.275	0.432	1.575	0.035	9.546	0.935	1.242	1.925	0.331	1.36	1.78	2.38	0.914
11	1.084	3.482	0.708	1.193	0.438	0.84	7.755	0.221	1.65	0.023	11.66	0.893	1.231	1.741	0.394	1.365	1.526	1.779	0.8
12	1.109	3.421	0.742	2.194	0.438	0.809	3.124	0.487	1.496	0.03	11.234	1.007	1.224	1.741	0.418	1.349	1.426	2.108	0.853
13	1.018	3.49	0.771	1.845	0.43	0.803	1.893	0.978	2.064	0.02	12.028	0.953	1.219	2.044	0.457	1.346	1.215	1.323	0.728
14	1.098	3.511	0.745	1.775	0.438	0.831	3.044	0.502	1.361	0.154	10.714	0.94	1.219	2.306	0.43	1.392	2.342	2.013	0.813
15	1.202	7.042	0.713	1.689	0.438	0.828	3.593	0.416	1.349	0.157	10.865	0.898	1.216	2.272	0.371	1.493	2.357	1.713	0.807
16	1.231	15.273	0.778	1.528	0.438	0.874	4.22	0.344	1.403	0.149	10.906	0.96	1.216	2.555	0.307	2.215	1.385	1.705	0.857
17	1.224	14.761	0.761	3.491	0.338	0.861	3.318	0.398	1.508	0.158	11.366	1.061	1.353	2.391	0.231	2.691	3.707	1.787	0.866
18	1.177	17.503	0.704	1.433	0.438	0.757	4.941	0.253	1.659	0.169	9.695	1	1.308	2.826	0.322	1.377	1.361	3.304	1.001
19	1.147	30.336	0.6	1.526	0.438	0.771	3.413	0.371	1.541	0.18	6.896	0.96	1.216	4.192	0.29	2.643	1.236	1.856	0.879
20	1.455	11.335	0.711	1.794	0.482	0.774	2.698	0.918	1.789	0.19	8.213	1.063	1.216	4.098	0.472	1.625	1.196	1.542	0.783
21	1.1	16.281	0.693	1.747	0.438	0.771	2.367	0.842	1.758	0.202	9.455	1.069	1.218	4.058	0.598	1.453	7.671	1.332	0.907
22	1.057	22.319	2.008	1.447	0.438	0.695	2.463	0.875	1.733	0.196	9.386	1.029	2.236	2.715	0.65	2.05	8.722	1.497	0.82
23	1.166	17.463	0.751	1.533	0.438	0.654	1.686	0.811	1.767	0.202	9.367	1.157	3.59	2.588	0.725	1.347	9.8	2.185	0.917

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical, chemical & botanical products, 15. Rubber plastic product, 16. Manufacturing of textiles, 17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.

Appendix 4-Table- 4: Value of EPFS

	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018

1	0.835	0.228	7.277	0.656	1.423	1.071	1	0.525	1.283	1.36	0.375	2.912	0.357	2.472	1.133	0.193	4.609	1.061	1.062
2	0.748	0.279	6.868	0.614	1.485	1.097	0.727	0.797	1.226	1.409	0.202	4.952	0.195	4.724	1.085	0.253	3.375	1.105	1.061
3	1.609	0.215	6.751	0.683	1.464	1	0.663	0.748	1.565	0.955	0.5	2.699	0.15	5.88	0.883	0.291	4.417	0.441	2.27
4	1.011	0.315	6.431	0.83	1.23	0.606	0.692	1.541	1.571	0.749	0.618	2.148	0.11	7.654	1.195	0.287	3.258	0.755	0.549
5	0.937	0.243	1.658	2.908	1.39	0.538	1.076	1.128	1.532	0.833	0.561	0.89	0.311	6.881	1.124	0.187	4.733	0.669	0.301
6	1.468	0.172	3.136	1.852	0.486	1.159	0.909	1.194	1.476	0.829	0.463	1.718	0.197	7.048	1.151	0.367	2.871	1	0.198
7	1.257	0.154	3.072	2.111	0.473	1.072	0.943	1.556	1.146	1.048	0.541	1.216	0.186	7.18	0.988	0.493	2.618	1	0.231
8	1.657	0.206	4.587	1.243	0.442	1.071	1.904	1.108	1	0.888	1.126	0.966	0.118	6.942	1.078	0.471	2.499	1	0.147
9	1.19	0.183	8.303	0.432	0.974	1.013	1.448	1.135	1.257	1.136	1	0.516	0.255	7.599	1	0.445	2.246	0.793	0.274
10	0.996	0.187	5.348	0.563	1.015	1.09	1.634	1.092	1.077	1.116	0.8	0.786	0.245	3.317	1.826	0.525	2.113	0.543	0.653
11	1.644	0.194	3.046	0.706	1.273	0.976	2.011	1	0.982	0.845	1.205	0.604	0.259	5.476	1.116	0.463	1.345	1.263	0.371
12	1.843	0.351	2.956	0.372	1.446	1.028	1.45	1.123	1.11	0.689	1.243	0.431	0.393	5.76	1.129	0.494	1.147	1.347	0.153
13	1.563	0.415	2.873	0.377	1.819	0.711	0.977	2.071	1.015	1	0.893	0.486	0.386	4.839	1.233	0.872	0.431	2.204	0.535

14	0.903	0.413	3.305	0.578	1.669	0.708	1.607	1.051	0.123	7.497	1.042	0.683	0.317	3.907	1.341	1.029	0.618	1.373	0.319
15	2.336	0.184	5.265	0.47	1.664	0.706	1.223	1.527	0.102	8.367	1.034	0.87	0.213	4.874	1.252	0.754	0.831	1.595	1
16	1.638	0.231	3.795	0.711	1.222	0.709	1.63	1.135	0.111	7.919	1.056	0.561	0.349	5.501	0.403	2.46	0.627	1.219	1.196
17	1.68	0.341	2.472	0.263	4.282	0.576	1.828	1	0.11	7.62	1.173	0.658	0.298	4.469	0.464	2.205	0.775	0.997	0.591
18	1.258	0.753	1.285	1.104	1.234	0.557	2.089	1	0.1	9.503	1.051	0.488	0.45	4.56	0.322	2.677	0.793	1.463	0.602
19	0.887	2	0.826	0.69	1.344	0.576	1.961	1.024	0.112	10.078	0.96	0.494	0.548	3.84	0.252	3.963	0.611	1.635	0.619
20	0.49	3.315	0.889	0.425	1.882	0.597	2.12	1.109	0.136	7.344	1	0.533	0.51	3.221	0.362	2.74	0.681	1.689	0.735
21	0.398	2.02	1.244	0.458	1.187	0.833	1.375	1.398	0.155	7.427	1	0.571	0.458	2.826	0.374	3.427	1.026	1.026	0.674
22	0.397	2.521	1	0.493	1.23	0.902	0.806	2.066	0.191	4.663	1.139	0.831	1.023	0.768	0.337	4.93	1	1	0.438
23	0.662	2.491	0.761	0.588	1.225	1.823	0.392	2.502	0.226	4.418	1.018	0.966	1.035	1	0.35	2.058	1.366	1.016	0.502

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical,chemical& botanical products,15. Rubber plastic product,16. Manufacturing of textiles,
17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.

Appendix 5-Table-5(a): change of MPI in each time period(unit%), 1/MPI-1

DMU	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
1	1.6	2.55	-8.35	1.06	9.23	1.32	-5.17	1.29	-4.24	13.70	-3.9	-7.49	6.75	-7.50	6.13	2.55	-8.37	-1.92	6.08
2	8.6	1.36	-8.23	9.31	6.00	1.18	-4.66	2.35	-3.92	11.98	6.03	-8.46	3.09	1.04	8.87	1.82	-7.56	-1.69	-1.88
3	-4.38	4.16	-8.02	3.12	1.01	1.01	-1.20	6.50	-5.39	19.40	-2.24	-7.65	4.26	-5.00	2.42	1.51	-8.28	3.62	-5.05
4	-1.90	-6.8	-7.83	-1.21	3.20	3.20	-1.50	-2.66	-5.54	26.77	-3.99	-0.69	5.06	-8.11	6.67	1.66	-7.66	-4.0	7.70
5	-1.74	2.48	-1.2	-8.13	5.71	8.09	-4.47	2.8	-5.40	24.64	-2.97	-0.17	1.46	-6.48	2.19	2.93	-8.37	-1.11	2.62
6	-5.20	8.45	-5.04	-7.61	24.64	1.88	-4.26	1.00	-5.50	23.39	-2.73	-0.50	2.78	-1.83	1.37	1.00	-7.62	-2.34	10.49
7	-4.54	1.11	-4.35	-8.52	16.24	2.21	-3.39	-2.48	-4.81	28.41	-3.16	-0.38	2.92	-6.27	2.27	4.88	-7.51	-3.60	2.94
8	-5.63	5.04	-6.20	-7.86	21.22	3.04	-7.58	1.82	-2.16	28.41	-8.91	-0.01	5.17	-6.25	2.46	5.63	-7.30	-4.13	7.66
9	-4.11	7.64	-8.07	4.51	1.34	3.07	-7.09	5.11	-5.40	26.77	7.92	1.10	1.93	-7.87	2.10	6.56	-6.94	-1.09	3.84
10	-1.88	5.27	-7.39	6.03	1.26	1.83	-8.13	1.11	-4.11	24.00	-8.69	3.61	2.28	-8.43	6.58	4.01	-7.34	-2.26	6.75

11	-4.39	4.84	-5.36	1.88	7.92	2.20	-8.21	3.52	-3.83	49.00	-7.53	8.55	2.13	-8.95	1.27	5.80	-5.13	-5.55	2.36
12	-5.11	-1.66	-5.44	2.25	5.77	2.02	-7.79	8.28	-3.98	46.61	-7.48	1.30	1.07	33.48	1.11	5.02	-389	-6.48	6.63
13	-3.71	-3.09	-5.48	4.39	2.79	7.54	-4.59	-5.06	-5.23	49.00	3.48	1.16	1.12	-8.99	7.76	-1.48	9.08	-6.57	1.56
14	0.08	-3.11	-5.94	-2.5	3.68	7.01	-7.96	8.98	4.95	-1.36	-1.42	5.58	1.59	-8.89	7.33	-3.01	-3.09	-6.38	2.86
15	-6.44	-2.28	-7.34	2.59	3.72	7.09	-7.72	5.75	6.24	-2.40	-1.90	2.80	2.86	-6.8	1.15	-1.12	-4.90	-6.34	2.39
16	-5.04	-7.17	-6.61	-7.9	8.69	6.16	-8.55	1.56	5.41	-1.53	-3.41	8.59	1.35	-7.53	7.13	-8.17	1.52	-5.19	-2.5
17	-5.13	-8.01	-4.69	8.7	-3.09	1.02	-8.35	1.51	5.02	-1.71	-7.00	4.33	1.47	4.56	8.34	-8.31	-6.52	-4.38	9.57
18	-3.25	-6.86	1.06	-3.68	8.48	1.37	2.11	2.95	5.02	-3.76	4.319	1.04	7.01	-6.53	8.61	-7.29	-7.4	-7.93	6.61
19	-1.7	4.75	1.02	-5.1	6.98	1.24	-8.51	1.63	4.81	-4.49	-8.49	1.10	0.49	-8.36	12.69	11.14	3.25	-6.71	8.38
20	4.04	-8.68	5.82	3.11	1.04	1.16	-8.25	-1.8	3.09	-2.83	-8.78	7.64	0.61	-6.88	4.84	-7.75	2.29	-6.16	7.36
21	1.28	-6.54	1.60	2.48	9.23	5.55	-6.93	-1.50	2.67	-3.34	-8.94	6.39	0.79	-3.20	3.46	-7.99	-8.73	-2.68	6.37
22	1.38	-8.40	-5.02	4.01	8.55	5.97	-4.96	-4.47	2.03	9.3	4.53	1.70	-0.56	-5.21	3.56	8.17	-8.85	-3.32	1.78

23	2.95	-7.15	7.48	1.09	8.62	-1.61	5.13	-5.07	1.50	1.22	-8.95	-1.06	-0.73	-6.14	2.93	-6.39	-7.05	-5.50	1.16

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical, chemical & botanical products, 15. Rubber plastic product, 16. Manufacturing of textiles, 17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.

Appendix 6-Table-5(b): Change of TEC in each time period(unit%), 1/TEC-1

	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
1	-1.51	-7.13	2.00	3.55	1.73	1.48	-5.17	2.06	-2.60	19.00	-6.40	-2.70	-4.02	-3.82	0.828	-3.16	-2.48	-1.43	7.06
2	-1.87	-6.82	2.15	1.86	1.37	1.39	-6.12	-1.7	-2.54	17.18	-6.76	-2.35	-2.01	-5.50	1.049	-2.85	-1.78	-8.2	-1.38
3	-9.7	-6.96	3.35	-1.03	1.94	1.01	-4.16	2.33	-2.79	18.60	-6.12	-3.67	-2.09	-5.10	2.030	-2.70	-239	-3.99	1.24
4	-1.82	-7.06	3.95	-2.71	4.18	1.55	-4.12	1.30	-3.00	20.27	-6.28	-3.47	-3.35	-4.99	0.992	-2.36	-237	-2.48	-2.8
5	-2.26	-6.97	6.37	-4.56	8.34	3.90	-4.05	1.60	-2.95	20.27	-6.06	-2.67	-2.34	-4.64	2.597	-2.65	-229	-4.05	9.1
6	-2.95	-6.83	5.55	-5.58	11.34	3.77	-4.78	3.14	-3.36	19.40	-6.64	-1.53	-2.53	-3.72	1.732	-2.65	-316	-2.34	1.262
7	-3.15	-6.74	7.36	-6.89	7.13	3.09	-3.77	1.71	-4.05	29.30	-6.30	-2.46	-2.71	-4.34	2.236	-2.66	-3.48	-3.60	-8.0
8	-2.76	-6.90	7.42	-7.34	8.80	3.97	-5.39	3.09	-2.16	25.31	-8.77	-5.1	-2.74	-4.52	2.731	-2.64	-3.26	-4.13	2.77

9	-2.99	-6.77	6.05	-3.73	1.28	3.23	-5.78	7.15	-4.22	30.25	-9.01	8.7	-2.51	-4.83	2.106	-2.63	-3.14	-2.93	3.28
10	-1.92	-7.15	3.95	-9.7	1.30	2.90	-6.95	1.31	-3.65	27.57	-8.95	7.0	-1.95	-4.81	2.021	-2.65	-4.38	-5.80	9.4
11	-7.7	-7.13	4.12	-1.62	1.28	1.90	-8.71	3.52	-3.94	42.47	-9.14	1.20	-1.88	-4.26	1.538	-2.67	-3.45	-4.38	2.50
12	-9.8	-7.08	3.48	-5.44	1.28	2.36	-6.80	1.05	-3.32	32.33	-9.11	-7.0	-1.83	-4.26	1.392	-2.59	-2.99	-5.26	1.72
13	-1.8	-7.13	2.97	-4.58	1.32	2.45	-4.72	2.2	-5.16	49.00	-9.17	4.9	-1.80	-5.11	1.188	-2.57	-1.77	-2.44	3.74
14	-8.9	-7.15	3.42	-4.37	1.28	2.03	-6.71	9.92	-2.65	5.49	-9.07	6.4	-1.80	-5.66	1.326	-2.82	-5.73	-5.03	2.30
15	-1.68	-8.58	4.03	-4.08	1.28	2.08	-7.22	1.40	-2.59	5.36	-9.08	1.14	-1.78	-5.60	1.695	-3.30	-5.76	-4.16	2.39
16	-1.88	-9.35	2.85	-3.46	1.28	1.44	-7.63	1.90	-2.87	5.71	-9.08	4.2	-1.78	-6.09	2.257	-5.49	-2.78	-4.13	1.67
17	-1.83	-9.32	3.14	-7.14	1.95	1.61	-6.99	1.51	-3.37	5.32	-9.12	-5.7	-2.61	-5.82	3.329	-6.28	-7.30	-4.40	1.55
18	-1.50	-9.43	4.20	-3.02	1.28	3.21	-7.98	2.95	-3.97	4.91	-8.97	0.0	-2.35	-6.46	2.10	-2.74	-2.65	-6.97	-1.0
19	-1.28	-9.67	6.67	-3.45	1.28	2.97	-7.07	1.69	-3.51	4.55	-8.55	4.2	-1.78	-7.61	2.44	-6.22	-1.91	-4.61	1.38
20	-3.13	-9.12	4.06	-4.43	1.07	2.92	-6.29	8.9	-4.41	4.26	-8.78	-5.9	-1.78	-7.56	1.11	-3.85	-1.64	-3.51	2.77
21	-9.1	-9.39	4.43	-4.28	1.28	2.97	-5.78	1.88	-4.31	3.95	-8.94	-6.5	-1.79	-7.54	6.72	-3.12	-8.70	-2.49	1.03
22	-5.4	-.9.55	-5.02	-3.09	1.28	4.39	-5.94	1.43	-4.23	4.10	-8.93	-2.8	-5.53	-6.32	5.38	-5.12	-8.85	-3.32	2.20
23	-1.42	-9.43	3.32	-3.48	1.28	5.29	-4.07	2.33	-4.34	3.95	-8.93	-1.36	-7.21	-6.14	3.79	-258	-8.98	-5.42	9.1

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical, chemical & botanical products,15. Rubber plastic product, 16. Manufacturing of textiles,

17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.

Appendix 7-Table-5(c): Change of EPF in each time period(unit%), 1/EPF-1

DMU	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
1	1.98	3.38	-8.63	5.24	-2.97	-6.6	0.0	9.05	-2.21	-2.65	1.66	-0.657	1.80	-5.95	-1.17	4.18	-7.83	-5.7	-5.8
2	3.37	2.58	-8.54	6.29	-3.27	-8.8	3.76	2.55	-1.84	-2.90	3.95	-0.798	4.12	-7.88	-7.8	2.95	-7.04	-9.5	-5.7
3	-3.78	3.65	-8.52	4.64	-3.17	0.0	5.08	3.37	-3.61	4.70	1.00	-0.629	5.66	-8.30	1.33	2.43	-7.74	1.26	-5.59
4	-1.1	2.17	-8.45	2.05	-1.87	6.50	4.45	-3.51	-3.63	3.35	6.18	-0.534	8.09	-8.69	-1.63	2.48	-6.93	3.25	8.21
5	6.7	3.11	-3.97	-6.56	-2.81	8.59	-7.1	-1.13	-3.47	2.00	7.83	0.124	2.21	-8.55	-110	4.34	-7.89	4.95	2.32
6	-3.19	4.81	-6.81	-4.60	1.05	-1.37	1.00	-1.62	-3.22	2.06	1.16	-0.418	4.07	-8.58	-131	1.72	-6.52	0.00	4.05
7	-2.04	5.49	-6.74	-5.26	1.11	-6.7	6.0	-3.57	-1.27	-4.6	8.48	-0.178	4.37	-8.61	1.2	1.02	-6.18	0.00	3.32
8	-3.96	3.85	-7.82	-1.95	1.26	-6.6	-4.75	-9.70	0.0	1.26	-1.12	0.035	7.47	-8.56	-7.2	1.12	-6.00	0.00	5.80
9	-1.60	4.46	-8.80	1.31	2.7	-1.3	-3.09	-1.19	-2.04	-1.20	0.00	0.938	2.92	-8.68	0.00	1.24	-5.55	2.61	2.65
10	4.0	4.34	-8.13	7.76	-1.5	-8.3	-3.88	-8.4	-7.1	-1.04	2.50	0.272	3.08	-6.99	-4.52	9.05	-5.27	8.42	5.31
11	-3.92	4.15	-6.72	4.16	-2.14	2.5	-5.03	0.00	1.8	1.83	-1.70	0.656	2.86	-8.17	-1.04	1.16	-2.57	-2.08	1.69
12	-4.57	1.84	-6.62	1.688	-3.08	-2.7	-3.10	-1.10	-9.9	4.51	-1.95	1.320	1.54	-8.26	-1.14	1.02	-1.28	-2.58	5.53
13	-3.60	1.41	-6.52	1.653	-4.50	4.06	2.4	-5.17	-1.5	0.00	1.20	1.058	1.59	-7.93	-1.89	1.47	1.32	-5.46	8.69

14	1.07	1.42	-6.97	7.30	-4.01	4.12	-3.78	-4.90	7.13	-8.67	-4.00	0.464	2.15	-7.44	-2.54	-2.8	6.18	-2.72	2.13
15	-5.72	4.43	-8.10	1.128	-3.99	4.16	-1.82	-3.45	8.80	-8.80	-3.30	0.149	3.69	-7.95	-2.01	3.26	2.03	-3.73	0.00
16	-3.89	3.32	-7.36	4.06	-1.82	4.10	-3.87	-1.19	8.00	-8.74	-5.30	0.783	1.86	-8.18	1.48	-5.93	5.95	-1.80	-1.64
17	-4.05	1.93	-5.95	2.80	-7.66	7.36	-4.53	0.00	8.09	-8.69	-1.47	0.520	2.35	-7.76	1.15	-5.46	2.90	3.0	6.92
18	-2.05	3.28	-2.22	-9.4	-1.90	7.95	-5.21	0.00	9.00	-8.95	-4.90	1.049	1.22	-7.81	2.10	-6.26	2.61	-3.16	6.61
19	1.27	-5.00	2.11	4.49	-2.56	7.36	-4.90	-2.3	7.92	-9.01	4.20	1.024	8.25	-7.40	2.96	-7.48	6.37	-3.88	6.16
20	1.04	-6.98	1.25	1.35	-4.69	6.75	-5.28	-9.8	6.35	-8.64	0.00	8.76	9.61	-6.90	1.76	-6.35	4.68	-4.08	3.61
21	1.51	-5.05	-1.96	1.18	-1.58	2.00	-2.73	-2.85	5.45	-8.65	0.00	7.51	1.18	-6.46	1.67	-7.08	-2.5	-2.5	4.84
22	1.51	-6.03	0.00	1.02	-1.87	1.09	2.41	-5.16	4.23	-7.86	-1.22	2.03	-2.2	3.02	1.96	-7.97	0.00	0.00	1.28
23	5.11	-5.99	3.14	7.01	-1.84	-4.51	1.55	-6.00	3.42	-7.74	-1.8	3.5	-3.4	0.00	1.85	-5.14	-2.68	-1.6	9.92

1. Manufacturing of Basic Metal, 2. Beverages, 3.Chemical and Chemical Products, 4.Coke and Refined Petroleum Products, 5.Computer and Electronic Optical products, 6.Electrical Equipments, 7.Fabricated Metal Products except Machinery and Equipments, 8. Manufacturing of Food Products, 9. Manufacturing of furniture, 10.Manufacturing of leather related products, 11. Manufacturing of machinery and equipments, 12. Other Non Metallic Mineral products, 13. Manufacturing of paper and paper products, 14.Phamachitical medical, chemical & botanical products,15. Rubber plastic product, 16. Manufacturing of textiles,17. Manufacturing of tobacco products, 18. Manufacturing of wearing apparels, 19. Manufacturing of wood and wood products, 20. Other manufacturing, 21.printing and reproduction of media, 22.Publishing Activities, 23.Crop animal production and Hunting related.