THE CONTRIBUTION OF THE CONSTRUCTION INDUSTRY TO ECONOMIC DEVELOPMENT IN LIBYA

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A thesis submitted in fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

October 2013

ABSTRACT

It is widely recognised that the construction industry has a positive role to accelerate the wheel of economic growth in any country. This research is concerned with the Libyan construction industry (LCI). Libya is a developing country which suffered from a big loss in its infrastructures and its unemployment rate increased to 30% in the middle of 2013. Regarding the importance of the construction industry through the role it has in providing infrastructure and creating employment and the poor economic condition of Libya, the rationale of this research follows the example of other nations such as Turkey, Singapore, Malaysia , and Middle East countries where the construction industry was evolved with a target to further boost up the process of economic development. The case of Libya in this regard is valid for the financial stability in the country given its oil reserves and the capacity of the country to absorb migrated skilled labour. This situation is expected to follow the fall of Gaddafi's regime. The approach of selecting construction as providing input to economic growth follows the strong evidence of the significant role that the construction industry plays in economic growth of the country. The construction industry contributes to economic growth from the demand side and in the traditional Keynesian economy, sustainable short-run economic growth is dependent on the increased demand. For example, in the UK, construction's 2.5% growth in the third quarter of 2013 helped the overall economy grow by 0.8% over the same period. In comparison with the other industries that contribute to the economic growth of developing countries, the construction industry is more labour-intensive while the developing countries are mostly labour-abundant. The main aim of this research is to investigate the

contribution of the construction industry to economic development in order to establish a comprehensive list of recommendations and a guideline for achieving an efficient construction industry to accelerate the process of economic growth. For this aim, the first objective is to examine the causal relationship between the construction industry and gross domestic product (GDP) as a measure of the economic growth and between the construction industry and other economic sectors. To achieve the aim of this research, Granger causality tests have been conducted. The financial data about the expenditure on the construction industry in Libya and its share in the GDP of the country and the share of the other economic sectors in the GDP during 1986-2009 was provided by an authority from the Libyan construction industry. First, The Augmented Dickey Fuller (ADF) and the Philip Perron (PP) unit root tests were conducted to confirm that the tested time series are stationary. After that, to determine the existence of the long-run causal relationship between the CI and GDP, Engle-Granger co-integration test was used and, finally, vector error correction (VER) model was employed to detect the direction of the causal relationship between the two variables. The study found that in Libya, like in other countries, the relationship between the construction industry and GDP is bi-directional: GDP produces a short-term impact on the investment in the construction industry while investment in the construction industry produces a long-term impact on GDP. However, except for trade, no economic sector was found to have a causal relationship with the construction industry. According to these findings, another objective was established in this research: to identify safety and total quality management (TQM) which can play an important role in growing the efficiency of the Libyan construction industry. To achieve this objective,

telephone conversations were conducted with the officials of the largest construction company in the city of Benghazi. The findings indicated that the TQM does not exist in the construction company and, although the safety department does exist, it works via strict procedures. Thus, opportunity to increase the performance of the CI in order to increase its contribution to economic growth does exist through implementation of the safety and TQM implementation in Licccbyan construction companies.

The previous studies used the causal relationship just to prove specific hypotheses. The novelty of this research is to obtain benefits from the existence of the causal relationship from the CI to GDP in the long term through suggesting major issues as safety and TQM implementation to raise the performance of the CI in the current period in order to increase its contribution to the economic growth in the future.

Contribution to knowledge

This study is an attempt to investigate the role of the Libyan construction industry in the country's economic development by using the causal relationship between the construction industry and the economic variables; therefore, this study will be the first empirical study to use the causal relationship to demonstrate the role of the construction industry in the Libyan economy. Also, it will provide new information to the Libyan decision makers regarding the strategic role of the construction sector, shape fundamental changes, help in developing the processes, procedures and operations by employing TQM in all economic sectors in Libya, and it can be of interest to professionals involved in the construction economies of other such developing nations.

DEDICATION

To my father's soul

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study. First and foremost I offer my gratitude especially to my first supervisor, Dr. Yassine Malaine, who, unfortunately, left the world very early. I pray peace for his soul and thank him greatly for all his contribution to my research. Special thanks for my supervisor, Professor Ahmed Al-Shamma'a who took care of my dissertation and taught me the skills of research. His critical comments on the work made it possible for me to conduct the research at the best level. Thanks also go to Mrs Liz Hoare, Research Administrator, who supported me with her useful advice. Also I would like to thank my special friends, Thamina, for her untiring effort in encouraging me, and Ragaa for her assistance, my university for its supervision, my family for their understanding and endless love, and my government for sponsoring my research. I cannot forget their contribution in the accomplishment of the research and, therefore, I wish to attribute credit to them for this feat.

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Introduction

1.1 Introduction

The construction industry plays an important role in the national economy and economic development of any country. The importance of the construction industry is due to the role it has in the economy, but that role varies greatly from one nation to another. In developing countries, the construction industry is a vital sector providing mainly new infrastructure in the form of roads, railways, airports as well as new hospitals, schools, housing and other buildings (Khan, 2008). In developed countries the emphasis is on professional services and on maintenance and repair construction (Ruddock, 2009, Bon and Bietroforte, 1999). The main purpose of this study is to draw attention to the contribution of the construction industry in Libya by investigating its relationships with gross domestic product and with other sectors, whereas the construction industry stimulates the growth of other sectors through a complex system of linkages which are defined in backward and forward directions. Any changes in the construction industry affect other sectors through its linkages (Xing, 2005). Therefore, better linkages with other sectors provide a more rapid growth in the economy, as well as providing the opportunity to foresee bottlenecks and take action in time to prevent them from emerging (Yu Song, Liu, 2006). The Libyan construction industry is already having difficult in coping with the rapid growth in modern forms of construction.

However, poor infrastructure besides unemployment is the main problem in the Libyan economy. Therefore, the search for a solution to the construction problems should focus on new suggestions which can be carried out in the construction industry companies for improving and developing its performance, thereby increasing the industry's contribution to economic growth.

1.2 An Overview of the Libyan Construction Industry

The Libyan construction industry has been considerably expanded since the early 1970s (Mkras, 2004). In 1975, the government began to recognise the importance of the construction industry and made some significant efforts to make it more efficient. At that time, there were about 2000 contractors, many of them functioning on the basis of proprietorships and partnerships. Then, the contracting firms were merged into a smaller number of larger firms capable of carrying out large construction projects such as building factories and civil engineering projects. In the late 1970s, the industrial sector was planned by the government, and one of the world's largest civil engineering water projects (the Great Man Made River) was planned, designed and constructed during the last two decades. In the 1980s, the construction industry was seriously hampered by several problems such as the elimination of local private construction companies and their incorporation into the public sector, and the decrease in the number of foreign workers, besides the huge decline in oil revenues. Therefore, the construction projects which were implemented by the government in the 1970s and 1980s did not succeed in raising the productive efficiency of other sectors of Libya's economy such as agriculture, industry and tourism (Ngab, 2007).

In the 1990s, the economy was in decline as a result of the sanctions and embargoes placed on Libya by the United Nations (UN). In 2000, with the lifting of sanctions, the Libyan government announced its plans to attract foreign investment, especially in power generation, water projects, and the oil and gas industry, and to use the oil revenues to finance the development projects (Biltayib, 2006). In addition, Libya's major goals are to reduce unemployment and to develop all cities through construction projects such as hotels, business centres, airports, roadways, ports and all kind of infrastructure-superstructure.

1.3 Economic Development in Libya

The situation regarding Libyan economic development could be outlined in the following stages:

Stage 1: Pre-Gaddafi Period (1951-1969)

- Libya was in desperate economic conditions, due to the absence of a developed agricultural system, and its hydrocarbon wealth was not known to the world.

- After the oil fields were developed in 1962, the economy was transformed from a primitive economy into an oil-based economy.

Stage 2: The Gaddafi Period (1969-2011)

- At the start of Gaddafi's rule, Libya was very enthusiastic about economic development. The revenues of oil sales were used in constructing the country's infrastructure.

- In 1992, Libya witnessed a period of recession as a result of the UN sanctions, decreasing oil prices and the poor management of the public sector.

- After the UN sanctions were lifted in 2003, coupled with oil prices increases, some improvements were noticed in the Libyan economy.

- However, Gaddafi's lack of concern for the population in general and his poor economic decisions led to deterioration in the economic condition of the country such as increasing unemployment and delays in the infrastructure projects.

Stage 3: Post-Gaddafi Challenges (2011-)

Today, Libya faces a tough road ahead in its political transition and reconstruction. So the challenges will be:

- Building a new political system that consists of institutions of civil society.
- Restoration of its oil-exporting sector to generate funds for rebuilding its infrastructure and economy.
- Ensuring that jobs are created**.**

1.4 Key Factors of the Construction Industry

The construction industry of a country is one of those industries that are involved in supply of public goods. Construction of infrastructure is the only job of a firm involved in the construction industry but the complexity of this job and the numerous factors affecting the development of process cannot be neglected. Fox and Skitmore (2002) identified six factors that can be drivers or barriers in the development of the construction industry of a country. The factors include policies and visions of the industry and its

long-term effectiveness, availability of resources (both tangible and institutional), best culture in practice, thoughts, and behaviours, availability of financial and human capital, technological advancements to improve production performance, and culture of learning and development.

1.5 Aim and Objectives of the Research

The current situation of inefficiency in the Libyan construction industry requires the use of an effective policy for improving its role to accelerate economic development. Therefore, this study aims to investigate the contribution of the Libyan construction industry to the country's economic development over the last two decades. To achieve this aim, the following objectives are formulated:

1- To investigate the causal relationship between the construction industry and economic development through economic theories and empirical studies.

2- To investigate the nature and direction of the causal relationship between the construction industry and the gross domestic product (as a measure of economic growth).

3- To analyse the causal relationships between the construction industry and other economic sectors.

4- To identify a safety and total quality management approach that can play an important role in growing the efficiency of the Libyan construction industry.

5- To propose recommendations for policy makers and future research based on the findings.

6- To propose a guideline for the new government to development the construction industry in Libya.

1.6 Research Methodology

An econometric analysis has been conducted in this study to see the causal relationship between the construction industry (CI) and the aggregate economy (GDP) and between the construction industry and all other economic sectors of Libya, using time series annual data (1986 to 2009). This suggests that the process to achieve the objectives involves time series analysis. Given this realisation, an appropriate time series model must be chosen. The relationship between time series variables can be determined in numerous ways to obtain the association and direction of cause and effect relationships between the variables in the short-term as well as in the long-term.

The mode chosen was presented initially by Granger (1969) and then developed by Engle and Yoo (1987) to determine the co-integration and causality relationships between economic variables. This model is a statistical hypothesis test for determining whether one time series is useful in forecasting another. More complex extensions to nonlinear cases exist; however the extensions are often more difficult to apply in practice (Chen et al, 2006). Therefore, this model is chosen because, mostly, a regression is the simplest method to determine the relationship between a dependent time series variable and one or more independent time series; it provides an estimation of the long-term causal relationship between economic activities, minimising the error that is between estimated and actual values. In addition, most economic studies achieved understandable results by using this model when investigating the causal relationship between economic variables.

When time series data are used for analysis in econometrics, several statistical tests must be undertaken. If the time series data that are used in a statistical test are not stationary,

that is if they contain a unit root, then the relationship obtained through regression might be spurious. To avoid this problem, in this research, each time series is individually tested to become stationary at first differences or second differences through Augmented Dickey Fuller (ADF) and Phillip Perron (PP) test. After confirmation that all data are stationary, the series is used to find out the long-run relationship, as a non-stationary series, even if not related in the short run, may be related in the long run to the other series. By short run or long run, it is meant that for annual time series, the complete effect of independent variables on the dependent variable can occur within one year or in more than one year respectively. Engle-Granger co-integration test is used to determine the existence of the long-run causal relationship among the variables. Once it is confirmed that the dependent variable is affected by the independent variables in the long run, the direction of the causal relationship between the variables in the short and long run has been detected by applying a vector error correction model (VEC). However, the pairwise Granger causality test is used to determine the causal relationship between the construction industry and the other economic sectors in the short run for investigating the linkages between these variables to discover the bottlenecks affecting growth in the Libyan economy.

The methodology of this study will be presented in detail in Chapter four.

1.7 Limitations of the Research

This study suffers from a number of two limitations. The first limitation was the shortage of data and information regarding the Libyan construction industry and other economic variables: as this study was limited to the data available through the period from 1986 to

2009 a problem was presented in getting data for the recent years. The second limitation was faced when the researcher decided to analyse the backward and forward linkages between the construction industry and other economic sectors by using an Input-Output model which is a method of systematically quantifying the mutual interrelationships among the various sectors of an economic system. The coefficients of an input-output table describe in quantitative terms the relationship between the inputs it absorbs and the output it produces. In the input-output table the interdependence among the sectors of a given economy is described by a set of linear equations expressing the balances between the total input and the aggregate output of each commodity and service produced and used in a period of time. Until recently, Libya has not issued these tables to present the interdependence between its economic components. As a result, instead of using these tables, the researcher conducted an econometric method called the Granger causal test for examining the output linkages between the construction industry and other economic sectors. The study overcame these limitations through reviewing the information and literature on the construction industry and economy of Libya.

1.8 Justifications for this Research

The general consensus among economists and scholars is that an enhanced construction industry leads to positive economic growth. So, the need for this study can be attributed to a number of justifications such as:

- No previous studies have been carried out to analyse the total impact of the construction industry on the Libyan economy.

- The importance of causal relationships between the construction industry and economic growth in policy terms particularly when the aim is to achieve economic growth (Anaman, 2007). This study is an attempt to obtain a benefit from the existence of the causal relationship between CI and GDP to suggest effective policies for improving the construction performance, which could lead to economic growth.
- Literature available is mainly focused on developed countries (Ruddock and Lopes, 2006). Due to the requirement of extensive human and financial capital and the dependency on technological advancements, development of the construction industry is considered as a subject for the developed countries. It is often understood as an outcome of development rather than the factor behind development. This study explores the channels through which the construction industry affects the development process of a developing country.

1.9 Thesis Structure

The structure of the thesis is as follows:

Chapter one provides an introduction to the research topic.

Chapter two discusses the concepts of economic growth and development and a literature review on the theories of economic growth and development and the economic strategies in developing countries is undertaken. Additionally, the chapter explores the characteristics of the construction industry, discusses the role of construction in developing countries, and explains the relationships between the construction industry and economic development with a focus on the causality relationships.

Chapter three reviews the economic and political systems in Libya through the period before, during and after Gaddafi's regime. This chapter also provides the main political and economic issues in Libya during the period from 1951 to 2011. These issues presented are discovering oil in 1962, starting the Gaddafi regime in 1969, adopting Gaddafi's theory of Marxism-driven socialist development, Libya facing a difficult time in the 1980s due to restricted economic policies that Gaddafi had adopted, and the deteriorating economic conditions from 1992 to 2003 due to the UN sanctions. Finally, this chapter reviews the main challenges facing the new government in Libya.

Chapter four describes the methodology used in this study. Firstly, it defines the construction industry in Libya, then presents its evolution and reviews its position in the Libyan economy and provides a brief overview about employment in the Libyan construction industry. Secondly, as in gaps in the literature that have been found and the objectives of the thesis, the methodology will seek to analyse the causality relationships between the construction industry (CI) and Gross Domestic Product (GDP) and between the CI and other economic sectors by applying an econometric model called Granger causality test.

Chapter five presents the results of the data analysis and discusses these results and reviews a selected approach called Safety and Total Quality Management that could be used in Libya to contribute to improving the quality of its construction industry.

Chapter six is a concluding chapter which summarises the issues raised by the application of the methodology and suggests policies that need to be applied in the future to help the construction industry to contribute to economic development in Libya; this will be done

through providing a set of recommendations for government or policy makers. Finally, the chapter presents the areas in which future work may be pursued.

Chapter Two
Economic Development and the Construction Industry: A Theoretical Dimension

2.1 Introduction

Economic growth and development has been a subject of great interest for many years. The contributions of early economists highlighted grave concerns about the wealth of nations and the relevant roles of various factors leading to economic growth[1]. However, during the second half of the 20th century, governments and policy makers in several developing countries directed their efforts to eliminating the obstacles to growth and development.

The generally unsuccessful path many African, Asian and Latin American countries have taken in terms of economic growth and development during the last fifty years or so has been related to a set of economic, social and political variables prevailing in these countries. Among them we can list cloudy policy-making environments, poor education and distressing health conditions, poor technological attainments, corruption and income inequality.

This chapter will review the literature on theories of economic growth and development, economic development strategies currently in practice in developing

[1] For instance, Smith's Wealth of Nations (1776) and Ricardo's Principles (1817) paid special attention to specialisation in production and international trade, respectively, as important variables to promote economic growth and thus wealth. For a comprehensive treatment of the classical growth theories including Smith's and Ricardo's, see Eltis (1984).

countries, and the relationship between the Construction Industry and Economic Development through economic theories and empirical studies.

Part one

2.2 Conceptual Discussion of Growth and Development

Researchers have tended to use economic development and economic growth without distinguishing one from the other. Flammang (1979) argued that both constructs are different processes that compete in the short run but are complementary in the long run. Researchers such as Malizia and Fesser (1999) and Todaro (2013) explained that, on one side, economic growth has a short-term orientation that aims at quantitative changes in the economy like increases in production or job creation. On the other side, economic development has a long-term orientation that aims at qualitative changes in the society in general such as improvements in the quality of life.

Economic growth is defined as increases in the size of an economy over a period of time (Allen and Thomas, 2013). It is a quantitative change that implies a rise in capacity to supply goods and services to the population in general (Kuznets, 2012). Researchers who have studied the relationship between economic growth and new firm formation at the regional level of analysis have considered economic growth as changes in employment (Audretsch and Fritsch, 2010; Van Stel, 2012; U.S. Department of Commerce, 2013). In the context of a growing economy, this process of development involves a reduction in poverty levels, inequality among the population, and unemployment (Todaro, 2013). As a result, the process of economic development is considered now as an increase in the living standards of the population that leads to prosperity.

To reconcile these measurement differences, this thesis considers that economic growth involves quantitative changes while economic development involves qualitative changes. Such distinctions take into account empirical research conducted at various levels of analysis (e.g. Audretsch and Fritsch, 2010; and Van Stel *et al*., 2012). On one hand, this thesis considers economic growth as changes in employment. In that respect, the economic sectors in the country are increasing their labour force due to improvements in existing capacity and productivity. Following Allen and Thomas (2013), the size of the economy is growing because new resources (e.g. labour) are being added. A change in employment is a quantitative change because it is not possible to determine if the jobs created require specific skills, pay a certain level of wages, or belong to a particular industry. On the other hand, this thesis considers economic development as changes in the production level. Particularly, due to the unit of analysis, economic development is measured by changes in Gross Domestic Product (GDP) at a country level. Changes in GDP represent improvements in the country's productivity that can be translated into expanding opportunities for the operating units (e.g. higher levels of revenues that can be reinvested), better job conditions (e.g. higher levels of wages for employees), or even better living standards for the population. Moreover, changes in the GDP can also imply that operating units are involved in value-added activities that improve their products and/or services (Porter, 2013). As a result, changes in GDP imply qualitative changes in the country. In sum, the distinction between qualitative and quantitative changes is the main consideration when explaining the economic development and growth of a country.

2.3 Growth and Development Theories

This section discusses the existing theories of growth and development. The purpose of discussing these theories is to identify which theories provide a theoretical framework of this research so that the findings of this research are discussed in accordance with these theories. The literature presents multiple and competing theories of economic development and growth. The 1940s and 1950s are famous in the field of economic development for having witnessed the appearance of important contributions by many authors. Among them are the pioneering idea by Rosenstein-Rodan (1943), who emphasises the role of complementarily in the industrialisation process, and the relevant contributions by Nurkse (1952) on 'vicious-virtuous' circles, upon which the formation of capital in underdeveloped areas is subjected. Hirschman's (1958) contribution on economic growth fostered by industry linkages is a key in any account of the process of development theory advances in this phase. This process has been referred to as the gale of creative destruction where old firms are replaced by lots of innovating entrepreneurs and the economy develops due to these new combinations (Schumpeter, 1934). Grossman and Helpman (1994) emphasised that the firms are created by innovative entrepreneurs. The establishment of new firms in a cluster is advised by the balanced-growth proponents, who point to the relevance of linkages escaping from the deadlock. People working with more and better tools in a number of these industries will actually be better off because of the establishment of industry, which is characterised by businesses and industries that sell and buy their products with substantial linkages (Schaffer *et al.*, 2004).

2.3.1 Schumpeter's Theory of Economic Development

Schumpeter (1934) started with the description of the circular flow where no economic development is attained. The circular flow comprises exchanges of goods between producers and consumers in perfect equilibrium. With the economic perspective of perfect competition, sellers earn no economic profits and no economic development occurs in the circular flow. However, growth may still occur due to population growth.

The process of economic development starts with the disruption of the circular flow as new combinations are introduced into the economy. Schumpeter (1934) explained that the new combinations are "the introduction of a new good, the introduction of a new method of production, the opening of a new market, the conquest of a new source of supply of raw materials, of half-manufactured goods, and the carrying out of the new organisation of any industry." Schumpeter identifies as entrepreneurs "those individuals who carry out the new combinations and innovate in the market." These new combinations replace old ones, but contain elements drawn from the existing combinations. The new combinations appear in a large numbers of firms and are "embodied, as it were, in new firms which generally do not arise out of the old ones but start producing beside them" .This implies that new firms start to compete with old firms, which may gradually start to mature and disappear. This process has been referred as the gale of creative destruction where old firms are replaced by swarms of innovating entrepreneurs.

Schumpeter notes that entrepreneurs can access the means of production by obtaining purchasing power from credit in order to carry out the new combinations. Capitalists and bankers, then, function as providers of purchasing power. The process follows

this sequence: a) credit provides the purchasing power to facilitate the new combinations; b) capitalists provide the credit that enables entrepreneurs to access the market; c) credit is converted into capital when entrepreneurs take control for acquiring the means needed to produce and market the new combinations. Because the selling of new combinations produces a surplus over their production costs, the result is the entrepreneurial profit that causes economic development.

The inflows of money obtained from the new combinations also serve as capital that the entrepreneurs accumulate for making the cycle of production again. The accumulation of wealth repays the credit to the capitalists and the aspect of interest is considered as "the premium paid over future purchasing power" (Schumpeter, 1934). Moreover, the interest taxes the entrepreneurial profits because the capitalists are the risk bearers for lending the money to produce the new combinations.

Schumpeter concludes his theory with the description of the business cycle. As the equilibrium of the circular flow is disrupted by the entry of new firms, there is a boom and an expansion into a region because (1) the entrepreneurial profits develop the economy and (2) there is an increase in purchasing power due to the access to credit. The economy can also experience contractions, as credit is repaid and imitators erode the entrepreneurial profits of the pioneers. The new combinations become established and incorporated into the circular flow to attain equilibrium in the market. However, this new equilibrium is attained at a higher level because the entrepreneurial profit remains in the economy. In other words, the society evolved and the economy was developed due to the new combinations. A new process of development may occur when the process of introducing new combinations starts again. The capital that was taken out of circulation when the entrepreneurs repaid the credit becomes available to new generations of entrepreneurs who once again disrupt the circular flow.

In sum, Schumpeter describes economic development and its process as a product of discontinuities to the circular flow. Society advances and evolves when the new combinations disrupt the circular flow. Innovating activities cause the decay and disappearance of mature industries. As a result, the production capabilities of a country can be changed, altered, and improved by the innovating activities.

2.3.2 Central Place Theory

Christaller (1935) established that there are distinct hierarchies of central places, which are spatially related. Central place theory is concerned with the spatial arrangement of activities that serve the consuming population in surrounding market areas (Noyelle and Stanback, 1984). Christaller (1935) assumed that the hierarchic system of central places is homogeneous and the spatial structure is determined on purely economic factors that lead to spatial differentiation (Von Boventer, 1969). Noyelle and Stanback (1984:29) established that "Activities that require small markets will locate in numerous small central places; those that require larger markets will locate in a smaller number of larger central places at greater distances from one to another." This implies that there are differences in the economic development of higher and lower order central places. Palm (1981) implied that the theory explains why smaller cities will have limited services like gas stations or taverns while more specialised services can be found in metropolitan areas (Chrisman, 1985).

Losch (1940) developed a competing model that starts with an easy form. He builds a system of cities from the lowest-order centre places upward to higher order central places. By doing these progressions around a central place of higher order, his economic landscape is divided into poor and rich sectors where, except for the metropolis, no sector is able to offer all goods and services. Palm (1981) explains that

Losch's model can serve to explain the effects of manufacturing activities while Christaller's approach is more applicable to retail and service activities.

2.3.3 Theories of Agglomeration

A starting point for the various theories of agglomeration is the work of Marshall (1890) about the concept of economic externalities. Economic externalities occur when the actions of particular economic sectors affect other sectors in a country. For example, the opening of a new manufacturing sector brings externalities to an economy as new jobs are created, suppliers are needed, and the overall production of the economy is increased. The theory of agglomeration stresses that economies benefit from the favourable effects that are produced by the externalities like skill and availability of labour, access to markets, shared technological knowledge, supplier availability, etc. (Marshall, 1890). Marshall's work has been influential in theories like clusters (Porter, 2012), endogenous growth (Romer, 1994; Lucas, 1988), and economic geography (Krugman, 1991), all of which are discussed below.

Endogenous Growth Theory: Romer (1994) and Lucas (1988) addressed the shortcomings of the neoclassical model of growth by considering the effects of technology and investments in human capital (Todaro, 2000). This implies that technology and human capital are endogenous elements that produce economic growth in a country. Romer (1994) viewed his model as "An equilibrium model of endogenous technological change in which long-run growth is driven primarily by the accumulation of knowledge by forward-looking, profit-maximising agents." He focuses on knowledge as a basic form of capital and departs from Solow (1956). The assumption concerning knowledge is based on Arrow's (1962) idea that knowledge is acquired with investment and production. The investments that firms make in

knowledge create natural externalities as it spillover to other economic actors within and between industries in a country. Because of the investments in knowledge, Romer assumes that the production of goods is a function of the stock of knowledge that generates increasing returns. However, the production of knowledge is assumed to exhibit decreasing returns to balance the model because consumption and utility cannot grow faster. Lucas (1988) relied on Uzawa (1965) to state that economic externalities reside in human capital. In that respect, Lucas (1988) follows Jacobs' (1969) view about the role that cities have on generating opportunities for people to interact and generate growth.

This follows Arrow's (1962) observation that private sectors rather than public sectors contribute more to technological advances. In addition, there is a second fact concerning the existence of monopoly rents for exploiting new discoveries in the market. The monopoly rents are later destroyed when other entrepreneurs start to copy and imitate the innovator (Grossman and Helpman, 1994). Romer (1994) indicated that because endogenous growth theory involves these two facts (technologic advances and monopoly rents) it resembles the work of Schumpeter (1934). Thus, the development process of an economy starts from innovations that spillover into the market to allow the entry of imitators who can also foster the introduction of more innovations that benefit society (Grossman and Helpman, 1994).

Clusters* and *Competitive Advantage: Porter (2012) argued that nations can develop their economies by concentrating on nurturing specific clusters of manufacturing and service activities. The competitive advantage of nations comes from factors of production, demand conditions, supporting and related industries, and firm context. These are important determinants for cluster formation.

Poter (2012) further argued that the innovation and competition resulted from knowledge spillover effects can stimulate growth in a region where the innovation is concentrated. Old firms and new firms, both initiate technological advancemans due to the increased competition. Thus, economic development is attained when the innovation of some firms forces the rest of the firms in the cluster to be more competitive.

Porter (2013) explained that clusters include a wide variety of linked industries and other institutions that provide opportunities for new firm formation. According to Porter (2012), the establishment of new firms in the cluster is possible as knowledge spillover from the technological advancements and local competition opens the opportunity to entrepreneurs. In that matter, the cluster creates an entrepreneurial climate to foster new firm formation.

***Economic Geography*:** Using central place theory as one of his foundations, Krugman (1991) developed the theory of economic geography, the location of factors of production in space, to emphasise the role of local industries in the economic development. He developed a simple model where a region can be divided into an industrialised core and an agricultural periphery. Krugman assumes that agricultural production has constant returns to scale and an intensive use of immobile land. Then, he assumes that manufacturing firms tend to locate in areas with large demand to realise increasing economies of scale and minimise transportation costs. Economic development is generated when the knowledge spillover that occurs within the industries in the core sector increases the overall output. The local manufacturers will attract other firms to produce a variety of goods that consequently increases overall employment. As a result, manufacturers will want to locate where other manufacturing firms are currently operating (Krugman, 1998).

Fujita and Krugman (2004) argued that the model can explain why certain locations are more developed than others. The concentration of industries and the availability of skilled labour that can transfer knowledge among firms can provide more opportunities for expansion to generate economic development in the long run.

The theories in sections 2.3.1 to 2.3.3 provide the theoretical framework of the current research. However, there are numerous other theories that are not included in the theoretical framework. Following is an assessment of the excluded theories.

2.4 Other Economic Theories of Growth

Harrod (1939) emphasised the need for economies to save and invest a portion of their output to generate growth. However, his model is not balanced because it does not consider technological change and assumes constant returns in productivity (Solow, 1956; Todaro, 2000). Stern (1991) argued that these shortcomings imply that the rate of economic growth in the long run is determined only by the growth of the population.

Solow (1956) extended the Harrod model by adding labour and technology to the growth equation and allowing substitutions of labour for capital in production. Solow considers the rate of savings and population growth as exogenous factors that determine a steady level of income per capita. Furthermore, he estimates that regions become richer due to higher savings rates or become poorer due to higher population growth rates.

Technical progress is considered as the residual factor explaining long-term growth and is assumed exogenous. The theory implies that output growth is the result of one or more of these factors: technological improvements, investment through saving to

increase capital, and education and population growth resulting in increased quality and quantity of labour. However, the current research excludes Solow's model from the theoretical framework due to the following shortcomings:

First, by considering technological progress as exogenous, it is not possible to analyse the determinants of technology improvements because it is independent of the decisions taken by economic agents. Second, the theory cannot explain large differences in residuals across countries with similar technologies. Third, the theory cannot provide an explanation for the pace of historical growth in economies around the world. This is called the Solow residual as the theory leaves unexplained 50% of historical growth in the industrialised countries (Todaro, 2000).

2.5 Definition of Developing Countries

The World Bank (2012) classifies countries into one of four groupings on the basis of Gross National Income (GNI) per capita, as follows:

- Low income: $1,025 or less
- Lower middle income: $1,026 to $4,035
- Upper middle income: $4,036 to $12,475
- High income: $12,476 or more

Low and middle-income economies are sometimes referred to as developing economies. The term is used for convenience; it is not intended to imply that all economies in the group are experiencing similar development or that other economies have reached a preferred or final stage of development. However, classification of countries by income does not necessarily reflect development status; for example, in Libya, which although it has a high rate of income per capita, is considered to be a

developing country. Despite the obvious diversity of countries and classification schemes, however, most third-world nations share a common set of characteristics that represent their overall level of development. The literacy level is low compared with that in developed nations. Much of the sparse education provided is ill-suited and often irrelevant to the needs of the developing nations. This situation is closely related to the skill level, not only of the labour force, but also of the management personnel in the construction industry in developing countries (Wells, 2006).

2.6 Economic Development Strategies in Practice

This part of the thesis offers a summary of growth and development models and strategies currently in use by developing countries. It goes through the task of constructing a general outline to serve as a solid base to guide practices aimed at helping the developing world to get away from the obstacles to development. It will be conjectured that a sound route can be envisioned via the use of practical guides coming from different theoretical branches. Specifically, the advances of the new growth-development theory in the nineties and the recognition of the important role attached to the new literature on the political economy of developing countries have made it possible to search for alternative ways towards economic growth and development in undeveloped areas. The theories discussed in this section relate to the current research due to their focus on technological advancement and industrialisation in the process of economic development of developing countries. The current research also seeks for such a model with the difference that development of the construction industry is taken as an input to growth rather than as an output of growth.

2.6.1 The New Growth Theory and the Resurgence of Development Theory

New growth theory has two basic branches, which are included here for their importance as regards developing countries, for policy formation. The first refers to models featuring technological advances that endogenously generate externality effects. Here the production function presents rising profits to scale due to the occurrence of spillover effects coming from different sources. The second is related to models that use the AK-technology, where permanent profits to scale, due to the accretion of all kinds of capital - physical, human and knowledge - are present. [2] "Beyond these new models there are at least two extensions that deserve mention, mainly if economic policy is concerned: *Growth-cum-government* as in (Barro, 1990). These models will be summarised and policy implication derived.

Regarding the first branch of the new growth theory, the works of Romer (1986) and Lucas (1988) are the most important to highlight the relevance of human capital, education and knowledge. The second branch is renowned as the AK-technology frame. Rebelo's (1991) model is an instance of AK-technology.

(i) Skills-Learning-Knowledge Spillovers: The Romer-Lucas Model

Romer (1986) considered the generic production function for a firm in the economy, where output for this firm is a function of its physical capital and intensive labour.

The cost effectiveness of the long-run per capita growth rate of consumption depends on the difference between the marginal productivity of capital and the discount rate, since the international parameter is less than one but positive. Therefore, this model

[2] Other models of the new growth theory are endogenous population growth models and endogenous frontier technology creation models, the former being relatively less relevant in the new growth literature, the latter of reduced relevance to developing countries.

predicts continued long-run growth for a given country depending on how productive technology is.

(ii) Policy Implication from the Romer-Lucas Model

As far as external economies are concerned, the public good character of knowledge and its impact on learning and skills is crucial to let one person's investment in new knowledge benefits all agents in the economy. As Easterly (1998: 12) states:

> ″If investment in physical capital creates new knowledge (Romer 1986, 1987), then there will be spillover from each agent's investments, to knowledge useful for all the other agents in the economy. Economies that already have high capital will have the highest returns for new investment... (Also) formal and informal interactions between individuals impart knowledge. Then there will be a spillover from the average level of wide formal schooling that will create more knowledge that informal interactions will disseminate. This in turn increases the incentive of the individual to invest in schooling. If the spillover effect is strong enough, then the virtuous and vicious circles will form. In the virtuous circle, the level of education in the society is high, so the incentive to invest in education is high, so the level of education in the society is high. In the vicious circle, the level of education in the society is low, so the incentive to invest in education is low, so the level of education in the society remains low. Public policy could shift the economy from the vicious circle to a virtuous one by removing taxes on investment in schooling or by subsidising schooling″.

(iii) Accumulation of All Types of Capital: The Rebelo AK-Technology Model

Rebelo's (1991) model solved the production and consumption issue in a similar way as in the Romer-Lucas model summarised above. The distinctive aspects are Rebelo's AK production function and his assumption of the types of capital which agents in an economy can accumulate. It is assumed that an individual can accumulate all types of capital - physical, human, knowledge, learning, etc. In consequence, constant returns to scale are obtained and positive long-run per capita growth rates for capital income and consumption result.

2.6.2 The New Development Theory

The new development literature of the 1980s and 90s included contributions to several distinct branches. Among the contributions of the new development trend, multiple equilibria models based on external economies and spillover effects, as well as on institutional arrangements, are important pieces.

Resuscitating Rodan-Nurske, Murphy (1989) formulated the so-called 'big push': industrialisation in the context of multiple equilibria based on purely economic incentives. Another piece in this trend is the contribution by Rodriguez-Clare (1996), emphasised the role of multinational corporations as a source of Hirchman's linkage effects. It is important to note here that these models aim to generalise the basic elements constraining development in the undeveloped world.

Theorists in economic development (Jacobs, 1969; Krugman, 1991; Porter, 2012; Romer, 1986) have emphasised how a nation is developed from the new knowledge created by new firms. Their arguments have emerged from the notions described by

Schumpeter (1934) about how the introduction of new combinations provides advances in the nation. Kent (1982) argued that the entrepreneurs play a role in changing the socioeconomic structure as well as the living standards of the population. For example, Baumol (1990) explained that the allocation of resources in entrepreneurial activities can have direct effects in the development of innovation and in the dissemination of technological discoveries in a given economy. This implies that the population can benefit from the introduction of new goods and services. Moreover, Hill and Brennan (2000) explained that it is the strategy of the new firms operating in a region that can serve as a direct indication of how the region is going to be developed. In that matter, the entry of innovating firms in highly competitive sectors will result in improvements in the overall well-being of the economy. However, the effects of new firm formation on economic development are not immediate because some new firms may not survive in the long run due to the liability of newness (Stinchcombe, 1965). It takes time for the economy to absorb the influx of new firms, as some researchers have found in studies conducted in Europe (Audrestch and Fritsch, 2002; Van Stel and Storey, 2004).

Researchers have explained that the skills and abilities of entrepreneurs provide a direct influence on the economic development of a country (Murphy *et al*., 1991; Smith, Glasson and Chadwick, 2005). Qualitative changes such as new knowledge creation or improvements in economic factors (poverty, income, unemployment, etc.) occur in the country as a flow of new ventures starts to operate in certain sectors of the economy, particularly when the country is in the process of development (Wennekers *et al*., 2005). For example, Audrestch (1995) explained that new ventures are more important in industries that are characterised by possessing an entrepreneurial technological regime. These firms provide innovative elements that

not only revolutionise the industry but also disseminate new knowledge in the country. Moreover, Fritsch and Mueller (2004) explained that the entry of new firms can generate long-term effects on the development of a country. Obtaining evidence from German regions, they observed that the indirect effects of new firm formation in terms of increasing competitiveness, securing efficiency, accelerating structural changes, and providing greater variety can have effects on job growth. Furthermore, new businesses represent an expansion of capacities as they provide innovations that are later embedded in the country. Fristch and Mueller (2004) concluded that these effects that produce the formation of new firms generate long-term prosperity in the country. As described earlier, changes in GDP imply that a country is increasing its production level to benefit not only the operating firms but also the rest of the society. As a result, the entry of new firms in a country will contribute to an increase in the GDP of the country and such improvement will generate prosperity in the economy. In this thesis, these theories are regarded as important knowledge for assessing the relationship between the construction industry and other gross domestic product to enhance the economic development in Libya.

2.7 The New Political Economy Literature

The rising significance growth-development theorists and practitioners have given to inner characteristics of developing countries, as regards their social-economic-political settings, has promoted the surfacing of a significant body of literature intimately connected to strategy design, execution and improvement in the developing countries.

The suggestions from Dollar and Svensson (1998) are major in any deliberation of growth-development questions in the developing countries. They confirm that, if

internal vulnerabilities are known to exist in poor countries, adjustment programmes' ineffectiveness is an almost sure result, because the likelihood of achievement of foreign-supported structural adjustment programmes is completely determined by internal characteristics inherent to a specific developing country - no matter what the World Bank staff does in terms of perfecting, supervising or improving the overall programme-related activities. In terms of Libya, the political instability in the recent time will be a main challenge facing the new government.

2.8 Ethnic Diversity and Polarisation: Easterly and Levine on Africa's Growth Tragedy

Easterly and Levine (1997) confirmed a big association between ethnic disintegration and poor growth policies in developing countries. They assert that the presence of ethnic divisions in a country unfavourably influences economic growth because of poor selection of strategy, and show Africa's growth tragedy in three decades (1960s, 1970s and 1980s) as experiential proof supporting the arguments on ethno-linguistic diversity.

Besides their studies in Africa, a number of general predictions can be conceived. The major results are as follows. Firstly, ethnic disintegration supports the adoption of poor-growth policies. Secondly, ethnic divisions mean that there is no overall agreement on conditions for growth enhancement in relation to public goods. These two products of ethnic variation have a powerful effect on the planning and requirements of infrastructure in a chosen country when compared to the direct impact of ethnic disintegration on growth itself. Non-existence of ethnic diversity and disintegration in Libya will be a helpful factor in achieving economic development.

Key tenets of the new growth-development theory that highlight the most important variables to be crucial in fostering economic growth-development are outlined as follows:

- Education is seen as an important source of economic performance. Many new growth models bring this prediction. Schooling, skills, knowledge, and learning - all relate to essential sources of external economies and spillover to affect a society positively.
- The provision of productive inputs and general infrastructure as well as law and order by the government are key to the process of sustained economic growth-development
- Trade engagement is another way in which to prompt external economies, learning, knowledge, etc. International trade is a powerful mechanism leading to economic prosperity.
- Wage incentives, as a source of increased demand, may lead to a process of industrialisation and growth.
- Multinationals, if known to generate positive linkage effects, may engender economic prosperity in poor areas.
- Coalition formation blocking poor institutional arrangements may translate into an important source of social changes in the developing world.

Part two

2.9 Characteristics of the Construction Industry in Developing Countries

The construction industry, whether in developed or developing countries, faces conditions of uncertainty and risk. But sources of such risk are more concentrated in developing countries and include volatility, relatively unskilled labour forces, low levels of productivity, poor infrastructure, fraudulent practices, certain financing characteristics typical in developing countries, and government influence.

Construction activity is highly cyclical in nature in developing countries and one of the first industries to feel the effects of an economic recession (UNIDO, 2006).

Construction activity in developing countries draws mostly on the unskilled agricultural labour. Therefore, a reliable supply of labour will be affected largely by the seasonal demand for agricultural labour (Coukis and Grimes, 1980).

Besides the sparse quantity of available workers in developing country labour pools, another problem is the quality of labourers. Simpson (1987) found that levels of labour productivity are extremely low in developing countries compared with those of developed nations. Poor dietary habits, low standards of personal hygiene, lack of experienced management, and sometimes overstaffing of certain activities are partially responsible for the low productivity in developing countries.

In developing countries, large projects usually are funded through loans and grants form international agencies or developed countries' governments and investments from private firms based in other countries (Zuvekas, 1979). The most important

sources of multilateral finance for construction projects are the World Bank and International Monetary Fund (IMF). These institutions lend funds at interest rates below those charged by other private lenders and sometimes lend for very long periods of time at no interest (Zuvekas, 1979).

2.10 Role of Construction in Developing Economies

The process of growth and the process of development, although they can work apart in the long run, are dependent on each other for completion. For the case of a developing economy, the focus on the production of capital stock is crucial to improve the process of economic growth, as the process of economic growth and its effects are primarily reflected in the improved lifestyle of the population. The contribution of the construction industry in the growth of a developing economy is reflected in the definition of economic growth provided by Mankiw (2010: 191). The author defines economic growth as the increase in gross domestic product (GDP) measured as total output or everyone's total income. The construction industry is responsible for the supply of the basic need of shelter. To be specific, the supply of infrastructure for dwelling such as buildings, and infrastructure to assist humans in other activities such as roads, harbours, and bridges is the responsibility of the construction industry. The economies of the developed countries mostly in Europe started to depend on construction activities specifically because of the aftermath of World War II (Lopes, 2011). The economy as a whole and the major sectors of an economy in both developed and developing countries are dependent on the hefty contribution of the construction industry in the development of the economy (Khan, 2008:281). An array of substantial qualities is adjusted in the requirement of modern life in the urban areas which is fulfilled by the construction industry. Thus, a wide

spectrum of meso-economy is formed in the process of development of the developing countries, which is maintained by the construction industry (Bon and Hutchison, 2000).

The construction industry contributes to economic growth from the demand side and in the traditional Keynesian economy sustainable short-run economic growth is dependent on the increased demand (Wigren and Wilhelmsson, 2009). In comparison with the other industries that contribute to the economic growth of developing country, the industry of construction is more labour-intensive, while the developing countries are mostly labour-abundant (Giang ve Pheng, 2011).

Possible measures of the role of the industry in the economic growth include:

- As confirmed in World Bank (2012), the critical role of constrction infrastructure development , is certainly provides a sizable contribution to fixed capital formation.
- Construction is relatively labour- intensive in using a large number of workers in most developing countries. The industry imploys 20-30% of the labour force in developing countries (UNIDO, 2006).
- Due to the role of the GDP in stimulating the economic growth,, the contribution of the construction industry to GDP is considered as an important tool for investigating the industry's role in the economic growth.
- The construction share in the GDP depends on several factors, such as the relative size of the sector in the country and the finance resources (Laumas,2007). Table 2.1 shows that the construction contribute largly to GDP of a country. For example , in 2009, 2010, 2012 the figures of the construction share of the GDP for Singapore, Hong Kong and Malaysia and in the Gulf States such as Saudi Arabia and Oman confirms that the role of the

construction into the economic growth goes up with high rates from year to year. This prosperity reflects the best use of the economic resources in these countries.

CONTRY	2009	2010	2012
Singapore	29.1%	31.2%	43.00%
Hong Kong	9.5%	12.6%	15.5%
Malaysia	25.3%	33.1%	45.00%
Saudi Arabia	7.55	9.55	16.75
Oman	4.6%	5.4%	8.00%

Table2.1,Contribution of CI to GDP in some developing countries

Source: IMF Country Authorities and staff estimates (2012).

2.11 Relationship between the Construction Industry and Economic Development through Economic Theories and Empirical Studies

Construction plays a major role in the economic development of any country. It plays a major role in the economy by contributing significantly to the gross domestic product, employing a sizeable portion of the working population, accounting for about half of the capital formation, and increasing strongly with other sectors of the economy (Hillibrandt, 1984). Thus, a healthy construction industry is considered both a result of, and a prerequisite for, economic development. Adding to the importance of the construction industry is its pivotal role in infrastructure development. Infrastructure can be the foundation of both economic and social development but often becomes instead a bottleneck to economic expansion in developing countries (World Bank, 1993).

The construction industry encompasses a vast set of activities whose final output ranges from houses, hospitals and roads to harbours, factories, and airports. The industry has a number of important features: it is oriented predominantly to the public sector, its products require long lead times to plan and build, its products require long-term investment, and the products consist of fixed structures (Zahlan, 1984).

The construction industries of both developed and developing countries are volatile. However, volatility is more severe in developing countries and resources are more scarce (Wells, 1986).

Developing countries possess many common characteristics, such as low standard of living, political instability, unemployment and underemployment, and low levels of productivity. Furthermore, the fluctuating demand for construction, tied to political and economic volatility (Moavenzadeh, 1984), makes it extremely difficult to forecast the growth of construction and assess policies to stimulate its development. The construction industry is cyclical in nature and is one of the first industries to feel the effect of an economic recession (UNIDO, 1993). These phenomena, along with financial and other business risks, hinder the development of this sector.

The construction industry in developing countries may be viewed as a sector of the economy which is responsible for the planning, design, construction, maintenance, and eventual demolition of buildings and works which enables economic activities to be performed. It is essentially a service industry, obtaining its inputs from various sectors of the economy with which it is interrelated and interlinked in a complex manner.

In this thesis the main relationship that will be analysed is a causal relationship between the construction industry and GDP, as well as the same kind of relationship between the CI and other economic sectors.

2.12 Causal Relationship between the Construction Industry and Economic Growth

According to the definition provided by World Bank reports, the construction industry is an economic sector which transforms various resources into constructed economic and social infrastructure and facilities (Grifa, 2006). Its involvement is not confined to the construction sector but extends to a number of supplementary sectors such as planning and development, designing, research, supply of materials and consultant organisations. Their roles are collectively influenced by any change or deformation in the policy of the key industry. Good planning and design of the built environment can enhance the productivity and quality of our working and social lives (The Building Economist, 2006). Thus, an efficient construction industry will have to work in cooperation with all the sectors of the government to aid the development of the country.

In developing countries, where economic growth is taking place rapidly, the construction industry starts from providing shelter to the people; at least 35% of the construction is in the form of dwellings (Movenzadeh, Janet1975). This is because in an economically developing country it is necessary to provide people with a high standard of living places. During three consecutive development plans in Libya (1975-1990), a total of 10% capital was invested in improving and constructing residential buildings in the country (Omer, 2001). The high standard of living brought modernisation in the lifestyle of the people, transplanting European and Western

construction firms and equipment into the country (Hassn, 1982). This also increases the load on the energy resources of the country, reducing its usefulness for other sectors of economy. However, there is a lesser causality relationship to be seen between economy and energy consumption for the UK, US and Poland (Mozumder and Marthe, 2007). The overall economic growth in MENA (Middle East and North African) countries is observed because of liberalised financial policies, lifting of bans from the banking system and an increased rate of interest for the credit flotation in the countries (Goodchild, 1997).

Financial development is termed as the potential of a country to divert its savings towards the development of other institutions (Libya RCBMC, 2002). This phenomenon is again dependent upon the traditional economic boundaries of a country comprising the capabilities of its institutions and policies, financial market diversity and nature, and the presence of local and foreign agents in financial markets. The capability of economic institutions can also be measured from the production of quality human resources.

2.13 Empirical Studies in the Causal Relationship between Economic Activities and Economic Growth

The following table presents some of the previous studies on the causal relationship between economic growth and economic activities. This table is divided into six columns. Column 1 presents the author and the date issue of each study, column 2 presents the country which is under study, column 3 presents the period of time series, column 4 presents the economic variables used in the analysis, column 5 presents the chosen methodology used in analysing the causal relationship between the variables and column 6 presents the results obtained from the data analysis.

The following terms refer to the variables that have been are used in these studies:

GDP: Gross Domestic Product.

BRPU: Building and Residential (Public).

BRPR: Building and Residential (Private).

FD: Financial Development.

MENA: Middle East and North Africa.

HD: Human Development.

CF: Construction Flow.

ER: Exchange Rate.

CO: Construction Output.

1 **Studies**	2 **Countries**	3 **Period**	4 **Variables**	5 **Method**	6 **Findings**
Ozkan *et al.* 2012	Turkey	1987-2008	GDP and (infrastructure investment, building& Residential public & private)	Granger causality tests	Infra-investment, BRPU and BRPR have a direct relationship with GDP
Kar *et al.* 2011	MENA Countries	1980-2007	Financial Development & GDP	A panel causality testing approach	The causality between FD & GDP is sensitive to the measurements of FD in the MENA
Mzumder and Marthe 2007	Bangladesh	1971-1999	Per capita electricity & per capita GNP	Co-integration & Causality test	GNP causes Energy Consumption
Shahbaz et al 2011	10 Asian countries	1971-2000	Human Development & GDP	A panel causality testing approach	GDP causes HD And vice versa

Tse and Ganesan 1997	Hong Kong	1983-1989	GDP & Construction flows	Granger causality test	GDP causes CF not vice versa
Alikhan 2008	Pakistan	1995-2005	GDP and CF	Granger causality test	CF precedes GDP. GDP does not precede CF
Chiu and Chau 2005	Hong Kong	1973-2003	Prices, Investment &GDP	Co-integration & Granger causality	No causal relationship between E & GDP. Prices lead GDP
Mingmen and Ruili 2010	China	1995-2005	GDP & Stock prices	Co-integration & Granger causality	No Granger cause
Assadzadeh and Naj 2009	Iran	1968-2007	GDP, Tourism income and Exchange rate	Johansen co-integration test	Causa relationship between GDP & Tourism and no relationship between ER & GDP in the long-run
Piyapong 2008	USA	1985-1997	Infrastructure & Employment	Granger causality & VAR model	Infrstructure causes employment increase
Matahin 2012	Malaysia	1970-2009	Agricultural output Industrial output	Johansen test & Granger causality test	Causality from Industrial to Agricultural in the short and long run periods
Steven and Enel 2011	USA	1990-2004	Employment, Wages & Infrastructure	Error correction Model	Weak causal relationship between the three variabls
Rune and Mats 2007	USA	1970-2007	GDP, Infrastructure & Residential	Granger causality test	Infrastructure causes GDP in the short run & Residential has a long run effect on the GDP
Alcina and Lopes 2011	Portugal	1970-2008	GDP & Construction output	Granger causality test	Unidirectional causality from GDP to CO
Hiiweed, et al. 1999	Malysia	1987-1997	GDP & Houses	Granger causality test	GDP causes houses

Mallalla, 2010	Barbados	1990-2008	GDP & Construction investment	Granger causality test	Bi-directional causality
Thanuja et al. 2006	Sri Lanka	1980-2004	GDP & Construction investment	Granger causality test	Construction causes GDP and not vice versa
Green 1997	Hong Kong	1959-1992	GDP, Residential & Non-residential investment	Granger causality test	Residential causes GDP and not vice versa while Non-residential does not cause GDP but is caused by GDP
Tes and Ganesan 1997	Hong Kong	1983-1989	GDP & Construction flows	Granger causality test	GDP leads the CF and not vice versa

Table 2.2 Previous studies on the causality between economic growth and economic activities

The previous studies that focus on the causal relationship between economic variables can be summarised into three main categories: (1) no causality, (2) unidirectional causality and (3) bi-directional causality between two variables. The bi-directional and the unidirectional can exist in both the long and short run. Depending upon what kind of causal relationships exists, the policy implications of these relationships can be significant to provide policy recommendations that can be applied in the country. The results of some of these studies can be an important basis in interpreting and validating the results of this research.

Table 2.1 provides a summary of the relevant studies. For instance, study of the human development index is also an indicator of economic development (Shahbaz, Iqbal and Butt, 2011). There are two types of causality chains which include people and economic growth. One is Economic Growth to Human Development (EG →HD), where the resources from national income are being diverted to other industrial sectors (Shahbaz, *et al.*, 2011), for example the national progress of the country is

increasing on a per year basis from 2006, the progress is likely in 35 key industrial sectors alongside the development of the CI of Asian countries (Research and Martets, 2012). The second relation is Human Development helps Economic Growth (HD→ EG) (Shahbaz, *et al.*, 2011). The non-availability of a skilled workforce in Libya, and the socialisation policy of Gaddafi have discouraged the construction-related skill development in the country, which has attracted skilled human resources from Africa and South Asia and construction firms from the West (Grifa, 2006). The findings from the studies differ not only across countries but also across methodologies.

Part three

2.14 Safety and Total Quality Management (TQM) implementation issues in the Libyan construction industry

Many countries such as Saudi Arabia, Yemen, China, Turkey and Hong Kong have implemented the policies of safety and total quality management for increasing the efficiency of their economic sectors.

Based on the findings gained from the causality relationship between the construction industry and gross domestic product, the safety and total quality implementation are suggested due to their important role in growing the efficiency of the Libyan construction industry to increase the industry's contribution to the country's future growth. Therefore, it is necessary to present these two concepts through the literature review and previous studies.

2.14.1 Definition of TQM

Quality management system is a subject that is currently receiving increasing attention worldwide (Ahmed, 2005). TQM can be seen as a search for productivity improvement and customer satisfaction, and as an approach for improving the competitiveness, effectiveness and flexibility of the whole organisation (Ahmed, 2005). Also, it is defined as the culture of an organisation committed to customer satisfaction through continuous improvement (Bakar, 2011).

2.14.2 Total Quality Management through Literature Review

Libya, which is a developing country, has to go through a lot of problems with respect to quality. Recently, as Pargeter (2009) explains, Libya has started liberalising its economy and improving its competitiveness both at the national level and the global level. The operation of a TQM programme has been taken in to account by many authors in the past few years (Millett and Harvey, 1999; Memon, 2012; Teddese and Osada, 2010; Djerdjour and Patel, 2000; Williams, 2006). All of these authors have observed the problems from various points of views and they explore various perspectives among the outcomes. The following aspects and linked problems are taken into account as being critical and important for achieving effective TQM implementation within any company; hence, the characteristics prominent in them are the important characteristics that influence the TQM implementation within any company.

(i) Top Management Commitment and Leadership in the Libyan Construction Industry

Leadership with customer focus are the two main components for the Libyan TQM where the customers give the common focus or target for TQM. Leadership is the capacity to influence confidence and assistance among those required to accomplish the company goals. Tumi, Omran and Pakir (2009) explained the idea of leadership capacity of the top management to develop practice and future vision for the company or firm which operates with the altering customer need. As stated by Juran and Gryna (1993), particular roles of top management can be recognised as quality policies, developing and executing quality goals to provide resources. Tumi, Omran and Pakir (2009) identified the critical roles of leadership in developing the goal. So the idea of leadership can be explained as the potential of top management to lead the organisation in a consistent way, going for long-term future business effectiveness.

(ii) Teamwork

For accomplishing the organisational objectives, the team is problematic in Libyan construction. It has long been understood that individuals working collaboratively in a team or group having common aims are usually more efficient and successful than individuals working alone. TQM identifies that the team approach should not be restricted to the internal company team; however, it should be used to go ahead with vendors and external customers under their umbrella.

(iii) Training and Education

Training is an important aspect for any effective quality management programme (Sultan, 2005). Chief executives and quality experts have effectively executed training programmes and education in their companies. Training programmes must target all the people in the company as the quality under the TQM is the duty of everyone in the

company. The employees from the top management to the labour-force must comprehend the philosophies of TQM. Collaborative work is significant to enhance all the procedures in which the TQM approach is needed.

(iv) Communication

As stated by Sultan (2005), effective communication will result in decreasing the fear amongst a company's employees. Effective communication is significant in accomplishing TQM and reducing the fears that can prevent the employees from participating in the company activities. Deming (1986) suggests to 'get out of the fear' requires management to change. TQM is a conscious procedure of betterment. Effective communication and a good response system are significant in conveying the ideas to the management and to implement the important changes that are needed.

As stated by Sternberg and Rocha (2007) for Saudi Arabia and Sternberg and Rocha (2007) for Jordan in Egypt, most of the Arab countries are still in the developing stage of incorporating the quality management initiative of QMS and TQM.. They all provide us with the same prohibitions:

- Lack of management involvement, vision and systemisation and lack of consistency of purpose - this can cause the business to only be run for a particular time period.
- Lack of expertise and potential from the top and middle managements in the quality management field.
- Least level of awareness and comprehension of TQM.

Certain construction issues like fluctuation of demand cause problems for TQM but that TQM could assist an organisation to cope with these issues. In other words, where TQM could be a solution for the construction industry issues, some of these

issues are themselves hindrances for TQM execution. On the other side, the solution of outside issues is a more challenging task and in certain cases the industry has no control over such problems. The possible negative influences of labour laws and taxes are two of the external issues facing the industry. At the same time, most of the external challenges could be solved via direct government involvement.

As stated by Sternberg and Rocha (cited in Rice and Habbershon, 2007) the industry issues will remain until each company of the construction industry starts to take the responsibility for bringing the changes within their own company. Such changes can be initiated via the successful implementations of TQM. In other words, going through TQM by the major involved parties (owner, designer, contractor and supplier) in the construction industry will accomplish the essential changes needed for the industry's betterment. Under TQM, there is a chain of supplier and customer relationship and TQM focuses on this relationship. The relationship among the four participant parties of the construction industry can be seen in the context of the supplier-customer relationship. Every party has a reverse supplier-customer relationship, although the owner, who might be seen as a customer to the contractor at first look, is a supplier to the contractor in certain activities like giving the work permits or paying the invoices.

According to Black (2012), The TQM ideology is very well comprehended and broadly put into action in Europe, North America and Japan, as well as the progressing economies of East Asia. But certain organisations have to face certain problems in using TQM effectively. These problems may not be because of the TQM idea itself; instead there might have been issues arising from cultural aspects. But this often produced outcomes missing the complete picture of TQM. As Black (2012) also stated, the quality programmes used in developing countries are not successful

because of the lack of comprehension of quality management (QM). Laub and Gamel (2011) identified unsuccessful comprehension of top management of TQM programmes' needs and usage process. But it is precisely that the top management is required to have a better comprehension of the purpose of TQM, so that TQM can be put into action with ways to calculate its business effect and areas where its advantages may be present. Laub and Gamel also identified the lack of comprehension of procedure by the people required to know and understand the internal and external procedures that may be influenced when betterment in any procedure is needed. Also, they found no variation between American and Spanish quality managers, discerning their common lack of knowledge about TQM. Similarly, as stated by Al-Musleh (2010), one of the most crucial challenges to organisations is to provide all their staff with a detailed comprehension of TQM.

(v) Difficulties of TQM Implementation in the Construction Industry

Stimson, Stough and Roberts (2002) suggested the causes for why execution of TQM in the construction industry is a problem. They said that the reason for the challenge is the perspective or 'paradigm' that construction leaders have about their industry. The construction leaders, they discussed, have faith in what they termed as five "cant's":

1. One cannot implement industrial management solutions to the construction industry; construction industry solutions need to be exclusive to the construction industry because of the exclusive nature of the construction industry.
2. One cannot perform a statistical study of construction procedures since they are exclusive and non-repetitive.

3. One cannot capitalise in training at the job level, as individual employment is short-term, the people have no organisational loyalty and the environment is very harsh.

4. One cannot spend money on management procedures since there is too much competition and the margins will not allow it.

5. One cannot take time away from doing work for seminars, retreats or symposia.

2.14.3 Definition of Safety

Safety is an area concerned with protecting the safety of people engaged in work. The aim of this strategy is to adopt a safe work environment through focusing on improving the working environment in order for it to become conducive to safety and health, and to develop the work organisations and working cultures to support health and safety (Georges, n.d.). The other definition of safety and health adopted by the Joint ILO/WHO Committee (1950) is: "Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations."

2.14.4 Safety in the Construction Industry

Alasamri (2012) recognised that poor safety awareness of organisations' top leaders and poor safety awareness of projects managers were the major aspects influencing the construction safety performance in Saudi. Looking at Saudi Arabia, he said that the responsibility for safety on any construction projects should be shared between all the parties that are carrying out the projects: the owners, designer and contractor.

Alasamri's study in Saudi observed that the reasons for accidents were the poor safety awareness of top leaders; absence of training; poor safety awareness of managers;

unwillingness to input resources for safety; absence of certified expert labour; poor equipment; lack of first aid measures; lack of quick implementation of safety regulation; lack of organisational commitment; low educational level of workers; and poor safety thinking of workers. In Libya, most of the managers think that safety processes ultimately enhance the cost of construction, according to Tumi, Omran and Pakir (2009). They also found that the accident costs and safety processes are not considered in the contractors' bid and only the insurance cost is considered for those items in Libya. The feedback of managers in their survey indicates that the implementation of safety procedures and regulations costs around 0.25-2% of total project value in Libya. Re-assessing the total cost of accidents and injuries to the construction industry, it has been shown that the total cost of accidents has increased to somewhere between 7.9% and 15% of the total costs of non-residential new construction to the Libyan construction industry (Kartam, 2000; Hassouna, 2005). Pack's (2011) study in China demonstrated that there was an agreement between the people who gave feedback to their surveys stating that the safety regulation is important to decrease accidents on construction sites.

2.15 Summary

This chapter has reviewed the literature relating to the various aspects of the thesis by splitting it into three parts: part one looked at the concept of economic development and growth and gave a review of the growth and development theories, part two looked at the construction industry and its role in the economic growth, and part three looked at safety and total quality management.

In part one, firstly, the concept of growth and development was reviewed. From the review, it is obvious that the economic growth is related to quantitative changes and the economic development is related to qualitative changes. Secondly, the economic

theories of the economic growth and development were presented followed by the economic theories of the growth and development in the developing countries with a review of the new growth and development theories and the political economy literature. The key points of these theories are summarised as follows:

In part one,

- Developing countries with great levels of difference in income and wealth may be hindered from escaping from the trap of poverty as per growth-augmenting strategies. Reorganisation should be considered first, even if it brings lower growth in the short run.
- Internal scouring of interest groups in specific countries must be considered before attempting to plan or implement any policy. If this is not focused on, it may result in the delay of policy or implemented policies will not be effective.
- Countries that face ethno-linguistic disintegration, or disintegration of any other kind, must devise mechanisms to pacify a variety of demands and aims. For example, if public infrastructure is being badly completed because of ethnic diversity, governments should think of a way to resolve this problem before corruption schemes, poor institutional arrangements, rent-seeking behaviours - all must be given special attention before any growth-development strategy is visualised in developing countries.

In part two,

- The construction industry in developing countries faces conditions of uncertainty and risk; these conditions include volatility, relatively unskilled labour force, low levels of productivity, poor infrastructure, fraudulent practices, and government influence

- Despite these characteristics, there are some developing counties such as Singapore, Hong Kong, Malaysia, Saudi Araiba and Omen whose construction sector played an important role in the economic growth.
- The relationship between the construction industry and economic development was reviewed and the researcher confirmed the existence of this relationship in both developed and developing countries, but the characteristics of the developing countries such as political instability, unemployment and low level of productivity make it difficult to forecast its growth.
- Despite the growing literature on the contribution of the construction industry to economic growth and development, it appears that many gaps still exist in the current literature. In particular, no attempt has been made to examine the role of the construction industry in the economic growth and development of the Libyan economy.

In part three,

- Safety and total quality management concepts were defined.
- The two concepts were discussed through the literature review and previous studies. The outline of this review confirmed that, safety and TQM implementation should lead to increase the efficiency of the construction industry. This result encouraged the researcher to suggest applying these two policies for growing the efficiency of the Libyan construction industry.

This thesis tries to fill the gap in the literature by using in-depth regression analysis, unit root analysis, co-integration analysis and Granger causality test with error correction test to investigate the contribution of the construction industry to Libyan economy. In particular, it attempts to achieve the following objectives:

- To investigate the causal relationship between the construction industry and economic development through economic theories and empirical studies.
- To investigate the nature and direction of the causal relationship between the construction industry and gross domestic product (as a measure of the growth in Libya).
- To analyse the relationships between the construction industry and other economic sectors.
- To identify safety and total quality management approach which can play an important role in growing the efficiency of the Libyan construction industry.
- To propose recommendations for policy makers and future researches based on the findings.
- To propose a guideline for the new government to development the construction industry in Libya.

Following the outcomes of this chapter, the next chapter explores the place of study, showing how Libya as a developing country needs studies to investigate its construction sector and economic growth.

Chapter Three
Libyan Economic and Political Systems

3.1 Introduction

Libya is an African country which remained under several colonial rulers until she sought independence on 24 December, 1951. The last colonial regime was Italian, after which time the country was transformed into a land ruled by the local autonomous Amir together with the Italian administration. In 1951, the Libyan delegate attended the UN (United Nations) conference, representing the country, making Libya the first country in the world to gain independence through UN resolution. Libya came under the monarchy of the As-Sanusi dynasty, which ruled until 1969 when Muammar Gaddafi seized control by overthrowing the crown through a bloodless revolution. Libya had been in desperate economic and political conditions since independence, and the monarchy had failed to find the solution. In Gaddafi's system, at first the government increased the literacy rate of the country and developed its national infrastructure solely with the revenue generated from Libyan oilfields. His efforts were not restricted to Libya only; he was in close alliance with other African countries, offering the African human resources employment opportunities in Libya (Pack, 2013).

Libya's economic prosperity did not last. Problems began to arise when Gaddafi adopted a harsh domestic policy by reforming the constitution of the country and publishing the "Green Book" in 1973. Though Gaddafi did a lot for the progress of his

nation, and protected the international posture of Libya by his close alliance to the UK, USA and Russia, neighbouring African countries and the Muslim world, he was averse to his domestic rivals and went to the extent of killing them through bombardment. There are several other factors which rendered him infamous in his own country - one of which was the deteriorating economic conditions.

After Gaddafi, it is an open challenge for his successors to restore peace and prosperity in the country through effective policies. A liberal democracy is a challenge for the new government of Libya which has ousted the Gaddafi rule. The unease at national level is the host of many other problems such as mass migration of the population towards the Western world and the prospects for terrorist organisations to settle in Libya. The dwindling economy may not be effective in utilising the resources of the country. However, Libya is still not under a foreign debt, which may auger a good economic future for the country if a strong political system is established without a delay.

3.2 Political System in Libya 1951-1969

King Idris Sansui was proclaimed the king of independent Libya in 1951. This political system was a monarchy, so all the powers were exercised by the King and the rule had to remain within his line of succession. The council was comprised of lower and upper houses: the upper house was to be handpicked by the King himself and this part held the veto over power as well as authority to dissolve the lower house.

At Independence, the Kingdom of Libya consisted of three provinces - Cyrenaica, Tripolitania and Fezzan - that had virtually nothing in common socially, economically

and politically (Vandewalle, 1998). The Italian fascists had destroyed all the institutions that the state had developed during the Ottoman rule. The Libyan state at independence, according to Vandewalle (1998), was more than "a geographical expression" as Metternich has said about Italy a century earlier. There was no significant political will among the leadership to unify the tri-directional units of the country. The abandonment of the Kingdom's federal system and its subsequent real unification took place as a response to the demands of an oil economy that required unified legal structure and central control instead of administratively autonomous regions (Vandewalle 1998). A large number of social institutions were developed which employed the growing urban population. The government successfully developed the constitution and endorsed it in 1964.

The abundance of revenue to the Kingdom because of oil exports had created trading issues among the regions, regarding the distribution of finances. As a consequence of differences, several political rivalries were born in the country. By 1969, a combination of factors - traditional distrust of the hierarchal structure of the modern statehood, rapid international inflows and a reluctant state building process begun partly in response to the capital inflow (Vandewalle 1981) - proved disastrous for the nascent national integration. As a result, the government failed to suppress the political groups and the military removed the king from the throne and Muammar Gaddafi assumed power.

3.3 Political System in Libya 1969-2011

Muammar Gaddafi assumed power in 1969, and ruled for 42 years; this is the longest rule of any of the non-royal dictators in the history of the world.

Gaddafi rose to power with the aim of revolutionising the political strata of his country. He had the ideology to bring African countries together on a common platform; he was averse to the dictatorship in other countries, and during his reign he adopted a strong foreign and domestic policy. Oil leases were renegotiated and many of the companies nationalised (Black and Clark, 2012). Gaddafi adopted a strong domestic policy towards national integration with all the powers concentrated in him. Gaddafi, initially, had the backing of the executive of the legislative council and he tried to implement the socialist reforms in Libya. In 1973, he tried to get rid of the traditional political system prevailing in Libya. He replaced the worn-out system of Libyan politics with his Third Universal Theory. According to this theory, the new system has to contain a disavowal of capitalism and communism in favour of socialism, popular democracy, Arab unity, and progressive Islam (Black and Clark, 2012). Gaddafi wrote the Green Book in 1975 and made it part of the constitution on 23 March 1973. This book contained his concepts of democracy, by which the legislature and the legal political system has to fulfil its duties by holding consultations with the people. It is difficult to estimate the number of the People's General Conference members, which ranges between hundreds and thousands at varying times (ANHRI, 2011).

Internally, the Libyan government started to change the structure; Gaddafi himself had started to tighten the security, increasing his control over the population. The strong security had served as a system of espionage, with which he had been able to brutally crush any of the opposition. There was a disturbance among the system of

powers, because Gaddafi was barely a lieutenant when he assumed power. Gaddafi's regime was in close alliance with the African nations and the policy of reconciliation towards them was adopted. The elite structure of Libya was composed of the close relatives and friends of Gaddafi. It is the domination of this tribe since the revolution of 1969 that has been responsible in large part for the alienation of the country's eastern regions (Pargeter, 2009).

3.4 Economic Development in Libya 1951-2011

At the time of independence in 1951, the country was in desperate economic conditions, due to the absence of a developed agricultural system, and the hydrocarbon wealth of the state was not known to the world. The government had made settlements with Italy for economic gain. The agreement made in 1956 to transfer Italian public property rights to Libya brought 7.7 million US dollars in aid, and the Italian government spent 3.7 million US dollars to complete colonial projects in Libya (Wright, 1981). Libya became a member of the Arab League in 1953, and in 1956 the Suez Canal issue arose, mainly because of Libya's dependence on the West for finance and defence matters. By the 1957/58 financial year, total foreign aid amounted to 38.2 million US dollars; in 1957, spending by foreign oil companies amounted to 48.3 million US dollars (Wright 1981). When the oil fields were developed the hope for the survival of the economy was revived and the economy was transformed from a primitive economy into an oil-based economy.

Between 1970 and 1983, Libya was very enthusiastic about economic development; it fixed the revenue generated from the oil sales to construct the infrastructure of Libya. Villages were electrified and the desert irrigated (Black and Clark, 2012). The government of Gaddafi created employment opportunities for the human resources of

North African and Sub-Saharan states of Africa. It created their place in the oil fields of Libya. Libya rapidly evolved into a major destination for migrants from a wide array of countries (Haas, 2008). However, Libya's domestic political image and the international image began to perish in the late 80s.

On 30 December, 1988, the UN Security Council condemned the involvement of Libyan citizens in the plot of the Lockerbie bombing, which caused the crash of a Pan Am flight in Scotland. In order to pressurise Libya, two resolutions were passed, in 1992 and 1993, imposing sanctions on the country. The UN sanctions became a problem for Libya because of its oil exporting. From the mid-1980s up to 1999 the Libyan economy witnessed a period of recession as a result of the UN sanctions, decreasing oil prices and poor management in the public sector. After the UN sanctions were lifted in 2003 and oil prices increased, rapid improvements were noticed in the Libyan economy, because, as mentioned above, the Libyan economy depends primarily upon revenues from the oil and gas sector. The growth rate of Gross Domestic Product (GDP) recorded an increase until 2008, then in 2009 it declined by 0.7%; this decrease is attributable to the decrease in the growth rate of the oil and gas sector by 7.7%.

3.5 The Main Political and Economic Issues (1951-2011)

Libya is considered as the child of UN and international forces. The country was divided among the tribes and under the three capitals. The traces of Italian regimes were still found in the Libyan soil and the institutions were limited. Running the country was perhaps the greatest challenge confronting the Al-Sanussi dynasty. Libya was a fortunate country, as it had gained foreign aid in abundance right from its foundation. The most important asset of the country was its oil, which brought it

economic prosperity. However, lack of national integration, reliance on the west for military support, and unequal distribution of resources led to the fall of the government.

After the fall of the Sanussi dynasty, the Gaddafi regime intentionally ignored the development in the eastern part of the country due to their differences with the Sanussi territory of Cyrenaica. It was strange for a country having such a huge wealth of oil not to spend any of it on a particular part of the country (Pargeter, 2009). In 1973, Gaddafi adopted the theory of Marxism-driven socialist development. After that time until the late 80s the government did not suffer any opposition or uprising. Mostly problems in the way of progress occurred; Black and Clark (2012) have described that the Gaddafi regime never adopted a policy towards development; instead most of Gaddafi's actions were haphazard and without pre-planning. He would do anything to evolve the natural ideology of the Libyan Nation.

Gaddafi's vision was to spend the oil wealth on African-Arab nationalism and other activities of his own interests, instead of introducing a new economic plan to use the oil wealth for the welfare of the state. After the revolution, Gaddafi decided to crush any voice opposing his plans. Thus, this is how Gaddafi pushed the Libyan nation in his own interest and used the biggest resources of the country in the same direction.

The decade comprising the years 1973-82 is the decade of economic development in Libya. The revolution completed all of its phases. The local bureaucratic governance was formed and the control was put in the hands of the people after the nationalisation of resources. The channel of prosperity started just after the oil wealth came into the hands of the people. By the year 1975, the control of economic resources went into the hands of the ruling class, who had put the people in charge only in theory but not

in practice (Vandewalle, 1998). The situation prevailed until 1982, when a massive drop in the revenue generated from the oil exports occurred. Gaddafi, in his political thoughts, was much too idealistic; hence he never considered it worthwhile to develop other resources of revenue. The year of the US invasion, 1992, brought another challenge for Gaddafi's power, as oil revenues were reduced to only 4 billion dollars. Libya was facing tough competition among other oil exporters because of her growing turmoil with the West (Vandewalle, 1998). The US had halted all the oil imports from Libya, and compelled the Gaddafi government to introduce new polices of macroeconomic strategy. The conditions were worsening for Libya because of sanctions: the UN sanctions in 1992 and 1993 banned the transfer of oil technology to Libya in addition to the military aid (Hurd, 2005). Her foreign accounts were withheld when she needed the revenue from oil sales into the international world. Though no sanctions were imposed on oil sales from Libya, the transfer of oil technology to the country stopped the development of the oil industry, halting the employment generation cycle. The Gaddafi government started to run down, the economic conditions in the country were deteriorating owing to the increasing unemployment, and the conditions of immigrants who had gathered in Libya during its construction phase and peaceful days were worsening. Attitudes towards immigrants hardened, with a major anti-immigrant backlash occurring after clashes between Libyans and African workers in 2000 led to the deaths of dozens or perhaps hundreds of sub-Saharan migrants (Haas, 2008). The Libyan authorities introduce more strict laws on immigration, which at once started the migration of immigrants to Europe. The migrations were not confined to the Africans. Many Pakistani, Indian and Chinese people also fled to Europe.

The last blow to Gaddafi rule was due to his stubbornness over the democratic freedom in the country. Gaddafi had pushed his nation in whatever direction he wished. In some places he limited the movement of people and on the other hand he forced people to attend demonstrations organised by the government, for example, to display in front of media the dismay of people of Jamhoria as a result of UN-imposed sanctions, which he confronted as unlawful and thus ignored. Gaddafi had ruled inconsistently in Libya for four decades. Though his rule was declining, he was becoming unpopular in his own country, and he was rendered a criminal before the ICC, he was not ready to vacate the presidential seat. A last blow to his rule was given when NATO fighters attacked his convey, from where he was killed by the rebels.

3.6 Post-Gaddafi Challenges

Gaddafi had concentrated all powers to his person; restricting the authority to one hand had crippled the institutions. Pack (2011) has quoted an American diplomat as stating that "In Libya, the situation of building a nation is even more complex because it is lacking in robust state-level institutions". In Libya, the traditional democratic systems are absent and the people are more accommodating of the local government system. During Gaddafi's reign, institutions were nationalised and their authority was to come automatically from the public itself. In that situation, Gaddafi introduced a new concept of "democracy", where people had no experience of exercising power for themselves, and this situation has continued even into independence. Therefore, the first challenge facing the new government is building a new political system that consists of institutions of civil society.

Gaddafi used the wealth of the country for his own policies and development, and hence there was no system of revenue expenditure. The rule of Gaddafi was ended by

the civil war which destroyed most of the infrastructure of the country. So, for Libya the second challenge will be concentration on rebuilding its position as an oil-exporting nation, albeit with a ruined infrastructure (Nickolas 2011). Analysts say Libya faces a tough road ahead in its political transition and reconstruction. Among the top challenges are the restoration of stability and power transition (Laub and Kim, 2011). Finally, the Libyan economy is debt free; the remaining loss will be repaid by the support of the West and the oil wealth.

3.7 Summary

In an extensive review of the history of the political system in Libya and the current challenges that it faces, some interesting points are revealed. These points further emphasise the need to focus on the development of CI with the purpose of its feedback on the economy of Libya. It is revealed that, at the end of the long dictatorship, the people of Libya face internal challenges, which are accelerating with the exposure to the outer world. Although in Gaddafi's regime the institutions were nationalised, the people have low exposure of how to make use of their power in running the public institutions. The CI serves as a major sector to provide public goods related to infrastructure and transportations. Therefore, the need to develop the CI in Libya can result in two potential benefits. The progress in construction will eventually improve the lifestyle of people and the outcome of CI will be fed back to the system for accelerating the process of growth. Strategic management in Libya lacks a guideline of directing the outcomes of CI to the economic growth of the country. Therefore, the current research aims at proposing a guideline with the help of determining the relationship between CI development and economic growth. How can this be purpose be achieved? The method adopted is described in the next chapter

Chapter Four
Research Methodology

4.1 Introduction

In the Libyan economy the largest source of foreign exchange and a major financial resource of the nation is its abundant oil wealth, ever since the discovery of Libyan oil in 1950. This date synchronised with the independence of Libya from the Italian colonial system. This was the time when Libya lacked both institutional and civil infrastructure. Those that remained were destroyed by the revolutionary Arab regimes in order to remove any sign of colonialism from the Libyan soil. However, during late 1956, the Libyan monarch King Idris was successful in negotiating with Italian construction firms to complete their unfinished tasks in the country. In this way not only the properties owned by the Italian government were passed to the Libyan people and authorities but also a considerable amount of foreign reserves filled the accounts of the Libyan government (Obeidi, 2013). The establishment of the Libyan construction industry also resulted in the increase in skilled labourers. (Ngab, 2007, p. 202) has described construction in the independent Libya as a social activity rather than an organised economic industry. He also added that the conventional art of construction had passed through generations to generations, reflecting the cultures and values of Libyan Arab tribes. This is how the environment of public construction affected the status of the construction industry in Libya. After the attainment of political independence in the year 1969, the oil boom of 1970 followed, providing a lot of money for the revolutionary Arab leader Gaddafi to launch a new project for

public welfare and to strengthen the process of economic prosperity in the country. Libya witnessed voluminous and large-scale construction, resulting in the highest consumption of cement in the world by 1970 (Ngab, 2007, p. 202). Like all other industries in Libya, the construction industry also carried the influence of the dictatorial reign of Gaddafi. The country's development slowed after 1980, due to the reduction of oil-generated income. The construction industry was directly responsible for this because it was not well-enough established to provide (or support) economic growth. The Libyan construction industry (LCI) lacked planners, experts, designers and economists and thus it did not sufficiently consider Libya's social, geographical and economic circumstances (Grifa 2006, p. 60). Grifa added that the LCI has suffered many setbacks and hindrances because of rapid political and economic changes in the country. In such an unstable environment, operational problems have adversely affected the growth of the LCI.

In the previous chapters, it is observed that Libya is the one of the biggest oil economies of the Middle East. The country has made unchecked development since the exploration and export of oil goods. This wealth has been used to enhance the lifestyle of the Libyan population, with high-quality dwelling places being the first and foremost requirement. Huge civil engineering and construction projects have been initiated in the country, engaging both local and foreign labour. Thus, the construction industry has not only contributed to the metropolitan development of the country but also invited the foreign technology of construction via international construction firms. Besides generating skilful human resources, the construction industry of Libya has contributed to the GDP of the country. This chapter presents the research methodology that is employed in the research. Methodology depicts the procedure followed and approach chosen to achieve the objective of this research. The chapter

discusses different approaches and designs and the selects one of them to be applied. Moreover, the data collection sources are discussed.

4.2 Definition of 'Construction Industry'

Construction is defined by the Oxford Advanced Learner's Dictionary (7th edition) as "the process or method of building or making something, especially roads, buildings, bridges, etc". Grifa (2006, p. 116) has quoted The International Standard Industrial Classification of all economic activities (ISIC), defining construction as "General construction and special trade construction for buildings and civil engineering, building installation and building completion…". This process includes repairing old buildings, replacing an existing one with a new one, as well as executing a new building plan in order to fulfil a public and economic need. Thus, construction is responsible for maintaining a certain level of infrastructure in a country which is necessary to meet its social and economic needs.

According to the Merriam-Webster English Dictionary, industry means a habitual effort conducted by a distinct group of productive and profit-making enterprises, (www.merriam-webster.com). Industry is recognised from its product; hence, a construction industry is recognised from its work. The term "Construction Industry" is defined by the Business Dictionary as the sector of national economy engaged in preparation of land and construction, alteration, and repair of buildings, and other real property (www.buinessdictonary.com). The Construction Industry (CI) involves policy makers, planers, designers, engineers, contractors, sub-contractors and labourers as human resources to decide, design, approve, finance and execute a plan which is required for public welfare, economic development and providing employment to the people. The establishment of manufacturing facilities also comes

within the scope of the CI within a country. In so far as the cement and steel manufacturing industry assists the construction industry for the procurement of the materials of construction, it can be said that the CI is a broad organisation which transfers construction resources into the physical built environment (Grifa, 2006, p. 17). The CI is a sequential operation in which the process of construction takes place. In this process, all the raw materials manufactured by diverse systems of industry are assembled as one single product called construction. Serpell and Alarcon stated that the CI is seen as a set of processes and operations which transform construction inputs (materials and information) into completed or partially completed products. The revenue generated by the government is spent on new construction, and relocation, repair and establishment of new buildings; consequently, poor economic conditions in a country also influence its CI. Moavenzadeh and Rossow (1975) have mentioned that CI has to rely upon other industries for goods and services; the development of the construction industry therefore stimulates these ancillary industries, thus encouraging further economic growth. Hence CI is involved in the development of infrastructure in a country from fulfilling the very basic social needs of the public by providing shelters for them and improving their living conditions to paving the way to larger economic developments.

4.3 The Evolution of the Construction Industry in Libya

Libya is a country which has remained under diverse political leadership after its independence. This scenario has an impact on the socioeconomic life of the people of Libya and development of the country's institutions and industrial sector. Libya is an oil economy and oil forms the basis of the evolution of the construction industry. In 1950, construction in the country was traditional, based upon local skills and

contemporary building materials. Cement as an essential building element was not very popular - by 1964 it was used in only 2% of buildings (Ngab, 2007, p. 203). If we analyse the living situation of the people at the time, this is not surprising, for it has been discussed already that the first and foremost requirement of a construction industry is providing shelter to the people (Moavenzadeh and Rossow, 1975, p. 4). The CI developed out of social needs which were met by the traditional methods of construction. It was quite natural for the nascent country to develop a small-scale CI as compared to the wealthy and developed nations like the Kingdom of Saudi Arabia and those in the West.

The second stage of Libyan economic development started with the political revolution of 1969 made by Gaddafi. During 1970-2000, radical changes were made in all sectors of life and massive investments were made by the government to improve the living standards of the people. CI received special attention as development programmes were launched to meet the urgent infrastructure needs, such as roads, schools, hospitals and other buildings. The greatest construction boom started in 1970 and transformed an indigenous CI to a cement-based industry (Ngab, 2007, p. 203). The demand for cement reached 6 million tons and cement formed the essential ingredient in almost all Libyan construction. The traditional dry materials of construction were forgotten and the new materials derived from cement were consumed in all kind of buildings, regardless of the location, climate and environment (Tumi, 2009). Figure 4.1 shows the supply and demand relation of cement in the CI. Construction operations started to be conducted by small, organised firms under the supervision of professionals and skilled men

The Figure 4.1: The annual consumption of cement in the Libyan construction industry. Source: Ngab (2007, p. 204) originally presented here cannot be made freely available via LJMU digital collections because of copyright. The figure was sourced at bibliographic reference.

Figure 4.1: The annual consumption of cement in the Libyan construction industry. Source: Ngab (2007, p. 204).

The figure shows the annual consumption of cement in million tons, which is showing an increasing trend up to the year 2008. However, the year 1996 witnessed a drop in cement demand because of prevailing adverse economic conditions in the country as a consequence of the sanctions and a diminishing popularity of the Gaddafi government in Libya. The foreign policy change and the fostering of international relations of the Libyan government brought prosperity and progress in Libya.

At the time of revolution, the government decided to create shelters for more than 180,000 families (Salama, 2005). At this stage of construction, not only the government but the private sector investors also carried a great share in the development of CI. The government did not rely upon the local construction firms but professionals were hired from western nations like France, Germany, Spain, Italy and

Turkey. The road network was established and the people were given the property rights of their new and modernised residential homes. With the increase of comfort and the higher living standards, Libya also attracted a good number of immigrants from African countries as well as from the rural neighbourhoods of Benghazi and Tripoli. The process of urbanisation gave rise to demands in the major cities. The concrete and high-rise buildings were normal in the cities and they were erected without the distinction of place and location, which was detrimental to the agricultural trend in the country All of these factors contributed to raise the population of the urban areas, posing a challenge to the government to provide housing and facilities for the increasing population of the cities. These challenges led the government to engage more in construction-related activities. Despite all of its needs, the government had to cut its expenditure at the height of the crisis during 1986-2000, and the domestic construction activities were slowed down (Ngab, 2007, p. 205). However, there was still a demand for domestic construction; two studies conducted by the General People's Committee (2000) and the Secretariat of Services Affairs (2002) showed the housing crisis in Libya. These studies calculated that the housing shortage was around 165,000 dwelling units, and that national housing need would be around 492,000 dwelling units between 2002 and 2011.

At the time when the domestic construction was finished in the 90s, the greatest civil-engineering project of human history was underway: the "man-made river", made across the Sahara desert to provide a water supply to Libya's growing urban population. After the discovery of oil wealth, the search for fresh water in Libya began in 1953. Fresh water was found at the bottom of the Sahara desert in the southern part of the country. The fresh water aquifers covered a huge area in the country beneath the desert and, as described by Gaddafi, this water was a last hope for

the survival of the Libyan population settled on the Northern coastal strip. In the coastal urban areas, the population was multiplying and the existing water resources were at higher risk from the increased consumption as well as from the seawater intrusion from the coastline into the aquifer. Agricultural soils were threatened with infertility by the increasingly salty profile of the groundwater. The project cost 30 billion dollars, and deployed 4m diameter and 7m long pipes buried underground to carry water from south to north along a 4000km route from 13000 wells, each 500 metres deep. The total cost of the project was more than US $25 billion and the project was completed without the financial support of major countries or loan from the World Bank (School, 2012).

After 2000, due to the changes in the policies of Libyan dictator, Moammar Gaddafi, Libya witnessed a new era of international exposure. The government had to divert its attention from oil and gas, military, power generation and water projects towards high-scale building of cities, airports, roads, hotels and resorts for the next booming industry in Libya, which was tourism. To address domestic construction, home loans were extended to the people along with the privatisation of public sector firms, and private businesses were encouraged (Bilayib, 2006)

4.4 The Position of the Construction Industry in the Libyan Economy

The economy and the construction industry are interdependent and both eventually rely upon the political conditions of a country. At the time of Independence during 1950, Libya was a poor country. Having been based on agriculture, most of the workforce were employed in agriculture and related tasks. The discovery of oil wealth has changed the fate of tribal Arabs of Libya. Following the revolution and oil boom, Libya's economy was finally established as being based on oil. The revenue generated

by the oil sales to the international market urged the government to spend the money on improving the economic standards of the people. The money was spent on improving the living standards of the people and developing the coastline and to sustain the lavish urban lifestyle. However, a composite economic plan was still absent in the policies of the government. This is the reason why the CI in Libya was never characterised as a huge industry with greater economic developmental plans. The LCI has always been used to fulfil the policies of the dictator rather than towards its institutional development.

With the increase of GDP the share of the CI in the GDP of developed and developing countries also increases. A study constructed by the United Nations (1993) has shown that value added in construction represents between 3%-5% of GDP in most of the developing countries and between 5%-9% in most developed ones (Moavenzadeh and Rossow, 1975, p. 9). The United Nations (2006) has reported that the CI in Libya contributes to its GDP by 5.3%, which is very low in comparison to other oil economies. The OECD (Organisation for Economic Cooperation and Development) (2008) has highlighted seven main factors contributing to the GDP of the country; the following figure shows the contribution of these sectors.

Figure 4.2: GDP by sector in 2006. Source: OECD (2008, p. 376).

The figure shows the construction industry having a share of only 2.7% in the GDP of the country while the industry excluding petroleum is also 2.7%. The main reason behind this share is that Libya is an oil-based economy, whose decisions are made by the central dictatorial authority and huge revenue is earned from the hydrocarbon reserves. The second reason is the socialist economy of the country. Libya has invested 16.9% in the non-oil economic sectors, which is much more as compared to other countries having conditions similar to that of Libya (OECD, 2008, p. 378). This investment was not worthwhile because the Libyan economy did not have enough capacity to absorb this much investment. Tumi *et al.* (2009, p. 265) do not consider it wise to observe the CI in isolation, for even with this small share in GDP, the CI has influenced the economic growth. The CI has the unique character in the economy of the country, that it influences all other industrial sectors. In 2011, the new budget was announced for Libya in which public funding for the development of infrastructure

and other industrial developmental projects was promulgated. Under such radical policies for the development of the sector, the LCI witnessed a 9% year-on-year real progress, ranking it high globally (Africa Research Bulletin, 2011). According to the same report, the nominal growth in the LCI has remained 26%, with increasing talk of inflation in the industry because of increases in the material costs of construction. In the same budget, the four-year plan for domestic construction was also announced, with a proposed investment of 100 billion dollars. The economic prosperity and the presence of a huge population of young people are raising the demand for new facilities which can only be met by launching investment-intensive construction projects. The Libyan government also wants to diversify its financial resources in addition to the petroleum industry, to keep the economic wheel moving in the wake of another fuel price crisis.

4.5 Employment in the Libyan Construction Industry

Right after the political revolution, the life of the people was made comfortable by huge investment in the public sector. The construction industry has transformed traditional and indigenous builders into small businesses and they are occupied by well-educated professionals having skills and qualifications for the required job of construction. The increased standard of living increased the population of the country, creating huge human resources, while the employment opportunities were vanishing in the wake of economic crisis during 1986-2000. The OECD (2008, p. 383) has described a higher unemployment rate prevailing during 2003, which had remained at 17.1%. However, by 2006, the government had employed 60.7% of the workforce into the social services, launching new developmental projects in the country, most of which were ancillary industry to the CI. It was a huge step to convert the country into

a market economy and private sector businesses and manufacturing facilities were encouraged.

When the effect of sanctions was eroded and the international relations of the Libyan government were normal, the country was ahead of the rest of the African countries in meeting international standards of construction. The technology transfer agreement between Libya and the West paved the way for the professionals of the LCI to be aware of the advancements in the industry. Thomas and Dargusch (2011, p. 31) have reported that foreign investment paved the way for the modernised infrastructure in the country; for this, engineers and management professionals of the Libyan CI were assessed and were given appropriate training in new technologies and knowledge in which they were lacking . However, being in an oil economy, Libyan people were less attracted to the education of construction-related skills. For mega projects launched in the country, the government has to rely upon foreign labour from the West and Asian countries (Antipolis, 2002, p. 18). The political economy of Libya was directly related to its foreign relations. When the sanctions were imposed, the foreigners, alongside Libya's skilled labourers, left Libyan soil, leaving all of the construction projects unfinished (Grifa, 2006, p. 109). Libya's skilled professionals were left out of jobs in the CI because of lack of investment in the industry by the government itself.

The greatest hindrance in the hiring process of the workforce is the socialist law of the country (Green Book). According to this rule, a Libyan cannot be a wage earner; instead he should be a partner in the enterprises. Therefore, the only way left for the local indigenous workforce to be involved in the CI is through informal construction activities. Such groups of workers are either self-employed or part of an unregistered workforce providing services to the Libyan construction industry. Consequently, most of the small firms doing construction business around the capitals were illegal and

their working statistics were never taken into account. On the other hand, the formal construction firms were those having registered with the official authorities and having a good number of foreigners, mostly immigrants from neighbouring African countries and the poor Asian countries. This is the main reason behind the fact that the Libyan CI workforce had remained unknown.

At the time of crisis, in order to maintain economic balance, the government created employment for the people within its own structure. The employment generated by the services sector of the government also includes the civil engineering department. At that time, Gaddafi was also working on the idea of water supply, hence the larger number of skilled labour and the professionals were hired by the government in that project. Similarly, when the government adopted the policy of developing tourism, the CI diverted its approach towards the development of resorts, roads and recreational places (Antipolis, 2002, p. 26). Hence, the CI in Libya has remained as part and parcel of all of the developmental projects from their execution to the maintenance and repair. However, it did not work well under the severe economic conditions of the country because developmental projects and policies of the government were dependent upon the oil revenue.

4.6 Research Approach

Two broad categories of research in terms of approach are employed to reach conclusions: inductive and deductive. The inductive research approach directs the process from specific observations to general knowledge while the deductive research approach directs the process from general observations to specific knowledge. The approach chosen in this research is inductive. Hence, specific information at specific times is processed to reach the general conclusion. The inductive approach is more

scientific in nature than the deductive approach as the conclusion in the inductive approach is drawn based on observations rather than theories. The inductive approach is also known as a bottom-up approach, which is a process of using particular instances to infer a general law. The process is a three-step method: (1) systematic observation of the under-investigation phenomenon, (2) identification of themes or pattern in the observation, and (3) development of the theory with the help of the pattern observed. Following is a schematic representation of inductive approach.

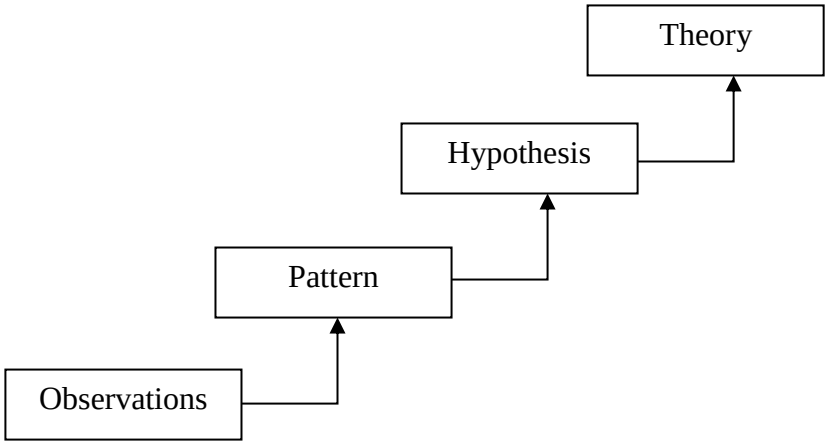

Figure 4.1: Bottom-up Approach of Research

Observations are the in form of review of the literature and collection of data. Pattern in the collected data are observable via different statistical methods. Another range of statistical method could test the hypothesis, whose results lead to the conclusion of the research, which is a new theory or extension of an existing theory.

4.7 Philosophy behind the Research Approach

The research philosophy is the confirmation about the data that are obtained through a specific procedure and later it is analysed. The current research study covered case study approach as took the case of Libya and secondary sources thus, it is considered as Positivism. In positivism research philosophy, subjective information is derived from analysis of logical and mathematical models. Thus, research is performed under

the perspectives of sources of knowledge available for the study. The findings and views obtained through the positivism approach are based on scientific postulates and derive from empirical findings that are holding the views for the society according to the laws, which are particular for each case. This sort of research approach is useful in order to obtain the full understanding of the natural environment and the researchers could not avoid the factors, which may affect the phenomena of the research study, since case study and secondary sources have several forms but the researcher has the reasonability to maintain the exact meaning of the scientific knowledge. Thus, positivism philosophy has a glorious approach and it includes a variety of details (Myers, 1997).

4.8 Research Method

In general, there are two kinds of methodology used in explaining hypotheses and analysing data, Quantitative and Qualitative. This section is an in-depth comparison of quantitative and qualitative methods and their features as found in the literature. After a brief comparison, the chosen method will be stated.

4.8.1 Qualitative Method

The qualitative approach is based upon developing a hypothesis, for example, based upon the actual scenario in the construction industry. At the next stage, this hypothesis is judged against the literary evidence of the facts and by interviewing experts. The qualitative approach relies primarily on the collection of qualitative data in the form of words, pictures, and objects. This method is employed in many different academic disciplines traditional in social sciences. The qualitative approach introduces information only on particular hypotheses and Quantitative methods can be used to verify which of such hypotheses are true (Lazo, 2010). In addition, it aims to

gather in-depth understanding of human behaviour and involves the extensive study of the claims made by the researcher according to the previously conducted work. For example, the common qualitative approach is based upon Delphi test. Sultan (2005) has employed this test to find out the importance of the construction industry in Yemen. This test is utilised in qualitative research. Hypotheses help in developing a survey questionnaire encompassing the objectives of the research. This questionnaire is further used to conduct a census among the market experts and the personnel involved in the economic policy making for the construction industry in a country. The collecting the Evidence is the next stage of qualitative testing in which the facts provided by the market experts are analysed according to the actual industry reports, in order to accept or reject the hypothesis. The cumulative result may be demonstrated in bar graphs to represent the profitability percentage of the industry. Once the results of the qualitative study are analysed, a conclusion is drawn either confirming a hypothesis or putting forward a new fact. Qualitative analysis is preferred when the empirical study of the statistics is required. Qualitative analysis is based upon empirical analysis of the facts, which is made after the evaluation of the survey questionnaire

4.8.2 Quantitative Method

The quantitative approach depends upon the collection of quantitative data such as statistics and percentages. This approach uses a number of methods and models such as time-series analysis and input-output analysis, and often it contains descriptive statistics and inferential statistics in order to test the raw data and to unveil the facts accordingly. In other words, it is the process of presenting and interpreting numerical data. The objective of quantitative research is to employ mathematical models,

theories or hypotheses pertaining to phenomena. Quantitative method is widely used in social sciences such as economics, marketing and political science (Bryman,2006)

Table 4.1 presents a comparison between quantitative and qualitative approaches to make obvious the main differences between them.

	Quantitative	**Qualitative**
General Framework	Seek to confirm hypotheses about phenomena. Instruments use more rigid style of eliciting and categorising responses to questions. Use highly structured methods such as questionnaires, surveys and structured observation.	Seek to explore phenomena. Instruments use more flexible, iterative style of eliciting and categorising responses to questions. Use semi-structured methods such as in-depth interviews, focus groups and participant observation.
Data Formats	Numerical	Textual
Analytical Objectives	To quantify variation. To predict causal relationships. To describe characteristics of a population.	To describe variation. To describe and explain relationships. To describe individual experiences. To describe group norms.
Question Formats	Closed	Open-ended
Flexibility in Study Design	Study design is stable from beginning to end. Participant responses do not influence or determine how and which questions researchers ask next. Study design is subject to statistical assumptions and conditions.	Some aspects of the study are flexible. Participant responses affect how and which questions researchers ask next. Study design is iterative, that is data collection and research questions are adjusted according to what is learned

Table 4.1: Comparison between quantitative and qualitative methods
Source: Ahmed (2011)

In light of the above analysis, this research employs the quantitative method of study. As the objectives of this study are to propose a guideline and recommendations for development of the construction industry in Libya, this requires generalising the findings. It is observed that results obtained via a quantitative method are easier to generalise than that obtained via a qualitative method

4.9 Collection of Data

The data for the analysis will be provided by the authority of the Libyan construction industry. This data will comprise the capital amount invested for the development of the construction industry in Libya against its share in the GDP of the country for those respective years. The unit of the investment used in this research is million Libyan dinar. The authentication of this data can be obtained from the Central Bank of Libya and the Ministry of Planning of Libya. The figures are collected from the financial data during 1986-2009. This period was chosen for two reasons: the first reason is the shortage in data and the second reason is that Libya during this period went through economic and political crises, which influenced economic growth and the construction industry. These are finalised figures also attested from the economic census of the country. These data do not contain the information on profit or loss statements during these years. The following data are analysed in this study through the econometric computer software called Eviews.

YEAR	Expenditure on the Construction Industry	GDP of the construction Industry	Total Gross Domestic Product
1986	316.3	492.6	6960.7
1987	219.4	411.2	6011.6
1888	236.2	383.8	6186.0
1989	269	451.4	7191.0
1990	206.6	457.8	8246.9
1991	169.5	339.9	8757.3
1992	66.8	458.8	9231.9
1993	0	513.4	9137.7
1994	43.6	493	9670.8
1995	49	477.9	10672.3
1996	86	671.5	12327.3
1997	95	702.9	13800.5
1998	80.9	713	12610.6
1999	130.5	803.6	14075.2
2000	234.1	1087.1	17620.2
2001	299.5	1538	21868.5
2002	471.7	1935.1	30549.4
2003	195.4	1787	37640.0
2004	346.6	2159.2	48159.0
2005	343.1	2683.5	66618.6
2006	2733.2	3129.3	79029.9
2007	3724.39	4198.4	92693.6
2008	10962.84	5994.5	116639.6
2009	8978.5	7577.5	86288.9

Table 4.2: Expenditure on the construction industry and GDP at constant prices with Million Libyan Dinar
Source: Ministry of Planning – Libyan National Accounts 1986-2000, Central Bank of Libya, Economics Bulletin 2000-2009

Year	Cons	Agri	Manufact	Mining	Trade	Transport	G-l Services	Other Services	Electricity
1986	492.6	384.7	359.6	2654.9	636.0	484.6	1063.3	103.3	116.6
1987	411.2	471.2	334.5	1944.1	660.8	552.3	967.7	117.5	119.1
1988	383.8	423.3	397.2	1654.9	721.1	599.7	1203.7	133.8	123.1
1989	451.4	439.8	412.3	2157.8	779.6	596.5	1421.3	152.4	173.0
1990	457.8	482.9	457.6	3349.4	789.5	645.8	1147.7	174.2	152.2
1991	339.9	542.4	476.1	3215.7	873.9	703.2	1653.9	198.7	181.6
1992	458.8	630.2	555.0	3151.1	926.5	747.4	1896.8	226.2	169.0
1993	513.4	708.8	699.6	2603.2	1176.3	786.0	1684.0	230.4	193.2
1994	493.0	827.9	604.0	303.4	1148.8	804.2	1740.7	233.9	203.8
1995	477.9	933.4	743.1	3512.9	1267.1	905.4	1729.8	254.6	216.7
1996	671.5	1174.5	702.9	4147.8	1488.0	986.2	2020.9	295.2	232.3
1997	702.9	1267.0	818.6	4702.7	1619.9	1129.0	2303.5	326.0	244.1
1998	713.0	1394.3	779.3	2984.2	1714.4	1167.6	2524.4	337.2	259.9
1999	803.6	1449.9	863.1	4219.2	1693.3	1211.7	2429.2	358.6	270.4
2000	1087.1	1437.7	889.7	7374.6	1685.9	1213.9	2665.8	391.5	270.0
2001	1538.0	1392.2	877.8	3652.5	1882.4	1299.3	2901.4	411.1	284.6
2002	1935.1	1348.8	813.1	13712.7	2089.5	1429.2	3222.3	427.5	293.7
2003	1787.0	1375.8	1991.9	16165.2	2075.9	1812.0	3606.5	451.2	303.1
2004	2159.2	1439.3	2451.8	29277.9	2194.9	1944.0	3558.6	441.0	734.3
2005	2683.5	1447.5	3124.8	44121.5	2657.5	2412.6	4481.9	470.0	876.6
2006	3129.3	1643.1	3602.6	35953.3	2863.3	2724.2	4935.1	533.0	972.7
2007	4198.4	1905.3	4032.1	62397.1	3396.3	3299.5	6507.3	364.3	1019.1
2008	5994.5	2247.9	4888.8	18277.3	3949.5	3884.2	6670.7	643.1	1204.5
2009	7577.5	2382.7	5447.6	47231.2	4298.1	4125.8	687.8	705.5	1334.6

Table 4.3: Gross Domestic Product of the economic sectors in Libya (1986-2009) at cost factor price.

Source: Ministry of Planning – Libyan National Accounts 1986-2000, Central Bank of Libya, Economics Bulletin 2000-2009.

4.10 Variables' Definitions

1. *Gross Domestic Product*: (GDP): The monetary value of all the finished goods and services produced within a country's borders in a specific time.

2. *Expenditure on Construction***:** The actual expenditure on the construction as investment in a specific time.

3. *The GDP of each Economic Sector*: The value of a sector's output in a specific year at market price (investopedia.com, n.d).

According to a classification of the Libyan economic sectors, Trade sector includes Hotels and Restaurants, General Services sector includes Health and Education Services, Transportation sector includes Telecommunications (Economic Bulletin 2010).

4.11 Research Methodology: Granger Causality Tests

There are two analytical tools that have been widely used for measuring the relationships between economic variables: (i) Leontief's input-output analysis and (ii) an econometric method based on Granger causality tests. The application of input-output analysis is hampered by the unavailability and unreliability of data, which seem to be common problems in the developing countries (Miller, 1996). Libya, as a developing country, is suffering from the same problem. Therefore, in this study Granger causality tests were conducted to examine the relationship between the CI and GDP, as well as to analyse the linkages between the CI and other economic sectors in order to determine the causal effects among sectoral output changes. Granger causality is a statistical concept that is commonly used to investigate the relationships between economic variables. The causality test aims to verify that the knowledge of the past value of one variable is useful in forecasting another (Seth, 2007).

There are plenty of reasons behind choosing the Granger causality test to determine an accurate relationship between the industrial growth and the economic progress. First, the Granger causality test indicates the respective growth in the economy by the per capita contribution of the construction industry (Mozumder and Marathe, 2007). The second reason is that the policy of financial development which was introduced for MENA (Middle East and North Africa) countries requires the causality test to determine the integrated development in the economy (Kar *et al.*, 2011). The raw data for this study are based upon time series. The economic data presented in relation to GDP can cause a positive shock to the economy of a country on a long-term basis. So the Granger causality test is used because of the presence of multiplier factors for the

future shock adjustments (Beaudreau, 2010). In this way, this test could help in formulating the fiscal policy of the country on the basis of the results and facts.

The economic series data may comprise fragments of data collected on a day-by-day basis or year-by-year basis. It became complicated to analyse data of such variable frequency. In most of the tests, high-frequency data are often ignored and not included in research studies. The Granger causality test does not waste any of the data; instead it makes use of heterogeneous data in a way that both high and low frequencies are analysed symmetrically (Ghysels and Valkanov, 2009). In this test two data series, X and Y, are used; the Granger test is to use the data series I (1) due to the super consistency in the properties of the estimation (Ozkan *et al.*, 2012), where, Y is used for low frequency data series and X is used for a high frequency data series..

The Granger causality test helps in determining the causal relationships between GDP and construction industry growth in Libya, and determine the linkages between the construction industry and other economic sectors. The purpose of this selection is not the annulment of the qualitative approach as a research method. The purpose of the research is to use the best possible research technique according to the data provided for the research and the outcomes expected from it.

Time-series data are based upon the economic statistics. Though these data are already evident from the economic census of the country, we still need some statistical tests to check the reliability of that data. These will include unit root tests.

4.11.1 Unit-Root Test

The unit root test is applied to determine where the time series is stationary or non-stationary and the data shows a set of variable economic situations, so it is obvious that the results of these tests will be variable as well. A time series is said to be stationary if it shows the tendency of returning to its mean value in a more or less constant range (Harris, 1995). By another meaning, the data are stationary if their views fluctuate around their mean which is constant and equal to zero. The unit root test is very important because if the series is non-stationary, this means that it has means and variances that changed over time because of reasons such as inflation, exchange rate, interest rate and unemployment and using non-stationary data in the model will lead to a problem of spurious regression, whereby the findings show statistically significant relationships between the variables in the model, but in fact, that is implying contemporaneous correlation rather than true causal relationships (Granger and Newbold, 1974; Harris, 1995). The order of integration is determined by the number of times that the data has to be differenced to become stationary. If the data becomes stationary at d times of differences, it is said to be integrated to order I(d). Two tests encompass the two following tests:

(i) Augmented Dickey Fuller Test (ADF)

The reason for performing regression analysis using (ADF) unit root test is that the error term will be lagged independent (Ozkan *et al*, 2012). The ADF is based upon the expression in equation (1)

$$\Delta Y_t = \alpha + \rho Y_{t-1} + \delta T + \sum_{i=1}^{n} b_{1i} \Delta Y_{t-i} + \varepsilon \quad ti = 1, 2, \ldots \qquad (1)$$

Where $\Delta Y_t = Y_t - Y_{t-1}$, is deemed as a drift term, α is a constant term, δ is a coefficient on a time term, T indicated the time trends along the null hypothesis, H_o: ρ

$= 0$ and its alternative hypothesis H1 : $\rho \neq 0$,where ρ is the least square estimate, n shows the number of lags while ε is the indication of error in the data.

(ii) Phillip Perron (PP) Test

PP test is used to fit the regression analysis made by the ADF test (Phillip Perron). The PP test is based upon the following mathematical equation

$$y_i = \alpha + \rho y_{i-1} + \epsilon \qquad (2)$$

In this equation, i= 1,2,3,….. Also, in this test, the regression is y on lagged y.

In both tests, the time series is determined to be stationary or non-stationary by comparing the calculated value with the critical value at 1%, 5% and 10% of significance level. A time series is said to be stationary if the calculated value is bigger than the critical value.

The PP test corrects any serial correlation in the error non-parametrically by modifying the ADF. Also, the user of PP test does not have to specify a lag length as in the ADF test. A lagged value means that the independent variable is distributed over a number of past values. They are important explanatory variables in most economic relationships because economic behaviour in any one period is determined by past experience and past patterns of behaviour.

4.11.2 Engle-Granger Co-integration Test

In this test, the Engle-Granger co-integration test is used to determine the accuracy of co-integration in the data series. In addition to that, this test is conducted to make sure that there is an equilibrium long-run relationship between variables and it is helpful in determining the long-term economic impacts of the data used in the study. The Engel-Granger test proceeds in two steps. The first step involves the following static Ordinary Least Square (OLS) regression for estimating β_1

$$y_t = \beta_0 + \beta_1 x_t + u_t \quad (3)$$

In this equation x and y are the non-stationary series and u_t is the residual data. The time series are said to be co- integration if the residual is itself stationary. In effect, the non-stationary I(1) cancels the values of each other generating the stationary I(0) residual. So, the second step is running a Dickey Fuller regression analysis on the residuals to determine if it is stationary. This test will be based upon the equation:

$$u_t = \gamma u_{t-1} + \eta_t \quad (4)$$

Where u_t is the residual, γ is a parameter of the lagged residual and η_t is an error.

The regression is based upon a hypothesis, which in turn defines the existence of co-integration. Ozkan *et al.* (2012) have supported the view of Engle and Granger that if the hypothesis $\gamma = 0$ and there will be a unit root negating a co-integration between the series. Otherwise, if γ is smaller than that of a critical value, the residuals will be stationary. Despite the application of two units root tests the error in the data series is not eliminated yet. The single-error correction model is applied for this reason.

The Engle-Granger co-integration model will provide the co-integration between the data series by eliminating the error through ECM (Error Correction Model).

4.11.3 Error Correction Model

Co-integration implies the existence of Granger causality but it does not indicate the direction of the causal relationship. The dynamic Granger causality can be obtained from the vector error correction model (VECM) derived from the long-run co-integration relationship. Engel and Granger (1987) showed that if the two time series (X, Y) are co-integrated, the VECM will be written as follows:

$$\Delta Y_\tau = \alpha + \sum_{i-1}^{k} \beta_i \Delta Y_{\tau-i} + \sum_{i=1}^{k} \gamma_i \, \Delta X_{\tau-i} + \delta \varepsilon_{\tau-1} + \mu_\tau \quad (5)$$

$$\Delta X_\tau = \alpha + \sum_{i-1}^{k} \beta_i \Delta X_{\tau-i} + \sum_{i=1}^{k} Y_i \ \Delta X_{\tau-i} + \delta \varepsilon_{\tau-1} + \mu_\tau \qquad (6)$$

Where $\varepsilon_{\tau-1}$ refers to the error correction term derived from the long-run co-integration relationship. VECM is a useful method for testing the long-run and short-run relationships between the model variables.

The above tests have been applied to achieve the objective of determining the causal relationship between the construction industry and GDP. For achieving the objective of determining the causal relationships between the construction industry and other economic sectors, the pairwise Granger causality test has been applied instead of the VECM to indicate the direction of the causality relationship. In this case, the main issue in validating this objective is to make obvious the interdependences between the construction industry and other economic sectors in the short run not in the long run. Whereas, if the two time series are stationary at the same order, that suggests that there is a possibility to apply the pairwise causality test to indicate the direction of the short-run causal relationship between the two variables (Farag, 2010). This information would help to arrange economic policies to achieve economic development in the future.

4.11.4 Pairwise Granger Causality Test

The Pairwise Granger causality test indicates the direction of the causality relationship in the short run and two data series, X and Y are used; the Granger test is to use the data series I (d) due to the super consistency in the properties of the estimation (Ozkan *et al.*, 2012).The equations are as follows:

$$x_\tau = \alpha_0 + \sum_{i=1}^{m} \propto_{1i} x_{t-1} + \sum_{i=1}^{n} \alpha_{2i} \ y_{t-1} + \mu_t \qquad (7)$$

$$y_\tau = b_0 + \sum_{i=1}^{q} b_{1i} \, y_{t-1} + \sum_{i=1}^{r} b_{2i} x_{t-1} + v_t \qquad (8)$$

In these expressions, the values of μ_t and $v_t$with respect to t are uncorrelated and white noise error term series; however, they are only random variables of distributive nature. The random variable is an un observer random variable which may be positive or negative or equal zero and it is assumed to be an independent variable. Random errors μ_t and v_t include any factors that randomly affect the dependent variable but it is neglected and does not appear. The variables m, n, r and q are the optimal lag lengths and they are determined by Schwarz Bayesian Criterion (SBC) or log-likelihood ratio (LR) tests.

After confirming the stationary of each time series, the Granger causality may be determined. In Granger causality test, the two variables are usually analysed together, while testing for their interaction. Y Granger causes X if the coefficients of α_{2i} are statistically significant. This can be tested by performing an F-tests of the null hypothesis of $\alpha_{2i} = 0$, given assumptions of covariance stationary on X and Y. The reverse causality holds if coefficients of b_{2i} are statistically significant while α_{2i} are not. However, if both α_{2i} and $b_{2i}$are statistically significant, then there is a bi-directional causality between the two variables (Khan, 2008)

4.12 Summary

This chapter has presented the condition of the Libyan construction industry, showing that it has suffered many setbacks and hindrances because of rapid political and economic changes in the country. In such an unstable environment, absences of appropriate technical coupled with operational problems have adversely affected its growth. This chapter has provided a background for the discussion of the empirical results in chapter six of this thesis. Moreover, this chapter has presented a comparison between quantitative and qualitative methods and has then explained the quantitative

methods, which have been applied in this thesis. To validate the objective of examining the causality relationship between the construction industry and gross domestic product, Granger causality tests have been applied. This method includes a unit root test, which has been applied through Augmented Dickey Fuller test and Phillip Perron test; these tests are to determine that the time series is stationary or non-stationary. Then the co-integration test has been applied to determine the accuracy of the causality relationship in the long-run period; and then, to indicate the direction of the causality relationship between the two variables, the error correction model has been applied.

For validating the objective of examining the relationships between the construction industry and other economic sectors in the short-run period, the unit root tests and the pairwise Granger causality test have been conducted. The following chapter reviews and discuss the results.

Chapter Five

Data Analysis and Results' Discussion

5.1 Introduction

The review of the literature revealed that the construction industry plays a significant role in strengthening the economy of a country, which in turn leads to growth in other economic sectors. To have empirical evidence of the effect of the construction industry on GDP and other economic sectors, it was important to conduct a statistical regression analysis on expenditure on the construction industry, GDP and other economic sectors.

In this chapter, the results of the analysis conducted on the selected time-series data are presented. The chapter details not only the empirical results but also their relationship with the findings reported in previous studies as well as their limitations and scope.

5.2 Evaluation of Results for the First Objective

The first objective of the study was to investigate the strength and direction of the causal relationship between the CI and GDP. Before conducting the regression analysis, a unit root test was conducted to confirm that the given time series are stationary. This was conducted to avoid the spurious regression problem caused by non-stationary series. After that, the co-integration between the two time series was tested to ensure that there can be a long-term relationship between the two. Granger

Causality Test was then conducted to test the direction of the causal relationship. All variables were expressed in natural logarithm so as to minimise the scale effect.

5.2.1. Unit Root Test

With reference to the unit root tests in Chapter four, the ADF and PP tests have been applied to the Libyan construction industry (LCI) and Gross Domestic Product (GDP) for determining the stationary of data. The results are presented in Table 5.1 and Table 5.2 as follows:

Variable	Calculated value	5%	Test	
LCI	-1.601385	-3.632896	ADF	Constant, Linear Trend
	0.554714	-1.957204	ADF	None
DLCI	-3.938142	-3.644963	ADF	Constant, Linear Trend
	-3.457135	-1.958088	ADF	None
D2LCI	-5.169486	-3.658446	ADF	Constant, Linear Trend
	-5.482890	-1.959071	ADF	None
LCI	-2.223093	-3.622033	PP	Constant, Linear Trend
	0.372916	-1.956406	PP	None
DLCI	-8.629436	-3.632896	PP	Constant, Linear Trend
	-6.033462	-1.957204	PP	None
D2LCI	-29.82677	-3.644963	PP	Constant, Linear Trend
	-29.68276	-1.958088	PP	None

LCI: At level, DLCI: At first differences, D2LCI: At second differences

Table 5.1: Unit Root Test of Expenditure on the Libyan Construction Industry

Table 5.1 reports the ADF and PP test statistics of the natural logarithm of LCI. The results from the ADF test indicated that the LCI time series is non-stationary in its level form, since the null hypothesis of the unit root with and without trend cannot be rejected at 5% significance level because the calculated values (1.60, 0.55) were less than the critical values at 5% significance level (3.63, 1.95) . The ADF results at first differences DLCI and at second differences D2LCI rejected the hypothesis of the existence of a unit root at 5% significance level because the calculated values (5.16, 5.48) were more than the critical values (3.65, 1.95). Therefore, the LCI time series is

stationary at first and second differences. The PP test confirmed this result due to its large calculated values.

Variable	Calculated value	5%	Test	
LGDP	-1.739469	-3.632896	ADF	Constant, Linear Trend
	1.356693	-1.957204	ADF	None
DLGDP	-2.163184	-3.644963	ADF	Constant, Linear Trend
	-1.606544	-1.958088	ADF	None
D2LGDP	-3.774185	-3.658446	ADF	Constant, Linear Trend
	-3.846151	-1.959071	ADF	None
LGDP	-2.125642	-3.622033	PP	Constant, Linear Trend
	-1.375621	-1.956406	PP	None
DLGDP	-3.754075	-3.932896	PP	Constant, Linear Trend
	-1.393391	-1.957204	PP	None
D2LGDP	-5.846214	-3.644963	PP	Constant, Linear Trend
	-5.839391	-1.958088	PP	None

Table 5.2: Unit Root Test of Gross Domestic Product

Table 5.2 presents the ADF and PP tests of the nature logarithm of the LGDP time series. The ADF test reported that the time series was stationary just at the second differences D2GDP, because the calculated values (3.77, 3.84) were more than the critical values at 5% significance level (3.65, 1.95). The PP test confirmed this result due to its calculated values.

On plotting the two series on graph, Figures 5.1 and 5.2 were obtained.

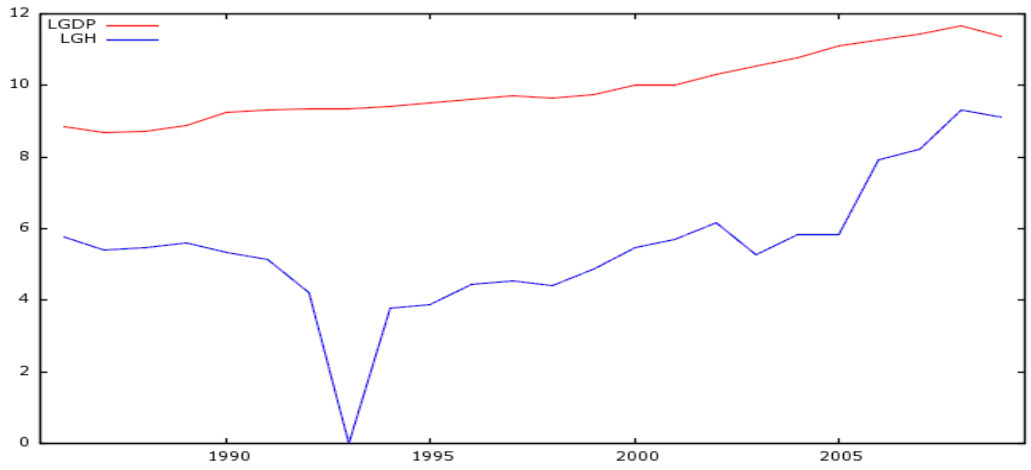

Figure 5.1: Time series of Gross Domestic Product (GDP) and Expenditure on the Libyan construction industry (LCI)

In Figure 5.1, the vertical axis indicates to GDP and CI values, while the horizontal axis presents the time series year from 1986 to 2009.

In Figure 5.2, the vertical axis shows the t-distribuition through the study period.

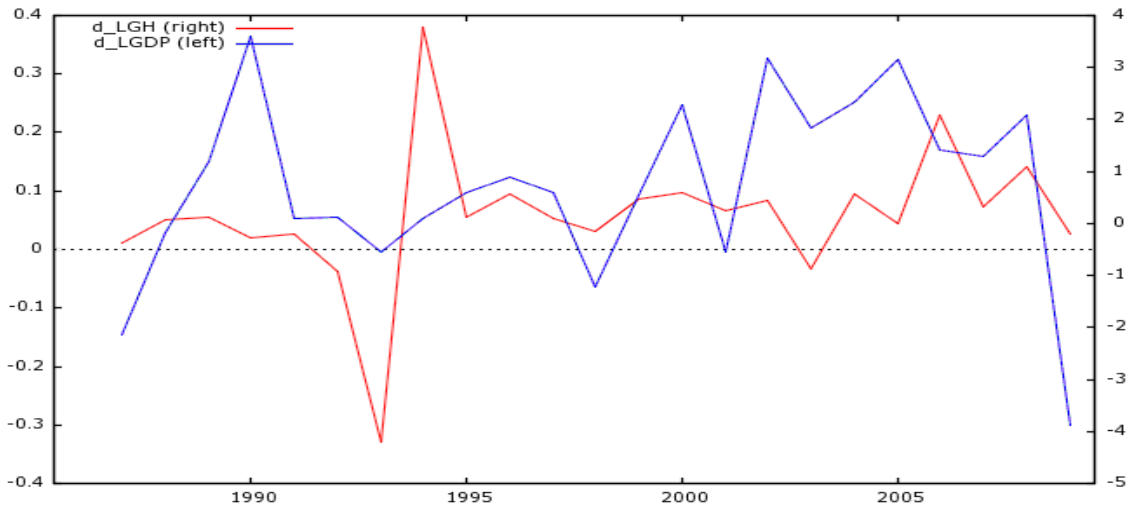

Figure 5.2 Time series of gross domestic product (GDP) and expenditure on the Libyan construction industry (LCI) stationary at the second differences.

The figure shows the time series curves are fluctuated around the dashed line which presents the mean = 0; this fluctuation means the data are stationary.

5.2.2. Engle-Granger Co-integration Test

The null hypothesis of this test was there is no co-integration and the alternative hypothesis was there is co-integration between the variables.

Table 5.3 shows the result of the co-integration test for the residuals of regression for the two variables RCI and RGDP. As can be seen, the test's results reject the null hypothesis due to the critical value at 5% significance level, which was less than the calculated value, and, therefore, the residuals of the two variables' regression are stationary. Thus, the two series are co-integrated. As mentioned in Chapter four, since the residual of the two variables are stationary that means there is a long-run relationship between LCI and LGDP

Variable	Calculated value	5%	Test	
RGDP	-1.924568	-1.632896	ADF	Constant, Linear Trend
	-2.025552	-1.957204	ADF	None
	-2.425511	-1.622033	PP	Constant, Linear Trend
	-2.128940	-1.956406	PP	None
RCI	-1.736963	-1.632896	ADF	Constant, Linear Trend
	-2.049669	-1.957204	ADF	None
	-2.312022	-1.622033	PP	Constant, Linear Trend
	-2.513506	-1.956406	PP	None

Table 5.3: Unit Root Test for Residual of the two variables

RCI: Residual of the construction industry. RGDP: Residual of gross domestic product. Appendix 1 pp. 133-134 shows the figures of the residuals.

5.2.3 Vector Error Correction Model (VECM)

Co-integration between the two series implies the existence of Granger causality between them. So, to find out the direction of the causality relationship, the vector

error correction (VEC) model was employed. The advantage of using this model is that it can determine the relationship between two variables in the both short and long run. The results are represented as follows:

When the pendent variable is LCI the direction of the causality relationship is as follows:

The critical values of the F distribution at a specific significance level are provided in statistical tables' indexes in all statistical books. These tables with their sources are given in Appendix 1 pp. 139-141.

Significance level	%1	%5	10%	25%
Critical value	4.32	2.79	2.21	1.48

Regression Equation	F-statistic	Lagged	Direction of causality
DLCI/DLGDP	5.72828	2,2	DLGDP to DCI

The large value of F-statistics 5.72 indicate that, in the short run, there is a causality relationship running from GDP to the construction industry

Regression Equation	Coefficient	T-statistic for error correction vector	Direction of causality
DLCI/DLGDP	1.5079	2.7834	DLCI to DLGDP

However, in the long run there is no causality relationship from GDP to the construction industry. This result is due to the non-significance value of the T-statistic for error correction vector; it was more than zero (2.78).

When the dependent variable is GDP, the direction of the causality relationship is as follows:

Significance level	%1	%5	10%	25%
Critical value	4.58	2.93	2.29	1.48

Regression Equation	F-statistic	Lagged	Direction of causality
DLCI/DLGDP	0.912804	1,1	DLCI to DLGDP

The small value of F-statistics indicate that, in the short run, there is no causality relationship from the construction industry to GDP

Regression Equation	Coefficient	T-statistic for error correction vector	Direction of causality
DLCI/DLGDP	0.0174317	-0.4748	DLCI to DLGDP

However, in the long run there is a causality relationship running from the construction industry to GDP because the error correction vector is significant, it is negative value

5.3 Evaluation of Results for the Second Objective

In this section, the unit root tests have been applied for determining the stationary of economic sectors' time series individually. After achieving the stationary data, a Pairwise Granger causality test has been conducted to indicate the causal relationship between the construction industry and other economic sectors.

5.3.1 Unit Root Test: Table 5.4 presents results of the ADF and PP unit root test on the output of Agriculture, Construction, Electricity, General Service, Manufacturing, Mining & Oil, Trade, Transport and Other Services.

VARIABLES at level	ADF		P.P		Situation
	calculated value	t-statistic (5%)	calculated value	t-statistic (5%)	
AGRICULTURE	-3.157427	-3.644963	-1.572560	-3.622033	Non stationary at level
	2.157548	-1.957204	3.572179	-1.956406	Non stationary at level
CONSTRUCTION	3.512263	-1.956406	-2.194778	-3.622033	Non stationary at level
	-1.509924	-3.622033	3.505008	-1.956406	Non stationary at level
ELECTRICITY	2.674977	-1.956406	-1.496780	-3.622033	Non stationary at level
	-3.548643	-3.632896	2.858970	-1.956406	Non stationary at level

GENERAL SERVICES	-0.305870	-1.956406	4.274979	-3.622033	Non stationary at level
	-1.568181	-3.622033	-0.305873	-1.956406	Non stationary at level
MANUFACTUR	2.874314	-1.956406	-1.517203	-3.622033	Non stationary at level
	-3.504763	-3.622033	2.874314	-1.956406	Non stationary at level
MINING_OIL	0.952585	-1.957204	-3.469590	-3.622033	Non stationary at level
	-1.091368	-3.673616	1.313110	-1.956406	Non stationary at level
OTHER SERVICES	0.413809	-1.961409	-3.311302	-3.622033	Non stationary at level
	-1.823880	-3.622033	3.914506	-1.956406	Non stationary at level
TRADE	5.956746	-1.956406	-1.823880	-3.622033	Non stationary at level
	-0.391310	-3.622033	6.980281	-1.956406	Non stationary at level
TRANSPORTATION	7.394408	-1.956406	-0.491901	-3.622033	Non stationary at level
	-3.446793	-3.632896	6.462283	-1.956406	Non stationary at level
At First Differeneces					
AGRICULTURE	-2.596919	-1.957204	-3.621518	-3.632896	Non stationary at first differences
	-6.188532	-3.644963	-2.665492	-1.957204	Stationary at first differences
CONSTRUCTIO	0.457335	-1.960171	-9.877435	-3.632896	Stationary at first differences
	-5.034999	-3.632896	-2.698302	-1.957204	Stationary at first differences
ELECTRICITY	-3.837407	-1.957204	-5.035975	-3.632896	Stationary at first differences
	-0.883299	-3.632896	-3.875048	-1.957204	Stationary at first differences
GENERAL SERVICES	-1.451786	-1.957204	-1.031453	-3.632896	Non stationary at first differences
	-5.393009	-3.632896	-1.449225	-1.957204	Non stationary at first differences
MANUFACTUR	-3.831475	-1.957204	-5.393009	-3.632896	Stationary at first differences
	-7.067628	-3.632896	-3.890963	-1.957204	Stationary at first differences
MINING_OIL	-7.100471	-1.957204	-10.08518	-3.632896	Stationary at first differences
	-4.211605	-3.673616	-7.335988	-1.957204	Stationary at first differences
OTHER SERVICES	-2.085535	-1.961409	-8.531292	-3.632896	Stationary at first differences
	-5.078270	-3.632896	-5.121644	-1.957204	Stationary at first differences
TRADE	-2.360357	-1.957204	-5.103688	-3.632896	Stationary at first differences

	-4.608721	-3.632896	-2.360357	-1.957204	Stationary at first differences
TRANSPORTATION	-0.886686	-1.958088	-4.611428	-3.632896	Stationary at first differences
	-8.455613	-3.644963	-1.810629	-1.957204	Non stationary at first differences
At Second Difference					
AGRICULTURE	-9.035426	-1.958088	-7.924068	-3.644963	Stationary at second differences
	-5.882387	-3.673616	-8.394204	-1.958088	Stationary at second differences
CONSTRUCTION	-5.865037	-1.960171	-12.19772	-3.644963	Stationary at second differences
	-7.974445	-3.644963	-10.07769	-1.958088	Stationary at second differences
ELECTRICITY	-8.395257	-1.958088	-22.35332	-3.644963	Stationary at second differences
	-1.777820	-3.644963	-21.85712	-1.958088	Stationary at second differences
GENERAL SERVICES	-1.623563	-1.958088	-3.810506	-3.644963	Stationary at second differences
	-1.777820	-3.644963	-1.678241	-1.958088	Stationary at second differences
MANUFACTUR	-1.623563	-1.958088	-25.33767	-3.644963	Stationary at second differences
	-8.649094	-3.644963	-25.61363	-1.958088	Stationary at second differences
MINING_OIL	-9.121037	-1.958088	-29.72476	-3.644963	Stationary at second differences
	-5.701404	-3.658446	-28.18778	-1.958088	Stationary at second differences
OTHER SERVICES	-6.047920	-1.959071	-16.14767	-3.644963	Stationary at second differences
	-4.936675	-3.690814	-15.05136	-1.958088	Stationary at second differences
TRADE	-4.625894	-1.961409	-19.88414	-3.644963	Stationary at second differences
	-5.628538	-3.658446	-19.83706	-1.958088	Stationary at second differences
IONTRANSPORTAT	-5.932674	-1.959071	-8.174539	-3.644963	Stationary at second differences
	-8.078896	-3.644963	-8.665619	-1.958088	Stationary at second differences

Table 5.4: Unit Root Tests of Output at different economic sectors

The above table clearly shows that the time series of all sectors are stationary at second differences, because the calculated values more than the critical value of t-statistic at 5% significance level.

5.3.2 Pairwise Granger Causality Test

To examine the direction of relationship between construction and other economic sectors of the country in the short run, the Pairwise Granger Causality Test was conducted. The results of the test are shown in Table 5.5:

No	Direction of Causality	$F_{tab.}$	F-Statistic	Decision
1	CONSTRUCTION► AGRICULTURE	2.90	1.32001	does not Granger Cause
2	AGRICULTURE ► CONSTRUCTION	2.90	0.56165	does not Granger Cause
3	ELECTRICITYI►CONSTRUCTION	2.90	1.20040	does not Granger Cause
4	CONSTRUCTION ►ELECTRICITY	2.90	1.10177	does not Granger Cause
5	GENERAL SERVICES ►CONSTRUCTION	2.90	1.37908	does not Granger Cause
6	CONSTRUCTION ►GENERAL SERVICES	2.90	0.06379	does not Granger Cause
7	MANUFACTUREE ►CONSTRUCTION	2.90	0.47572	does not Granger Cause
8	CONSTRUCTION ►MANUFACTURE	2.90	0.76779	does not Granger Cause
9	MINING AND OIL►CONSTRUCTION	2.90	0.52763	does not Granger Cause
10	CONSTRUCTION ►MINING AND OIL	2.90	2.45389	does not Granger Cause
11	OTHER SERVICES ►CONSTRUCTION	2.90	0.27678	does not Granger Cause
12	CONSTRUCTION► OTHER SERVICES	2.90	0.84954	does not Granger Cause
13	**TRADE►CONSTRUCTION**	2.90	**3.39254**	**Granger Cause**
14	**CONSTRUCTION ► TRADE**	2.90	**4.58159**	**Granger Cause**
15	TRANSPORTATION►CONSTRUCTION	2.90	0.11648	does not Granger Cause
16	CONSTRUCTION►TRANSPORTATION	2.90	0.09903	does not Granger Cause

Table 5.5: Granger causality test between the construction industry and other economic sectors in the short run.

As shown in the above table, there is no causal relationship between the construction industry and other economic sectors, except for the trade sector where there is a bi-directional relationship, because the calculated value of the F-statistic is more than its critical value at 5% significant level (2.90). This value is given in Appendix 1 p. 141.

This result means that output of the trade sector affects output of the construction sector and vice versa.

No.	Direction of Causality	$F_{tab.}$	F-Statistic	Decision
1	ELECTRICITY ► AGRICULTURE	2.90	0.52398	does not Granger Cause
2	AGRICULTURE ► ELECTRICITY	2.90	0.33390	does not Granger Cause
3	GENERAL SERVICES ► AGRICULTURE	2.90	0.18554	does not Granger Cause
4	AGRICULTURE ► GENERAL SERVICES	2.90	0.02186	does not Granger Cause
5	MANUFACTURE ► AGRICULTURE	2.90	2.51745	does not Granger Cause
6	AGRICULTURE► MANUFACTURE	2.90	0.34231	does not Granger Cause
7	MINING and OIL ► AGRICULTURE	2.90	4.31763	Granger Cause
8	AGRICULTURE ► MINING and OIL	2.90	1.62835	does not Granger Cause
9	OTHER SERVICES ► AGRICULTURE	2.90	0.92175	does not Granger Cause
10	AGRICULTURE ► OTHER SERVICES	2.90	0.48511	does not Granger Cause
11	TRADE ► AGRICULTURE	2.90	0.73069	does not Granger Cause
12	AGRICULTURE ► TRADE	2.90	1.01886	does not Granger Cause
13	TRANSPORTATION ► AGRICUL	2.90	2.93597	Granger Cause
14	AGRICULTURE ►TRANSPORTATION	2.90	0.32007	does not Granger Cause
15	GENERALTURE ►ELECTRICITY	2.90	0.17084	does not Granger Cause
16	ELECTRICITY► GENERAL SERVICES	2.90	0.10775	does not Granger Cause
17	MANUFACTURE► ELECTRICITY	2.90	28.7707	Granger Cause
18	ELECTRICITY ► MANUFACTURE	2.90	0.09758	does not Granger Cause
19	MINING and OIL ►ELECTRICITY	2.90	0.54209	does not Granger Cause
20	ELECTRICITY ► MINING and OIL	2.90	0.06764	does not Granger Cause
21	OTHER SERVICES ► ELECTRICITY	2.90	0.09909	does not Granger Cause
22	ELECTRICITY► OTHER SERVICES	2.90	0.42233	does not Granger Cause
23	OTHER SERVICES ►TRADE	2.90	1.20975	does not Granger Cause
24	TRADE ►ELECTRICITY	2.90	1.42458	does not Granger Cause
25	ELECTRICITY ► TRADE	2.90	0.16215	does not Granger Cause
26	TRANSPORTATION► ELECTRICITY	2.90	4.02554	Granger Cause
27	ELECTRICITY► TRANSPORTATION	2.90	0.18480	does not Granger Cause
28	MANUFACTURE► GENERAL SERVICES	2.90	0.02072	does not Granger Cause
29	GENERAL SERVICES ► MANUFACTURE	2.90	0.37673	does not Granger Cause
30	MINING and OIL ►GENERAL SERVICES	2.90	1.10998	does not Granger Cause
31	GENERAL SERVICES► MINING and OIL	2.90	0.14672	does not Granger Cause
32	OTHER SERVICE►GENERAL SERVICES	2.90	39.0880	Granger Cause
33	GENERAL SERVICES ►OTHER SERVICE	2.90	1.00448	does not Granger Cause
34	TRADE ► GENERAL SERVICES	2.90	0.44799	does not Granger Cause
35	GENERAL SERVICES ► TRADE	2.90	2.09707	does not Granger Cause
36	TRANSPORTATION► GENERAL SERVIC	2.90	0.12010	does not Granger Cause
37	GENERAL SERVIC ►TRANSPORTATION	2.90	0.25424	does not Granger Cause
38	MINING and OIL► MANUFACTURE	2.90	0.33216	does not Granger Cause
39	MANUFACTURE ► MINING and OIL	2.90	0.11537	does not Granger Cause
40	OTHER SERVICES► MANUFACTURE	2.90	0.10859	does not Granger Cause
41	MANUFACTURE ► OTHER SERVICES	2.90	0.13665	does not Granger Cause
42	TRADE ► MANUFACTURE	2.90	0.97371	does not Granger Cause
43	MANUFACTURE► TRADE	2.90	0.37355	does not Granger Cause
44	TRANSPORTATION► MANUFACTURE	2.90	1.12812	does not Granger Cause
45	MANUFACTURE ►TRANSPORTATION	2.90	4.98409	Granger Cause
46	OTHER S ERVICES►MINING and OIL	2.90	1.23690	does not Granger Cause
47	MINING and OIL► OTHER SERVICES	2.90	3.56627	Granger Cause
48	TRADE ►MINING and OIL	2.90	3.01535	Granger Cause
49	MINING and OIL ► TRADE	2.90	0.03344	does not Granger Cause
50	TRANSPORTATION ►MINING and OIL	2.90	0.05575	does not Granger Cause
51	MINING ► TRANSPORTATION	2.90	0.91622	does not Granger Cause
52	TRADE ► OTHER SERVICES	2.90	2.48591	does not Granger Cause
53	TRANSPORTATION ►OTHER SERVICES	2.90	0.99749	does not Granger Cause
54	OTHER SERVICES► TRANSPORTATION	2.90	1.48131	does not Granger Cause

55	TRANSPORTATION ►TRADE	2.90	0.23551	does not Granger Cause
56	TRADE ► TRANSPORTATION	2.90	0.12463	does not Granger Cause

Table 5.6: Granger causality test among different economic sectors

Granger test was also conducted in-between the different economic sectors other than the construction sector. The results are shown in Table 5.6

As can be seen, the results proved that Mining industry Granger causes Agriculture industry while Transport industry also Granger causes Agriculture industry. There is a causal relationship from Manufacturing and Transport industries to Electrical industry and from Manufacturing to Transport Industry. Other Service sector was found to Granger cause General Service sector while Mining industry Granger causes Other service and Trade Industry Granger causes Mining industry.

5.4 Discussion

5.4.1 Causal Relationship between the Construction Industry and GDP

The results reported above indicate that the expenditure on construction industry and the GDP of the country are stationary at their second difference. The two variables are found to be co-integrated and, thus, have a long-term relationship. The Granger causality test revealed that there is a short-term causal relationship from GDP to expenditure on the construction industry. However, a long-term causal relationship runs from expenditure on the construction industry to GDP.

The results of the present study confirm the claim of Hillibrandt (1984), who argued that the construction industry can contribute significantly to the GDP of a country. However, it is interesting to note that there is also a short-term relationship from GDP to the investment on the construction sector, showing that countries with higher GDP

are more prone to high expenditure on the construction sector. This explains the cyclical nature of the growth in the construction industry, which was highlighted by the report of the UNIDO (1993).

The construction industry is responsible for the development of infrastructure through construction of public and private residential buildings. Therefore, the direct relationship between GDP and construction sectors explains the results of Okan *et al.* (2012), who reported the causal relationship from GDP to investment in the infrastructure sector, and public and private residential buildings. The bi-directional relationship of GDP with human development in Asian countries (Shahbaz *et al.*, 2011) is also clarified with the findings that GDP affects the expenditure on the construction industry, which in turn is directly related to human development through improving the standard of living for the general population of the country.

The long-term impact of expenditure on the construction industry to the improved GDP is attributed to the employment created by this industry. As found by Piyapong (2008), investment in infrastructure development in the USA caused an increase in employment. The results of the present study show that in Libya, as well, such a relationship probably exists.

5.4.2 Causal Relationship between the Construction Industry and Other Economic Sectors

Contrary to expectation, the construction industry was found to Granger cause only the trade sector. No other sector was found to have any causal relationship with the construction industry in Libya. The result is difficult to explain because no previous study has reported such a singular effect of the construction industry. However, since

trade influences the openness of the economy and foreign investment is critical for the growth of the construction sector in Libya, the result seems quite understandable.

Absence of links between construction and other economic sectors is quite surprising because it has been reported in previous studies that the construction industry stimulates the growth of other sectors and is stimulated itself by the growth of other sectors through cyclic linkage (Xing, 2005; Ofori, 1990; Bon and Pietroforte, 1993). However, such a linkage is absent from the Libyan economy. Thus, Libya presents a special case to study. Closer analysis of the economic sectors of Libya is needed to understand this absence of linkage.

If we look closer at the linkage between other economic sectors, as shown in Figure 5.4, it becomes clear that the linkage is quite complex and, although there is no direct causal relationship between construction and other economic sectors, it is indirectly related to them. Looking at Figure 5.4, it can be said that the construction industry affects the trade industry which influences the mining industry. The mining industry, in turn, affects the agriculture sector and other service sector.

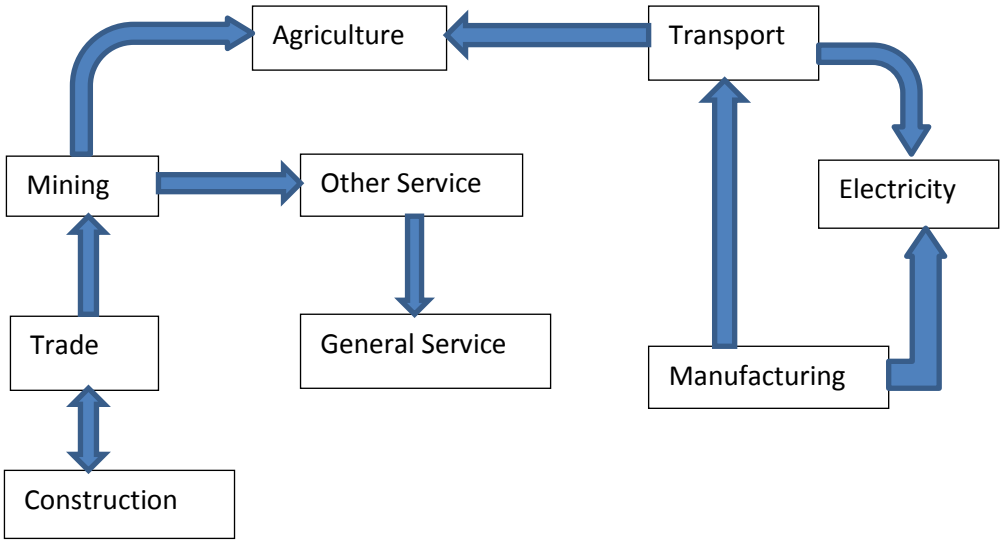

Figure 5.3: Causal Relationships between different economic sectors of the Libyan Economy

An important relationship shown by the present study is the triangular relationship among the manufacturing, electricity and transport sectors. Thus, the manufacturing sector plays a vital role in the economic development of the country by affecting the growth of electricity and transport sectors, which are two very important economic sectors of the country.

For validating and further exploring the results of this study, telephone conversations were conducted with economic experts from the Libyan construction sector, who presented the important points behind the lack of linkages between the construction industry and other economic sectors. They confirmed that Libyan economic sectors still suffer from lack of possibilities, and bottlenecks. These bottlenecks include:

(1) A chaotic economy: most of the sectors work in isolation from each other. The Libyan economy depends on oil and gas exports, which represent more than 96% of Libyan exports.

(2) Inefficient investments implemented in the CI and other non-oil sectors.

(3) Low levels of health and education services and the continuing problems of housing infrastructure.

(4) Imbalance in funding administrative structure in the public sector institutions, the failure of privatisation programmes and the delay in a lot of projects.

(5) Emergence of the unemployment problem among the many categories of Libyan society.

(6) Continued mergers, cancellation and change in the administrative institutions, which reflect the administrative chaos, the instability and the mismanagement in most public institutions.

(7) Lack of information and data about economic indicators.

These bottlenecks and other negative phenomena reflect the wrong polices that were applied over the past decades and led the Libyan economy to such a chaotic state.

Returning to the obtained result of the existence of a causality relationship from the construction industry to economic growth in the long-run: this result confirms that the CI should contribute to the economic growth in the long-run; but looking at the value of the CI's coefficient = 0.01; this result means that if the CI increases by one unit, the GDP will increase by 0.01 unit. In other words, the contribution of the CI to economic growth is very low, whereas, considering the significance of the construction industry to economic growth with the collapsed situation of the Libyan construction situation, it is necessary to identify a major issue affecting the efficiency of the industry and take corrective action to increase economic growth and development in Libya. Through the literature review and previous studies, the suggested policies and strategies are formulated. It is hoped that the safety and total quality management approach will be the solution for improving performance in the Libyan construction industry.

In addition to the discussion of these two concepts through the literature review and previous studies on Libya, telephone conversations were conducted with the manager of the Libyan Public Construction Company in Benghazi to identify the current status and highlight the current challenges faced by the construction company in the implantation of safety and TQM. This company is considered as the main and largest company which is responsible for the infrastructure projects in Benghazi. The reasons for choosing the city of Benghazi as a case study are: firstly, although Benghazi is the second city in Libya, it has suffered from poor infrastructure in the last decades. Secondly, most of the previous studies on Libya have focused on Tripoli city which it is the capital of Libya.

It should be pointed out here that Libya after the war in 2011 is still in a difficult situation, where it is difficult to conduct interviews or focus group with the directors of companies. This, coupled with the weakness of the internet in Libya, led to the researcher using telephone conservations as a tool for identifying the safety and the TQM strategies in the Libyan construction industry. The conversations were conducted with the top director and with the other management directors in the company such as the director of operational management, finance management and public relations management; also some conversations were conducted with some of the workers who work in the employees' affairs department in this company. The questions were as follows:

1- How do you define quality? What does quality mean to you?
2- How do you define safety? What does safety mean to you?
3- What challenges do you face in your job?
4- Do you feel that your job has safe working conditions?
5- What factors have an impact on your performance?

The findings of these conversations outlined in the following points:

- Nonexistence of a TQM strategy in the company.
- Lack of awareness of TQM concept.
- Training is in scarce.
- Customer services in the Libyan Public Construction Company are ineffective.
- Main issues concerning the demonstration of the construction company is the cost.
- Occupational Safety Department exists but it works in strict procedures.
- Delay in the completion of projects due to the improper planning, financial issues, slow decision making, late deliveries of materials and equipments and lack of effective communication.
- Bureaucratic procedures cause a decline in the performance level of the company.

These findings could be generalised to the rest of the eastern Libyan cites, because the construction companies in these cities are dependent on the construction company that is located in Benghazi.

5.5 Summary

This chapter reviewed and discussed all the results of the study, and made the following conclusions:

1- There is a causality relationship from GDP to the CI in the short run.

2- There is a causality relationship from the CI to GDP in the long run.

3- There is no causal relationship between the CI and other economic sectors except trade, where there is a bi-directional relationship.

4- The mining industry Granger causes agriculture industry while transport industry also Granger causes agriculture industry

5- There is a causal relationship from manufacturing and transport industries to electrical industry and from manufacturing to transport industry

6- Other service sector was found to Granger causes general service sector while mining industry Granger causes other service and trade industry Granger causes mining industry.

These results have been discussed and an approach of increasing safety plus TQM is suggested to increase the efficiency of the construction industry. To investigate the role of safety and TQM in increasing the efficiency of the construction industry in Libya, the Libyan Public Construction Company in the city of Benghazi was chosen and telephone conversations were conducted with its top management and the main findings were nonexistence of a TQM strategy in the company, bureaucratic procedures affect the performance level, safety department works in strict procedures and there is a lack of effective communication.

The final chapter presents a conclusion of this thesis with recommendations for future research and for policy makers.

Chapter six

Conclusion

6.1. Introduction

The construction industry has been reported in the literature to be a key player in the economy of any country and its growth can lead to great improvement in the economic conditions of developing countries. Through the complex inter-linkages between the different economic sectors, the construction industry has been claimed to influence the development of other important economic sectors like agriculture and the service industry. However, no previous study has looked into the role of the construction industry in the Libyan economy. The present study aimed to find that role by analysing the causal relationship of investment in the construction industry with GDP and out-put of other economic sectors of the Libyan economy. Based on the review of literature, it was assumed that the construction industry will have a causal linkage with the overall economic development of Libya as well as with the growth of important economic sectors of the country.

Statistical analysis of the data collected from the authority of the Libyan construction industry was statistically analysed and the findings obtained from this analysis were presented and discussed in the previous chapter. In this chapter, the conclusions drawn from these findings are presented. The chapter starts with a brief overview of the study's findings, followed by a detailed description of the conclusions. At the end

of the chapter, the lessons learned during the research process are reported as recommendations for future researchers and for policy makers and a guideline is proposed.

6.2 Summary of Findings

Investment in the construction industry is found to have a long-term impact on GDP while GDP was found to have short-term impacts on investment in the construction industry. No particular linkage between the construction industry and other economic sectors was found. Only the trade industry was found to have a bi-directional relationship with the construction industry. However, variation in the Trade industry itself causes changes in the Mining industry which affects other services and the Agriculture sector of the economy. One important secondary finding of the present study is the closer relationship between manufacturing, transport and electricity sectors.

The Libyan government is facing the issue of unemployment and the construction industry is the solution they are seeking. The industry is believed to improve the economy of the country but no concrete evidence is yet provided to prove this positive effect of the construction industry on the Libyan economy. In the present study, an attempt was made to examine such an effect. From the above-stated findings, the positive role of the construction industry on the economic development of Libya by influencing its GDP is evidential. It can also be concluded that the construction industry also depends on the GDP of a country for its growth, though for the short term only. The link is quite understandable. GDP gives the initial push to the development of the construction industry by providing more investment in the sector. However, the benefits are long term and once the industry is fully established it will

provide a long-lasting positive impact on the GDP of the country. The CI not only provides work but also improves the living standards of the general public with better infrastructure and improved housing conditions. This positive and bi-directional causal relationship of the construction industry with the economy is also present in other countries and it is quite likely that the impact will be present in countries where no such research has yet been conducted. The result is, therefore, generalisable.

However, in the case of Libya, the construction industry did not demonstrate any significant impact on other economic sectors except Trade. Likewise, except for Trade, no economic sector is producing any particular impact on the construction industry of Libya. Nevertheless, other economic sectors like Agriculture, Mining, and Manufacturing, etc., have a complex system of linkage with each other. Thus, it can be said that the economic structure of Libya is quite different from the economic structure of other developed and developing countries on which previous studies were conducted and such a relationship was found.

The third objective of the present study was to investigate the relationship of the construction industry with the overall economy and other economic sectors; it is beyond its scope to highlight the reason for the non-existence of such a relationship. However, from the review of the status of the construction industry in the country, there is a possibility that the lack of political attention towards this sector has led to its isolation from the other economic sectors. It is further evident by its bi-directional relationship with trade, showing the high involvement of foreign investment in this sector. No other sector of the economy except mining is affected by the variation in trade. Thus, with openness in the economy and with growth in trade, the construction industry is likely to grow. Implementation of a safety and TQM approach was

suggested to increase the efficiency of the construction industry and the contribution of this industry to Libya's economic growth and development.

6.3 Recommendations for the Future

The present study was conducted on a very important industry which is contributing significantly to the growth of GDP and producing employment for the public. It is, therefore, important to highlight the lessons learned by the researcher during the course of this study. The lessons are both related to the research methodology and design and to the practical issues associated with the economic policy making of Libya. Based on these lessons, here are a few recommendations for future researchers and policy makers.

6.3.1 Recommendations for Policy Makers

The present study produces important findings for practical considerations. The government of Libya, in particular the officials responsible for economic planning, must understand that, for the development and progress of the construction industry, they ought to first improve Libya's GDP by improving other contributors to GDP. Once there is enough economic stability for the construction industry to prosper, the industry will serve as a major contributor to GDP for the long run. Also, focus ought to be on development of the trade sector, as construction and trade industries are found to have a close bi-directional link. Improvement in one led to improvement in the other. As to the classification of sectors in Libya, the trade sector includes hotels and restaurants. Therefore, the economic policy makers should establish another important sector - a tourism sector, which will be an effective sector in stimulating the economic growth and development in the future.

One important secondary finding of the present study is that variation in the manufacturing industry of Libya led to variation in the transport and electrical industries, while variation in the transport industry also led to variation in the electrical industry. Thus, the three industries have closer ties, and growth in the manufacturing or transport sector is critical to the growth of the electrical sector. Although these three sectors were not proved to have ties with the construction industry, they are important in their own regard and policies ought to be made with consideration to these sectors as well. Based on the discussion of the experts' opinions, the following recommendations are made to provide solutions for those problems facing the Libyan policy makers:

1- Making proper plans to avoid delay in the construction projects.

2- Reducing the dependence on oil revenues as a main resource for funding the economic projects, and developing plans to provide other resources.

3- Providing a database and information about business, investment environment and economic sectors is a vital mission. This database should include financial and general economic indicators. Therefore, existence of an advanced database is very important for improving the performance and efficiency of economic policies.

4- Providing clear policies and incentives to attract the local and foreign investors to contribute to advanced economic development.

5- Making an urgent policy for increasing investment in the construction industry to eliminate the loss in infrastructure and the unemployment problem.

6- The new government must ensure that it is able to provide an expanding set of services while setting a foundation for the country's future prosperity.

All these recommendations are directed at the new government and decisions makers in Libya.

6.3.2 Proposed Guidelines to improve the Construction Industry in Libya

The following guidelines are proposed by the researcher:

- Management development would affect the situation more positively than any other advice. Therefore, it is necessary to improve the ability of government human resources at all levels to do an active role in improving the sector's efficiency.
- The Libyan government decisions should be based on competence and avoiding low quality projects
- The government should put more effort into providing solutions for avoiding the issues that cause delays in the construction projects.

  The government should ensure that all construction companies initiate an effective TQM.
- The government should create a Department of Occupational Health and Safety Administration with powerful penalties for those who breach safety.
- The government should consistently checking the safety performance on the construction sites in order to obtain effective performance from the construction companies.
- The government should provide annual safety lessons on how to improve the safety performance on the construction sites for officials responsible for safety in the construction projects.
- The government should provide programmes on how to develop skills, knowledge and information in the construction companies.

- The guidelines for improving the construction industry should be established without any bureaucratic procedures.

6.3.3 Recommendations for Future Research

The present study did not find causal linkages between the construction industry and other economic sectors except trade. This absence of linkages needs future exploration to determine the possible cause between the construction industry and other economic sectors. A future researcher ought to either conduct detailed qualitative research on the topic or a quantitative study with larger time-series data extending to more than two decades.

The present study has only analysed the impact of expenditure on the construction industry and its output. Future research ought to be conducted on other measures such as market share of the construction industry, size and productivity, and other similar financial measures of the performance of the construction industry. In particular, it is highly recommended that the impact of the variation in the construction industry on the employment status of Libya should be examined in future. Such studies will provide more insight into the role of the construction industry in the Libyan economy and will also enable the policy makers to make better decisions based on concrete evidence.

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Appendix 1

Analysis of the Relationship between the Construction Industry and GDP

The variables

Logarithm of Expenditure on construction industry	CI	Expenditure on construction industry	CI
Logarithm of Gross domestic product	LGDP	Gross domestic product	GDP

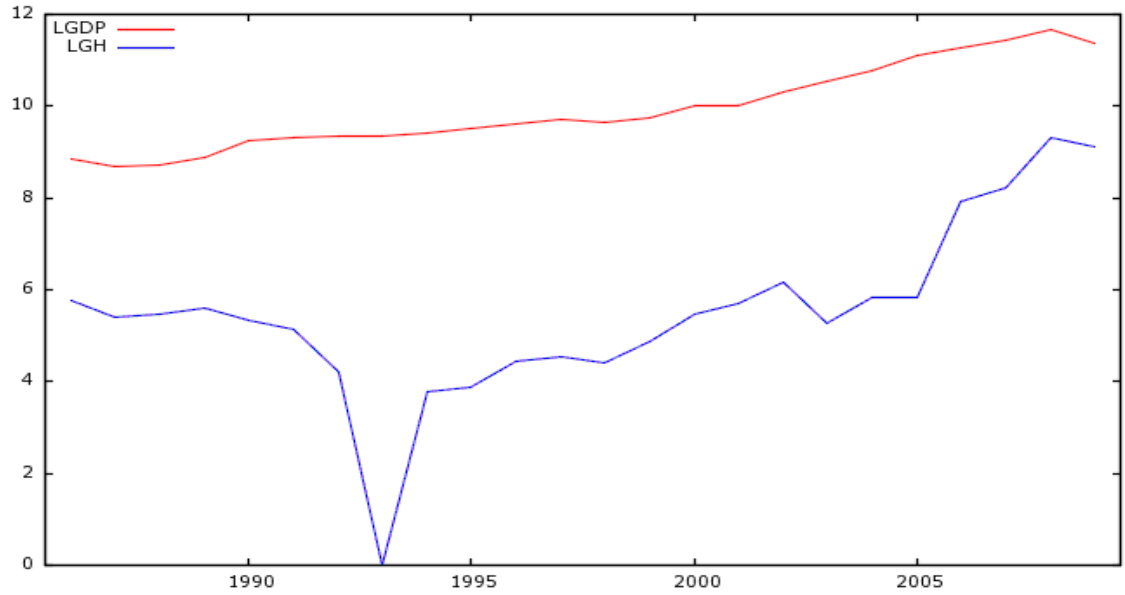
Change the variables to logarithm Values

YEAR	GDP	LGDP	CI	LCI
1986	6960.7	8.84804	316.3	5.756691
1987	6011.6	8.70145	219.4	5.390897
1988	6186	8.73004	236.2	5.464679
1989	7191	8.88059	269	5.594711
1990	10354	9.24513	206.6	5.330785
1991	10924.6	9.29877	169.5	5.132853
1992	11555.9	9.35495	66.8	4.201703
1993	11511.9	9.35114	0	00
1994	12146.5	9.40480	43.6	3.775057
1995	13387.2	9.50205	49	3.891820
1996	15162.7	9.62659	86	4.454347
1997	16700.8	9.72321	95	4.553877
1998	15655.6	9.65858	80.9	4.393214
1999	17185.4	9.75182	130.5	4.871373
2000	22016.6	9.99955	234.1	5.455748
2001	21926.7	9.99546	299.5	5.702114
2002	30389.8	10.32186	471.7	6.156343
2003	37423.4	10.53005	195.4	5.275049
2004	48159	10.78226	346.6	5.848171

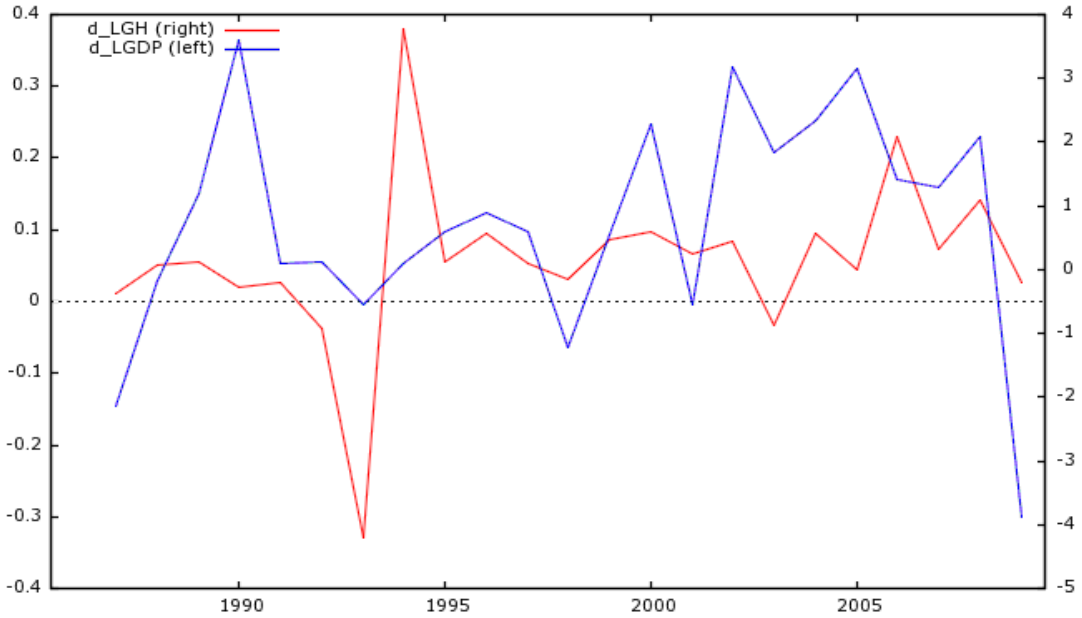
2005	66618.6	11.10674	343.1	5.838022
2006	79029.9	11.27758	2733.2	7.913228
2007	92693.6	11.43705	3724.39	8.222658
2008	116639.6	11.66684	10962.84	9.302267
2009	86288.93	11.36546	8978.5	9.102588

Causality Relationship between (LGDPand LCI)

Time series of Gross domestic product(GDP) and Expenditure on construction industry(LCI)



Time series of Gross domestic product (GDP) and Expenditure on construction industry (LCI) at the first differences



CORRELOGRAM LGDP

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.767	0.767	15.972	0.000
		2	0.510	-0.192	23.341	0.000
		3	0.318	-0.002	26.346	0.000
		4	0.205	0.033	27.657	0.000
		5	0.164	0.066	28.538	0.000
		6	0.146	0.009	29.276	0.000
		7	0.123	-0.010	29.836	0.000
		8	0.103	0.015	30.250	0.000
		9	0.079	-0.008	30.509	0.000
		10	0.060	0.005	30.668	0.001
		11	0.030	-0.040	30.713	0.001
		12	0.000	-0.019	30.713	0.002

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.506	0.506	6.9541	0.008
		2	0.239	-0.023	8.5758	0.014
		3	0.147	0.047	9.2211	0.026
		4	0.106	0.023	9.5730	0.048
		5	0.096	0.038	9.8782	0.079
		6	0.054	-0.022	9.9796	0.126
		7	-0.017	-0.061	9.9899	0.189
		8	-0.014	0.020	9.9977	0.265
		9	-0.004	0.001	9.9984	0.351
		10	-0.003	-0.002	9.9987	0.441
		11	-0.002	0.002	9.9989	0.530
		12	0.000	0.007	9.9989	0.616

CORRELOGRAM LCI

Unit root tests for variables
Expenditure on construction industry (LCI)

Variable	Calculated value	5%	10%	Test	
LCI	-1.601385	-3.632896	-3.254671	ADF	Constant, Linear Trend
	0.554714	-1.957204	-1.608175	ADF	None
DLCI	-3.938142	-3.644963	-3.261452	ADF	Constant, Linear Trend
	-3.457135	-1.958088	-1.607830	ADF	None
D2LCI	-5.169486	-3.658446	-3.268973	ADF	Constant, Linear Trend
	-5.482890	-1.959071	-1.607456	ADF	None
LCI	-2.223093	-3.622033	-3.248592	PP	Constant, Linear Trend
	0.372916	-1.956406	-1.608495	PP	None
DLCI	-8.629436	-3.632896	-3.254671	PP	Constant, Linear Trend
	-6.033462	-1.957204	-1.608175	PP	None
D2LCI	-29.82677	-3.644963	-3.261452	PP	Constant, Linear Trend
	-29.68276	-1.958088	-1.607830	PP	None

Second differences	D2LCI	First differences	DLCI

Gross domestic product (LGDP)

Variable	Calculated value	5%	10%	Test	
LGDP	-1.739469	-3.632896	-3.254671	ADF	Constant, Linear Trend
	1.356693	-1.957204	-1.608175	ADF	None
DLGDP	-2.163184	-3.644963	-3.261452	ADF	Constant, Linear Trend
	-1.606544	-1.958088	-1.607830	ADF	None
D2LGDP	-3.774185	-3.658446	-3.268973	ADF	Constant, Linear Trend
	-3.846151	-1.959071	-1.607456	ADF	None
LGDP	-2.125642	-3.622033	-3.248592	PP	Constant, Linear Trend
	1.375621	-1.956406	-1.608495	PP	None
DLGDP	-3.754075	-3.932896	-3.254671	PP	Constant, Linear Trend
	-2.393391	-1.957204	-1.608175	PP	None
D2LGDP	-5.846214	-3.644963	-3.261452	PP	Constant, Linear Trend
	-5.839391	-1.958088	-1.607830	PP	None

Second differences	D2LGDP	First differences	DLGDP

Cointegration test (E-G)

$$LGDP_t = \alpha + \beta LCI_t + \varepsilon_{t1}$$
$$LCI_t = \alpha + \beta LGDP_t + \varepsilon_{t2}$$

With getting the regression residuals of the previous two equations, the stationary test will be as follows:

$$u_{1t} = \rho u_{t-1} + V_t$$
$$u_{2t} = \rho u_{t-1} + V_t$$

YEAR	D2LGDP	D2LCI	RPCI	RPGDP
1986	0	0	1.77873286	-1.17927936
1987	0	0	1.61518536	-1.20851905
1988	0.17518	0.439576	1.64952246	-1.20359904
1989	0.12196	0.056250	1.57184446	-1.09476458
1990	0.21399	-0.393958	0.8049719	-0.64555453
1991	-0.31090	0.065994	0.53303416	-0.528416
1992	0.00254	-0.733218	-0.47562596	-0.17351393
1993	-0.05999	-3.270553	-4.6720724	1.17062368
1994	0.05747	7.976760	-0.97104873	0.0132083
1995	0.04359	-3.658294	-0.98845908	0.07299958
1996	0.02729	0.445764	-0.59775675	0.01707539
1997	-0.02792	-0.462997	-0.63153091	0.08176519
1998	-0.16125	-0.260193	-0.70302554	0.06867746
1999	0.15787	0.638822	-0.35350739	0.00851936
2000	0.15449	0.106216	-0.11091917	0.06877611
2001	-0.25182	-0.338009	0.1410897	-0.01435052
2002	0.33049	0.207863	0.14499293	0.16632835
2003	-0.11821	-1.335523	-1.02353551	0.65724613
2004	0.04402	1.454416	-0.79838123	0.72559296
2005	0.07227	-0.583271	-1.25620703	1.05332886
2006	-0.15364	2.085355	0.58329537	0.55842239
2007	-0.01137	-1.765776	0.67270867	0.6186242
2008	0.07032	0.770179	1.43528226	0.50206503
2009	-0.53117	-1.279288	1.65140957	0.26474401

CAUSALITY TEST (VECM)

$$\Delta 2LCI_t = \beta_0 + \sum_{i=1}^{m} \beta_i \Delta 2LCI_{t-i} + \sum_{i=1}^{n} \alpha_j \Delta 2LGDP_{t-j} + V_t$$
$$\Delta 2LGDP_t = \alpha_0 + \sum_{j=1}^{n} \alpha_j \Delta 2LGDP_{t-j} + \sum_{i=1}^{m} \beta_i \Delta 2LCI_{t-i} + U_t$$

UNIT ROOT FOR RESIDUAL

Variable	Calculated value	5%	10%	Test	
RPGDP	-1.924568	-1.632896	-3.254671	ADF	Constant, Linear Trend
	-2.025552	-1.957204	-1.608175	ADF	None
	-2.425511	-1.622033	-3.248592	PP	Constant, Linear Trend
	-2.128940	-1.956406	-1.608495	PP	None
RPCI	-1.736963	-1.632896	-3.254671	ADF	Constant, Linear Trend
	-2.049669	-1.957204	-1.608175	ADF	None
	-2.312022	-1.622033	-3.248592	PP	Constant, Linear Trend
	-2.513506	-1.956406	-1.608495	PP	None

Residual regression D2GDP on D2LCI	RRCI	Residual regression D2LCI on D2LGDP	RRGDP

$$D2LCI_t = \beta_0 + \sum_{i=1}^{m} \beta_i D2LCI_{t-i} + \sum_{i=1}^{n} \alpha_j D2LGDP_{t-j} + \rho RGP_{t-1} + V_t$$

$$D2LGDP_t = \alpha_0 + \sum_{j=1}^{n} \alpha_j D2LGDP_{t-j} + \sum_{i=1}^{m} \beta_i D2LCI_{t-i} + U_t$$

VER Model:

$$D2LCI_t = \beta_0 + \sum_{i=1}^{m} \beta_i D2LCI_{t-i} + \sum_{i=1}^{n} \alpha_j D2LGDP_{t-j} + V_t$$

VAR Lag Order Selection Criteria
Endogenous variables: D2LGH
Exogenous variables: C
Date: 09/21/10 Time: 18:13
Sample: 1986 2009
Included observations: 20

HQ	SC	AIC	FPE	LR	LogL	Lag
4.590403	4.630471	4.580684	5.713837	NA	-44.80684	0
4.182547	4.262683*	4.163109	3.765584	9.316350*	-39.63109	1
4.166340*	4.286543	4.137183	3.675125*	2.140743	-38.37183	2
4.191045	4.351316	4.152170	3.742514	1.360221	-37.52170	3
4.180651	4.380990	4.132057*	3.687710	1.801689	-36.32057	4

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: D2LGH(-2)
Exogenous variables: C D2LGDP

Sample: 1986 2009
Included observations: 18

SC	AIC	FPE	LR	LogL	Lag
4.878391	4.779461	6.976208	NA	-41.01515	0
4.531650*	4.383255	4.704488	7.609758*	-36.44930	1
4.550136	4.352276*	4.581103*	1.989262	-35.17048	2
4.623694	4.376369	4.727900	1.131238	-34.38732	3
4.669373	4.372582	4.764467	1.378774	-33.35324	4

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: D2LGDP
Exogenous variables: CI
Date: 09/21/10 Time: 18:15
Sample: 1986 2009
Included observations: 20

HQ	SC	AIC	FPE	LR	LogL	Lag
-0.373929	-0.333861	-0.383648	0.039898	NA*	4.836479	0
-0.461543*	-0.381407*	-0.480980*	0.036218*	3.551985	6.809804	1
-0.377308	-0.257105	-0.406465	0.039083	0.433237	7.064649	2
-0.290307	-0.130036	-0.329183	0.042358	0.363487	7.291829	3
-0.242907	-0.042569	-0.291502	0.044221	0.934784	7.915018	4

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: D2LGDP(-1)
Exogenous variables: C D2LCI
Sample: 1986 2009
Included observations: 19

HQ	SC	AIC	FPE	LR	LogL	Lag
-0.697931	-0.615341	-0.714756	0.028672	NA*	8.790182	0
-0.811643*	-0.687758*	-0.836880*	0.025423*	3.638200	10.95036	1
-0.766957	-0.601778	-0.800607	0.026461	1.034845	11.60577	2
-0.653399	-0.446925	-0.695462	0.029580	0.001653	11.60689	3
-0.704727	-0.456957	-0.755201	0.028135	2.145036	13.17441	4

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

So the equation will be as follows:

$$D2LCI = \alpha_0 + \beta_0 D2LCI_{t-1} + \beta_1 D2LCI_{t-2} + \alpha_0 D2LGDP + \alpha_1 D2LGDP_{t-1} + \alpha_2 D2LGDP_{t-2} + \rho RGP_{t-1} + U_t$$

Model 3: OLS estimates using the 22 observations 1988-2009
Dependent variable: D2LCI

	p-value	*t-statistic*	*Std. Error*	*Coefficient*	*Variable*
	0.74207	-0.3353	0.317988	-0.106607	const
**	0.03552	2.3101	1.94639	4.49639	D2LGDP
	0.11133	1.6919	2.68668	4.54563	D2LGDP_1
*	0.05534	2.0775	2.41005	5.00698	D2LGDP_2
**	0.01392	2.7834	0.541742	1.5079	RGDP_1
***	0.00078	-4.1954	0.190502	-0.799226	D2LCI_1
*	0.06136	-2.0222	0.190174	-0.384577	D2LCI_2

Mean of dependent variable = 0.00755068
Standard deviation of dep. var. = 2.22104
Sum of squared residuals = 31.4749
Standard error of residuals = 1.44856
Unadjusted R^2 = 0.69617
Adjusted R^2 = 0.574638
F-statistic (6, 15) = 5.72828 (p-value = 0.00285)
Durbin-Watson statistic = 1.76402
First-order autocorrelation coeff. = 0.0780576
Durbin's h stat. 0.73339
(Using variable 19 for h stat, with T' = 21)
Log-likelihood = -35.1563
Akaike information criterion = 84.3126
Schwarz Bayesian criterion = 91.9499
Hannan-Quinn criterion = 86.111

$$D2LGDP_t = \alpha_0 + \sum_{j=1}^{n} \alpha_j D2LGDP_{t-j} + \sum_{i=1}^{m} \beta_i D2LCI_{t-i} + U_t$$

The equation will be as follows:

$$D2LGDP = \beta_0 + \beta_1 D2LGDP_{t-1} + \alpha_0 D2LCI + \alpha_1 D2LCI_{t-1} + \rho RPG_{t-1} + U_t$$

Model 4: OLS estimates using the 23 observations 1987-2009
Dependent variable: D2LGDP

p-value	*t-statistic*	*Std. Error*	*Coefficient*	*Variable*
0.98347	0.0210	0.0398635	0.00083765	const
0.44064	-0.4748	0.0367143	0.0174317	RCI_1
0.39754	0.8666	0.0298277	0.02585	D2LCI
0.53759	0.6285	0.0250825	0.0157636	D2LCI_1
0.11328	-1.6647	0.275069	-0.457909	D2LGDP_1

Mean of dependent variable = -0.00673
Standard deviation of dep. var. = 0.187894
Sum of squared residuals = 0.645708
Standard error of residuals = 0.189401
Unadjusted R^2 = 0.168638
Adjusted R^2 = -0.0161092
F-statistic (4, 18) = 0.912804 (p-value = 0.478)
Durbin-Watson statistic = 1.81267
First-order autocorrelation coeff. = -0.170963
Log-likelihood = 8.45278
Akaike information criterion = -6.90556
Schwarz Bayesian criterion = -1.22809
Hannan-Quinn criterion = -5.4776

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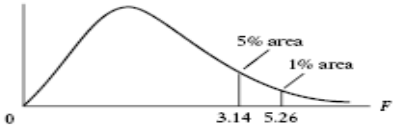
TABLE D.3 UPPER PERCENTAGE POINTS OF THE F DISTRIBUTION

Example

$\Pr(F > 1.59) = 0.25$
$\Pr(F > 2.42) = 0.10$ for df $N_1 = 10$
$\Pr(F > 3.14) = 0.05$ and $N_2 = 9$
$\Pr(F > 5.26) = 0.01$



df for denominator N_2	Pr	df for numerator N_1: 1	2	3	4	5	6	7	8	9	10	11	12
1	.25	5.83	7.50	8.20	8.58	8.82	8.98	9.10	9.19	9.26	9.32	9.36	9.41
	.10	39.9	49.5	53.6	55.8	57.2	58.2	58.9	59.4	59.9	60.2	60.5	60.7
	.05	161	200	216	225	230	234	237	239	241	242	243	244
2	.25	2.57	3.00	3.15	3.23	3.28	3.31	3.34	3.35	3.37	3.38	3.39	3.39
	.10	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38	9.39	9.40	9.41
	.05	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4
	.01	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.4	99.4	99.4
3	.25	2.02	2.28	2.36	2.39	2.41	2.42	2.43	2.44	2.44	2.44	2.45	2.45
	.10	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24	5.23	5.22	5.22
	.05	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.76	8.74
	.01	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3	27.2	27.1	27.1
4	.25	1.81	2.00	2.05	2.06	2.07	2.08	2.08	2.08	2.08	2.08	2.08	2.08
	.10	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94	3.92	3.91	3.90
	.05	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.94	5.91
	.01	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7	14.5	14.4	14.4
5	.25	1.69	1.85	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
	.10	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32	3.30	3.28	3.27
	.05	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.71	4.68
	.01	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2	10.1	9.96	9.89
6	.25	1.62	1.76	1.78	1.79	1.79	1.78	1.78	1.78	1.77	1.77	1.77	1.77
	.10	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96	2.94	2.92	2.90
	.05	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00
	.01	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.79	7.72
7	.25	1.57	1.70	1.72	1.72	1.71	1.71	1.70	1.70	1.69	1.69	1.69	1.68
	.10	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72	2.70	2.68	2.67
	.05	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.60	3.57
	.01	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.54	6.47
8	.25	1.54	1.66	1.67	1.66	1.66	1.65	1.64	1.64	1.63	1.63	1.63	1.62
	.10	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56	2.54	2.52	2.50
	.05	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.31	3.28
	.01	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.73	5.67
9	.25	1.51	1.62	1.63	1.63	1.62	1.61	1.60	1.60	1.59	1.59	1.58	1.58
	.10	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44	2.42	2.40	2.38
	.05	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.10	3.07
	.01	10.6	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.18	5.11

Source: From E. S. Pearson and H. O. Hartley, eds., *Biometrika Tables for Statisticians*, vol. 1, 3d ed., table 18, Cambridge University Press, New York, 1966. Reproduced by permission of the editors and trustees of *Biometrika*.

df for denominator N_2	Pr	df for numerator N_1: 15	20	24	30	40	50	60	100	120	200	500	∞
1	.25	9.49	9.58	9.63	9.67	9.71	9.74	9.76	9.78	9.80	9.82	9.84	9.85
	.10	61.2	61.7	62.0	62.3	62.5	62.7	62.8	63.0	63.1	63.2	63.3	63.3
	.05	246	248	249	250	251	252	252	253	253	254	254	254
2	.25	3.41	3.43	3.43	3.44	3.45	3.45	3.46	3.47	3.47	3.48	3.48	3.48
	.10	9.42	9.44	9.45	9.46	9.47	9.47	9.47	9.48	9.48	9.49	9.49	9.49
	.05	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5
	.01	99.4	99.4	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5
3	.25	2.46	2.46	2.46	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47
	.10	5.20	5.18	5.18	5.17	5.16	5.15	5.15	5.14	5.14	5.14	5.14	5.13
	.05	8.70	8.66	8.64	8.62	8.59	8.58	8.57	8.55	8.55	8.54	8.53	8.53
	.01	26.9	26.7	26.6	26.5	26.4	26.4	26.3	26.2	26.2	26.2	26.1	26.1
4	.25	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08
	.10	3.87	3.84	3.83	3.82	3.80	3.80	3.79	3.78	3.78	3.77	3.76	3.76
	.05	5.86	5.80	5.77	5.75	5.72	5.70	5.69	5.66	5.66	5.65	5.64	5.63
	.01	14.2	14.0	13.9	13.8	13.7	13.7	13.7	13.6	13.6	13.5	13.5	13.5
5	.25	1.89	1.88	1.88	1.88	1.88	1.88	1.87	1.87	1.87	1.87	1.87	1.87
	.10	3.24	3.21	3.19	3.17	3.16	3.15	3.14	3.13	3.12	3.12	3.11	3.10
	.05	4.62	4.56	4.53	4.50	4.46	4.44	4.43	4.41	4.40	4.39	4.37	4.36
	.01	9.72	9.55	9.47	9.38	9.29	9.24	9.20	9.13	9.11	9.08	9.04	9.02
6	.25	1.76	1.76	1.75	1.75	1.75	1.75	1.74	1.74	1.74	1.74	1.74	1.74
	.10	2.87	2.84	2.82	2.80	2.78	2.77	2.76	2.75	2.74	2.73	2.73	2.72
	.05	3.94	3.87	3.84	3.81	3.77	3.75	3.74	3.71	3.70	3.69	3.68	3.67
	.01	7.56	7.40	7.31	7.23	7.14	7.09	7.06	6.99	6.97	6.93	6.90	6.88
7	.25	1.68	1.67	1.67	1.66	1.66	1.66	1.65	1.65	1.65	1.65	1.65	1.65
	.10	2.63	2.59	2.58	2.56	2.54	2.52	2.51	2.50	2.49	2.48	2.48	2.47
	.05	3.51	3.44	3.41	3.38	3.34	3.32	3.30	3.27	3.27	3.25	3.24	3.23
	.01	6.31	6.16	6.07	5.99	5.91	5.86	5.82	5.75	5.74	5.70	5.67	5.65
8	.25	1.62	1.61	1.60	1.60	1.59	1.59	1.59	1.58	1.58	1.58	1.58	1.58
	.10	2.46	2.42	2.40	2.38	2.36	2.35	2.34	2.32	2.32	2.31	2.30	2.29
	.05	3.22	3.15	3.12	3.08	3.04	2.02	3.01	2.97	2.97	2.95	2.94	2.93
	.01	5.52	5.36	5.28	5.20	5.12	5.07	5.03	4.96	4.95	4.91	4.88	4.86
9	.25	1.57	1.56	1.56	1.55	1.55	1.54	1.54	1.53	1.53	1.53	1.53	1.53
	.10	2.34	2.30	2.28	2.25	2.23	2.22	2.21	2.19	2.18	2.17	2.17	2.16
	.05	3.01	2.94	2.90	2.86	2.83	2.80	2.79	2.76	2.75	2.73	2.72	2.71
	.01	4.96	4.81	4.73	4.65	4.57	4.52	4.48	4.42	4.40	4.36	4.33	4.31

(*Continued*)

TABLE D.3 UPPER PERCENTAGE POINTS OF THE *F* DISTRIBUTION *(Continued)*

df for denominator N_2	Pr	df for numerator N_1: 1	2	3	4	5	6	7	8	9	10	11	12
10	.25	1.49	1.60	1.60	1.59	1.59	1.58	1.57	1.56	1.56	1.55	1.55	1.54
	.10	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35	2.32	2.30	2.28
	.05	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.94	2.91
	.01	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.77	4.71
11	.25	1.47	1.58	1.58	1.57	1.56	1.55	1.54	1.53	1.53	1.52	1.52	1.51
	.10	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27	2.25	2.23	2.21
	.05	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.82	2.79
	.01	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.46	4.40
12	.25	1.46	1.56	1.56	1.55	1.54	1.53	1.52	1.51	1.51	1.50	1.50	1.49
	.10	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21	2.19	2.17	2.15
	.05	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.72	2.69
	.01	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.22	4.16
13	.25	1.45	1.55	1.55	1.53	1.52	1.51	1.50	1.49	1.49	1.48	1.47	1.47
	.10	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16	2.14	2.12	2.10
	.05	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.63	2.60
	.01	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	4.02	3.96
14	.25	1.44	1.53	1.53	1.52	1.51	1.50	1.49	1.48	1.47	1.46	1.46	1.45
	.10	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12	2.10	2.08	2.05
	.05	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.57	2.53
	.01	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.86	3.80
15	.25	1.43	1.52	1.52	1.51	1.49	1.48	1.47	1.46	1.46	1.45	1.44	1.44
	.10	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09	2.06	2.04	2.02
	.05	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.51	2.48
	.01	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.73	3.67
16	.25	1.42	1.51	1.51	1.50	1.48	1.47	1.46	1.45	1.44	1.44	1.44	1.43
	.10	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06	2.03	2.01	1.99
	.05	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.46	2.42
	.01	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.62	3.55
17	.25	1.42	1.51	1.50	1.49	1.47	1.46	1.45	1.44	1.43	1.43	1.42	1.41
	.10	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.06	2.03	2.00	1.98	1.96
	.05	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.41	2.38
	.01	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.52	3.46
18	.25	1.41	1.50	1.49	1.48	1.46	1.45	1.44	1.43	1.42	1.42	1.41	1.40
	.10	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.04	2.00	1.98	1.96	1.93
	.05	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.37	2.34
	.01	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.43	3.37
19	.25	1.41	1.49	1.49	1.47	1.46	1.44	1.43	1.42	1.41	1.41	1.40	1.40
	.10	2.99	2.61	2.40	2.27	2.18	2.11	2.06	2.02	1.98	1.96	1.94	1.91
	.05	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.34	2.31
	.01	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.36	3.30
20	.25	1.40	1.49	1.48	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.39
	.10	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96	1.94	1.92	1.89
	.05	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.31	2.28
	.01	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.29	3.23

df for denominator N_2	Pr	df for numerator N_1: 15	20	24	30	40	50	60	100	120	200	500	∞
10	.25	1.53	1.52	1.52	1.51	1.51	1.50	1.50	1.49	1.49	1.49	1.48	1.48
	.10	2.24	2.20	2.18	2.16	2.13	2.12	2.11	2.09	2.08	2.07	2.06	2.06
	.05	2.85	2.77	2.74	2.70	2.66	2.64	2.62	2.59	2.58	2.56	2.55	2.54
	.01	4.56	4.41	4.33	4.25	4.17	4.12	4.08	4.01	4.00	3.96	3.93	3.91
11	.25	1.50	1.49	1.49	1.48	1.47	1.47	1.47	1.46	1.46	1.46	1.45	1.45
	.10	2.17	2.12	2.10	2.08	2.05	2.04	2.03	2.00	2.00	1.99	1.98	1.97
	.05	2.72	2.65	2.61	2.57	2.53	2.51	2.49	2.46	2.45	2.43	2.42	2.40
	.01	4.25	4.10	4.02	3.94	3.86	3.81	3.78	3.71	3.69	3.66	3.62	3.60
12	.25	1.48	1.47	1.46	1.45	1.45	1.44	1.44	1.43	1.43	1.43	1.42	1.42
	.10	2.10	2.06	2.04	2.01	1.99	1.97	1.96	1.94	1.93	1.92	1.91	1.90
	.05	2.62	2.54	2.51	2.47	2.43	2.40	2.38	2.35	2.34	2.32	2.31	2.30
	.01	4.01	3.86	3.78	3.70	3.62	3.57	3.54	3.47	3.45	3.41	3.38	3.36
13	.25	1.46	1.45	1.44	1.43	1.42	1.42	1.42	1.41	1.41	1.40	1.40	1.40
	.10	2.05	2.01	1.98	1.96	1.93	1.92	1.90	1.88	1.88	1.86	1.85	1.85
	.05	2.53	2.46	2.42	2.38	2.34	2.31	2.30	2.26	2.25	2.23	2.22	2.21
	.01	3.82	3.66	3.59	3.51	3.43	3.38	3.34	3.27	3.25	3.22	3.19	3.17
14	.25	1.44	1.43	1.42	1.41	1.41	1.40	1.40	1.39	1.39	1.39	1.38	1.38
	.10	2.01	1.96	1.94	1.91	1.89	1.87	1.86	1.83	1.83	1.82	1.80	1.80
	.05	2.46	2.39	2.35	2.31	2.27	2.24	2.22	2.19	2.18	2.16	2.14	2.13
	.01	3.66	3.51	3.43	3.35	3.27	3.22	3.18	3.11	3.09	3.06	3.03	3.00
15	.25	1.43	1.41	1.41	1.40	1.39	1.39	1.38	1.38	1.37	1.37	1.36	1.36
	.10	1.97	1.92	1.90	1.87	1.85	1.83	1.82	1.79	1.79	1.77	1.76	1.76
	.05	2.40	2.33	2.29	2.25	2.20	2.18	2.16	2.12	2.11	2.10	2.08	2.07
	.01	3.52	3.37	3.29	3.21	3.13	3.08	3.05	2.98	2.96	2.92	2.89	2.87
16	.25	1.41	1.40	1.39	1.38	1.37	1.37	1.36	1.36	1.35	1.35	1.34	1.34
	.10	1.94	1.89	1.87	1.84	1.81	1.79	1.78	1.76	1.75	1.74	1.73	1.72
	.05	2.35	2.28	2.24	2.19	2.15	2.12	2.11	2.07	2.06	2.04	2.02	2.01
	.01	3.41	3.26	3.18	3.10	3.02	2.97	2.93	2.86	2.84	2.81	2.78	2.75
17	.25	1.40	1.39	1.38	1.37	1.36	1.35	1.35	1.34	1.34	1.34	1.33	1.33
	.10	1.91	1.86	1.84	1.81	1.78	1.76	1.75	1.73	1.72	1.71	1.69	1.69
	.05	2.31	2.23	2.19	2.15	2.10	2.08	2.06	2.02	2.01	1.99	1.97	1.96
	.01	3.31	3.16	3.08	3.00	2.92	2.87	2.83	2.76	2.75	2.71	2.68	2.65
18	.25	1.39	1.38	1.37	1.36	1.35	1.34	1.34	1.33	1.33	1.32	1.32	1.32
	.10	1.89	1.84	1.81	1.78	1.75	1.74	1.72	1.70	1.69	1.68	1.67	1.66
	.05	2.27	2.19	2.15	2.11	2.06	2.04	2.02	1.98	1.97	1.95	1.93	1.92
	.01	3.23	3.08	3.00	2.92	2.84	2.78	2.75	2.68	2.66	2.62	2.59	2.57
19	.25	1.38	1.37	1.36	1.35	1.34	1.33	1.33	1.32	1.32	1.31	1.31	1.30
	.10	1.86	1.81	1.79	1.76	1.73	1.71	1.70	1.67	1.67	1.65	1.64	1.63
	.05	2.23	2.16	2.11	2.07	2.03	2.00	1.98	1.94	1.93	1.91	1.89	1.88
	.01	3.15	3.00	2.92	2.84	2.76	2.71	2.67	2.60	2.58	2.55	2.51	2.49
20	.25	1.37	1.36	1.35	1.34	1.33	1.33	1.32	1.31	1.31	1.30	1.30	1.29
	.10	1.84	1.79	1.77	1.74	1.71	1.69	1.68	1.65	1.64	1.63	1.62	1.61
	.05	2.20	2.12	2.08	2.04	1.99	1.97	1.95	1.91	1.90	1.88	1.86	1.84
	.01	3.09	2.94	2.86	2.78	2.69	2.64	2.61	2.54	2.52	2.48	2.44	2.42

(Continued)

TABLE D.3 UPPER PERCENTAGE POINTS OF THE *F* DISTRIBUTION (*Continued*)

df for denominator N_2	Pr	df for numerator N_1 1	2	3	4	5	6	7	8	9	10	11	12
22	.25	1.40	1.48	1.47	1.45	1.44	1.42	1.41	1.40	1.39	1.39	1.38	1.37
	.10	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.97	1.93	1.90	1.88	1.86
	.05	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.26	2.23
	.01	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.18	3.12
24	.25	1.39	1.47	1.46	1.44	1.43	1.41	1.40	1.39	1.38	1.38	1.37	1.36
	.10	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91	1.88	1.85	1.83
	.05	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.21	2.18
	.01	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.09	3.03
26	.25	1.38	1.46	1.45	1.44	1.42	1.41	1.39	1.38	1.37	1.37	1.36	1.35
	.10	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.92	1.88	1.86	1.84	1.81
	.05	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.18	2.15
	.01	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	3.02	2.96
28	.25	1.38	1.46	1.45	1.43	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34
	.10	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90	1.87	1.84	1.81	1.79
	.05	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.15	2.12
	.01	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.96	2.90
30	.25	1.38	1.45	1.44	1.42	1.41	1.39	1.38	1.37	1.36	1.35	1.35	1.34
	.10	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88	1.85	1.82	1.79	1.77
	.05	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.13	2.09
	.01	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.91	2.84
40	.25	1.36	1.44	1.42	1.40	1.39	1.37	1.36	1.35	1.34	1.33	1.32	1.31
	.10	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83	1.79	1.76	1.73	1.71
	.05	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.04	2.00
	.01	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.73	2.66
60	.25	1.35	1.42	1.41	1.38	1.37	1.35	1.33	1.32	1.31	1.30	1.29	1.29
	.10	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74	1.71	1.68	1.66
	.05	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.95	1.92
	.01	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.56	2.50
120	.25	1.34	1.40	1.39	1.37	1.35	1.33	1.31	1.30	1.29	1.28	1.27	1.26
	.10	2.75	2.35	2.13	1.99	1.90	1.82	1.77	1.72	1.68	1.65	1.62	1.60
	.05	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.87	1.83
	.01	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.40	2.34
200	.25	1.33	1.39	1.38	1.36	1.34	1.32	1.31	1.29	1.28	1.27	1.26	1.25
	.10	2.73	2.33	2.11	1.97	1.88	1.80	1.75	1.70	1.66	1.63	1.60	1.57
	.05	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98	1.93	1.88	1.84	1.80
	.01	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60	2.50	2.41	2.34	2.27
∞	.25	1.32	1.39	1.37	1.35	1.33	1.31	1.29	1.28	1.27	1.25	1.24	1.24
	.10	2.71	2.30	2.08	1.94	1.85	1.77	1.72	1.67	1.63	1.60	1.57	1.55
	.05	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.79	1.75
	.01	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.25	2.18

df for denominator N_2	Pr	df for numerator N_1 15	20	24	30	40	50	60	100	120	200	500	∞
22	.25	1.36	1.34	1.33	1.32	1.31	1.31	1.30	1.30	1.30	1.29	1.29	1.28
	.10	1.81	1.76	1.73	1.70	1.67	1.65	1.64	1.61	1.60	1.59	1.58	1.57
	.05	2.15	2.07	2.03	1.98	1.94	1.91	1.89	1.85	1.84	1.82	1.80	1.78
	.01	2.98	2.83	2.75	2.67	2.58	2.53	2.50	2.42	2.40	2.36	2.33	2.31
24	.25	1.35	1.33	1.32	1.31	1.30	1.29	1.29	1.28	1.28	1.27	1.27	1.26
	.10	1.78	1.73	1.70	1.67	1.64	1.62	1.61	1.58	1.57	1.56	1.54	1.53
	.05	2.11	2.03	1.98	1.94	1.89	1.86	1.84	1.80	1.79	1.77	1.75	1.73
	.01	2.89	2.74	2.66	2.58	2.49	2.44	2.40	2.33	2.31	2.27	2.24	2.21
26	.25	1.34	1.32	1.31	1.30	1.29	1.28	1.28	1.26	1.26	1.26	1.25	1.25
	.10	1.76	1.71	1.68	1.65	1.61	1.59	1.58	1.55	1.54	1.53	1.51	1.50
	.05	2.07	1.99	1.95	1.90	1.85	1.82	1.80	1.76	1.75	1.73	1.71	1.69
	.01	2.81	2.66	2.58	2.50	2.42	2.36	2.33	2.25	2.23	2.19	2.16	2.13
28	.25	1.33	1.31	1.30	1.29	1.28	1.27	1.27	1.26	1.25	1.25	1.24	1.24
	.10	1.74	1.69	1.66	1.63	1.59	1.57	1.56	1.53	1.52	1.50	1.49	1.48
	.05	2.04	1.96	1.91	1.87	1.82	1.79	1.77	1.73	1.71	1.69	1.67	1.65
	.01	2.75	2.60	2.52	2.44	2.35	2.30	2.26	2.19	2.17	2.13	2.09	2.06
30	.25	1.32	1.30	1.29	1.28	1.27	1.26	1.26	1.25	1.24	1.24	1.23	1.23
	.10	1.72	1.67	1.64	1.61	1.57	1.55	1.54	1.51	1.50	1.48	1.47	1.46
	.05	2.01	1.93	1.89	1.84	1.79	1.76	1.74	1.70	1.68	1.66	1.64	1.62
	.01	2.70	2.55	2.47	2.39	2.30	2.25	2.21	2.13	2.11	2.07	2.03	2.01
40	.25	1.30	1.28	1.26	1.25	1.24	1.23	1.22	1.21	1.21	1.20	1.19	1.19
	.10	1.66	1.61	1.57	1.54	1.51	1.48	1.47	1.43	1.42	1.41	1.39	1.38
	.05	1.92	1.84	1.79	1.74	1.69	1.66	1.64	1.59	1.58	1.55	1.53	1.51
	.01	2.52	2.37	2.29	2.20	2.11	2.06	2.02	1.94	1.92	1.87	1.83	1.80
60	.25	1.27	1.25	1.24	1.22	1.21	1.20	1.19	1.17	1.17	1.16	1.15	1.15
	.10	1.60	1.54	1.51	1.48	1.44	1.41	1.40	1.36	1.35	1.33	1.31	1.29
	.05	1.84	1.75	1.70	1.65	1.59	1.56	1.53	1.48	1.47	1.44	1.41	1.39
	.01	2.35	2.20	2.12	2.03	1.94	1.88	1.84	1.75	1.73	1.68	1.63	1.60
120	.25	1.24	1.22	1.21	1.19	1.18	1.17	1.16	1.14	1.13	1.12	1.11	1.10
	.10	1.55	1.48	1.45	1.41	1.37	1.34	1.32	1.27	1.26	1.24	1.21	1.19
	.05	1.75	1.66	1.61	1.55	1.50	1.46	1.43	1.37	1.35	1.32	1.28	1.25
	.01	2.19	2.03	1.95	1.86	1.76	1.70	1.66	1.56	1.53	1.48	1.42	1.38
200	.25	1.23	1.21	1.20	1.18	1.16	1.14	1.12	1.11	1.10	1.09	1.08	1.06
	.10	1.52	1.46	1.42	1.38	1.34	1.31	1.28	1.24	1.22	1.20	1.17	1.14
	.05	1.72	1.62	1.57	1.52	1.46	1.41	1.39	1.32	1.29	1.26	1.22	1.19
	.01	2.13	1.97	1.89	1.79	1.69	1.63	1.58	1.48	1.44	1.39	1.33	1.28
∞	.25	1.22	1.19	1.18	1.16	1.14	1.13	1.12	1.09	1.08	1.07	1.04	1.00
	.10	1.49	1.42	1.38	1.34	1.30	1.26	1.24	1.18	1.17	1.13	1.08	1.00
	.05	1.67	1.57	1.52	1.46	1.39	1.35	1.32	1.24	1.22	1.17	1.11	1.00
	.01	2.04	1.88	1.79	1.70	1.59	1.52	1.47	1.36	1.32	1.25	1.15	1.00

Appendix 2

Causality Relationships between the Construction Industry and Economic Sectors

Null Hypothesis: D_D_L_ AGRICUL has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-9.035426	Augmented Dickey-Fuller test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_AGRICUL)
Method: Least Squares
Date: 11/06/12 Time: 04:09
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.035426	0.147865	-1.336019	D_D_L_AGRICUL(-1)

0.009662	Mean dependent var	0.802298	R-squared
0.144253	S.D. dependent var	0.802298	Adjusted R-squared
-2.609040	Akaike info criterion	0.064140	S.E. of regression
-2.559300	Schwarz criterion	0.082280	Sum squared resid
1.635204	Durbin-Watson stat	28.39492	Log likelihood

Null Hypothesis: D_D_L_CONSTRU has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0008	-5.882387	Augmented Dickey-Fuller test statistic	
	-4.532598	1% level	Test critical values:
	-3.673616	5% level	
	-3.277364	10% level	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20
Null Hypothesis: D_D_L_CONSTRU has a unit root
Exogenous: None
Lag Length: 2 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-5.865037	Augmented Dickey-Fuller test statistic	
	-2.692358	1% level	Test critical values:
	-1.960171	5% level	
	-1.607051	10% level	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20
observations and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(D_D_L_CONSTRU)
Method: Least Squares
Date: 11/06/12 Time: 04:10
Sample (adjusted): 1991 2009
Included observations: 19 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-5.865037	0.539768	-3.165762	D_D_L_CONSTRU(-1)
0.0027	3.550273	0.370858	1.316647	D(D_D_L_CONSTRU(-1))
0.0400	2.234893	0.211478	0.472632	D(D_D_L_CONSTRU(-2))

0.001387	Mean dependent var	0.839634	R-squared
0.389469	S.D. dependent var	0.819588	Adjusted R-squared
-0.616638	Akaike info criterion	0.165427	S.E. of regression
-0.467516	Schwarz criterion	0.437856	Sum squared resid
1.808213	Durbin-Watson stat	8.858064	Log likelihood

observations and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_CONSTRU)
Method: Least Squares
Date: 11/06/12 Time: 04:10
Sample (adjusted): 1991 2009
Included observations: 19 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-5.882387	0.563533	-3.314920	D_D_L_CONSTRU(-1)
0.0026	3.658927	0.386920	1.415711	D(D_D_L_CONSTRU(-1))
0.0324	2.375080	0.219562	0.521478	D(D_D_L_CONSTRU(-2))
0.7814	0.282862	0.106966	0.030256	C
0.8685	0.168668	0.007100	0.001198	@TREND(1986)

0.001387	Mean dependent var	0.854551	R-squared
0.389469	S.D. dependent var	0.812994	Adjusted R-squared
-0.503749	Akaike info criterion	0.168422	S.E. of regression
-0.255212	Schwarz criterion	0.397126	Sum squared resid
20.56343	F-statistic	9.785611	Log likelihood
0.000010	Prob(F-statistic)	1.887073	Durbin-Watson stat

Null Hypothesis: D_D_L_ELECTRI has a unit root
Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-7.974445	Augmented Dickey-Fuller test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_ELECTRI)
Method: Least Squares
Date: 11/06/12 Time: 04:10
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-7.974445	0.195606	-1.559847	D_D_L_ELECTRI(-1)
0.8531	0.187849	0.134695	0.025302	C
0.8838	-0.148263	0.009391	-0.001392	@TREND(1986)

-0.003638	Mean dependent var	0.779412	R-squared
0.526364	S.D. dependent var	0.754902	Adjusted R-squared
0.279815	Akaike info criterion	0.260589	S.E. of regression
0.429033	Schwarz criterion	1.222315	Sum squared resid
31.80007	F-statistic	0.061937	Log likelihood
0.000001	Prob(F-statistic)	2.209547	Durbin-Watson stat

Null Hypothesis: D_D_L_ELECTRI has a unit root

Exogenous: None

Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-8.395257	Augmented Dickey-Fuller test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(D_D_L_ELECTRI)

Method: Least Squares

Date: 11/06/12 Time: 04:11

Sample (adjusted): 1989 2009

Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.395257	0.185706	-1.559049	D_D_L_ELECTRI(-1)

-0.003638	Mean dependent var	0.778946	R-squared
0.526364	S.D. dependent var	0.778946	Adjusted R-squared
0.091448	Akaike info criterion	0.247477	S.E. of regression
0.141188	Schwarz criterion	1.224896	Sum squared resid
2.206764	Durbin-Watson stat	0.039791	Log likelihood

Null Hypothesis: D_D_L_GENERAL has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.6789	-1.777820	Augmented Dickey-Fuller test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_GENERAL)
Method: Least Squares
Date: 11/06/12 Time: 04:11
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0923	-1.777820	0.547720	-0.973748	D_D_L_GENERAL(-1)
0.3722	0.915184	0.279467	0.255763	C
0.1565	-1.478586	0.019483	-0.028807	@TREND(1986)

-0.124249	Mean dependent var	0.213696	R-squared
0.575786	S.D. dependent var	0.126329	Adjusted R-squared
1.730349	Akaike info criterion	0.538189	S.E. of regression
1.879567	Schwarz criterion	5.213652	Sum squared resid
2.445953	F-statistic	-15.16867	Log likelihood
0.114899	Prob(F-statistic)	1.294756	Durbin-Watson stat

Null Hypothesis: D_D_L_GENERAL has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0971	-1.623563	Augmented Dickey-Fuller test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_GENERAL)
Method: Least Squares
Date: 11/06/12 Time: 04:11
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.1201	-1.623563	0.561372	-0.911423	D_D_L_GENERAL(-1)

-0.124249	Mean dependent var	0.073250	R-squared
0.575786	S.D. dependent var	0.073250	Adjusted R-squared
1.704213	Akaike info criterion	0.554296	S.E. of regression
1.753953	Schwarz criterion	6.144889	Sum squared resid
1.134836	Durbin-Watson stat	-16.89424	Log likelihood

Null Hypothesis: D_D_L_GENERAL has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.6789	-1.777820	Augmented Dickey-Fuller test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_GENERAL)
Method: Least Squares
Date: 11/06/12 Time: 04:12
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0923	-1.777820	0.547720	-0.973748	D_D_L_GENERAL(-1)
0.3722	0.915184	0.279467	0.255763	C
0.1565	-1.478586	0.019483	-0.028807	@TREND(1986)

-0.124249	Mean dependent var	0.213696	R-squared
0.575786	S.D. dependent var	0.126329	Adjusted R-squared
1.730349	Akaike info criterion	0.538189	S.E. of regression
1.879567	Schwarz criterion	5.213652	Sum squared resid
2.445953	F-statistic	-15.16867	Log likelihood
0.114899	Prob(F-statistic)	1.294756	Durbin-Watson stat

Null Hypothesis: D_D_L_GENERAL has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0971	-1.623563	Augmented Dickey-Fuller test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_GENERAL)
Method: Least Squares
Date: 11/06/12 Time: 04:12
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.1201	-1.623563	0.561372	-0.911423	D_D_L_GENERAL(-1)

-0.124249	Mean dependent var	0.073250	R-squared
0.575786	S.D. dependent var	0.073250	Adjusted R-squared
1.704213	Akaike info criterion	0.554296	S.E. of regression
1.753953	Schwarz criterion	6.144889	Sum squared resid
1.134836	Durbin-Watson stat	-16.89424	Log likelihood

Null Hypothesis: D_D_L_MANUFAC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-8.649094	Augmented Dickey-Fuller test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_MANUFAC)
Method: Least Squares
Date: 11/06/12 Time: 04:13
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.649094	0.185008	-1.600148	D_D_L_MANUFAC(-1)
0.9263	0.093843	0.135155	0.012683	C
0.9477	-0.066453	0.009419	-0.000626	@TREND(1986)

-0.015647	Mean dependent var	0.806148	R-squared
0.562861	S.D. dependent var	0.784608	Adjusted R-squared
0.284699	Akaike info criterion	0.261226	S.E. of regression
0.433917	Schwarz criterion	1.228299	Sum squared resid
37.42706	F-statistic	0.010660	Log likelihood
0.000000	Prob(F-statistic)	2.329244	Durbin-Watson stat

Null Hypothesis: D_D_L_MANUFAC has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-9.121037	Augmented Dickey-Fuller test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_MANUFAC)
Method: Least Squares
Date: 11/06/12 Time: 04:13
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.121037	0.175325	-1.599143	D_D_L_MANUFAC(-1)

-0.015647	Mean dependent var	0.806032	R-squared
0.562861	S.D. dependent var	0.806032	Adjusted R-squared
0.094820	Akaike info criterion	0.247894	S.E. of regression
0.144559	Schwarz criterion	1.229033	Sum squared resid
2.329350	Durbin-Watson stat	0.004390	Log likelihood

Null Hypothesis: D_D_L_MINING_ has a unit root

Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0009	-5.701404	Augmented Dickey-Fuller test statistic	
	-4.498307	1% level	Test critical values:
	-3.658446	5% level	
	-3.268973	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_MINING_)
Method: Least Squares
Date: 11/06/12 Time: 04:13
Sample (adjusted): 1990 2009
Included observations: 20 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-5.701404	0.427517	-2.437450	D_D_L_MINING_(-1)
0.0818	1.856814	0.239300	0.444335	D(D_D_L_MINING_(-1))
0.8177	0.234297	0.659320	0.154477	C
0.8031	-0.253535	0.045016	-0.011413	@TREND(1986)

0.087542	Mean dependent var	0.860589	R-squared
2.827497	S.D. dependent var	0.834449	Adjusted R-squared
3.295039	Akaike info criterion	1.150449	S.E. of regression
3.494185	Schwarz criterion	21.17654	Sum squared resid
32.92285	F-statistic	-28.95039	Log likelihood
0.000000	Prob(F-statistic)	2.231329	Durbin-Watson stat

Null Hypothesis: D_D_L_MINING_ has a unit root
Exogenous: None
Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-6.047920	Augmented Dickey-Fuller test statistic	
	-2.685718	1% level	Test critical values:
	-1.959071	5% level	
	-1.607456	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_MINING_)
Method: Least Squares
Date: 11/06/12 Time: 04:13
Sample (adjusted): 1990 2009
Included observations: 20 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-6.047920	0.400830	-2.424188	D_D_L_MINING_(-1)
0.0670	1.949368	0.225150	0.438899	D(D_D_L_MINING_(-1))

0.087542	Mean dependent var	0.860029	R-squared
2.827497	S.D. dependent var	0.852253	Adjusted R-squared
3.099049	Akaike info criterion	1.086831	S.E. of regression
3.198622	Schwarz criterion	21.26163	Sum squared resid
2.233597	Durbin-Watson stat	-28.99049	Log likelihood

Null Hypothesis: D_D_L_OTHER_S has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0051	-4.936675	Augmented Dickey-Fuller test statistic	
	-4.571559	1% level	Test critical values:
	-3.690814	5% level	
	-3.286909	10% level	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_OTHER_S)
Method: Least Squares
Date: 11/06/12 Time: 04:14
Sample (adjusted): 1992 2009
Included observations: 18 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0003	-4.936675	1.597246	-7.885083	D_D_L_OTHER_S(-1)
0.0039	3.561042	1.450935	5.166841	D(D_D_L_OTHER_S(-1))
0.0350	2.375753	1.049898	2.494298	D(D_D_L_OTHER_S(-2))
0.0081	3.170623	0.707077	2.241874	D(D_D_L_OTHER_S(-3))
0.2845	-1.120305	0.083073	-0.093067	C
0.5566	0.604695	0.005519	0.003338	@TREND(1986)

-0.026312	Mean dependent var	0.965262	R-squared
0.517320	S.D. dependent var	0.950787	Adjusted R-squared
-1.230715	Akaike info criterion	0.114762	S.E. of regression
-0.933924	Schwarz criterion	0.158043	Sum squared resid
66.68797	F-statistic	17.07643	Log likelihood
0.000000	Prob(F-statistic)	2.078085	Durbin-Watson stat

Null Hypothesis: D_D_L_OTHER_S has a unit root

Exogenous: None
Lag Length: 3 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0001	-4.625894	Augmented Dickey-Fuller test statistic	
	-2.699769	1% level	Test critical values:
	-1.961409	5% level	
	-1.606610	10% level	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_OTHER_S)
Method: Least Squares
Date: 11/06/12 Time: 04:14
Sample (adjusted): 1992 2009
Included observations: 18 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0004	-4.625894	1.515495	-7.010518	D_D_L_OTHER_S(-1)
0.0066	3.182526	1.377273	4.383209	D(D_D_L_OTHER_S(-1))
0.0723	1.943909	1.020250	1.983273	D(D_D_L_OTHER_S(-2))
0.0125	2.865906	0.691984	1.983161	D(D_D_L_OTHER_S(-3))

-0.026312	Mean dependent var	0.957237	R-squared
0.517320	S.D. dependent var	0.948073	Adjusted R-squared
-1.245100	Akaike info criterion	0.117884	S.E. of regression
-1.047240	Schwarz criterion	0.194553	Sum squared resid
1.829920	Durbin-Watson stat	15.20590	Log likelihood

Null Hypothesis: D_D_L_TRADE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0011	-5.628538	Augmented Dickey-Fuller test statistic	
	-4.498307	1% level	Test critical values:
	-3.658446	5% level	
	-3.268973	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_TRADE)
Method: Least Squares
Date: 11/06/12 Time: 04:15
Sample (adjusted): 1990 2009
Included observations: 20 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-5.628538	0.400042	-2.251653	D_D_L_TRADE(-1)
0.0573	2.048346	0.227262	0.465511	D(D_D_L_TRADE(-1))
0.8645	-0.173403	0.050729	-0.008796	C
0.7575	0.314053	0.003469	0.001089	@TREND(1986)

-0.002850	Mean dependent var	0.810194	R-squared
0.187339	S.D. dependent var	0.774606	Adjusted R-squared
-1.824842	Akaike info criterion	0.088940	S.E. of regression
-1.625696	Schwarz criterion	0.126567	Sum squared resid
22.76556	F-statistic	22.24842	Log likelihood
0.000005	Prob(F-statistic)	2.239703	Durbin-Watson stat

Null Hypothesis: D_D_L_TRADE has a unit root
Exogenous: None

Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-5.932674	Augmented Dickey-Fuller test statistic	
	-2.685718	1% level	Test critical values:
	-1.959071	5% level	
	-1.607456	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_TRADE)
Method: Least Squares
Date: 11/06/12 Time: 04:15
Sample (adjusted): 1990 2009
Included observations: 20 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-5.932674	0.375359	-2.226883	D_D_L_TRADE(-1)
0.0482	2.119484	0.213670	0.452871	D(D_D_L_TRADE(-1))

-0.002850	Mean dependent var	0.808009	R-squared
0.187339	S.D. dependent var	0.797343	Adjusted R-squared
-2.013396	Akaike info criterion	0.084335	S.E. of regression
-1.913823	Schwarz criterion	0.128024	Sum squared resid
2.228968	Durbin-Watson stat	22.13396	Log likelihood

Null Hypothesis: D_D_L_TRANSPO has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

Prob.*	t-Statistic		
0.0000	-8.078896	Augmented Dickey-Fuller test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_D_L_TRANSPO)
Method: Least Squares
Date: 11/06/12 Time: 04:16
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.078896	0.198557	-1.604120	D_D_L_TRANSPO(-1)
0.9070	-0.118518	0.037209	-0.004410	C
0.9003	0.127054	0.002600	0.000330	@TREND(1986)

-0.002589	Mean dependent var	0.785485	R-squared
0.146794	S.D. dependent var	0.761650	Adjusted R-squared
-2.302020	Akaike info criterion	0.071667	S.E. of regression
-2.152803	Schwarz criterion	0.092450	Sum squared resid
32.95517	F-statistic	27.17121	Log likelihood
0.000001	Prob(F-statistic)	1.783325	Durbin-Watson stat

Null Hypothesis: D_D_L_AGRICUL has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-7.924068	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.003740	Residual variance (no correction)
0.004626	HAC corrected variance (Bartlett kernel)

Dependent Variable: D(D_D_L_AGRICUL)
Method: Least Squares
Date: 11/07/12 Time: 01:12
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.455613	0.155133	-1.311743	D_D_L_AGRICUL(-1)
0.3724	0.914842	0.034709	0.031753	C
0.4483	-0.775096	0.002425	-0.001879	@TREND(1986)

0.009662	Mean dependent var	0.811271	R-squared
0.144253	S.D. dependent var	0.790301	Adjusted R-squared
-2.465014	Akaike info criterion	0.066058	S.E. of regression
-2.315796	Schwarz criterion	0.078545	Sum squared resid
38.68751	F-statistic	28.88264	Log likelihood
0.000000	Prob(F-statistic)	1.737897	Durbin-Watson stat

Null Hypothesis: D_D_L_CONSTRU has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-12.19772	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.045351	Residual variance (no correction)
0.005199	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_CONSTRU)
Method: Least Squares
Date: 11/07/12 Time: 01:13
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-6.044751	0.222482	-1.344848	D_D_L_CONSTRU(-1)
0.7098	0.378109	0.119135	0.045046	C
0.8421	-0.202157	0.008291	-0.001676	@TREND(1986)

-0.011117	Mean dependent var	0.670002	R-squared
0.379867	S.D. dependent var	0.633336	Adjusted R-squared
0.030263	Akaike info criterion	0.230020	S.E. of regression
0.179480	Schwarz criterion	0.952366	Sum squared resid
18.27291	F-statistic	2.682239	Log likelihood
0.000046	Prob(F-statistic)	2.370997	Durbin-Watson stat

Null Hypothesis: D_D_L_CONSTRU has a unit root
Exogenous: None
Bandwidth: 9 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-10.07769	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

0.045987	Residual variance (no correction)
0.009569	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_CONSTRU)
Method: Least Squares
Date: 11/07/12 Time: 01:13
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-6.310473	0.211148	-1.332442	D_D_L_CONSTRU(-1)

-0.011117	Mean dependent var	0.665375	R-squared
0.379867	S.D. dependent var	0.665375	Adjusted R-squared
-0.146288	Akaike info criterion	0.219741	S.E. of regression
-0.096548	Schwarz criterion	0.965721	Sum squared resid
2.350154	Durbin-Watson stat	2.536019	Log likelihood

Null Hypothesis: D_D_L_ELECTRI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 19 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-22.35332	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.058205	Residual variance (no correction)
0.004507	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_ELECTRI)
Method: Least Squares
Date: 11/07/12 Time: 01:13
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-7.974445	0.195606	-1.559847	D_D_L_ELECTRI(-1)
0.8531	0.187849	0.134695	0.025302	C
0.8838	-0.148263	0.009391	-0.001392	@TREND(1986)

-0.003638	Mean dependent var	0.779412	R-squared
0.526364	S.D. dependent var	0.754902	Adjusted R-squared
0.279815	Akaike info criterion	0.260589	S.E. of regression
0.429033	Schwarz criterion	1.222315	Sum squared resid
31.80007	F-statistic	0.061937	Log likelihood
0.000001	Prob(F-statistic)	2.209547	Durbin-Watson stat

Null Hypothesis: D_D_L_GENERAL has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.6632	-3.810506	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.248269	Residual variance (no correction)
0.250105	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_GENERAL)
Method: Least Squares
Date: 11/07/12 Time: 01:14
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0923	-1.777820	0.547720	-0.973748	D_D_L_GENERAL(-1)
0.3722	0.915184	0.279467	0.255763	C
0.1565	-1.478586	0.019483	-0.028807	@TREND(1986)

-0.124249	Mean dependent var	0.213696	R-squared
0.575786	S.D. dependent var	0.126329	Adjusted R-squared
1.730349	Akaike info criterion	0.538189	S.E. of regression
1.879567	Schwarz criterion	5.213652	Sum squared resid
2.445953	F-statistic	-15.16867	Log likelihood
0.114899	Prob(F-statistic)	1.294756	Durbin-Watson stat

Null Hypothesis: D_D_L_GENERAL has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0875	-1.678241	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

0.292614	Residual variance (no correction)
0.295869	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_GENERAL)
Method: Least Squares
Date: 11/07/12 Time: 01:14
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.1201	-1.623563	0.561372	-0.911423	D_D_L_GENERAL(-1)

-0.124249	Mean dependent var	0.073250	R-squared
0.575786	S.D. dependent var	0.073250	Adjusted R-squared
1.704213	Akaike info criterion	0.554296	S.E. of regression
1.753953	Schwarz criterion	6.144889	Sum squared resid
1.134836	Durbin-Watson stat	-16.89424	Log likelihood

Null Hypothesis: D_D_L_MANUFAC has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 20 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-25.33767	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.058490	Residual variance (no correction)
0.004448	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_MANUFAC)
Method: Least Squares
Date: 11/07/12 Time: 01:14
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.649094	0.185008	-1.600148	D_D_L_MANUFAC(-1)
0.9263	0.093843	0.135155	0.012683	C
0.9477	-0.066453	0.009419	-0.000626	@TREND(1986)

-0.015647	Mean dependent var	0.806148	R-squared
0.562861	S.D. dependent var	0.784608	Adjusted R-squared
0.284699	Akaike info criterion	0.261226	S.E. of regression
0.433917	Schwarz criterion	1.228299	Sum squared resid
37.42706	F-statistic	0.010660	Log likelihood
0.000000	Prob(F-statistic)	2.329244	Durbin-Watson stat

Null Hypothesis: D_D_L_MANUFAC has a unit root
Exogenous: None
Bandwidth: 20 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0001	-25.61363	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

0.058525	Residual variance (no correction)
0.004988	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_MANUFAC)
Method: Least Squares
Date: 11/07/12 Time: 01:15
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.121037	0.175325	-1.599143	D_D_L_MANUFAC(-1)

-0.015647	Mean dependent var	0.806032	R-squared
0.562861	S.D. dependent var	0.806032	Adjusted R-squared
0.094820	Akaike info criterion	0.247894	S.E. of regression
0.144559	Schwarz criterion	1.229033	Sum squared resid
2.329350	Durbin-Watson stat	0.004390	Log likelihood

Null Hypothesis: D_D_L_MINING_ has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 14 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-29.72476	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

1.235360	Residual variance (no correction)
0.081849	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_MINING_)
Method: Least Squares
Date: 11/07/12 Time: 01:15
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.321147	0.183976	-1.714870	D_D_L_MINING_(-1)
0.8040	0.251903	0.622507	0.156811	C
0.8138	-0.238955	0.043498	-0.010394	@TREND(1986)

0.096510	Mean dependent var	0.829251	R-squared
2.756210	S.D. dependent var	0.810279	Adjusted R-squared
3.334954	Akaike info criterion	1.200522	S.E. of regression
3.484172	Schwarz criterion	25.94257	Sum squared resid
43.70892	F-statistic	-32.01702	Log likelihood
0.000000	Prob(F-statistic)	2.524485	Durbin-Watson stat

Null Hypothesis: D_D_L_MINING_ has a unit root
Exogenous: None
Bandwidth: 14 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0001	-28.18778	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

1.239758	Residual variance (no correction)
0.105225	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_MINING_)
Method: Least Squares
Date: 11/07/12 Time: 01:16
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-9.842039	0.173824	-1.710781	D_D_L_MINING_(-1)

0.096510	Mean dependent var	0.828643	R-squared
2.756210	S.D. dependent var	0.828643	Adjusted R-squared
3.148031	Akaike info criterion	1.140941	S.E. of regression
3.197770	Schwarz criterion	26.03492	Sum squared resid
2.518936	Durbin-Watson stat	-32.05433	Log likelihood

Null Hypothesis: D_D_L_OTHER_S has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 9 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-16.14767	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.029482	Residual variance (no correction)
0.010317	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_OTHER_S)
Method: Least Squares
Date: 11/07/12 Time: 01:16
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-10.64451	0.172816	-1.839538	D_D_L_OTHER_S(-1)
0.4306	-0.806318	0.096784	-0.078039	C
0.3033	1.059782	0.006811	0.007218	@TREND(1986)

-0.022706	Mean dependent var	0.863967	R-squared
0.477033	S.D. dependent var	0.848852	Adjusted R-squared
-0.400392	Akaike info criterion	0.185460	S.E. of regression
-0.251174	Schwarz criterion	0.619117	Sum squared resid
57.16020	F-statistic	7.204113	Log likelihood
0.000000	Prob(F-statistic)	2.348129	Durbin-Watson stat

Null Hypothesis: D_D_L_OTHER_S has a unit root
Exogenous: None
Bandwidth: 8 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0001	-15.05136	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

0.031546	Residual variance (no correction)
0.013604	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_OTHER_S)
Method: Least Squares
Date: 11/07/12 Time: 01:16
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-10.85024	0.165785	-1.798803	D_D_L_OTHER_S(-1)

-0.022706	Mean dependent var	0.854440	R-squared
0.477033	S.D. dependent var	0.854440	Adjusted R-squared
-0.523183	Akaike info criterion	0.181999	S.E. of regression
-0.473444	Schwarz criterion	0.662473	Sum squared resid
2.302848	Durbin-Watson stat	6.493422	Log likelihood

Null Hypothesis: D_D_L_TRADE has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 13 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-19.88414	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.007622	Residual variance (no correction)
0.000643	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_TRADE)
Method: Least Squares
Date: 11/07/12 Time: 01:17
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-7.570235	0.201853	-1.528076	D_D_L_TRADE(-1)
0.9981	0.002454	0.048737	0.000120	C
0.9540	0.058446	0.003399	0.000199	@TREND(1986)

-0.005495	Mean dependent var	0.761009	R-squared
0.182997	S.D. dependent var	0.734454	Adjusted R-squared
-1.753096	Akaike info criterion	0.094301	S.E. of regression
-1.603879	Schwarz criterion	0.160067	Sum squared resid
28.65830	F-statistic	21.40751	Log likelihood
0.000003	Prob(F-statistic)	2.433600	Durbin-Watson stat

Null Hypothesis: D_D_L_TRADE has a unit root
Exogenous: None
Bandwidth: 13 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0001	-19.83706	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

0.007631	Residual variance (no correction)
0.000748	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_TRADE)
Method: Least Squares
Date: 11/07/12 Time: 01:17
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-7.979261	0.191303	-1.526454	D_D_L_TRADE(-1)

-0.005495	Mean dependent var	0.760735	R-squared
0.182997	S.D. dependent var	0.760735	Adjusted R-squared
-1.942429	Akaike info criterion	0.089513	S.E. of regression
-1.892690	Schwarz criterion	0.160250	Sum squared resid
2.432339	Durbin-Watson stat	21.39550	Log likelihood

Null Hypothesis: D_D_L_TRANSPO has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-8.174539	Phillips-Perron test statistic	
	-4.467895	1% level	Test critical values:
	-3.644963	5% level	
	-3.261452	10% level	

*MacKinnon (1996) one-sided p-values.

0.004402	Residual variance (no correction)
0.004211	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_TRANSPO)
Method: Least Squares
Date: 11/07/12 Time: 01:17
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.078896	0.198557	-1.604120	D_D_L_TRANSPO(-1)
0.9070	-0.118518	0.037209	-0.004410	C
0.9003	0.127054	0.002600	0.000330	@TREND(1986)

-0.002589	Mean dependent var	0.785485	R-squared
0.146794	S.D. dependent var	0.761650	Adjusted R-squared
-2.302020	Akaike info criterion	0.071667	S.E. of regression
-2.152803	Schwarz criterion	0.092450	Sum squared resid
32.95517	F-statistic	27.17121	Log likelihood
0.000001	Prob(F-statistic)	1.783325	Durbin-Watson stat

Null Hypothesis: D_D_L_TRANSPO has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West using Bartlett kernel)

Prob.*	Adj. t-Stat		
0.0000	-8.665619	Phillips-Perron test statistic	
	-2.679735	1% level	Test critical values:
	-1.958088	5% level	
	-1.607830	10% level	

*MacKinnon (1996) one-sided p-values.

0.004406	Residual variance (no correction)
0.004208	HAC corrected variance (Bartlett kernel)

Phillips-Perron Test Equation
Dependent Variable: D(D_D_L_TRANSPO)
Method: Least Squares
Date: 11/07/12 Time: 01:18
Sample (adjusted): 1989 2009
Included observations: 21 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-8.554548	0.187183	-1.601267	D_D_L_TRANSPO(-1)

-0.002589	Mean dependent var	0.785292	R-squared
0.146794	S.D. dependent var	0.785292	Adjusted R-squared
-2.491597	Akaike info criterion	0.068020	S.E. of regression
-2.441858	Schwarz criterion	0.092533	Sum squared resid
1.787295	Durbin-Watson stat	27.16177	Log likelihood

Pairwise Granger Causality Tests
Date: 11/10/12 Time: 21:45
Sample: 1986 2009
Lags: 2

Probability	F-Statistic	Obs	Null Hypothesis:
0.29644	1.32001	20	D_D_L_CONSTRU does not Granger Cause D_D_L_AGRICUL
0.58181	0.56165		D_D_L_AGRICUL does not Granger Cause D_D_L_CONSTRU
0.60261	0.52398	20	D_D_L_ELECTRI does not Granger Cause D_D_L_AGRICUL
0.72132	0.33390		D_D_L_AGRICUL does not Granger Cause D_D_L_ELECTRI
0.83254	0.18554	20	D_D_L_GENERAL does not Granger Cause D_D_L_AGRICUL
0.97841	0.02186		D_D_L_AGRICUL does not Granger Cause D_D_L_GENERAL
0.11410	2.51745	20	D_D_L_MANUFAC does not Granger Cause D_D_L_AGRICUL
0.71553	0.34231		D_D_L_AGRICUL does not Granger Cause D_D_L_MANUFAC
0.03304	4.31763	20	D_D_L_MINING_ does not Granger Cause D_D_L_AGRICUL
0.22910	1.62835		D_D_L_AGRICUL does not Granger Cause D_D_L_MINING_
0.41922	0.92175	20	D_D_L_OTHER_S does not Granger Cause D_D_L_AGRICUL
0.62496	0.48511		D_D_L_AGRICUL does not Granger Cause D_D_L_OTHER_S
0.49795	0.73069	20	D_D_L_TRADE does not Granger Cause D_D_L_AGRICUL
0.38468	1.01886		D_D_L_AGRICUL does not Granger Cause D_D_L_TRADE
0.08394	2.93597	20	D_D_L_TRANSPO does not Granger Cause D_D_L_AGRICUL
0.73093	0.32007		D_D_L_AGRICUL does not Granger Cause D_D_L_TRANSPO
0.32841	1.20040	20	D_D_L_ELECTRI does not Granger Cause

			D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.35772	1.10177		D_D_L_ELECTRI
			D_D_L_GENERAL does not Granger Cause
0.28197	1.37908	20	D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.93845	0.06379		D_D_L_GENERAL
			D_D_L_MANUFAC does not Granger Cause
0.63050	0.47572	20	D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.48144	0.76779		D_D_L_MANUFAC
			D_D_L_MINING_ does not Granger Cause
0.60056	0.52763	20	D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.11968	2.45389		D_D_L_MINING_
			D_D_L_OTHER_S does not Granger Cause
0.76201	0.27678	20	D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.44719	0.84954		D_D_L_OTHER_S
			D_D_L_TRADE does not Granger Cause
0.06088	3.39254	20	D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.02799	4.58159		D_D_L_TRADE
			D_D_L_TRANSPO does not Granger Cause
0.89084	0.11648	20	D_D_L_CONSTRU
			D_D_L_CONSTRU does not Granger Cause
0.90631	0.09903		D_D_L_TRANSPO
			D_D_L_GENERAL does not Granger Cause
0.84458	0.17084	20	D_D_L_ELECTRI
			D_D_L_ELECTRI does not Granger Cause
0.89854	0.10775		D_D_L_GENERAL
			D_D_L_MANUFAC does not Granger Cause
7.3E-06	28.7707	20	D_D_L_ELECTRI
			D_D_L_ELECTRI does not Granger Cause
0.90760	0.09758		D_D_L_MANUFAC
			D_D_L_MINING_ does not Granger Cause
0.59251	0.54209	20	D_D_L_ELECTRI
			D_D_L_ELECTRI does not Granger Cause
0.93488	0.06764		D_D_L_MINING_
			D_D_L_OTHER_S does not Granger Cause
0.90625	0.09909	20	D_D_L_ELECTRI
			D_D_L_ELECTRI does not Granger Cause
0.66307	0.42233		D_D_L_OTHER_S
			D_D_L_TRADE does not Granger Cause
0.27136	1.42458	20	D_D_L_ELECTRI
			D_D_L_ELECTRI does not Granger Cause
0.85178	0.16215		D_D_L_TRADE

			D_D_L_TRANSPO does not Granger Cause
0.03986	4.02554	20	D_D_L_ELECTRI
			D_D_L_ELECTRI does not Granger Cause
0.83314	0.18480		D_D_L_TRANSPO
			D_D_L_MANUFAC does not Granger Cause
0.97952	0.02072	20	D_D_L_GENERAL
			D_D_L_GENERAL does not Granger Cause
0.69241	0.37673		D_D_L_MANUFAC
			D_D_L_MINING_ does not Granger Cause
0.35518	1.10998	20	D_D_L_GENERAL
			D_D_L_GENERAL does not Granger Cause
0.86476	0.14672		D_D_L_MINING_
			D_D_L_OTHER_S does not Granger Cause
1.1E-06	39.0880	20	D_D_L_GENERAL
			D_D_L_GENERAL does not Granger Cause
0.38959	1.00448		D_D_L_OTHER_S
			D_D_L_TRADE does not Granger Cause
0.64719	0.44799	20	D_D_L_GENERAL
			D_D_L_GENERAL does not Granger Cause
0.15737	2.09707		D_D_L_TRADE
			D_D_L_TRANSPO does not Granger Cause
0.88768	0.12010	20	D_D_L_GENERAL
			D_D_L_GENERAL does not Granger Cause
0.77878	0.25424		D_D_L_TRANSPO
			D_D_L_MINING_ does not Granger Cause
0.72252	0.33216	20	D_D_L_MANUFAC
			D_D_L_MANUFAC does not Granger Cause
0.89182	0.11537		D_D_L_MINING_
			D_D_L_OTHER_S does not Granger Cause
0.89780	0.10859	20	D_D_L_MANUFAC
			D_D_L_MANUFAC does not Granger Cause
0.87335	0.13665		D_D_L_OTHER_S
			D_D_L_TRADE does not Granger Cause
0.40032	0.97371	20	D_D_L_MANUFAC
			D_D_L_MANUFAC does not Granger Cause
0.69451	0.37355		D_D_L_TRADE
			D_D_L_TRANSPO does not Granger Cause
0.34961	1.12812	20	D_D_L_MANUFAC
			D_D_L_MANUFAC does not Granger Cause
0.02189	4.98409		D_D_L_TRANSPO
			D_D_L_OTHER_S does not Granger Cause
0.31826	1.23690	20	D_D_L_MINING_
			D_D_L_MINING_ does not Granger Cause
0.05407	3.56627		D_D_L_OTHER_S
			D_D_L_TRADE does not Granger Cause
0.07930	3.01535	20	D_D_L_MINING_
			D_D_L_MINING_ does not Granger Cause
0.96718	0.03344		D_D_L_TRADE

			D_D_L_TRANSPO does not Granger Cause
0.94597	0.05575	20	D_D_L_MINING_
			D_D_L_MINING_ does not Granger Cause
0.42129	0.91622		D_D_L_TRANSPO
			D_D_L_TRADE does not Granger Cause
0.11683	2.48591	20	D_D_L_OTHER_S
			D_D_L_OTHER_S does not Granger Cause
0.32577	1.20975		D_D_L_TRADE
			D_D_L_TRANSPO does not Granger Cause
0.39199	0.99749	20	D_D_L_OTHER_S
			D_D_L_OTHER_S does not Granger Cause
0.25877	1.48131		D_D_L_TRANSPO
			D_D_L_TRANSPO does not Granger Cause
0.79304	0.23551	20	D_D_L_TRADE
			D_D_L_TRADE does not Granger Cause
0.88373	0.12463		D_D_L_TRANSPO