ST. MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES

AN ANALYSIS OF THE PERFORMANCE OF LARGE AND MIDDLE LEVEL MANUFACTURING INDUSTRIES: THE CASE OF ETHIOPIA (1991-2017)

BY
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MAY 2018
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A THESIS SUBMITTED TO SCHOOL OF POST GRADUATE STUDIES (INSTITUTE OF AGRICULTURE AND DEVELOPMENT STUDIES) ST. MARY'S UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE MASTERS OF ARTS IN DEVELOPMENT ECONOMICS

MAY 2018
ADDIS ABABA, ETHIOPIA

APPROVAL SHEET

As members of board of examining of the final MSc thesis open defense, we certify that we have read and evaluated the thesis prepared by Faruk Jemal under the title "AN ANALYSIS OF THE PERFORMANCE OF LARGE AND MIDDLE LEVEL MANUFACTURING INDUSTRIES: THE CASE OF ETHIOPIA (1991-2017)" we recommend that this thesis to be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Development Economics

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DECLARATION

I, Faruk Jemal, declared that this thesis is my original work and has not been presented for a first degree or master's degree in any other university, and that all source of materials used for this thesis have been duly acknowledged.

______________________________	______________________________
Name	**Signature**

St. Mary’s University, Addis Ababa

May 2018

ENDORSEMENT

This thesis has been submitted to St. Mary's University, school of Graduate Studies for examination with my approval as a university advisor.

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Advisor Signature

St. Mary's University, Addis Ababa May 2018

ACKNOWLEDGEMENTS

First and for most, I would like to give my glory and praise to the almighty GOD who lets me stay in life these days and helped me in every action for conducting this paper.

My heartfelt gratitude and appreciation goes to my advisor Dr Girma Estiphanose for his continuous guidance, constructive comments, technical supports and welcoming approach in every steps of my research work.

I would like to extend my gratitude to my wife, Rahmet Gebru, children and my siblings especially, Tofik Jemal, for their underlying support throughout my Study. Finally yet importantly, I want to thank my relatives and colleagues who have stood behind me to accomplish this task.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

EEA	Ethiopian Economic Association
EPDRF	Ethiopian Peoples of Democratic Republic Front
FDI	Foreign Direct Investment
GCF	Gross Capital Formation
GDP	Gross Domestic Product
GDPPC	Gross Domestic Product per Capital
GMM	Generalized Methods of Moments
GNI	Gross National Income
GNP	Gross National Product
GPI	Genuine Progress Indicator
H-D	Harrod- Domar
HDI	Human Development Index
IMF	International Monetary Fund
LAC	Latin America and the Caribbean's
LM	Langragian Multiplier
MOFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
M&F	Manufacturing of Food and Beverages
MT	Manufacturing of Tobacco Products
MTX	Manufacturing of Textiles Products
MWA	Manufacturing of Wearing Apparel except fur apparel
MT&F	Manufacturing Tinning and Dressing of Leather,
MFW	Manufacturing of foot wear luggage and handbags
MWP	Manufacturing of Wood and Products of Wood and Cork except furniture and beverage
MPP	Manufacturing of Paper, Paper Products and Printing
MCH	Manufacturing of chemicals and chemical products
MRP	Manufacturing of rubber and plastic products
MNM	Manufacturing of other Non-metallic Mineral Products
MBI	Manufacturing of Basic Iron and Steel

MFM	Manufacturing of Fabricated Metals except machine and equipment
MME	Manufacturing of Machine and Equipment
MMV	Manufacturing of Motor Vehicles
MFUR	Manufacturing of Furniture's
RIN	Real Income
SOC	Stock of Capital
Noem	Number of Employees

LIST OF TABLES

Page

ABSTRACT

The Ethiopian economy, during the period of command economy, was the weakest in sub-Saharan Africa. However, this has showed recovery due to the new policy the country has started to follow ever since EPRDF took over power after the failure of command economic policy, which was followed by dirge regime. Nonetheless, the share of the manufacturing sector's to GDP was still insignificant. This study analyzed the performance of manufacturing particularly the Large and Medium level manufacturing sub –sector in Ethiopia from 1961/62 to 2016/17 using the secondary data from CSA. The data provides number of labor, fixed asset employed and gross revenue and are adjusted by consumer price index deflector using the Growth accounting methodologically. The study adopted a descriptive analysis to measure partial factor productivity (productivity of labor and capital) and to give more explanation about the elasticity of the factors. The finding indicates existence of large inefficiencies that explains at least 14 percent of output variation among firms; the existence of decreasing returns to scale is an indication that firms are operating above their optimal scale (proportion of factors). From this study, it is recommended that both government and industry need to play their respective parts, with government as a facilitator and formulator of policies conducive for growth of industry and industry itself taking initiatives must include research and development, investment in to newer and more efficient technologies, improvement of existing facilities for better productivity.

Keywords: Ethiopian manufacturing, Growth Accounting analysis, TFP.

CHAPTER ONE

1.1. Background of the Study

Although manufacturing exhibits a small sector in African economies, in terms of share of total output or employment, growth of this sector has been long considered crucial for economic development. This special interest in manufacturing stems from the belief that the sector is a potential engine of modernization, a creator of skilled jobs, and a generator of positive spillover effect as has been seen in highly industrialized economies. The contribution of agriculture to the national income is very small and is estimated to be less than 37.2 percent, while the share of industry is about 21.3 percent.

Accordingly evaluating the performance of industries is vital tool for studying or evaluating the performance of a particular scenario in comparison in order to attain objectives of the study. Performance analysis can be done on the basis of ROI, profits, revenue and value added etc. Analyzing the industries performance can be done by reviewing an industries or firms performance against efficient resource allocation; and also monitoring and control of the input and output of manufacturing systems in order to attain system optimization. Performance of manufacturing systems covers a wide spectrum of technology and management activities.

Ethiopia's economy is dominated by Smallholder agriculture that provides over 85 percent of the total employment and foreign exchange earnings and approximately 45 percent of the Gross Domestic Product (GDP). In terms of sectors contribution to GDP, the service sector has remained dominant by accounting for 45.6% of GDP in 2011/12 followed by agriculture contributing about 44% and industry 11%. Large and medium size manufacturing accounted for 6.2 % and small scale industry and handicrafts represented 2.5% to GDP (MoFED, 2011/2012). This shows that the contribution of the manufacturing sector is minimal and that the agriculture and service industry dominates the Ethiopian Economy. The fact that the contribution of the manufacturing sector to GDP is minimal exhibits the infant stage of manufacturing activities or industrialization in Ethiopia.

Table1: Share of GDP by Major Industrial Classification (in percentage)

Sector	2011/12
GDP	100
Agriculture and allied industries	44.75
Industry	10.85
Services	45.0

Source: MOFED

This indicates that despite its rapid growth relative to agriculture and service sectors, the share of industrial sector in GDP is still very low. Calling for enhanced investment in manufacturing sector taking into account the country's competitive advantage. Manufacturing sector increased by 15.8 percent and constituted about 31.8 percent of industrial output growth and 4.6 percent of real GDP growth. Construction industry on the other hand, contributed more than half (56.1 percent) to industrial sector growth and 8.5 percent to GDP growth. This implies that construction sector is currently the leading industry due to expansion in construction of roads, railways, dams and residential houses. Meanwhile, electricity & water and mining& quarrying contributed 6.5 and 5.6 percent to industrial growth, respectively (Table1).

The history of Ethiopian manufacturing sector is more or less related to the post Ethio-Italy war. During the Italian occupation/aggression, there were small-scale manufacturing producing consumer goods such as soap and textiles (Eshetu, 1995:194-195 and 201). About 67 percent of the establishments were fully and partially owned by foreigners (Getnet, 2003). In the second half of 1940s, there was very few manufacturing industry, which accounted for only 1% of the national income. Industrialization really begun in the 1950s. The Imperial Government initiated a ten-year program of industrial development (1945-55). The three successive Five-Year Development Plans (1958-1962, 1963-67 and 1969) followed this.

After the collapse of the Imperial regime, the Derg nationalized enterprises involved in major economic activities and the private sector was only allowed to participate in small-scale industries and handicraft activities. With regard to industrialization, there were not any economic plans for the first four years (1975-1978), with all sectors of the economy declining as the period was characterized by intense political confrontation.

In the post-Derg era, key strategic direction of industrial development is given to micro and small scale industrial development. In addition, medium and large scale industries are also given special emphasis. In the fiscal year 2011/12, the industrial sector grew by 13.6%. Compared to the 2010/11 performance of 15% and the 2011/12 target of 17.9%, the growth rate of the industrial sector in 2011/12 showed short falls of 1.4 and 4.3 percentage points respectively. Whereas medium and large-scale manufacturing, construction and energy sub-sectors showed growth performance.

Concerning Medium and Large-Scale Manufacturing Industry, several strategies are indicated in the GTP which aims at enabling the Medium and Large-Scale Manufacturing Industries to create competitive national economy by ensuring rapid and sustainable technological transfer; to become export oriented; and to create a conducive environment for micro and small enterprises and agricultural developments by adopting, on the one hand, and evolution in their MFP and LP on the other.

1.2. Statement of the Problem

Through providing support to manufacturing companies, in 2011/12 the Government planned to generate a total of USD 644.2 million from manufacturing exports. However, the total amount generated was only USD 255.4 million (MOFED 2011/12, Annual progress Report). This was due to the low performance of medium and large scale manufacturing firms to exploit these opportunities and transform other challenges of the sector as incentives given to them all round and effective support, encourage industries which produce goods for the export market and substitute imports.

Economic growth is the focus of all government activities. This would come from growth of different sectors like the agriculture sector, the service sector, and the industry sector. Industry sector growth, as many agrees, is an essential component for any country’s development in many aspects. As a result, this sector has attracted enormous attention in policy making.

Given the importance of efficiency as performance indicator, there is a large body of technical efficiency studies in the literature for manufacturing industries in both developing and developed countries. Examples for developed countries include: Caves and Barton (1990) for the US, Green and Mayes (1991) for United Kingdom, Caves (1992) for Australian manufacturing, and Martin-Marcos and Suarez-Galvez (2000) for Spanish manufacturing. Some of the empirical studies on the question of efficiency in African manufacturing industries include Söderbom and Teal (2004) for Ghana's manufacturing, Aggrey et al. (2010) for Kenyan, Tanzanian and Ugandan manufacturing industries, Ngui-Muchai and Muniu (2012) for Kenyan manufacturing.

With regard to Ethiopia, several studies have been undertaken on the performance of Ethiopian Large and Medium level manufacturing industries and TFP, using different factors that affect productivity. Nevertheless, these researches are done mostly on impact of one or two variables on the performance in different time periods rather than using potential determinants or source of productivity in general. Using a Cobb-Douglas, Constant Elasticity of Substitution (CES Admit (1998) analyzed the technical progress of the manufacturing sector in Ethiopia for the period 1976–1995) and translog models. The results showed a zero or negative TFP growth.

The exceptional finding by Gebreeyesus (2008), using the annual CSA census of medium and large manufacturing industries, found the sector exhibited an annual average productivity growth of about 9.3 percent between 1996 and 2003, with entry and exit of firms being the major source of productivity growth, this can be considered as the effect of competition between firms. There are studies (Soderbom 2011; Siba and Soderbom 2011; Bigsten and Gebreeyesus ;and Bigsten and Gebreeyesus 2009) which used the CSA panel data on large and medium manufacturing industries to study issues such as performance, growth, and productivity of firms.

This paper tries to achieve this objective by analyzing the Ethiopian manufacturing industry, studying its recent development, TFP and factors related to it, and by estimating production functions in which labor and capital input combinations are considered in order to obtain a number of Total factor Productivity (TFP) measures and thus determine its performance at industry level. Moreover, it aims to determine econometrically some of the factors that tend to influence TFP and Productivity growth. This paper also performs a direct comparison between sectors in dimensions such as share of revenue, capital accumulation and labor growth.

Therefore, this research tries to find how total factor productivity growth influences the manufacturing sector by using Growth Accounting Model which was not applied in previous analysis. Moreover, the data set this study used is a bit longer period of time (25 years) from 1991/92 to 2016/17 E.C. This makes a significant boundary between the datasets of other previous studies and that of this study‘s.

1.3. Objective of the Study

1.3.1 General Objective

The main objective of the study is to empirically examine the performance of firms for the Ethiopian large and medium scale manufacturing industry.

1.3.2 The Specific Objectives

- To examine TPF for large and medium scale manufacturing firms using the recent panel dataset; to examine its performance and the effect of the different inputs as a single index of production function.
- To show how this relation changes at different inputs enables the firms to cohorts more rigorously.
- To examine whether there exists persistence of performance among firms.

1.4. Research Question

The study critically investigates the following questions regarding the performance of Ethiopian medium and large level manufacturing industries.

- What are the main factors for the productivity of the industry?
- Is there a growth of TFP that contribute to the productivity of the industry?
- Which factor contributes mainly for the growth of productivity, labor or capital?

1.5. Significance of the Study

The study has the following significances

- To policy makers, incumbent and prospective firms in the following way: Policy makers can wisely intervene in improving firm performance by assisting firms abilities to tackle those factors that inhabit growth and by helping them to attain those factors that positively affect employment growth.

- This will be a compliment to implement the newly developed government plan, growth and transformation plan (GTP). It will give a direction as to how the private and public large and medium level manufacturing industries are operating and give an insight on what must be done to improve their performance and sustenance in the market.
- It will be the guiding paper for those potential entrants by providing information on what the performance of incumbent firms' look like in this particular industry.

1.6. Organization of the Paper

This research work has five chapters for its presentation. Chapter one provides introduction part of the research while the second and third chapters deal with literature review and data and methodological framework respectively. The literature review part describes different theories concerning performance factor. Issues concerning the type, source and nature of data along with the method of analysis are discussed in the third chapter. In the fourth chapter, the finding of the paper (using both descriptive and econometric analysis) are presented. Finally, the conclusions and the recommendations of the study are entertained in the last chapter of the paper.

CHAPTER TWO

REVIEW LITERATURE

2.1. Theoretical literature review

2.1.1 Neoclassical Growth Theories and the Exogenous Theory of Robert Solow

The first neo-classical growth theories were emerged in 1950s-1960s.The main representatives of this school are Alfred Marshall (1842-1924), Carla Menger (1840-1921), Friedrich Von Wieser (1851-1926), Leon Walras (1834-1910), John Bates (1847-1938), William Stanley Jevons (1835-1882), Iriving Fisher (1867-1947), Robert Solow (1924-present) and others. One of the most influential neo-classical growth theorist has been that of Noble prize winner (in 1987), an American economist Robert Solow. Solow's theory was outlined for the first time in an article entitled 'A Contribution to the Theory of Economic Growth', (1956) and then developed in to the 'Technical Change and Aggregate Production Function', (1957).

The basic framework of neo-classical growth model which was firstly developed by Robert Solow (1956) and Trevor Swan (1956) states that at any point in time the total output of the economy depends on the quality and quantity of physical capital employed, the quantity of labor employed, and the average level of skills of the labor force. However, once the economy reaches the full equilibrium level, additional growth in the stock of capital per worker will only take place if productivity increases, either through enhanced capital stock or through improvements in the quality of the labor force.

The basic assumptions of the Solow model include constant returns to scale, diminishing marginal productivity of capital, exogenously determined technical progress and substitutability between capital and labor, and his basic question was "what are the main determinants of economic growth in the long term?" According to him, economies will conditionally converge to the same level of income if they have the same saving rate, depreciation rate, and laborforce growth rate and productivity growth position.

2.1.2 Theory of Endogenous Economic Growth

A new stage in the development of the theory of economic growth occurred in the mid-1980’s, which allowed talking about the "new growth theory". For the first time, in formal mathematical and economic models, the American economists Paul Romer (1955-until now) and Robert Lucas (1937-until now), hypothesized about the endogenous character of the most important technological innovations based on investment (contribution) in technological development and in human capital (skill and knowledge) through Research and Development(R&D). Most importantly, the scientific and technical progress has been considered as an endogenous, growth factor generated by internal causes. Endogenous growth theory seeks to explain the existence of increasing returns to scale and the divergence of long-term growth patterns among countries. The main contribution of this theory is that it emphasis on the link between technical innovation, human capital and institution including government. In this theory, the central motive of profit maximization of business firms are considered to determine technological progress as these firms involve in R&D seeking new and better idea.

In the theories of endogenous growth, technological progress is not the only possible cause of economic growth in the long term. The value of intensive high-quality determinants of economic growth (parameter A in neo-classical theory) is defined in the theories of endogenous growth with the following factors: The quality of human capital, which depends on investment in human development (education, health) creation of the necessary condition and prerequisites for the protection of intellectual property right in the conditions of imperfect competition state support for the development of science and technology. The role of government in creating a favorable investment climate and attracting new technologies .Therefore the theories of endogenous growth in contrast to neoclassical ones are in favor of state’s intervention in the development process.

Thus, endogenous growth theories allowed formalizing the relationship between the mechanisms of economic growth and the process of obtaining and accumulating new knowledge, which is materialized in technological innovations. These theories examine the reasons for the differences in growth rates of different countries the effectiveness of various measures of the state’s scientific, technical and industrial policies as well as the impact of the processes of international integration and trade on economic growth (Snowdon and R. Vane, 2005)

2.1.3. Total Factor Productivity (TFP)

In a simply way, is defined as output per unit of inputs. It is the ratio of aggregate output index to aggregate input index and measures the efficiency of all inputs in a production process. In other word, TFP is the portion of output not explained by the amount of inputs used in production. This is known as a “residual.” The original idea that output may not be wholly explained by amount of inputs (Fabricant (1954), Abramowitz et al (1956), and Solow (1957). Fabricant (1954) argued that if increase in national income per capita is above the increase in total input per capita, the source of economic advance is improving efficiency.Abramowitz (1956) little was known about the causes of productivity change and defined the residual as “a measure of our ignorance.” With the works of Solow (1957), the analysis of TFP got wide attention and became included in the so called Solow growth theory. In the Solow growth theory and other productivity models, the analysis of TFP, at macro or micro level, starts with the production function of the type Yit = AitF(Xit); relating the output (Y) of a generic unit (firm/industry/country) i at time t to a vector of inputs (X) and with the term A describing how much output a given unit is able to produce from a certain amount of inputs, given the technological level (Del Gatto et al. 2011). The TFP index is then: TFP it = Ait = Yit/F(Xit), which is the ratio of output produced to total inputs employed.

Earlier works mainly focused on the estimation of TFP growth, and TFP is accordingly measured by the Solow residual in the growth accounting model. TFP growth is the result of change in efficiency of an economic production, which is the result of technological change. This TFP growth is believed to be the only source of long run growth. For instance, using a growth accounting method Young (1992) found no total factor productivity growth in Singapore and argued that Singapore will only be able to sustain further growth by reorienting its policies from factor accumulation toward the considerably more subtle issue of technological change. In line with this, Krug man (1994) stated that sustained growth in a nation's per capita income can only occur if there is a rise in output per unit of input.

While the growth accounting is mainly a macro analysis, there are many other methods used to study TFP at an individual (firm/plant) level. Micro analysis is increasingly applied to study TFP. It is mainly related with how inputs are efficiently utilized at a firm level. The increasing attention towards firm level studies is because of the increasing availability of establishment level data, and focus of growth theories on non-competitive markets. Such markets cause inefficiency as firms deviate from the efficient allocation of inputs and optimal production level. The Solow growth theory assumes perfect competition—which is less likely to prevail, especially in developing economies—and exogenous technological progress, which determines the productivity of inputs. However, the new growth theories acknowledge the existence of market imperfections and endogenous determination of technological progress via investment in human capital.

To discuss how TFP is measured at micro level, it is important to review the basic microeconomic theories of production.(Coelli,2008) In microeconomic theory, producers are assumed to maximize their profit. The production theory starts by defining the production function, the technology that firms use to convert input/s into output/s. The production curve/frontier, a graphic depiction of the production function, represents the boundary of the maximum output that can be obtained from a given input vector (or the minimum input usage required to produce any given output vector). In this way the optimization problem involves determining the amount of inputs that minimizes the cost of producing a given level of output or that maximizes output for a given cost outlay. Accordingly, the traditional practice of production analysis involves estimating production and cost functions assuming that firms operate on their production curve (frontier), i.e. firms are assumed to be technically efficient.

However, not all producers succeed in utilizing the minimum inputs required to produce outputs they choose to produce, given the technology at their disposal (Kumbhakar and Lovell, 2000). Producers, for reasons such as management inefficiencies, market related problems, and other internal and external factors, may not be able to produce the maximum possible output (technical efficiency) or attain minimum cost (a locative efficiency) in production, which results into non-optimal profit. Thus, not all producers are output (technical), cost (a locative), or profit efficient. This observation gave rise to the study of firms' technical and a locative efficiency.

The growth accounting method of TFP analysis considers technical change as an equivalent with TFP growth. However, technical change is one factor that contributes to TFP growth. Improvements in technical, allocate, and scale efficiency of firms are also important factors that affect TFP growth. Consequently, unlike the macro level productivity analysis which considers technical change as TFP growth the micro level productivity analysis decomposes TFP growth into its components: technical change, changes in technical/ a locative efficiency, and scale efficiency.

2.1.4. Overview of Productivity Measure

Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input use, while there is no disagreement on this general notion, a look at the productivity literature and its various applications reveals very quickly that there is neither a unique purpose for, nor a single measure of productivity. Nevertheless, perusing measure of productivity measurement includes:-

Technology- frequently stated objective of measuring productivity growth is to trace technical change. Technology has been described as "the currently known ways of converting resources into outputs desired by the economy" (Griliches, 1987) and appears either in its disembodied form (such as new blueprints, scientific results, new organizational techniques) or embodied in new products (advances in the design and quality of new vintages of capital goods and intermediate inputs). In spite of the frequent explicit or implicit association of productivity measures with technical change, the link is not straight forward.

Efficiency- the quest for identifying changes in efficiency is conceptually different from identifying technical change. Full efficiency in an engineering sense means that a production process has achieved the maximum amount of output that is physically achievable with current technology, and given a fixed amount of inputs (Die wert and Lawrence, 1999).

Technical efficiency gains are thus a movement towards "best practice", or the elimination of technical and organizational inefficiencies. Not every form of technical efficiency makes, however, economic sense, and this is captured by the notion of locative efficiency, which implies profit-maximizing behavior on the side of the firm. One notes that when productivity measurement concerns the industry level, efficiency gains can either be due to improved efficiency in individual establishments that make up the industry or to a shift of production towards more efficient establishments.

Real cost savings- a pragmatic way to describe the essence of measured productivity change. Although it is conceptually possible to isolate different types of efficiency changes, technical change and economies of scale, this remains a difficult task in practice.

The Solow growth theory assumes perfect competition—which is less likely to prevail, especially in developing economies—and exogenous technological progress, which determines the productivity of inputs. However, the new growth theories acknowledge the existence of market imperfections and endogenous determination of technological progress via investment in human capital. Productivity is typically measured residually and this residual captures not only the above-mentioned factors but also changes in capacity utilization, learning-by-doing and measurement errors of all kinds. Harberger (1998) re-stated the point that there is a myriad of sources behind productivity growth and labeled it the real cost savings. In this sense, productivity measurement in practice could be seen as a quest to identify real cost savings in production.

Benchmarking production processes. In the field of business economics, comparisons of productivity measures for specific production processes can help to identify inefficiencies. Typically, the relevant productivity measures are expressed in physical units (e.g. cars per day, passenger-miles per person) and highly specific. This fulfils the purpose of factory-to factory comparisons, but has the disadvantage that the resulting productivity measures are difficult to combine or aggregate.

Living standards Measurement of productivity is a key element towards assessing standards of living. A simple example is per capita income, probably the most common measure of living standards: income per person in an economy varies directly with one measure of labor productivity, value added per hour worked. In this sense, measuring labor productivity helps to better understand the development of living standards; another example is the long-term trend in multifactor productivity (MFP). This indicator is useful in assessing an economy’s underlying productive capacity (“potential output”), itself an important measure of the growth possibilities of economies and of inflationary pressures

2.1.5. Main Types of Productivity Measures

There are many different productivity measures. The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data. Broadly, productivity measures can be classified as:-

Single factor productivity measures (relating a measure of output to a single measure of input), or Multifactor productivity measures (relating a measure of output to a bundle of inputs). Another distinction, of particular relevance at the industry or firm level is between productivity measures that relate some measure of gross output to one or several inputs and those that use a value-added concept to capture movements of output. Table 1 uses these criteria to enumerate the main productivity measures. The list is in complete insofar as single productivity measures can also be defined over intermediate inputs and labor-capital multifactor productivity can, in principle, be evaluated based on gross output. However, in the interest of simplicity, The Table was restricted to the most frequently used productive Measures. These are measures of labor and capital production.

Table: 2 Overview of main productivity measures (own composition)

Type of output measures	Type of impute measure			
	labor	capital	Capital and labor	Capital labor and intermediate inputs (energy material, service)
Gross output	Labor productivity based on (gross output)	Capital productivity(based on gross output)	Capital-labor MFP (based on gross output)	KLEMS multifactor productivity
Gross output	Labor Productivity based on (value-added)value added	Capital productivity(based on value added)	Capital-labor MFP (based on value added0	
Value added	Single factor productivity measures		Multifactor productivity measures	

Multifactor productivity measures (MFP), either in the form of capital-labor MFP, based on a value-added concept of output, or in the form of capital-labor-energy materials MFP (KLEMS), based on a concept of gross output. Among those measures, value-added based labor productivity is the single most frequently computed productivity statistic, followed by capital-labor MFP and KLEMS MFP. These measures are not independent of each other. For example, it is possible to identify various driving forces behind labor productivity growth, one of which is the rate of MFP change. This and other links between productivity measures can be established with the help of the economic theory of production once productivity measures are conceptualized based on economic theory, there are several ways to go about their empirical implementation. From a broad methodological viewpoint:-

Parametric approaches can be distinguished from non-parametric ones. In the first case, econometric techniques are applied to estimate parameters of a production function and so obtain direct measures of productivity growth and is non parametric. In the second case, properties of a production function and results from the economic theory of production are used to identify empirical measures that provide a satisfactory approximation to the unknown "true" and economically defined index number the growth accounting approach to productivity measurement is a prominent example for non-parametric techniques

2.1.6. Total Factor Productivity (TFP)

Total factor productivity measures account for the use of a number of factor inputs in production and, therefore, are more suitable for performance measurement and comparisons across firms and for a given firm over time (Coelli et al., 2005). In this context, TFP can be defined as a ratioof aggregate output produced relative to aggregate input used. This aggregation of inputs and outputs raises the problems of index number. In another term, how can we aggregate inputs and outputs without biasing our calculation?

Three different views exist on what TFP means (Lipsey and Carlaw, 2002). The first conventional opinion considers TFP as the measure of the rate of technical change (see for example, Law, 2000; Krug man, 1996; Young, 1992 among others). The second view (Jorgensen and Griliches, 1967) regards that TFP measures only free lunches of technical change, which are mainly associated with externalities and scale effects. The third view is highly skeptical whether TFP measures anything-useful (Metcalfe, 1987; Griliches, 1995). Kathuria et al., (2011) provides the following possibilities on what TFP growth means in literature:

TFP Growth = Output growth – Input growth = Technical/Technological change/Progress = Embodied (or endogenous) technical change + Disembodied (exogenous) technical change= Changes in technical efficiency + technological progress

Among these definitions, the later authors mention that the first one is the most commonly used. As per definition, TFP growth incorporates all the residual factors after accounting for input growth, and has also been hailed as an "index of ignorance" (Abramovitz, 1956).

2.1.7. Measures of the TFP growth

There are basically two approaches to measure the TFP growth - the frontier and non-frontier approaches (figure 4). Each of these approaches is further divided into parametric and non-parametric techniques.

In frontier approach, the objective is to estimate the best obtainable positions based on the estimation of a bounding function, given inputs and prices levels. For example, a cost frontier traces the minimum attainable cost given input prices and output while a "production frontier" traces the set of maximum attainable output for a given set of inputs and technology. This approach is different from the parametric non-frontier approaches where an average function is often estimated by the ordinary least square regression as the line of best fit through the sample data (Kathuria et al., 2011).

Moreover, the frontier approaches identify the role of technical efficiency in overall firm performances while non-frontier approaches assume that firms are technically efficient (Kathuria, 2011). This difference results in different interpretation of TFP growth estimated from both approaches.

TFP growth as obtained from frontier approach consists of two components: (i) outward shifts of the production function resulting from technological progress, and (ii) technical efficiency related to the movements towards the production frontier. On the other hand, the non-frontier approach considers technological progress as a measure of TFP growth.

Both frontier and non-frontier approaches can be estimated through parametric and non-parametric techniques. Parametric estimations need the specification of a functional form for the frontier and parameters are estimated through econometric techniques using sample data and outputs. One important implication of this issue is that the accuracy of the derived estimates is sensitive to the specified functional form. In contrast, this latter point is the strength of the non-parametric methods (such as data envelopment analysis DEA, or other mathematical programming methods), which are parameters free and does not assume any functional forms. However, one shortcoming of the latter non-parametric approaches is that no direct statistical tests can be carried out to validate the estimate.

2.1.8. Non-Frontier Approaches

2.1.8.1. Non-parametric techniques (TFP index numbers)

A common feature of the TFP index number is that the empirical estimation of different TFP indexes is based on different weighting methods of inputs and outputs. In most empirical studies, the Divisia, Solow, and the Tornqvist indexes are frequently used.

Solow index

Solow uses a Cobb-Douglas production function (PF) in order to calculate the TFPG. For the estimation of this PF, he assumes a constant return to scale, autonomous Hick'schange, and that the factor payments are equal to their marginal products. The production function is then under the following form:

$$Y = F(K,L,t)$$

Q, K, and L, respectively represent the output, capital, and labor. A(t) is a multiplicative factor accounting for the shift of the production function between two time periods (at given levels of capital or labor). Solow then addressed the key question of measuring A(t)using index number approach. The solution is based on the logarithmic differential of the production function.

$$\frac{\dot{Q}_t}{Q_t} = \frac{\partial Q}{\partial K}\frac{K_t}{Q_t}\frac{\dot{K}_t}{K_t} + \frac{\partial Q}{\partial L}\frac{L_t}{Q_t}\frac{\dot{L}_t}{L_t} + \frac{\dot{A}_t}{A}$$

The equation above indicates that the output growth (left hand side) is divided into growth in capital and labor (inputs) both weighted by their output elasticities, and the growth in the Hicksian efficiency index (A(t)). Assuming that each input is acquired by a value which corresponds to its marginal product, and then we will have:

$$\frac{\partial Q}{\partial K} = \frac{r_t}{p_t}$$

What is more important, however, is the rate of change of total productivity over time, that is, technological progress. Technological capability, the learning process of production and engineering management improves the production function, hence productivity levels. More output would be generated with the same level of inputs. Considering the same production function, and by total differentiation, the rate of growth of total factor productivity can be obtained thus:

$$Y = AL^{\alpha} K^{\beta}$$
$$(\Delta Y/Y) = (\partial Y/\partial A)\Delta A/Y + (\partial Y/\partial L)\Delta L/Y + (\partial Y/\partial K)\Delta K/Y$$
$$\Delta Y/Y = \Delta A/A + \alpha(\Delta L/L) + \beta(\Delta K/K)$$

Rearranging (3) further, the rate of change of TFP can be derived as:

$$\Delta A/A = \Delta Y/Y - \alpha(\Delta L/L) - \beta(\Delta K/K)$$

The rate of change of TFP is estimated as the growth rate in output net of the contribution of growth in inputs, i.e., what remains after the determinants that can be measured (capital and labor) are accounted for. TFP captures anything that changes the relation between measured inputs and measured output.

However, note that productivity change may not be a measure of efficiency. A firm, which has already attained an efficient level of resource allocation, i.e., equilibrium condition under a competitive market, may not make further growth in productivity. In this case, a decline in productivity growth indicates that the firm is becoming inefficient.

For further analysis, it is useful to rewrite the above equation in the following way:

$$\Delta(Y/L)/(Y/L) \quad = \beta[\Delta(K/L)/(K/L)] + \Delta A/A$$

This is a decomposition of labor productivity growth into the contribution of capital deepening plus the residual, the rate of growth of TFP. [Dollar, et al. 1990] The first term in the right hand side of equation (5) is the rate of growth of labor productivity attributable to the increase in capital utilized per unit of labor. The residual, ($\Delta A/A$), is the difference between the actual growth in labor productivity and the amount of the advance that can be accounted for by capital deepening.

Conceptually, the factors affecting the efficiency of an economic unit of production, such as a firm, can be classified into two categories: those within the firm's sphere of direct influence and those outside a firm's direct control. (Nishimizu, et al. 1986) The distinction between these categories is useful in understanding some of the limitations of the analytical framework for measuring TFP, appreciating what TFP indices represent, their uses and applications.

Factors within a firm's sphere of direct control are those referred to as technology. These factors can be further divided into two groups. One group has to do with the efficiency of each input, which can change quite independently of the input's quantity in production and independently of the amount and efficiency of any other input combined in production. This group includes factors such as the influence of training and education on labor productivity, new technology embodied in machinery and equipment, and high grades of primary inputs. The other group of factors affect the efficiency of performance of different inputs simultaneously and the efficiency of interaction among different inputs in a production process. It includes management of a firm, layout of physical plant, economies of scale, efficiency in the management of product portfolio, and other factors that take advantage of what is called economies of scope (for example, shared overhead costs among different production lines).

Factors beyond a firm's direct control have to do with the production environment. They include availability of infrastructure (roads, telecommunication, power, water, etc.) and demand conditions that affect the performance of a firm through fluctuations in capacity utilization. They include, inter alia, government policies and regulations that affect prices or allocation of products and inputs (for example, tariffs, taxes, subsidies, foreign exchange allocation system, pricing policy), the degree of competition in the market place (for example, investment, licensing, state monopoly), and the management autonomy of firms themselves.

Measured TFP changes capture the impact of all these factors. Changes in technological levels – that is shift in the production function – are difficult to distinguish empirically from changes in TFP that occur within the given level of technology. Both changes, however, respond to decisions at the enterprise level. These decisions,in turn, are motivated and constrained by changes in the production environment. One objective of TFP analysis is to measure the impact of changes in the production environment on cost performance. For all these reasons, TFP analysis, when there is good quality data, is quite comprehensive and tells a good story about the firm or the industry. However, as useful as TFP analysis is, it is quite sensitive to the availability and quality of data; hence, the need to be cautious in its interpretation especially in countries where there is reason to suspect the quality of the data.

$$\frac{\partial Q}{\partial L} = \frac{w_t}{p_t}$$

Consequently, the unobservable elasticities will be converted into observable income shares SK and SL. The Solow index will be calculated as:

$$R_t = \frac{\dot{Q}_t}{Q_t} - s_t^K \frac{\dot{K}_t}{K_t} - s_t^L \frac{\dot{L}_t}{L_t} = \frac{\dot{A}_t}{A}$$

DIVISIA Index

A Divisia index can be defined as a theoretical construct to create index number series for continuous-time data on prices and quantities of goods exchanged. It is designed to incorporate quantity and price changes over time from sub-components, which are measured in different units (labor hours and equipment in currency).

A Divisia quantity index has a rate of growth equal to a weighted average of rates of growth of its component quantities. Similarly, a Divisia price index has a rate of growth equal to a weighted average of rates of growth of its component prices. The weights in either case are the relative value shares of each component in total value.

In a single output case, TFP growth (sxy) is defined as:

$$T\dot{F}P = \dot{Y} - \sum_j S_j \dot{X}_J,$$

Where Y is the output, Xj is a vector of inputs (j=1,2,...,J),. A dot over a variable indicates its rate of change between two time periods (annual change). In case of multiple outputs, the TFP growth will be defined as:

$$T\dot{F}P = \sum_m R_m \dot{Y} - \sum_j S_j \dot{X}_J$$

Where;

- R_m is the output value share: $R_m = P_m Y_m / \sum_m P_m Y_m,$
- P_m is the price of the output Y_m

Tornqvist Index

Among index number methods, Tornqvist-Theil Index, which is an approximation toDivisia Index, is to be used in the APEWC-MENA project for constructing the aggregate output index and aggregate input index. Explanation on theoretical properties and issues in measurement of the productivity through the Tornqvist Index can be found in Diewert (1978, 1980); Christensen

(1975); Capalbo and Antle (1988) and Coelli et al., (2005). The Tornqvist output, input and TFP index in logarithm for can be expressed as follows:

Output index:

$$Ln\left(\frac{Q_t}{Q_{t-1}}\right) = {}^1\!/_2 \sum_j (R_{j,t} + R_{j,t-1}) Ln(\frac{Q_{j,t}}{Q_{j,t-1}})$$

Input index

$$Ln\left(\frac{X_t}{X_{t-1}}\right) = {}^1\!/_2 \sum_i (S_{i,t} + S_{i,t-1}) Ln(\frac{X_{i,t}}{X_{i,t-1}})$$

TFP index:

$$Ln\left(\frac{TFP_t}{TFP_{t-1}}\right) = Ln\left(\frac{Q_t}{Q_{t-1}}\right) - Ln\left(\frac{X_t}{X_{t-1}}\right)$$

Where;
$R_{j,t}$ is the share of output *(j)* in total revenue in time (t),
$Q_{j,t}$ is the output *(j)* in time *(t)*,
$S_{i,t}$ is the share of input *(i)* in total input cost, and
$X_{i,t}$ is the input *(i)* in time *(t)*,

The TFP index (last equation) measures TFP changes by calculating the weighted differences in the growth rates of outputs and inputs. The growth rates are in log ratio form, and the weights are revenue and cost shares for outputs and inputs, respectively.

The TFP index as defined in the last equation can be used as an approximation of technological progress, assuming that producers behave competitively, that the production technology is input-output separable, and that there is no technical inefficiency (Antle and Capalbo, 1988).

2.1.8.2. Parametric Methods

As shown in figure 4, both frontier and non-frontier approaches can be further divided into parametric and non-parametric methods. The non-frontier two main approaches in non-frontier methods for the estimation of growth in TFP are the production function approach (also called parametric approach), and the growth accounting approach (also called non-parametric index number method). Both parametric and non-parametric approaches of the non-frontier method see the production function as starting point. Consider:

$$Y = A(t)f(Xx) \text{ and } V = A(t)f(x')$$

Where Y is a single homogenous output, A(t) is an index of technological change or of TFP, f(X) is the functional for of the production function. On used specifying the type of the relationship between Y and X (inputs: labor and capital), V is the real value added, f (X') is the functional form of the relationship between V and (X': input vector)

The non-parametric approach makes reference to the production function estimation, which involves the specification of the functional forms for A(t), f(X) and f(X'). The functional form which is most often used for A(t) is given as (Kathuria et al., 2011) :

$$A(t) = A_0 \, e^{\gamma t}$$

The equation above implies that technological progress occur at a constant rate of γ. A part from specifying a functional from for the technological change, f(X) and f(X') also need to be specified. Three major forms of production function are the most used in literature for TFP change measurement: (i) Cobb-Douglas production function; (ii) CES (Constant Elasticity of Substitution) production function and; (iii) TL (Transcendental Logarithmic) production function. Hereby the functional form corresponding to the CD production function (which is the most used among the previous forms):

$$\log\left(\frac{V_i}{L_i}\right) = a + (\alpha + \beta - 1)\log(L_i) + \beta\log\left(\frac{K_i}{L_i}\right) + \gamma t + \mu_i$$

Where V, L, K, and t are real value added, labor, capital, and time respectively.

γ, α's and β's are constants and denote the rate of technical progress, partial elasticity of output with respect to labor, and partial elasticity of output with respect to capital, respectively. By estimating this production function empirically, we can obtain (i) a measure of growth of TFP (or the rate of technical change γ); and (ii) exact information on returns to scale (Kathuria et al., 2011). In fact, if (α + β -1) is not significantly different from 0, the assumption of CRS (constant returns to scale) hold true. Depending on this magnitude, we can also find out if we are faced to increasing or decreasing returns to scale conditions.

2.1.9. Frontier Approaches for TFP Calculation

Frontier approaches for estimation of TFP growth assume the existence of a production function corresponding to the set of maximum attainable output levels for a given input combinations. The advantage of this approach is that it decomposes the changes in TFP into technological progress and technical efficiency changes. The former associated with changes in the best-practice production frontier, and the latter with other productivity changes, such as learning by doing, improved managerial practices, and changes in the efficiency with which a known technology is applied (Kathuria et al., 2011). The two main approaches in the estimation of TFP growth using frontier methods are the Malmquist (nonparametric approach) and the stochastic frontier (parametric) approaches.

2.1.9.1. Parametric approaches (based in Econometric models)

The stochastic frontier method (Aigner et al., 1977) estimated used cross sectional data of N observed firms. It assumes that a firm (i) uses inputs Xi (i = 1, …,N) to produce an output Yi, and the function can be written as follows:

$$Y_i = f(X_i, \beta)e^{(\delta_i - u_i)}$$

The particularity of this model is that the error term is divided into two main components. These are the usual random noise component (□□) and the inefficiency component (ui). The noise component is measuring measurement errors and other random errors which are beyond the firm capacity. This error term is normally distributed with a mean 0, and constant variance□□2. (ui) are assumed to be independently and identically distributed, they are also assumed to be non-negative. U takes a value of 0 when the firm is fully efficient (technical efficiency equal 1), and a value lower than 0 when the firm faces some technical inefficiencies. Thus, the value of u measures the firm efficiency level which is also expressing how far a firm's given output is from its potential output compared other firms of the sample.

2.1.9.2. Non parametric approaches (Double Envelope Applications (DEA) and the Malmquist index)

This research methodology is similar to the stochastic frontier approach with the unique difference of non-requirement for parameters estimation for the farmers' production technology description. Instead, the technology of the best performing farmers is considered as benchmark, and the efficiency of the rest of farmers in the sample will be measured accordingly. The Use of DEA approach aims to provide measures of the efficiency and productivity of firms.

For the DEA approach, data requirement are the same than for the SFA modelling approach. The same type of input-output matrix is needed in order to be able to calculate firm's TFP and efficiency. Panel data is also possible and suitable to use in DEA.

Unlike the parametric estimation, the deterministic estimation has a single one sided error component where u is greater than 0 represent technical inefficiency (Kathuria et al., 2011). The Approaches to Total Factor Productivity Measurements in the Agriculture Economy shortcoming of the DEA approach is that all deviations from the frontier are considered as technical inefficiencies. TFP change in DEA approach is estimated through changes in Malmquist productivity index.

Caves et al (1982) first introduced the Malmquist productivity index. The non-parametric estimation of this index was initiated by Färe et al, (1994). Färe et al., (1994) showed that comparing each firm to the best practice frontier provides a measure of its efficiency and a measure of shift in the frontier (from one period to another) which is also similar to the technological progress. The Malmquist index measuring the TFP change is then a product of the latter both components. It is defined through a distance function measuring the TFP growth between two time periods by calculating the ratio of the distances of each data point relative to a common technology (Kathuria et al., 2011). It is decomposes productivity into technical change and technical efficiency change (Coelli, 2008). Based on Färe et al., (1994), the Malmquist index can be written as:

$$m_0(y_{t+1}, x_{t+1s}, y_t, x_t) = \left[\frac{d_0^t(y_{t+1}, x_{t+1})}{d_0^t(y_t, x_t)} \times \frac{d_0^{t+1}(y_{t+1}, x_{t+1})}{d_0^{t+1}(y_t, x_t)}\right]^{1/2}$$

Where (t) is the initial (reference) time period and (t+1) is the final period. $d_0^t(y_t, x_t)$ Represents from the period t observation to the period (t+1) technology. m0 higher than 1 indicates a TFP growth between both periods while a value of m0 lower than 1 indicates a TFP decline. The Malmquist in equation below is representing the productivity of the production point (xt+1, yt+1) relative to the production point (xt, yt). This index is in fact a geometric mean of two output-based Malmquist TFP indices; one index uses the period (t) technology and the other period (t+1) technology.

CHAPTER THREE

RESEARCH METHDOLOGY AND DATA

This chapter gives details on how the research is carried out. Therefore, the researcher concentrates on the methods that uses throughout the study to accomplish the research objectives. It includes the research design, the type, source of the data and methods of collection used, the model specifications, estimation procedure.

3.1. Research Design

The study design employs an explanatory or causal research design in order to achieve its objectives. It is the most appropriate design for identifying the causal relationships between the growth of productivity and other major productivity variables.

3.2. Data Type, Source and Methods of Collection

The data used for this study is a quantitative data type which is based on some measurement of characteristics. Because most time series analysis are quantitative in nature and all the variables used in this model are macroeconomic, variables that are expressed in quantitative terms. The study employs secondary data that are collected from Ethiopian Statistics Agency (CSA), Ministry of Finance and Economic Development (MOFED) etc.

3.3. Methods of Data Analysis

The study uses both the Descriptive and Econometric Methods of data analysis. Graphs and tables are descriptive statistical methods used to briefly explain the macroeconomic performances and trends of the variables used in the model .The econometrics analysis includes testing of important test and interpretation of results based on econometric model results. To analyze the data, the statistical package of Stata version 14 is used.

3.3.1 Econometrics Model Specification

The neo-classical Solow growth model explains economic growth as resulting from the combination of two elements namely capital and labor. However, Lucas extended the Solow growth model by including one more variable that explains economic growth, which is human capital. Apart from capital and labor, Solow decomposes the growth in output into three components capital, labor and total factor productivity (Solow residual).The neo-classical Solow growth model explains economic growth as resulting from the combination of two elements namely capital, labor technology change. This approach utilizes the standard neoclassical production function as a starting point for decomposing the contribution of factor inputs and technological change to output growth.

Yt= AtKtaLβt------------------------------------(3.1)

Where Yt represents output, Kt capital input, Lt labor input and At for the state of technology (Total Factor Productivity) and the parameter α and β are the output elasticity of capital and labor equation (3.1) with respect to time, dividing it by Y, and re arranging it, Further taking the logarithm on both side and rearranging yields:

lnYt = lnA0+ƛt+alnKt+blnLt..........................3.2

lnYt = B0+B1ƛ+B2lnKt+B3lnLt.+εt....... ....3.3

Where ε t refers to the disturbance term, the output elasticity of capital (B2) and labor (B3)and the technology (TFP)coefficient of(B1) are then estimated using time series data on output, capital stock and labor respectively.

The production function further simplified by taking the first derivation of each terms with respect to time on both side of the equation 3.3

lnYt /dt= dB0 /dt +dB1ƛ/dt+dB2lnKt/dt+dB3lnLt./dt+εt....... ....3.4

Applying the fact that the rate of change of the logarithm of a variable equals the growth rate of that variable to equation 3.4 yields the growth accounting equation of:

ΔY/Y = B1+B2ΔK/K+B3 ΔL/L…………(3.5)

Where B2 and B32 are the growth elasticity of capital and lobar inputs,

ΔY/Y actual growth rate of output (Δrinc)

ΔK/K actual growth rate of capital

$\Delta L/L$ actual growth rate of labor

And ($\Delta A/A$) The total factor productivity growth is then derived as residua.

The above equation states that output growth which was Peroxide bt Rincis dependent variable on factor productivity, labor force and physical capital accumulation. The actual growth in output can be applied in to the contribution of growth of inputs and total factor productivity given the output elasticity and growth rate of labor and capital input with the help of equation 3.1.The contribution of an input equals the product of the output elasticity of that inputs and the growth rate for output and inputs are computed as average for different sub periods over the sample period.

3.3.2 Concepts and Definitions

Number Employed: - includes all persons on the payroll whether seasonal or temporary workers. The number of seasonal and temporary workers has been adjusted to give the equivalent of full-time worker

Revenue from Sales: - represents the total sales value of all products and by-products during the reference year, valued at market price.

Gross Value of Production: - includes the sales value of all products of the establishment, the net change of stocks between the beginning and end of the reference period in the value of finished goods and the value of semi-finished goods, the value of industrial services rendered to others, the value of goods bought and resold without any transformation or processing, and other receipts. The valuation of Gross Value of Production is in terms of producers' values where indirect taxes are included in the value of sales of the establishment and the value of subsidies received is excluded.

Fixed Capital Assets: - are those with a productive life of one year or more which are intended for the use of the establishment including fixed assets made by the establishment's own labor force for its own use. They are valued in this report at book-value at the end of the reference year that is the net book value at the beginning, plus new capital expenditure minus those sold and disposed and depreciation during the reference year.

Gross Value of Production: - includes the sales value of all products of the establishment, the net change of stocks between the beginning and end of the reference period in the value of finished goods and the value of semi-finished goods, the value of industrial services rendered to others, the value of goods bought and resold without any transformation or processing, and other receipts. The valuation of Gross Value of Production is in terms of producers' values where indirect taxes are included in the value of sales of the establishment and the value of subsidies received is excluded.

3.4. Research Hypothesis

The study hypothesized the following:

H0: All physical stock of capital and labor do not simultaneously determine the growth of real income.

H1: All physical stock of capital and labor do simultaneously determine the growth of real income.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Descriptive Analysis

4.1.1. Productivity Analysis

The two important partial productivity measures are productivity labor and capital. Labor productivity measures the ratio of real income to different measures of Labor input. Labor can be measured by total labor hours of work, total number of employees, or the total wage bill. In the discussion below, I used total no of employees employed as a measure of labor because of lack of data on hours worked and number of temporal employees. Implicit sectoral GDP deflator and CPI deflate real income by the manufacturing sector respectively. Thus, the productivity of labor, ratio of real income to total no of employees, indicate the real productivity of a Birr (in real terms). On the other hand, productivity of capital is measured by the ratio of real income to the total fixed capital.

The Appendix A shows the ratio of real RIC to no of employees of the all manufacturing firm's shows declining trends in the earlier periods. However, the trend has shown an improvement after 2002/03. The average of the ratio for the period 1995/06–2001/02 was 0.68 showing an average annual decrement at the rate of 0.68 percent. Unlike this period, the average productivity of a Birr earned by the manufacturing industry was 1.4 showing an average annual increment at rate of 1.4 percent. Productivity (real income per no of employees) of 1.4 implies that for every Birr the industry earns roughly amounting to 1.3 Birr. The productivity of capital has also showed the same trend as the productivity of labor. Average productivity of capital for the periods 1991/06–2001/02 and 2002/03–2016/17 was -0.01 and –0.01 with an average annual rate of growth of negative -1.2 percent. The productivity of capital (value added per unit of fixed productive capital) is very small compared to that of productivity of labor.

As shown in the Appendix C, Labor productivity in 1991/92–2001/02 was high in sectors producing non-metallic mineral products, rubber and plastic products, and food and beverages. Higher productivity in such sectors could result from having better technologies, high competition, and high market demand. The fast growth of the economy, like the construction sector, creates a large demand for non-metallic mineral products (products such as glass, structural clay, and cement), rubber and plastic products, and even food and beverages, and it may encourage the producers to use better technology that improve labor productivity. In contrast, productivity of labor is low in sectors producing wearing apparel and textiles. Manufacturers of n-metallic minerals, fabricated metal, textile, and wearing apparel have achieved better increase in their labor productivity than others. Regarding productivity of capital, it is high inspectors producing paper products and printing, non-metallic minerals, food, and beverages. Manufacturers of wearing apparels and textiles have low capital productivity similar to their labor productivity. This is possibly because of the large value of capital used in the production process compared to the no of employees employed.

To sum, the two productivity measures show that the Ethiopian manufacturing sector has low factor productivities; especially capital productivity is very small. The trend of both productivity measures, however, showed improvements in recent years as the average annual growth of both productivity measures were positive for most sectors in the period 2002/03–2016/17.

In the recent period, producers of non-metallic products, and rubber and plastic are seen to have higher capital intensity while producers of paper products and printing have lower Capital intensity. With only these observations, we can argue that producers with higher Capital intensity will have higher labor productivity and producers with lower capital intensity will have better capital productivity. However, taking all manufacturing industries into consideration it will be difficult to make such conclusion.

What is also apparent with respect to the performance of these firms, high variation in the ratios among firms reflects, apart from the difference in the degree of productiveness, the production technique employed, i.e., labor or capital intensity, or any mixture of these factors. For instance a firm that is recording the highest value added to labor ratio, but the lowest value added to capital ratio may have employed a highly capital-intensive production technique and vice versa. Hence, there seems to be some correlation between corresponding labor and capital productivity ratios. While firms with divergent labor and capital productivities registered a declining trend, those with relatively equal, or nearly equal, labor and capital productivity ratios showed positive growth.

The overall declining trend of both labor and capital productivities may not be surprising in light of the lack of capital deepening, or lack of investment/renovation in these firms. For all sample firms, capital intensity declined at an annual average rate of 1.3 percent, implying a gradual de-capitalization process. Considering individual establishments, the lack of capital deepening, therefore, is one of the major factors for the deterioration in labor productivity. The overall decline in capital intensity, labor and capital productivities have an obvious implication for total factor productivity. Over the period under consideration and even for earlier periods, Befekadu & Berhanu, (1999/2000), TFP has been consistently falling. This is precisely the trend in the Ethiopian tanning sector.

4.2. Econometrics Results

4.2.1. Unit Root test

Most macroeconomic time series are trended and therefore in most cases are non-stationary. If non-stationary of the macro variables is not corrected, it would lead to the problem of spurious regression (false relationships among the variables).So before utilizing the data in estimating ARDL, it is imperative to check the time series properties of each series. When a series contains unit root, it is common to transform the variables through differencing so as to make it stationary. In order to determine the degree of integration, a unit root test is carried out using the standard Augmented Dickey Fuller (ADF) , model all of the variables should not be integrated of order two (I (2)). But, they should be a mixture of integrated of order zero (I (0)) and integrated of order one I (1).

When the ADF test statistic is larger than the critical value in absolute terms and lower, Mackinnon (1996) one sided p values, the null hypothesis of unit root test is rejected; and if the absolute value of ADF test statistic is lower than that critical values or higher Mackinnon (1996) one sided p values, we fail to reject the null hypothesis.

Table (3) shows the results of ADF for unit root. The test was done for two alternative specifications. First it is tested with constant but no trend and then it is tested with constant and trend.

Table 3: Summary of the ADF test result

Variable name	ADF test model		
	Constant only	Including trend term	
Inc	Has unit root	Has unit root	I(1)
Noem	Has unit root	Has unit root	I(1)
Soc	Has unit root	Has unit root	I(1)
Rinc	Has no unit root	Has no unit root	I(0)
Lnrinc	Has no unit root	Has no unit root	I(0)
Lnsoc	Has unit root	Has no unit root	I(0)
Lnnoem	Has unit root	Has no unit root	I(0)

Therefore, for variables to be co-integrated (have long run relationship) all of them have to be non-stationary at level and be of the same order of integration. In our result shown in the above table (3), since the variables are stationary at level, co-integration is not plausible. Meaning error correction model is not applicable.

4.2.2. Productivity Growth

The critical technology parameters, the share of capital in output and the share of labor in output, for the manufacturing industry are econometrically estimated and using different production function estimates.

Table 4: Parameter estimation of production function of manufacturing industry

Dependent Variable: lnReal income eq (3.5)

Source	SS	df	MS		
				Number of obs =	25
				F(2, 23) =	4548.95
Model	3537.93809	2	1768.96905	Prob > F =	0.0000
Residual	8.94410279	23	.388874034	R-squared =	0.9975
				Adj R-squared =	0.9973
Total	3546.8822	25	141.875288	Root MSE =	.6236

lnrinc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnsoc	.0765847	.130458	0.59	0.563	-.1932882	.3464576
lnnoem	.930525	.1724207	5.40	0.000	.5738455	1.287204

Sample period 1991/92-2016/17

Table 4 presents the estimated coefficients of the labor and capital elasticity's in the production function. From this table, the income increment is due to change in labor and capital stock rather than total productivity growth (which actually mean skill and knowledge transfer)' we can see that the results of the elasticity estimated by OLS are in conformity with many other results on Ethiopian manufacturing (Mohammed (2008). The elasticity's of output with respect to labor are higher than the elasticity's of output with respect to capital, reflecting the high labor use in Ethiopian manufacturing. Once the input elasticity estimated, and the coefficient of capital accumulation is found insignificant that is there is no technological progress that is expected from it consequently the contribution of capital to increase productivity is insufficient.

4.2.3. TFP Analysis

As shown in the table Append B below the contribution of TFP for the growth of revenue (Rinc) is insignificant, income increment is due to change in labor and capital stock rather than total productivity growth (which actually mean skill and knowledge transfer)'. Based on the value of the coefficient of the natural logarithm of TFP when we regress on lnrinc with In TFP the regressing result showed that in Ethiopian middle land large manufacturing industries have never exhibited a total factor productivity that implied according to Solow growth theory. TFP growth as obtained from frontier approach consists of two components(i) Outward shifts of the production function resulting from technological progress, and (ii) technical efficiency related to the movements towards the production frontier accordingly the in industry have lack of technology transfer and subsequently lead to absence of TFP growth and remain stagnant (Annex I).

Table 5: The Effect of growth of TFP to Rinc

Source	SS	df	MS		
				Number of obs =	25
				F(1, 24) =	0.06
Model	8.94410448	1	8.94410448	Prob > F =	0.8075
Residual	3537.93809	24	147.414087	R-squared =	0.0025
				Adj R-squared =	-0.0390
Total	3546.8822	25	141.875288	Root MSE =	12.141

lnrinc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TFP	1	4.059767	0.25	0.808	-7.378947	9.378947

Regress in resultes of lnric, ln TFP stat

From the regression analysis, to find for any relation between the growth of real income with that of TFP, the t value of the TFP (natural log) is < 2 and we can conclude that that the TFP growth has no impact on the growth of the manufacturing sector for all firms collectively. As shown in the Appendix C, total factor productivity growth stagnant at an annual average rate of 0.010 percent over the 25 years.

This result is similar to the findings using Stochastic Frontier Model Melaku T. Abegaz,(2013). Total Factor Productivity and Technical Efficiency in the Ethiopian and total factor productivity (TFP) using unbalanced panel data collected by CSA, the empirical results indicate existence of large inefficiencies, that explains at least 14 percent of output variation among firms. And the results from Mohammed (2008) analyzed TFP and competitiveness of textile and garment industries using and a panel data from the MMIS (Large and Medium Manufacturing Industries Survey) (2001–2005). He found a negative TFP growth and that these sectors are uncompetitive, even in the domestic market Industrial groups.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This study evaluated TFP growth in the Ethiopian manufacturing sector using a growth accounting model. The model employed is used to evaluate and measure TFP growth and decompose it into its components. Translog production function with labor and capital. Methodologically, the study adopteda descriptive analysis to measure partial factor productivity (labor and capital productivity) and to give more explanation about the elasticity of the factors, Results of the descriptive partial productivity indicate deterioration in the productivity of labor and capital in the period 1991/92-2001/2002 and with little improvement with specific firms from 2002/03-2016/17.

Findings of the study agree with findings of other similar study carried out using Stochastic Frontier Model Melaku T. Abegaz, (2013). Total Factor Productivity and Technical Efficiency in the Ethiopian and total factor productivity (TFP) using unbalanced panel data collected by CSA, where the finding indicate existence of large inefficiencies that explains at least 14 percent of output variation among firms. The results from Mohammed (2008) analyzed TFP and competitiveness of textile and garment industries using a panel data from the MMIS (Large and Medium Manufacturing Industries Survey) (2001–2005). He found a negative TFP growth and that these sectors are uncompetitive, even in the domestic market Industrial groups.

With issue regarding deprecation of fixed asset, the decreasing returns to scale observed in the industry exhibited the fact that there is a large output elasticity with respect to labor as compared to the capital inputs significantly. But, the effect of capital accumulation is an important factor that determines TFP growth and production in general.

In the manufacturing survey of CSA producers claim that the lack of raw material is a major business constraint that hindered them in producing their full potential. Increasing availability of materials by creating different marketing and transportation channels or guiding firms to areas where supplies of raw materials are abundant is important to increase efficiency and productivity of firms Ratio of real income to stock of capital.

The existence of decreasing returns to scale is an indication that firms are operating above their optimal scale (proportion of factors). In this case firms may need to improve their scale to the optimal level by decreasing their costs of production, improving efficiency, and adjusting the proportion of factors to bring more intensive utilization of the more productive inputs. Having labor or capital above the optimal proportion will bring productivity down though production increases with increase in inputs. Thus, firms need to understand that and improve their scale of operation by improving the proportion of their inputs. Achievements in TFP growth can further be strengthened by improving the technical efficiency and scale efficiency of manufacturers. Promoting efficiency by creating an environment that makes employees advance their technical know-how, management skills, entrepreneurial and innovative skills is very important. Furthermore, productivity could also be increased through bringing, adopting, and imitating new technologies.

Finally, further investigations and thorough researches should be undertaken to identify the determinants of productivity, scale of operation and their changes. Such studies will help identify the causes of inefficiencies, sub-optimal or over optimal scale operation, and changes in technology. Policies will then be developed to bring changes in the manufacturing sector and to significantly contribute to the economic growth.

5.2. Policy Recommendation

Based on finding of the study, the following policy recommendations are made:

- Gross capital accumulation or investment in physical asset is a very significant factor for Ethiopian technological progress of efficiency. So the government of Ethiopia should give due attention to encapsulating a policy package that would give necessary support for the industry to upgrade the technology of fixed assets so that technical change will be observed from the industry that will enhance the share of this sector to GDP.

- In order to enhance the labor productivity, the government of Ethiopia should create adequate financial opportunities in order to increase both the quantity and quality of education and to provide basic and improved health services to the society. Such a policy intervention would bring competent labor force that would contribute to technological transfer, innovation and efficiency since education and health are the two main complementary pillars for development.

- Import substituting policy schemes should be given especial support and attention in order for Ethiopia to maintain its account balance which is currently become chronic problem in the economy, through the provision of integrated & adequate training, incentivizing investors in the sector, follow up and other means.

- In Ethiopia, labor is abundant and capital is scarce. As a result, in order to grow faster, Ethiopia should use this abundant resource properly (uses labor intensive technology). The finding reveals the fact that labor has a positive impact for the growth of Ethiopian economy. Therefore, in order to increase the contribution of labor to growth through efficiency, the government should work to upgrade knowledge and skills of labor force.

- Foreign Investment: the government should give more emphasis for bringing foreign investment so that the country would increase total factor productivity as inputs increase, provided this investment is used to promote efficiency of industry.

- Finally, LMMIS sector in Ethiopia does not properly play its role. Finance is very important to facilitate either capital investment or to execute day to day operations. Thus, the government should have a policy intervention to facilitate access to finance industries and it should also implement adequate follow up mechanisms in order to enhance manufacturing and increase the economic growth from the trickledown effects of the industry

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APPENDICES

Appendix I: Productivity analysis of firms for period 1991/92-2001/02 and 2002/2003-2016/17

Firms	Years	Average Real income /No Employees	Average Real income/stock of capital	Average Growth of RIC/No Employee	Average annual Growth of RIC/Soc
F&B	1991/92-2001/02 2002/03-2016/17	2.6 4.13	0.09 0.02	-0.85 0.12	-1.02 0.23
MTO	1991/92-2001/02 2002/03-2016/	3.5 9.19	1.4 0.03	-0.27 -0.13	-36.0 0.19
TXT	1991/92-2001/02 2002/03-2016/17	0.3 0.91	0.75 0.09	-0.20 -0.04	-11.0 -10.17
MWA	1991/92-2001/02 2002/03-2016/	0.75 0.9	0.266 0.24	-0.03 0.015	-3.3 -3.7
T&I	1991/92-2001/02 2002/03-20116/17	0.26 0.24	0.13 0.001	-0.61 0.18	-12.1 -8.10
MWP	1991/92-2001/02 2002/03-2016/17	0.13 .007	2.1 1.28	-2.56 -0.26	-14.23 -1.12
MPP	1991/92-2001/02 2002/03-2016/17	2.4 1.28	0.53 0.07	-0.03 0.015	-3.30 -3.72
MCH	1991/92-2001/02 2002/03-20116/17	0.66 0.54	0.33 0.03	-0.61 0.18	-12.05 -8.10
MRB	1991/92-2001/02 2002/03-2016/17	1.31 1.32	0.90 0.27	-2.56 -0.55	-14.23 -2.7
MNM	1991/92-2001/02 2002/03-2016/17	3.02 1.85	0.10 4.47	-1.5 0.25	-3.45 -5.62
MBI	1991/92-2001/02 2002/03-2016/17	2.8 2.15	0.10 4.47	-0.02 0.086	-0.04 0.10
MFM	1991/92-2001/02 2002/03-2016/17	2.81 2.15	0.05 0.01	-3.39 0.20	-2.95 0.44
MME	1991/92-2001/02 2002/03-2016/17	1.4 1.98	0.59 0.08	-0.05 -2.28	-4.44 -0.25
MMV	1991/92-2001/02 2002/03-2016/17	5.6 6.8	0.43 -0.17	-7.36 -0.65	-2.02 -1.06
MFUR	1991/92-2001/02 2002/03-2016/17	4.13 1.86	0.07 0.02	-9.38 0.166	-1.71 .099

Own calculation using (CSA) annual manufacturing sector survey report

Appendix II: Productivity analysis of firms for period 1991/92-2001/02 and 2002/2003-2016/17

Firms	Years	Average Real income /No Employees	Average Real income/stock of capital	Average Growth of RIC/No Employee	Average annual Growth of RIC/Soc
F&B	1991/92-2001/02 2002/03-2016/17	2.6 4.13	0.09 0.02	-0.85 0.12	-1.02 0.23
MTO	1991/92-2001/02 2002/03-2016/	3.5 9.19	1.4 0.03	-0.27 -0.13	-36.0 0.19
TXT	1991/92-2001/02 2002/03-2016/17	0.3 0.91	0.75 0.09	-0.20 -0.04	-11.0 -10.17
MWA	1991/92-2001/02 2002/03-2016/	0.75 0.9	0.266 0.24	-0.03 0.015	-3.3 -3.7
T&I	1991/92-2001/02 2002/03-20116/17	0.26 0.24	0.13 0.001	-0.61 0.18	-12.1 -8.10
MWP	1991/92-2001/02 2002/03-2016/17	0.13 .007	2.1 1.28	-2.56 -0.26	-14.23 -1.12
MPP	1991/92-2001/02 2002/03-2016/17	2.4 1.28	0.53 0.07	-0.03 0.015	-3.30 -3.72
MCH	1991/92-2001/02 2002/03-20116/17	0.66 0.54	0.33 0.03	-0.61 0.18	-12.05 -8.10
MRB	1991/92-2001/02 2002/03-2016/17	1.31 1.32	0.90 0.27	-2.56 -0.55	-14.23 -2.7
MNM	1991/92-2001/02 2002/03-2016/17	3.02 1.85	0.10 4.47	-1.5 0.25	-3.45 -5.62
MBI	1991/92-2001/02 2002/03-2016/17	2.8 2.15	0.10 4.47	-0.02 0.086	-0.04 0.10
MFM	1991/92-2001/02 2002/03-2016/17	2.81 2.15	0.05 0.01	-3.39 0.20	-2.95 0.44
MME	1991/92-2001/02 2002/03-2016/17	1.4 1.98	0.59 0.08	-0.05 -2.28	-4.44 -0.25
MMV	1991/92-2001/02 2002/03-2016/17	5.6 6.8	0.43 -0.17	-7.36 -0.65	-2.02 -1.06
MFUR	1991/92-2001/02 2002/03-2016/17	4.13 1.86	0.07 0.02	-9.38 0.166	-1.71 .099

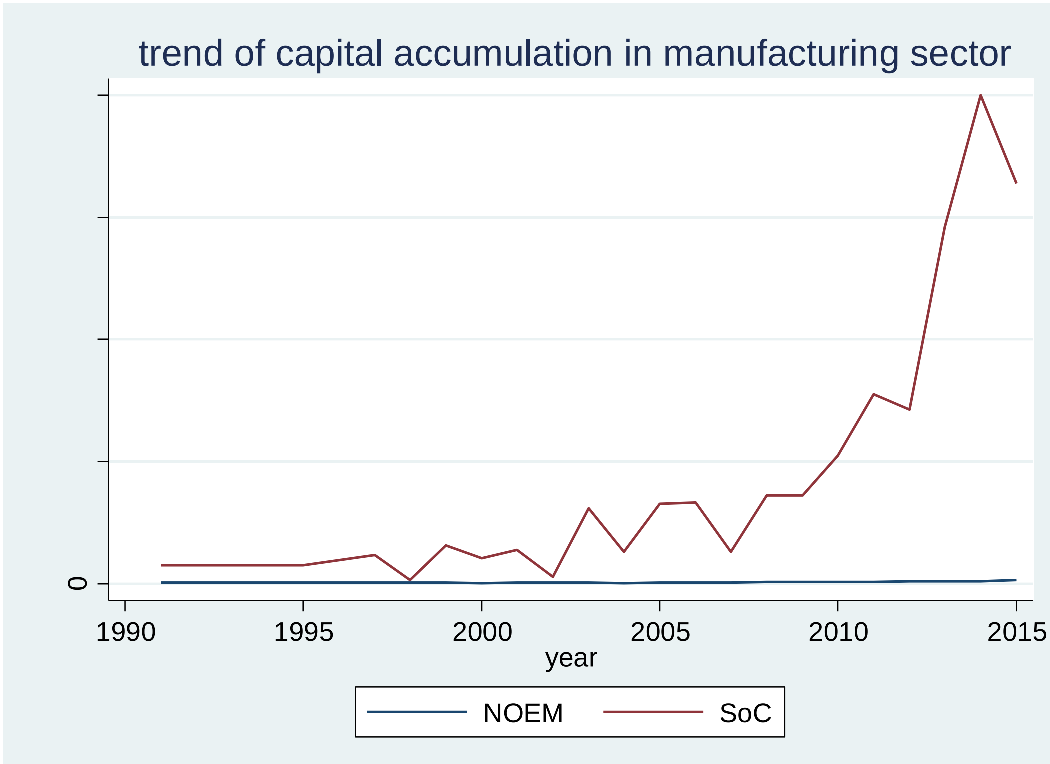
Own calculation using(CSA) annual manufacturing sector survey report

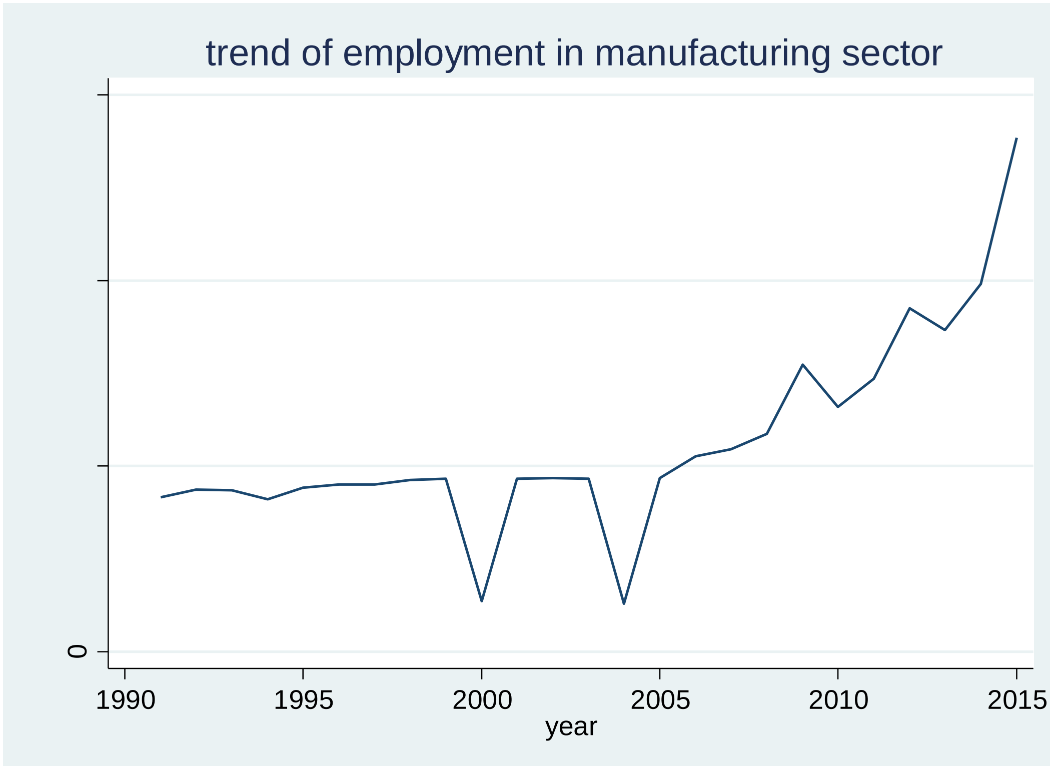
Appendix III: Variables used for computation

	inc	*noem*	*soc*	*cpi*	*rinc*	*lnrinc*	*lnsoc*	*lnnoem*	*TFP*	
1991	*4.70E+06*	*83170.4*	*1.50E+06*	*25.2*	*186705*	*12.13729*	*14.23553*	*11.32865*	*11.42631*	*2.435919*
1992	*4.80E+06*	*87474.4*	*1.50E+06*	*27.8*	*171976*	*12.05511*	*14.23553*	*11.3791*	*11.46094*	*2.438945*
1993	*4.70E+06*	*86863.7*	*1.50E+06*	*28.8*	*162832*	*12.00048*	*14.23553*	*11.3721*	*11.45613*	*2.438525*
1994	*4.90E+06*	*82082*	*1.50E+06*	*31*	*157502*	*11.96719*	*14.23553*	*11.31547*	*11.41727*	*2.435127*
1995	*4.60E+06*	*88296*	*1.50E+06*	*34.1*	*134663*	*11.81053*	*14.23553*	*11.38845*	*11.46736*	*2.439504*
1996	*4.60E+06*	*90213*	*1.90E+06*	*31.2*	*147248*	*11.89987*	*14.46863*	*11.40993*	*11.54189*	*2.445983*
1997	*5.50E+06*	*90039*	*2.30E+06*	*31.9*	*171209*	*12.05064*	*14.66475*	*11.408*	*11.59087*	*2.450217*
1998	*6.10E+06*	*92365*	*306574*	*32.2*	*189722*	*12.15331*	*12.63321*	*11.4335*	*11.08729*	*2.4058*
1999	*4.60E+06*	*93216*	*3.10E+06*	*34.8*	*132196*	*11.79204*	*14.95338*	*11.44267*	*11.6887*	*2.458622*
2000	*2.40E+06*	*678007*	*2.10E+06*	*35*	*67680.1*	*11.12255*	*14.54886*	*13.42691*	*12.94675*	*2.560844*
2001	*3.10E+06*	*93279.7*	*2.80E+06*	*32.1*	*95754.2*	*11.46954*	*14.83052*	*11.44336*	*11.65765*	*2.455963*
2002	*2.80E+06*	*93515*	*540745*	*32.7*	*87108.6*	*11.37491*	*13.2007*	*11.44588*	*11.24134*	*2.419598*
2003	*2.90E+06*	*93206*	*6.20E+06*	*38.5*	*75209.3*	*11.22803*	*15.63841*	*11.44257*	*11.86433*	*2.473536*
2004	*5.70E+06*	*25986*	*2.60E+06*	*39.7*	*142371*	*11.86619*	*14.77616*	*10.16531*	*10.76657*	*2.376446*
2005	*1.00E+07*	*96388*	*6.50E+06*	*44.8*	*231487*	*12.35228*	*15.68908*	*11.47614*	*11.90037*	*2.476569*
2006	*1.00E+07*	*105381*	*6.60E+06*	*50.4*	*205766*	*12.2345*	*15.70545*	*11.56534*	*11.96578*	*2.482051*
2007	*6.60E+06*	*109145*	*2.60E+06*	*59*	*111410*	*11.62097*	*14.77285*	*11.60043*	*11.75066*	*2.46391*
2008	*9.70E+06*	*117397*	*7.20E+06*	*85.3*	*113859*	*11.64271*	*15.79459*	*11.67332*	*12.06276*	*2.490123*
2009	*2.90E+07*	*154569*	*7.20E+06*	*92.5*	*312232*	*12.6515*	*15.79459*	*11.9484*	*12.25154*	*2.505652*
2010	*2.60E+07*	*131803*	*1.00E+07*	*100*	*260468*	*12.47024*	*16.16158*	*11.78906*	*12.23633*	*2.504409*
2011	*1.20E+07*	*147193*	*1.60E+07*	*133.2*	*92163.4*	*11.43132*	*16.55792*	*11.8995*	*12.41378*	*2.518807*
2012	*1.20E+07*	*185086*	*1.40E+07*	*163.6*	*73656.6*	*11.20717*	*16.47137*	*12.12858*	*12.54879*	*2.529625*
2013	*6.00E+07*	*173397*	*2.90E+07*	*176.8*	*337031*	*12.72793*	*17.18995*	*12.06334*	*12.68833*	*2.540683*
2014	*1.00E+08*	*198088*	*4.00E+07*	*189.8*	*535276*	*13.19054*	*17.50382*	*12.19647*	*12.86021*	*2.554138*
2015	*2.20E+07*	*276854*	*3.30E+07*	*209.1*	*104385*	*11.55584*	*17.30439*	*12.53125*	*13.03882*	*2.567931*

Input variables for state (rinc,soc.noem) computed based on CAS report

Appendix IV: Graphs showing trends of capital accumulation & employment in manufacturing sector




trend of employment in manufacturing sector
0
1990
1995
2000
2005
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year