INDUSTSTRIALIZATION OF ECONOMIES WITH LOW MANUFACTURING BASE

Atlaw Alemu

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This is to certify that the dissertation prepared by Atlaw Alemu entitled: *Industrialization of Economies with Low Manufacturing Base* and submitted in fulfillment of the requirements for the Degree of Doctor of Philosophy (Economics) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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It all began as an exciting exercise. Painful episodes followed with changes in ease and difficulty of meeting schedules of the coursework and writing the dissertation. At times, I regret that many people knew about my involvement in a PhD program, for the extension of period for completion raises undesirable comments. However, it went on with a determination to complete the undertaking whatever the difficulties! The driving forces that propelled the progress of the project were two. The urge to complete what I have started, a moral position, and the eagerness to arrive at a conclusion on the research issue, which was a curiosity to answer a life-long question. Now that I have reached the stage of concluding the project with answers to my questions, I am pleased and satisfied. The pains and anxiety are history, with lessons left behind.

My special gratitude goes to the patient and meticulous supervisor Professor Borje Johansson for his unreserved guidance and feedback. I don't forget Professor Ghazi Shukur for his kind support up to the time he quit advising for reasons beyond his control. Thanks to Kristofer Manson (PhD) to fill the gap created by the discontinuity of the role of Professor Ghazi Shukur. Kristofer's prompt responses and feedbacks were extremely important in enhancing the quality of the dissertation.

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The time I had for my family and close ones during the study was too short and hopefully I will compensate soon.

Atlaw Alemu
Addis Ababa, Oct 2015

ABSTRACT

The basic theme of the dissertation is placing **structure** *of economies as an intermediate explanatory factor for attainment of sustained growth of low-income economies that are in transition from stagnant agricultural economy to modern economic growth. The dissertation sets out with conceptualization of a model applicable to structures of low income and under industrialized economies, and hypothesizes on the long term outcomes of these structures. Sustained growth is the result of a particular structure in which manufacturing growth drives economic growth. A structure where transaction services have expanded beyond certain levels stunts manufacturing. Empirical investigations were carried out to test the hypotheses on 35 countries that were low-income economies in 1970.The results provide support for centrality of manufacturing and for the retarding effect of non-optimal growth of transaction services on manufacturing growth.*

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CHAPTER I: INTRODUCTION AND SUMMARY OF THE THESIS

I INTRODUCTION

This dissertation is composed of four parts. The first chapter introduces the theme of the entire body of articles that deal with the central issue, which is the crucial role of manufacturing in the process of industrialization of economies in transition from stagnant agrarian economy to modern economy. The second chapter addresses the conceptual framework and model. The third chapter is an empirical investigation seeking support from evidences on the centrality of manufacturing and the fourth chapter provides empirical findings on structural factors responsible for the pace of growth of manufacturing where the relationship of manufacturing and transaction services is investigated.

1.1 BACKGROUND AND MOTIVATION

In the report of UNIDO-UNCTAD (2011), the share of manufacturing in 2008 was 24% in developing economies of the world, 11% in African developing economies, and 10% in economies of Easter Africa. Ethiopian national accounts data reveals that the contribution to GDP of the industrial sector has remained about and below 13% and that of manufacturing below 5% (MOFED, 2011, unstat, 2011). For citizens of a low-income economy, where manufacturing contributes less than 5% of GDP, while agriculture and services each contributes above 40% of GDP, engagement in inquiries about the constraints of industrialization is a legitimate concern. The fact that this feature of the economy is common to many other low-income economies makes it natural to analyze these groups of countries together.

Most of these economies have remained low income for the past 50-60 years while few of them escaped low-income status(unstat, 2011). Explaining why most of them remained low income and why they failed to industrialize so far has remained a source of inspiration, and motivating factor for this study.

Since these countries are in the process of industrialization, we may have to wait for some more decades to see their progress. However, accumulated world experience in development tells us that a period of 50-60 years in transition, without escaping low-income status, is a sign of failure.

Economic history tells us that all economies were agrarian before mid eighteenth century (Bairoche, 1995; Maddisson, 2003). Per capita income (PCI) was low and stagnant in all agrarian economies. Agrarian technologies could not lead to sustained growth of PCI. Whenever PCI grew as a result of the introduction of new agrarian technology, population grew and depressed PCI (Hansen and Prescott, 2002). The advent of industrialization allowed modern economic growth that, in turn, enabled realization of sustained growth in PCI (Kuznets, 1966). Some leading countries started modern economic growth characterized by a steady real per capita income growth (Bairoche 1995; Maddisson, 2003) at the second half of the 19th century. The leading countries made transition to modern economic growth, escaping agrarian stagnancy, in a period of about 100 years (Bairoche 1995; Maddisson, 2003). Late comers reduced this transition period to 80years (USA), 50 years (Japan), and less than 50 years (newly industrialized economies). The failure of the others to escape low-income status in 50-60 years is a valid concern demanding explanation.

Moreover, the gap between the average income of the poorest and that of the richest group of countries is widening. In the early 1970s, there were over 70 countries below real per capita income of 1000USD. In 2011, the number declined to about 60. The average real per capita GDP of the richest 70 countries was about 35 fold of that of the poorest 70 countries in early 1970s. The disparity of average per capita GDP between the richest 60 countries and the poorest 60 countries grew to 60 fold in 2011(unstats, 2013).The gap in the average per capita GDPs is widening, partly because the poorest are not catching up. The failure to catch up needs explanation.

Among existing and most relevant explanations for failure to industrialize are:

- Differences in institutions[1] that define and enforce property rights, and encourage accumulation (Acemoglu and Robinson, 2012)
- Differences in policies that enhance efficiency and TFP of the modern sector (Parente and Prescott, 2003)

Both the explanations are plausible environmental[2] factors that influence economic decisions of individual economic actors. Apart from these environmental factors, there is an internal factor, upon

[1] Institutions are the written and unwritten rules, norms and constraints that humans devise to reduce uncertainty and control their environment (Menard and Shirley, 2008)

[2] Seen from the perspective of the individual decision maker

which environmental factors work to shape economic decisions. This internal factor is societal mindset manifested in individual preferences for economic activities and products. Mindsets of individuals in society as internal factor and the institutions and policies as environmental factors are responsible for the choice of economic activities or for the formation of the structure of the economy. The structure of the economy is the composition of economic activities. The two factors are interacting but independent influential factors for shaping economic structure. The environment influences internal factors but does not give it its quality in a sense that the ambient temperature does not convert an egg of a chicken to an owl.

Structure is thus, the embodiment of either the aggregation of individual choices following their mindset or the impression made by institutional constraining environment or the product of both depending on whichever is the stronger. In spite of the presence of good policies and institutions, some mindsets result in a certain structure that inhibits long-term growth. In similar way, some bad policies and institutions tend to prevent economic structure arising from good mindsets that favor long-term growth. What matters is the embodied structure, whichever way it is engendered. Societal mindset interacting with the environment (institutions and policies), underlies the structure and the structure shapes the long-term evolution of the economy. Thus, the economic structure embodies a certain preferences for economic activities and that structure is the outcome of the mindset of people, and the prevalent institutions and policies. Structure being the embodiments of aggregated individual preferences (choices of activities) or the choice for economic activities shaped by the impressions of institutional environment, which are exogenous factors, render structure an exogenous role. The structure becomes a key factor in the attainment of long-term (sustained) growth.

Members of society can make individual choices among economic activities based on their mindset. Society, collectively, can modify the economic environment by changing institutions and policies. For good policies and institutions to enhance growth and expansion, members of society have to make a choice of economic activity that ensures long-term growth. A choice of activity could be taming nature with traditional agriculture or extracting and harvesting nature with mining activities. This is one type of preference leading to a particular structure. A choice of manufacturing activity as the mode of dealing with nature and creation of products not given by nature to satisfy human needs is a preference forming the basis for another structure. Such kind of societal choice is

manifested by the respect and helpfulness exhibited towards handicrafts, hand skills, creativeness, inventions, modifications, reverses engineering, experimentation, manufacturing etc.
These preferences combined with the institutional and policy environments result in different structures having long-term consequences on per capita income growth. If a combination of preferences for activities and the institutional environment lead to a structure where manufacturing drives economic growth, then this structure ensures sustained growth. In the absence of such choice for economic activities, good institutions and policies do not result in a structure that leads to sustained per capita income growth. Neglect of this structural requirement for sustained per capita income growth makes the explanations based only on institutions and policies incomplete. Thus, the need to explain why some economies remained low-income and under-industrialized, and the incompleteness of the existing explanations prompted the study.

The study raises issues that require further theoretical argument and empirical evidence. Structure as an important factor for sustained growth has garnered both support and indifference in the literature and policy circles. The importance of manufacturing as a structural factor has been ignored in many instances of policy-making on the pretext of the absence of comparative advantages of developing/ underdeveloped countries in manufacturing. Policy-making and implementation in low-income countries has kept on giving inadequate support and emphasis to the issue. The treatment of manufacturing does not go beyond the treatment of any activity under the rubric of the private sector. Observing the inadequacy of the emphasis on manufacturing and because of the failure to industrialize in the past many decades, studies are still raising the issue. To assist policy-making and providing theoretical clarity and additional evidences, further theoretical arguments, models, and empirical evidences are called for.

The policy emphasis on agricultural development, with neglect of manufacturing, is a predominant strategy in developing countries since the 1970s. A typical case is the "Agricultural Development Led Industrialization" (ADLI) strategy of Ethiopia formulated in 1993 and pursued for the past twenty years. In this strategy, agricultural development is a prelude to industrialization. Government and donors' directed their efforts largely to the development of agriculture rather than manufacturing. The current 5-year plan known as Growth and Transformation Plan (GTP) declares that it is part of the ADLI strategy. The strategy is an expression of policy in the choice of economic activities that would have impact on long-term growth in per capita income. Under this strategy structure of the economy has remained to be a dominant agricultural sector and service sector taking over 85% share of the GDP. With the emphasis on agriculture, this structure will prevail for years to come. Whether this structure leads to sustained per capita income growth is doubtful. Currently, emphasis on agricultural and extractive industries and neglect of manufacturing is a common feature of policy making in low-income economies. The dominance of agriculture and services is the main feature of the structure of these economies. The investigation of the contribution of the structure of these economies to their stagnation in the growth of per-capita income is a timely issue.

The rationale for the emphasis of governments and donors, concerned about the development and progress of low-income countries, is the current comparative advantage rather than structural transformation ensuring long-term per capita growth of this group of countries. For economies dominated by subsistence agriculture, those policies persist in promoting the same structure. This study argues that persistence in policies and practices promoting such structure does not lead to sustained growth in per capita income and calls for change of mind.

It may be argued that the importance of manufacturing for sustained growth has already been dealt with in Kaldor(1966) and by others, questioning the value addition in studying the same subject now. However, Kaldor studied 12 advanced European countries with a different structure from the countries included in the current study. Other researchers, such as Cornwall (1976, 1977), Cripps and Tarling 1973, didn't refrain from studying the issue because Kaldor has already studied it. Studying an issue already raised does not make it irrelevant or the fact that it has been studied previously does not mean it has garnered universal acceptance. Even if an issue is universally accepted, one can see any incongruent element and can question it.

While it would not be irrelevant to raise issues that others have already raised, the current study is not a repetition of others. It is not a study about already advanced economies; it is about countries that were low income in 1970, among which very few have come out of low-income status in 42 years period. On top of the relevance of studying structure as an issue, the group of countries studied makes it all the more relevant. The group of countries included in the study provides additional evidence on an issue that has not been settled. The fact that other researchers such as Wells and Thrilwall 2003 for Africa; Lavopa and Szirmai 2012 for 92 countries; Szirmai and

Verspagen 2011 for 90 countries have raised similar issue shows that the issue is a live issue of contemporary importance.

Therefore, there is a need for theoretical argument and empirical evidence on the importance of structure in general and manufacturing growth led structure in particular. The value additions of this study is further strengthening the argument for manufacturing with a unique approach and a unique, structural theoretical growth model pertinent to dual economies. In addition to deriving important implications from the analysis of the model, the study provides empirical support to the implications of the model using a unique empirical method that uses wavelet decomposition of the time series data. Moreover, it incorporates, in original manner, structural factors that are not addressed by other studies. The incorporation of transaction costs within the structural model is a case in point. It is a different approach from others but converging with some of the existing studies on the importance of structure and manufacturing.

1.2 THE HYPOTHESES

The importance of structure for sustained growth emanates from the fundamental assumption that a structural transformation towards the attainment of a particular structure, enhances capital accumulation and capital accumulation leads to the attainment of per capita income growth in the long-run.

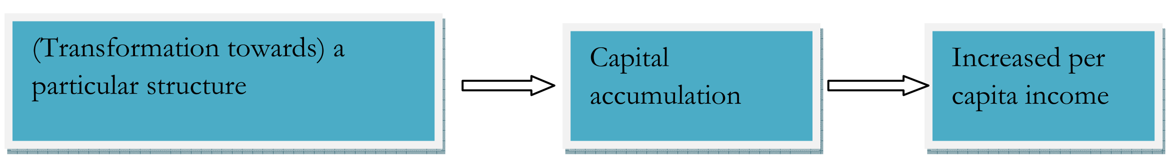


Figure 1.1 Links between structure, Accumulation, and Per capita income

The need to explain the failure of a number of countries to attain sustained per capita income growth and the failure to come out of low-income status through structural transformation towards a growing manufacturing sector in which it is the leading economic activity of a country guided this study to formulate a conceptual model and hypotheses to be tested empirically. The first chapter sets the theoretical background and formulates the conceptual model from which implications are drawn. The implications form the hypotheses.

The first hypothesis attempts to settle the old issue regarding the sectoral importance of manufacturing, in contrast to agriculture, as a leading sector to attain long term growth and industrialization. The hypothesis states "G*rowth of manufactured goods production has greater impact than growth of agricultural goods production on sustained growth of low-income economies at large*". Countries performance in the attainment of sustained growth is explained by the nature of the structural transformation. The structure signifies the sector driving the growth of the economy. A low-income economy, where manufacturing growth does not drive the growth process, fails to attain sustained growth. Agriculture led growth does not lead to sustained growth.

The second hypothesis is about structural factors responsible in facilitating or hindering manufacturing growth. It is an attempt to answer why many countries fail to develop their manufacturing sector. The explaining hypothesis arises from the observed structure of low- income economies, where service and agricultural sectors dominate. Services are taking over the share in GDP while agricultural share is declining. Services stand in the way of manufacturing taking away the share in input resources and output. Services are predominantly transaction services. The hypothesis claims that the level and direction of growth of transaction services matters for manufacturing growth. It states "*There is an optimal level of transaction services*, *where growth of transaction services above the optimal level negatively affects manufacturing growth and growth of transaction services that are below the optimal level enhance manufacturing of low income economies*".

The hypothesis claims that non-optimal transaction services affect manufacturing growth in low-income economies. The faster growth of services suggests that greater magnitude of inputs is shifting to this sector. While the main purpose of services is facilitating goods production and consumption, its faster growth means it absorbs greater inputs while denying the flow of the necessary inputs to goods production. Services are growing at the expense of goods producing sectors. Services are competing out manufacturing in the historical battle for taking over the role and share of agriculture. This hypothesis uniquely shifts the focus of attention from the traditional approach of taking away the share of agriculture in favor of industry to taking away the share of services in favor of manufacturing.

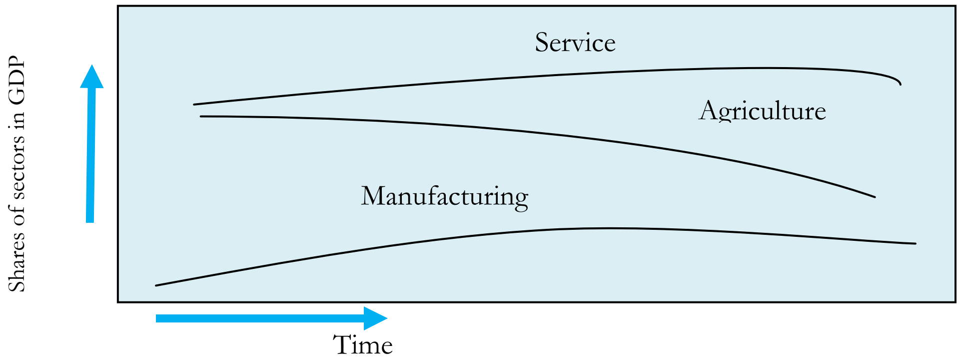


Fig1.2. A *typical structure of a low income economy*

1.3 THE OBJECTIVES

This study is composed of three parts addressing three broad and interconnected objectives. The broad objectives of the three chapters are:

- Establishing a theoretical framework and conceptual model that upholds the significance of structure and manufacturing for sustained growth of low-income economies: The second part of the study addresses this objective.
- Providing empirical evidence on the centrality of manufacturing for sustained growth of LICs: The third part of the study addresses this objective.
- Establishing the structural relationship between manufacturing and transaction services and indicating the structural factors that prompt or inhibit manufacturing growth: The fourth part of the study addresses this objective.

1.4 THE METHODOLOGY

The general approach of the study is formulating a conceptual model, deriving its implications and verifying those implications with empirical data in line with the "covering law" and "hypothetico-deductive" models of scientific explanation. The general approach and methodology followed to address the two hypotheses is similar, with some peculiarities introduced to suit each hypothesis.

The data

The data employed are those obtained from United Nations National Accounts Main Aggregates Database on GDP and components of GDP of all countries. The economies under investigation are those with low per capita GDP, arbitrarily taken to be below 1000 USD in 1970. The per capita GDP is computed taking 2005 as base year. The economies falling into this category are 71 in number of which the first 35 countries in alphabetical order are included in the study (Appendix 3.5). These economies are economies in transition from traditional agricultural economy to modern economy in the sense of Hansen and Prescott (2002) and Parente and Prescott (2003). Although the economies falling to this category are 43 from Africa, 24 from Asia and 4 from Latin America and Caribbean, the study took the first 35 of these countries in alphabetical order, by which 24 countries from Africa, 8 countries from Asia and 3 countries from Latin America and Caribbean. The study chose the period of the past 42 years between 1970 and 2011 based on availability of data for all economies. Some of these countries have made big progress in attaining per capita GDP exceeding 1000 USD, while others are still below that mark.

Tab1.1: Regional distribution of Countries with less than 1000USD per capita GDP in 1970

Region	Total Number of countries with PCI below 1000USD in 1970	The first 35 countries in Alphabetical order included in the study
Africa	43	24
Asia	24	8
Latin America and Caribbean	4	3

The method of analysis involves fitting VAR(P)/ VECM models to detect long-term relations of sectors to GDP or to manufacturing and that requires preparation of the data of selected sectoral GDP and economy wide GDP. The preparation of data involves orthogonalization and wavelet transformation of the time series data on sectoral GDPs and GDP of the economy at large.

The selected sectors and the need for orthogonalization

Among the sectoral GDPs in the economy, we consider value added of goods producing sectors, particularly manufacturing and agricultural goods value added. Other goods supplying sectors interact with the selected sectors (agriculture and manufacturing)and we do not simply ignore other goods supplying sectors, since the omission will bias the estimated impacts of the considered sectors, i.e., manufacturing and agriculture. The time series length of the available data is 42 years. The VAR (P)/ VECM models necessitate the use of some lags of the variables. The involved VAR(P)/VECM model and the time series length of the available data dictate the reduction of the number of vectors in the analysis. Inclusion of other goods supplying sectors such as construction, mining, and utilities, however, increases the number of variables in the analysis and leads to loss of degrees of freedom.

Thus, we need to exclude other goods supplying sectors to avoid the loss of degrees of freedom that arise from using too many variables and their lags. The VAR/VECM analysis of GDP, manufacturing, and agricultural value added, at various time scales, takes place net of effects of other sectors. This requires orthogonalizing vectors of manufactured and agricultural value added from vectors of value added of other goods supplying sectors, before undertaking VAR/VECM fitting at different time scales. This enables to identify sectoral effects of manufacturing and agricultural goods production on growth of GDP. Orthogonalization is done using projection method (Han L. and Neumann M. 2007) as it is intuitive. The method orthonormalizes vectors in an inner-product space using the projection operator. Given vectors U and V the orthogonal Projection of V on U is :

$$\text{Projection}_{U}(V) = \frac{<U,V>}{<U,U>} U \qquad (12)$$

where $< U, V >$ is the inner- product of the vectors U and V.

The projection vector is that component of the vector V lying in the vector space of U.

The excluded sectors are part of the GDP and interact with included sectors. Their effect on GDP has to be removed to prevent the bias created by their omission. Their association with included sectors is captured by their projection on the included vectors. Their projection on the included vectors is to be removed from GDP. If V_i is the vector the effect of which is to be excluded, its projection in the vector space of U_i is estimated and subtracted from GDP(Y). The remaining effect of the excluded vector (V_i) on GDP is orthogonal to the included sectors.

$$Y - \sum\left(\frac{<U_i,V_j>}{<U_i,U_i>} U_i\right) \qquad (13)$$

where Y is GDP V_j are construction, utilities and mining, and U_i are manufacturing , agriculture and services. The component of vector V that is orthogonal to vector U is: $V_1 = V - \frac{<U,V>}{<U,U>} U_U$, which is left in the GDP as it is orthogonal to the included sectors. The service sector has to be othogonalized from the excluded sectors to remove their effects on GDP through services.

Computation of the changes in these othogonalized manufacturing and agricultural sectors as contributions to changes in value added of the economy precede the VAR/VECM and Granger causality analysis. This computation of changes in sectoral value added necessitates deciding the time span within which the changes occur. The first difference could be annual difference or difference of averages of two or more years. The levels could be annual, the averages of two years , four years etc. We use wavelet transformations to decompose differences and averages across various time scales.

Wavelet transformation of data

Analysis of levels and changes presupposes time scales. The time span considered could be single year, two years, three years, etc. The time scale, at which significant relations occur, may not be predetermined. Levels or differences of values for single consecutive year or for averages of two years or three years provide data of distinct resolution. What may be invisible at one time scale could be visible at others.

Annual outputs of sectors and the economy change over time. The changes over time are results of linkages and causal interactions of the sectors. The interactions and causalities could be between contemporaneous values or between past values of the outputs. The interactions may work themselves out in a relatively short or long period. Thus, the levels or differences of outputs at various time scales have to be known and the causal relationships in the corresponding time scales have to be investigated separately. This means, relations in mere annual differences or levels are not expected to show the entire causal relationships and effects of interactions until they have sufficiently worked themselves out.

Moreover, macroeconomic annual figures could possibly involve noises, arising from inaccuracies in data compilation and irregular disturbances or shocks affecting the economy. Averaging the figures across various time scales filters some of these noises and the data better reveals more regular patterns and longer-term relations in the economy.

Thus, levels or differences of average values in various time scales have to be considered. An analytic method chosen that enables filtering time series values at various time scales is wavelet analysis (Percival and Walden, 2000; Kaiser G.1994). Wavelets are useful to compute levels and differences in weighted averages of certain functions across varying averaging periods or scales. Changes in averages over various scales provide several layers of information different from the average levels themselves (Percival and Walden, 2000; Kaiser G.1994). For example, changes in annual output of consecutive years may inform differently about the progress of the economy than the annual output levels themselves. Differences in the averages or weighted averages of two, three, or four, etc., consecutive years may provide different information about the progress of an economy than the averages of outputs in two, three, four etc. years. To use topographic analogy, the average levels across longer time scales provide information on the bigger picture such as the profile of the mountain range, while the differences indicate the details such as the hills and valleys in the mountain range. The use of such a method is a new contribution to growth and structural analysis. Most studies do not consider time scale effects, other than lags, in relating macro economic variables.

With the use of appropriate wavelets, the time series data is transformed into other time series. Among the various wavelet transformations, the one selected for this purpose is Haar wavelet. Specifically, Haar wavelet of the Maximum Overlap Discrete Wavelet Transform (MODWT) is chosen (Percival and Walden, 2000; Kaiser G.1994). Levels and changes in average values of output of the economy or a particular sector are filtered in various time scales using Haar MODWT as the wavelet is made to pass through the time series data. The wavelet-transformed data is further used in VAR/VECM and Granger causality tests. A little excursion in to the nature of wavelets is helpful and it is provided in Appendix II. Such methods have been employed in other economic studies (Månsson, K. 2012; Hacker R. S., Karlsson H. K. and Månsson K, 2012).

Manufacturing and agricultural outputs and the orthogonalized GDP undergo transformation with Haar MODWT wavelet to obtain the wavelet coefficients. The sum of the inner product of the wavelet coefficients and the wavelets produce the details (D_i) and the smooth(S). The analysis involves relationships of differences of averages (the details $\mathbf{D}_j$), and the relationship of moving averages (smoothes $\mathbf{S}_j$). The smoothes (S_i) indicate the long-term trends of sectoral outputs. The relationships between smoothes detect impacts of scaled levels of value added of sectors on one another on long-term basis.

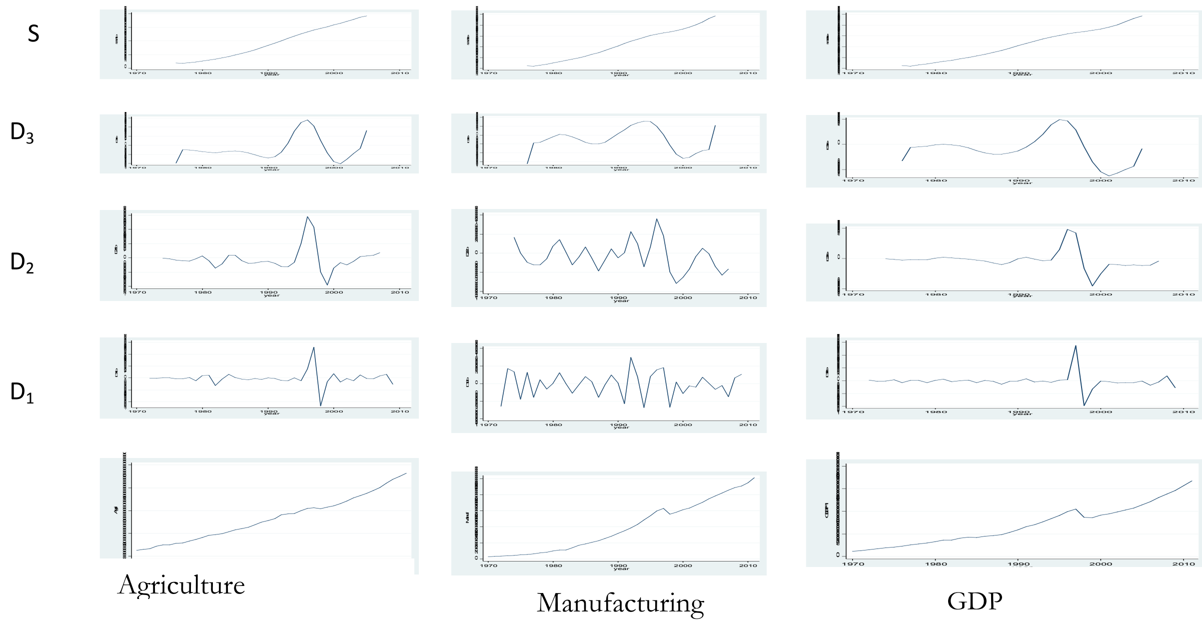


*Fig 1.3 Wavelet Decomposition of Value added (**Indonesia**) (excluding contributions of other sectors and services associated with those excluded sectors) The first graph at the bottom is before decomposition*

Fig 1.3 above is wavelet-decomposed data D_i and S for a particular economy. The details D_i and S_i are made ready to undergo time series regression using VAR/VECM procedures and granger-causality tests with impulse-response analysis. Orthogonalized impulse-responses indicate the existing causal relationship (Lutkepohl 2005). The cumulative orthogonalized impulse-responses in longer steps (42 steps in this case) reveal the positive or negative effects of the respective sectoral growth to growth of GDP in the period of study.

Software program and coding used to prepare and analyze the data is Stata 13. The data set employed is accessible from United Nations National Accounts Main Aggregates Database for low-income economies for countries listed in Appendix 3.5.

Data analysis method

Identification of the structure of economies involves identification of the effective lag length, the appropriate time scale, and the appropriate time series model(among 5 options), which differs from country to country. There is no guarantee to assume that sectoral interactions in each country behave in the same manner. In some countries, sectoral interactions would work themselves out in longer periods than in others. That means time series data of longer time scale may exhibit stable relationship in some countries while it may not in others. Since structures could be dissimilar across countries and since the aim is not to lump countries together to get an average structure, individual country-wise treatment and investigation becomes necessary. Time-series analysis rather than panel analysis became appropriate to meet the objectives of the study.

After detecting the particular prevalent structure in each country, the study categorizes countries with similar structure and undertakes a meta analysis (the analysis of the results) later. The meta analysis includes *contingency table analysis* to evaluate whether the number of identified cases are significantly different or not.

The orthogonalized and wavelet transformed sectoral time series data go through VAR/VECM fitting processes and the respective long-term relationships are detected. Granger causality and impulse-response tests will complement the analysis.

Various diagnostic checks take place before and after VAR/VECM analysis. The checks are:

- pre-estimation lag length test using the various information criteria,
  i.e., Akaike Information criterion(AIC), Final Prediction Error (FPE) , Hannan Quinn Information Criteria(HQIC), and Schwartz Bayesian Information Criterion(SBIC)
- post-estimation lag length test using exclusion Wald test,
- serial auto correlation test using LM test,
- stability test for VAR/VECM estimates using modulus of the Eigen values,
- rank test for the existence of co-integration relationship,
- Granger causality using Wald test

The sequence of the checks and analysis decision taken based on the diagnostics are depicted in the diamond shaped components of the flow chart below.

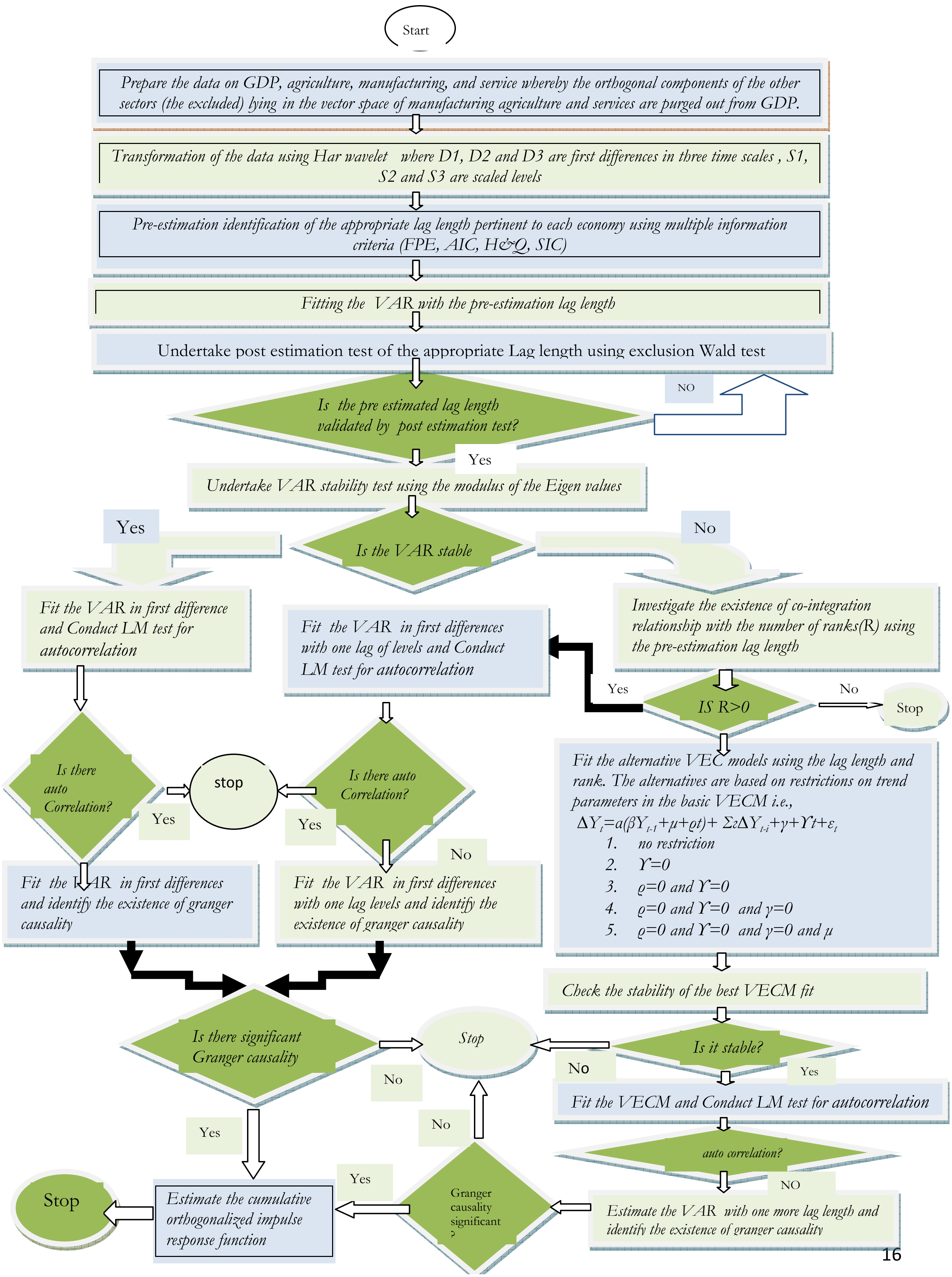
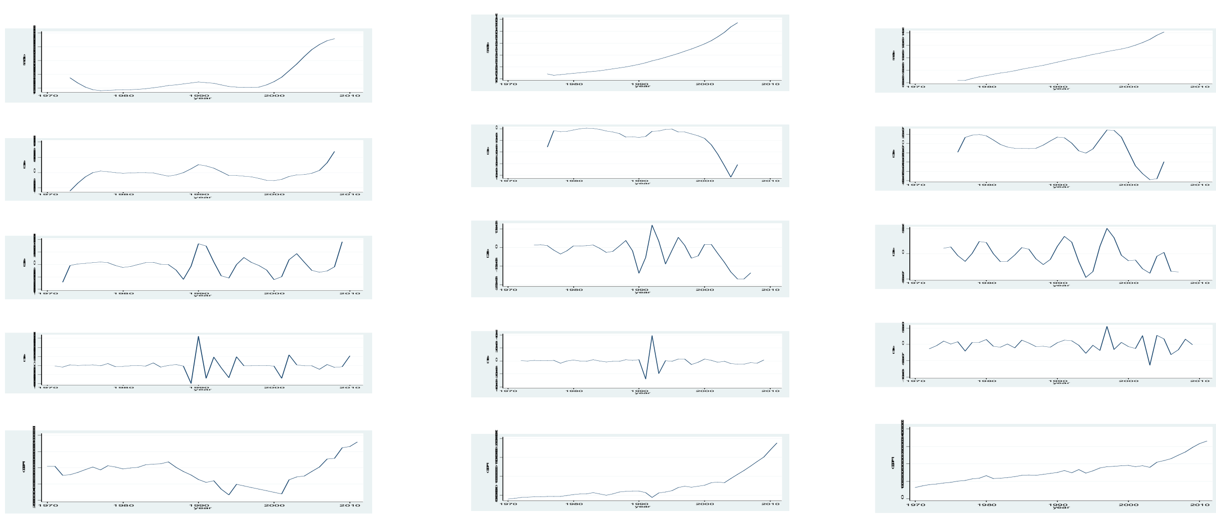


Fig 1.4 Flow chart of the Diagnostic and Estimation procedures followed

Vector auto regressive (VAR) model is fitted for first differences with the inclusion of lagged levels when co-integration relationship exists between levels. Otherwise, only the first differences are analyzed in a VAR framework excluding one step lagged levels. The association of the levels of sectoral GDPs is analyzed with a vector error correction model (VECM) framework when a stable long-term relationship is detected or when co-integration relationship exists. The applied empirical analysis framework to detect the structures of the economies is represented by the flow chart in figure 1.4 above.

Data is available for all economies in the 42 years period between 1970 and 2011). The time span of 42 years allows limited time scales in the wavelet analysis. The maximum time scale the periods allow is 8 years. The longer the time span the better it enables to detect long-run relations.

The time path of the wavelet transformed time series sectoral and total GDP data of countries are with differing applicable lag lengths, and with differing relationship across time scales (Fig1.5 below). Thus, the time series data per country need a separate treatment. Fig 1.5 indicates the variation in the structure of economies



Afghanistan Ethiopia Malwi

Fig:1.5: *Haar MODWT decomposed GDP data in three time scales and smooth for three countries The first layer at the bottom is before decomposition*

Addressing the first hypothesis

The hypothesis is about the particular structure that is responsible for the attainment of long-term GDP growth. The first task of the study is identifying the structure. The use of statistical or econometric techniques is to identify the structure; subsequently to uncover the long-term effect of the structure on per capita income. Testing the hypothesis involves bringing all the relevant components of GDP as structural factors and comparing their contributions. All other influences affecting GDP first affect the sectors and are, therefore, taken care of through the sectoral contributions. Levels and changes in GDP and sectoral value added in goods production constitute the entire universe. Changes in services are taken care of with their relationship to goods production. As per this approach, the analysis needs only the structural components of GDP. Other factors work behind the structural components.

The techniques are subservient to the basic requirements of testing the hypothesis as is founded in the theoretical model. The techniques are not the driving factors. One may clear off any worry about missing explanatory factors by consulting the basis for the use of econometric techniques, which is the constructed theoretical model. The model has incorporated the pertinent factors suggested by the theoretical arguments and it does not require other factors.

Testing the first hypothesis requires identification of the structure of each low-income economy and follow through the effects of that structure on long-term per capita income growth of the economy. Identification of the structure of economies is tantamount to identifying which sector in the long-run influences GDP growth for that particular economy. The sign and magnitude of the VAR/VECM coefficients, and the magnitude and direction of impulse-responses for significant Granger causal relationships of manufacturing or agriculture on GDP establish the structure of the economy. The identified structure is compared with the performance of the economy in terms of changes in real per capita GDP. To the best of the author's knowledge addressing the issue in this manner is a unique contribution.

Identifying the particular structure of each economy is necessary to compare the effect of that structure on the long-term per capita GDP growth of that economy. The empirical study begins by identifying the structure of each country and then explores the effects of that particular structure on the long-term per capita GDP growth of that economy. In identifying the structure of each economy, either the rate by which each sector contributes to GDP or the association of levels of sectoral GDPs with the levels of total GDP is assessed. The contribution of sectors to GDP is analyzed with vector auto regressive (VAR) model of first differences with inclusion of lagged levels at times when co-integration relationship exists. Otherwise, only the first differences are analyzed in a VAR framework excluding lagged levels. The association of the levels of sectoral GDPs to the levels of total GDP is analyzed with a vector error correction model (VECM) framework when a stable long-term relationship is detected or when co-integration relationship exists.

There are four exclusive empirical possibilities that appear as outcomes of the analysis. In the long run, (1) both sectors could be significantly and positively related to GDP; or (2) manufacturing is positively related to GDP while agriculture is not; or (3) both the sectors are not positively related to GDP; or (4) agriculture is positively related to GDP while manufacturing is not. The cases represent the different structures of the economies. To identify the long-term effect of the particular structure, we check the direction of changes in the sectors and the direction of change attained per capita GDP in the period considered. The average growth rate of per capita GDP in the period is the indicator of the effects of the structure of the economy.

Pivoting on manufacturing, the identification of a structure characterized by positive/higher coefficient of manufacturing in the VAR or VECM analysis or positive Granger causality of manufacturing in the analysis means GDP growth or decline and manufacturing growth or decline go together. If manufacturing has undergone actual positive long-term growth, then as per the hypothesis, an actual positive change in per capita GDP is expected. If the same is observed in the data of a country, then that provides support to the hypothesis. Given positive coefficient and positive Granger causal relationship and a decline in actual manufacturing suggests a decline in per-capita GDP growth. If that is observed in the data, then it provides weak support to the hypothesis.

With regard to agriculture, the concurrence of positive/higher coefficients or positive Granger causality of agriculture with actual positive changes in per capita GDP of a country does not provide support to the hypothesis, while negative/lower changes in per capita GDP with higher coefficients or positive sign of Granger causality support the hypothesis. Lower coefficients or Negative Granger causality of agriculture and increase in per capita GDP provide support to the hypothesis, while lower coefficients or negative sign of Granger causality of agriculture with actual decline in per capita GDP does not support the hypothesis. The findings of the study indicate that the hypothesis is supported in larger number of cases (refer Chapter 3).

Addressing the second hypothesis

The structural factor responsible for the performance of manufacturing is the size of transaction services. Transaction services enhance manufacturing when they are at lower levels while tending to retard it at higher levels. After orthogonalizing and wavelet transforming the time series data on manufacturing, agriculture, and services, coefficients of VAR and VECM are estimated and Granger causality and impulse response test are undertaken. The coefficients in the fitted models, Granger causality tests and the impulse responses indicate the structure, whether services are at a level that enhance manufacturing or not. The structure, coupled with the direction of change of services, allows prediction of performance in manufacturing growth. Comparison of predicted performance and actual performance in manufacturing either provides or denies support to the hypothesis. As in the method used for the first hypothesis in the second paper, to the best of the author's knowledge, addressing the issue in this manner is a unique contribution.

There are two significant cases of the coefficients of the fitted models or the Granger causality: lower or higher in the former case and Positive or Negative in the latter case. There are three possible cases of actual direction of growth (trend) of services, positive (+), negative (-) or no(0) growth. Each direction of causality is considered with the actual direction of growth of service to predict the growth of manufacturing and to compare the prediction with the actual growth of manufacturing. Comparison of the predicted growth in manufacturing with the actual growth of manufacturing serves to verify the hypotheses.

If the hypothesis is valid, a detected higher coefficient or a positive Granger causality and an actual positive trend in growth of services must result in growth of manufacturing. To verify the hypothesis, the predicted growth in manufacturing is compared with the actual direction of change in manufacturing. If the predicted and the actual are the same, the hypothesis has gotten support, otherwise not.

1.5 CONTRIBUTIONS AND MAIN FINDINGS OF THE THREE CHAPTERS

Summary of the first theme in Chapter II

In the second chapter, low-income economies are modeled in line with historical patterns of development to explain the structural factor influencing their sustained growth. The model signifies that the economies under study deserve a structural model pertinent to the reality and growth paths of dual economies. The growth of these countries is different from the growth of developed countries where already established growth models are more relevant. The production function is not similar to Solow, Neoclassical, Endogenous, or any other growth model relevant to developed economies. The attempt here is to push the frontier of our knowledge on the evolution of low-income economies that are still in the transition from agrarian economies to modern economies. The theoretical model abstracts manufacturing and subsistence agriculture as the only goods producing sectors.

The argument of the study is that subsistence agriculture does not support more than itself and at times unable to maintain itself under population pressure. The discussion is not on agricultural output per se but on contribution of subsistence agriculture to long-term growth. The model in the study incorporates subsistence agriculture with diminishing returns. It is true that productivity growth in agriculture must exist for industrial development to succeed. The problem of subsistence agriculture is lack or slow pace of productivity growth, whether that comes from labor productivity or land productivity. Land productivity is dependent on growth of the use of modern land augmenting technologies and labor productivity is engendered as less number but people that are more skilled engage in harnessing the land. Subsistence agriculture does not use land augmenting or labor-augmenting technologies, as it is extremely hard to have adequate surplus to acquire these technologies. With growing manufacturing, availability of locally produced modern agricultural inputs expands and agriculture modernizes. Modern agriculture, which is an activity that uses land augmenting manufactured inputs, and that engages people conversant with the use of the technologies, enhances industrial development. The author envisages that as agriculture modernizes, and ceases to be subsistence, its production function becomes similar to that of manufacturing, and the dual economic structure vanishes.

Manufacturing is modeled with increasing returns in capital while subsistence agriculture is with decreasing returns in labor use. Capital and labor committed to transaction services are treated as input reducing factors to goods production. Value added in services is modeled as some proportion of manufacturing and agricultural goods production. The formulated model of low-income economy has a dual nature as shown in the equation (1) below, where the first term in the right hand side is the value added of subsistence agriculture with its associated services and second term is the value added of manufacturing and its associated services.

$$Y_t = \left[\Gamma\left(\frac{\psi}{\varsigma}\right)^{u}(R_t - \psi_t)^{\beta}\right] + \left[\eta\left(\frac{\omega_t}{C_t}\right)^{u}(K_t - \omega_t)^{\alpha+\mu}(L_t - \varphi_t)^{1-\alpha}\right] \quad (1)$$

where $\Gamma, \varsigma, \beta, u\ \eta, C, \alpha, \mu$ are parameters[3] of the economy while $\omega_t, \psi_t, \varphi_t$ are exogenous variables representing resources committed to transaction services in the respective sector, and R_t, K_t and L_t are the endogenous variable in the model representing labor in agriculture, capital in manufacturing and labor in manufacturing respectively. This modeling, to the best of the author's knowledge, is a unique representation of the production function of a low-income economy in transition from subsistence agriculture to modern economy.

The model exhibits the possibility of stable equilibrium at lower level of capital accumulation and unstable equilibrium at a higher level of capital accumulation. The higher-level unstable equilibrium is associated with a critical stock of capital at which sustained growth follows when capital accumulation exceeds this critical stock in manufacturing sector. The critical capital stock is:

$$\mathbf{K}^* = \left(\frac{\delta}{s-\lambda}\right)^{\frac{\alpha}{\mu}}\left(\frac{1}{\eta}\right)^{\frac{1}{\mu}}\left(\frac{C}{\omega_t}\right)^{\frac{u}{\mu}}\left(\frac{\beta\bar{R}}{\theta(1-\alpha)}\right)^{\frac{1-\alpha}{\mu}} + \omega_t \quad \mathbf{(2)}$$

A movement to this level of capital stock from the lower side requires a special effort of exogenous infusion of capital to the manufacturing sector and this is the unique contribution of this study.

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[3] ref the symbols of the parameters in **APPENDIX 2: INDEX OF SYMBOLS**

Capital used for transaction services in manufacturing is **ω**. The commitment of capital in transaction services first facilitates the escape to sustained growth until it reaches some optimal level, beyond which it becomes hindrance. Manufacturing drives sustained growth, and expansion of transaction services in low income economies beyond the minimum required makes it increasingly difficult to attain sustained growth.

This depiction of the causal relationships of transaction services and manufacturing serves as a theoretical basis for balancing sectoral composition. Addressing the unhealthy growth of services at the expense of manufacturing in low-income economies is an important contribution of this study. The major structural factors implied by the model having policy implications are:

a) Manufactured goods production has greater impact than non-manufacturing goods production on sustained growth of the economy at large.
b) Difference in growth of share of manufacturing explains differences in the sustained growth of low-income economies.
c) Growth of transaction services in the long run stands in inverse relationship to manufacturing growth of low income economies
d) Institutional arrangements of society affect sustained growth of manufacturing through increased transaction services.
e) High depreciation, low effective rate of saving and smaller difference in productivity between subsistence agriculture and manufacturing obstruct sustained growth.

The discussion on the "Theoretical framework and model" is an original work of the author and its difference from other growth models is clearly indicated on page 44 to 45 subtitled "THE ROAD MAP OF THE EVOLUTION OF LOW INCOME ECONOMIES"(section 4.1). That section helps to have a clearer view of how the author diverges from or enriches the existing literature.

Summary of the second theme in Chapter III

In the third chapter, the study sets out to test that manufacturing led structure is central in attaining sustained growth of economies with low per capita income. The structure of economies and the sector driving the economy is detected with the magnitude and direction of the coefficients of the fitted VAR/VEC models and Granger causality and cumulative impulse-response tests for the first 35 (in alphabetical order) of the 71 economies.

Most countries exhibit significant relationship of the two sectors with GDP in first differences or levels at one or more timescales. Thirty-one, among thirty-five countries, exhibit significant relationships. Among the thirty-one, half of them exhibit significant relationship across more than one timescales. The largest number of significant cases appears in the co-integration relationships between moving averages of two consecutive years (S_1) and the next largest number of significant cases appears in differences of the averages of two years (D_2). This means timescales matter. Twenty-nine countries, among thirty-one, provide support to the hypothesis in either of the two methods.

Summary of the third theme in Chapter IV

In the fourth chapter, an attempt is made to find structural explanation for why manufacturing growth and share are retarded in considerable LICs. The study sets out to investigate whether the growth of services has retarded manufacturing growth in low-income economies by crowding out manufacturing from accessing inputs.

The analytical work that served as the basis for this study suggested that transaction services at lower levels enhance manufacturing while they tend to retard it at higher levels. Time series data on value of manufacturing output and value of services in economies were transformed by Haar wavelet and their relationship was examined at various time scales. The sign of co-integration coefficients and the impulse-responses were tested to find out the prevailing structure. The results indicate that non-positive coefficients and impulse responses relating growth of services and manufacturing prevails in significantly greater number of countries than the prevalence of positive relations.

The number of countries providing support to the hypothesis, in at least one time scale, is much greater than those not supporting the hypothesis. This result suggests that the level and direction of growth of services matter for manufacturing and for sustained growth of economies.

1.6 POLICY IMPLICATIONS

The major findings of the study are that:

- Empirical evidence suggest that existing structure of the economies in low-income countries is responsible for the pace of attainment of sustained growth,
- A structure with growing manufacturing ensures the attainment of long term growth, and
- Growth of services beyond the optimal level strangles manufacturing.

The policy implications of the findings are that low-income economies that are in transition from traditional agricultural economies to modern economies have to take structure into account and work towards advancing manufacturing. The current policy emphasis on agriculture has to shift to manufacturing so that sectors other than manufacturing and the whole economy grow in sustained manner. Transaction services have significant influences on manufacturing growth of low-income economies. Low-income countries have to reduce the burden of transaction services when they are non-optimal and enhance transaction services when they are less than optimal.

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APPENDIX 1.1: INDEX OF SYMBOLS

α	*Parameter representing share of capital*
β	*Parameter signifying diminishing returns in agriculture*
δ	*Rate of depreciation of capital in manufacturing*
η	*The efficiency of attaining potential output*
θ	*A ratio of labor productivity in subsistence agriculture to that in modern sector*
λ	*Part of saving rate wasted as leakage*
μ	*A parameter of increasing returns and externalities in manufacturing*
ς	*The minimum labor required to conduct most efficient transactions in or for agriculture*
φ	*Manufacturing labor diverted to transaction services in manufacturing*
ψ	*Agricultural labor diverted to transaction services in agriculture*
ω	*Capital used in transaction services in and for manufacturing*
c	*The minimum capital required to conduct most efficient transactions in and for manufacturing*
K	*Technology embodying capital stock*
K^*	*Critical capital stock*
L	*Labor input in manufacturing*
R	*Total labor input available to subsistence agriculture*
$\overline{R}$	*Per capita output in agriculture*
r	*The efficiency in attaining potential output with effective agricultural labor input*
s	*Aggregate saving rate*
u	*Exponential parameter of the multiplier of goods value added to include the arising service*
Y	*Total value added of the economy*

APPENDIX 1.2: WAVELETS

A wavelet is any function that integrates to zero and is square integrable to one (Percival and Walden, 2000; Kaiser G.1994). It is expressed as a real valued function ψ (.) defined over the real axis (-∞, ∞) satisfying two properties: namely

(1) The integral of ψ (.) is zero, i.e. $\int_{-\infty}^{\infty} \psi(u)\, du = 0$

(2) The square of ψ (.) integrates to unity, i.e., $\int_{-\infty}^{\infty} \psi(u)^2\, du = 1.$ (14)

With this definition in hand we may look for functions fulfilling the two conditions. To that effect we begin with an expression of the **difference in averages** of a function X(u) at time t in an averaging time scale (λ), which may be a year, two years, etc.

$$D(\lambda, t) = \frac{1}{\lambda}\left[\int_{t}^{t+\lambda} X(u)du - \int_{t-\lambda}^{t} X(u)du\right] \tag{15}$$

Since the two integrals above are integrals over adjacent non-overlapping intervals they can be combined into a single integral over the entire real axis with definition of domains for the functions as:

$$D(\lambda, t) = \int_{-\infty}^{\infty} V_{\lambda,t}(u)X(u)du), \tag{16}$$

$$\text{where } V_{\lambda,t}(u) = -\frac{1}{\lambda} \quad \text{if } t-\lambda < u \leq t$$
$$= \frac{1}{\lambda} \quad \text{if } t < u \leq t+\lambda$$
$$= 0 \quad \text{otherwise}$$

The differences of averages on a unit time scale (λ) and at a center time t (the middle of the interval) is equivalent to integrating the product of the time series data (represented by the function $X(u)$) and a function $V_{\lambda,t}(u)$. The function $V_{\lambda,t}(u)$ would fulfill the definition for wavelet if divided by a constant $\sqrt{2}$:

$$\text{Where, } \int_{-\infty}^{\infty} \frac{V_{\lambda,t}(u)}{\sqrt{2}} = -\frac{1}{\sqrt{2\lambda}} + \frac{1}{\sqrt{2\lambda}} = 0 \quad \text{and} \quad \int_{-\infty}^{\infty} \left(\frac{V_{\lambda,t}(u)}{\sqrt{2}}\right)^2 du = 1 \tag{17}$$

$\frac{V_{\lambda,t}(u)}{\sqrt{2}}$ is a particular wavelet known as Haar wavelet $(V_{\lambda,t}{}^{H}(u))$.

Since λ=1 $\quad V_{\lambda,t}{}^{H}(u) = -\frac{1}{\sqrt{2}}$ if $t\text{-}1 < u \leq t$

$= \frac{1}{\sqrt{2}}$ if $t < u \leq t+1$

$= 0$ elsewhere,

At other time scales $V_{\lambda,t}{}^{H}(u) = \frac{-1}{\sqrt{2\lambda}}$ if $t\text{-}1 < u \leq t$

$= \frac{1}{\sqrt{2\lambda}}$ if $t < u \leq t+1$

$= 0$ elsewhere

Thus $D(\lambda,t) = \int_{-\infty}^{\infty} \sqrt{2V}_{\lambda,t}{}^{H}(u)\, X(u)du$ and $\frac{D(\lambda,t)}{\sqrt{2}}$ is designated $W(\lambda,t)$

$$W(\lambda,t) = \int_{-\infty}^{\infty} V_{\lambda,t}{}^{H}(u)\, X(u)du \tag{18}$$

The time series transformed by varying λ continuously in $W^{H}(\lambda,t) = \int_{-\infty}^{\infty} V_{\lambda,t}{}^{H}(u)X(u)du$ is the Haar Continuous Wavelet Transform (CWT). **X**(u) can be recovered from the integral of the product of $W^{H}(\lambda,t)$ and $V_{\lambda,t}{}^{H}(u)$. The Discrete Wavelet Transform (DWT) may be thought as purposeful sub sampling of CWT with dyadic scales i.e., picking only λ of 2^{J-1} and t separated by multiples of 2^{J} where J=1,2, 3…. In DWT analysis of any time series X (u), we make use of wavelets h_J formed as basis-vectors, representing the time scales and shifts within a time scales, wavelet coefficients w, formed from matrix multiplication of these basis-vectors with **X** , an averaging vector $\boldsymbol{v}$ on the basis of the highest time scale, and a scaling coefficient $\mathbf{v}$ formed as a dot product of $\boldsymbol{v}$ and **X** . If we designate $D = h_J' w$ and $v'\mathbf{v}=\mathbf{S}$, recovering **X** from wavelet transforms goes as

$$\mathbf{X} = \left(\sum_{j=1}^{J} \mathbf{D_j}\right) + \mathbf{S} \tag{19}$$

This is a **multi-resolution** analysis of **X** where $\mathbf{D}_j$ are the details representing the differences of averages on various time scale and **S** is the smooth representing the moving average of the data on the highest time scale .

The wavelets of DWT are orthogonal. The averages and average of averages, formed from the DWT wavelets are sensitive to beginnings of the data points for averaging. The size of DWT wavelets is limited to the dyadic series and hence may suffer from too few observations for analysis. To overcome the deficiencies of DWT a modified version of DWT, which is Maximum Overlap Discrete wavelet Transform (MODWT), is used, although the orthogonality that is characteristic of DWT is lost in MODWT. In MODWT, the data is taken in circular fashion where the ends become adjacent points. At lower scales, this operation heavily distorts the differences of averages and hence the differences of the averages at the ends have to be dropped.

CHAPTER II: MANUFACTURING AND SUSTAINED GROWTH OF LOW INCOME ECONOMIES

ABSTRACT

The study views low-income economies from the perspective of historical patterns of development to explain the structural factor influencing their sustained growth. Structural factor pertains to sectoral composition and relations. With recognition of the stylized facts of low-income economies, a theoretical model is constructed taking manufacturing and subsistence agriculture as goods producing sectors and goods production as the basis for production of services. Manufacturing shows increasing returns in capital use while subsistence agriculture is with decreasing returns in labor use. Production functions of these sectors incorporate inefficiencies affecting inputs and outputs. Capital and labor committed to transaction services reduce the input going to goods production. Value added in services is a function of manufacturing and agricultural goods production. The model exhibits the possibility of stable equilibrium at lower level of capital accumulation and unstable equilibrium at a higher level of capital accumulation. At the higher-level unstable equilibrium, sustained growth starts as capital accumulation exceeds the critical capital stock associated with that equilibrium. Capital used for transaction services first facilitates the escape to sustained growth until it reaches some optimal level, beyond which it becomes hindrance. Manufacturing drives sustained growth, and expansion of transaction services beyond the minimum required makes it increasingly difficult to attain sustained growth.

Keywords: structure, dualism, modern growth, sustained growth, macro model, multi-sector growth, manufacturing, transaction services, industrialization, transformation, transition to modern growth, income convergence

JEL classification codes 0110, 014, 0410, 047, P52

INDEX OF SYMBOLS

α	*Parameter representing share of capital*
β	*Parameter signifying diminishing returns in agriculture*
δ	*Rate of depreciation of capital in manufacturing*
η	*The efficiency of attaining potential output*
θ	*A ratio of labor productivity in subsistence agriculture to that in modern sector*
λ	*Part of saving rate wasted as leakage*
μ	*A parameter of increasing returns and externalities in manufacturing*
ν	*The ratio of effective capital to total capital in manufacturing*
ς	*The minimum labor required to conduct most efficient transactions in or for agriculture*
φ	*Manufacturing labor diverted to transaction services in manufacturing*
ψ	*Agricultural labor diverted to transaction services in agriculture*
ω	*Capital used in transaction services in and for manufacturing*
b_1	*A parameter relating the value added in agricultural goods with that of services arising from agriculture*
b_2	*A parameter relating manufactured goods value added with that of services arising from manufacturing*
c	*The minimum capital required to conduct most efficient transactions in and for manufacturing*
Cn	*Aggregate Consumption*
K	*Technology embodying capital stock*
K^*	*Critical capital stock*
L	*Labor input in manufacturing*
M	*Value added of manufacturing and the associated services together*
M_g	*Goods value added in manufacturing sector*
R	*Total labor input available to subsistence agriculture*
$\overline{R}$	*Per capita output in agriculture*
r	*The efficiency in attaining potential output with effective agricultural labor input*
s	*Aggregate saving rate*
Ser	*Service value added*
u	*Exponential parameter of the multiplier of goods value added to include the arising service*
Y	*Total value added of the economy*

ACRONYMS AND ABBREVIATIONS

GDP	Gross Domestic Product
ISI	Import Substitution Industrialization
LIC	Low Income Countries
TFP	Total Factor Productivity
UN SNA	United Nations System of National Accounts
USD	United States Dollar
UNIDO	United Nations Industrial Development Organization
UNCTAD	United Nations Conference of Trade and Development

I INTRODCUTION

In the early 1970s, there were over 70 countries below real per capita income of 1000USD[4]. In 2012, the number declined to about 60. While the number of low-income countries declined, the disparity in income levels between countries has become staggeringly higher. Real per capita income of the richest 70 countries was about 35 fold of the poorest 70 countries in early 1970s. The disparity between the average per-capita income of the richest 60 countries and the poorest 60 countries grew to 60 fold in 2011(unstats, 2013). Income gaps are widening, partly because the poorest are not catching up. The failure to catch up has remained an object of concern of various studies, needing explanation.

Historically all countries were either similar or with little difference in their real per capita income before the 18th century (Bairoche,1995; Maddisson,2003) or before the beginning of the industrial revolution. Not only income differences were narrow, they were stagnant overall. Classical theory of the Iron Law of Wages of Malthus and Ricardo explained the stagnancy of income in agrarian economies. In those economies, population growth offsets gains in output growth, resulting in stagnant per capita income (Hansen and Prescott, 2002).

Some leading countries started modern economic growth (Kuznets, 1966), which was characterized by a steady per capita income growth, at the second half of the 19th century, (Bairoche 1995; Madisson, 2003). Solow (1956, 1957) pioneered modeling this growth and that model evolved to other variants such as neoclassical and endogenous growth theories. Production functions used in growth models of modern economies incorporate technology and variable factors where population has no offsetting effect on attained per capita income growth as it had in models of agrarian economies in classical growth theories.

The transition from classical stagnation to modern economic growth was characterized by irregular and unsteady growth, and, for leading countries, the transition to a steady growth in per capita

[4] GDPs of all countries are at constant 2005 prices in US Dollars

income took nearly a century (Bairoch 1995; Madisson, 2003). The take off to steady per capita income growth took different length of time for different countries. For late comers the transition and catch up with leaders took shorter time (Bairoch 1995, Madisson 2003).

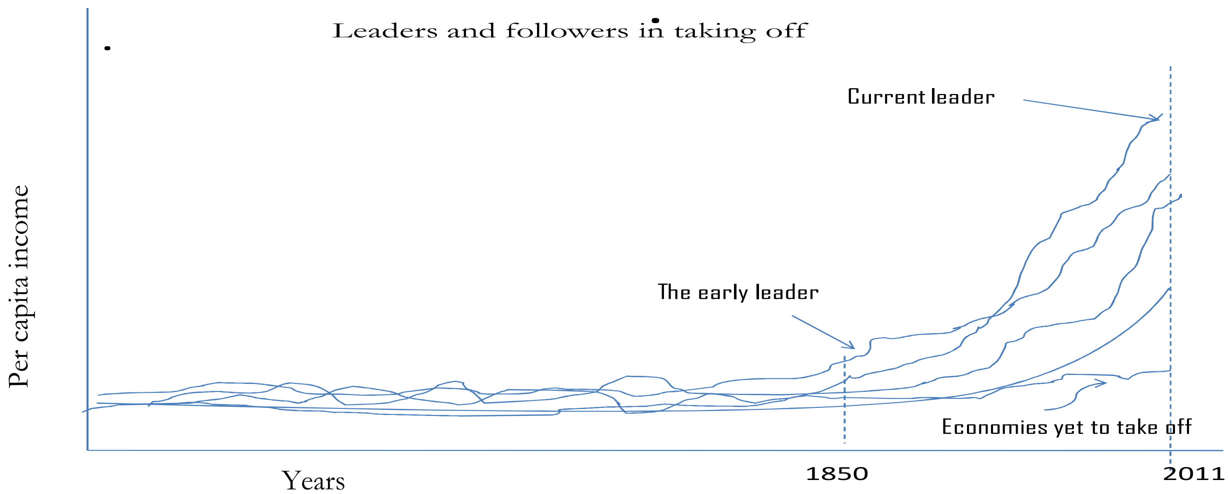

Fig 2.1 A schematic comparing per capita income growth of countries before, during, and after the industrial revolution: Adapted from the above mentioned descriptions of Economic historians and development thinkers'.

Considerable number of countries, particularly countries in Africa and Asia, has not yet taken off. The differences in income levels and failures to catch up have been addressed with various explanatory theories where difference in institutions (Acemoglu and Robinson, 2012), and differences in policy (Parente and Prescott, 2003) are some of them. Parente and Prescott (2003) explain the delays and speed differences in taking off with their unified theory, where differences in efficiency and TFP in the modern sector arising from policy differences take the center stage in the explanation.

Based on these explanations, the author of this study reviewed early takeoffs to sustained growth, and explored the role of economic structure in explaining the failure to take off of contemporary low income countries. The study recognizes that institutions and policies are important environmental factors that explain the failures to take of contemporary low income economies. However, as environmental factors, they are only one side of the explanations. The environmental factors work upon an internal factor. The internal factor is the evolving structure of the economy. The structure is the composition of the chosen economic activities, which in turn are the results of the aggregate mindsets of individuals in society manifested by preferences and choices of economic activities.

Environmental factors have effect on the existing mindsets and preferences in the same way that the ambient temperature affects eggs. The environment, however, does not convert an egg of a chicken to an owl. The same institutions and polices imposed on different mindsets and preferences will have different outcomes in terms of the composition of economic activities or structure. Economic structures are outcomes of the internal factors(mind set and preferences) and environmental factors(institutions and policies) Structures evolve (change and transform) thereby allowing or disallowing the accumulation of capital and long-term growth of the economy. Under this perspective, the study analyzes structure of economies as an immediate causal factor for accumulation and sustained growth of per capita income of economies, while institutions and policies affect accumulation and sustained growth of per capita income through their effect on structure.

Thus this study, in contrast to others, recognizes structure as an exogenous explanatory variable responsible for accumulation, sustained growth, and per capita income growth in the long-run. This alternative perspective better fits to the realities of contemporary low-income countries and it informs development policies better in conducting focused interventions based on the historic structure of low-income countries.

Economic development is the overarching goal of underdeveloped and developing economies and it involves growth sustained for a long period. There is a basic structural requirement that low income and under industrialized economies must have in order to attain growth sustained for a long period. Here, it is argued that the particular structure ensuring a low-income economy to attain sustained growth is an evolving structure where changes in manufacturing output and share drive the growth process. Thus, the argument begins with construction of a theoretical model of the aggregate production function that incorporates manufacturing and other structurally prominent features of low-income economies to highlight the significance of structure for sustained growth of low-income economies. The model helps to analyze the implications of the structure to economic stagnation and progress.

The first section (section 2) explores the literature on the relationship between structure and sustained growth. Section 3 formulates the theoretical framework; Section 4 presents the model structure; Section 5 describes the model implications and numerical illustrations. The last section is the conclusion and policy implication.

2. STRUCTURE AND SUSTAINED GROWTH

Following Kuznets (1966, 1989), structure here refers to the composition of the aggregate economy, particularly the relative importance of sectors. Literature that is more recent describes composition as the list of products, activities and actors (Pyka and Saviotti, 2011). With persistent gradual change in the composition of the economy through time, the particular structure evolves to another one and this persistent long-term change in the composition of the economy is structural change (Syrquin, 2008).

Growth is the expansion of the value added output in excess of the previous period. Sustained growth is self-reinforcing and long-term expansion of production with extensive or intensive dimensions (Pyka and Saviotti, 2011; Lipsey, Carlow and Bekar, 2005) rather than short lived and episodic expansion of output. The "Long-term' is a relative concept that has declined from a century long period (in the case of early leaders) to a period of few decades (for the late comers). Self-reinforcing and long-term growth requires the accumulation of capital that embodies technology. Every structure of economies may not support or enhance accumulation. Some structures support or enhance accumulation while others retard it. Here comes the link between sustained growth and structure. The literature in economic history, growth, and development, dealing with sustained growth, structure and structural change, do not share a common view, particularly on which specific structure leads to sustained growth of low income and under industrialized economies.

2.1 LESSONS FROM ECONOMIC HISTORY

The literature on economic history provides information on historical regularities where structure plays important role for economies to grow in persistent manner. Kuznets (1966, 1989) observes that modern economic growth is characterized by high rate of increase of product per worker or per capita, which is associated with a high rate of structural shifts, which were "changes in the shares of production sectors in the country's output, capital, and labor force". Kuznets concludes that the production sector that absorbs technology is the sector that contributes most for growth of total output per capita and that sector is the modern sector composed of manufacturing and related services in contrast to the agricultural sector. Similar historical regularity have been reported by Kaldor(1966), although the empirical findings were on twelve industrially developed countries. He concludes that the rate of growth of manufacturing (including public utilities and construction) is likely to exert a dominating influence on overall rate of economic growth, on account partly of the impact of manufacturing growth on the productivity of the industrial sector itself and partly by indirectly raising the productivity of the other sectors. The regularities have relevance for our study in that they put emphasis on sectoral contributions and structure. Maddison (2001) alludes to the importance of structure, by pointing to politicians and economist emphasis on sectors (physiocrats on agriculture, Kaldor, Mahalanobis, and many contemporary governments on industry) as important independent source of growth, and concludes that in the short term, structural shifts can be important for growth. Bairoch (1995) notices the labor productivity difference between manufacturing and agriculture before and after the industrial revolution in Western Europe, where agriculture remained with less labor productivity and far slower growth in labor productivity than manufacturing.

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2.2 LESSONS FROM DEVELOPMENT LITERATURE

The literature in development economics, while dealing with growth, poverty, and economic stagnancy, provides various arguments on structure. Growth through sectorally impartial market mechanisms stands as one outstandingly competing approach in development economics to growth coming through selective protection of the industrial sector, following Import Substitution Industrialization (ISI) strategy (Hewitt, Johnson and Wield, 1992; Rapley, 2002; Palma, 2008)

Modernization and structural change model of Lewis, A. (1954), the early structuralist emphasis on manufacturing in the economies of the periphery (Hewitt, Johnson and Weild , 1992; Palma, 2008) were based on structure. UNIDO's (2009) emphases on tailored industrial policy approach for the bottom billion and for stagnant middle income countries, UNIDO/UNCTAD (2011) special report on "African Industrialization" are the other instances of the literature emphasizing the importance of structure and manufacturing for economic growth. The arguments place manufacturing as the main source of technology and a major conduit for diffusion of new technologies to other sectors.

Syrquin (2008) emphasizes that structural change retards or enhances growth, depending on its pace and direction. Hausmann and Rodrik (2006) emphasize the production and export of high productivity items as sources of growth, which is recognition of the importance of a particular structure in production. Mann (2011) emphasizes the need for meso-economic considerations to link micro to macro, and recognize that sectors matter. The analysis on merit sectors (Mann, 2011) and the write up on economic growth through the emergence of new sectors (Pyka and Saviotti, 2011), are about structure. The thesis on Meso-economics, bridging micro and macro in a Schumpeterian Key (Dopfer, 2011), and changes in industrial structure and economic growth (Yoshikawa and Miyakawa, 2011) all share the theme that particular sector and structure matter for economic development and growth.

With the exception of few cases, neoclassical development thinking, in general, makes no differences among sectors to attain sustained growth, as all economic activities can equally be engines of growth if they happen to be sources of comparative advantage. Largely the view ignores structure and frames its analysis on a single aggregate production function. For this view, what matters for economic development is not the type of production but the unit price and the value of the output. The neoclassical development framework is based on generally competitive environment where technology and investment flow to a particular activity is guided by the rate of returns that tend towards equalization across activities.

This neoclassical theoretical argument, combined with the market reality of low-income economies, can serve as a point of departure for the structuralist argument. Considering the shift of resources among sectors as one important element of structural transformation (Syrquin, 2008), if returns are not equal across sectors, a shift of the factors to sectors with higher returns contributes to higher aggregate productivity growth. Under competitive markets, in economies with low manufacturing-base, there is a prospect of relatively high return on capital and technology in the manufacturing sector, and therefore the ensuing flow of capital and technology to the sector is crucial for growth. The market reality on the ground is imperfect and lacking the neoclassical speed of adjustment and that must retard growth of the economy at large, prolonging the existing structure with capital starved manufacturing. Theoretically, interventions towards making markets competitive in these economies enhance structural change by diverting the flow of resources to manufacturing.

Lin's (2012) argument in his New Structural-Economics framework is an admission of the need for structural change using neoclassical framework. Pasinetti (1993), in "Economic theory and the neglect of structural change" raises issues that are at the heart of our theme. Pasinetti's work has emboldened our study to be a legitimate enquiry into the importance of structure, an area enjoying perhaps less recognition than it deserves.

Various other strands of development thinking that do not lay emphasis on the existence of a particular structure to attain sustained growth are worth mentioning. In Sachs (2005) growth diagnosis and shock therapy, there is no clear entry point among economic activities, which can be singled out as necessary a priori, to bring about sustained growth, other than what the diagnosis tells. It could be manufacturing, service, or agriculture etc. Rodrik (2007) also uses growth diagnosis and emphasizes industrial policy, but the analysis does not single out and promote a particular sector to effect sustained growth. For Collier (2007) there is no reference to structural factors, let alone the role of manufacturing, as causes for falling in to development traps.

Thus, in development thinking, there are divergent views on the importance of structure for attainment of sustained growth and the sector to be promoted for sustained growth. The lack of recognition of structure as an important factor to attain sustained growth is reflected in development policies and strategies of governments in low-income economies. Emphasis on agriculture remained, for instance, a central government policy and donors' aid in Ethiopia and other African economies for decades. Such emphasis has to be reviewed to assess whether it denies low-income economies the basic structure required for accumulation of capital (embodying technology) that is necessary for long-term growth. In the context of under industrialized economies in general, there is a need for upgrading sectoral productivities, accumulating capital that embodies technology, and attaining high per capita income. In this connection, the prevailing sectoral emphasis requires revisit.

2.3 LESSON FROM THEORIES OF GROWTH

Single sector growth models reveal the underlying growth theory that does not recognize structure. Solow growth model (1956) and neoclassical growth models of Ramsey (1928)-Cass (1965)-Koopmans (1965) are instances of one sector models. Neoclassical growth theories assume the existence of aggregate production function relating optimally employed resources to a maximum net output. Exogenous technology and production factors constitute the arguments of the production function of the basic Solow and Neoclassical growth models that lead to convergence of economies to common steady state equilibrium. Growth models with endogenous technology as well use a single production function. Theories of growth that employ a single aggregate production function do not lay specific emphasis on the structure of the economy. In these growth theories, there is no special importance attached to a faster growth of any particular sector to initiate and sustain long-term growth.

On the empirical front, we find efforts of many serious economists under the Global Research Project 'Explaining Growth' to compile the most comprehensive empirical assessment of growth in developing and transition countries (McMahon and Squire, 2003). The effort to explain growth in the studies rests on four aspects of growth: sources of growth, microeconomic agents of growth, the role of markets in growth and the political economy of growth. Although the studies address the issue both from the traditional view of convergence to a single equilibrium and from the view of multiple equilibrium(with a reference to political economy and coordination problems), the overall focus of the researches has no reference to structure, in terms of sectoral contribution and share as a factor influencing sustained growth. The need to fill the gap in the literature on the role of structure in growth theories further inspires our study.

Despite the above-mentioned theoretical and empirical efforts that do not consider structure, some growth models within neoclassical framework consider the interactions of two or more sectors. Among earlier growth models, Uzawa's two-sector model, Von Neumann's multi-sector growth model, and Leonitief's input-output model are cases in point. The sectors considered in Uzawa's two sector model are consumption good and investment goods production (Solow, 1961), which are different from the structure we want to address in accordance with the historical pattern of development (i.e, the importance of production sectors of agriculture and manufacturing). Von Neumann's model is about expanding multi-sectoral economy and its general equilibrium characteristics and the optimal growth path (Neuman, 1946). The model recognizes structure and, if pursued, hints about sectoral importance, though its focus is on the existence of equilibrium and optimal path rather than on the importance of specific sector in driving the structural change and sustained growth. Leonitief's input-output framework is, as well, recognition of structure without directly specifying which sector is more important for sustained growth. Similarly with the Neumann model, Leontief's model identifies input-output coefficients, a_{ij} ,(which may depict the input of service i per unit output of good j) where a reduction of a_{ij} , will improve output in the entire economy.

Hansen and Prescott (2002) distinguish between classical and neoclassical growth to explain international income levels and differences. World economies remained under Malthusisan technology until mid–eighteenth century. Leading economies graduated to neoclassical technology and the onset of modern economic growth after 1820 (Madisson, 2005). There were periods in which Malthusian and Neoclassical technologies coexisted. Thus, the coexistence of the two is tantamount to a two-sector economy (land based or agricultural economy and modern industrial economy). The authors discuss this coexistence in their 'unified theory". The relevant aspect of the "unified theory" will be discussed in the section on theoretical models. Here it suffices to say that their approach is highly relevant to the concerns of our study.

3. THEORETICAL FRAMEWORK

This section deals with assumptions and theoretical arguments that served as foundations for the model that sets out with acceptance of the centrality of manufacturing. Section 3.1 argues, with the help of empirical regularities and theoretical underpinnings in previous works, why manufacturing is structurally important. Section 3.2 highlights the stylized facts of low-income economies, where traditional agricultural sector coexist with service dominated modern sector. In light of the theoretical arguments and the stylized facts, section 3.3 formulates the mathematical model representing sectors of the economy and the factors that affect their evolution.

3.1 WHY MANUFACTURING IS STRUCTURALLY IMPORTANT

The long-term growth path of any economy is path of co-moving aggregate demand and aggregate supply. Aggregate demand and supply have their own structure. Differences in growth paths of economies are differences arising either from their supply or demand structures. Since the production side of the economy absorbs changes in technology (Kuznets, 1966; Lipsey, Carlow and Bekar, 2005), the supply side may be taken as the basis upon which demand patterns arise.

Supply is composed of outputs from domestic production sectors and imports. The sectoral outputs are manufactured goods, non-manufactured goods, and services. Most services arise on the basis of goods supplied to the economy. Some services assist the production, consumption, and exchange of goods, while others are activities that are extensions of goods production. Change effecting services, marginal services and knowledge capturing services constitute the service sector in the United Nations System of National Accounts (UN SNA, 2008). Change effecting services arise to add value mainly on supplied goods. Knowledge capturing services are activities that arise essentially on high technology goods. Marginal services like insurance and banking are engendered to assist production and exchange. A structure of an economy with solid base in goods production is necessary to have viable services. Thus, goods from domestic production and imports are the basis for arising services. A structure of an economy that is founded on goods production provides opportunities and income for arising services and demand.

Economies differ in their sectoral compositions or structures. Differences between economies in their supply structure arise from differences in adopting economic activities (sectors) that apply technologies (products and processes) and that accumulate modern factors of production. Such differences in supply structure are reflected in differences in rates of sustained growth. Among structures of economies one with higher potential for production of a variety and large quantity of goods avails more opportunities for sustained expansion. A structure of an economy with limited scope in goods supply renders the economy stagnant at low level of equilibrium, while that structure well founded on a sector potentially capable of producing variety and large number of goods has a scope for expansion, allowing the economy to settle at higher level of equilibrium of demand and supply.

There are macroeconomic and microeconomic arguments for the centrality of manufacturing. Under macroeconomic arguments, we highlight that manufacturing has faster progress in technology; it has less of saturation phenomena, it has richer opportunities for diversification, it has greater possibilities to develop supply chains causing inter-sectoral delivery networks to expand. On the micro level, we argue that manufacturing excels in facilitating entrepreneurship.

As attested by the historical accounts of patterns of economic development (Kuznets, 1966; Bairoch, 1993; Maddison 2005), manufacturing, among goods producing sectors, stands as the most efficient vehicle to carry technological progress and effect factor accumulation. Manufacturing has diverse scope for technological change. Technology is either product technology or process technology. Technological progress improves processes that conserve factors or introduces new products as capital goods or consumer goods (Pyka and Saviotti, 2011).

Not only lessons learned from historical experiences but also contemporary sustained growth experiences of newly industrializing economies support the view. Newly industrialized countries have gone through a structural transformation in line with the historical pattern. Inherent external economies in manufacturing (Krugman, 1981), its technology absorption and capital accumulative nature (Kuznets 1966, 1989), its nature as a basis for the rise of various services(tertiary activities) and for enhancement of the productivity of primary activities are responsible for this role. Krugman(1981) emphasizes the inherent external economies in manufacturing and because of the external economies in manufacturing production, whichever country has the larger capital stock will have a higher flow of profit and will therefore grow faster. Diminishing returns that may follow the accumulation of capital are offset with embodied technologies within newly invested capital. The result is an ever-increasing divergence between the regions.

Modern machinery use larger quantity of energy; the use of more machinery means the use of more energy and hence more output. The use of modern energy sources, rather than the use of human and animal power, characterizes modern manufacturing. Emanating from its use of energy intensive capital goods, incipient modern manufacturing exhibits higher labor productivity than the other sectors. The use of techniques with high energy input in the production process results in multifold output per unit time as compared to techniques using low energy inputs. With the consumption of energy from modern sources, the possibility of fast or mass production and the ensuing high productivity of labor in modern manufacturing makes it by far the faster way of transformation of inputs to outputs, and creating wealth and prosperity than other activities with incomparably low energy use. Jorgenson (1984) reports from results of empirical studies that electrification as well as nonelectrical energy uses are interrelated with productivity growth. The observed possibility of automation and mechanization in manufacturing further increases the productivity of the sector (Baumol, 1967).

The use of manufactured inputs makes the other sectors more productive (Parente and Prescott, 2003 citing Johnson 2000, Kaldor,1966). Agriculture and other sectors highly benefit from a growing manufacturing sector in production and consumption linkages. Modern inputs to agriculture originate from manufacturing. The fertilizers and chemicals, the pumps and pipes of irrigation, the materials of agricultural construction, the storage and transport equipment for agriculture, the farm machinery and equipment, farmers durable and non-durable household goods etc. are manufactured goods required for advancing agricultural output and productivity. The inability to supply these inputs from local manufacturing sector would make it extremely hard for agriculture to improve its productivity and output.

In economies with a low manufacturing base, by virtue of the existence of low capital in the sector, the return to manufacturing investment must be high. The high return to capital, coupled with embodied technology in the capital employed in manufacturing, enhances manufacturing growth to maturity and that propels the economy forward. If the economy is constrained by many factors that are not conducive to manufacturing growth, manufacturing will be suppressed and unable to propel the economy to higher rate of sustained growth.

In a setting of developing or underdeveloped economy, import is the largest current source of manufactured products and processes. In light of the fact that sustained ability to import requires a sustained ability to export, and a perpetual import cannot be a viable source for most products, some effort in import substitution remains an opportunity. Import substitution is largely the activity space and specialty of manufacturing. Developing technological capability in manufacturing is a long-term solution to a chronic indebtedness of a developing economy by improving its trade balance through exports of manufactures.

Economic activities differ in the level of hosting entrepreneurs. Under conditions conducive to entrepreneurship, the sector, which likely hosts most entrepreneurs, is that availing larger number of products and processes as opportunities for entrepreneurship. The manufacturing sector is the sector having potentially a large number of products and processes in itself and creating opportunities for services associated with manufactured products and processes. Manufacturing avails more opportunities for entrepreneurial engagement in goods production and in the provision related services. It is instrumental to employment creation for the growing labor forces of a developing economy.

Since manufacturing sector has the highest actual or potential capacity to provide a variety of goods for direct consumption, indirect consumption and in forming the basis for emergence of services, a structure with growing manufacturing sector is associated with sustained growth. This thesis begins with a prior assumption that takes growth of manufacturing as a driving force of sustained growth in under industrialized economies. For low-income economies, attainment of sustained growth rate requires a structure where manufacturing drives the process of growth.

3.2 PERTINET STYLIZED FACTS OF LOW INCOME ECONOMIES

A typical low-income economy (LIC) has dual characteristics: has large sector producing traditional agricultural goods and a modern economy with small manufacturing and relatively larger services. Such duality is observed in considerable number of LICs (unstat, 2013). The agricultural sector is labor using and unable to absorb capital because of various factors among which are extremely low size of land holdings and prevalence of subsistence. Manufacturing is more capital using than agriculture and labor saving in relative terms. Manufacturing generates positive externalities and scale economies (Krugman 1981). This characteristic paves the ground for multiple equilibriums.

Current share of manufacturing is low and the growth of its share varies across economies (unstat 2013). Low income economies host relatively large service sector composed largely of transaction services. Leakages of savings as a result of high uncertainties on investment outcomes, or due to capital flight are not uncommon. Slow capital formation and low rate of flow of capital to manufacturing characterize the economies. The markets are highly imperfect (Banergee and Duflo 2004) and returns on investment are far from homogenous across industries and firms. Unskilled labor, unemployment or underemployment predominate the economies (ILOSTAT Database). There is little competition for labor from the supply side as goods producing sectors draw labor (L) from the unemployed and underemployed pool. There is no substantial competition for capital (K) as the demand for capital comes predominantly from the modern sector. Subsistence agriculture is labor using and affords little capital, until it modernizes and ceases to be subsistence.

4. THE MODEL STRUCTURE

In this section, the conceptual model is constructed and the road map of evolution of low-income economies is charted; the components constituting the structure of the economy are defined; capital use in transaction services and capital use in goods production are separately considered; the mathematical expression of the model is specified; other relevant inefficiencies affecting the evolution are incorporated.

4.1 THE ROAD MAP OF EVOLUTION OF LOW INCOME ECONOMIES

The economy is evolving through stages in accordance with observed historical patterns (fig.2.2 below). The level of capital accumulation demarcates the stages. The first stage is a stagnant subsistent agricultural economy with little or no capital accumulation. The second stage is a dual economy where subsistence agriculture coexists with capital using small modern manufacturing economy. In this stage, capital accumulation takes place in manufacturing and associated services in a precarious manner. The third stage is a matured economy with sustained growth (Kaldor, 1966; Kuznets, 1966, 1989; Hansen and Prescott, 2002; Parente and Prescott, 2003; Oded Galor, 2004) where the distinction between the modern and traditional sector disappears. The second stage, where multiple equilibriums are possible, is the focus of the modeling in this study. In this stage, the appropriate model is a model for a dual economy that differs from Solow model, which is a single aggregate production function fulfilling Inada conditions. It also differs from Roemer's endogenous growth model as it exhibits a dual nature and possibility of multiple equilibriums.

Growth theories applicable to contemporary low-income economies must specifically take these economies as transition economies from agrarian to modern economies in line with Hansen and Prescott (2002), Parente and Prescott(2003), Oded Galor(2004). They are dual economies mingling some characteristics from both phases and demanding a separate treatment in modeling. The second stage is a distinct stage representing the dual economies demanding a separate model where most growth literature does not address. A separate treatment of these economies makes use of historical lessons and provides a better perspective highlighting the reality of low-income countries. The stage combines characteristics pertaining to earlier agrarian economies suffering from Malthusian stagnation and characteristics of modern sustained growth pertaining to advanced economies

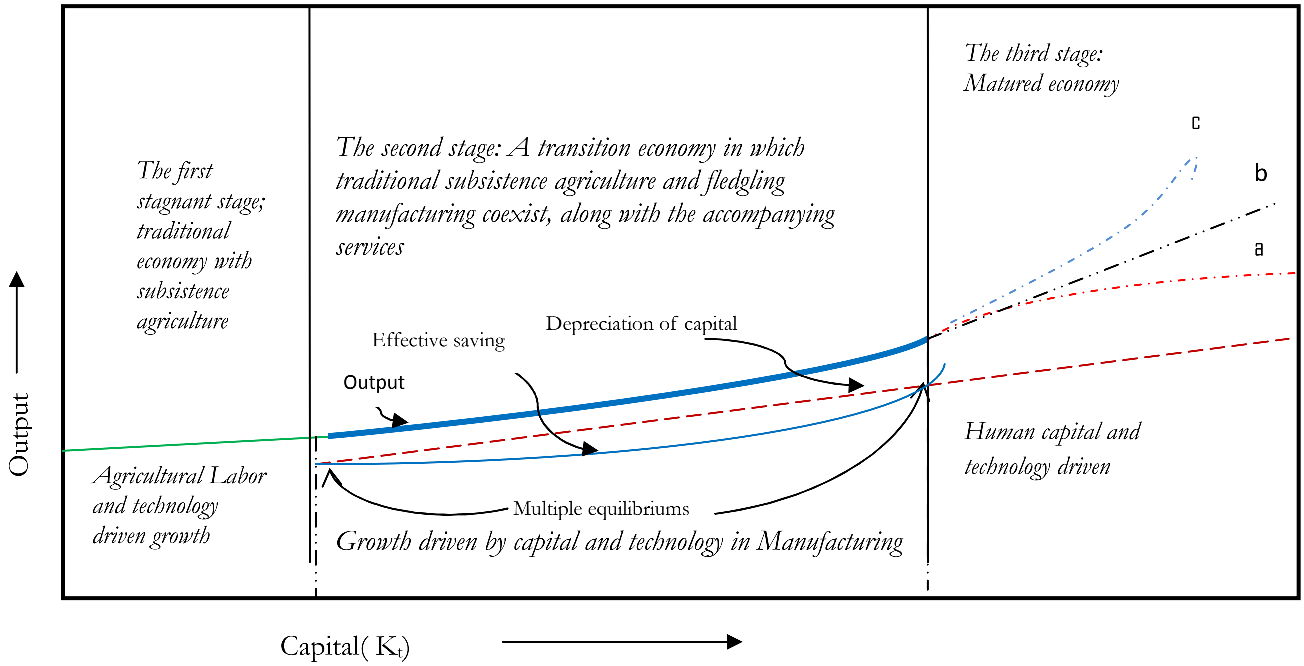

Fig 2.2 *Evolution of output in three stages*

Note that applicable models in the third stage are: a, b and c in fig 4.1 above, where

a - Solow model $Y= AK^{\alpha} L^{\beta}$ where Inada conditions are fulfilled,

b - AK model $Y= AK$

c - Roemer's Endogenous growth models $= AK^{\alpha+n}L^{1-\alpha}$

As observed in experiences of advanced economies, services may possibility be drivers of growth as the economy matures, i.e., when it reaches the third stage, where a, b, c type growth models become relevant. The above discussion on centrality of manufacturing is applicable only to low-income economies, where services stand as possible rivals to manufacturing.

4.2 THE STRUCTURAL COMPONENTS IN THE MODEL

The aggregate production function is composed of manufacturing as a modern goods production activity and agriculture as a traditional and subsistence activity, with services arising from the respective goods production sectors. The model reflects the positive externalities, the scale economies, and the capital and labor usage in manufacturing on the one hand and the labor intensity of agriculture with no capital. Inefficiencies that place actual output below potential output are incorporated reflecting prevalent market imperfections. The inefficiencies are output affecting, similar to that of Parente and Prescott (2003), on the one hand, and input reducing, on the other. Input-reducing inefficiencies are those diverting factors from goods production. Transactions processes use these input taking them away from direct use in goods production. To obtain the factor effectively used for goods production it requires to subtract the factor used for transaction services from the total amount of factors made available for production or inputs directly used for goods production may be computed as percentage of total available factors.

Parente and Prescott (2003) used entirely multiplicative efficiency parameters and TFP as output side effects rather than introducing input used for goods production by deducting from total available inputs. In this study, input side inefficiencies are introduced as *deductible*s from total inputs as well as *proportions* of total inputs not directly used for goods (equation 2a in Appendix 2.1). TFP is part carried in parameters of externalities and scale economies (μ) and partly in the multipliers (u). The inputs not directly used for goods production are essentially economy wide transaction costs for society that emanate from imperfections.

4.3 TRANSACTION AND NON TRANSACTION SERVICES

Services are composed of change effecting services, marginal services, and knowledge carrying services (UNSNA, 2008) that thrive on the basis of the size of goods produced by manufacturing and agricultural sectors. These services are categorized as transaction and non-transaction services based on the purpose they serve to society. Those extending the transformation of goods (or a group of goods) by adding new attributes to goods are non-transaction services and those services facilitating exchange of goods without adding new valuable attributes to the goods are transaction services. Non-transaction services are similar to goods production as they are more or less direct extension to goods production. Transaction services, though they arise to facilitate goods production and exchange, their association with goods production depends on the institutional arrangement prevailing in the economy.

Inputs to transaction services appear as transaction costs to goods production. Although non-transaction services compete for inputs with goods producing sectors, they do not appear as transaction costs to society. Conceptually, non-transaction services could be lumped together with goods production. The total value added of the economy is the combined outcome of goods production and services that arose on underlying produced goods. Since both transaction and non-transaction, services arise based on goods production and consumption, the combined value added can be expressed in terms of the value added of goods production. The value added of goods production and arising services is conceptualized as the product of a multiplier and goods value added. In our model, the multipliers are positively associated to the ratio of actual transaction costs to the minimum transaction cost required to efficiently run goods production.

4.4 SECTORAL PRODUCTION FUNCTIONS

Let Y be the total value added, $f(R)$ be the value added of subsistence agriculture with services arising from it and $M(K, \omega, L) = M$ be the value added of secondary activities (manufacturing) and the associated services. Subsistence agriculture and manufacturing are the basic elements of the structure. $f_g(R_t)$ and M_{gt} are goods production in agriculture and manufacturing sectors respectively while $f(R)$ and M include goods and the arising services together in the respective sector.

Services (Ser) are expressed in terms of goods producing sectors. Some services are assumed to arise on the basis of agricultural goods production and the others on the basis of manufactured goods. Thus, those services arising in or for agriculture are represented by a multiple of agricultural value added and a parameter b_1 while those arising in and for manufacturing are represented by manufacturing value added multiplied by a parameter b_2.

$$\text{Ser} = b_1 f_g(R_t) + b_2 M_{gt}, \qquad (1)^5$$

Value added in subsistence agriculture

Subsistence agriculture uses only labor[6] and the total labor input available to subsistence agriculture is(R_t). Goods value added in subsistence agricultural sector is $f_g(R_t)$. The value added of services

[5] Note that endogenous and exogenous variables have time subscripts since they change overtime. Parameters, which are assumed to persist for longer periods until institutional shocks take place, are expressed without time subscript.

[6] Subsistence agriculture is (assumed) not using physical and human capital. Physical and human capital is employed essentially in the production of goods and services of the modern sector. Manufacturing and arising services are the major users of capital formed. With more and more use of capital, subsistence agriculture gets transformed into the modern sector, in which case it is no more treated as traditional subsistence sector.

arising from agriculture is expressed in terms of agriculture as $b_1 f_g(R_t)$. The total value added owing to agriculture is, thus,

$$F(R_t) = f_g(R_t) + b_1 f_g(R_t) = (1 + b_1) f_g(R_t) \qquad (2)$$

Transaction services consume some part of the available agricultural labor, designated by ψ_t, and render it unused for agricultural goods production. ψ_t represents agricultural labor diverted to transaction services from goods production. It is an exogenous variable determined by the institutional setup of the economy. $R_t - \psi_t$ is the effective labor used for goods production in subsistence agriculture. r is the efficiency in attaining potential output with effective inputs. ς is the minimum labor that may be diverted from goods production to run agriculture most efficiently or it is the lower limit of ψ_t. Value added of services arising from agriculture is positively related to the labor diverted from agriculture (ψ_t). Since ς is the minimum transactional labor required to run goods production in agriculture, services value added owing to agriculture is positively associated with some power of the ratio $\frac{\psi_t}{\varsigma}$ and the value of agricultural goods produced $(R_t - \psi_t)^\beta$.

The total value added owing to agriculture $F(R_t)$ is a concave function of labor engaged in agricultural goods production and services arising from agricultural goods production as:

$$F(R_t) = r\left(\frac{\psi_t}{\varsigma}\right)^u (R_t - \psi_t)^\beta$$
$$\text{where } u \geq 0, (0 < \psi_t < R_t), \ (0 < \beta < 1), \ (0 < r < 1) \qquad (3)$$

r, ς, β, u are parameters of the economy while ψ_t is an exogenous variable and R_t is an endogenous variable in the model. b_1 in equation (2) above becomes : $b_1 = \left(\frac{\psi_t}{\varsigma}\right)^u - 1$ and the ratio $\left(\frac{\psi_t}{\varsigma}\right)^u$ is the multiplier of agricultural goods value added. Multiplying this ratio with agricultural goods value added enables to incorporate the value of the arising service in and for agriculture in the total value added the economy owes to agriculture. This ratio has to be greater than zero signifying the impossibility of production without transaction services. A greater-than-one ratio expresses the existence and extent of services generated on the basis of agriculture. While transaction costs reduce output of goods by competing for resources from input side, they may increase total value added of the sector and the associated services from the output side.

In this model, land is fixed and diminishing returns on agricultural labor sets in. The model suggests that output growth in agriculture is bound to stagnate[7]. The sector has little or no scope of contributing to the growth of the economy as agricultural population increases through time. From the input side, agricultural population growth increases labor. Agricultural labor diverted to transaction services (ψ_t) rises or falls with prevailing transaction costs, which, in turn, reduce the available net input to goods production accordingly.

Labor productivity in subsistence agriculture and arising services

$$\frac{\partial f(R_t)}{\partial R} = \Gamma\left(\frac{\psi_t}{\varsigma}\right)^u \beta \frac{(R_t - \psi_t)^\beta}{(R_t - \psi_t)} = \beta \frac{f(R_t)}{(R_t - \psi_t)} = \beta \bar{R} \quad \text{Where } \bar{R} \text{ is per capita output in agriculture} \quad (4)$$

Value added in manufacturing sector

The inputs to manufacturing are both technology embodying capital(K) and labor (L). Goods value added in manufacturing sector is M_{gt}. The value added of services arising from manufacturing is expressed in terms of manufactured goods as $b_2 M_{gt}$. The total value added owing to manufacturing (M_t) is, thus,

$$M_t = M_{gt} + b_2 M_{gt} = (1 + b_2) M_{gt} \quad (5)$$

Value added of the manufacturing sector exhibits increasing returns in capital use and capital embodies technology. Technology, which is the manner of "doing things" is embodied in the capital equipment and the knowledge of workers. Some capital is taken away from the available capital(K_t) to be used in transaction services in and for manufacturing. "ω_t" is capital used in transaction services in and for manufacturing. In the same way "φ_t" represents transaction cost in manufacturing in terms of labor. Both ω_t and φ_t are exogenous variables determined by the institutional environment of the economy. $(K_t - \omega_t)$ is effective capital and$(L_t - \varphi_t)$ is effective labor in manufactured goods production. η is the efficiency of attaining potential output. No goods

[7] It is assumed , on the basis of the stylized facts , that subsistence agriculture is incapable of using capital and modern inputs

production activity takes place without transaction costs. High transaction costs penalize the economy by depriving it of capital usable in goods production. C is the minimum capital required to conduct most efficient transactions in and for manufacturing or it is the lower limit of ω_t.

Value added of services arising from manufacturing is positively related to the amount of capital that is diverted from goods production (ω_t). Since "C" is the minimum amount of capital required for transactions needed to run goods production in manufacturing, services value added arising from manufacturing is positively associated with some power of the ratio $\frac{\omega_t}{C}$, and the value of manufactured goods (M_{gt}). We cannot avoid transaction costs and hence the ratio $\frac{\omega_t}{C}$ has to be greater than zero.

The total value added owing to manufacturing (M_t) is a function of capital and labor, with increasing returns to capital. It incorporates services arising from manufactured goods production. Thus

$$M_t = \eta(\frac{\omega_t}{C})^u (K_t - \omega_t)^{\alpha+\mu} (L_t - \varphi_t)^{1-\alpha} , \qquad (6)$$

$$(K_t - \omega_t)/K_t = \upsilon \qquad \omega_t = (1 - \upsilon)K_t \qquad (6a)$$

$(0 < \eta < 1), (0 < \alpha < 1), (0 < \mu < 1), (0 < \omega_t < K_t), (0 < \varphi_t < L),$ u>0

η, C, α, μ, u are parameters of the economy, where α is the share of capital parameter and μ is an increasing returns parameter, which is positive in sign. It signifies the positive externalities in manufacturing and other factors that are responsible for the existence of increasing returns to scale. ω_t and φ_t are exogenous variables while K_t is endogenous variable in the model. In manufacturing production function, if $\omega_t = C$, manufacturing output is penalized by reduction of available capital by an amount just enough to cover the optimal transactions. If $\frac{\omega_t}{C}$ is greater than one, then, manufacturing goods production is heavily penalized by capital flow away from it to conduct extra transaction services necessitated by the institutional environment. However, this is counted as additional value added in services on top of the values of manufactured goods. Hence $(\frac{\omega_t}{C})^u$

signifies the multiplier to value added of manufactured goods to incorporate value added in services created for and in manufacturing. b_2 in equation (5) above becomes : $b_2 = (\frac{\omega_t}{C})^u - 1$

The model implication for Labor productivity in manufacturing and arising services is derived as follows.

$$\frac{\partial M}{\partial L} = (1-\alpha)\eta(\frac{\omega_t}{C})^u(K_t - \omega_t)^{\mu+\alpha}(L_t - \varphi_t)^{-\alpha} \quad (7)$$

Labor productivities in the two sectors are not necessarily equal but assumed to move together. Assuming labor productivity of the traditional subsistence agricultural sector to be a fraction (θ) of that of the modern sector: *The relationship of labor productivities in the two sectors* is derived as follows:

$$\frac{\partial f(R_t)}{\partial R} = \beta\overline{R} = \theta\frac{\partial M}{\partial L_M} = \theta(1-\alpha)\eta(\frac{\omega_t}{C_t})^u(K_t - \omega_t)^{\mu+\alpha}(L_t - \varphi_t)^{-\alpha} \quad \text{where } (0<\theta \le 1) \quad (8)$$

Solving for L_t yields the following expression for labor demand in the modern sector as a function of labor productivity in subsistence agriculture ($\beta\overline{R_t}$) as:

$$L_t = \left[\frac{\theta(1-\alpha)}{\beta\overline{R_t}}\left(\eta(\frac{\omega_t}{C_t})^u\right)(K_t - \omega_t)^{\alpha+\mu}\right]^{\frac{1}{\alpha}} + \varphi_t \quad (9)$$

The labor demand in the manufacturing sector is composed of two components: the first expression within the brackets and that for transaction services (φ_t). The labor demand in manufacturing is inversely related to the productivity in manufacturing ($\frac{\beta\overline{R_t}}{\theta}$), which is expressed in terms of productivity in agriculture. Near full employment, the lower the productivity of agricultural labor $\beta\overline{R_t}$ the higher the labor demanded in manufactured goods production for a given ratio θ. Labor demand is linearly associated with transaction costs(φ_t). The significance of the entire expression lies in its use in the capital formation equations below, where labor productivity in subsistence agriculture ($\beta\overline{R}$) may be taken as an exogenous variable since it is determined outside the model pertinent to manufacturing.

Total value added

From the foregoing discussions, total value added of the economy (Y_t) is expressed as:

$$Y_t = \left[r(\frac{\psi_t}{\varsigma})^u(R_t - \psi_t)^\beta\right] + \left[\eta(\frac{\omega_t}{C})^u(K_t - \omega_t)^{\alpha+\mu}(L_t - \varphi_t)^{1-\alpha}\right] \quad (10)$$

This is a model of two goods producing sector with their associated services. The model highlights the factors allocated to transaction services that tend to reduce the inputs used in the production of goods.

4.5 INEFFICIENCIES

As mentioned in the stylized facts of low-income economies, additional to the transaction costs (ω_t), there are other inefficiencies in capital use. The inefficiencies are leakages of saved capital away from reinvestment in manufacturing. Part of savings may not be made available for investment because of the underdeveloped institutional environment or lack of information on investment outcomes, or due to capital flight. These not-invested savings are differences between the amount of output net of consumption and what is used in actual investment. The rate of saving being the ratio of output (Y) less consumption(Cn) to output (Y), i.e., s= (Y-Cn)/Y, effective saving rate is s-λ, where λ is that part of the saving rate that couldn't be used to the formation of capital**.** It is economic frictional loss so to speak. The implication of λ, which is that part of the saving rate that couldn't be used to the formation of capital, for the equilibrium of the model is referred in sections 4.6 and 5.4 below.

In an undeveloped economy, it is possible that depreciation could be higher than the effective saving net of heavy frictional losses that burden the gross saving. For saving to exceed depreciation, it requires either the removal of forces leading to leakages or securing additional capital exogenously to compensate for depreciation and have net investment. The exogenous factors affecting capital formation in the manufacturing sector are: rates of physical depreciation and technological distance from the frontier, designated by depreciation rate (δ), proportion of savings not available for investment(λ) and levels of resources diverted to transactions services(ω_t). They play important role in the second stage of development of the economy. They lift up the capital requirement needed to escape from predominantly subsistence agricultural economy, which is the lower level equilibrium. We analyze their effects on the evolution of the economy and equilibrium outcomes through the law of motion of capital (Acemoglu 2009).

4.6 CAPITAL ACCUMULATION AND ESCAPE TO SUSTAINED GROWTH

The thesis of this study is that structure is important in facilitating and enhancing accumulation. The structure of the economy is seen as composed of goods producing two sectors: manufacturing and subsistence agriculture along with their associated services. The output of subsistence agriculture is "hand to mouth" that it is assumed to save little and hence its savings are negligible. Manufacturing sector and the associated services use capital and there is a possibility of producing surplus and hence saving in this sector. Capital accumulation takes place in the economy out of saving at some exogenous rate (s). The rate (s) is determined by various factors exogenous to the economy, which we do not pretend to have complete knowledge about. Whatever is saved, however, is used to replenish worn, torn, and outdated physical and human capital, cover investment related transaction costs necessitated by the institutional environment or the lack of it and the remaining used for the expansion of output. Thus, effective saving partly replaces depreciated capital and partly forms additions (change in capital stock (dK)) on capital stock (Acemoglu 2009)

Thus, Effective saving = Net change in capital stock + Depreciation

$$(s-\lambda)\left(\eta\left(\frac{\omega_t}{C}\right)^u\right)(K_t-\omega_t)^{\alpha+\mu}(L_t-\varphi_t)^{1-\alpha} = dK \quad + \quad \delta(K_t-\omega_t) \tag{11}$$

Rearranging equation (11)

$$dK = (s-\lambda)\left(\eta\left(\frac{\omega_t}{C}\right)^u\right)(K_t-\omega_t)^{\alpha+\mu}(L_t-\varphi_t)^{1-\alpha} - \delta(K_t-\omega_t) \tag{11a}$$

$$= (s-\lambda)\eta\left(\frac{\omega_t}{C}\right)^u (K_t-\omega_t)^{\alpha+\mu}\left[\frac{\theta(1-\alpha}{\beta\bar{R}})\left(\eta\left(\frac{\omega_t}{C}\right)^u\right)(K_t-\omega_t)^{\alpha+\mu}\right]^{\frac{1-\alpha}{\alpha}} - \delta(K_t-\omega_t) \tag{11b}$$

where: $(0< s< 1)$, $(0< \delta< 1)$, and $(0< \lambda <1)$

The change in capital (dK) could be zero, positive, or negative. When change in capital (dK) is negative capital stock declines through time. The decline continues until capital stock (K) just covers the transaction services (ω_t); i.e. $K_t = \omega_t$. This is the lower level equilibrium at which not only K_t and ω_t but also depreciation and saving are equalized. When change in capital (dK) is positive accumulation of capital stock goes on, widening the gap between K_t and ω_t. In cases where K_t and ω_t are different dK could be equal to zero when depreciation and saving equalize. This is the higher level equilibrium. The higher-level equilibrium capital stock is thus K=K* at which equation 11a above equals zero as in equation 12 below. This equilibrium is unstable since there is no endogenous force restoring K after changes in capital stock placing K below or above K* occurs.

$$(s-\lambda)\eta\left(\frac{\omega_t}{C}\right)^u (K_t-\omega_t)^{\mu+\alpha}\left[\frac{\theta(1-\alpha}{\beta\bar{R}})(\left(\eta\left(\frac{\omega_t}{C}\right)^u\right)(K_t-\omega_t)^{\alpha+\mu}\right]^{\frac{1-\alpha}{\alpha}} - \delta(K_t-\omega_t) = 0. \tag{12}$$

Solving for K_t we obtain the critical capital stock ($\mathbf{K}^*$) at that equilibrium. That capital stock at the state of the unstable equilibrium, expressed in terms of parameters and exogenous variables of manufacturing and related services, is:

$$\mathbf{K}^* = \left(\frac{\delta}{s-\lambda}\right)^{\frac{\alpha}{\mu}} \left(\frac{1}{\eta}\right)^{\frac{1}{\mu}} \left(\frac{C}{\omega_t}\right)^{\frac{u}{\mu}} \left(\frac{\beta\bar{R}}{\theta(1-\alpha)}\right)^{\frac{1-\alpha}{\mu}} + \omega_t \qquad (13)$$

K^* is the critical capital stock to be exceeded in order to attain sustained growth in the modern sector (in manufacturing and services arising from manufacturing). The significance of the attainment of this critical capital stock for sustained growth of low-income economies is similar to the recognition of large-scale planned investment providing optimal size for complementarities and positive externalities of different industries in the "big push" literature (Rodan R, 1943; Murphy K.M., Shleifer A, Vishny R.W. 1989).

5. MODEL IMPLICATIONS AND NUMERICAL ILLUSTRATIONS

Low Income Countries (LICs) face multiple equilibriums at low level of output, the higher of which is unstable. The main challenge of economies in LICs is placing themselves on a sustained growth path after escaping the multiple equilibriums. Escape is possible when the economy stocks capital that exceeds the critical capital stock (K*). The size of K* signifies the ease or difficulty of escaping to sustained growth. Analysis of the implication of the model goes by way of investigating (a) how the economy evolves with changes in critical capital (K*), (b) the effects of the changes in the exogenous variables and parameters on the critical capital stock (K*) and (c) the structural importance of manufacturing in driving the dual economy to sustained growth.

The exogenous variables of interest are: capital used in transaction services (ω_t), or efficiency of capital use in manufacturing(υ_t), which is the ratio of effective capital to total capital, and labor productivity in manufacturing expressed in terms of labor productivity in subsistence agriculture ($\frac{\beta\bar{R}_t}{\theta}$). More important parameters of interest are depreciation rate of capital(δ), the rate of savings(s), rate of leakage in savings (λ), efficient level of capital used in transaction services(C) and technical efficiency(η). These exogenous variables and parameters deserve focused analysis and emphasis for their immediate relevance with manufacturing growth and policy implications.

The direction of growth of K* will be discussed in relation to other parameters to highlight the effects of institutional changes on manufacturing and the ease to escape to sustained growth. The parameters are reflections of deep-rooted institutional settings of the economy, such as share of capital (α), measure of increasing returns and externalities generated by aggregate capital(μ), exponential converter of goods value added to total value added incorporating services (u).

5.1 CRITICAL CAPITAL STOCK K*, SAVINGS AND DEPRECIATION

The second stage of the economy, as depicted in fig2.2 above, is bounded by a lower level subsistence economy and a higher-level matured economy. In this transition stage (second stage), there is an unstable equilibrium. If disturbed at the unstable equilibrium, the economy either moves to the lower level equilibrium or moves to higher level transformation depending on whether *K* is greater or less than K^*. If by chance or design the economy accumulates capital that exceeds K* and escapes the unstable equilibrium, a persistent change follows towards maturity where it assumes a different structure having no more a distinction between agriculture and manufacturing.

The transition becomes clearer with the analysis of the state of K and K*. If K>K* accumulation of technology embodied capital continues and sustained growth follows. It goes without saying that capital formation is greater than depreciation when capital stock is above the critical level (K*). When K is less K* capital stock continues to decline towards ω (i.e., K→ ω) until a lower level equilibrium is reached, where the stock of capital is so low to keep the economy at near subsistence level (i.e., Y→ ($r\frac{\psi}{\varsigma}(R_t - \psi_t)^{\beta}$. In this state, unless intervention takes place, capital in manufacturing does not endogenously sustain itself. If there is exogenous replenishment of capital from outside the modern sector, but without enabling capital stock to exceed K*, the economy remains between the two equilibriums in a state of disequilibrium. Economies in which K* is low, escape is easier and in others where K* is high, escape is difficult. It necessitates higher accumulation of capital to escape. It is important to note that economies having effective savings always greater than depreciation do not pass through the second stage and hence they move to sustained growth without experiencing multiple equilibriums.

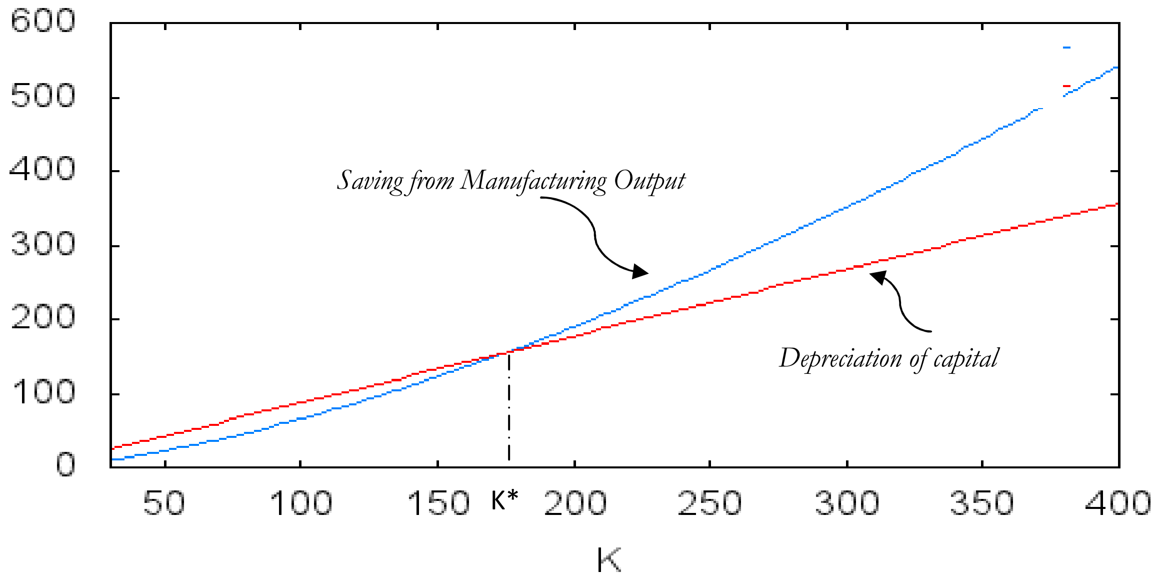

Fig 2.3 Savings, Depreciation and Critical Capital (K)*

5.2 DEPRECIATION RATE (δ) AND CRITICAL CAPITAL STOCK (K*)

Depreciation rate (δ) signifies the rate of wear and tear of capital and the rate at which capital becomes outdated. Holding other parameters and exogenous variables constant, if δ increases, K* as well increases and it becomes more difficult to escape to a path of sustained growth. An economy experiencing high depreciation rate requires greater stock of capital to escape to sustained growth, which means greater difficulty to the economy. The growth of critical capital with growth of depreciation rate is positive but the rate of growth declines faster at lower levels of deprecation and steady at higher levels of depreciation (fig 2.4).

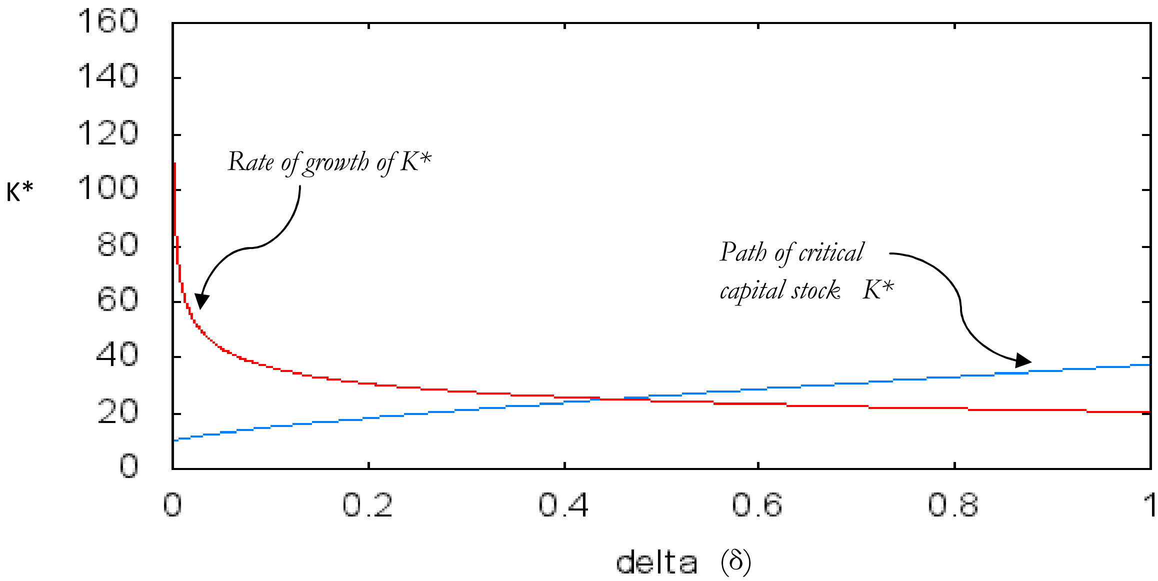

Fig 2.4 the path of K as the depreciation rate (δ) increases for specific values of parameters within their allowable range*

5.3 CAPITAL USED FOR TRANSACTION SERVICES (ω) AND CRITICAL CAPITAL (K*)

As the capital used for transaction services (ω_t) increases, the critical capital (K*) declines faster, until it reaches the minimum efficient level (C), making escape to sustained growth easier. After ω_t exceeds C, the critical capital stock increases, making escape to sustained growth more and more difficult in a linear fashion (fig.2.5). This suggests that the expansion of transaction services in low income economies beyond some minimum required is not helping the attainment of sustained growth.

The same can be analyzed with efficiency of use of capital in manufacturing and the critical capital stock. The efficiency of capital use, as expressed in equation 6a, is $v_t = (K_t - \omega_t)/K_t$. Keeping other parameters and exogenous variables constant, if υ_t increases the critical capital stock declines. As the efficiency of use of capital in manufacturing increases the critical capital stock declines, which means reduced capital usage in transaction service makes escape to sustained growth easier, confirming the result above. With increased efficiency in capital use, escape becomes easier. The rate of decline in the critical capital (K*) slows as efficiency increases. Since υ_t stands in inverse relationship to ω_t, its effect on K* has to be opposite to that of ω_t i.e., as υ_t increases ω_t declines and K* also declines.

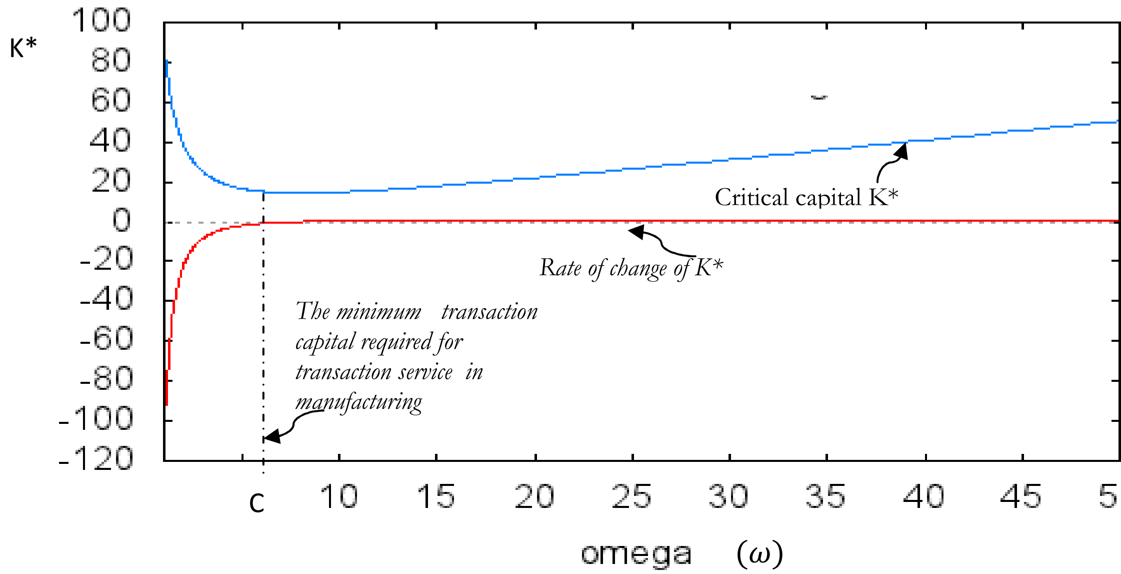

Fig 2.5 the path of K as capital used in transaction services (ω) increases for specific values of parameters within their allowable range*

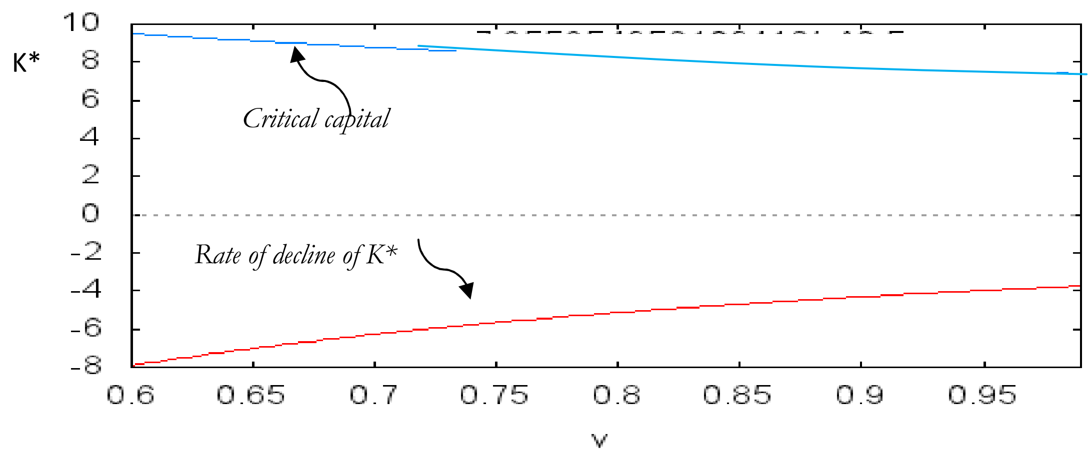

Fig 2.6 the path of K as the efficiency of capital usage in manufacturing (υ) increases for specific values of parameters within their allowable range*

5.4 RATE OF SAVING(s) AND THE RATE OF LEAKAGE OF SAVING (λ) AND (K*)

The rate of saving is negatively related with the critical capital stock (K*). With higher rate of saving, the required capital stock to escape to sustained growth declines, making it easier to escape. On the other hand, increase in the rate of leakage of saving (λ) increases K*. Economies that waste their savings at a higher rate face more difficulty to escape to sustained growth. It implies that it is not only saving at higher rate that helps growth but also efficiently converting savings to investment.

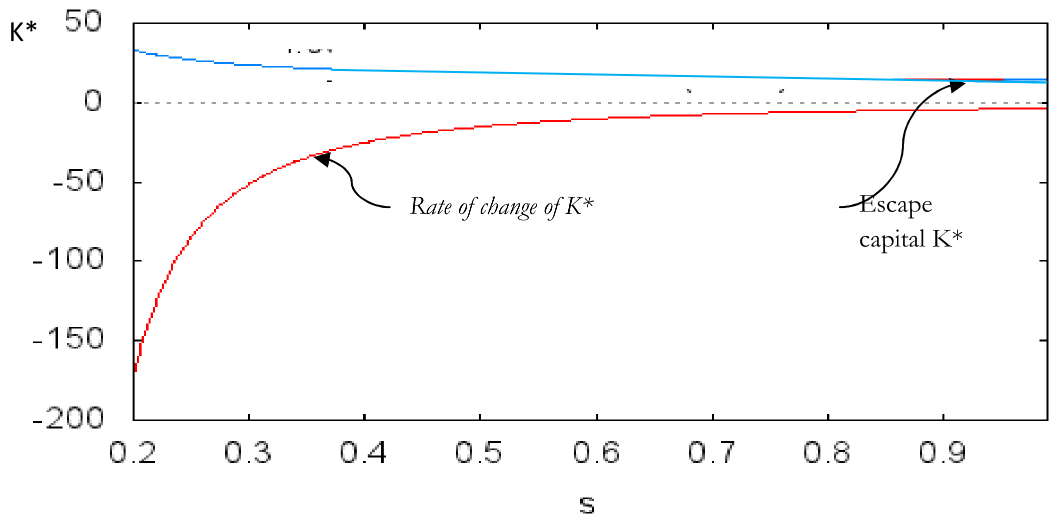

Fig 2.7 the path of K as the rate of saving (s) increases for specific values of parameters within their allowable range*

5.5 EFFICIENT LEVEL OF CAPITAL USED IN TRANSACTION SERVICES(C) AND K*

The efficient level of capital used in transaction service(C) is the minimum capital to be allocated to transaction services. This efficient level varies with the institutional setting and natural environment of the economy. Economies that accomplish transaction services at lower cost will have lower C. The level of trust, respect for property rights, rule of law, ease of flow of information, ease to transfer property, the ease in the social and natural environment to transport goods, the level of frictions etc shape the level of C. Critical capital stock (K*) increases with increases in C.

5.6 OTHER PARAMETERS AND K*

Increases in technical efficiency (η) reduce the critical capital requirement for obvious reason. Increase in share of capital (α) magnifies the effects of the ratio $\frac{\delta}{s-\lambda}$ and diminishes the effects of $\frac{\beta\bar{R}}{\theta}$. Greater labor elasticity of agricultural output (β) and greater exponential conversion of goods value added to total value added (u) also stand in positive relationship with K*. The parameter of externality generated by aggregate capital (μ) stands in negative relationship with K*. Productivity ratio of labor in agricultural and manufacturing(θ) is inversely related with K*. Average product of agricultural labor ($\bar{R}$) is positively related to K*.

5.7 SUBSISTENCE AGRICULTURE, MANUFACTURING SECTOR AND TOTAL VALUE ADDED

Manufacturing contribution increases faster than agricultural output as capital and labor inputs increase in the economy. Increasing returns and capital accumulation in manufacturing contribute to growth of total output greater than the contribution of agriculture. Value added of subsistence agriculture remains stagnant while manufacturing output rises in an increasing manner with the commitment of more resources to the economy. The share of manufacturing and associated services grows as output grows. Increasing returns in manufacturing is responsible for the shape of the total output that allowed unstable equilibrium. Economies that face depreciation of capital lower than saving in manufacturing right from the beginning do not experience multiple equilibriums and easily move on the sustained growth path. Manufacturing growth and share have to grow for output to grow in sustained manner (fig 2.8).

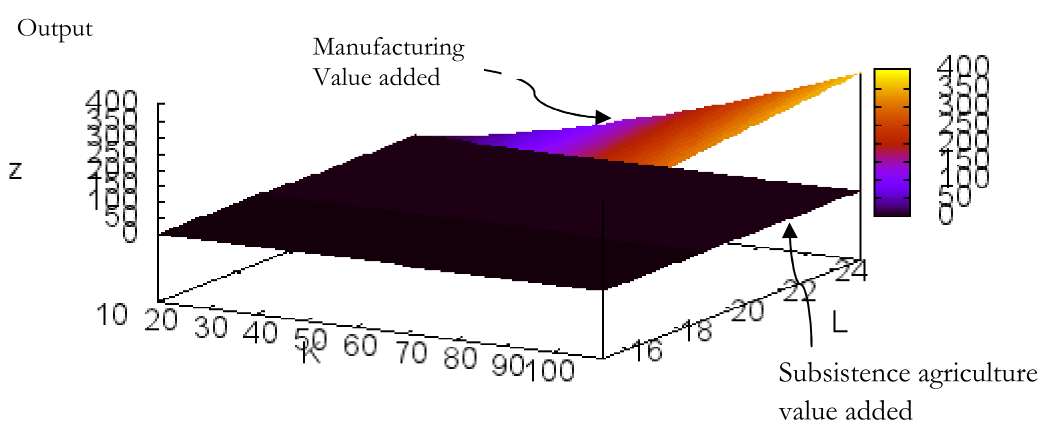

Fig 2.8 The path of manufacturing and subsistence agriculture as the capital accumulation and labor increase for specific values of parameters within their allowable range.

6 CONCLUSIONS

Based on the theoretical arguments and the stylized facts of low-income economies, a structural model is constructed, taking goods production as the basis for services, with incorporation of inefficiencies. Capital committed to transaction services is considered as transaction costs to society and it reduces the inputs required to goods production. As such, inefficiencies are considered not only as output affecting but also as input reducing as well.

Alternative modalities of incorporating the inefficiencies from the input side were compared with one another (Appendix 2.1). The alternative considerations of taking deductible input or taking the proportion of use of input in the production-function result in similar outcomes. The introduction of transaction costs as deductible from inputs provides additional insight to the role played by transaction services. Capital used for transaction services first facilitates the escape to sustained growth until it reaches some level, beyond which it becomes hindrance. Expansion of transaction services in low-income economies, beyond the required minimum, strangles manufacturing and is not helping the attainment of sustained growth.

The model conveys, as expected, that long run (sustained) output growth is driven by capital accumulation in manufacturing where embodied technology is employed. In the model, which is dictated by the theoretical base, manufacturing exhibits increasing returns to scale and that rendered the production function convexity in capital use. In the stage of transition where economies find themselves, the success to or failure from attaining sustained growth and industrialization depends on the attainment of growth in capital accumulation beyond the critical stock in manufacturing. If the share of manufacturing does not grow, that would retard the rate of accumulation of capital, and implicitly technology, in the economy and hence the economy fails to attain sustained expansion.

Factors working against the attainment of sustained growth of manufacturing and associated services are leakages in saving (e.g. capital flight), increasing depreciation, increased transaction costs and inefficiencies. Differences in the rates of savings, depreciation, levels of transaction costs and inefficiencies arising from prevailing market imperfections explain differences in the required critical capital stock in manufacturing and predict differences in attaining sustained growth of low-income economies. Institutional factors and inefficiencies affect sustained growth of Low Income Economies through their effect on manufacturing.

The peculiarity of the model is its emphasis on structure where success or failure in growth of manufacturing determines success or failure in sustained growth. Growth in manufacturing, in the presence of stagnant agriculture, implies growth in manufacturing share. An economy with growing manufacturing share is a structure with product and process technologies accommodating growing number of entrepreneurs and workers, employing ever-increasing capital and technology with self-reinforcing production. Moreover, the model finds expression for effects of deeper institutional factors shaping the level of transaction costs, transaction costs affecting formation of capital, which in turn affects manufacturing growth.

Since aggregate demand and supply levels move together, low trended supply has to go generally with low trended demand. If supply goes in a higher trended path demand will follow or if supply structure does not respond to growth of demand, demand will eventually follow the low trended supply. Differences in the time path of low-income economies are to be explained with the evolving structure and the factors behind the evolution. Thus, the major structural factors implied by the model have policy implications, which are summarized as follows:

i) Manufactured goods production has greater impact than non-manufacturing goods production on sustained growth of the economy at large.

ii) Difference in growth of share of manufacturing explains differences in the sustained growth of low-income economies.

iii) There is optimal level of transaction service beyond which growth of transaction services stands in inverse relationship to manufacturing growth of low income economies

iv) Institutional arrangements of society affect sustained growth of manufacturing through increased transaction services.

v) High depreciation, low effective saving rate and smaller difference in productivity between subsistence agriculture and manufacturing obstruct sustained growth through their effect on manufacturing.

The model is a representation of evolving low income economies that have not yet placed themselves on sustained growth path for certain. The model uses theoretical constructs and stylized facts to represent fairly a low income under industrialized economy. The significance of the model in representing the salient features of such economies is crucial for predictions and policy formulations. The implications stated above motivate empirical verifications in further studies to appraise the representation, and to guide policies for structural transformation.

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APPENDIX 2.1: Alternative expressions in the model

As alternative expression, we may use a proportion of R_t rather than $R_t - \psi_t$ in (1) above. The alternative expression to (1) above, using input side *proportions* of capital dedicated to transaction services(τ) and transforming the corresponding output multipliers, keeping the parameter u= 1, becomes:

$$f(R_t) = r\frac{(1-\tau)\tau^{\beta}}{\varsigma}(\tau R_t)^{\beta+1} \qquad (1a)$$

The alternative expression to equation (3) above using input side proportions of capital used in transaction services and output multipliers, keeping the parameter u=1, becomes:

$$M_t = \eta\frac{(1-\upsilon)(\upsilon^{\alpha+\mu+1})}{C}(K_t)^{\alpha+\mu+1}(L_t - \varphi_t)^{1-\alpha}. \qquad (3b)$$

The alternative expression to (8) above, using input side *proportions* of capital dedicated to transaction services(τ) and (υ) , and transforming the corresponding output multipliers, becomes:

$$Y_t = \left[r\frac{(1-\tau)\tau^{\beta}}{\varsigma}(\tau R_t)^{\beta+1}\right] + \left[\eta\frac{(1-\upsilon)(\upsilon^{\alpha+\mu+1})}{C}(K_t)^{\alpha+\mu+1}(L_t - \varphi_t)^{1-\alpha}\right]. \qquad (8a)$$

The alternative to the expression (13) above using proportions of capital removed to transaction services as: $K^* = \frac{1}{\upsilon^{\left(\frac{\alpha^2+\alpha\mu+\mu}{\alpha^2+\alpha\mu+\mu+1}\right)}}\left(\frac{\delta}{s-\lambda}\right)^{\frac{\alpha}{\alpha^2+\alpha\mu+\mu+1}}\left(\frac{(1+\beta)\overline{R}\,C}{\theta(1-\alpha)\eta}\right)^{\frac{1}{\alpha^2+\alpha\mu+\mu+1}}$. (13a)

CHAPTERIII: MANUFACTURING GROWTH AND SUSTAINED GROWTH OF LOW INCOME ECONOMIES: EMPIRICAL EVIDENCES

Abstract

The hypothesis that this empirical analysis tests claims that manufactured goods production has greater impact than agricultural goods production on sustained growth of low-income economies. The analysis uses wavelet-decomposed data of contributions of manufacturing and agriculture to capture the effects of time scales. The wavelet decomposition enables detecting long run sectoral contributions to sustained growth of GDP. For a large set of countries, the test provides empirical support to the hypothesis. The quantitative analysis for empirical evidence on centrality of manufacturing and the application of wavelet decomposition of the time series data in the analysis are the main contributions of the study.

Keywords: time scales, wavelet decomposition, sectoral contribution, manufacturing growth, sustained growth, structure, dualism, modern growth, macro model, multi-sector growth, manufacturing, transaction services, industrialization, transformation, transition to modern growth, income convergence

JEL classification codes 0110, 014, 0410, 047, P52

1. INTRODUCTION

The study recognizes that institutions and policies are important environmental factors that act on the existing preferences and mindsets of society, giving rise to a particular economic structure. The structure enables or disables accumulation of capital, which is required to attain modern economic growth and sustained growth in per capita income. The economy in transition from agrarian stagnancy to modern growth is bounded by a lower level equilibrium of subsistence economy and a higher-level matured economy. In this transition stage, there is an unstable equilibrium. If disturbed at the unstable equilibrium, the economy either moves to the lower level equilibrium or moves to continuous transformation depending on whether capital stock (K) in the modern sector is greater or less than a critical stock(K^*), where K^* is derived from the low of motion of capital of the dual economy as:

$$\mathbf{K}^* = \left(\frac{\delta}{s-\lambda}\right)^{\frac{\alpha}{\mu}}\left(\left(\frac{1}{\eta}\right)^{\frac{1}{\mu}}\left(\frac{C}{\omega_t}\right)^{\frac{u}{\mu}}\right)\left(\frac{\beta\bar{R}}{\theta(1-\alpha)}\right)^{\frac{1-a}{\mu}} + \boldsymbol{\omega} \qquad \textit{(equation 13 above)}$$

If the economy exceeds the critical stock and escapes the unstable equilibrium it moves to a persistent change towards maturity where it assumes a different structure of advanced economies. The transition process depends on capital accumulation in the modern manufacturing sector. Capital used in manufactured goods production sector propels the economy forward with the generation of value added in goods and services.

The movement of a low-income economy to the higher equilibrium and to a sustained growth depends on the presence or the absence of a particular structure in which manufacturing growth and share drives economic growth. Thus, the transition of low-income economies from classical stagnation to modern economic growth hinges on this structure. The claim for this causal relationship rests on the fact that manufacturing is a sector having the highest actual or potential capacity to provide a variety of goods for direct consumption, indirect consumption and in forming the basis for emergence of services. This part of the study aims to verify the hypothesis that claims the centrality of manufacturing in attaining sustained growth of economies with low per capita income.

As per the theoretical argument guiding this study, the basic feature that ensures a low-income economy to attain sustained growth is the onset of growth driven by growth of output and share of manufacturing, which is the basis of structural change and industrialization. The objective of this study is to verify the centrality of manufacturing growth in attaining sustained growth of economies with low per capita income in contrast to growth led by agriculture.

The hypothesis to be empirically tested is "Manufactured goods production growth has greater impact than agricultural goods production growth on sustained growth of low-income economies at large" using data from United Nations National Accounts Main Aggregates Database.

The study sets out to test whether manufacturing led structure is central in attaining sustained growth of economies with low per capita income by isolating the sectoral contributions of manufacturing and agriculture from contributions of other goods supplying sectors. Sectoral contributions are captured by the long-term relationship of the first difference of the sectors with the first differences of GDP and by the long-term relationships of the levels of the sectors with the level of GDP at various time scales.

Manufacturing value added, agricultural value added, and GDP thus obtained are wavelet decomposed in three time scales and three moving averages (scaled smooth). The wavelet-transformed data goes through VAR /VECM analyses and granger-causality tests of individual economies in 42 years span. The sector driving the economy is detected with coefficients of the fitted models, and from the Granger causality and cumulative impulse-response tests.

The results of the analysis support the hypothesis in significantly larger number of cases. Economies with positive coefficients or positive granger-causality of changes and levels in manufacturing on changes and levels of GDP experienced sustained growth in per capita GDP while those with positive granger-causality of agriculture do not in large number of cases. The time scale in differences (D_2) and first and second moving averages in levels (S_1 and S_2) reveal these relations in more number of cases than the other time scales. The implication for development strategies in Low-Income economies is that structures matter for sustained growth, and a structure in which manufacturing growth drives GDP growth is necessary for the attainment of sustained growth in per capita GDP.

The contribution of this paper is both theoretical and methodological. The study provides support to an alternative explanation for success or failure of attainment of sustained growth and eventual narrowing of gaps in per capita GDP of LICs with advanced economies. The explanation lies in the structure of economies. The particular structure is that manufacturing growth driving the growth of a low-income economy. The methodological contribution is the application of wavelet decomposition of the time series in value added of sectors and the whole economy for subsequent analysis of VAR/VECM analysis and granger-causality and impulse-response tests. It transcends the usual method of analysis where a single time scale is considered.

The organization of the chapter is as follows: Section 2 discusses the data preparation and estimation methods. This section highlights the need for transforming the time series data and the model specifications along with the reason for employing the selected model. Section 3 reports the results of the analyses. Section 4 concludes and draws policy implications.

2 METHODOLOGICAL FRAMEWORK

Methodology essentially aims to link data with hypotheses that emanate from theories. The methodology is about identifying whether the hypothesis is supported or refuted by the data using an appropriate method of analysis. The nature of the hypothesis informs the choice of method of analysis and the method of analysis lays the foundation for the identification of required data and treatment of the data. This section begins with description of the method of analysis necessitated by the hypothesis and moves to selecting and transforming the data to suit the method of analysis.

2.1 METHOD OF ANALYSIS

The hypothesis says that structural change driven by manufacturing is necessary for long-term growth. An economy driven by manufacturing growth results in better per capita GDP in the long run than that driven by agricultural growth. The hypothesis is equivalent to the question: "the contribution of which sector is positively associated with long-term growth of the economy?" Addressing this question dictates the choice of the method of analysis.

Addressing the hypothesis or, alternatively, answering the research question requires comparison of the impacts of contributions of sectors on sustained growth of GDPs. Comparison of the impacts presupposes existence of causal relationship between changes in sectoral value added and changes in

GDP on the one hand and levels of sectoral value added with levels of GDP on the other hand. In a world of interaction among sectors and interactions of sectors with the whole economy, there is no better choice other than VAR/VECM analysis and Granger causality test to handle impacts of endogenous variables. Impacts of levels and changes in value added of sectors, and level and changes in GDP are all endogenous variables, each influencing one another. VAR models can be taken as reduced form of simultaneous equation models (Patterson, K.2002). The magnitude and sign of the coefficients of the best fitting VAR/ VECM models on the one hand and the presence of Granger causality indicate the long-term relationships and contributions of sector to total value added.

Granger causality tests, in turn, require impulse-response tests to identify the signs of contributions of sectors to sustained growth. A statement saying that M Granger causes GDP means that M influences GDP, but says nothing about the direction of influence. Thus, an increase of M may cause GDP to drop or to increase. To determine the sign of causation we consult the cumulative impulse-response results, which have positive or negative signs. Indentified signs of Granger causality tell us whether the particular sector positively or negatively influences the long-term growth of GDP. The direction of the long-term influence identified by the fitted VAR/VECM models and the sign and magnitude of the impulse-responses for identified Granger causal relationships will be juxtaposed with the actual change in per capita GDP to eventually glean supporting and non-supporting cases for the hypothesis in question.

In order to lay the basis for the VAR/VECM analysis and for the impulse response tests, we specify the underlying relationship between contributions of sectors and changes in GDP. The first differences of sectoral value added are contributions to the first difference of GDP and the long-term association between these contributions and changes in GDP tell which sector is relatively responsible for growth of the economy.

The deterministic value added ($\mathrm{Y_{git}}$) in goods production for an economy *i* at time *t* is:

$$\mathrm{Y_{git}} = \mathrm{M_{git}} + \mathrm{Ag_{git}} \qquad (9)$$

The deterministic total value added (goods and services) ($\mathrm{Y_{it}}$) $\mathrm{Y_{it}} = \mathrm{Y_{git}} + \mathrm{Ser_{it}}$ (10)

Expressing services in terms of goods: $Y_{ti} = M_{git} + Ag_{git} + \ b_1 Ag_{git} \ + \ b_2 M_{git}$ (10a)

(*From equation 1 in Chapter 2*)

$$Y_{ti} = \ (1 + b_2)M_{git} + \ (1 + b_1)Ag_{git} \quad (10b)$$

Y_{ti} is, however, stochastic as the relationship between goods production and services is a relationship between random variables.

The stochastic total value added is thus, expressed as $Y_{it} = \ (1 + b_2)M_{git} + \ (1 + b_1)Ag_{git} + \varepsilon_{it}$ Further considering the lag effects of each sector on itself and on the total value added the above relationships could be extended to Vector Auto Regressive (VAR) model and Co-integration models that are expressed in Vector Error Correction Models (VECM)

$$Y_{ti} = \ (1 + b_2)M_{git} + \Sigma\alpha_i M_{git-j} + \ (1 + b_1)Ag_{git} + \Sigma\beta_i Ag_{git-j} + \varepsilon_{it} \quad \text{(In levels)}$$

$$\Delta Y_{ti} = (1 + b_2)\Delta M_{git-j} + \Sigma\alpha_i M_{git-j} + (1 + b_1)\Delta Ag_{git-j} + \Sigma\beta_i Ag_{git-j} + \epsilon_{it} \quad \text{(In differences)}$$

for a country *i* at time *t* and at lag *j* ---(11)

2.2 VAR/VECM ANALYSIS, GRANGER CAUSALITY AND IMPULSE-RESPONSES

The time series model appropriate for the stationary first difference is VAR while for the non-stationary time series, but the linear combination of which is stationary (co-integrated), is VECM. Whenever they are stationary, the first differences of co-integrated levels are treated with VAR analysis that takes first lags of the levels as well (Lutekepohl 2005). The functional form of the VAR (P) analysis is:

$$\mathbf{\Delta Y_t = V + A_1 \Delta y_{t-1} + \cdots + A_p \Delta y_{t-p} + u_t, \quad t= 0,\pm 1,\pm 2, \ldots ,} \quad (20)$$

(for first differences coming from non co-integrated levels **)**

$$\mathbf{\Delta Y_t = V + \alpha_i \Sigma y_{t-i} + A_1 \Delta y_{t-1} + \cdots + A_p \Delta y_{t-p} + u_t, \quad t= 0,\pm 1,\pm 2, \ldots ,} \quad (21)$$

*(for first differences coming from co-integrated levels***)**

where $\mathbf{Y}_t = (y_{1t}, \ldots, y_{Kt})$ is a (K×1) random vector,

$\boldsymbol{\alpha}_i$ and $\mathbf{A}_i$ are fixed (K×K) coefficient matrices,

$\mathbf{V} = (\nu_1, \ldots, \nu_K)$ is a fixed ($K \times 1$) vector of intercept terms,

$\mathbf{u}_t$[8] $=(u_{1t}, \ldots, u_{Kt})$ is a K-dimensional white noise process,

where, $E(\mathbf{u}_t) = 0$, $E(\mathbf{u}_t\mathbf{u'}_t) = \boldsymbol{\Sigma}_u$ (covariance matrix)and $E(\mathbf{u}_t\mathbf{u'}_s) = 0$ for $\mathbf{s} \neq \mathbf{t}$.

$\mathbf{Y}_t$ vector, in the context of this study, consists of the wavelet transforms of GDP, manufacturing and agricultural value added, where t extends from 1 to 42 years.

The basic VECM applied **is:**

$$\boldsymbol{\Delta Y_t = \alpha(\beta Y_{t-1} + \mu + \varrho t) + \Sigma \Gamma \Delta Y_{t-I} + \gamma + \Upsilon t + \varepsilon_t}. \quad (22)$$

Alternative specification suiting the structure of each economy is to be fitted by placing restrictions on one or more of the trend parameters in the basic VECM. The alternatives restrictions placed on trend parameters in the basic VECM are :

no restriction at all;

$\Upsilon=0$;

both $\varrho=0$ and $\Upsilon=0$;

$\varrho=0$ and $\Upsilon=0$ and $\gamma=0$; and

all $\varrho=0$ and $\Upsilon=0$ and $\gamma=0$ and $\mu=0$

We estimate a stable VAR relation for two purposes : to test which sector has greater and significant relation to GDP and to test the existence of Granger causality and subsequently impulse response tests to see whether the Granger causality is of positive or negative sign. Granger causality rests on the principle that a cause cannot come after the effect, and if a variable X_t affects a variable Y_t, the former should help improving the predictions of the latter variable (Lutkephol, 2005).

While the detail wavelet transforms (Dj) are by definition stationary series we place stability tests and if found stable the time series are treated with VAR analysis. With VAR fitting, the smooth (S_j) undergo stability checks for level time series, and if the VAR fitting is not stable co-integration analysis is to be the appropriate approach. Since co-integration relations are not unique, Johansen's method of co-integration estimation follows to identify the maximum number of co-integration relations and sets of coefficients. The first co-integration relation is the one that takes

[8] The use of "u" here has no relation to that symbol used in the conceptual model

orthogonalized GDP as the explained variable, and the focus is on that co-integration relationship and the linear combination where the coefficient of GDP is 1. For co-integrated variables, Granger causality tests proceed following Lutkephol (2005), where we extend the lag length by one unit. Impulse-response relations proceed to see the positive or negative Granger causality associated with a pair of variables. It is to be noted that Granger causality tests indicate only the sectoral influences on one another and on the economy at large without showing the direction/sign of the impact. Impulse response relations show the positive or negative Granger causality associated with a pair of variables.

In the pursued method of analysis, the wavelet-decomposed time series data in various time scales undergo the tests. Vector autoregressive analysis on un-decomposed or non-transformed data lumps up effects on a single time scale and it may not detect the varying relations prevailing on various time scales. The appropriate lag lengths were determined through pre-estimation tests and confirmed by post estimation tests. The appropriate lag lengths per country are taken based on agreement of the four information criteria (FPE, AIC, HQIC, and SBIC) (Lutkepohl, 2005). In cases where there is no agreement between the criteria, we choose the lag length suggested by most criteria. If the criteria break even, we choose the better lag length suggested by post estimation tests using exclusion Wald test. In any case, the appropriate lag length used has to be confirmed by post estimation exclusion Wald tests.

Possible outcomes and supportive cases for the hypothesis

The magnitude and the direction (sign) of the coefficients of the fitted VAR/VEC models or the magnitude and direction of the cumulative orthogonalized impulse responses on significant Granger causal cases reflect the inherent structure of the economy. The magnitudes and directions of the coefficients and impulse responses may show any of the following four cases that simply indicate what the structures look like. Pursuing the arguments of the theoretical foundation, each structure has implication for sustained growth. Whether the theoretical implications were true or not finds empirical support by comparing the implied effect to the actual attained changes in per capita GDP in the given period.

Case 1 is an empirical situation where both sectors are significantly and positively related to GDP. Positive relation implies similar direction of change of the sectors and GDP. This case incorporates two possibilities: either GDP is positively responding to agriculture in greater magnitude or it responds to manufacturing in greater magnitude. The sector to which change in GDP responds in greater magnitude than the other is the driver of change of GDP. Since both the sectors are positively related to GDP, the sector with higher response drives the growth of the economy more than the other does. As per the theoretical argument pursued, in case Agriculture is generating greater response while manufacturing generates less, structural change is not expected. In case manufacturing is generating greater response while agricultural is generating less, structural change would follow if manufacturing grows. If manufacturing is not allowed to grow, even if it generates high response, the economy does not show good performance in per capita income in the end. Favoring manufacturing or suppressing it is a choice of society and the choice has long-term consequence.

In **Case 2** manufacturing has positive relation while agriculture has negative relation. While agriculture's contribution is declining, the economy is growing. In this case, clearly manufacturing is the sector with greater contribution and the driver of growth of the economy. If the economy has grown, it must have done so because of growth of manufacturing. Manufacturing is driving the economy, offsetting the negative contribution of agriculture. If the economy has not grown, it must have been because of stagnation or decline of manufacturing growth. Note that in this case even if agriculture is growing, as long as manufacturing is not growing, the economy does not show growth sustained for long. The structure of the economy is such that growth takes place if manufacturing expands. Enhancement of manufacturing again is a matter of choice.

In **Case 3,** both the sectors are negatively related to GDP, which means although the economy is growing the contributions of the two sectors to GDP are declining. If the economy was declining, it was not the result of decline of manufacturing or agriculture. The source of growth and driver of the economy are services and structural change has yet to come.

In **Case 4,** agriculture is the sector positively related to GDP while manufacturing is negatively related. The performance of the economy is dependent on agriculture, whether for its growth or stagnation. If the economy is still low-income economy, the economy is agricultural and no structural change is in the scene and the per capita income remains stagnant.

While the sectoral contributions in relation to GDP are detected by coefficients, or by Granger-causality and impulse-responses, they do not show the actual directions of changes in the sectoral contributions. Those economies having positive effect of manufacturing steadily grow if manufacturing is growing or steadily decline if manufacturing declines. If manufacturing is growing, this experience in structural change must have led to gaining higher per-capita income than others. Has this been observed in actual changes in per capita GDP? Have those economies, without positive causality of manufacturing, performed less in the attainment of per capita GDP? The answers to these questions help to verify the validity of the hypothesis. The detected relations and the respective attained performance in per capita GDP together tell whether the data support the hypothesis or not.

The per capita GDP considered is that GDP computed excluding income from sectors not in the analysis, which are orthogonalized from the included sectors. For example, we exclude the per capita GDP changes that result from natural resource extraction. We juxtapose the sign and magnitude of the relationships of sectors with performance in changes in per capita GDP, net of resource incomes and incomes from other sectors, to verify the validity of the hypothesis. Such juxtaposition reveals whether the long-term impact of manufacturing corresponds with higher level of per capita GDP or long-term dependence on agriculture leads to lower level of per capita GDP. Table 3.1 below shows the various cases and their implications to the hypothesis.

Accordingly, **Case 1** and **Case2** provide supports to the hypothesis via positive manufacturing drive of growth of GDP. If this structure is leading to higher per-capita GDP there is strong support to the hypothesis or if the structure leads to decline in per-capita GDP there is weak support via declining manufacturing growth. **Case3** and **Case4** provide strong support to the hypothesis via agricultural contribution leading to low performance in per-capita GDP. In other words, the strong cases for the hypothesis are those economies with positive impact of manufacturing really improving their per-capita GDP or positive agricultural impact not improving their per-capita GDP; weak supports are those economies where manufacturing is the driving sector but still per-capita GDP has not increased. If economies behave as expected, the hypothesis gets support, otherwise not (Table 3.1 below). The task of the Evidences section (section 3) is finding out where each economy falls; in cases supporting the hypothesis or in cases that do not support the hypothesis.

Tab 3.1: **Possible outcomes and implications for the hypothesis**

Cases	Signs of coefficients impulse responses of sectors on change in GDP		Further indicator required	Interpretation	Higher magnitude of coefficients or cumulative Responses of	Long-term Trend in per capita of sectoral value added	Changes in attained per capita GDP	Implications to the hypothesis
Case1	**Manu**	**+**	Magnitude of the response (*which response is greater?*)	The sector with higher magnitude has higher impact; if manufacturing generates higher responses, structural change is likely	Manuf	+	Positive	Supporting
							Negative	Not supporting
						-	Negative	Supporting
							Positive	Not supporting
	Agri	**+**			Agri	+	Positive	Not supporting
							Negative	Supporting
						-	Negative	Not Supporting
							Positive	Supporting
Case2	**Manu**	**+**	None	Manufacturing is driving the growth of GDP, suitable for structural transformation	Manuf	+	Positive	supporting
							Negative	Not Supporting
	Agri	**-**				-	Negative	supporting
							Positive	Not Supporting
Case3	**Manu**	**-**	None	The economy is services dependent , structural change yet to come		±	Positive	Not supporting
	Agri	**-**					Negative	Supporting
Case4	**Manu**	**-**	None	Agriculture is driving growth, structural change yet to come	Agri	+	Positive	Not supporting
							Negative	Supporting
	Agri	**+**				-	Negative	Not Supporting
							Positive	Supporting

3 EVIDENCES: ON THE PREVAILING STRUCTURE AND CHANGES IN PER CAPITA GDP ACROSS VARIOUS TIME SCALES

In testing the hypothesis, the sector driving the economy is detected with the magnitude and direction of the significant coefficients of the fitted VAR/VEC models on the one hand, and cumulative impulse-responses of those having significant (at least at 10%) Granger-causal relationship. The magnitude and sign of the coefficients or the cumulative impulse responses represent the structure of the economy. The detection of the structures with the former method is triangulated with the result obtained with the latter method.

Most countries exhibit significant relationship of agriculture and manufacturing with GDP in either first differences or levels or both at one or more timescales in both the methods (ref Table3.2). Countries without any significant relationship between the sectors and GDP in first differences, or in levels, may show significant relationship at second differences or in co-integration of the first differences, but this study does not pursue investigations beyond I(0) and I(1) time series.

VAR/ VECM coefficients

VAR coefficients are relationships of stationary differences and levels while VECM coefficients are co-integration relationships of levels. With the use of coefficients, thirty-one, among thirty-five countries, exhibit at least one significant relationship in one or more of the time scales. Among the thirty-one, half of them exhibit significant relationship across more than one timescales, while the rest half of the countries exhibit significant relationships at a single time scale only.

The number of significant cases in levels declines as the time scale increases. The largest number of significant relationships appears in co-integration relationship between moving averages of two-consecutive-years (S_1). Comparing D_j and S_i, S_1 reveals more number of significant relationships (i.e.15), than D_1 and D_2, where each of which reveals 10significant cases.

Table 3.2 Significant VAR/VECM relations

	Time scales for differences			Time scales for levels			All
	D1	D2	D3	S1	S2	S3	
Number of significant cases	10	10	3	15	9	5	31
Number of insignificant cases	25	25	32	20	26	30	4

Relationships that do not appear as significant in shorter time scales can be revealed in longer time scales. This means timescales matter. The conventional treatment of time series data, without decomposing it into different time scales, may not detect some underlying relationships. Annual outputs change over time as a result of sectoral linkages and causal interactions that may not be manifested in a predetermined time scale as the interactions may work themselves out in a relatively shorter or longer period. Decomposition by time scale captures the time effects of the interactions across various time scales after they have sufficiently worked themselves out. Thus, filtering the behaviors of the outputs at various time scales and investigating the long-term relationships in the corresponding time scales separately becomes useful and the results obtained attest to the merits of the method.

Long-term growth of some of the countries is driven by agriculture, some are driven by manufacturing, and still some are driven neither by agriculture nor by manufacturing. As detected by the sectoral contributions to long-term growth, the countries experience different structures. Thus, treating countries as if they have the same structure could be misleading. Analyses of levels indicates that similar number of countries are driven by agriculture and manufacturing and there are some countries which are not driven by agriculture or manufacturing.

Table 3.3 Identified growth driving sectors using VAR/VECM coefficients

	Time scales for differences			Time scales for levels		
	D1	|D2	D3	S1	S2	S3
Agriculture	5	4	1	7	4	1
Manufacturing	1	3	0	6	4	2
Neither Agriculture nor manufacturing	4	3	2	2	1	2
Total	10	10	3	15	9	5

Among the thirty-one countries, the number of cases **not** falsifying the hypothesis in any of the relevant time scales is 21. In the four countries among the thirty-one, the identified structures support the hypothesis in some time scales while they do not support the hypothesis in other time scales. These countries are Cameroon, Equatorial Guinea, Indonesia, and Lesotho, raising the number of countries providing support to the hypothesis in at least one time scale to 25. Six countries do not support the hypothesis in all time scales. The countries are Burkina Faso, Ethiopia, India, Kenya, Lao Peoples Democratic Republic, and Iraq. The first five of these economies draw their per-capita growth from very high service contribution while the sixth economy is drawing its growing per-capita GDP from mining and growing services. It might be argued that the method has detected the structure, but the time span is not long enough to show service or mining based growth is unsustainable for a low-income economy.

Table 3.4 Cases with VAR/VECM relationships for and against the hypothesis

Cases	Number of countries
-having no non-supporting cases	21
-having at least one supporting case	25
-having at least one non supporting case	10
-having no supporting case	6

Among the countries in which the GDP is significantly driven by manufacturing or agriculture those supporting and non-supporting cases vary with time scales. The differences in the number of cases supporting, not supporting the hypothesis and neutral (showing no significant relationship) across time scales is significant as can be confirmed by contingency table analysis. The probability in the chi-square test for all D_i and S_i is 0.027, which is a low probability warranting that the differences are not accidental. This result further confirms the methodical importance of considering time scales.

Table 3.5 Cases with VAR/VECM relationships for and against the hypothesis in time scales

Number of cases	Time scales for differences			Time scales for levels		
	D1	D2	D3	S1	S2	S3
Supporting the hypothesis	5	8	3	13	7	4
Not supporting the hypothesis	5	2	0	2	2	1
Neutral	25	25	32	20	26	30

Cumulative impulse-responses

Cumulative impulse responses are computed for economies where Granger causal relationships exist between GDP (obtained from sectors orthogonalized from excluded sectors) and the selected sectors. The cumulative impulse responses indicate the magnitude and direction of the effect of a unit impulse of a sector on the GDP in 42 years time. With the use of cumulative impulse responses, thirty among thirty-five countries exhibit at least one significant Granger causal relationship in one or more of the time scales. Among the thirty, more than half of them (i.e., 18) exhibit significant relationship across more than one timescales, while less than half of the countries(i.e.,12) exhibit significant Granger causal relationships at a single time scale only.

The number of significant cases declines as the time scale increases in differences and levels alike. The largest number of significant relationships appears in differences of two consecutive years (D_1) and in moving averages of two-consecutive-years (S_1). D_1 and S_1 reveal almost same number of significant relationships.

Table 3.6 Significant Granger causal relations

	Time scales for differences			Time scales for levels			All
	D1	D2	D3	S1	S2	S3	
Number of significant cases	12	10	3	13	11	6	30
Number of non significant cases	23	25	32	22	24	29	4

In the same pattern to the previous one, timescales matter in this method. Relationships that do not appear as significant in shorter time scales can be revealed in longer time scales. Decomposing time series data into different time scales is found to be important and useful to detect relationships that may not be detected on annual basis.

As it was found above, long-term growth of some of the countries is driven by agriculture, some are driven by manufacturing, and still some are driven neither by agriculture nor by manufacturing, signifying the existence of different structures in different countries. The analysis indicates that similar number of countries are driven by agriculture and manufacturing and there are some countries which are not driven by agriculture or manufacturing.

Table 3.7 Identified growth driving sector with cumulative impulse-response tests in time scales

	Time scales for differences			Time scales for levels		
	D1	|D2	D3	S1	S2	S3
Agriculture	9	4	1	5	1	2
Manufacturing	2	5	1	5	6	3
Neither Agriculture nor manufacturing	1	1	1	3	4	1
Total	11	10	3	13	11	6

Among the thirty countries, the number of cases **not** falsifying the hypothesis in any one of the relevant time scales is 22. In the four countries among the thirty, the identified structures do not support the hypothesis in some time scales while supporting the hypothesis in other time scales. The countries in this group are Ethiopia, Indonesia, Egypt and Cameroon. Cameroon and Indonesia exhibited the same result in the previous VAR/VECM analysis. Other four countries falsify the hypothesis in all relevant time scales. These countries are Equatorial Guinea, Lao Peoples Democratic Republic, Lesotho, and Iraq. Note that Lao Peoples Democratic Republic and Iraq were detected to be in this group in VAR/VECM analysis above. Equatorial Guinea and Iraq draw their per-capita growth from very high mining contribution while the Lesotho and Lao Peoples Democratic Republic are drawing their growing per-capita GDP from very high service contribution. In these cases again, the method has detected the structure but the time span is not long enough to show service or mining based growth is unsustainable for a country in transition to modern economic growth.

Table 3.8 Cases identified for and against the hypothesis using cumulative impulse-response tests

Cases	Number of countries
-having no non-supporting cases	22
-having at least one supporting case	26
-having at least one non supporting case	8
-having no supporting case	4

The results indicate that not only the sectoral impacts on GDP differ across countries and across time scales, but also sectoral and GDP relationships supporting and non-supporting the hypothesis vary with time scales. The probability value in the Chi-square test of the contingency table(Table 3.9 below) is 0.024, indicating the difference between those agreeing with hypothesis, those not agreeing and those neutral is not accidental.

Table 3.9 Cases identified for and against the hypothesis using cumulative impulse-response tests across time scales

Number of cases	Time scales for differences			Time scales for levels		
	D1	D2	D3	S1	S2	S3
Supporting the hypothesis	7	10	3	12	8	5
Not supporting the hypothesis	5	0	0	2	3	1
Neutral cases	23	25	32	21	24	29

In both the methods of identification of the structure of economies, in terms of the sector driving the economy in the given time span, the results are close to one another, with differences of one and maximum two. The Granger causality and impulse response test indentifies more cases not falsifying the hypothesis and reduces the number of countries that do not provide support to the hypothesis in all time scales to four.

Table 3.9 Comparison of VAR/ VECM results with Cumulative Impulse-Response

Cases	Number of countries	
	VAR/VECM method	Granger causality and Impulse-Responses method
-having no non-supporting cases	21	22
-having at least one supporting case	25	26
-having at least one non supporting case	10	8
-having no supporting case	6	4

The countries that do not commonly provide support to the hypothesis, in both the methods, are two: Lao Peoples Democratic Republic, and Iraq. The 29 countries with significant relations, among the 35, provide support to the hypothesis in one or more time scales.

4 CONCLUSION AND POLICY IMPLICATIONS

The study tested the hypothesis that a structure with "*Manufactured goods production growth has greater impact than agricultural goods production growth on sustained per capita income growth of low-income economies at large*". The methods used to identify the structure were **c**oefficients of VAR/VECM fittings on the one hand and Granger causality and impulse-responses on the other using Haar MODWT filtered time series data after orthogonalizing other goods supplying sectors (construction, mining, and utilities) from manufacturing, agriculture, and service value added. The GDPs of economies are constructed from manufacturing, agriculture, and services that are orthogonalization with construction, mining, and utilities. The goods producing sectors included in the analysis are agriculture and manufacturing. The treatment of the two sectors alone has the methodological merit of allowing higher degree of freedom. The Haar wavelet computes the differences between averages and the scaled moving averages of value added across various time scales.

Positive coefficient or positive impulse-response in significant Granger causal relations of manufacturing entails a structure conducive to transformation and the economy could grow in sustained manner, if manufacturing grows. The analyses indicate that not only the levels, but also the changes in manufacturing matter. Positive VAR/ VECM coefficients or positive Granger causality of manufacturing combined with higher actual performance in the attainment of per capita GDP provides strong support to the hypothesis. Agricultural negative Granger causality, coupled with lower performance in per capita GDP, lends support to the hypothesis from another angle. Few cases of negative coefficients or negative Granger causality of manufacturing, coupled with high performance in per capita GDP, appeared as cases that do not provide support to the hypothesis. Some cases of positive coefficients or positive Granger causality of agriculture and higher performance in per capita GDP appeared as cases against the hypothesis. With combined use of coefficients and impulse-responses, cases where the results across all time scales do not support the hypothesis are only two among the first alphabetically ordered 35 countries of the 71 low-income economies in 1970. Those providing support simultaneously across all time scales are 23, while those providing support at least in one time scale are 29.

Given the limitation posed by 42 years time span, the results are quite revealing. Those low- income countries with growing manufacturing sector are more likely to experience sustained growth than those that rely on agriculture. Those low-income countries that have stagnated growth in manufacturing are likely to stagnate in the level of economic activities. The result thus lends credence to the hypothesis.

The policy implication for Low Income Countries is that those economies, the sectoral emphasis of which is non-manufacturing, have to reconsider their strategies. The expansion of economic activities (growth of GDP) is likely to be more sustainable with growth of output of manufacturing. Manufacturing growth seems to enhance outputs of the rest of the sectors in the long-run as long run GDP growth is the result of all the sectors. Low income and under-industrialized countries have to enhance their manufacturing to achieve highly cherished goal of takeoff to sustained growth.

As per the theoretical foundation of the study, manufacturing growth is driven by the accumulation of technology-embodied capital and this process faces unstable equilibrium, making it difficult to escape to sustained growth. Accumulation of technology embodying capital in the manufacturing sector requires policy support and intervention until it exceeds some critical stock. Identifying and removal of various obstacles on the one hand and infusion of technology embodying capita into the sector are necessary interventions. The unstable equilibrium and the tendency to move to the lower equilibrium state suggest that without the interventions (removal of obstacles and infusion of capital) accumulation in manufacturing would not exceed the critical stock to escape to sustained growth.

The few cases that happened to be against the hypothesis should attract future researches to detect the exceptional underlying factors or the methodological limitations that led to that result. This study anticipates results in line with the hypothesis with the use of longer time-series data.

One may question what the value added of the analysis is, as it is "known" that countries cannot achieve high growth by relying on agriculture. The actual practices and policies pursued in low-income countries do not show that it is "known". The actual emphasis and policy support in these economies is not on manufacturing. Policymaking and implementation has remained lacking in the conviction on the importance of manufacturing. There is a need to provide formal and convincing arguments for manufacturing to policymakers and implementers of this group of countries.

This study provides a formal, theoretical and empirical basis, which goes beyond back-of-the-envelope calculations, for policymaking or for inspiring further studies addressing the crucial issues of failure to attain sustained growth by LICs. The time series analysis and the introduction of different time scales in detecting contributions of sectors and the structural relations to sustained growth provide firm basis to the arguments.

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APPENDIX 3.1: INDEX OF SYMBOLS

α	*Parameter representing share of capital*
β	*Parameter signifying diminishing returns in agriculture*
δ	*Rate of depreciation of capital in manufacturing*
η	*The efficiency of attaining potential output*
θ	*A ratio of labor productivity in subsistence agriculture to that in modern sector*
λ	*Part of saving rate wasted as leakage*
μ	*A parameter of increasing returns and externalities in manufacturing*
ν	*The ratio of effective capital to total capital in manufacturing*
ς	*The minimum labor required to conduct most efficient transactions in agriculture or it is the lower limit of* ψ
Σ	*covariance matrix*
φ	*Manufacturing labor diverted to transaction services in manufacturing*
ψ	*Agricultural labor diverted to transaction services in agriculture*
ω	*Capital used in transaction services in and for manufacturing*
Ag	*Value added of Agriculture and the associated services*
b_1	*A parameter relating agricultural goods value added with services value added arising from agriculture*
b_2	*A parameter relating manufactured goods value added with services value added arising from manufacturing*
c	*The minimum capital required to conduct most efficient transactions in and for manufacturing*
Cn	*Aggregate Consumption*
D_j	*Details*
S	*Smooth*
K	*Technology embodying capital*
K^*	*Critical capital stock*
L	*Labor input in manufacturing*
M	*Value added of manufacturing and the associated services*
M^g	*Goods value added in manufacturing sector*
Q_t	*Information set containing all the relevant information in the universe*
R	*Total labor input available to subsistence agriculture*
$\bar{R}$	*Per capita output in agriculture*
r	*The efficiency in attaining potential output with effective agricultural labor input*
s	*Aggregate saving rate*
Ser	*Service value added*
u	*Exponential parameter of the multiplier of goods value added to include the arising service*
Y	*Total value added of the economy*

APPENDIX 3.2: ACRONYMS AND ABBREVIATIONS

AIC	Akaike Information criterion
CWT	Continuous Wavelet Transform
DWT	Discrete Wavelet Transform
FPE	Final Prediction Error(Criterion)
GDP	Gross Domestic Product
HQIC	Hannan Quinn Information Criteria
IR	Impulse-Response
ISI	Import Substitution Industrialization
LIC	Low Income Countries
MODWT	Maximum Overlap Discrete Wavelet Transform
MSE	Mean Squared Error
PCI	Per - Capita Income
SBIC	Schwartz Bayesian Information Criterion
UN SNA	United Nations System of National Accounts
USD	United States Dollar
UNIDO	United Nations Industrial Development Organization
UNCTAD	United Nations Conference of Trade and Development
VAR	Vector Auto Regressive
VECM	Vector Error Correction Model

APPENDIX 3.3 Identified growth driving sectors with VAR/VECM coefficients

Identified driving sector Based on Relative magnitude and direction of coefficients in VAR/ VECM fittings

S/N	Country	The time scale at which significant relations are observed and the driving sector						Growth of Per Capita Manufacturing	Direction of Growth of Per Capita GDP net of excluded sectors
		D1	D2	D3	S1	S2	S3		
1	Afghanistan				A			-0.02	-
2	Benin				M			0.00	-
3	Bolivia				M	M		0.00	-
4	Botswana		M					0.05	+
5	Burkina-Faso		A					0.00	+
6	Burundi		N			A	N	-0.01	-
7	Cameroon		N	A	A	M		0.01	-
8	Central Africa			N				-0.01	-
9	Chad				A			0.00	-
10	Comoros	M			M			0.00	-
11	Congo			N				0.01	-
12	Dem Rep Cong				A	N	A	-0.07	-
13	Djibouti				M		M	-0.04	-
14	Egypt		M					0.05	+
15	Equatorial Guinea	N			N	M		0.03	+
16	Ethiopia	A	A					0.01	+
17	Gambia	A	N					0.00	-
18	Ghana	A	A					-0.03	-
19	Guinea	N						0.01	-
20	Guinea Bissau						M	-0.03	-
21	Haiti		A		A			-0.04	-
22	Hunduras				M	M		0.01	+
23	India	N						0.04	+
24	Indonesia	A	M					0.07	+
25	Iraq						N	-0.02	+
26	Kenya				M			0.01	-
27	Lao P D R					A		0.07	+
28	Lesotho	N			A			0.07	+
29	Liberia				N	A		-0.04	-
30	Madagaskar				A	A		-0.02	-
31	Malawi	A						0.00	-

APPENDIX 3.4 **Identified growth driving sector with Granger causality**

Identified driving sectors based on relative magnitude and direction of Granger causality and Impulse-Responses

S/N	Country	The time scale at which significant relations are observed						Growth of Per Capita Manufacturing	Direction of Growth of Per Capita GDP net of excluded sectors
		D1	D2	D3	S1	S2	S3		
1	Afghanistan				A			-0.02	-
2	Benin				M			0.00	-
3	Bolivia				M	M		0.00	-
4	Botswana		M					0.05	+
5	Burkina		M					0.00	+
6	Burundi		A			N	A	-0.01	-
7	Cameroon		N	N	A	M		0.01	-
8	Central Africa			M		M		-0.01	-
9	Chad				A			0.00	-
10	Comoros	M			M	M		0.00	-
11	Congo			A				0.01	-
12	Dem Rep Cong	A			A	A	M	-0.07	-
13	Djibouti				A		A	-0.04	-
14	Egypt	A	M					0.05	+
15	Equatorial Guinea	N			N	N		0.03	+
16	Ethiopia	A	M					0.01	+
17	Gambia	A	A			M		0.00	-
18	Ghana	A	A					-0.03	-
19	Guinea	A						0.01	-
20	Guinea-Bissau						M	-0.03	-
21	Haiti		A		M			-0.04	-
22	Honduras				M	M		0.01	+
23	India	M						0.04	+
24	Indonesia	A	M					0.07	+
25	Iraq						M	-0.02	+
26	Kenya				N		N	0.01	-
27	Lao P D R					N		0.07	+
28	Lesotho	A			N			0.07	+
29	Liberia				N	N		-0.04	-
30	Malawi	A						0.00	-

A- agriculture M- manufacturing N - neither agriculture nor manufacturing (both negatively related to GDP)

APPENDIX 3.5 GDP after Orthogonalizing Excluded Sectors

Country	1970	1974	1978	1982	1986	1990	1994	1998	2002	2006	2010	2011
Afghanistan	6.19E+09	5.42E+09	6.24E+09	6.06E+09	6.72E+09	4.57E+09	2.67E+09	3.38E+09	4.51E+09	6.08E+09	8.62E+09	9.17E+09
Bangladesh	1.27E+10	1.15E+10	1.29E+10	1.44E+10	1.73E+10	2.03E+10	2.39E+10	2.91E+10	3.57E+10	4.52E+10	5.71E+10	6.08E+10
Benin	8.87E+08	1.10E+09	1.11E+09	1.58E+09	1.80E+09	1.83E+09	2.12E+09	2.68E+09	3.28E+09	3.78E+09	4.37E+09	4.50E+09
Bhutan	-9.64E+06	-1.05E+07	-1.39E+07	-1.97E+07	-2.47E+06	1.62E+07	2.78E+07	2.20E+07	1.05E+08	1.35E+08	2.33E+08	2.58E+08
Bolivia	2.20E+09	2.66E+09	3.10E+09	2.93E+09	2.57E+09	3.00E+09	3.50E+09	4.34E+09	4.59E+09	5.38E+09	6.66E+09	7.07E+09
Botswana	-9.09E+08	-2.22E+09	-2.45E+09	-1.74E+09	-7.09E+08	-1.88E+09	-1.79E+09	-1.59E+09	-3.74E+07	3.31E+08	-1.39E+09	-1.80E+09
Burkina Faso	1.03E+09	1.26E+09	1.56E+09	1.64E+09	1.77E+09	1.88E+09	2.19E+09	2.93E+09	3.57E+09	4.56E+09	5.61E+09	5.92E+09
Burundi	5.40E+08	5.54E+08	7.05E+08	7.65E+08	9.11E+08	1.04E+09	1.01E+09	9.08E+08	9.50E+08	1.05E+09	1.34E+09	1.39E+09
Cambodia	2.09E+09	1.44E+09	1.22E+09	1.00E+09	1.19E+09	1.71E+09	2.23E+09	2.70E+09	3.78E+09	5.67E+09	7.08E+09	7.55E+09
Cameroon	2.74E+09	3.40E+09	4.95E+09	6.07E+09	6.33E+09	4.93E+09	4.34E+09	5.47E+09	5.92E+09	6.78E+09	7.37E+09	7.69E+09
Cape Verde	1.18E+08	1.33E+08	1.19E+08	1.49E+08	1.80E+08	2.08E+08	2.69E+08	3.74E+08	5.57E+08	7.63E+08	9.25E+08	9.91E+08
Central African Republic	7.70E+08	7.30E+08	8.38E+08	8.03E+08	8.63E+08	8.55E+08	9.06E+08	9.83E+08	1.05E+09	1.07E+09	1.18E+09	1.22E+09
Chad	-1.19E+06	6.29E+05	-5.95E+06	-5.69E+07	-1.91E+07	-1.08E+08	1.67E+08	1.85E+08	2.10E+08	1.98E+09	2.08E+09	2.14E+09
Comoros	1.14E+08	1.34E+08	1.54E+08	2.01E+08	2.25E+08	2.28E+08	2.37E+08	2.55E+08	2.82E+08	3.02E+08	3.18E+08	3.25E+08
Congo	-2.60E+09	-2.34E+09	-2.67E+09	-3.42E+09	-4.37E+09	-4.53E+09	-3.03E+09	-2.61E+09	-3.91E+09	-5.48E+09	-6.80E+09	-7.62E+09
Democratic Republic of the Congo	6.77E+09	8.28E+09	6.25E+09	6.27E+09	7.56E+09	7.09E+09	4.99E+09	4.68E+09	4.37E+09	5.75E+09	7.16E+09	7.66E+09
Djibouti	2.55E+08	2.83E+08	2.49E+08	3.13E+08	3.05E+08	3.29E+08	3.43E+08	3.64E+08	4.00E+08	5.15E+08	6.13E+08	6.45E+08
Egypt	1.93E+09	1.80E+09	4.83E+09	7.19E+09	1.21E+10	1.66E+10	2.20E+10	2.56E+10	2.99E+10	3.72E+10	4.87E+10	4.98E+10
Equatorial Guinea	-2.78E+09	-3.27E+09	-3.56E+09	-4.04E+09	-3.95E+09	-4.58E+09	-5.07E+09	-5.44E+09	-6.14E+09	-9.22E+09	-1.14E+10	-1.22E+10
Ethiopia (Former)	4.01E+09	4.57E+09	4.65E+09	5.37E+09	5.38E+09	6.12E+09	5.90E+09	7.09E+09	8.50E+09	1.15E+10	1.70E+10	1.88E+10
Gambia	1.58E+08	1.77E+08	2.15E+08	2.49E+08	2.59E+08	3.09E+08	3.47E+08	3.80E+08	4.61E+08	5.19E+08	6.54E+08	6.90E+08
Ghana	4.09E+09	4.92E+09	4.52E+09	4.33E+09	4.79E+09	5.78E+09	7.52E+09	8.78E+09	1.05E+10	1.29E+10	1.69E+10	1.99E+10
Guinea	1.95E+08	2.24E+08	2.57E+08	2.64E+08	2.97E+08	3.71E+08	4.05E+08	5.70E+08	6.59E+08	6.90E+08	8.31E+08	8.69E+08
Guinea-Bissau	3.07E+08	3.33E+08	3.94E+08	3.43E+08	3.58E+08	4.44E+08	4.87E+08	4.16E+08	4.89E+08	5.38E+08	6.40E+08	6.68E+08
Haiti	1.58E+09	1.86E+09	2.12E+09	2.33E+09	2.37E+09	2.49E+09	2.19E+09	2.51E+09	2.57E+09	2.59E+09	2.62E+09	2.77E+09
Honduras	1.91E+09	2.24E+09	3.11E+09	3.31E+09	3.59E+09	4.16E+09	4.80E+09	5.57E+09	6.06E+09	7.63E+09	8.50E+09	8.79E+09
India	9.04E+10	9.55E+10	1.21E+11	1.38E+11	1.74E+11	2.26E+11	2.70E+11	3.48E+11	4.36E+11	6.15E+11	8.38E+11	9.10E+11
Indonesia	1.18E+10	1.95E+10	2.81E+10	3.66E+10	4.45E+10	5.91E+10	8.35E+10	8.68E+10	9.86E+10	1.21E+11	1.57E+11	1.67E+11
Iraq	-2.13E+10	-2.67E+10	-3.51E+10	-4.94E+10	-5.61E+10	-5.54E+10	-3.46E+10	-5.62E+10	-6.72E+10	-7.15E+10	-5.96E+10	-6.75E+10
Kenya	4.10E+09	5.05E+09	6.11E+09	7.13E+09	8.22E+09	1.01E+10	1.06E+10	1.20E+10	1.29E+10	1.58E+10	1.89E+10	1.97E+10
Lao People's Democratic Republic	2.64E+08	3.24E+08	3.52E+08	4.69E+08	5.83E+08	6.77E+08	8.45E+08	1.03E+09	1.29E+09	1.72E+09	2.31E+09	2.51E+09
Lesotho	1.68E+08	2.42E+08	4.32E+08	3.94E+08	4.42E+08	5.61E+08	6.90E+08	7.77E+08	8.36E+08	9.77E+08	1.21E+09	1.24E+09
Liberia	7.26E+08	8.07E+08	8.18E+08	8.20E+08	7.54E+08	3.50E+08	1.08E+08	3.50E+08	5.68E+08	4.33E+08	5.99E+08	6.52E+08
Madagascar	2.94E+09	2.98E+09	2.92E+09	2.91E+09	3.07E+09	3.45E+09	3.33E+09	3.73E+09	3.79E+09	4.82E+09	5.30E+09	5.39E+09
Malawi	6.50E+08	9.06E+08	1.15E+09	1.18E+09	1.37E+09	1.51E+09	1.47E+09	1.87E+09	1.89E+09	2.31E+09	3.16E+09	3.31E+09

CHAPTER IV: MANUFACTURING GROWTH AND TRANSACTION SERVICES IN LOW INCOME ECONOMIES: A WAVELET APPROACH

ABSTRACT

The study claims that the level and direction of growth of transaction services matters for manufacturing growth. It begins with detection of the sign of the coefficients of VAR/VECM fitting, and Granger causal and impulse-response relationship. Based on the detected relationship and the actual direction of change of services the study predicts growth of manufacturing value added at various time scales. We compare the predicted and the actual direction of changes of the manufacturing value added. The results indicate that non-positive VAR/VECM coefficients and cumulative impulse-responses between services and manufacturing prevail in significantly greater number of countries than the prevalence of positive relations. The countries where the predicted direction of growth in manufacturing value added coincided with the actual direction of change were significantly greater in number than those countries where coincidence does not appear. This result provides evidence for the hypothesis that the level and direction of growth of services matter for manufacturing, and policies towards the provision of optimal services is important for manufacturing growth in low-income economies.

Keywords: Manufacturing growth, Transaction services, Granger causality, Impulse-response tests, structure, dualism, modern growth, sustained growth, macro model, multi-sector growth, industrialization, transformation, transition to modern growth, income convergence

JEL classification codes 0110, 014, 0410, 047, P52

I INTRODUCTION

1.1 BACKGROUND AND THE PROBLEM

In low-income economies, the share of agriculture and services in total value added dominates while the share of manufacturing is diminutive (Ref United Nations database, 2012). The trend in structural transformation of these economies evinces declining share of agriculture, stagnant manufacturing, and expanding services. In many cases, the gradually declining share of agricultural sector is giving way to the expansion of share of services, rather than manufacturing, where the share of services has grown to reach and exceed 50%. The conventional view on sectoral competition between industry and agriculture has to give way to the competition between manufacturing and services. The observed pattern is that of bypassing the historic stage where matured manufacturing precedes dominance of services. There is a strong reason to suspect that manufacturing is like a plant languishing under strong rival tree that denies it the necessary nutrients.

This state of low manufacturing share and growing share of services provided the motivation to model the economies in a way that enables investigating whether the growth of output of services has retarded manufacturing growth by crowding out manufacturing from accessing inputs. The faster growth of services suggests that a greater magnitude of resources is shifting to this sector. The service sector, which is meant largely to facilitate goods production and consumption, is denying the flow of the necessary inputs to goods production.

Thus, the aim of this study is investigating growth of transaction services as the structural factor responsible for growth or stagnation of manufacturing in low-income economies. The theoretical model of low-income economies used in this study defines the structural link between manufacturing growth and transaction services. The study investigates, case by case, whether the expansion of services has led to manufacturing growth or whether it has retarded manufacturing growth. Here, the underlying assumption is that the formation of large service is a long-term process that embodies the aggregate preference of members of society and the imprint of the institutional environment. Since structure is a slowly changing variable, it acts as an exogenous factor that can be taken as a policy variable.

1.2 THE OBJECTIVES

The overall objective of the study is investigating the effects of services on manufacturing growth. The specific objectives are:

- Identifying the long term structural relationship between services and manufacturing
- Predicting the direction of change of manufacturing based on the identified structure

1.3 THE HYPOTHESIS AND THE METHODOLOGY

The model implies that there is non-linear relationship between the magnitude of capital required (K*) to escape low-level equilibrium in manufacturing output and that required in transaction services (ω)(ref. Chapter 2). At lower levels, the growth of transaction services facilitates escape (K* becomes smaller) while at higher levels its growth intensifies the difficulty to escape (K* increases), suggesting the existence of an optimal level of services. The hypothesis emanating from this relationship is that "Growth of transaction services below the optimal level enhances manufacturing while growth of transaction services above the optimal level hinders manufacturing growth of low income economies".

The hypothesis is tested using case-by-case analysis of the structural relations of sectors in low-income economies. Long-term relationships between interacting sectors are detected as the underlying structure of the economy. Pursuant to the identification of the structure, the effect of that structure on the long term growth of manufacturing is further predicted. The predicted direction of growth of manufacturing is compared with the actual direction of growth of manufacturing to test the claim of the hypothesis.

The structure or the underlying relationships between the sectors, is detected via co-integration or vector auto regressive relationships, and Granger causality and impulse response tests. The focal sectors are manufacturing, agriculture, and services. The economies under investigation are economies that were low income in 1970. With the criterion of 1000USD per capita income at 2005 prices, there were 71 economies falling in this category and the first 35 in alphabetical order were taken in a sample to see the structural effect for the past 42 years.

Consideration of interactions of sectors necessitates deciding the time span within which the interactions take place. Wavelet decomposition of the time series data detects the outcomes of interactions in various time scales. Among the various wavelet transformations, the one selected for this purpose is Haar wavelet. The wavelet-transformed data goes through VAR/VECM analysis. Granger causality and impulse response tests complement the VAR/VECM analysis.

1.4 PREVIEW OF THE RESULTS

The results of the analysis support the hypothesis in significantly large number of cases. Economies with positive co-integration relationship of services and manufacturing experienced sustained growth in manufacturing when services grow or they experienced decline in manufacturing when services declined. Those economies with negative relationship of services on manufacturing experienced growth in manufacturing with decline in services and experienced decline in manufacturing with growing services in a large number of cases. The structural relations of most economies support the hypothesis.

Time scales are found to be important as the relationships are observed in longer time scales in some cases and in shorter time scales in others. Relationships of levels reveal significant structures relations in more number of cases than differences. The implication for development strategies of low-income economies is that structures matter for sustained growth (long-term growth) of manufacturing and a structure with prevalence of optimal services is necessary for the attainment of sustained growth of manufacturing.

One of the contributions of this paper is that it provides additional empirical evidence on the explanation for success or failure of attainment of long-term manufacturing growth. The explanation lies in the structure of economies with optimal services. The other contribution is methodological, which is the application of wavelet decomposition of time series data for subsequent analysis of effects of time scales. It transcends the usual method of analysis where a single time scale is considered.

1.5 ORGANIZATION OF THE STUDY

Part 2 goes to a brief excursion to theory that defines the relationship between services and goods production and the rationale for taking services as extensions of goods production. It highlights the analytical and empirical implications of the assumptions of the theory that served as the basis for the hypothesis. Part three discusses methodological issues: data preparation and estimation methods.

The need to transform the time series data, empirical model specifications, and the reason behind the selected model is highlighted in this section. In part four results of the analyses will be reported. In Part five conclusions and policy implications are drawn.

2. SERVICES AS EXTENSIONS OF GOODS PRODUCTION

2.1 THE UNDERLYING MODEL

As attested by the historical accounts on patterns of economic development (Kuznets, 1966; Bairoch, 1993; Maddison 2005), manufacturing, among goods producing sectors, stands as the most efficient vehicle for transformation. Newly industrialized countries have gone through a structural transformation in line with the historical pattern. A low-income economy evolves through stages in accordance with observed historical patterns. The first stage is a stagnant agricultural economy, the second is a dual economy where subsistence agriculture coexists with small modern manufacturing economy, while the third stage is a matured economy (Kaldor, 1966; Kuznets, 1966, 1989; Hansen and Prescott, 2002; Parente and Prescott, 2003) where the distinction between modern and traditional sector disappears. A typical low-income economy, with dual characteristics, falls in the second stage of the evolution. UN data base (unstat, 2013) indicates that considerable number of LICs have a dual structure. Current share of manufacturing is low and the growth of its share varies across economies (unstat 2013).

The centrality of manufacturing for low income economies to transform themselves to higher income through a long-term growth process is described in Chapter 2 and verified in Chapter 3. Fitting to the second stage and the stylized facts of LICs, a model conceptualizing the aggregate production function composed of manufacturing as a modern goods production activity and agriculture as a traditional, subsistence activity is formulated. The model depicts services as arising on the basis of goods production. In the model accounts for inefficiencies, reflecting prevalent market imperfections, that place actual output below potential output.

The inefficiencies are output-affecting ones similar to that of Parente and Prescott (2003), on the one hand, and input reducing ones, on the other. Input reducing inefficiencies are expressed either with subtraction of factors not used in actual goods production while being used to effect transactions, or as percentage of total inputs not directly used for goods production. These inputs not directly used for goods production are essentially economy wide transaction costs for society that emanate from imperfections. Inputs to transaction services appear as transaction costs to goods production. Although non-transaction services compete for inputs with goods producing sectors they do not appear as transaction costs to society. Conceptually non-transaction services could be lumped together with goods production. The total value added of the economy is the combined outcome of goods production and services that arose based on goods produced. Since both transaction and non-transaction-services emerge based on goods production and consumption, the combined value added can be expressed in terms of the value added of goods production as described in Chapter 2.

The model has led to the important finding of a critical capital stock K* that has to be exceeded in order the economy to be in a sustained growth path. The economy in transition from stagnancy to modern growth is bounded by a lower level equilibrium of subsistence economy and a higher-level matured economy. In this transition stage, there is a possibility for the existence of an unstable equilibrium depending on the size of the parameters of the economy such as δ(depreciation rate), s(saving rate) and λ(the rate of saving leakage)(Ref Chapter 2). Economies having effective savings that is always greater than depreciation move to sustained growth without experiencing multiple equilibriums. In the presence of the unstable equilibrium, the economy either moves to the lower level equilibrium or moves to higher level transformation depending on whether capital stock (*K*) in the modern sector is greater or less than a critical stock(K^*), where K^* is derived from low of motion of capital as:

$$\mathbf{K}^* = \left(\frac{\delta}{s-\lambda}\right)^{\frac{\alpha}{\mu}}\left(\left(\frac{1}{\eta}\right)^{\frac{1}{\mu}}\left(\frac{C}{\omega_t}\right)^{\frac{u}{\mu}}\right)\left(\frac{\beta\bar{R}}{\theta(1-\alpha)}\right)^{\frac{1-a}{\mu}} + \omega_t$$

(Refer the section on model structure in Chapter 2)

If the economy exceeds the critical stock and escapes the unstable equilibrium it moves to a persistent change towards maturity where it assumes a different structure having no more a distinction between subsistence agriculture and manufacturing. The theoretical analysis places emphasis in capital accumulation in the modern manufacturing sector that propels the economy forward with generation of additional value added in services. Critical stock ($\mathbf{K}^*$) varies with **ω** (the capital committed to transaction services). Critical stock first declines and then increases as **ω** increases. **ω** represents transaction services, which are transaction costs to society. The model prediction of the evolution of **K*** with changes in **ω** is depicted Fig 1 below**.**

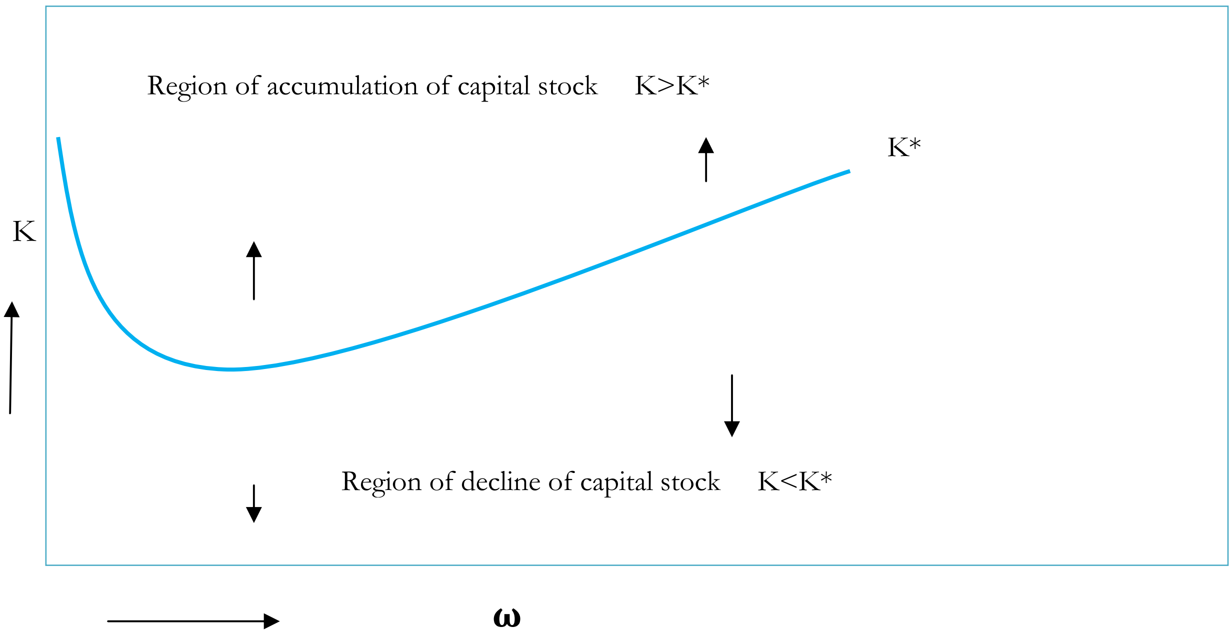

Fig 4.1 Critical capital stock K and* **ω**

The explanation pursued in this paper for transition of low-income economies from classical stagnation to modern economic growth hinges on structure. The onset of structural change characterized by faster growth of output and share of manufacturing is the basic feature that ensures a low-income economy to attain sustained growth. What structural factor explains the retarded manufacturing growth in LICs that do not have achieved sustained growth?

2.2 THE NATURE OF SERVICES

Economic production is an activity that produces goods and services for others. SNA (2008) defines goods as physical, produced objects with demand whose ownership can be transferred in market transactions. The production of goods and the exchange of goods are separate activities. Services are results of production activity that change the conditions of consuming units (change effecting services) or that facilitate the exchanges of products(margin services) or that provide storage, communication and dissemination of information, advice and entertainment with repeated access (knowledge capturing products). Services assist the production, consumption, and exchange of goods. Change effecting services arise to add value mainly on supplied goods. Knowledge capturing services arise essentially on high tech goods. Marginal services like insurance and banking serve the purpose of facilitating production and exchange of goods.

In change-effecting services, production and trading are not separate activities. In this type of services, the conditions of the consuming units change when changes are made on: condition of the consumer's goods by transporting, cleaning, or repairing them; physical or mental condition of persons by transporting, providing accommodation, undertaking medical/surgical treatment, improving the appearance, providing education, information, advice and entertainment. For change-effecting services such as transporting, cleaning, and repairing to exist, consumer goods must exist. The magnitude of such services is dependent on the magnitude of produced goods. As such, they are extensions of goods production. Changes in physical or mental conditions of persons occurs largely with the use of goods in the form of gadgets and facilities, such as transport vehicles, houses, and appliances in accommodations, medicines and equipment, chemicals and tools, stationery and laboratory facilities, electronic and musical equipment, which are all goods. The magnitude of provision of these services is dependent on the magnitude of the available relevant goods and, as such, there is reasonable ground to establish the relationship between service outputs and relevant goods output.

In margin services too, production and trading do not take place separately. These services are required for facilitation of exchange of goods and other services as it happens with wholesaling, retailing, and financial intermediations. Wholesaling and retailing services are dependent on the supply of goods. Financial services in the final analysis assist production and consumption activities. The magnitude of output of these services is associated with goods supply in the economy. As such, there is adequate ground to associate the output of such services with the output of goods production processes.

The provision, storage, communication and dissemination of information, advice and entertainment to the consuming unit in accessing the knowledge repeatedly through knowledge-capturing products is performed with the use of goods(paper or electronic media). The provision of these services is directly associated with relevant goods production. The magnitude of the output of these services is dependent on the magnitude of the output of the goods used in providing the services.

In general, services accomplish two activities: extending the transformation of goods (or a group of goods) by adding new attributes valuable to users, or they facilitate exchange of goods without adding new valuable attributes to goods. Those services facilitating exchange are treated as transaction services in this study while the others are non-transaction services. Non-transaction services are similar to goods production as they are more or less direct extension to goods production. Transaction services, though they arise to facilitate goods production and exchange, their association with goods production depends on the institutional arrangement prevailing in the economy and on individually chosen method of dealing with the institutional and technological arrangements by economic actors. The evolution of transaction services is a slow process that takes place a long period. More discussion on this issue follows in the next section.

The two services may be performed by same institutional unit and may not be recorded in its accounts as separate entities. However, they remain to be conceptually different kinds of services based on their importance in improving the welfare of society. Society's welfare improves by committing more resources to introduce more attributes per unit of existing goods (or group of goods). Society's welfare does not improve by increased commitment of resources to increase the costs of facilitation, because utility is derived from the attributes of the goods not from the facilitation cost. Society becomes better off from the perpetual reduction of transaction costs and with perpetual increment in attributes of goods.

In International Standards for Industrial Classification (ISIC) revision 4 (2008) and in SNA (2008), services are classified into various sectors: wholesale and retail, transport and communication, and others.

Tab 4.1 Classifying services into Transaction and Non transaction services

ISIC/ SNA classification of services	Regrouping as transaction or non transaction services in this study	
	Transaction	Non transaction
G 45–47 Wholesale and retail trade; repair of motor vehicles and motorcycles	Wholesale and retail trade	Repair
H 49–53 Transportation and storage	√	
I 55–56 Accommodation and food service activities		√
J 58–63 Information and communication	√(those facilitating transactions)	√(those providing utility)
K 64–66 Financial and insurance activities	√	
L 68 Real estate activities	√	
M 69–75 Professional, scientific and technical activities	√(facilitators)	√(used in creation of products and knowledge)
N 77–82 Administrative and support service activities	√	
O 84 Public administration and defense; compulsory social security	√	
P 85 Education		√
Q 86–88 Human health and social work activities		√
R 90–93 Arts, entertainment and recreation		√
S 94–96 Other service activities	√	
T 97–98 Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use		√
U 99 Activities of extraterritorial organizations and bodies	√	

Conceptually this study reclassifies activities that are categorized as services in national accounts statistics. Transaction and non-transaction services are lumped together in the national accounts data of countries and it becomes clear from the outset that the organization of existing statistics necessitates careful interpretation of results, as it is not organized in line with the conceptual framework of this study. Transaction services constitute the overwhelmingly larger part of services. For example in Ethiopian national accounts, 86% of the entire services fall as transaction services (Tab 4.2),. In many low-income countries, the situation is similar. Discussions on services are predominantly discussions on transaction services. It is hoped that the data used for services reflects the extent of transaction services. Future studies can improvise on this aspect by careful segregation of the transaction and non-transaction services in the countries covered by the study. Thus, the service sector is largely transaction services and taking the service sector in lieu of transaction services is justified as similar dominance of the transaction services in the service sector prevails in low-income countries.

Tab 4.2: Shares of transaction and non-transaction services within the services sector of Ethiopia

Transaction services	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Whole Sale and Retail Trade	0.37	0.37	0.37	0.36	0.36	0.36	0.37	0.38	0.38	0.37	0.36	0.34	0.35	0.36
Hotels and Restaurants	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.06
Transport and Communications	0.09	0.10	0.10	0.11	0.11	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Financial Intermediation	0.05	0.05	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.05	0.06	0.07	0.05
Real Estate, Renting and Business Activities	0.14	0.15	0.18	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.19	0.21	0.20	0.18
Public Administration and Defense	0.15	0.13	0.11	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.10
Proportion of total transaction services														0.86

Non-transaction services	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Education	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Health and Social Work	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Other Community , Social & Personal Services	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.07
Private Households with Employed Persons	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Proportion of total non-transaction services														0.14

2.3 TRANSACTION SERVICES: AS FACILITATORS AND COSTS TO SOCIETY

Essentially a substantial portion of services facilitates production and consumption of goods. They are transaction services. Their existence largely depends on the extent of the difficulty faced in accessing inputs by goods producers and difficulties in accessing finished goods by consumers. Their magnitude depends on choices made in the method of addressing the constraints of production and consumption by economic actors.

When difficulties abound in goods production, resources are committed to transaction services to overcome the difficulties and to facilitate the production of goods. Had these difficulties been non-existent, these resources would have been committed to goods production and consumption. Reduction of the difficulties necessitates reduction of resources committed to transaction services. The expansion of transaction services diverts inputs that would, otherwise, be used for the expansion of production of goods.

Society's utility is derived from the goods not from the transaction services. Transaction services are transaction costs to society. The amount of resources committed depends not only on the extent of difficulties faced but also on the method introduced to address them. The level of resources committed in transaction services is in the short run an exogenous factor reflecting the institutional state in society, and individually opted responses to the institutional arrangements.

Transaction costs are thus additional resources committed during production and exchange apart from direct input or output costs. They are committed in securing inputs by the producer and in availing outputs to the buyer, in the process of production or consumption of goods. These costs are recognized in the literature to incorporate search-and-information costs, bargaining costs, costs of agreement and drawing contract, costs of enforcement of contracts, brokerage fees, bank fees, state taxes, costs of traveling, costs of transporting, costs of storing and waiting in effecting the transactions. On aggregate level, part of the costs in public administration and defense, banking, insurance and financial services, part of costs in transport and telecommunication services, costs for wholesaling and retail services are transaction costs for society.

Part of change effecting services, all margin services, and part of knowledge capturing services are facilitating transactions taking place between producers and consumers and fall into transaction services. Wallis and North (1986, 1988) take wholesale, retail trade, finance, insurance, and real estate as aggregate transaction sectors**.** The authors exclude transport from the category of transaction sectors on the ground that transportation services are transformation costs rather than transaction costs. Transaction costs arise in making exchanges or in performing the transaction function while transformation costs arise in transforming inputs into outputs or in performing the transformation function (Wallis and North, 1986).

Our study categorizes transportation costs as transaction costs on the ground that they arise during exchange of goods by intervening operators to facilitate exchange between producers and consumers. Moreover, neither the producer's nor the consumer's welfare improves by the added cost of transportation during exchange as the goods' physical attributes do not change in a sense that the consumer does not distinguish between a good of the same quality that was transported from distant places and that produced locally. Bread produced locally, with ingredients that are identical with that produced in a different place but transported to the former locality, provides same satisfaction to the consumer. The labor and capital spent in producing (transforming) the inputs to outputs are same in both but one is bought from local sources with no transportation costs while the other is bought from distant places with additional costs incurred to have it(transaction costs).

Transformation process changes goods used as inputs to different quality goods called outputs, providing utility to the user different from the inputs. If changes in quality of a good are measured by the additional satisfaction created as a result of the change, the change brought about by transportation service is not a transformation cost since welfare of the person consuming the transported bread is no better than when consuming the local bread made of identical ingredients. On aggregate level, a country using the same technology of production with that used by another country but experiencing more transportation costs within or outside the country is no better in its welfare. A country does not increase the quality and quantity of its output by new impediments that increase the costs of transportation of goods. In other words, it is better conceptually to incorporate transportation with transaction services rather than transformation services. In taking this conceptualization, it might be useful to be reminded of Kuznets remark (as cited in Wallis and North, 1986) "no economic measure is neutral, that is unaffected by economic theories of production, value, and welfare, and the broader social philosophy encompassing them."

Transaction costs are incurred in return for transaction services. Some of these transaction services reduce the effects of uncertainty. Some reduce spatial and temporal barriers while some are regulatory. Some are sources of government finance while some of them may be instruments of policy. Some of them are rents squeezed by agents who do not contribute to production but who could be obstacle when unsatisfied (bribery and other forms of corruptions are cases in point). Most of them affect input and output prices while some are directed at regulating exchanges and enforcing property rights. They may be visible in official statistic in aggregate form to some extent while a significant portion may not be visible in official statistics.

Transaction costs for brokerage services is incurred by agents to reduce the ignorance and uncertainty about the various dimensions of commodities that producers purchase or sale as inputs or outputs. The information needed could be about any of the spatial, temporal, qualitative, or quantitative dimensions of the commodities. When there is no supply of brokerage service in situations where producers face dearth of information, there follows a heavy loss in terms of actual profit or planned profit. If there exists limited supply of brokerage services, prices of brokerage will be exorbitant and unfavorable to producers. Too low brokerage fee leads to insufficient supply of the service and hence more lack of information. That means there is an optimal range of brokerage fee that society cannot avoid as long as information lack prevails. Unless sources of information are abundant, such services are necessary to facilitate economic transactions. Society can only reduce transaction costs of the brokerage type to an optimal level, not avoiding them completely. Similarly, insurance, contract drawing, and contract enforcement costs cannot be avoided but reduced as they are outcomes of uncertainties and absence of trust. Bank fees, state taxes, transport and telecommunication costs can similarly be reduced but not avoided.

In the short run, transformation costs are largely endogenous to the economic system while transaction costs are exogenous impositions on the economic system. Economic forces of demand and supply interact to result in transformation costs, where prices and quantities reflect scarcity of the commodities directly or the scarcity of the inputs used in their production. Endogenous economic processes ensue subsequent to shocks on market forces to restore previous states unless a stronger non-market force is at work in blocking the restoring process. The non-market force works by way of blocking market interactions and increasing the transaction costs of the market.

Non-economic factors engender transaction costs. The mechanisms for the reduction of these costs lie in adoption of new institutional arrangements and by introduction of new methods of interactions. While adopted technologies generally increase productivity by reducing transformation costs, obsolete and persistent institutions, and rigid mindset that does not adopt new method of social interactions perpetuate transaction costs. Non-existence of appropriate institutions also keeps transaction costs soaring. Market forces are in favor of selecting beneficial technologies through transactions unless blocked by non-economic factors that increase transaction costs.

North and Wallis (1994) acknowledge that historically *at the level of the firm, over time, transformation costs have been falling, while transaction costs have been rising*. Rigid institutional arrangements and environments may not have allowed transaction costs to decline. The distinction between exogenous transaction costs caused by institutional and social preference and endogenous transformation costs leads to an important orientation of the focus of analysis to the effects of transaction costs on economic growth, with a particular focus on manufacturing growth. This orientation directs eventually to selecting policy variables, which happen to be exogenous to the economic system.

Transaction costs may be reduced by working from two directions; one by reduction of causes of lack of information or uncertainty, and the other by optimal supply of the institutions that reduce risks and provide information and insurance services. Reduction of causes of uncertainty and ignorance include expansion of technical knowledge on causes and effects, expansion of technology, removal of communication barriers, building thrust, understanding and social responsibility. Optimal supply of transaction services reduces transaction costs. Keeping low supply of the services would raise prices of the services too much for transactions to take place. Too much transaction costs are fetters to economic activity. What facilitates transaction is not the total absence of transaction costs, which is tantamount to experiencing infinite costs, but the presence of the transaction services at low costs.

2.4 GOODS AND SERVICES COMPETING FOR RESOURCES

The economy in transition from agrarian stagnancy to modern growth is bounded by a lower level equilibrium of subsistence economy and a higher-level matured economy. In this transition stage, there is an unstable equilibrium. If disturbed at the unstable equilibrium, the economy either moves to the lower level equilibrium or moves to higher level transformation depending on capital stock (*K*) in relation to the critical stock(K^*) in the modern sector.

If the economy accumulates capital that exceeds the critical stock and escapes the unstable equilibrium it moves to a persistent change towards maturity where it assumes a different structure having no more a distinction between traditional agriculture and modern manufacturing. To highlight some of the determinants of the capital stock K*, it is worth mentioning the exogenous variable ω and the parameter λ that represent the prevalent difficulty in transactions. They play important role in determining the required critical capital $K^*$to escape lower level equilibrium. Higher values of ω and λ tend to increase the required capital K*. The higher the allocation of capital in transaction services the more difficult and resource demanding is escaping to higher-level equilibrium.

Transaction services dominate the service sector and they are manifestations of inefficiencies. The inefficiencies affect not only the output, but also reduce the effective level of inputs used for goods production. Increased transaction costs reflect increased inefficiencies, making it difficult to attain sustained growth in manufacturing and associated services. Commitment of capital to transaction services reduces the inputs going to goods production. Differences in the levels of transaction costs across economies arise from prevailing market imperfections of low-income economies. Capital used for transaction services first facilitates the escape to sustained growth until it reaches some level, beyond which it becomes hindrance. Expansion of transaction services in low-income economies beyond the minimum required crowds out manufacturing and retards the attainment of sustained growth.

The rate of change of manufacturing value added with respect to changes in resources committed to transaction services $\boldsymbol{\omega}$ is:

$$\frac{dM}{d\omega} = d/d\omega\left[\eta\left(\frac{\omega_t}{C_t}\right)^{u}(K_t-\omega_t)^{\alpha+\mu}\left(L_t-\varphi_t\right)^{1-\alpha}\right] \;=\; \left[\frac{u}{\omega}-\frac{\alpha+\mu}{K-\omega}\right]M \quad (1)$$

$$\frac{dM}{d\omega} = 0 \quad \text{at} \quad \boldsymbol{\omega} = \frac{u}{\alpha+\mu+u}K = \boldsymbol{\omega}^{*} \;, \quad (2)$$

$$\frac{dM}{d\omega} > 0 \text{ at } \boldsymbol{\omega} < \frac{u}{\alpha+\mu+u}K \text{(Transaction services are helpful for manufacturing until } \omega = \omega^{*}) \quad (3)$$

$$\frac{dM}{d\omega} < 0 \quad \text{at} \quad \boldsymbol{\omega} > \frac{u}{\alpha+\mu+u}K \text{ (Transaction services retard manufacturing after } \omega > \omega *) \quad (4)$$

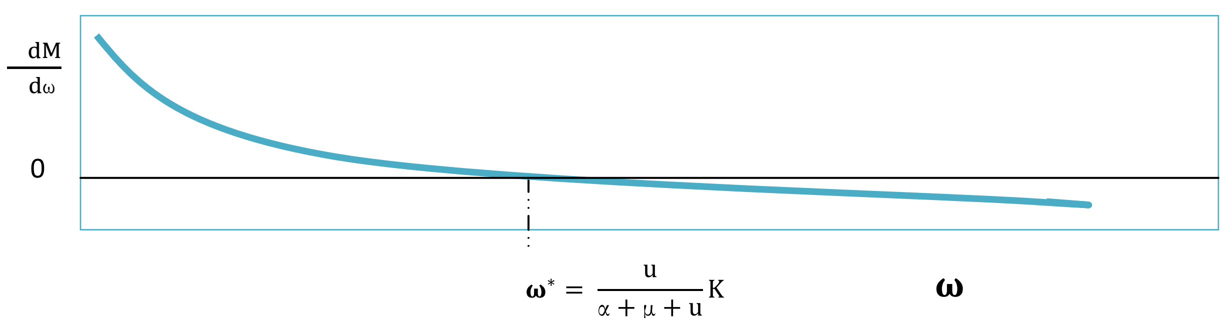

Fig 4.2 Rate of change of manufacturing with respect to transaction costs

The model shows that the expansion of transaction services has negative effect on manufacturing after reaching some stage of usage of capital "$\boldsymbol{\omega}^{*}$", which is a function of capital stock(K). The expansion of services beyond this level causes retarded growth of value added in manufacturing. When capital used in transaction services $\boldsymbol{\omega}$ is less than "$\boldsymbol{\omega}^{*}$", change in the value added of manufacturing is positive with changes in $\boldsymbol{\omega}$. In economies where manufacturing and services are negatively related we have the ground to conclude that transaction services are greater than "ω^*". Conversely, in economies with positive causal relationship of services to manufacturing, we may conclude that transaction services have not exceeded the minimum level of transaction services required for facilitation. This study empirically explores the prevailing causal relationship of services and manufacturing, and infers whether the transaction cost level is greater or less than"$\boldsymbol{\omega}^*$" .

Note that "$\boldsymbol{\omega}^*$", which is the stock of capital spent on optimal transaction services, grows with growth of capital stock K. For higher stock of capital (K), the capital ($\boldsymbol{\omega}^*$) required to run optimal transaction services increases. For a particular value of K, $\boldsymbol{\omega}^*$ assumes fixed value. Otherwise, as K grows $\boldsymbol{\omega}^*$ also grows.

3. METHODOLOGICAL FRAMEWORK AND MODEL

This section undertakes empirical verification of the theoretical claims made above via testing the hypothesis using econometric methodological framework. Designating "$\boldsymbol{\omega}^*$" as the optimum level of transaction costs required to facilitate transactions, the hypothesis becomes:

- Growth of transaction services, which use capital less than"$\boldsymbol{\omega}^*$", advances manufacturing growth, while growth of transaction services making use of capital beyond $\boldsymbol{\omega}^*$ (which have grown beyond the optimal required for facilitating transactions) retards manufacturing growth in low-income economies.

The study sets out to test whether or not growth of services in economies with capital spent on transaction services ω where $\omega < \omega^*$ advance manufacturing growth while services using $\omega > \omega^*$ retard manufacturing growth.

In the method followed to test the hypothesis, changes and levels of manufacturing, services, and agriculture are filtered in various time scales by the chosen wavelets to undertake VAR / VECM analysis. The signs of the coefficients of services in VAR/ VECM fittings are used to detect the long term relationships between services and manufacturing that prevailed in the economies. Granger causality and impulse response tests complement the process of detection of the prevalent relationship. The detected relationship enables the prediction of the direction of growth of manufacturing if the hypothesis is true. Comparison of the predicted direction of growth of manufacturing with the actual growth of manufacturing tests the validity of the hypothesis.

3.1 THE GENERAL APPROACH

The method of analysis directly follows from the relations in equations: 1, 2, 3 and 4 above.

$$\frac{dM}{M} = \left[\frac{u d\omega}{\omega} - \frac{(\alpha+\mu)d\omega}{K-\omega}\right] = f\left(\frac{d\omega}{\omega}\right) \qquad (5)$$

Growth in manufacturing is a function of growth in transaction costs. The model also implies that growth of manufacturing is zero when $\boldsymbol{\omega} = \frac{u}{\alpha+\mu+u}K = \boldsymbol{\omega}^*$, positive when $\omega < \frac{u}{\alpha+\mu+u}K$ and negative when $\omega > \frac{u}{\alpha+\mu+u}K$.

Since the level of "$\boldsymbol{\omega}^*$" for an economy is not known, the level of $\boldsymbol{\omega}$ is inferred from the sign of the coefficients of the fitted VAR/VECM models and sign of the cumulative impulse responses of services on manufacturing. The analysis proceeds by identifying the long-term relationships detected by co-integration analysis and the Granger causal relationship between services and manufacturing. The signs of the coefficients of the VAR/ VECM models enable to infer the relative level of $\boldsymbol{\omega}$ with respect to $\boldsymbol{\omega}^*$. The direction of Granger causality detected by the sign of the cumulative impulse responses help to triangulate the results found in the VAR/VECM analysis. The actual direction of growth of service is used to predict the performance in growth of manufacturing, as per the hypothesis, and comparing the predicted performance of manufacturing with actual performance enable to verify the hypothesis.

VAR/VECM fitting and Granger causality tests accompanied by impulse response tests indicate positive, negative or no relationship of services with manufacturing. Under positive relationship with manufacturing growth, actual growth of services predicts advances in manufacturing or negative growth of services predicts retarded manufacturing. Under inverse relationship with manufacturing, growth of services predicts retarded manufacturing and decline in services predicts advances in manufacturing. If the predicted performance in manufacturing is the same as the actual performance in manufacturing the hypotheses gets support from the data. The following table (Table 4.3) outlines the various empirical possibilities and verification schemes applied in this study. There are two significant relationships: Positive and Negative. There are three possible cases of actual direction of growth (trend) of services, positive (+), negative (-) or no(0) growth. Each sign of the relationship is considered with the actual direction of growth of service to predict the growth of manufacturing and to compare the prediction with the actual growth of manufacturing. For example, a case where positive VAR/ VECM or Granger causality is detected and the actual trend in growth is positive for services, if the hypothesis is valid, that must result in growth of manufacturing. To verify the hypothesis, the predicted growth in manufacturing is compared with the actual direction of growth of manufacturing. If the predicted and the actual are same, the hypothesis has gotten support, otherwise not.

Tab 4.3: Possible Outcomes and Supportive Cases for the Hypothesis

Granger causality of orthogonalized Services on Manufacturing	Actual trend of services in 42 years	Predicted direction of changes in manufacturing	Actual Direction of Changes of Manufacturing	Implications for the hypothesis
+ve (Under positive causal relationship, the implied level of services consume capital $\omega<\omega^*$)	-	-	0	weakly supportive
			-	supportive
			+	Not supportive
	+	+	0	weakly supportive
			-	Not supportive
			+	supportive
	0	≤ 0	0	supportive
			+	Not supportive
			-	supportive
-ve (Under negative causal relationship Implied Level of services consume capital $\omega>\omega^*$)	-	+	0	weakly supportive
			-	Not supportive
			+	supportive
	+	-	0	weakly supportive
			-	supportive
			+	Not supportive
	0	≥ 0	0	supportive
			-	Not supportive
			+	supportive

3.2 DATA AND ANALYSIS OF THE DATA

The method of analysis specified above requires preparation of the sectoral output data in various time scales to detect long-term relations between services and manufacturing. The data are wavelet decomposed in to details (D_j) and smooth (S_i) before going through VAR/VECM analysis and Impulse response tests (Ref. Chapter 1). The VAR/VECM fittings and the diagnostic tests follow the general procedures outlined in Chapter 1.

The wavelet-transformed time-series sectoral data are with differing applicable lag lengths, and with differing time scale relationship. Thus, the time series data per country has to be treated separately. In some cases, structural breaks exist that necessitate case-by-case analysis. The economies are economies in transition where structural changes take place in rates that differ from country to country. Moreover, the prevalence of structural change necessitates the recognition of existence of unstable parameters in the analyses. The relationship between sectoral contributions and the economy at large that are to be investigated are thus averages of the changing parameters in the period under investigation.

The data employed are those obtained from United Nations National Accounts Main Aggregates Database on manufacturing, agriculture, and services. The economies under investigation are the first 35 countries in alphabetical order among 71 countries with low per capita income (PCI), arbitrarily taken to be below 1000 USD in 1970. The countries are the same countries in the analysis of the centrality of manufacturing in Chapter 3.

This part of the study employs the same procedures and principles specified in the flow chart of the data analysis section of Chapter 1 and the principles of VAR/VECM analysis and Granger causality tests described in section 3.2 of Chapter 3. The differences are changes in variables, where manufacturing takes the place of GDP, and services come in to the picture along with agriculture. The VAR/VECM models used as in Chapters 1 and 3 are:

$\mathbf{\Delta Y_t = V+\alpha_i \Sigma y_{t-i}+A_1 \Delta y_{t-1} +\cdot\cdot+A_p \Delta y_{t-p}+u_t, t=0,\pm1,\pm2, .,}$ *(VAR of first differences of co-integrated levels*)

$\mathbf{\Delta Y_t = V + A_1 \Delta y_{t-1} + \cdot \cdot + A_p \Delta y_{t-p}+u_t, t= 0,\pm1,\pm2, . ,}$*(VAR of first differences of non co-integrated levels)*

$\mathbf{\Delta Y_t=\alpha(\beta Y_{t-1}+\mu+\varrho t)+ \Sigma \Gamma \Delta Y_{t-i}+\gamma+\Upsilon t+\varepsilon_t}$. (*VECM for I(1) variables*)

where $\mathbf{Y}_t$ = is the vector of wavelet transformed value added of manufacturing, agriculture and services

4. THE EVIDENCES: RESULTS OF VAR/VECM FITTINGS, GRANGER CAUSALITY AND IMPULSE-RESPONSES

The long term relationship of services and manufacturing is detected with the magnitude and direction of the significant coefficients of the fitted VAR/VEC models on the one hand, and cumulative impulse-responses of those having significant relationship (at least at 10%) in Granger causality. The magnitude and sign of the coefficients or the sign of the cumulative impulse responses represent the structural relationships in the economies. Detections of the structures with the former method are triangulated with the latter.

Most countries exhibit significant relationship of services with manufacturing either in first differences or levels or both at one or more timescales in both the methods (ref. Table 4.4 and Table 4.11). Countries without any significant relationship between the sectors in first differences, or in levels, may show significant relationship at second differences or in co-integration of the first differences, but this study does not pursue investigations beyond I(0) and I(1) time series.

VAR/ VECM coefficients

VAR coefficients are relationships of stationary differences and levels of manufacturing, agriculture, and services. VECM coefficients are co-integration relationships of levels of the three sectors. With the use of coefficients, twenty, among thirty-five countries, exhibit at least one significant relationship in one or more of the time scales. Among the twenty, two-third of them exhibit significant relationship across more than one timescales, while one-third of the countries exhibit significant relationships at a single time scale only.

The number of significant cases in levels and differences declines as the time scale increases. The largest number of significant relationships appears in co-integration relationship between moving averages of two-consecutive-years (S_1) and first differences (D_1) of two consecutive years, where each time scale reveals 15 significant relationships.

Table 4.4 Number of significant cases with VAR/VECM analysis

	Time scales for differences			Time scales for levels			All
	D1	D2	D3	S1	S2	S3	
Number of significant cases	15	7	3	15	8	7	15
Number of non significant cases	20	28	31	20	27	28	20
Total number of cases	35	35	35	35	35	35	35

In some cases, relationships between manufacturing and services do not appear as significant in shorter time scales but appearing as significant in longer time scales. This hints that timescales matter. The conventional treatment of time series data, without decomposing it into different time scales, may not detect some underlying relationships. Sectoral impacts and linkages effects may not be detected in a predetermined time scale as the interactions may work themselves out in a relatively short or long period. Decomposition by time scale helps to capture the time effects of the interactions across various time scales after they have sufficiently worked themselves out. Thus, filtering the outputs at various time scales and investigating the long-term relationships in the corresponding time scales separately becomes useful and the results obtained hint to the usefulness of the method.

Long-term growth of services in some of the countries is positively assist manufacturing, while in some countries services stand in negative relationship with manufacturing. Still in some countries, services do reveal neither positive nor negative relationship significantly. The existence of cases where services do not reveal positive significant relationship, even if they do not show negative relationship either, hints two possibilities: services are related to sectors other than manufacturing or the level of analysis has to go beyond I(0) and I(1) time series to detect significant relationships. In any case, the fact that they do not assist manufacturing positively means that resources have not been directed to activities leading to long-term growth. Considering the importance of manufacturing as central to the long-term growth of low-income economies, the commitment of resources in services that do not assist manufacturing is a lost opportunity. Seen from this perspective, the fifteen cases, among the thirty-five, that reveal no co-integration relationships of services with manufacturing, may be lumped together with those showing negative significant relationship, as both do not assist manufacturing. The number of cases where services stand in non-positive relationship with manufacturing is overwhelmingly large in every time scale. Services, in the long-term, seem to be not helpful to manufacturing in larger number of cases, both in levels and differences (Tables 4 and 5).

Table 4.5 Sign of the VAR/Co-integration Coefficients of Services

	Time scales for differences			Time scales for levels		
	D1	D2	D3	S1	S2	S3
Positive	6	1	2	10	4	7
Negative	4	3	0	5	4	0
Zero coefficients	5	3	1	0	0	0

Table 4.6 Significance across time scales

	Time scales for differences			Time scales for levels		
	D1	D2	D1	D2	D1	D2
All with significant relationship	15	7	3	15	8	7
All with no significant relationship	20	28	32	20	27	28
All with non-positive relationships	29	34	33	25	31	28
Total	35	35	35	35	35	35

The analysis further shows that relationships between services and manufacturing differ from country to country and across time scales. Countries are heterogynous in their structure. Thus, treating countries in the same way, as if they have the same structure, could be misleading.

The number of cases **not** falsifying the hypothesis in VAR analysis of differences differs from that obtained in co-integration analysis of levels. As observed, co-integration analysis detects larger number of cases supporting the hypothesis than VAR analysis does.

Results from VECM analysis

Among the twenty countries, the number of cases **not** falsifying the hypothesis, in VECM analysis, in any one time scale is 13. In another one country, the identified structures support the hypothesis in some time scales while not supporting the hypothesis in other time scales, raising the number of countries providing support to the hypothesis in at least one time scale to 14. One country does not support the hypothesis in all time scales.

Table4.7 Cases for and against the hypothesis in VECM analysis

Cases in VECM analysis	Number of countries
-having No non-supporting cases	13
-having at least one supporting case	14
-having at least one non supporting case	2
-having no supporting case	1

Results from VAR analysis

Among the twenty countries, the number of cases **not** falsifying the hypothesis, in VAR analysis, in any one time scale is 5. In other three countries, the identified structures support the hypothesis in some time scales while not supporting the hypothesis in other time scales, raising the number of countries providing support to the hypothesis in at least one time scale to 8. Five countries do not support the hypothesis in all time scales.

Table4.8 Cases for and against the hypothesis in VAR analysis

Cases in VAR analysis	Number of countries
-having No non-supporting cases	5
-having at least one supporting case	8
-having at least one non supporting case	8
-having no supporting case	3

Overall results in VAR/VECM analysis

Among the twenty countries, the number of cases **not** falsifying the hypothesis, in both VAR and VECM analysis, in any one time scale is 11. The number of cases supporting the hypothesis in at least one time scale is 20, which means no country with significant relationship reveals non supporting case to the hypothesis in the entire time scales.

Table 4.9 The hypothesis in both VAR/VECM analysis

Cases in both VAR/VECM analysis	Number of countries
Number of cases with no non supporting case	11
Number of cases supporting the hypothesis in at least one time scale	20
Number of cases supporting the hypothesis in no time scale	0

The supporting and non-supporting cases vary with time scales. The differences in the number of cases supporting and not supporting the hypothesis across time scales is significant as can be confirmed by contingency table analysis . The probability value of the chi-square, which is 0.00043, indicates that the differences are quite significant. This result further confirms the methodical importance of considering time scales.

Table 4.10 The hypothesis in both VAR/VECM analysis across time scales

Number of cases	Time scales for differences			Time scales for levels		
	D1	D2	D3	S1	S2	S3
Supporting the hypothesis	5	2	2	12	6	5
Not supporting the hypothesis	6	3	0	1	0	1
Neutral cases	24	30	33	22	29	29

Cumulative impulse-responses

Cumulative impulse responses are computed for economies where Granger causal relationships exist between manufacturing and services. The cumulative impulse responses indicate the magnitude and direction of the effect of a unit impulse of service on manufacturing in 42 years time. With the use of cumulative impulse responses, twenty-two among thirty-five countries exhibit at least one significant Granger causal relationship in one or more of the time scales. Among the twenty-two, about two-third of them (i.e., 13) exhibit significant relationship across more than one timescales, while about one-third of the countries(i.e.,8) exhibit significant Granger causal relationships at a single time scale only.

The number of significant cases declines as the time scale increases in differences and levels alike. The largest number of significant relationships appears in differences of two consecutive years (D1) and in moving averages of two-consecutive-years (S1). D1 and S1 reveal almost same number of significant relationships.

Table 4.11 Granger causal relationship across time scales

	Time scales for differences			Time scales for levels			All
	D1	D2	D3	S1	S2	S3	
Number of significant cases	12	7	5	9	6	6	12
Number of non significant cases	23	28	25	24	29	29	23
Total number of cases	35	35	35	35	35	35	35

In the same pattern to the VAR/VECM coefficients method, timescales matter in this method, as relationships that do not appear as significant in shorter time scales can be revealed in longer time scales. The analysis hints that decomposing time series data into different time scales could be important and useful to detect relationships that may not be detected on annual basis. Long-term growth of manufacturing in some of the countries is positively Granger caused by services, in some of them manufacturing is negatively Granger caused. The analyses indicate that similar number of countries has positive and negative Granger causal relationship.

Table 4.12 The sign of cumulative impulse-responses across time scales

Direction of Granger causality	Time scales for differences			Time scales for levels		
	D1	|D2	D3	S1	S2	S3
Negative	5	2	1	3	4	4
Positive	7	5	4	6	2	2

Among the twenty two countries, the number of cases **not** falsifying the hypothesis in any of the relevant time scales is 11. In the seven countries, among the twenty-two, the identified structures do not support the hypothesis in some time scales while supporting the hypothesis in other time scales. Other three countries falsify the hypothesis in all relevant time scales.

Table 4.13 Cases for and against the hypothesis with Impulse-Responses

Cases	Number of countries
-having no non-supporting cases	11
-having at least one supporting case	18
-having at least one non supporting case	11
-having no supporting case	3

The results indicate that not only the impact of services on manufacturing differ across countries and across time scales, but also cases supporting and non-supporting the hypothesis vary with time scales. Cases in levels reveal more supporting cases than non-supporting cases.

Table 4.14 Cases for and against the hypothesis with Impulse-Responses across time scales

Number of cases	Time scales for differences			Time scales for levels		
	D1	D2	D3	S1	S2	S3
Supporting the hypothesis	5	4	4	9	5	3
Not supporting the hypothesis	7	4	1	0	1	3
Neutral case	23	27	30	25	29	29

Chi square value of the contingency table

The differences in the number of cases directly supporting, directly not supporting the hypothesis and those that are taken as neutral because they do not show significant relationship across time scales is significant as can be confirmed by contingency table analysis where the probability value the chi-square test is 0.061.

Comparison of results in VAR/VECM Coefficients and Impulse-Responses

In both the methods of identification of the structure of economies, in terms of the service assisting or retarding manufacturing in the given time span, the results are close to one another, with differences of one and maximum two. The Granger causality and impulse response test indentifies less cases not falsifying the hypothesis and increases the number of countries that do not provide support to the hypothesis in all time scales.

Table: 15 Comparison of results

Cases	Number of countries	
	VAR/VECM method	Granger causality and Impulse-Responses method
-having no non-supporting cases	11	11
-having at least one supporting case	20	18
-having at least one non supporting case	10	11
-having no supporting case	0	3

5 CONCLUSION AND POLICY IMPLICATIONS

The study tested the hypothesis that relates services with manufacturing with a specific claim stating, "Growth of transaction services below the optimal level enhances manufacturing while growth of transaction services above the optimal level hinders manufacturing growth of low income economies". The methods used is identification of the coefficients of fitted VAR/VECM models on the one hand and Granger causality and impulse-responses on the other using Haar MODWT filtered time series data. The sectors included in the analysis are manufacturing, agriculture and services. The Haar wavelet computes the differences between averages and the scaled moving averages of value added across various time scales.

Given the limitation posed by 42 years time span, the results are quite revealing. The analyses indicate that not only the levels, but also the changes matter. Positive VAR/ VECM coefficients or positive Granger causality of manufacturing combined with actual growth of services lead to the attainment of growth in manufacturing, providing strong support to the hypothesis. Negative VAR/ VECM coefficients or negative impulse responses combined with actual growth of services leading to decline in manufacturing, lends support to the hypothesis from another angle. Few cases of negative coefficients or negative Granger causality of manufacturing, coupled with high actual growth in services leading to growth of manufacturing, appeared as cases that do not provide support to the hypothesis. Some cases of positive coefficients or positive Granger causality of services coupled with decline in services leading to growth in manufacturing appeared as additional cases against the hypothesis. With combined use of coefficients and impulse-responses, cases where the results across all time scales do not support the hypothesis are 3 among the first alphabetically ordered 35 countries of the 71 low-income economies in 1970. Those providing support simultaneously across all time scales are 12, while those providing support at least in one time scale are 23.

Countries in which services stand in non positive relationship with manufacturing are 25 and more in all time scales. Considering the importance of manufacturing as central to the long-term growth of low-income economies, many countries have put themselves in unfavorable trajectory by the commitment of resources in services that do not assist manufacturing. Services, in the long-term, seem to be not helpful to manufacturing in larger number of cases, both in levels and differences.

The policy implication of the results is that structure mattes and growth of transaction services has to be examined for being below optimal or above optimal level. Low Income Countries with non positive relation of services with manufacturing have to reconsider the structural limitations to manufacturing growth and sustained growth at large. The expansion of economic activities (growth of GDP) is likely to be more sustainable with growth of output of manufacturing and manufacturing is choked by the prevalent size of services. Low income and under-industrialized countries have to enhance their manufacturing to achieve highly cherished goal of takeoff to sustained growth with redirecting the resources to manufacturing from services.

Particular emphasis goes to the low-income economies, where low level of manufacturing and long-term stagnancy of growth in manufacturing are observed. This state of manufacturing in this group of countries is the result of the structure of the economies where transaction services have out grown manufacturing. The prevailing factors in these economies have given rise to a service dominating structure that has crowded out manufacturing in resource use to the extent that growth in manufacturing and growth in the overall economy has been retarded in the long-run. To reverse this outcome manufacturing growth has to be emphasized and establishing favorable condition towards reducing transaction costs through institutional changes has to be pursued.

As per the theoretical foundation and stylized facts of the study, transaction services dominate services and service growth is driven by the existing institutional environment and social preferences. The services, particularly the transaction services are in place to address the inefficiencies and in proportion to the inefficiencies. The resources committed to services reflect the prevailing inefficiencies. It requires removal of the institutional and social preference environment to reduce the growth of resources committed to transaction services. Identifying and removal of various obstacles on the one hand and installing social technologies requiring less resources to facilitate goods production and exchange should be the direction that low income economies follow.

In economies with less than optimal services, it would be advisable in expanding services to facilitate manufacturing growth. The process of identification of optimal levels of services could be informed with VECM coefficients and impulse response test of wavelet decomposed sectoral value added.

The few cases that happened to be against the hypothesis should attract future researches to detect the exceptional underlying factors or the methodological limitations that led to that result. This study anticipates results in line with the hypothesis with the use of longer time-series data.

This study provides a formal, theoretical and empirical basis, for policymaking or for inspiring further studies addressing the crucial issues of failure to attain sustained growth in manufacturing of LICs. The time series analysis and the introduction of different time scales in detecting the contribution of services to manufacturing growth of low income economies and the structural relations eventually affecting sustained growth provide firm basis to the arguments.

To advance knowledge in this area of research, the reorganization of national accounts data in a way that enables to identify transaction and non-transaction services is important. Future research with the use of longer time series length and wavelet decomposition in longer time scales would enrich our knowledge on the structural importance and sectoral interdependence in low-income economies.

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APPENDIX 4.1: INDEX OF SYMBOLS

α	*Parameter representing share of capital*
β	*Parameter signifying diminishing returns in agriculture*
δ	*Rate of depreciation of capital in manufacturing*
η	*The efficiency of attaining potential output*
θ	*A ratio of labor productivity in subsistence agriculture to that in modern sector*
λ	*Part of saving rate wasted as leakage*
μ	*A parameter of increasing returns and externalities in manufacturing*
ν	*The ratio of effective capital to total capital in manufacturing*
ς	*The minimum labor diverted from agriculture most efficiently or it is the lower limit of* ψ
Σ	*covariance matrix*
φ	*Manufacturing labor diverted to transaction services in agriculture*
ψ	*Agricultural labor diverted to transaction services in agriculture*
ω	*Capital used in transaction services in and for manufacturing*
Ag	*Value added of Agriculture and the associated services*
b_1	*A parameter relating agricultural goods value added with services arising from agriculture*
b_2	*A parameter relating manufactured goods value added with services arising from manufacturing*
c	*The minimum capital required to conduct most efficient transactions in and for manufacturing*
Cn	*Aggregate Consumption*
D_j	*Details*
S_i	*Smooth*
K	*Capital that embodies technology*
K^*	*Critical capital stock*
L	*Labor input in manufacturing*
M	*Value added of manufacturing and the associated services*
M_g	*Goods value added in manufacturing sector*
Q_t	*Information set containing all the relevant information in the universe*
R	*Total labor input available to subsistence agriculture*
$\bar{R}$	*Per capita output in agriculture*
r	*The efficiency in attaining potential output with effective agricultural labor input*
s	*Aggregate saving rate*
Ser	*Service value added*
u	*Exponential parameter of the multiplier of goods value added to include the arising service*
Y	*Total value added of the economy*

APPENDIX 4.2: ACRONYMS AND ABBREVIATIONS

AIC	Akaike Information criterion
CWT	Continuous Wavelet Transform
DWT	Discrete Wavelet Transform
FPE	Final Prediction Error(Criterion)
GDP	Gross Domestic Product
HQIC	Hannan Quinn Information Criteria
IR	Impulse-Response
ISI	Import Substitution Industrialization
LIC	Low Income Countries
MODWT	Maximum Overlap Discrete Wavelet Transform
MSE	Mean Squared Error
PCI	Per - Capita Income
SBIC	Schwartz Bayesian Information Criterion
UN SNA	United Nations System of National Accounts
USD	United States Dollar
UNIDO	United Nations Industrial Development Organization
UNCTAD	United Nations Conference of Trade and Development
VAR	Vector Auto Regressive
VECM	Vector Error Correction Model

APPENDIX 4.3.: VALUE ADDED OF AGRICULTURE, MANUFACTURING, AND SERVICES AT CONSTANT 2005 PRICES IN MILLIONS US DOLLARS IN TEN YEARS INTERVAL (before orthogonalization)(*taken from United Nations Main Aggregates Database*)

COUNTRY	SECTOR	1970	1980	1990	2000	2010
Afghanistan	Agriculture,	4725	5036	1990	1938	2639
	Manufacturing	682	843	1165	592	1248
	Service	848	1059	2545	950	5889
Bangladesh	Agriculture,	5864	5706	7250	9844	13815
	Manufacturing	2257	2729	3511	6567	13530
	Service	8084	9722	15992	26147	47930
Benin	Agriculture,	279	377	704	1198	1667
	Manufacturing	137	144	164	284	373
	Service	653	912	1211	1805	2761
Bhutan	Agriculture,	55	84	143	160	196
	Manufacturing	4	4	22	43	113
	Service	26	38	168	344	928
Bolivia	Agriculture,	398	596	707	947	1228
	Manufacturing	452	724	677	955	1419
	Service	2208	3458	3429	5252	7556
Botswana	Agriculture,	79	174	197	202	234
	Manufacturing	14	84	215	302	452
	Service	235	1092	3583	7122	10426
BurkinaFaso	Agriculture,	439	436	629	1283	2960
	Manufacturing	177	269	351	391	486
	Service	501	889	1167	1828	3868
Burundi	Agriculture,	361	416	574	488	475
	Manufacturing	79	148	252	132	168
	Service	115	171	345	350	934
Cambodia	Agriculture,	1236	590	1053	1510	2480
	Manufacturing	194	93	157	586	1617
	Service	1194	570	851	1726	3983
Cameroon	Agriculture,	928	1803	2099	2647	3953
	Manufacturing	719	1292	2114	2513	2992
	Service	3406	6228	7213	7676	10755
Cape Verde	Agriculture,	47	63	77	97	149
	Manufacturing	12	13	24	41	45
	Service	147	146	272	555	1055
Central African Republic	Agriculture,	317	383	475	668	776
	Manufacturing	55	76	80	80	101
	Service	523	497	518	568	574
Chad	Agriculture,	595	510	537	1002	1641
	Manufacturing	137	94	256	226	410

COUNTRY	SECTOR	1970	1980	1990	2000	2010
Equatorial. Guinea	Agriculture,	78	99	119	182	229
	Manufacturing	1	2	2	4	16
	Service	170	217	260	2352	9877
Ethiopia (F)	Agriculture	2506	2840	2877	4242	7967
	Manufacturing	164	240	313	520	1026
	Service	973	1700	2540	11994	30912
Gambia	Agriculture	114	109	104	152	230
	Manufacturing	12	18	26	31	40
	Service	100	147	266	359	479
Ghana	Agriculture,	2533	2855	2953	4082	6521
	Manufacturing	2008	1672	1830	1372	1942
	Service	1987	2074	3533	7278	14372
Guinea	Agriculture,	209	280	366	548	601
	Manufacturing	54	72	96	150	199
	Service	654	875	1181	1644	2155
Guinea-Bissau	Agriculture,	139	89	186	237	299
	Manufacturing	90	100	98	74	73
	Service	64	176	276	256	282
Haiti	Agriculture,	1026	1193	1294	886	851
	Manufacturing	527	1175	969	376	348
	Service	926	1644	1828	2579	2832
Honduras	Agriculture,	485	635	828	1063	1413
	Manufacturing	385	710	951	1405	2022
	Service	1454	2805	3351	4710	8236
India	Agriculture,	61855	71753	100984	127915	174403
	Manufacturing	15937	23630	48979	86748	188591
	Service	60150	91395	172190	341489	811109
Indonesia	Agriculture,	12513	18190	25682	32049	44993
	Manufacturing	2556	10019	31735	61460	94886
	Service	23372	53408	92771	133409	237405
Iraq	Agriculture,	1326	1541	2391	2658	2730
	Manufacturing	370	1300	1129	1206	1164
	Service	17222	36672	31020	49409	55537
Kenya	Agriculture,	1556	2252	3331	3853	4821
	Manufacturing	354	922	1472	1676	2445
	Service	2915	4823	7618	8641	13417
Lao People's Democratic	Agriculture,	211	303	527	827	1144
	Manufacturing	14	20	46	144	347

	Service	893	692	1375	1636	4719	Republic	Service	186	267	469	886	2354
Comoros	Agriculture	53	84	122	164	211	Lesotho	Agriculture,	112	134	128	137	123
	Manufacturing	5	8	12	15	18		Manufacturing	12	23	65	141	277
	Service	85	135	168	164	205		Service	168	325	535	819	1176
Congo	Agriculture,	126	170	225	203	332	Liberia	Agriculture,	303	451	343	607	561
	Manufacturing	74	93	174	131	342		Manufacturing	33	55	42	27	56
	Service	1268	2388	3986	4554	7033		Service	590	692	216	154	310
D RC	Agriculture,	2636	2754	3598	3347	4140	Madagascar	Agriculture,	754	800	987	1178	1458
	Manufacturing	784	1609	1356	333	460		Manufacturing	462	552	469	580	699
	Service	5054	4383	4942	2060	4544		Service	1544	1733	1963	2405	3136
Djibouti	Agriculture,	11	11	15	19	30	Malawi	Agriculture,	300	457	524	861	1088
	Manufacturing	12	18	17	14	23		Manufacturing	81	140	211	214	372
	Service	303	352	462	521	753		Service	425	877	1082	1277	2381
Egypt	Agriculture,	4482	5796	7963	10931	15231							
	Manufacturing	1906	2841	7036	12954	20761							
	Service	5339	16880	35684	50827	85788							

APPENDIX 4.5: SECTORAL GROWTH IN 40 YEARS

	Countries	Agriculture	Manufacturing	Services
1	Afghanistan	-0.44	0.83	5.94
2	Bangladesh	1.36	4.99	4.93
3	Benin	4.97	1.72	3.23
4	Bhutan	2.56	27.25	34.69
5	Bolivia	2.09	2.14	2.42
6	Botswana	1.96	31.29	43.37
7	Burkina Faso	5.74	1.75	6.72
8	Burundi	0.32	1.13	7.12
9	Cambodia	1.01	7.34	2.34
10	Cameroon	3.26	3.16	2.16
11	Cape Verde	2.17	2.75	6.18
12	Central African Republic	1.45	0.84	0.10
13	Chad	1.76	1.99	4.28
14	Comoros	2.98	2.60	1.41
15	Congo	1.63	3.62	4.55
16	Dem. Rep. of the Congo	0.57	-0.41	-0.10
17	Djibouti	1.73	0.92	1.49
18	Egypt	2.40	9.89	15.07
19	Equatorial Guinea	1.94	15.00	57.10
20	Ethiopia (Former)	2.18	5.26	30.77
21	Gambia	1.02	2.33	3.79
22	Ghana	1.57	-0.03	6.23
23	Guinea	1.88	2.69	2.30
24	Guinea-Bissau	1.15	-0.19	3.41
25	Haiti	-0.17	-0.34	2.06
26	Honduras	1.91	4.25	4.66
27	India	1.82	10.83	12.48
28	Indonesia	2.60	36.12	9.16
29	Iraq	1.06	2.15	2.22
30	Kenya	2.10	5.91	3.60
31	Lao People's Dem.Rep	4.42	23.79	11.66
32	Lesotho	0.10	22.08	6.00
33	Liberia	0.85	0.70	-0.47
34	Madagascar	0.93	0.51	1.03
35	Malawi	2.63	3.59	4.60

APPENDIX4.6: Identified sign of significant relationship between service and manufacturing based on relative magnitude and direction of coefficients in VAR/ VECM fittings

S/N	Country	The time scale at which significant relations are observed and the sign of the relation b/n service and manufacturing						Growth of service	Expected sign of growth of manufacturing						Actual Direction of Growth of Manu
		D1	D2	D3	S1	S2	S3	smoothened	D1	D2	D3	S1	S2	S3	smoothened
1	Afganistan				-	-		0.033				-	-		0.001
2	Bangladesh							0.047							0.051
3	Benin				+	+		0.034				+	+		0.027
4	Bhutan							0.078							0.085
5	Bolivia	-			+	+	+	0.028	-			+	+	+	0.024
6	Botswana				+		+	0.092				+		+	0.074
7	Burkina	-						0.050	-						0.026
8	Burundi							0.048							0.009
9	Cambodia							0.038							0.070
10	Cameroon	-		+		+	+	0.033	-		+		+	+	0.032
11	Cape Verde	-			+		+	0.055	-			+		+	0.040
12	Central Africa	+			-	-		0.000	+			≥0	≥0		0.011
13	Chad	0	-		+			0.034		-		+			0.028
14	Comoros							0.020							0.033
15	Congo	0	0		-			0.003	0	0					0.033
16	Dem Rep Cong		0			-		-0.025							-0.035
17	Djibouti	+	+				+	0.020	+	+				+	0.004
18	Egypt	+						0.065	+						0.065
19	Equatorial Guinea							0.062							0.061
20	Ethiopia	0	-	+				0.053		-	+				0.041
21	Gambia	+						0.040	+						0.038
22	Ghana	+	-					0.055	+	-					-0.003
23	Guinea							0.029							0.035
24	Guinea-Bissau		0		+	+	+	0.034							-0.009

25	Haiti				-	-	+	0.013				-	-	+	-0.025
26	Honduras				+			0.039				+			0.039
27	India	0						0.068							0.062
28	Indonesia							0.061							0.091
29	Iraq							0.048							0.008
30	Kenya							0.037							0.041
31	Lao peoples DR			0				0.058							0.087
32	Lesotho	+			-			0.043	+			-			0.090
33	Liberia	0			+			-0.053				-			-0.019
34	Madagascar				+			0.015				+			0.011
35	Malawi				+			0.032				+			0.028

APPENDIX 4.7: Identified sign of significant relationship between service and manufacturing based on relative magnitude and direction of Cumulative IRF

		The time scale at which significant relations are observed and the sign of the relation b/n service and manufacturing						Growth of service	Expected sign of growth of manufacturing						Actual Direction of Growth of Manu
S/N	Country	D1	D2	D3	S1	S2	S3	smoothened	D1	D2	D3	S1	S2	S3	smoothened
1	Afghanistan					-		0.03					-		0.00
2	Bangladesh							0.05							0.05
3	Benin				+	+		0.03				+	+		0.03
4	Bhutan							0.08							0.09
5	Bolivia	-			+	-	-	0.03	-			+	-	-	0.02
6	Botswana		+		+		-	0.09		+		+		-	0.07
7	Burkina	-						0.05	-						0.03
8	Burundi							0.05							0.01
9	Cambodia							0.04							0.07
10	Cameroon			+			+	0.03			+			+	0.03
11	Capeverde	-		+	+			0.05	-		+	+			0.04

12	Central Africa	+			-	-		0.00	≤0			≥0	≥0		0.01
13	Chad		+	-				0.03		+	-				0.03
14	Comoros							0.02							0.03
15	Congo	+	+		-			0.00	≤0	≤0		≥0			0.03
16	Dem Rep Cong		-					-0.03		+					-0.04
17	Djibouti	+	+				-	0.02	+	+				-	0.00
18	Egypt	+						0.07	+						0.07
19	Equatorial Guinea							0.06							0.06
20	Ethiopia	-	-	+				0.05	-	-	+				0.04
21	Gambia	+						0.04	+						0.04
22	Ghana	+	+					0.06	+	+					0.00
23	Guinea							0.03							0.03
24	Guinea-Bissau		-		+	+	+	0.03		-		+	+	+	0.01*
25	Haiti				-	-	-	0.01				-	-	-	-0.03
26	Honduras							0.04							0.04
27	India	-						0.07	-						0.06
28	Indonesia							0.06							0.09
29	Iraq							0.05							0.01
30	Kenya							0.04							0.04
31	Lao peoples DR			+				0.06			+				0.09
32	Lesotho	+						0.04	+						0.09
33	Liberia							-0.05							-0.02
34	Madagascar				+			0.01				+			0.01
35	Malawi							0.03							0.03