CHAPTER 2

THEORITICAL FRAMEWORK OF MODELS REAGRDING PRODUCTIVITY AND TECHNICAL EFFICIENCY AND LITERATURE REVIEW

2.1 Introduction of Literature Review

This section of the study is talking about the review of literature. Literature review plays a very important role in research work. It creates a gap between current study and past knowledge of the related subject. Increase the knowledge of researcher which makes roadmap for new research. And it also helps to discover research methods and tools for the study. This chapter deals with the existing literatures regarding the study. The reviewed literature is divided in three major parts:

2.2 Theoretical literature review

2.3 Empirical literature review

2.4 Methodological literature review

2.2 Theoretical literature review:

The concept of neutral progress was given by the following economists:

Hicks' Neutral Technical Progress (1932) in his book 'Theory of Wages' propounded the neutral technical progress concept. Under this, efficiency of all factors increases in the same proportion and the ratio of marginal productivities of the factors, that is, MP_K/MP_L is constant for a given K/L ratio.

$$y = t.f\,(K, L) \text{ where } t = \text{technology index}$$

Harrod's Neutral Technical Progress (1948) 'Towards a Dynamic Economy' Harrod's Neutral Technical Progress is labour augmenting, that is, the labour efficiency improves. As a result, marginal productivity of labour (MP_L) increases with a given constant K/L ratio. Relative input shares remain the same for a given Capital-Output (K/O) ratio.

$$y = f(K, T(t) L)$$

Solow's Neutral Technical Progress (1957) in his study with the title of 'Technical change and the aggregate production function' presents the concept of technical progress. It is capital augmenting. As a result, marginal productivity of capital (MPK) will increase with a given K/L ratio. Relative input shares remain the same for a given labour-output (L/O) ratio.

$$y = F(T(t) K, L)$$

These models are mainly known as exogenous models of Technical progress. Modern economists came with the concept of endogenous technological progress.

Classical views on Productivity:

Although technological progress did not get importance in the work of classical economists like Malthus, Ricardo and Mills, it is considered to be a major determinant of economic growth today. Subsequently, in the works of Marx and Schumpeter it got some importance with varied degrees. Later on, the concept came to the fore after the works of Tinbergen (1942), Schmookler (1952), Kendrick (1956), Fabricant (1954), Abramowitz (1956) and Solow (1957).

Index numbers (TFP): In this approach, under a number of assumptions, it is possible to calculate A, the technology coefficient or TFP coefficient without a specified exact production function or rigidity assuming it to be uniform across observations. There are two indices: Solow index (developed by Solow in 1957) and Translog index (developed by Diewert in 1976).

Solow index: Solow index assumes that elasticity of substitution between labour and capital to equal to one.

In A = lnY – (1-α.)lnL – α lnK

Translog index: the translog index of TFP is equals to-

$$\Delta \ln \quad TFPt = \Delta \ln \quad Yt - \frac{[(SLt + SLt - 1)}{2} * \Delta \ln \quad Lt] - [\frac{SKt + SKt - 1}{2} * \Delta \ln \quad Kt]$$

Solow factor productivity:

Solow (1956) also demonstrated that cross country differences in technology may generate important cross country differences in income per capita. Technology is positively correlated with income per capita. To find out the technical change there are many methods available. One of them is Solow residual; a very popular method. Let the growth rate of aggregate output **(g_y)**, the growth rate of aggregate capital **(g_k)**, the growth rate of aggregate labour **(g_L)** and α as the capital share. The Solow residual is defined as **$g_y - \alpha * g_k - (1-\alpha) * g_L$**. To find accuracy in Solow residual there are following assumptions:

1. The production function is neoclassical means constant return to scale.

2. There is perfect competition in factor market.

3. The growth rates of the inputs are measured accurately.

An increase in either A, K, L will lead to increase in output while lobour and capital inputs are tangible, total factor productivity appears to be more intangible as it is depends on the knowledge of workers we can say that on human capital. Technological capability is closely related to capability in research and development. Economic change, including technological change, is evolutionary process. Much technological change is cumulative within firms and within economies. The analysis explains some reasons behind this phenomenon. It then focuses on the internal organization of research and development within firms. Research and development is necessary for competitiveness but it is almost depend on human skill or human capital. Technical skills and information are key components in the process of technological change and competitions are the major sets of influences on the innovativeness and competitiveness of firms. As we know that resources are limited just like capital and lobour, we have to create efficient technology for proper utilization of these resources because this utilization of resource fulfills the needs of huge population.

Endogenous growth models:

The Endogenous theories are the result of reaction against the deficiencies in the Solow-swan model. In these models long run growth of an economy depends on the endogenous factors not on the exogenous factors like population growth and rate of technological progress which depends on saving rate. Endogenous growth models does not criticized neoclassical theories of growth, as these models are the extended version of neoclassical theories. Endogenous models, also known as new growth theory. Endogenous growth models focus on: Human capital, Knowledge, Innovation, Research and development, and investment etc. these theories consider the spillover effect or externalities of investment in technology. Some endogenous models are explained below:

Arrow (1962) in his paper entitled 'The Economic Implication of Learning by Doing' introduce the concept of learning by doing by regarding it as endogenous growth model. The theory focused upon how you gain by learning by doing which helps in decreasing the average cost. In other words, firms always increase in its efficiency to produce more. Stock of knowledge change in increasing trend and workers become more familiar with the work as volume of output increase.

Romer (1986) presented a paper on endogenous growth entitled ‘Increasing Returns and Long-run Growth’ and told that creation of knowledge is sub product of investment so the model is also known as learning by investment model. Knowledge is considered to be a non – rival good. Romer focuses on research and development which helps in creating more knowledge. According to him there is possibility of externalities that is returns to investment helps in creating more knowledge and it is quite possible that knowledge may show decreasing returns.

Lucas (1988) in his paper with the title of ‘On the Mechanics of Economic Development’ focused upon investment in human capital. According to this model growth rate is the combination of growth rate of labour and growth rate of per capita investment in human capital.

Romer (1990) in his study with the title of ‘Endogenous Technological Change’ Growth in this model is driven by technological change that arises from intentional investment decisions made by profit maximizing agents. According to this model technology treated as input or we can say that as endogenous factor and other feature of technology is that it is a non-rival, partially excludable good. Because of the non-convexity introduced by a non-rival good, price-taking competition cannot be supported, and instead, the equilibrium is one with monopolistic competition. The main conclusions are that the stock of human capital determines the rate of growth, that too little human capital is devoted to research in equilibrium, that integration into world markets will increase growth rates, and that having a large population is not sufficient to generate growth. Output per hour worked in the United States today is ten times as valuable as output per hour worked 100 years ago. (Maddison, 1982). Since the 1950s, economists have attributed much of the change in output per hour worked either directly or indirectly to technological change. (Abromowitz (1956), Kendrick (1956), Solow (1957). From a native point of view this seems right. The raw materials that we use have not changed, but as a result of trial and error, experimentation, refinement, and scientific investigation, the instructions that we follow for combining raw materials have become vastly more sophisticated. One hundred years ago, all we could do to get visual stimulation from iron oxide was to use it as pigment. Now we put it on plastic tape and use it to make video cassette recordings. The argument presented in this paper is based on three premises. The first is that technological change—improvement in the instructions for mixing together raw materials— lies at the heart of economic growth. As a result, the model presented here resembles the Solow (1956) model with technological change. Technological change provides the incentive for continued capital accumulation, and together, capital accumulation and technological change account for much of the increase in output per hour worked. The second premise is that technological change arises in large part because of intentional actions taken by people who respond to market incentives. Thus, the model is one of endogenous rather than exogenous technological change. This does not mean that everyone who contributes to technological change is motivated by market incentives. An academic scientist who is supported by government grants may be totally insulated from them. The premise here is that market incentives nonetheless play an essential role in the process whereby new knowledge is translated into goods with practical value. The third and most fundamental premise is that instructions for working with raw materials are inherently different from other economic goods. Once the cost of creating a new set of instructions has been incurred, the instructions can be used over and over again at no additional cost. Developing new and better instructions is equivalent to incurring a fixed cost. This property is taken to be the defining characteristic of technology.

2.3 Empirical literature review:

Singh (2015) in his study entitled 'Technical Change and Productivity Growth in the Indian Sugar Industry' examines the technical change and productivity growth in 40 Indian sugar companies with the help of MPI approach. The study time period is 2004-05 to 2013-14. The study is based on secondary company level panel data the results of the study showed 0.7%negative growth rate of TFP. And technical regress is the reason behind to make TFP growth negative. In this study five variables were used as input namely Capital Cost (CA), Employee Cost (EMP), Row Material (RM), Energy and Fuel (E&F) and Other Manufacturing Expenses (OME) at constant price level 2004-05 and Value of Output (VOP) taken as output variable.

Khavi et al. (2012) in his study entitled 'Analysis of Total Factor Productivity Growth of Sugar Beet in Iran Using Malmquist Approach' analyzed total factor productivity growth of sugar beet industry in Iran with the time series data taken during 1989-90 through 2007-08, was examined with the help of one of the latest non-parametric approach MPI. In their study amount of seeds, fertilizers, insecticides, herbicides, labour, water and acreage in one hand were taken as inputs and output of sugar beet production were taken as output. In their study they found that sugar beet production TFP growth increases with 6% in their study period. In this study first total factor productivity growth was calculated and the effective factors in changing the growth of total factors were determined through MPI. Results showed that changes in efficiency, technology and productivity of total factors during the study period have had positive growth in productivity of total factors of production. As the average productivity growth of total factors was 6% and average technological growth of sugar beet was 6.2%. But average productivity growth was showing negative trend and scale growth is estimated to zero which showed that there was lack of efficiency.

Hossain et. al (2012) conducted a study titled An Application of Non-Linear Cobb-Douglas Production Function to Selected Manufacturing Industries in Bangladesh. The study considers Cobb-Douglas production function with Additive and Multiplicative error term. The main purpose of this study is to select the appropriate C-D production function for some selected manufacturing industries in Bangladesh. Logarithmic transforming regression method and Newton Raphson method used to find the gradient of C-D production function .results of the study shows that there are economies of scale in the manufacturing of Drugs & Pharmaceuticals, Furniture & Fixtures, Iron & steel basic, Leather & Footwear, Fabricated Metal Products, Plastic products, Printing & Publications, Tobacco since $\gamma<1$ for the industries. And other industries like Beverage, Chemical, Glass & glass products, Leather & Leather products, Paper & Paper products, Textile, Wood & Crock products shows diseconomies of scale with $\gamma>1$.

Mandal and Madheswaran (2012) in their study entitled with Productivity Growth in Indian Cement Industry: A Panel Estimation of Stochastic Production Frontier, to estimate total factor productivity growth in the Indian cement industry. Applying stochastic frontier approach to estimate TFP growth and then decomposed it into technical progress and technical efficiency. The time period of the study is from 1989-90 to 2006-07. Empirical results show that TFP growth is driven by technological progress not by the technical efficiency. Total Factor Productivity growth found 5.37% of output growth and 94.63% of output growth has been achieved through input growth. So there is needed to take steps by government to improve productivity efficiency.

Saliola and Seker (2011) in their study entitled Total Factor Productivity across the Developing World observed TFP performance of developing countries of world with the help of micro level data from manufacturing countries in 80 developed countries. The data source of the study was surveys' of World Bank Enterprises survey in 2006. Solow residual method used to estimate the TFP which is the residual part of Cobb-Douglas production function not defined by inputs like labour, capital and intermediates as the study defines. Indonesia has the highest aggregate productivity among the countries that were surveyed in 2008-09 and second position covered by Turkey while Brazil has the highest average productivity among countries that were surveyed in 2006-07 and Peru has the highest aggregate productivity among these countries and in average productivity Peru stands at lowest place. In 2008-09 Brazil stands out for having the highest average productivity in the garment and chemicals industries and also performed well in food industry. And in the 2006-07 surveyed, Mexico comes relatively good performance in garment and chemicals. Regional analysis

Kumar and Arora (2011) conducted a study with the title of 'Assessing Technical Efficiency of Sugar Industry in Uttar Pradesh: An Application of Data Envelopment Analysis. The study examines the technological efficiency in sugar industry of Uttar Pradesh commonly known as the sugar bowl of India. Using firm level data of 86 sugar mills operating in UP during the time period of 2003-04. Total technical inefficiency is about to 19% and pure technical and scale efficiency contributed the same share.

Rahmen (2010) conducted a study with the title of 'Efficiency Dynamic of Sugar Industry of Pakistan' applied DEA approach to estimate the total factor productivity growth , technical efficiency change and technological progress in Pakistan sugar industry using panel data for 20 sugar firms from 1998 to 2007.and MPI was used to measure the productivity Growth. The empirical estimates on the performance of sugar industry fielded serval striking results. The Malmquist TFP Result rejects a tormenting picture for the sugar industry. Overall sugar industry improved. Technological progress by 0.8% while managerial efficiency change put a negative effect on the productivity by a same percentage as result the overall total factor productivity during 1998-2007 remained almost static with a decline of 0.1%. If we see the

TFP and its components in individual year for overall sugar industry, it presents divergent trend.

Fogarasi (2006) in his study entitled Efficiency and Total Factor Productivity in post-EU accession Hungarian Sugar Beet Production examines the efficiency and total factor productivity in Hungarian beet sugar production applying non parametric approach of DEA is used to calculated the TFP growth and then Malmquist productivity index is used to decompose the technical progress and technical efficiency. During study years 2004 and 2005, TFP increased by 9%. The major reason increment in TFP was Technical Progress of 8% while technical efficiency played a limited role in improving the performance of sugar beet production.

Miller and Upadhyay (2000) analysis in his study the effects of openness, trade orientation, and human capital on total factor productivity for a pooled (time series + cross sectional data) sample of developed and developing countries. Total factor productivity depends upon economical (cost effective) specification of the aggregate production function. Potential determinants of total factor productivity include measures of openness, trade Orientation and human capital. Higher openness benefits total factor productivity. Outward-oriented countries experience higher total factor productivity, over and above the positive effect of openness. Generally, total factor productivity positively affected by Human Capital. In poor countries, however, human capital interacts with openness to achieve a positive effect. In this study to estimate total factor productivity from a cost effective specification of the aggregate production function involving output per worker, capital per worker, and the labor force, both with and without the stock of human capital. Then, try to search for possible determinants of total factor productivity, with special emphasis on trade variables. Results show that open economy generally benefits total factor productivity it helps to increasing exports to GDP and it also helpful to improve the terms of trade and depricate the value of currency in world market. Moreover, the stock of human capital contributes positively to total factor productivity in many, but not all, specifications. That is, human capital has a negative effect on total factor productivity in high-income countries and a positive effect in middle-income countries and low-income countries as result of opening of economies.

Fare et al (1994) in their paper titled with Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries. This study examines the productivity growth in 17 OECD countries over the period 1979-1988 which is the time of nine years. A non-parametric programming method is used to calculate Malmquist productivity indexes. These are decomposed into two component measures, namely, technical change and efficiency change. The study finds that U.S. productivity growth is slightly higher than average, all of which is due to technical change. Japan's productivity growth is the highest in the sample, with almost half due to efficiency change. In this paper we apply recently developed techniques to the analysis of productivity growth for a sample of OECD countries. The technique we use allows us to decompose productivity growth into two mutually exclusive and exhaustive components: changes in technical efficiency over time and shifts in technology over time. These components lend themselves in a natural way to the identification of catching up and the identification of innovation, respectively.

Jha and Sahni (1993) analyzed the technical efficiency of Indian Sugar industry. Study is based on secondary data with the period time period of 1960-61 to 1986-87 which is taken from the two authentic sites first is Census of Indian manufacturers (CMI) and second is Annual survey of Industries (ASI). The results of the study show the downward trend in the pattern of allocative inefficiency in the Indian sugar industry. Translog index method is used to calculate TFP.

Acharya and Nair (1978) examined empirical issue in Total Factor Productivity Growth of Cement industry in India over the time period of 1959-60 to 1970-71. Data source was Annual Survey of Industries. Solow index has been used to estimate the Total factor productivity growth. Results of the study analysis that the given increasing returns to scale the industry can reap the benefits of scale expansion. Moreover, the analysis of TFP growth using Solow index exhibits no monotonic trend in TFP growth.

Gupta and Patel (1976) in their study entitled with 'Production Function in Indian Sugar Industry' estimated Different forms of Production functions for Indian sugar industry. The study was confined the time period of 1946-1966 and further divided the study period in two parts: 1946-1958 and 1959-66. The data used in this study taken from Census Manufacturing Industries (CMI) and the Annual Survey of Industries (ASI). The study revealed zero neutral technical progress and results showed the increasing returns of Scale for the industry. And there was unit elasticity of substation between labour and capital. In terms of factor elasticity of output labour become more powerful factor than capital to find out the parameters of production function ordinary least square method (OLS) used after transforming the production function in Logarithmic form.

Sastry (1966) in his study entitled 'Measurement of Productivity and Production Function in Sugar Industry in India: 1951-1961' calculated the growth of output and trends in labour Productivity within the time period of 1951-1961, which is the time of 10 years. The main purpose of this study is towards measuring of productivity change in the sugar industry of india during the study period. This attempts at analyzing separately at aggregate and regional level because of its heterogeneous characteristic. Productivity change is measured through the total factor productivity indices and average productivity ratios. These indices are estimated by the output per unit of input per unit approach. The growth in labour productivity is purely attributed to the capital available per labour. And all other residual factors effect was negatively because of old machinery and technology used in sugar industry of India. Labour of Andhra Pradesh, Bombay and Madras have been found more efficient than capital and on the other side Bihar and Uttar Pradesh showed inverse situation. Productivity showed the negative value at both aggregate and regional level.

2.4 Methodological literature review:

The literature reports three approaches to measure technical efficiency:

(i) The index numbers approach

(ii) The econometric approach

(iii) The mathematical programming approach.

The index numbers approach includes multi-factor productivity models, financial and operational ratios. The econometric approach presupposes a theoretical production function to serve as the standard of technical efficiency. The Cobb-Douglas, Translog, and Leontief type functions are most commonly used to approximate the production function as they are easily transformed into linear forms. Econometric models are further divided into Stochastic and non-Stochastic models. The mathematical programming approach does not require the use of a specified functional form for the production data. This approach was pioneered by Charnes, Cooper and Rhodes (1978) and is called Data Envelopment Analysis (DEA).

While econometric methods (e.g. regression analysis) employ "average observations" mathematical programming methods (e.g. DEA) use "production frontiers" or "best practice observations" for efficiency analysis. A detailed discussion of input-reducing and output-increasing orientations of technical efficiency and DEA is provided in the subsequent sections. In this section of study we explains the DEA approach related review and try to explain the history of DEA till its present.

2.4.1 Data Envelop Analysis related review

According to classical economists, labor productivity was considered as an overall measure of efficiency. According to **Farrell (1957),** this ratio (units produced divided by labor hours) was not appropriate as a measure of technical efficiency (TE) as it included only labor and ignored other important factors such as materials, energy, and capital. Thus he proposed a measure of technical efficiency that incorporated all inputs in an aggregated scalar form and also overcame the difficulty of converting multi-component input vectors into scalars. Thus the technical efficiency formulation for multiple input-output configurations is:

Technical Efficiency = Aggregate Output Measure/ Aggregate Input Measure

The inputs are all resources that are consumed to generate the outputs. From equation the above equation, it can be seen that technical efficiency for a firm relates to its ability to:

(i) O**utput-increasing efficiency**: Produce maximum output with the use of constant use of inputs.

(ii) **Input reducing efficiency:** Use minimum inputs to produce a constant output.

Charnes, Cooper, and Rhodes (1978) extended **Farrell's (1957)** work in the measurement of technical efficiency and developed Data Envelopment Analysis (DEA). It is a non parametric approach which is originally propounded by Charnes, Cooper and Rhodes to making relative efficiency in organizations or in Decision Making Units. The CCR model is based on linear programming approach. Data of output and inputs of relative Decision Making units needed to find technical efficiency in this approach.

Banker, Charnes, and Cooper (1984) In DEA an inefficient DMU can be made efficient by projection onto the efficient frontier or the envelopment surface. However, the DEA model used determines the actual point of projection that is chosen on the envelopment surface. The CCR model assumes constant returns to scale *i.e.,* if all inputs are increased proportionally by a certain amount then the outputs will also increase proportionally by the same amount. However, Banker, Charnes, and Cooper (1984) noted that the constant returns to scale assumption skewed the results when making comparisons among DMUs differing significantly in size. In such situations it would be pertinent to know how the scale of operation of a DMU impacts it's (in) efficiency. Thus, **Banker et al (1984)** developed a new formulation of data envelopment analysis that is commonly known as the BCC model. The BCC model enables the use of a new empirical production function and is used to compute efficiency under the assumption of variable returns to scale *i.e.,* a proportional increase in inputs need not necessarily yield a proportional increase in outputs.

Whereas the CCR model addresses aggregate (technical and scale) efficiency, the BCC model addresses pure technical and Scale efficiency. Efficiency is made up of technical (physical) efficiency and scale efficiency. Scale efficiency is explained through (Boussofiane *et al.* (1991)).

***i.e.*, Aggregate Efficiency** = Scale Efficiency * Technical Efficiency

Fare and Lovell (1978) Non- Radial measures used to put side by side DMUs to the efficient frontier or isoquant and not the efficient subset of the isoquant. This sometimes results in a DMU using excess inputs also being termed efficient as compared to a DMU on the efficient subset. Secondly, the radial measure of technical efficiency is mainly based on Farrell's (1957) assumptions of the production function which limits its application to production technologies that satisfy those assumptions. And lastly, radial measures involve proportional reduction/augmentation of input/output mixes respectively which is not always feasible in real world scenarios. Fare and Lovell (1978) developed a non-radial measure that addresses these shortcomings for the production function by terming only DMUs on the efficient subset as efficient and by scaling input factors by different proportions to define the path of projection onto the efficient subset.

2.4.2 Malmquist Productivity Index related reviews

Fare et al (1994) this paper decomposed the MPI into technical efficiency and technical change component. This helped us to identify improvement in efficiency and contribution of technological progress and innovation to productivity growth in sugar industry.

Coelli (1994) in his working paper entitled 'A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program explained the DEA (Data Envelopment Analysis) approach with MPI. In his paper with the help of three examples which are based on these approaches told that how the application of DEAP version 2.1 can be used to measure the cost efficiency between DMUs, comparison of between them and also MPI approach with DEA to measure the productivity and its sources with Panel data. The study is the full explanation of productivity change and its sources. It explained the both input oriented and output oriented approaches of the DEA and also taking about the assumptions and condition to use the approaches of MPI. Basically his study is based upon how to use the computer application DEAP Version 2.1 and hoe it is useful for the study of productivity and technological change and its efficiency parameters of any firm.

Alithin (2001) in his study entitled 'Measurement of Productivity Changes: Two Malmquist index approaches' he took comparison between the basic period of MPI which is developed by the **Caves Christensen** and **Diewert (1982)** and adjacent malmquist productivity index which is developed by **Fare, Grosskopt, Lindegren** and **Rooj (1989).** Both of the Versions Measures efficiency Changes between two time periods similarly. But technical change is measure by them differently. The adjacent version primarily a two period notion and measure the shift in the Technology frontier as the shift at the time t and t+1. To measure technological changes it uses adjacent time period. So, two shifts are averaged geometrically. The shift in the frontier measured by the base period index is given as the ratio in the shift in the frontier at time t and t+1. Both shifts are related to the technology in the base fixed year and and the shift in the frontier is always measured in relation to the technology of the fixed period. thus base period index is also a two period notion. But it uses an additional period to uses to measure the productivity change.

Balk (2001) in his study with the title 'Scale Efficiency and Productivity Change' tried to develop a generic measure of scale efficiency for a multiple inputs and multiple outputs of firms using modern approach of production relate theories. To measure the technological change, technical efficiency and scale efficiency is the second purpose of the study. Malmquist productivity index is well known approach to measure productivity, technological change and technical efficiency but in this study three other approaches were introduced to measure the scale change. This study told the sticky difference between the different modern approaches of the productivity change and its sources. The study has main focused on the scale efficiency.

Tohidi (2012) in his paper entitled 'A global cost Malmquist productivity index using data envelopment analysis' new cost Malmquist productivity index which is the measure of single measure of productivity, it is circular. This study is mainly based on the input oriented approach of the MPI. This approach of the MPI with DEA is mainly used for the comparison of the DMU (Decision Making Units) efficiency or cost efficiency.

This section of the study is concluded that the MPI (Malmquist Productivity index) is between the modern approaches it is one of the most well known approach to estimate the

Productivity change and technological progress. It is the attracted the researchers and also the firms to analyses the efficiency of their production function.

2.5 Research Gap

There are several study have been conducted on the productivity and efficiency of sugar industry. But in other studies, there are number of tools used in order to estimate the total factor productivity such as Solow index, translog index, Data Envelopment Analysis. In the present tools used MPI with a non parametric approach of DEA that is out-put oriented approach. And the tool used in the present study is totally differ from the tools used in earlier study. MPI used in few earlier studies but it was input oriented.