ABBRIVIATIONS

.

MPI: Malmquist Productivity index approach; it is the chain, which measures a change in efficiency relative to a base year.

UAE: United Arab Emirate States.

MFI: Microfinance Institutions.

SFA: stochastic frontier approach; one of nonparametric model for measuring efficiency.

DFA: distribution free approach; one of efficiency measurement method.

LDB: Large Domestic Bank.

MFI$_s$: Microfinance Institutions.

Chapter Two
Literature review

2.1. Introduction:

Efficiency of institutions using data envelopment analysis (DEA) method where these studies applied different models. These studies revealed a set of results that no doubt have contributed to clarify the researcher's vision to measure the efficiency of different decision making units. The study is concentrated on measuring the technical efficiency and productivity change for the Sudanese mechanized rain fed agricultural –sub sector, specifically the south Kordofan and Gedaref states.

The measurement of productivity change is another important aspect to consider when dealing with efficiency and performance of different organizations banks, financial institutions public services …etc. Therefore technical efficiency and efficiency change should be measured .The other aspects of DEA is a Malmquist productivity index (MPI) specially when focusing on inefficiency aspects of non-parametric models. Malmquist productivity index is currently regarded as the most popular index due to the ability to handle a number of information dealing with panel data. Productivity growth can decompose into two important elements; technical change refers to the change of frontier level and efficiency change which refers to the individual productivity displacement with respect to the frontier.

This chapter reviews various studies, and relevant periodicals concerning technical efficiency and productivity change measurements. After a comprehensive survey to all available resources, the researcher found a number of studies related to measuring technical efficiency and productivity change. Other studies were found, but they were not directly focusing on the topic. In the following, 19 of these studies the researcher found that most of these studies have been used in Bank and

financial institution efficiency literatures (Raphael, 2013; (Bereket & Lalitha, 2012; Walid , 2011; Mansouri & Akasha 2010; Loretta & fetal, 2003; Georg & H .Simih ,2003; Barry& Jan, 2002; Ana& Jean, 2000; . BEREKET & LALITH, 2012 ; A. Maghyereh, 2003 ;) .While some studies have been employed in Public services Efficiency literatures (Mohammed samil, 2009; N.Kontodim &D.NIAKAS, 2006 ;).Other studies were used in the industrial Efficiency literatures (Abdurrahman and others, 2011; ALPER. 2006; Fariekh. 2008; Kemal & Boğaziçi 2007). There was only one study out of 18 of studies that discussed measuring the efficiency of agricultural sector .

The most important study among these studies was Raphael, 2013 , the main similarity between Raphael and the current study is that the Raphael, 2013, model is used in this study to measure technical efficiency and productivity change in mechanized rain fed schemes in the areas of the study in Sudan. Also; Barry& Jan, 2002; Ana& Jean, 2000 studies were important for their relation with the current study. Both of them comparing the units working in the same conditions, in terms of efficiency and productivity change. Other studies contributed in increasing researcher knowledge's in terms of efficiency measurements and productivity change.

Below These studies were reviewed.

- Raphael. (2013). In this study the author measured the productivity change of Tanzanian commercial Banks for period of seven years. The approach presented in this study is the Data Envelopment Analysis (DEA) which measures the Malmquist productivity index (MPI) and its components.

The study found that most commercial banks recorded improvement in efficiency change by 67 percent, technical change improvement by 83 percent, and pure technical change improvement by 67 percent and scale efficiency change by 50

percent. In general the efficiency change mean of Large Domestic Bank. (LDB) was higher compared with the rest of the groups, similarly the mean of the total factor productivity of small banks were higher compared with rest of the groups. Also the study found that both groups of commercial banks experienced technological progress, however the efficiency gained during the period of the study was due to improvement in technical efficiency rather than scale efficiency, the results implied that small banks have invested in technological innovation, so as to reduce related costs of production.

The important side in the study was the use of (DEA) and the total factor productivity index (MPI) and its components pure technical change, efficiency change and scale efficiency for seven years.

- Bereket& Lalitha (2012).In this study the authors tried to examine the total factor productivity change in the Ethiopian Microfinance Institutions over period (2004-2009). The data was collected from(19)Microfinance Institutions , the study specified two inputs and three outputs, the number of employees and operating of expenses are specified as inputs whereas, outputs are interests and fee income ,gross loan portfolio and number of loan outstanding.

The study results showed that the Malmquist productivity Index(MPI) experienced by micro finance industry has average 3.8% annually during the period of the study.

Exception of the year 2000-2005(decline in productivity) the micro finance had reported productivity progress in the study period (i.e. productivity rose of 5.5 percent , 5.8percent , 0.3

percent and 7.7 percent in the years 2005-2006, 2006-2007, 2007-2008, 2008-2009 respectively .

The main source of total factor productivity (MPI) growth for the MFIs was attributed to the technical efficiency change (10.1 increases) 16 out of 19 MFIs has shown improvement in technical efficiency change. In contrast only 5 out of 19 have shown improvement in technological change, suggested that there had been deterioration in the performance of the best practice micro finance institutions.

Further the results showed that pure technical efficiency increased by 8.9 percent while scale efficiency contributed on average (1.1) percent increase and hence suggested that during the study period Ethiopian MFIs have experienced mainly increment of pure technical efficiency (improvement in management practice) rather than improvement in optimum size (scale efficiency change)

The study suggested that technical progress should be pursued in order to meet the dual objectives of reaching many poor people and financial sustainability.

- Abdurrahman &Others (2011). This paper used DEA approach to estimate Total Factor Productivity Growth, technical change and technological progress in Pakistan Sugar Industry, using panel data of twenty sugar firms, covering the period 1998 to 2007.

Abdurrahman used Malmquist Total Factor Index to measure productivity growth.

The study found that over all sugar Industry technological change increased by 0.8%, while managerial efficiency change put

negative effect on productivity by the same percentage, as a result the overall total productivity during the period study remained almost static with decline of o.1% , the results from individual Industries showed that static MPI growth was mainly contributed by technical efficiency , which decline for nine sugar firms and remain equal to one for nine sugar firms , while the technical efficiency was positive for nine out of twenty sugar firms .

 Also the study found that the pattern of TFP growth tends to be driven more by technical change rather than improvements in technical efficiency, and sugar industry was week in terms of managerial efficiency, which could be explained by general reduction in the quality of managerial decision – making among the best practice firms. Further, the study suggested that Pakistan sugar industry was facing serious productivity problems, where no increase is recorded in total factor productivity during the period of the study there for , this industry must increase total factor productivity in most of firms under study . Also there are needs to improve both technical efficiency and technological progress. The management aspects was also very important in term of capital, efforts could be made to increase the research and development activity for its role in reaching technological progress , increase in skilled labor through well training to reduce skill shortage which hamper technological adoption.

The research noted that the methodology used in this study was useful, not only it can measure the (MPI), but also it measures how each DMU_s can improve efficiency due to the main components of total factor productivity

- Mansouri& Akasha (2010).The study like others tries to analyze and investigate the relative efficiency of Eight of Algerian commercial banks, the study applied multi –criteria non-parametric technique, data envelopment analysis (DEA). Also the study aims to provide the reference for a bank's managers in determining future operation strategies.

The results of the study indicated that, this eight banks divergence to choice their costs to average level 72%, also the result showed that public banks showed bad scores.

Mansouri& Akasha paper showed that the Islamic banks were less efficient in terms of cost and profit from the rest of the conventional banks, although they are more profitable than traditional banks.

The paper also showed that there is a strong correlation between the performance of banks and cost efficiency in the Arabic banks.

Mansouri & Akasha paper is important from different perspective as it explained the different efficiency measurements which classified into conventional one based on financial indicators and modern methods for instance the data envelopment analysis.

- Walid Abdo (2011).The study aims at measuring the efficiency of Arabic banks by using different methods of efficiency measurements. These methods are classified into conventional ones based on financial indicators, as well as modern approach for instance parametric methods and non-parametric such as data envelopment analysis, the study sample included (10) Banks from various Arab States as follows:(Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia and UAE) .The

inputs data included lending, labor and capital, while output data were loans and investment.

- Roberta &Others (2009)**.** Roberta and others authors in this paper investigated costs, technical, and locative efficiency for Brazil bank during (2000- 2007). The paper used the data envelopment analysis (DEA) approach to estimate efficiency scores.

The paper results showed that Brazil banks have low levels of economic (cost) efficiency compared with the banks in U.S and Europe during period (2000-2007), the economic inefficiency in Brazil banks can be attributed mainly to technical inefficiency rather than a locative efficiency. Also the paper found that there is no evidence of differences in economic efficiency due to type of activity and bank size.

It can be noticed that the use of (DEA) to estimate the costs, technical, and locative efficiency in banks sector for seven years.

-Mohammed Shamil (2009). Mohammed Shamil paper aimed at employing the data envelopment Analysis (DEA) method in assessing the relative efficiency of the Saudi Governmental Universities. The number of teaching Staff, and the money employed were used as inputs, and the numbers of Enrolled Students, and Graduates final Year were used as outputs. The study found the number of Universities with maximum relative efficiency (100%) are (5) out of 11 Universities. The percentage of inefficiency was determined for each inefficient University, together with the extent of inputs that could be reduced and the

extent of outputs that could be increased in these provinces, in order to help these Universities to be fully efficient.

Finally, for each of the inefficient Universities, bench-marking provinces were defined. These bench-marking Universities were able to realize relative efficiency although they work under the same competitive circumstances as inefficient Universities.

The idea of using the standard model of efficiency measurement is good, but here the problem is in the way of defining the inputs and outputs of the model, still there are number of descriptive inputs and outputs variable which are important in Universities performance. Studying these factors can give good finding.

- Tilal (2009) .In recent years, some organizations used (DEA) models to measure their performance; they have used this method as away to reach the great level of efficiency. Tilal study was the most important that evaluate the performance of health services in Saudi Arabia by measuring the relative efficiency of primary health care centers and government hospitals. The study used (DEA) method ,where the number of doctors, and the number of nurses, and the number of categories of medical assistance and the number of centers were used as inputs, and the number of Patient Visits to clinics, the number of laboratory tests, and the number of patients using imaging radiation were model outputs .

Tilal shows that the average relative efficiency of primary health care centers is (83.5%), which means that primary health care centers in the Kingdom should be able to provide the same level of output using (83.5%) of the current inputs or increase the

output by (16.5%), or using the same levels of current inputs if it is100% efficient. According to the indicator of productivity, overall area of the primary health care centers there are (8) scored full efficiency, the increased is (40%).

Also the study found that the average relative efficiency of all government hospitals (89.9%), indicating that these hospitals can reduce the current input by (10.1%) and provide the same level of services (outputs) or greater service to the beneficiaries.

Basing on the results the research, the most important recommendation are: re-distribution of health resources, and most importantly manpower in primary health care centers and government hospitals so as to reach the optimal level of efficiency, also there are needs for further studies on the reasons behind lack of health facilities and relative inefficiency in the external factors. The ten years as duration of the study can give good results.

- FraihKh. Humadi (2008) . FraihKh. Humadi presents a framework for (DEA) methodology and explained how this methodology can be applied; also they mentioned in their study the advantages of using Data envelopment analysis as a performance measurement tool and benchmarking tool and .Also the study use both two ways of data envelopment analysis and give a detailed explanation about the application of the methodology.

The sample of the study was twelve (12) out of thirty five (35) factories. The results showed that no significant fluctuation in technical efficiency for all factories except one factory which

showed wide range of efficiency (68%-100%). FA6 factory showed highest level of efficiency (185) times, it was the reference to other factories to promote their efficiency.

FraihKh . Humadi found that the typical efficiency indicators for input orientation frontier and output orientation frontier for each plant were as follows:

- The plants that had achieved efficiency three times were only two
- The plants that had achieved efficiency twice (only one).
- The plants that had achieved efficiency throughout the period mentioned were seven.

- Kemal and Boğaziçi (2007)**.**The study analyzed the performance of electricity generation plants in Turkey. The data set contains inputs from 65 thermal, hydro and wind power plants, owned by private and public sectors. Data envelopment analysis (DEA) is used as the primary mathematical tool. Two efficiency indexes, reflecting operational and investment performance, are defined and pursued. Constant returns to scale, variable returns to scale and assurance region type DEA models are used in the analysis. Scale efficiency is also considered. Performance comparisons include public versus private sector plants, and natural gas versus coal versus oil fired plants. Also, relationships between efficiency scores and various input/output factors are investigated and some interesting trends are identified**.**

The most useful dimension within this study framework is explaining the two assumption of (DEA) , constant return to the scale(CRS) and variable return to scale(VRS) , also the size of sample is big and that means it can gives good results .

- Alper Karaduman (2006) .This study aims at measuring relative efficiency and productivity change for 17 Turkish automotive companies which are the main Turkish automotive industries. The step wise method approach are used to determine the inputs and outputs factors, the two inputs variables used are the company payments for raw material and payment for wages, the three outputs variables are domestic sales, exports, and capacity usage.

The results illustrated that there were negative effect of 2001 economic crisis on automotive industry can be observed. Besides, it is seen that the efficiency change by time showed difference from company to company because, they produce 7 type of vehicles and there are important differences between them, such as production technology, market, demand …etc.

Alper Karaduman paper found according to the results of model solved Toyota exist in 9 reference set of inefficient units. Similarly Askam exist in 8, Hyundai, Hyundai Assan and M. Benz Truk in (4) reference, Uzeel exists in 3, and Ford Otosan exists in 2 reference set.

On the other hand according to efficiency score:

-The most factories are inefficient in 2001.

- Askam and Toyota are 100% efficient in years 2001, 2003, 2004 and 2005.

The other most efficient company is Askam and actually it is efficiency score is 1 in all five years under (VRS) assumption.

-M. Benz and Ford Otosan and Oyakrenault are the other companies of which total efficiency score are relatively high.

The study recommended that the automotive companies should keep their capacity usage rate high as possible because, idle capacity means costs. The automotive companies should pay attention to their payment (costs).

- Kontodimopoulos &D.NIAKAS (2006.Analysis of Malmquist Total Factor Productivity in Dialysis Facilities.The study aims is to examine the total factor productivity of dialysis facilities in Greece over 12 years period, data envelopment analysis (DEA) approach was used to compute Malmquist productivity indices.

The sample of the study was consisted of 73 dialysis facilities through the entire study period (1993 -2004), the results from this study constitute the first opportunity to study productivity of dialysis facilities in Greece, the components of productivity decomposed into technical efficiency change, scale efficiency change and technological change are calculated for each year. Although interesting sub period effects are observed, conclusion could not be generalized for the entire study period due to alternating trend, and then the study suggested that preliminary insight to productivity in this sector has been obtained, but particularly sub period must be isolated.

- Measuring the University Library Efficiency Using Data Envelopment Analysis. Gerhard (2004). Gerhard analyzed the Technical efficiency of(118) University Library , these libraries were selected randomly from the German-speaking countries (Austria, Germany Swaziland) and English-speaking countries (United States, Australia and Canada).The paper applied (DEA) method to identify the efficient and inefficient of University Libraries. Gerhard study found that among the (118) University

Libraries there were only (10) libraries that have the full efficient 100%, in addition to that there were no differences between these libraries from English-speaking and German-speaking countries or between small and large university libraries.

.

The study mentioned in this study some advantages of the data envelopment analysis method such as:

- This method provides accurate information about the libraries assessment.

 - This method distinguishes between efficient libraries that used less inputs to produce outputs (inputs orientation) or that have achieved higher outputs by using inputs (outputs orientation)

-The method specifies the efficiency level of evaluated libraries and reference set of efficient libraries.

 The study considers the (DEA) as an appropriate method for the public institutions evaluation and non-profit organizations such as libraries, in the absence of information on prices of inputs and outputs.

- Efficiency of Banks. Georg & H .Simih (2003) **.**This study aims at measuring the cost efficiency and profitability of the banking sector in Central and Eastern Europe, the sample of the study included (12) countries of variable economies analytic. Georg and H .Simih used stochastic frontier approach (SFA) and the distribution free approach (DFA).

 Georg and H .Simih study found that Central and Eastern Europe banking market managerial inefficiencies were inefficient. The alternative profit efficiency levels are found to be significantly lower relative to cost efficiency.

According to the SFA, approximately one-third of banks' profits were inefficient, and almost one-half, the higher efficiency levels are associated with larger size, higher profitability and equity. Finally, foreign banks are found to be more cost efficient but less profit efficient relative to domestically owned private banks and state-owned banks.

The paper explains the (DEA) and (stochastic frontier) approaches suggesting that It could be of interest to extend the analysis to other sectors such as insurance and other financial institutions.

- The effect of Financial Libration on THE Efficiency of Financial Institutions. Maghyereh (2003).The main objective of Maghyereh study was to measure the effect of the policy of financial liberalization on the efficiency of financial institutions before and after financial libration policy.

The sample of the study included the commercial banks in Jordan, so as to determine whether liberalization of financial institutions had contributed in improving the efficiency of the banking sector. A parametric and non-parametric method data envelopment analysis (DEA) were used under the two assumptions (CRS) and (VRS) for this purpose .Also the paper used second-stage regressions and parametric approach which included stochastic frontier analysis, the free disposal hall, thick frontier and the Distribution Free Approaches (DFA).These two approaches employed different techniques to envelop a data set with different assumptions for random noise and for the structure of production technology. These assumptions generated the strengths and weaknesses of both approaches.

The paper indicated that the average efficiency score of Jordanian banks grow well in comparison with the efficiency score of banks in developed countries .Also the study showed that the large banks demonstrated the faster productivity growth during the liberalization. In fact, largest banks have been the pioneers of many new products and practices in the system.

This paper considered important from different perspective as it explains the (DEA) assumption and other efficiency measurements such as stochastic frontier analysis.

- Applying Efficiency Measurements Techniques to Central Banks. Loretta & Fetal (2003) . Loretta and Fetal review the standard techniques of efficiency measurement, and discussed some of the issues that arise in applying the of efficiency measurement techniques to the central Bank which has been applied in the State of Sweden.

The paper reviewed the standard techniques for measuring efficiency, addresses a number of the subjects of measuring efficiency in central banks through a number of previous studies relevant to the subject of banking efficiency.

The strength of Loretta and fetal paper lies in its reviewing the obstacle that faces the application of standard methods for measuring the efficiency of central banks such as:

- It is difficult to measure some of the central banking outputs, and the complicated nature of multiple functions of central banks.

- The multiple objectives pursued by central banks make application of the standard techniques.

Basin on the above discussion, the researchers can take these problems into account when studying the same field, and there is still considerable scope for future research, more study can be attempt on different (DEA) models.

- Deregulation entry of Foreign Banks and Bank Efficiency in Australia. (Barry and Jan 2002). Barry and Jan study compared the efficiency of foreign-owned banks operating in Australia with Australian domestic banks after deregulation of the Australian banking system during the early and mid-1980s .The objective of the study is to determine if foreign banks were more efficient than domestic banks during the estimation period of 1988 to 2001. The study used the data envelopment analysis (DEA) method, and Total Factor Productivity indices to consider the efficiency of both foreign banks and domestics banks and the dynamics of efficiency change in Australia post-deregulation.

The (DEA) results show that foreign banks were on average more inputs efficient than domestic banks, mainly due to their superior scale efficiency. However, this superior efficiency did not necessarily result in superior profits. The study showed that the Bank efficiency has increased during post-deregulation, and that the diversity in types of banks operating in Australia was an important source of the dynamic in efficiency change.

- Measuring the marketing efficiency, of Tabuk agricultural company. Saad (2001) . Saad paper employed a new approach to measure marketing efficiency of Tabok agricultural company. The study used quantitative economic analysis methods, specifically relied on standard models, and logarithm model to examine the efficiency of income and costs for economic activities in the company. Also the researcher used financial indicators to analyze

the financial position of the company and as indicators to measure the effectiveness of the overall performance of the company.

The study used the company's data during the study period (1991-2001(.

The study found that productivity per hectare of wheat and barley had increased at 9.04% 0.25% respectively during the period (1991-2001), more over the study showed that the key factors of marketing inefficiency were:

-Seasonality of agricultural products.

- Great competition of foreign agricultural production to the local production.

- increasing of transportation costs.

 - Merchants and mediator controller over agricultural production markets.

- DEA is anon parametric linear program which does not require outputs and inputs prices in order the best practice production frontier to be defined.

- Anon- parametric evolution of banking efficiency in Portugal new &old banks .Ana Canhoto and Jean Dermine(2000).In this paper Ana and Jean applied Anon parametric the data envelopment analysis (DEA) method to evaluate the efficiency of Portuguese banks for the period 1990 to1995 .The purpose of this paper is: first to quantify the impact of deregulation on the efficiency of the Portuguese banking system. A second objective of this paper is to

quantify the relative efficiency of new domestic banks as compared to that of older existing banks.

The sample of the study include twenty banking institutions, These include twelve old commercial banks or saving banks, five new banks and three foreign banks. These twenty banking institutions control 92.6% of banking assets and 97.6% of branches in 1990.The Bank outputs included the deposits, security and interbank and the number of banks braches, while the inputs included the number of employees and capital.

The banks' output vector includes loans, deposits, securities, interbank assets/liabilities9 measured in Portuguese escudos, and the number of branches. The input vector includes the number of employees and physical capital.

The study found that the new banks show the highest meanof efficiency of 77% (86%) compared to 62% (73%) for the old commercial banks. the Malmquist productivity index for the new banks is larger than that for the old banks, an indicator of superior improvement in efficiency over time. Therefore, the efficiency of new banks is superior to that of old banks.

On the other hand there were differences of means between old and new banks that mean it is statistically significant.

Finally the Ana and Jean found that Portugal present an interesting case to study the impact on bank efficiency of rapid deregulation in a previously repressed banking system. The case of Portugal allows quantifying the impact of deregulation on technical efficiency over time and across groups of banks from different generations, the old and the new. The non-parametric

Data Envelopment Analysis shows an improvement in efficiency for the overall sample over time of the order of 59% over the years 1990-1995. The new banks dominate the old ones in terms of efficiency with an average efficiency score of 77% compared to 62%. Moreover, the Malmquist productivity index indicates that the new banks consolidate their relative efficiency advantage over time.

Based on the above mentioned it is interesting to note that there are four fields of the availableliteratures included Banks sector, financial institutions, industrial, public services and agriculture sectors. These studies used different efficiency measurements to assess efficiency and productivity change of various DMU_s. Moreover, these models can be used to improve the inefficiency element in performance .On the other hand, Malmquist index can be decomposed into components due to change in the technical efficiency and movement due to change in technology ,under the alternative assumptions of DEA ,(CRS) and(VRS) .Many authors and researchers in the literature review that related to the measurements of efficiency and productivity change by using different models, all of this studies used the main efficiency method ; (DEA) with different ways and assumption , because this method provides a new techniques for measuring efficiency. The following section discussed the study literature based on previous classification.

2.2 The gap in the literatures studies:

Several alternatives (DEA) models have been employed in banks and financial institution efficiency literature, while the literatures on the efficiency of agricultural sector were only one. This study investigated the marketing efficiency of Tabok agricultural company. Another important point is observed that there were no studies on efficiency of productive system, the important element in each (DMU_s) which consist of the main production inputs, processing and outputs. The

current study used the data envelopment analysis (DEA) approach in order to measure the technical efficiency and productivity change, this approach is directly focused on the technical efficiency and productivity change in (MRC) Schemes in the areas of the study in terms of Sesame and Sorghum production. This approach can help in identifying the reference set, efficient frontier (as the best practice production technology) to promote the inefficiency of other schemes in the sample.

In the coming chapter, the study will throw lights on some methodological issues which are concern with the study; some concepts related to the Data Envelopment Analysis (DEA) and Total Factor of productivity (TFP) Index Approach, which are based on operation research concepts and theories.