Estimating the Relationship between GDP Growth and Government Expenditure in Libya: an Analysis of Wagner's Law
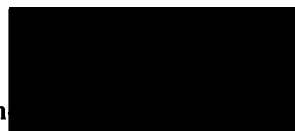
Taweel, Musa B. M.

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy at Abertay University Dundee.

March 2010

I certify that this is the true and accurate version of the thesis approved by the examiners

Sign █████████ (Director of Studies)   Date: 9/4/2010

Estimating the Relationship between GDP Growth and Government Expenditure in Libya: an Analysis of Wagner's Law

By

Musa B. M. Taweel

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy at Abertay University Dundee.

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Dundee Business School

University Abertay of Dundee

Abstract

The relationship between government expenditure and gross domestic product (GDP) has been subject to extensive research both in the field of public finance and macroeconomic modelling. More than one hundred years ago Adolph Wagner proposed a positive correlation between the level of gross domestic product growth and public spending. In this study six versions of Wagner's law were empirically tested employing aggregate and disaggregated annual time series data for the Libyan economy covering the period 1962-2005.

This thesis investigated the relationship between government expenditure and gross domestic product growth, in terms of total GDP and non-oil GDP. Engle and Granger's two-step cointegration analysis has been used to test the long-run relationship between government expenditure and total real GDP for Libya, whereas the short-run relationship is estimated using the error correction model (ECM). The causation between government expenditure and GDP growth is examined using the Granger causality test.

It was found that public expenditure and GDP variables in all six versions of Wagner's law are non-stationary in levels, but stationary in first differences, that is, they are integrated of order one I(1), in terms of total GDP and non-oil GDP and the six categories also. The cointegration tests indicated that there is mixed evidence of a long-run relationship between government expenditure and gross domestic product in terms of total GDP and non-oil GDP using aggregate data. Furthermore, a long-run equilibrium relationship with disaggregate data is also established. The results suggest mixed evidence in support of Wagner's law for the period under review.

The results from the ECM equations reconfirmed the validity of Wagner's law in the short-run for total real GDP and government expenditure, as well as the short-run relationship with disaggregate data. Also, the results indicate that the short-run relationship between government spending and total real non-oil GDP does not exist for the period under review, with the exceptions of versions two and three where dummies were used

Finally, the study used Granger causality testing procedure to determine the direction of causality. The results provide some evidence of a unidirectional causation running from gross domestic product to government expenditure in total real GDP, and mixed results with total real non-oil GDP. Also, this study has made contribution to knowledge. Specifically, it fills the gap in the public finance area of Libyan growth studies by testing Wagner's law on the Libyan economy. Also, this study has used the long-run and short-run relationship between government expenditure and total gross domestic product with GDP and non-oil GDP, as well as undertaking a causality analysis between the relevant variables.

DEDICATION

This thesis is dedicated to my **Parents** and my wife **Amina** for her patience, support,

and encouragement and offering the right environment for the success of my research,

also, dedicated to my children **Malak, Khasem, Zakariya** and **Ayyub.**

ACKNOWLEDGEMENTS

Declaration

I hereby declare that I am the author of this thesis, that the work of which this thesis is a record has been done by my self, and that it has not previously been accepted for a higher degree.

Sign ………………………………………………….. Date ………………………….

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List of Abbreviations

ln	The symbol denotes the natural logarithm
GDP	Real Gross Domestic Product
TGX	Real Total Government Expenditure
TGXC	Real Total Government Expenditure on Consumption
GDP/POP	Per capita real Gross Domestic Product
TGX/POP	Per capita Government Expenditure
TGX/GDP	Share of Real Total Government Expenditure in Real Gross Domestic Product,
Non-Oil GDP	Real non-oil Gross Domestic Product
Non-Oil GDP/POP	Per capita Real non-oil Gross Domestic Product
TGX/ Non-Oil GDP	Share of Real Total Government Expenditure in Real non-oil Gross Domestic Product
POP	Population
TGXEDU	Real Government Expenditure on Education
TGXHEA	Real Government Expenditure on Heath
TGXAGR	Real Government Expenditure on Agriculture
TGXH&P	Real Government Expenditure on Housing and Public Utilities
TGXMAN	Real Government Expenditure on Manufacturing
TGXT&C	Real Government Expenditure on Transportation and Communication
ADF	Augmented Dickey-Fuller Statistic
PP	Phillips-Perron Statistic
ECM	Error Correction Model
P&W	Peacock and Wiseman

WH	Wagner's hypothesis
LD	Libyan Dinar
GCT	Granger causality tests

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Government expenditure is the amount that the government spends in order to maintain its functions as well as promoting the well being of society and the economy as a whole. However, the expenditure on government activities over time makes it more and more difficult to determine which part goes to recurrent expenditure and which goes to capital expenditure. Moreover, government spending to boost the economy and social well being takes two different forms. One way of spending is through public goods and services that the government provides to its people. For example, the expenditure on public education, public health, transfers, subsidies and sometimes even grants to its people, or to foreign countries.

The other form is spending on infrastructure that are more of an investment that have a rate of return, such as goods and services that are part of the country's current output, private goods and services. When the government buys the services of the factors of production and uses them to produce goods and services in the public sector of the economy either as "free" or as "an investment", these factors of production become unavailable for the private sector. In practice, most governments do undertake projects based on their social rate of return and their lack of provision by the private sector, because these kinds of goods and services are unprofitable to them either as public goods or because of externalities.

The size of government and more specifically the size of government expenditure have demonstrated an upward trend. In the last few decades considerable attention has focused on the growth of the size of the government sector, both in absolute terms and as percentages of GDP with many countries using either time-series data or cross-sectional data or both.

Wagner offered a model of the determination of public expenditure in which public expenditure growth was a natural consequence of the growth in national income. In other words it was endogenously determined. The most accepted interpretation of this law states that an increase in economic activities causes an increase in government activities, and in turn, increasing public expenditure. In addition, Wagner and others later found that, for almost all modern states, real government expenditure increases at a faster rate than that of national output.

This chapter consists of nine sections. Research background will be in section 1.2. Section 1.3 introduces the components of public expenditure, while section 1.4 discusses the objectives of the research. Section 1.5 was on the study methodology. Section 1.6 introduces the research problem while section 1.7 discusses the significance of the study. Data set and computer software presented in section 1.8. Finally, the structure of the thesis is described in section 1.9.

1.2 Research Background.

During the last four decades the Libyan economy has witnessed dramatic improvement as a result of the discovery and exploitation of oil, and the development of its political and socio-economic life. Since 1969, there has been a systematic change in the Libyan economy. These changes are reflective of changes

in the Libyan economic framework; namely a shift from a capitalist economy to a socialist economy.

The macro-level planning in Libya has aimed at releasing the national economy from foreign entanglement and influence, and transforming it into a productive national economy before discover of oil. In so doing, a central economic planning model has been adopted as a means of developing and implementing a number of social and economic transformation strategies. As part of this process, the government acquired almost every Libyan company, and nationalised the entire private sector. This resulted in public sector control over most of the country economic activities.

The impact of oil revenues on economic and social development was clear and there were steady and systematic changes in the economy[1]. The Libyan economy became dependent upon an oil sector that contributed 98% to 100% of the country exports revenues[2]. This increase has provided the Libyan government with the opportunity to formulate and implement several agents of its social and economic transformation. These have been aimed at the non-oil sector to create a diversified economy and achieve self-sufficiency and self-reliance. Also, this revenue allows the Libyan government to make huge investments in the Libyan economic sectors. These investments in these sectors contribute to gross domestic product (GDP) increase and growth (Secretariat of General Committee, 2002)

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[1] See chapter four for additional details.
[2] See section (4.6.1.2) chapter four.

1.3 Components of Public Expenditure

In this study we can classify public expenditure into the six categories in the Figure 1.1. This figure shows the government expenditure classified by functional or economic categories (Chu and Hemming, 1991). The functional classification makes known the government priority in spending for social and economic sectors during development plans. These sectors reflect the objectives of government economic development see Figure 1.1 below. The study in this work focuses on the major categories in government functional expenditure like education, health, agriculture, housing and public utilities, manufacturing, transportation and communication[3].

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[3] Source: General Planning Council.

Figure 1.1 Expenditure Classifications

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                    ┌─────────────────────────────┐
                    │  Expenditure Classification  │
                    └─────────────────────────────┘
                       /                      \
        ┌──────────────┐              ┌──────────────────┐
        │  Functional  │              │ Economic Sectors │
        └──────────────┘              └──────────────────┘
   ┌──────────────┐            ┌─────────────────────────┐
   │  Education   │            │  Goods Producing Sectors │
   └──────────────┘            └─────────────────────────┘
   ┌──────────────┐            ┌─────────────────────────┐
   │   Health     │            │ Economic Services Sectors│
   └──────────────┘            └─────────────────────────┘
   ┌──────────────┐            ┌─────────────────────────┐
   │  Agriculture │            │  Social Services Sectors │
   └──────────────┘            └─────────────────────────┘
   ┌──────────────┐            ┌─────────────────────────┐
   │  Housing &   │            │      Other Sectors       │
   │ Public       │            └─────────────────────────┘
   │ Utilities    │
   └──────────────┘
   ┌──────────────┐
   │ Manufacturing│
   └──────────────┘
   ┌──────────────┐
   │Transportation &│
   │ communication  │
   └──────────────┘
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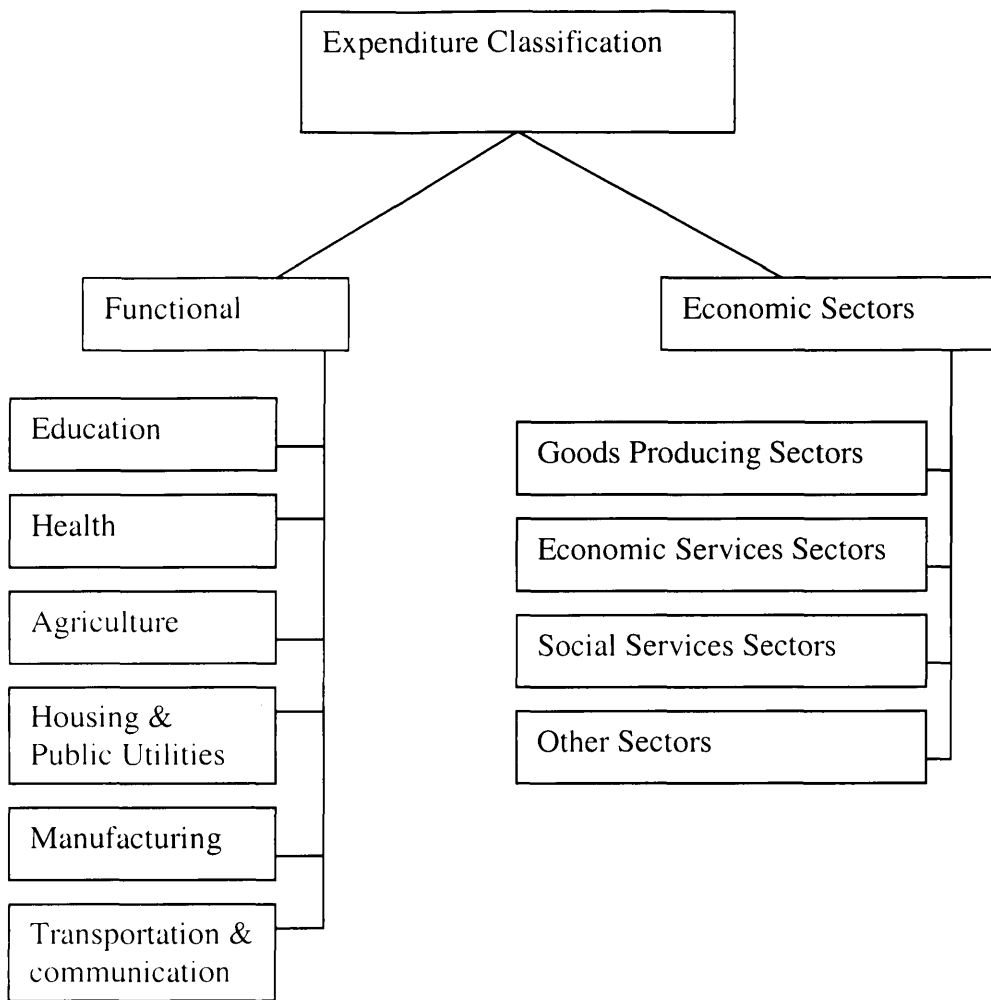
1.3.1 The Functional Classification

The functional classification relates to government spending in the social and economic sectors. Government expenditure has been summarised into four major groups as follows:

1.   Goods Producing Sectors

    • Agriculture

    • Industry

    • energy

2.   Economic Services Sectors

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- Housing & Public Utilities

- Communication & Transportation

3.   Social Services Sectors

- Education

- Health

- Justice

- Information & Culture & Tourism

4.   Other Sectors

- Economy & Trade

- Planning & Finance

- Foreign Affairs

- And Others

This study examines the sectors that include government functional expenditure such as: education, health, agriculture, housing and public utilities, manufacturing, transportation and communication. This is because these functions accounted for the largest share of recurrent expenditure in the period covered by the development plans.

1.4 Objectives of the Study

The study aims to shed full light on the relationship between government expenditure and gross domestic product (GDP) growth attained by Libya within the period 1962-2005. Accordingly, we would also like to examine whether the level of development itself added to the growth of government expenditure. This analysis takes the following form:

a.   *This research intends to investigate the existence of long-run and short-run relationship between the six versions of Wagner's law and the Libyan economy.*

b.   *The study also investigates the long-run and short-run equilibrium between Libyan GDP and six categories of government functional expenditure*

c.   *To examine the Granger causality test between government expenditure and gross domestic product in Libya over the period 1962-2005 and six categories of government functional expenditure.*

d.   *To investigate the Libyan economy, as to whether it supports Wagner's law or not by testing Libyan data for the period 1962-2005.*

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1.5   Study Methodology

Our methodology in this study employed four types of econometric tests namely: unit root tests, Cointegration test, error correction models and Granger causality test we used annual data for Libya over the period 1962-2005, and investigate the evidence of Wagner's law over this period.

As a prerequisite of modern empirical analysis, unit root tests should be applied to the time series whose properties are required to be either stationary or integrated of order one I(1). Specifically, the study will undertake both Augmented Dickey-Fuller (ADF) tests and Phillips-Perron (1989) tests.

Cointegration analysis, which has emerged as a recent econometric development, is utilised to examine the long-run relationship equilibrium between integrated time series. Our cointegration analysis using the residual based Engle and Granger

approach is evidently very easy to use, also we can use this method since there are only two variables in the system to test the cointegration relationship. But in other situations, if there are more variables, there could potentially be more than one linearly independent cointegration relationship. Thus, it is appropriate instead to examine the issue of cointegration within the Johansen framework (Brooks, 2008).

For short-run analysis the study uses the error correction model (ECM). The estimated error correction model coefficient should be negative and statistically significant in the short-run relationship. With respect to the Granger representation theorem, negative and statistical significant error correction coefficients are necessary conditions for the variables to be cointegrated (Peter. 1998).

The study also uses the Granger causality test to examine the validity of Wagner's hypothesis for Libya. There are two reasons for choosing the Granger causality test. First, Wagner's law postulates that the growth of government expenditure is a result of the growth of the economy. This implies that the growth of the economy causes the growth of government expenditure. Secondly, the choice of Granger causality is made to conform to some of the earlier studies that applied the same set of tools to examine the applicability of Wagner's law.

The law hypothesises that the causality runs from gross domestic product (GDP), to the share of total government expenditure (TGX). In this methodology, the study investigates and examines at least six versions of this law with real (GDP), and with real non-oil (GDP) in Libya. Also, the study tests the relationship between the government functional expenditure and GDP.

1.6 The Research Problem

The role of government expenditure in promoting economic growth remains a debatable subject in both developing and industrial countries (Chletsos and Kollias, 1997; Henrekson, 1992 and Hsieh and Lai, 1994). In studying the growth of the size of government, and more specifically government expenditure, history has shown that real government expenditure has increased continuously over time in almost every country. The role and size of government is thought to play a very important role in raising economic growth especially in developing countries, like Libya.

In Libya, until the mid-1980s, the public sector controlled major economic activities. Since then, the government has tried to reduce the economy's dependence on public expenditure and has begun to open the door for more privatization of economic activities and put more effort in to maintaining a steady growth rate of Libya's GDP, especially in non-oil GDP. The size of the government depends on the functions the government is controlling directly in the economy for productive and non- productive activities. The crucial questions in this study are:

1. Is there a long-run (equilibrium) relationship between economic growth and an increase in government expenditure?

2. What is the direction of causation between economic growth and real government expenditure?

   These questions will be examined in this study.

1.7   Significance of the Study

Since the Libyan economy is dominated, more or less, by the oil sector and a large central government, oil prices play an important role in determining the level of government expenditure. Libyan Policy makers have usually been unwilling to cut government expenditure because of concerns about the potential negative impact on non-oil growth and non-oil activity due to the volatility in oil prices.

In this study we will focus on estimating six versions of Wagner's law, to test the relationship between GDP growth and government expenditure in the long-run and short-run. Also, this study examines the relationship between government functional expenditure and gross domestic product. The study used the causality theory to test this relation, and we expect one of three possible findings:

1- Wagner's law holds, which means that there is unidirectional causality from GDP to TGX: that is GDP causes TGX. In this case, the total real government expenditure (TGX) has no effect on economic growth and development including growth of non-oil real GDP.

2- The opposite holds which means that there is unidirectional causality from TGX to GDP: that is, TGX causes GDP (Keynesian proposition)

3- Or there is bidirectional causality between GDP and TGX.

In all the above findings an objective of the study is to focus on the importance of the real growth in non-oil activities as a result of oil revenues.

1.8 Data and Computer Software

The study will cover the time period for which the data is available for the Libyan economy from 1962-2005. The study will use annual data, because only annual data is available covering this period. This is the sample for all the variables in the model. The year 1962 is considered as the initial year because the year 1962 is the first complete year of oil exports, and secondly, it is the starting year of the systematic national accounts in Libya (Zarmouh, 1998:12). The data in this study consists of the following variables:

1-   The variables used in Wagner's law

- Real Gross Domestic Product (GDP)

- Real Non-Oil Gross Domestic Product (Non- Oil GDP)

- Total Real Government Expenditure (TGX)

- Total Real Government Expenditure on Final Consumption (TGXC)

- Population (POP).

- Dummy variable 1 for the impact of discovery of oil on economic growth (Dum=1 at 1969-2005, and Zero otherwise)

- Dummy variable 2 used for the effects of the UN sanctions on the Libyan economy (Dum=zero during no sanctions, and one from 1985-2003)

2-   Six sectors of government functional expenditure as follows.

- TGXEDU= real government expenditure on education[4]

- TGXHEA= real government expenditure on health

- TGXAGR= real government expenditure on agriculture

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[4]- All variables expressed in million LDs

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- TGXH&P= real government expenditure on housing and public utilities

- TGXMAN= real government expenditure on manufacturing

- TGXT&C=real government expenditure on transportation and communication

The estimation was calculated by using Eviews 4, (computer software), available in the Dundee Business School.

1.9 The Structure of the Study

As already stated, this study addresses estimation of the relationship between government expenditure and gross domestic product growth in Libya during 1962-2005. We will now briefly outline the structure of this thesis. This thesis is organised as follows:

Chapter Two focuses on the theoretical literature on the role of government in the economy from different perspectives. This chapter also reviews the relevant theories of government expenditure and economic growth. This chapter discusses six different formulations of Wagner's law which the study used in the analysis of the relationship between government expenditure and economic growth.

Chapter Three is a description of the empirical literature on Wagner's law. After the publication of English translations of Wagner's law in 1958, Wagner's law has become very popular in academic circles and it has been analysed and tested by many researchers. Some of these researchers have applied traditional regression analysis, whilst some others used causality testing, and more recently cointegration analysis has appeared in the literature. The empirical literature looks extensively at

the studies done on Wagner's law in developed and developing countries. In this chapter the study surveys empirical studies which test Wagner's law.

Chapter Four is on the historical background of the growth of gross domestic product and government expenditure in Libya during the period 1962-2005. The aim of this chapter is to familiarise the reader with the historical, political, social and economic aspects of Libyan society. Different issues will be highlighted in the chapter, including the geographic description and historical background of the country and the main changes in the political and economic systems since independence. Moreover, this chapter discusses and gives some information on the UN sanctions on Libya.

Chapter Five presents the methodology adopted for this study. We test Wagner's law on the Libyan economy using annual data for the sample period 1962-2005. As we know Wagner's law has been tested by many researchers for developed and developing countries. These studies have found strong evidence in favour of Wagner's law, especially in a time series framework. The present chapter will adopt a Granger- causality test to examine the causal relationship between various measures of government expenditure and economic growth to test the relationship in the short-run. Also, the study uses cointegration analysis to test the long-run equilibrium relationship between the variables using the two step test for cointegration proposed in Engle and Granger (1987). Before these tests, we used the Dickey and Fuller (1981) and Phillips and Perron (1988), to determine whether the series are integrated of order I(1) against the alternative that they are integrated of order zero I(0).

Chapter Six examines the relationship between growth GDP and non-oil GDP and government expenditure from a long-run equilibrium perspective by employing cointegration techniques. In this chapter, by employing a recent advanced econometric technique (cointegration analysis), we examine the validity of Wagner's law to the Libyan economy using date for the period 1962-2005. Firstly, we start with ADF and PP tests to check whether the variables are cointegrated or not. Then we can run the analysis using residual based methods proposed by (Engle and Granger, 1987) to test for cointegration between GDP and other integrated variables including government expenditure.

Chapter Seven focuses on the short-run relationship to test the validity of Wagner's law in the case of the Libyan economy. We test the relationship between economic growth and government expenditure. As shown in chapter six we can test for the short-run for all variables that are cointegrated. Within this framework, we test whether there is any short-run relationship between GDP and public expenditure. Standard Granger causality tests were used and, also the error correction model test was employed.

Chapter Eight analyses the government functional expenditure in six sectors of the economy in which the government aims to satisfy the social needs of its people and to implement its long-term goal. The study uses data from 1962-2005 to estimate functional expenditure. To analyse the time series data used in this study we started to check whether the series are stationary or non stationary using the Dickey-Fuller test and as well as Phillips and Perron. Then, in this chapter the study involved testing for cointegration using Engle and Granger two steps to detect the existence of a long-run relationship between the variables included in this analysis. To

investigate the short-run equilibrium relationship the study used an error correction

model and Granger causality test to estimate if there is a short-run relationship.

Chapter Nine provides a summary and conclusion to the study. It offers a brief

review of the main findings, and an explanation of the study's contribution to

knowledge in theory and practice. It also describes the policy implications of the

study results. Finally, the limitations of the study are explained and suggestions for

future research are made.

Chapter Two

Theoretical Studies of the Wagner's Hypothesis

2.1 Introduction

The role and the size of government expenditure in promoting economic growth has long been the concern of economists and policy makers in both industrialised and developing countries. Over the twentieth century, both the role and the size of government economic activity have expanded in most industrial countries. Economic research has taken two main approaches to this development. One has been to take the size of state activity as exogenous to the economic development process, and to ask what effect state activity has on economic growth. This approach has often been termed the 'Keynesian approach'. The line of research following this approach has studied the level of government activity at which the rate of economic growth is optimized, and this level is referred to as the "optimal size of government".

This approach has been adopted and tested extensively in the public choice economics literature. (Yavas, 1998) observed that the size and type of expansion of government expenditure in an economy differs according to the stage of development. He observed that in underdeveloped countries a significant portion of government expenditure is directed at developing economic infrastructure and there this type of government expenditure will have a stimulating effect on private sector production and, consequently, will stimulate the growth of the economy. In contrast to underdeveloped countries, Yavas's study suggested that developed countries already have most of their infrastructure established and a major part of

their government spending is on welfare programs and various social services. (Dar and AmirKhalkhali, 2002) predicted that there is an optimal size of government activity in the economy and if this optimal size exceeds a maximum then it causes a negative effect on economic growth.

Other scholars have adopted a similar approach by investigating the relationship between government expenditure and economic growth as a non-linear process; a proposition that was first empirically tested in endogenous growth models. (Heitger, 2001) for instance, hypothesized that government activity on public goods has a positive impact on economic growth, but this positive impact tends to decline, or even reverse, if government further increases its activity over some optimal size. In this sense, Heitger was hypothesizing that there is an optimal size of government activity in the economy.

In addition, some scholars have advocated the use of an allocated efficiency rule to establish the optimal size of government (Sanjeev, 2003) suggested that the size of government spending is optimal when the social marginal cost of public resources is equal to their social marginal benefit. It is not the intention here to cover the literature on these approaches to the relationship between government expenditure and economic growth. But the main concern of this thesis is with the approach which considers the expansion of government expenditure as endogenous and being driven by economic development. On one hand, government expenditure is seen as an exogenous factor which can be used as a policy instrument to influence growth (Keynes). On the other hand, government expenditure is seen as an endogenous factor or as an outcome, not the reason for growth (Wagner).

Since at least the late nineteenth century, works in public economics literature have tried to establish criteria by which the revenue and activity policies of government should be evaluated. While other scholars had written on the topic before this time, they did so generally as part of a wider analysis of the determinants of economic growth, such as Smith (1776) in his "Wealth of Nations" and Mill (1848) the author of "Principles of Political Economy". Smith and Mill intended to explain the principles by which revenue and expenditure policies could be determined as part of their investigation of the relationship between the state and economy.

The German economist, Adolph Wagner, was perhaps the first to propose a direct hypothesis that the expansion of government activity responds positively to changes in economic development, so that as a country's income rises, the size of that country's public sector, relative to the whole economy, rises too. Wagner observed a growing role of the state as a provider of social services in areas such as education, transportation and infrastructure. He also noted that technology, such as steam technology, was making it easier for the state to organize its own production plants more efficiently than the private sector and that the demand for public goods was growing faster than the demand for private goods.

Most of the nineteenth century literature was concerned with the appropriate "role" of government. Wagner directed his attention to the "size" of government by proposing a hypothesis which predicted that economic development would be accompanied by a relative growth of the public sector in the economy. In particular, Wagner suggested that during industrialization the size of government activity relative to the economy would grow at a rate greater than the rate of growth of income. That is, the Wagner's hypotheses (WH) which has also been

referred to as Wagner's law. Wagner's law has attracted a great deal of interest in the public economics literature and has been tested for different economies both over time and across countries. As with many hypotheses that are proposed in general terms, several interpretations of the Wagner's law have been proposed and tested in the existing literature. Some of these studies have supported the WH as an explanation of the expansion of the size of government activity in the economy, and other studies have found evidence that does not support it, or contradicts the different interpretations and, also the existing testing procedures and results.

It is useful to make two brief notes at this moment. First, the study should note that the explanation of Wagner's Law in this Chapter is very brief compared to the discussion on the Keynesian explanation. Wagner's Law identifies the reasons why government expenditure grows. Keynes, on the other hand, treats government expenditure as a stimulus to the growth of the economy. In hypothesis testing, government expenditure in the Keynesian model is the independent variable. In contrast, in Wagner's Law, government expenditure is the dependent variable. Wagner's Law and Keynesian explanation are modeled in the following way:

Wagner's Law $$\frac{TGX}{POP} = f\left[\frac{GDP}{POP}\right] \qquad (2.1)$$

Keynesian explanation $$\frac{GDP}{POP} = f\left[\frac{TGX}{POP}\right] \qquad (2.2)$$

Where, GDP=Gross Domestic Product, TGX = Government Expenditure, POP = Population.

Secondly, the reference to Keynesian economics in this study is made only with respect to the role of government expenditures on national income measured by way of GDP.

This thesis will focus on an empirical assessment of Wagner's Law. The remainder of the chapter is structured as follows: Section 2.2 will give some explanation about the definition of government expenditure; Section 2.3 will discuss the economic theories of Government Expenditure and economic growth, Section 2.4 discusses the different interpretations of the Wagner's law and, finally, Section 2.5 summarises the chapter.

2.2 The Definition of Government Expenditure

In defining government expenditure it is first necessary to decide which spending agencies to include and then which items of their expenditure to take into account. There are four possible spending agencies to consider: central government, local government, the national insurance fund and the nationalised industries. There is a consensus about the inclusion of the first two. There is also a strong case for including the national insurance fund because its disbursement is entirely determined by government policy and its income is derived partly from a general exchequer contribution (raised by taxation), and partly from levies on employers and employees of a largely compulsory nature and scarcely distinguishable from taxes more difficult question is the treatment of nationalised industries.

Public expenditure reflects the policy choices of government. Once government decides upon which goods and service to provide and the quantity and quality in which they will be produced, public expenditures represent the costs of carrying out these policies. This definition is broad to enable us to make two distinctions. First, there are the costs of providing goods and services through the public expenditure, i.e. the amount that appears in the public sector accounts. Secondly,

most rules, regulations and laws introduced by government result in private sector expenditure.

For example, the passing of a law that requires a hotel to install minimum fire precautions will result in the hotel owner spending money. Another example would be the policy of 'care in the community' which is being pursued in the UK at present[1]. This wider definition of public expenditure is of interest when one is discussing the costs of government actions. However, for most purposes, a narrower definition of public expenditure is used (Brown and Jackson, 1990). In the national income accounts, public expenditures is represented by two broad categories of government activity. First, there is comprehensive public expenditure. These expenditures correspond to the government's purchases of current goods and services (i.e. labour, consumables etc.), and capital goods and services (i.e. public sector investment in roads, schools, hospitals etc.). Exhaustive public expenditures are purchases of inputs by the public sector and are calculated by multiplying the volume of inputs by the input prices. Exhaustive public expenditures are claims on the resources of the economy, so that their use by the public sector precludes their use by other sectors. The second category of public expenditures is transfer expenditures, such as public expenditures on pensions, subsidies, unemployment benefits.

In the public expenditure literature, there is still a big debate about transfers. While some claim that transfers payments should be included in an analysis of the growth of public expenditure, others exclude such expenditures. The study will discuss this point in detail below, because of its importance.

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[1] -Mentally ill patients are removed from public sector hospitals to their own or relative's homes.

As (Griffiths and Wall, 1991) mentions, the UK Central Statistical Office (CSO) offers at least ten measures of the size of public expenditure. However, no single measure of public expenditure has met with universal agreement, and even when one has been widely used for some time, it can be subject to change for a variety of reasons. The changes in the definition of public expenditure in Libya will be discussed in chapter 4. As mentioned before, government decisions are reflected in public and private sector expenditures. Almost every government action results in expenditure changes in both sectors (Rice, 1983).

2.3 Public (Government) Expenditure Theories Approach

One can distinguish among four main different theories of government spending (expenditure) based on how each theory deals with both government expenditure and government revenue:

- Wagner's Law.

- The Displacement-Concentration (Effect) Hypotheses.

- The Theory of Bureaucracy.

- Keynesian Theory Approach.

2.3.1 The Wagner Hypothesis

Since our main focus in this study is based on the relationship between the growth of government and the growth of the economy (GDP), as propounded by Wagner's law, our emphasis from this point onward will be directed to this issue. This section will analyse the theoretical foundations of Wagner's law. For a long time there was no specific model to determine the role of public expenditure in promoting economic growth. Undoubtedly, some classical economists, e.g. Adam

Smith, paid attention to tendencies in the long-term trend in public expenditure, but there was no attempt to translate such observations into a general theory (Tarschys, 1975). It is important to recognize that "Wagner was writing at a specific time and place; when many scholars in Germany became filled with nationalism and the desire for a strong state to heal the political and economic disorders affecting the German society" (Getzler, 2000, p.13). Writing between 1877 and 1893, Adolph[2] Wagner hypothesised that as an economy developed, the level of government expenditure would increase. Wagner argued that public expenditure growth is a natural consequence of the growth and development of the economy.

The *"law of increasing expansion of public, and particularly state, activities" becomes for the fiscal economy the law of the increasing expansion of fiscal requirements growth and, often even more so, those of local authorities, when administration is decentralised and local government well organised. Recently, there has been a marked increase in Germany in the fiscal requirement of municipalities, especially urban ones. That law is the result of empirical observation in progressive countries, at least in our Western European civilisation: its explanation justification and cause is the pressure for social progress and public economy, especially compulsory public economy. Financial stringency may hamper the expansion of state activities, causing their extent to be conditioned by revenue rather than the other way round, as is more usual. But in the long run the desire for development of a progressive people will always overcome these financial difficulties.*

Wagner postulated that the expansion of government expenditure arises because of the expansion in the fiscal requirement of "public and particularly state activities". According to him, this expansion is due to the growth "of fiscal requirements" of the state and local authorities of the government of "progressive countries" as a result of the "pressure for social progress". Similarly, Wagner (1883), writing

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[2]- Most references on Wagner's law established that Wagner's writing dated between 1877 and 1893. The main English translations, Three Extracts On Public Finance, which were translated by Nancy Cooke were taken from Finanzwissenschaft, Part 1, Third Edition, Leipzig 1883, pp.4-16, and 69-76. These were first published in the Classics in the Theory of Public Finance edited by R.A.Musgrave and A.T.Peacock, Macmillan, 1958.

more than one hundred years ago, offered a model of the determination of public expenditure in which public expenditure growth was a natural consequence of economic growth. He was a leading German economist of the time. On the basis of his empirical findings, he "formulated a law of expanding state expenditure; which pointed to the growing importance of government activities and expenditure as an inevitable feature of the progressive state" (Bird, 1972). He was the first scholar to recognize the existence of a positive correlation between the level of economic development and the size of the public sector. He hypothesized a functional relationship between the growth of an economy and the growth of government activities such that the government sector grows faster than that of the economy. According, to (Henrekson, 1993), Wagner saw there are four main reasons for an increased governmental role:

1- First, industrialization and modernization would lead to a substitution of public for private activities. Expenditure on law and order as well as on contractual enforcement would have to be increased.

2- Second, the growth in real income would facilitate the relative expansion of the income elastic 'cultural and welfare' expenditure.

3- Education and culture are two areas in which the government could be a better provider than the private sector. Thus, the public sector would grow after basic needs of the people are satisfied and the consumption pattern of people expands towards activities such as education and culture.

4- Finally, natural monopolies such as the railroads had to be taken over by the government because private companies would be unable to run these undertakings efficiently because it would be impossible to raise the huge finances that are needed for the development of these natural monopolies.

His views were formulated as a law and are often referred to as "Wagner's Law". His main contribution in this field was that he tried to establish generalisations about public expenditure, not from postulations about the logic of choice (deductively), but rather by direct inference from historical evidence (inductively). Wagner's Law, stated simply, and proposes that there is a long-run tendency for public expenditure to grow relative to some national income aggregate such as GDP. After the publication of English translations of Wagner's works in 1958, Wagner's Law has become very popular in academic circles and it has been analysed and tested by many researchers, for example, (Gupta, 1967), (Goffman, 1968), (Pryor, 1968), (Musgrave, 1969), (Peacock-Wiseman, 1980) and (Chletsos and Kollias, 1997). Some of these researchers have applied traditional regression analysis, whilst some others have used causality testing, and more recently cointegration analysis has appeared in the literature. Empirical tests of Wagner's Law have yielded results that differ considerably from country to country and period to period (Safa Demirbas, 1999).

From the above discussion, Wagner's Law can be interpreted as treating public expenditure as an outcome, or an endogenous factor. Wagner's Law requires the causality to run from gross domestic product (GDP) or GDP per capita to government expenditure in contrast to the Keynesian approach in which causality is seen to run from government expenditure to GDP (Keynes, 1936). Finally, there are at least six versions of Wagner's Law which have been empirically investigated, and we are going to discuss each one of them in more detail in section 2.4.

2.3.2 The Displacement Effect Hypothesis

The displacement (effect) hypothesis was propounded by Peacock and Wiseman, (1961). In the literature, it has been closely linked to Wagner's law although there are some differences between the two. Peacock and Wiseman (1961) reject Wagner's historical determinism. Their own model is not restricted to simple economic phenomena but it encompasses social and political dimensions such as voting behaviour and group attitudes.

After examining whether there are any permanent influences, such as population, prices, and income on the size of public expenditures, they argue that there is still an unexplained part of public expenditure growth. When Peacock and Wiseman (1961) looked at the growth of public expenditure in the United Kingdom over the period from 1955 to 1980, they put forward two basic propositions. These are: (a) total public expenditure has risen faster than GDP over the period and so the public sector takes an increasing proportion of economic resources for its own use; and (b) there is a clear 'displacement effect' in the two world wars. According to them, although British public expenditure decreased after the wars, it did not return to its pre-war level, and a similar pattern was to be observed in other affected countries. At this point, it may be worth quoting Peacock and Wiseman's own explanation of the displacement effect:

"When societies are not being subjected to unusual pressures, people's ideas about tolerable burdens of taxation, translated into ideas of reasonable tax rates, tend also to be fairly stable. There may thus be a persistent divergence between ideas about desirable public spending and ideas about the limits of taxation. The divergence may be narrowed by large-scale social disturbances, such as major wars. Such disturbances may create a displacement effect, shifting public revenues and expenditures to new levels. After the

disturbance is over new ideas of tolerable tax levels emerge, and a new plateau of expenditure may be reached, with public expenditures again taking a broadly constant share of gross national product, though a different share from the former one (Peacock and Wiseman, 1961: xxiv".

According to Nagarajan (1979), there are two versions of the displacement effect. The original version implies that 'social disturbances' would tend to increase the level of public expenditure in relation to national output, accompanied by a shift in the level of taxes. The second version does not stress shifts in the ratio of public spending to national output. It is likely that the 'inspection process' may generate a different kind of displacement which is an inter-functional shift without shifting the levels of aggregate spending and taxes (Nagarajan, 1979). Bird (1971), argues that such interfunctional shifts are not really related to the displacement effect. However, if the "interfunctional shift" is accompanied by a shift in the level of aggregate expenditure and taxes, then it would be a displacement effect (Nagarajan, 1979). According to Brown and Jackson (1990), the inspection effect arises from voters' keener awareness of social problems during the period of social upheaval. Inherently, wars or other social upheavals arouse the sentiments of community. Hence, government expands its provision of services in order to improve social conditions and the government is able to finance these higher levels of expenditure. These effects can lead to a shift in the level of public expenditure in relation to national output. So, public expenditures do not return to their former levels.

Peacock and Wiseman suggested the opportunity of considering the dependence of government upon revenues raised by taxation, and therefore the relevance of the

constraints imposed on public expenditure by the electors, willingness to pay taxes, and encouraged further research on government growth, more focused on empirical data. In particular, from their analysis of the time-pattern of the British general government expenditure, Peacock and Wiseman elaborated their "displacement theory hypothesis". It is important to notice that they do not deny the importance of many of the characteristics of government expenditure to which Wagner's law draws attention, but they are more interested in yearly changes, rather than in the secular behaviour of the public sector size and the permanent influences on government expenditure.

2.3.3 The Theory of Bureaucracy

This theory is concerned with the role and influence of the self-interested bureaucracy in determining the level of public spending. The most important and pioneering work on the effect of bureaucratic behaviour were conducted by Niskanen (1971). Niskanen argued that bureaucrats derived their utility by the size of their bureau's budget[3]. This follows a "career centred motivation" with a desire "to move up, in the hierarchy" (Tullock, 1965). Niskanen (1971) introduced the concept of budget maximising bureaucrats. Budget maximising behaviour of bureaucrats, therefore, can be seen as a product of the utility maximisation game (Niskanen, 1971 Borcheding, 1977).[4] This approach in analysing public expenditure growth considers that the over-expansion of the public sector is due to the existence of bureaucratic power (Tullock, 1976).The literature shows several

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[3]- Niskanen obviously, was referring to the United States bureaucrats. As rightly pointed out by Jackson (1985), in the United States, the salary of bureau's chief is related to the bureau's budget. Jakson argued that this is not the case in Britain whereby the salary of the bureau's chief is not related to the size of the bureau nor its budget. Neither is it the case with Libya.
[4]- Borcherding argued that non-economic factors explain "more than one-third, and possibly, one half of the growth of the government spending" (1977b:56).

ways in which bureaucrats can contribute towards higher government expenditure. Primarily important in this analysis is that bureaucrats are self-interested individuals seeking personal gains. The utility derived by bureaucrats is the function of:

$$U = F[S, C, R, P, Pa, O, MC, M]$$ (2.3)

Where S = salary, C = comfort or perquisites [of the office], R = public reputation, P = power, Pa = patronage, O = output of the bureau, MC = ease of making change and M = ease of managing the bureau. Niskanen argued that all except the last two –ease of making change and ease of managing – could have a dramatic effect on the bureau's budget being the "positive monotonic function of the total budget of the bureau during the bureaucrat's tenure in office"(Niskanen, 1971). In deciding on the bureau's budget, the bureaucrat will ensure that "the budget must be equal to or greater than the minimum total costs of supplying the output expected by the bureau's sponsor" (Niskanen, 1971).

Niskanen's bureaucratic model was an extension of Down's (1967). Down divides bureaucrats into five categories: climbers, conservers, zealots, advocates and statesman.[5] Down argued that the effect on bureau's budgets is less from one category to another with climbers being the most budget maximising. Nevertheless (Margolis, 1975) argued that for the climbers the most self-interested seekers of all the categories, it is easier to make a career by changing from one bureau to

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[5]   All these exhibit different goals. Climbers' goals obviously lien self interest. Conservers will conserve their position. Zealots are devoted to the cause of the bureau. Advocates are loyal to the cause of the bureau. Lastly, statesmen are considered as an ideal public servant. If applied to Niskanen budget maximising behaviour, with this type of personality differences, except for the statesman, it is likely that others could contribute to the expansion in their bureau's budget.

another. Therefore, if climbers can achieve a better position by changing from one bureau to another, it is unlikely that they will be budget maximizers.

Conservers, as defined by Down, will only conserve what they already have, which also means that they will not be budget- maximizers. The only likely ones are zealots and advocates. Down seems to accept that zealots and advocates will tend to create new bureau. The strength of bureaucratic theory depends much on the transparency of bureaucratic activities. Weber (1973), for example, argued that bureaucrats prefer poorly informed and powerless parliaments, not to expose themselves to the public, so as to keep their work secret from the public scrutiny and will fight any attempt to gain control over them. This is possible through the game they establish with politicians in the context of a principal-agent relationship[6]. Niskanen (1971), has points out that "one can expect that the interactions between executives and legislators, bureaucrats and politicians are subjected to the constraint of re-election" which shows the self-interest behaviour in both arms of the government.

Downsian and Niskanen theory of democracy rest mainly on the assumption of budget maximising behaviour of bureaucrats and Niskanen believed that bureaucrats succeeded in their budget-maximisers quest. The main problem with Niskanen's theory is the assumption that all bureaucrats are budget maximisation. Dunleavy (1985) argued otherwise, that budget maximizers are not the maxim of the majority of bureaucrats. Nonetheless, Niskanen's assumption itself lacks empirical evidence even though in a later writing Niskanen (1975) cited evidence

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[6]- Brown and Jacson (1990) argued that the relationship between the bureaucrats and politicians can be viewed in the context of principal-agent relationship.

in support of it. Among the ways bureaucrats can raise the level of government spending is by demanding better pay and better working conditions Klein (1990) which will also allow them what Peacock (1978) termed as on the job leisure. On the other hand, bureaucratic expansion may also arise because of a much more complex network of government functions (Jackson, 1990 Klein, 1976) due to industrialisation and development.

2.3.4 Keynesian Theory Approach

In contrast to Wagner's approach, there is another approach mentioned earlier which is associated with Keynes. Keynesian theory was based on the role that the government plays in the cases when aggregate demand in the economy is declining or remains stagnant. Keynes (1933) noticed that many types of government expenditure could contribute to economic growth positively by directly increasing aggregate demand. Therefore, the government can step in and stimulate economic activity by increasing aggregate demand, increasing income and in turn reducing unemployment.

Keynes's theory was simple, intuitive and practical-- firms will hire more labour only if they believe they can sell the extra output. Consequently, if demand as a whole declines, they will cut back production and lay workers off. However, by laying workers off, the income of potential customer's decreases and, thus, aggregate demand will be even lower. Then, as firms do not see demand rise again; they have no incentive to rehire. The economy, in short, is caught in a vicious circle of high unemployment and low demand. This is where an exogenous agency, such as a government, can step in and, by increasing demand, lead the economy

into a virtuous cycle of high demand and high employment. Keynes (1936) developed the principle of effective demand: as government expenditure increases, the notional income increases too. Therefore, the causality, in the Keynesian approach, runs from government expenditure to national income and public expenditure is seen as an exogenous factor or instrument to be used to stimulate economic growth.

Keynesianism is generally a theory of economic stabilization, not a theory of government growth. It does not suggest that government, in fighting economic fluctuations, would necessarily increase or decrease its relative size. While budget imbalances, dictated by fiscal activism, are acceptable on a yearly basis, a Keynesian premise is that over a number of years the budget would be balanced. The size of government expenditure is viewed as an exogenous factor.

2.4 - Interpretations of the Wagner Hypothesis

After the publication of English translations of Wagner's hypothesis, his hypothesis has provided scope for a range of different interpretations in the existing literature. It is possible to identify at least six of these interpretations, Peacock and Wiseman (1967), Gupta, S.P. (1967), Goffman (1968), Pryor (1968), Musgrave (1969) and Mann (1980).The discussion in the following subsections will critically review the interpretations of the WH.

2.4.1 Peacock and Wiseman (1967)

Peacock and Wiseman (P&W) interpret the WH as:

"The proportion of public expenditures to gross national product that must be expected to rise over the foreseeable future" (Peacock and Wiseman, 1961, p, 10).

The P&W interpretation of the WH envisages that public expenditure should increase easily and consistently at a rate higher than the rate of increase in national income, and they assumed that the growth of public expenditure is associated with changes in the demand for public services. Those changes in demand are mainly due to the growth in income per capita and population. However, Wagner considered other factors, such as a steadily developing division of labour, technology and scientific progress, as well as the increasing complexity of transport and communication, which would lead to a higher level of government expenditure. This is a function of national income and can be represented in the general relationship shown in equation (2.4).

$$TGX = f(GDP) \tag{2.4}$$

Where TGX represents total government expenditure and GDP represents Gross Domestic Product. A few comments can be made on the P&W interpretation. First, it can be considered to be the first modern analysis to revive the WH, and began the modern measurement of the state as a fiscal activity vie TGX. Second, it rejected both the organic theory of the state explicit in Wagner, and also rejected the mechanism by which any expansion would take place.

The problem they suggested was that state activities may increase, but not for the reason or in the way that Wagner hypothesised. However, they adopted Wagner's

historical approach to study the behaviour of British public expenditure by looking at the relevant time-series and historical facts. In rejecting the theoretical foundations of the WH, its organic view of the state and its alleged demand-side focus and the validity of the WH in explaining the pattern of state activity growth.

They found that state activity displayed a step-wise, rather than gradual, pattern of government growth. Third, Wagner did not suggest a precise functional form of the relationship between the size of public expenditure and economic development. However, the P&W interpretation of the WH still proposes a linear relationship between the two economic variables as depicted in equation (2.5).

$$TGX = \alpha + \beta(GDP) \tag{2.5}$$

P&W were concerned primarily with the time-pattern of public expenditure growth, and in so doing proposed their own stepwise process of public expenditure growth, where they stress the importance of supply side crises such as wars and depressions. They argued that the greater role of government during these times leads to increases in the tolerable burden of taxation, rather than the smooth 'organic' demand-led growth that they argued was proposed by Wagner. According to P&W, the crisis level of taxation tends to remain high after the crisis has passed because the expanded bureaucracy will act to ensure its continued new levels of funding, albeit for a different suite of post-crisis expenditure.

They further argued that crises, especially war, can concentrate power at the national level. They called their hypothesis the "displacement" effect and it is typified by public expenditure, which is rapidly flexible upwards during crises, but

is inflexible downwards after the crises. However, the P&W displacement hypothesis was unable to explain the sustained large rise in the role of the public sector after World War II in the United Kingdom or in other countries (Bird, 1972).

This ensures an elasticity of TGX with respect to GDP greater than 1, so that, in some range of GDP, the share of government in GDP is increasing. Further, it also ensures that as GDP increases, the elasticity falls to 1 and that TGX grows in equal proportion to GDP and the share TGX/GDP reaches a maximum. However, there is still an important issue; the asymptote value could be greater than 1. Further, very importantly, negative values of TGX do not make economic sense. This would indicate that perhaps a better direction would be to directly model the relationship of the share of TGX/GDP with some measure of the level of the economy such as GDP or GNP per capita. P&W functional form could suffer from an endogenous problem. This problem may happen in P&W model if both Keynes and Wagner are right. That is, TGX causes GDP and GDP causes TGX.

However, it should be pointed out that all models which test the WH and have TGX or any measure in levels of government expenditure on the left hand side of the equation could suffer from an endogenous repressor problem, (Verbeek 2000, p.122). In time-series, a clear way to overcome this problem would be to introduce the lagged variable income, or the lagged variable income per capita, as an instrumental variable in the two stage least square model, (Greene, 2003,p.74).

2.4.2 Gupta, S.P. (1967)

Gupta (1967) interpreted the WH by considering the relationship between state activity and national income as:

"Government expenditure must increase at a rate faster than that of the national income" Gupta, (1967, p. 426).

Gupta measured the size of government by TGX per capita, and economic development by GDP per capita, as shown in the general relationship depicted in equation (2.6):

$$\frac{TGX}{POP} = f\left(\frac{GDP}{POP}\right) \qquad (2.6)$$

Where (POP) represents population and the other variables are as defined previously. Gupta examined the time-pattern of public expenditure growth for a group of countries. The countries he tested were: the UK, Germany, U.S.A., Canada, and Sweden. Gupta suggested that the P&W version of the WH refers only to the shift in the level of government expenditure in relation to national output.

He suggested that P&W were looking for the association between social upheaval, economic growth and the level of government expenditure. Gupta argued that the concept of a tolerable burden of taxation adopted by P&W could explain shifts in the level of public expenditure during wars and crises, but cannot explain the shift in the level of public expenditure during a depression since taxes are reduced in this period. Gupta explained further that including other methods of financing in

addition to taxes, such as deficit financing, in the P&W concept of a tolerable burden, might provide a better explanation. Gupta may be the first to devise rigorous statistical tests for a displacement effect, separately testing for a shift in the government expenditure level and whether social upheaval is associated with the change in the income elasticity of government expenditure in relation to economic growth.

To test for the WH and the 'displacement' effect, Gupta adopted a double logarithmic functional form, which is depicted in equation (2.7)

$$\ln\left(\frac{TGX}{POP}\right) = \alpha + \beta \ln\left(\frac{GDP}{POP}\right) \tag{2.7}$$

Gupta's logarithmic form gives a constant elasticity score on the left hand side variable of the equation (TGX/POP) with respect to the right hand side variable (GDP/POP). Gupta's model of the WH is different from that of P&W in a way that the left and right hand side variables are now represented as ratios to population. Gupta also tested for the WH using a log-linear function form whilst P&W functional work implies a simple linear form. Because TGX and GDP exhibit strong simultaneity, Gupta's log-linear functional form suffers from an identification problem, as did P&W functional form.

The test results suggested that a shift in the level of TGX per capita was associated with the great depression in the United States and Canada, which could not be explained by P&W displacement effect hypothesis. Gupta justified this on the grounds that the shift associated with the great depression occurred because much new expenditure, such as welfare services and subsidies and assistance generated

by the great depression, were mostly deficit financed. The results also suggested that a significant change in the income elasticity of the level of TGX per capita with respect to per capita GDP is associated with each major social upheaval but with no generalisation of its direction. In the case of Sweden, where there were no social upheavals, the income elasticity of the level of TGX per capita also changed positively after the Second World War, which presented some support for the WH in Sweden during that period.

The results of the tests in Gupta's study suggested a limited acceptance of the WH in most of the countries included in the tests. Gupta (1967) introduced a non-linear model of the WH and suggested that modelling the WH this way might give a better understanding of the behaviour of public expenditure in relation to national income over time and across countries. His results did not contradict the WH but he did not develop his non-linear model further to a sensible form that places boundaries on the level of government expenditure. However, Gupta's non-linear interpretation marked a significant step in the development of the interpretations of the WH, since he was the first to recognise that the growth of government relative to national income would follow a non-linear process.

Gupta's (1967) linear interpretation has been adopted and tested for different economies by many scholars in the existing literature. Michas (1974) tested Gupta's version of the WH for Canada during the period from 1950 to 1961 and he found support for the WH during that period. Nomura (1995) tested Gupta's version of the WH for Japan during the period from 1960 to 1991 and found support for it, whereas Singh and Sahni (1984) tested Gupta's version for India during the period from 1950 to 1980 and they found no support. Other studies have

been carried out and tested Gupta's version of the WH such as Chletsos and

Kollias (1997) for Greece, and Ansari, et al. (1997) for three African countries.

2.4.3 Pryor (1968)

Pryor analysed the growth of public expenditure in market and centrally planned

economies. The market economies included were the USA, West Germany,

Austria, Ireland, Italy, Greece, and Yugoslavia[7]. The centralised economies

included were Czechoslovakia, East Germany, the USSR, Hungary, Poland,

Romania and Bulgaria. Unlike the two previous works, Pryor (1968) interpreted

the WH such that in growing economies, public consumption expenditure became

an increasingly larger component of the national income. His interpretation is

different from both the Gupta and P&W interpretations in that Pryor narrowed the

definition of government. His interpretation of the WH as depicted in equation

(2.8)

$$\frac{TGXC}{GDP} = f\left(\frac{GDP}{POP}\right)$$ (2.8)

Where TGXC denotes total government expenditure on consumption, and other

variables as presented previously. Pryor tested the WH using a log-linear

functional form as depicted in equation (2.9)

$$\ln\left(\frac{TGXC}{GDP}\right) = \alpha + \beta \ln\left(\frac{GDP}{POP}\right)$$ (2.9)

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[7] The inclusion of Yugoslavia as a market economy is based upon Pryor's classification of economies.

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Pryor modelled the WH with the dependent variable being the ratio of TGXC to GDP. Pryor's study aimed at comparing market and centrally planned economies, focusing the study on 'Comparative Economic Systems'. Wagner applied his hypothesis to market economies where free competition prevailed in the market, and democracy is an important driver of the government expenditure process. However, Pryor's analysis is differentiated from other previous analyses in that it attempted to examine the effects of different types of conditions and variables on the forms of the WH. For instance, he examined the effect of economic development on TGXC for different economic systems instead of a group of countries which do not seem to fit his interpretation of the WH for the highly underdeveloped and the highly developed economies.

Pryor employed both cross-section and time-series data to test the WH and found that Wagner's generalization seems applicable on both bases for countries that are in the process of transforming their economies from rural agricultural to urban industrialization. He thought that this stage might be described as the beginning of an industrial economy. Pryor also disaggregated TGXC to observe the behaviour of the different components of TGXC over time along with the development of the economy.

Pryor found mixed results when he disaggregated TGXC into different components and tested with cross-sectional data. On the one hand, he found that empirical tests using the internal security, foreign aid, and research and development categories did not contradict the WH. On the other hand, he found that economic development seemed to have little explanatory power for the military, welfare,

education and health expenditure categories. However, in almost all time-series samples, per capita income significantly affected TGXC.

Pryor's interpretation of the WH has been used and tested by a number of scholars in the existing literature. (Abizadeh and Yousefi, 1988) tested Pryor's version of the WH for the USA during the period from 1950 to 1984. Their results support the WH for the USA during that period. (Hondroyiannis and Papapetrou, 1995) tested Pryor's version of the WH for Greece during the period from 1951 to 1992.Their results suggested no support for the hypothesis. (Iyare and Lorde, 2004) tested Pryor's version for nine Caribbean countries. They found mixed results for the WH.

2.4.4 Goffman (1968) and Goffman and Mahar (1971)

Goffman (1968), and Goffman and Mahar (1971), interpreted the WH in the following way:

"The public sector's share of the community's output increases with economic development" Goffman (1968, p.59).

"As a nation experiences economic development and growth, an increase must occur in the activity of the public sector and the ratio of increase, when converted into expenditure terms, would exceed the rate of increase in output per capita" *(Goffman 1968,p.359)*

Goffman (1968) and Goffman and Mahar (1971), interpretations involve a relationship of the WH as in the following functional form:

$$TGX = f\left(\frac{GDP}{POP}\right)$$
(2.10)

Where variables are as defined previously. In the general form the dependent variable is the level of government expenditure and the measure of development is the level of GDP per capita. Goffman, and Goffman and Mahar; did not use standard econometric methods, such as the linear stochastic model; rather they used simple ratios between the dependent and independent variables. Based on these ratios they calculated the elasticity of government expenditure with respect to GDP per capita over points in TGX/GDP space. One can only presume that they must have envisaged a linear relationship:

$$TGX = \alpha + \beta\left(\frac{GDP}{POP}\right)$$
(2.11)

Following P&W (1961, p.10), Goffman measured government growth in absolute levels and suggested that Wagner provided little reason for measuring the rise of public expenditure as proportional to income. Gupta suggested that Wagner's proportional rise relies on Wagner's typically Germanic view of the state. In other words, Goffman suggested that Wagner thought that it was desirable for the state to grow at a rate that would increase the share of state functions in output.

Goffman criticized previous studies of the WH in that they presented their results in terms of the rising or falling of the ratios of public expenditures relative to income instead of in terms of the values of the elasticity. Goffman's view of the elasticity of demand in the WH proposes that the percentage change in income leads to a greater percentage change in expenditures. Goffman did not actually test for the WH; instead, he relied on simple ratios of percentage changes in government spending and GDP, and interpreted the resulting ratios as elasticity.

Whilst Goffman, and Goffman and Mahar, are critical of some previous studies, there are two issues with their work. First, they ignored the potential for an endogenous regressor brought about by potential simultaneity between TGX and GDP/POP. Second, even though they argue for analysis couched in terms of the elasticity of TGX with respect to GDP per capita in favour of the ratio TGX/GDP, they appear to ignore some elasticity issues. For the elasticity of TGX with respect to GDP/POP to be greater than unity, the linear form of their interpretation requires a negative intercept for TGX, implying negative TGX scores for low levels of GDP/POP. Furthermore, the linear form must mean that the limit to the measure of elasticity described here must approach one. Thus, as GDP/POP grows larger, TGX growth approaches GDP/POP growth so that TGX/GDP reaches the same maximum level. However, there is no guarantee that this maximum is less than one.

Some studies have tested the Goffman and Goffman and Maher version of the WH. (Wagner and Weber, 1977) tested the version for 34 countries during the period 1950 to 1972 and they found no support for the WH. (Courakis, et al. 1993), tested the version for Greece and Portugal during the period 1958-1985 and also found no support for the WH. (Bohl, 1996), tested the version for the G7[8] countries during the different time periods and he found mixed results for the hypothesis.

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[8] Germany (1850-1913), the UK (1870-1995), Canada (1950-1994), France (1972-1995), Italy (1950-1991), Japan (1955-1993), and the USA (1959-1995).

2.4.5 Musgrave (1969)

During 1969, he interpreted the WH as follows:

"The preposition of expanding scale, obviously, must be interpreted as postulating a rising share of the public sector in the economy. Absolute increases in the size of the budget can hardly fail to result as the economy expands" (Musgrave, 1969, p.74)

Musgrave's interpretation of the WH assumes a functional relationship between the ratio of total public expenditure to GNP and per capita income as depicted in equation (2.12):

$$\frac{TGX}{GDP} = f\left(\frac{GDP}{POP}\right)$$
(2.12)

This functional relationship proposes that, with the development process represented by per capita income (GDP/POP), the share of government expenditure in national income (TGX/GDP) will increase at a higher rate than that of per capita income. Musgrave tested for the WH using the linear functional form as depicted in equation (2.13).

$$\left(\frac{TGX}{GDP}\right) = \alpha + \beta\left(\frac{GDP}{POP}\right)$$
(2.13)

This linear form requires that (TGX/GDP) is a positive function of (GDP/POP) if economic development is to lead to a relative increase in government expenditure as posited by Wagner. Clearly, there must be an upper limit to this expansion and the linear form will not control this limit. Unfortunately, the specific functional form adopted by Musgrave in equation (2.10), is the simple linear form. There are

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clear problems with this form because it does not place lower and upper limits of zero and one respectively on the share variable (TGX/GDP). This issue is very well recognized in modern micro econometrics with the use of logistics and logic regressions (Greene, 2003). It could well be that the estimation methods Musgrave's work produced such linear models. Nevertheless, it may be that his result could be explained by using a more appropriate functional form.

Musgrave examined economic factors that might support the hypothesis of a rising share of public expenditure in GDP by studying the development of a country from low to high per capita income in the course of economic growth. Musgrave's version is differentiated from other versions of the WH in several ways. First, his interpretation considers shares instead of absolute levels and so is less likely to suffer from the endogenous problem. Second, following Wagner, Musgrave considered the cause of particular types of public expenditure. He accepted the distinction between defence and civilian functions, but his choice did not conform to Wagner's choice of expenditure categories: protection, general administration, economic administration, and education. Instead, Musgrave asserted that civilian expenditures might be better examined in economic categories such as public capital formation, public consumption, and transfers.

Musgrave expected that the rise of the public share in total capital formation will be relatively high in the early stages of development, but with less predictable change thereafter, and that the ratio of transfers will tend to decline with rising income. His foundation was that the facilities for private capital formation are limited in the early stages of development, and public production of certain capital goods might therefore be necessary. However, at a later stage of development, the

institutions for private capital formation become more developed and the provision of such capital goods may be left to the private sector.

Musgrave suggests that the WH covers only the earlier to middle stages of economic development and does not apply to the post-industrialised states. However, Musgrave suggests that changing private consumption patterns might call for complementary private investment, so that the net effect on the public share depends on each particular case.

While this might have motivated Musgrave to a non-linear version of the WH, he retains the linear form of earlier interpretations. Musgrave's version has been adopted and tested in many studies in the existing literature where most of these studies have generally obtained results supporting the WH. (Murthy, 1994), tested the Musgrave version for Mexico during the period 1950 to 1980 and found support for the hypothesis. (Lin, 1995), tested Musgrave's version for Mexico during two different periods 1950 to 1980 and 1950 to 1990 and found support for the WH. (Islam, 2001) tested the Musgrave version for the USA during the period 1929 to 1996 and obtain results that support the WH. (Alleyne, 1999), tested Musgrave's version for 4 Caribbean countries[9] and obtained results that did not support the WH in those countries.

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[9] Jamaica (1953-1991), Guyana (1950-1990), Barbados 91960-1997), and Trinidad and Tobago (1950-1991).

2.4.6 Mann (1980)

Mann (1980) tested all earlier interpretations of the WH for Mexico over the period from 1925 to 1976. His results suggested that P&W, Goffman and Mahar, and Gupta's versions support the WH in Mexico since the elasticity coefficients exceed unity. Opposites are obtained with the share versions of the WH when compared to Musgrave and Pryor.

Mann modified the P&W interpretation into a structural share version of the WH. Mann interpreted the WH by considering the share of public expenditure in income should increase at a rate higher than the rate of increase in national income. Mann's formulation of the WH translates into the functional relationship:

$$\frac{TGX}{GDP} = f(GDP) \qquad (2.14)$$

Where GDP represents national income and the other variables are as defined previously. Man used a log-linear functional form as depicted in equation (2.15) to test his general relationship for Mexican data:

$$\ln(TGX/GDP) = \alpha + \beta \ln(GDP) \qquad (2.15)$$

This form, developed by Mann's is different in that it measures fiscal expenditure to the level of GDP, as did Pryor and Musgrave but, unlike those authors; Mann relates this share to the level of GDP rather than GDP per capita. Mann's results suggested that the WH is supported only by the proportional levels of spending in the overall public sector and the changing industrial and demographic structure in terms of urbanization of Mexico.

2.5 Summary

From the last three theories we can conclude: first, unreasonable definitions of upheavals reduce the displacement-concentration hypothesis into a variation of Wagner's law and second, the rather un-testable theory of bureaucracy complements at best other explanations of government growth. Since the Keynesian Theory is more appropriately a theory of economic stabilization, not a theory of government growth, this study prefers a focus on Wagner's Hypothesis.

Therefore, this study will focus on testing six versions of Wagner's law for the Libyan economy in Section 2.4 the different interpretations of the Wagner's hypothesis that have been produced in the existing literature were reviewed. All of these interpretations have related the growth in public expenditure to economic development which was seen to determine that expenditure. All existing interpretations of the WH have measured the state as a fiscal entity and they have not considered the regulatory aspects of the state in their analysis. In the next chapter, we will be discussing the empirical literature on Wagner's hypothesis.

Chapter Three

Empirical Studies of Wagner's Hypothesis

3.1 Introduction

In this study we investigate the impact of government expenditure on economic growth using time series data for Libya. In this chapter we conduct a brief survey of empirical studies. In recent decades economic researchers have shown interest in verifying and understanding the linkage between total government expenditure, fiscal policy and economic growth. Neoclassical economics in modelling economic growth was developed by Robert Solow (1956) neoclassical growth model suggested that fiscal variables such as the level of taxation and the level of government expenditure can affect the level of income in the short run, but will have no effect on the rate of economic growth in the long-run. On the other hand, it suggests that some economies may be wealthier than others, in the long-run.

This neoclassical growth model of Solow has been challenged in recent years on both the expenditure side as well as the revenue side. Here we would like to summarize some results of these critiques from both sides. On the expenditure side, there are many instruments of fiscal policy known to have or to have long-run growth effects.

(Robert Lucas, 1988) discussed the idea that the investment in human capital through education increases the stock of human capital and that human capital is an important factor in determining the economic growth rate of a country. Thus, if returns to education exhibit non-decreasing return to scale in producible factors of production then this increase in education expenditure can be seen as a major

source of long-run economic growth. In addition, there are also other examples of the influence of government expenditure on economic growth in the long run, such as the effect of government expenditure on infrastructure when it exhibits the character of a public good.

In regard to Solow's suggestion that all countries in the long-run should grow at the same rate, most of the recent studies in this matter suggested that there are substantial differences in the economic growth rates of countries over long time periods (Quah, 1996; Gwartney and Lawson, 1997).

Moreover, there are now good theoretical reasons for which different countries could have, and maintain, different economic growth rates (Lucas 1988; Romer 1997). The impacts of government expenditure on economic growth in the long run have been empirically studied since the early 1980s. In this regard two different views have been presented.

The first view (Ram, 1986; Bhat, Nirmala and Kannabiran, 1994) is that large government size is likely to be an impediment to economic growth on account of (a) government operations are often conducted inefficiently, (b) the regulatory process imposes excessive burdens and costs on an economic system, (c) fiscal and monetary policies tend to distort economic incentives and lower the productivity of the system and (d) government taxation may produce a misallocation of resources as well as disincentives. The second view (Ram, 1986; Lin, 1994), is that large government size supports economic growth because (a) the government can play a role in mediating the conflicts between private and social interests, (b) there is a prevention of exploitation of the country by foreigners, (c) productive investment will be high and will provide a socially optimal direction for growth and

development, (d) the government can provide the economic infrastructure to facilitate economic growth and improve resource allocation, (e) government transfer payments can help maintain social harmony, (f) government expenditure on health and education can improve the quality of the labour force and productivity and (h) subsidies to targeted export industries can improve the trade balance and accelerate economic growth.

In this framework (Libya is not included in any of these studies) empirical investigations, have yielded contradictory results. Some of them found a negative relationship between the two variables, which supports the hypothesis that rising government expenditure is connected with a decline in economic growth, and some studies found a positive relationship between the two variables which supports the hypothesis that government expenditure is associated positively with economic growth, and other studies do not find any evidence of a significant relationship between government expenditure and economic growth in the long-run.

The remainder of this chapter discusses as follows: Section 3.2 reviews the empirical studies on government expenditure and economic growth in general. Section 3.3 is a survey of empirical studies testing Wagner's hypothesis. Section 3.4 reviews the different econometric procedures followed in the time-series analyses of the Wagner hypothesis. Section 3.5 summarizes the chapter.

3.2 Empirical Studies of Government Expenditure and Economic Growth

The link between government expenditure and economic growth has attracted considerable interest on the part of economic researchers both at the theoretical and the empirical level. This section will survey a number of studies.

Landau (1983) examines the relationship between the share of government consumption expenditure in GDP and the rate of growth of real per capita GDP. He uses data from ninety-six countries, both less-developed countries (LDCs) and developed countries, for the period 1961- 1976, based on a basic regression model. The findings of the study suggested a negative relationship between the share of government consumption expenditure in GDP and the rate of growth of per capita GDP.

Another study by Ram (1986) which used cross section and time series data over 115 countries, through the period 1960-1980 found a positive and significant effect of government expenditure on economic growth. This could well be stronger in lower income countries.

Another study by Easterly and Rebelo (1993), investigated data from one-hundred developed countries as well as most of the third world countries, for the period 1970-1988. They found a positive correlation between the shares of expenditures on education in total government expenditure and economic growth. This provides evidence that this type of government expenditure is important for growth.

Lin (1994) used the rate of change in the share of government consumption in GDP as a proxy for government size, for a sample of 62 countries (20 were advanced developed countries and 42 developing countries). He found that non-productive government expenditure had a negative but insignificant impact on developed countries economic growth in the short and medium term, while it had a positive but insignificant impact on developing countries in the short run and negative but insignificant impact on them in the medium term.

Another study is from Gwartney et al (1998); they investigated data for the period 1960-1996 for the members of Organization for Economic Cooperation and Development (OECD) and data for the period 1980-1995 for a larger set of 60 countries around the world[1]. Both are cross-sectional studies using long time based on a basic regression model. The findings of these studies showed a strong and persistent negative relationship between government expenditure and growth of GDP, for both the developed economies of the OECD and for a larger set of 60 nations around the world.

Therefore, they concluded that when government expenditure is too high, economic growth will be retarded. Such findings are reasonable because more rapid growth is possible, but the higher potential growth can only be achieved if countries are willing to reduce the relative size of government. Also, they concluded that there are a number of available data series that have not been exploited, among them date on government debt, taxation, interest rate and trade balance. On the other hand, there are some studies that found a positive effect of government expenditure on economic growth in developing countries which at the same time indicated no impact on economic growth in developed countries.

Fasano and Wang (2001), used cointegration and an error correction model to investigate and examine the relationship between government expenditure disaggregated into current and capital spending, and the economic growth of real non-oil GDP in some of the GCC countries for the period 1980-1999 (Kuwait was

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[1] The study did not include any nation of the former Soviet Union, China or former communist nations from Eastern Europe.

excluded from their examination due to missing information regarding the years 1990 and 1991 as a result of the Iraqi invasion).

The results obtained from the study showed no significant relation between disaggregated government expenditure and growth in non-oil economic growth. In other words, their conclusion did not support the assertion that government expenditure tends to affect non-oil GDP growth in these countries or vice versa. One of the problems with this study is that the data used are not publicly available and, hence, it is difficult to judge the reliability of the results.

Satter (1993) investigated data for 24 OECD countries (developed industrial market economies), and a group of 31 low income developing economies for the period 1950-1984 and found that there is a positive relationship between government expenditure and economic growth in the low income developing countries, while there is a negative impact between government expenditure and economic growth in OECD countries.

He concluded that the role of government in these OECD economies is largely indirect, leaving the private sector with enough freedom to operate the different kinds of productive activities, while the role of government in the low income developing economies in almost all of productive activities. The conclusion that the author derives from this study is very reasonable and realistic in our world today. A number of leading economists have argued that the government size has no impact, one way or another, on economic performance of industrial market economies. For the low-income economies the evidence, though mixed, points more towards a positive overall impact of government on growth performance.

Al-Yousif (2000) used a framework similar to Ram's (1986), as built on a two sector production function (government sector and non-government sector). Ordinary Least Squares (OLS) is used to investigate the effect of government expenditure on economic growth using the two different models with annual data for Saudi Arabia for the period 1963-1992.

He concludes that each model has a different result. However, one of the models shows a positive relationship between government expenditure and economic growth which suggests that government expenditure has a positive effect on economic growth.

The result of this study indicates that the nature of the impact of government spending on economic growth significantly depends on the way of measuring government size. Therefore, the government sector in Saudi Arabia, with its large oil revenue, largely dominated the economy. It sounds reasonable and acceptable to say that Ram's model with its supportive evidence for the role of government in Saudi economy is a good model to be utilized.

3.3 A Survey of Empirical Studies which test Wagner's Hypothesis

A number of researchers have focused on Wagner's Hypothesis for specific countries, as well as for groups of countries using both time-series and cross-sectional data sets. Wagner's law postulates that when economic activity grows there is a tendency for government activities to increase not only in line with the growth in the economic activity but more than proportionately. In this section we will divide the studies which test Wagner's Hypothesis as follows.

3.3.1 Studies Supporting Wagner's Hypothesis

For the purposes of this analysis, this section classifies these studies into supporting studies, with results that suggest a tendency for government expenditure to increase along with economic development, which is consistent with Wagner's hypothesis. A more detailed review of these studies as follows.

Musgrave (1969), examines the course of public expenditure using time series data for the United Kingdom, the United States, and Germany, covering the period from 1890-1960. Over this period, per capita real income and total public expenditures as a percentage of GNP increased sharply in all three countries. His result in this study supports the Wagner's hypothesis.

Ram (1986), tests Wagner's hypothesis for 63 developed and developing countries for the period from 1950-1980 he has another study (1987), which covered the same time period but this time for a group of 115 countries. He found limited support for Wagner's hypothesis. The results, in both studies, indicated that while there is support for the proposition in some time-series data, such support is lacking in most cross-sectional estimates.

Therefore, much of the support for Wagner's hypothesis reported in some other cross-section studies was probably due to either use of limited samples or inadequate data when comparing across the other studies. In addition, they did not take into account the enormous cross-national diversity in economic and political structure. Therefore, much caution is needed in either proposing or expecting a common pattern in all countries.

Henrekson (1992), tests Wagner's hypothesis using time series data for the period from 1861-1988 for Sweden. This study used cointegration techniques. Although very few time-series studies have failed to find strong support for Wagner's hypothesis, he claims that previous studies of Wagner's hypothesis suffer from various methodological shortcomings that make their results highly questionable. For example, he shows that these findings are likely to be spurious because they have been performed on non-stationary variables that are not cointegrated Henrekson (1992). He applied cointegration analysis to Swedish data on Wagner's hypothesis. He was unable to find any long-run relationship between public expenditure as a share of GDP and GDP per capita.

Murthy (1993), investigates what determines the presence of a long-run link between the share of government expenditure in real GDP and real GDP per capita in the case of the Mexican economy for the period from 1950-1980. The findings show that the share of government in real GDP and real GDP per capita are cointegrated and thus there is a positive long-run relationship between the variables under investigation. However, this study looked only at one part of Wagner's hypothesis, which is the long-run relationship between the two variables, but did not employ the Granger-Causality procedure to determine the direction of this relationship. The Granger-Causality test is an important procedure to determine whether Wagner's hypothesis is suitable or not.

Islam (2001), tests Wagner's hypothesis on the relationship between the government sector and development of the economy for the USA using annual time-series data for the period from 1929-1996. The study used econometric techniques such as cointegration and exogeneity to test this relationship. The

empirical results found strong support for the hypothesis for the USA, and the results found strong evidence of a long-run equilibrium relationship between per capita real income and the relative size of government.

Al-Faris (2002), investigated the relationship between government expenditure and economic growth for the Gulf Cooperation Council (GCC) countries2, using data from the period 1970-1979. This article investigated this relationship empirically within the framework of the Wagner and Keynes hypotheses. He used cointegration and unit root tests for testing Wagner's hypothesis. The analysis gave evidence which supporting Wagner's hypothesis in the majority of these countries.

Chang (2002), examines five different versions of Wagner's hypothesis by employing annual time-series data on six countries, three of which are part of the emerging industrialized countries (South Korea, Taiwan and Thailand) and three industrialized countries (USA, Japan and United Kingdom), for the period 1951-1996. The results of this study supported the existence of a long-run relationship between income and government expenditure for all countries studied with the exception of Thailand.

Al-Obaid (2004), investigated the long-run relationship between total government expenditure and real gross domestic product and its direction using time-series data for the period from 1970- 2001 for Saudi Arabia. The findings show that the share of government expenditure in real GDP and real GDP per capita are cointegrated and thus there is a positive long-run relationship between the variables under

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[2] GCC refers to Gulf cooperation council countries. These are Saudi Arabia, the United Arab Emirates (UAE), Kuwait, Oman, Bahrain, and Qatar.

investigation this confirms the validity of Wagner's hypothesis in the case of the Saudi Arabian economy during the period under investigation. This study is a very good example of applying the recent econometric methods, the co-integration technique and the Granger-Causality procedure, to detect the long-run relationship between the variables under investigation and to determine the causality that runs from GDP to TGX as Wagner hypothesised. We will apply this in this study.

Yuk (2005), investigated the long-run relationship between economic growth and government spending by examining interactions among GDP. The study used the data for the share of government expenditure to GDP and the share of exports to GDP for the United Kingdom over the period from 1830-1993. The Granger-Causality procedure was used to analyse data in this relationship and the results of the study supported Wagner's hypothesis.

Quijano and Garcia (2005), investigated a long-run relationship between government expenditure and real gross domestic product for the Philippines covering the period from 1980-2004 to test Wagner's hypothesis for the Philippines. Their study used Johansen's co-integration and the Granger causality test to analyse the relationship between government spending and economic growth. The results of this study found support for Wagner's hypothesis in the short-run and long-run in the Philippines over this test period.

3.3.2 Studies which do not Support Wagner's Hypothesis

The second section has results that mainly found no relationship between government expenditure and economic development and, therefore, do not support the Wagner hypothesis.

Mann (1980) conducts a test using time series data for two periods for Mexico 1925-1976 and 1941-1976. He included the proportion of GDP generated in manufacturing, the proportion of GDP generated in agriculture and the proportion of the population in urban areas as explanatory variables in order to capture Wagner's Hypothesis. Mann tested the six versions of Wagner's Hypothesis and his results did not support Wagner's hypothesis for Mexico.

Afxention and Serletis (1996) tested Wagner's hypothesis for six countries3 for the period from 1961- 1991. They found no evidence supporting Wagner's hypothesis that there was a long-run relationship between total government expenditure and GDP, and also between the three categories of government expenditures (consumption, transfer, and subsidies). In this study, Germany, as the strongest economic power, was used as a model for the rest of the EU countries in this study on which they were expected to converge.

Another study by Ansari et al (1997), examined Wagner's hypothesis for three African countries, Ghana from the period 1963-1988, Kenya from 1964-1989, and South Africa from 1957-1990, there results gave no evidence supporting the existence of a long-run relationship between government expenditure and national income for Wagner's hypothesis.

Another study by Courakis et al (1993), examined the relationship between aggregate income and public expenditures in Greece and Portugal during the period from 1958 – 1985. Their analysis found that permanent income, relative prices, stabilisation policy and socio-political factors are the main determinants of

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3 France, Italy, Germany, Belgium, Netherlands, and Luxembourg.

public expenditures, but the results reveal significant differences in responses to these determinants across components of expenditures between the two countries. They found no support for the per capita formulation of Wagner's hypothesis in the case of Portugal and Greece.

Gemmell (1990), points to the importance of relative prices in explaining public expenditure growth. He argues that (tests of Wagner's hypothesis using current price data are liable to produce biased outcomes). He used the revised data set produced by summers and Heston (1988), for the period from 1960 – 1985 for 117 countries. The measure of government used in his study is government real consumption expenditure. His study found almost no support for Wagner's hypothesis using the conventional, but narrow, interpretations of income elasticity as government real output (expenditure) in excess of unity.

Burney (2002) investigated the relationship between public expenditure and a number of socioeconomic variables in Kuwait, including the level of income. He used time series econometrics, including unit roots and co- integration test, and an error correction model. This paper analysed the long-run equilibrium relationship between public expenditure and the relevant socioeconomic variables, for an oil-exporting developing economy, based on time-series data covering the period 1969-1995. The results in this paper showed little support for the existence of a long-run equilibrium relationship between public expenditure and the socioeconomic variables, and the evidence does not support Wagner's hypothesis in Kuwait.

Halicioglu (2003) used cointegration in his study to test Wagner's hypothesis in the case of Turkey over the period 1960-2000 the study tested the empirical effect of government expenditure on economic development. The empirical evidence provided for Turkey in this study using modern time-series econometric techniques does not support Wagner's hypothesis in the case of Turkey for this period.

Huang (2006) estimated the long-run relationship between government expenditure and output. The study empirically tested Wagner's law for China and Taiwan, using annual time-series data covering the period from 1979-2002. This study used Granger non-causality tests for estimating this relationship. His results do not support Wagner's law for China and Taiwan over this test period.

3.3.3 Studies with Mixed Results for Wagner's Hypothesis:

The third section describes tests, of which are of mixed results; these studies have estimated the relationship between government expenditure and GDP. The results in this section were mixed, showing a positive relationship between government expenditure and GDP for some economies and negative relationship for others.

Abizadeh and Gray (1985) test the hypothesis for 53 countries grouped into poor, developing and developed groups for the period 1963-1979. The hypothesised relationship between economic development and the growth of government expenditure was supported for the developing countries group, but not for the poor or for the developed countries groups. It was observed that for the developed countries group there is a decline in the ratio of government expenditure with increased economic development.

Comparing between time series and cross-section data for the elasticity of the ratio of government expenditure to GDP with respect to GDP per capita, (Ram,1987) concluded that cross-section results did not support Wagner's hypothesis but that the time series data supported it in 60% of the 115 countries covered in his study. Problems in the data forced Ram (1987) to analyse the data for two periods 1950-1980 and 1960-1980. He found that in the period 1950- 1980, when using shares of government expenditure to national income, the elasticity was positive in 36 of the 63 countries. And for the period 1960 -1980 the elasticity is positive in 70 of the 115 countries.

In another study of the State of United Arab Emirates by Ghali and AL-Shamsi (1997) used cointegration and an error correction model for the period 1973-1995 and tested for a causal relationship between both current and capital government expenditures on the growth rate of the real GDP. Their analysis provides evidence that government investment in capital supports the existence of a long-run positive effect on economic growth, at the same time, the effect of government consumption was found to be insignificant.

Singh (1998) investigated the evidence of Wagner's hypothesis in a case study of Malaysia using time-series data for the period from 1950-1992. Two types of analysis were performed. The first one examined the long-run relationship between GDP and government expenditure. The second one applied a Granger causality test between the growth rates of the two sets of variables. His conclusion for this study was as follows: in the first analysis there was a positive long-run relationship between GDP and government expenditure, in the second analysis, there was no evidence that the growth of GDP caused growth of government expenditure and

vice versa. It is worth mentioning here that causality tests indicate the absence of a short-run relationship whereas the presence of cointegration indicates the presence of a long-run relationship.

Biswal et al (1999), test Wagner's hypothesis versus Keynesian hypothesis by examining the relationship between national income and total public expenditure for Canada during the period from 1950-1995. To test these hypotheses, this study used Engle and Granger's (1987), two-step co-integration and error correction model. This study gave mixed results for both Wagner's hypothesis and the Keynesian hypothesis. When the study examined aggregate expenditure it found support for the two hypotheses, but not supported either hypothesis when disaggregated public expenditure date was used.

Halicioglu (2003) analysed Wagner's hypothesis in the case of Turkey over the period from 1960-2000. This paper used modern time-series econometric techniques to test the validity of WH for Turkey. His results were mixed for the validity of Wagner's hypothesis. A positive long run relationship was found between the share of government in GDP and real per capita income growth which supports the Wagner's hypothesis. However, the Granger causality test revealed that Wagner's hypothesis does not hold for Turkey.

Wahab (2004) tested Wagner's hypothesis using the annual data for the government and GDP time series for the period 1950-2000, for the OECD countries[4]. His study obtained mixed results for Wagner's hypothesis, and the

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[4] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Germany, Hungary, Poland, Slovak Republic and Czech Republic.

results suggest that government expenditure increases less than proportionately with accelerating economic growth and decreases more than proportionately with decelerating economic growth. However, one can note that this is a long time-series pooled across few countries. That is, it is a long, narrow pooled sample.

Iyare and Lorde (2004) test Wagner's hypothesis for the nine Caribbean countries. The study employed aggregate annual time-series data and different periods to all of these countries. The study examined the stationary properties of the data available, and applied the two step Engle and Granger (1987) cointegration and error correction procedure. The results were mixed for Wagner's hypothesis. The results indicate that a long-run equilibrium relationship between income and government expenditure does not exist for the countries studied apart from the exceptions of Grenada, Guyana and Jamaica. However, the direction of causality runs from income to government expenditure only for Guyana.

3.4 Models of the Wagner Hypothesis

The different interpretations of Wagner's hypothesis discussed in chapter two have formed the basis for six different general forms of Wagner's relationship. These general forms are expressed in the following general equations, where the distinction is in terms of variables used rather than their functional form:

$$TGX = f(GDP) \qquad \text{Peacock and Wiseman (1961)} \qquad (3.1)$$

$$TGX/POP = f(GDP/POP) \qquad \text{Gupta (1967)} \qquad (3.2)$$

$$TGXC/GDP = f(GDP/POP) \qquad \text{Pryor (1968)} \qquad (3.3)$$

$$TGX/GDP = f(GDP/POP) \qquad \text{Musgrave (1969)} \qquad (3.4)$$

$$TGX = f(GDP/POP) \qquad\qquad \text{Goffman (1968)} \qquad\qquad (3.5)$$

$$TGX/GDP = f(GDP) \qquad\qquad \text{Mann (1980)} \qquad\qquad (3.6)$$

The interpretations of these variables are mentioned in chapter two. These general specifications have formed the basis for at least 12 models of the Wagner's hypothesis in existing studies:

$$TGX = \alpha + \beta GDP + \varepsilon$$
$$\ln TGX = \alpha + \beta \ln GDP + \varepsilon$$
$$\text{Peacock and Wiseman} \qquad\qquad (3.7)$$

$$TGX/POP = \alpha + \beta(GDP/POP) + \varepsilon$$
$$\ln(TGX/POP) = \alpha + \beta \ln(GDP/POP) + \varepsilon$$
$$\text{Gupta} \qquad\qquad (3.8)$$

$$(TGXC/GDP) = \alpha + \beta(GDP/POP) + \varepsilon$$
$$\ln(TGXC/GDP) = \alpha + \beta \ln(GDP/POP) + \varepsilon$$
$$\text{Pryor} \qquad\qquad (3.9)$$

$$(TGX/GDP) = \alpha + \beta(GDP/POP) + \varepsilon$$
$$\ln(TGX/GDP) = \alpha + \beta \ln(GDP/POP) + \varepsilon$$
$$\text{Musgrave} \qquad\qquad (3.10)$$

$$TGX = \alpha + \beta(GDP/POP) + \varepsilon$$
$$\ln TGX = \alpha + \beta \ln(GDP/P) + \varepsilon$$
$$\text{Goffman} \qquad\qquad (3.11)$$

$$TGX / GDP = \alpha + \beta GDP + \varepsilon$$
$$\ln(TGX/GDP) = \alpha + \beta \ln(GDP) + \varepsilon$$
$$\text{Mann} \qquad\qquad (3.12)$$

The first equation in each pair represents a linear specification of Wagner's hypothesis of that particular version. The second equation represents a log-linear model of the Wagner's hypothesis of that particular version. Log-linear models are linear in their parameters, but, not in their variables. It is notable that the left hand side of the equation is either modelled in shares (3.9), (3.10) and (3.12) or modelled in per capita in (3.7), (3.8) and (3.11).

3.5 Summary.

Wagner's hypothesis was confirmed for some empirical studies, or for some of the countries tested, but in others it is either rejected or cannot be confirmed. This chapter has reviewed the testing methodologies followed in the existing studies of Wagner's hypothesis and tried to determine whether there is a patterns to the results in terms of the methods used. However, Libya is not included in the previous studies because we did not find any study that tested Wagner's hypothesis for Libya.

This chapter distinguished between the different types of econometric analyses followed in the existing studies of Wagner's hypothesis. These types of analysis varied between time series data and cross-sectional data. Time series data have been mostly used for empirical studies that have tested Wagner's hypothesis. Most of these studies have been applied to developed and industrial countries. Cross-sectional data have been primarily used for developing countries to test for Wagner's hypothesis.

This chapter also reviewed studies that measured the economic variables in Wagner's hypothesis namely: government size and economic growth. The majority

of these studies measured government expenditure at the aggregate level where all expenditures are included and they have measured economic development using income growth.

A significant development in time-series tests of Wagner's hypothesis is the application of modern co-integration regression. This thesis focused on those studies that used OLS regression and studies that used modern time-series techniques to test for Wagner's hypothesis.

An overview of the Libyan economic environment will be provided in the following chapter (Chapter Four).

CHAPTER FOUR

A Review of the Libyan Economy

4.1 Introduction

The Libyan economy prior to the discovery of oil in 1959, and its commercial production in 1962, was classified as one of the poorest countries in the world[1]. Libya needed Aid from international organisations and foreign countries (Vandewalle, 1998) because it had no significant economic resources to begin the development process, nor did it have suitable funds to finance economic development plans and overcome the severe economic conditions existing in Libya at the time of independence. Three United Nations technical assistance teams made study-tours of Libya in 1950-1951 (Wright, 1981). One of these was headed by Benjamin Higgins who noted the poor conditions existing at the time:

> *When Libya became an independent nation under United Nations auspices at the end of 1951, the prospects for Libyan economic and social development were discouraging to Libyans and foreigner's alike (Higgins, 1968, p.819). Libya has been great merit as a case study as a prototype of a poor country. We need not construct an abstract model of an economy when the bulk of the people live on a subsistence level, where per capital income is well below $40 per year, where there are no sources of power and no mineral resources, where agricultural expansion is severely limited by climatic conditions, where capital formation is zero or less, where there is no skilled labour supply and no indigenous entrepreneurship (Higgins, 1959, p.26).*

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[1] Higgins (1959) also noted that Libya combines within the borders of one country virtually all the obstacles to development that can be found anywhere: geographic, economic, political, sociological, and technological. Higgins believed that if Libya could be brought to a stage of sustained growth there would be hope for every country in the world.

The purpose of this chapter is to show the characteristics of the Libyan economy prior to the discovery of oil and to discuss the financial and economic development of the economy after the discovery of oil. The remainder of the chapter is divided into eight main sections. Section 4.2 discusses the Libyan environment and provides information about the State's geography and population. Section 4.3 focuses on the political. Section 4.4 discusses the development plans before and after the discovery of oil. Section 4.5 is on the State's budget. The changes of Gross Domestic Product (GDP) are discussed in section 4.6. Section 4.7 analyses the impact of US and UN sanctions on Libya. The final section provides a summary.

4.2 General Information on Libya

Libya (officially named the Socialist People's Libyan Arab Jamahiriya) is located in the north of Africa and is bounded by the Mediterranean Sea. To its north it borders Tunisia and Algeria to its west and Egypt and Sudan to its east. Its southern border meets Chad and the Niger Republic. The total land area of Libya is approximately 1,759,540 square kilometres and is considered to be the fourth largest country in Africa, but about 42% of the land is desert. Only 10% of the remaining 58% of the area is populated and the rest is a dry, barren, uninhabited region (Farley, 1971, p. 25). The population of Libya in 1911 was approximately 750,000. In 1942 it was about 500,000. This loss was due to death in war and to Allied and Axis campaigns. According to the 1973 census, Libya had a population of slightly more than two million. However, by 1993 it was estimated to have risen to more than four million (National Authority for Information and Documentation, 1994) and in 2001 it was 5,500,000. The population average growth

rate is 2.02%. The majority of the population live in or around the coastal cities, especially in Tripoli and Benghazi. Libya has a long coastline; it is around 1,900 km. However, the vast majority of the land of Libya is desert, as shown in the map below

Figure 4.1 Libya's Map
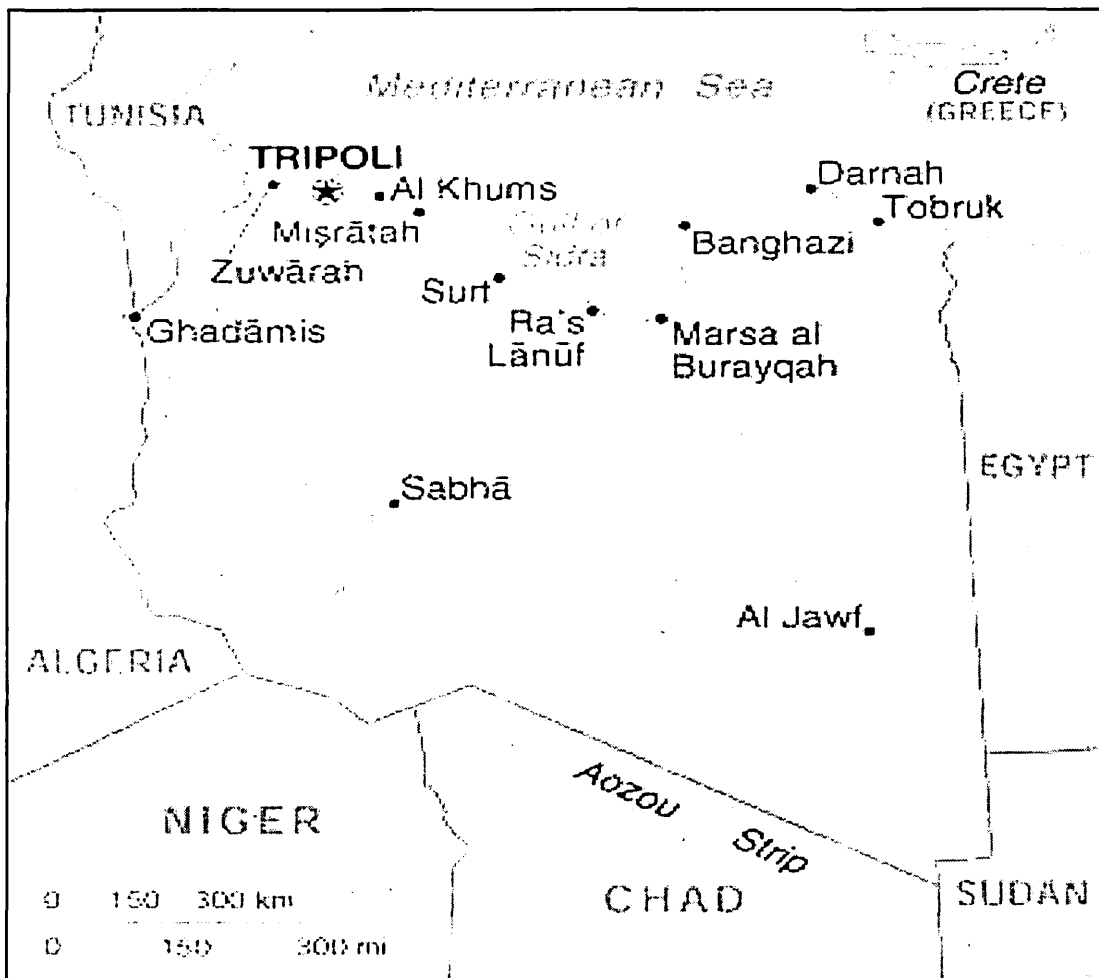
Source: Country Analysis Briefs (2005), Libya.

4.3 Political Environment.

As already mentioned, the year 1962 signalled a turning point in the history of Libya, clearly representing the dividing line between the oil and the pre-oil eras, because it was in this year that the first shipment of oil from the country took place . Since then Libya's economy has undergone, and is still undergoing, major structural changes. Change has taken place in all fields: economic and political considerations are the primary influence and the major determinants of the investment climate. A country's level of development, the state of the balance of payments, inflation rates and currency stability are very important factors in the investment climate. Infrastructure facilities, international transportation and communication networks are vital influences on the investment climate as well.

This section presents a brief description of the political background and reviews the Libyan economy through three main stages and considers the main changes in Libyan politics and economy. The first stage is the period before 1952, known as the colonial era, the second stage is the period between 1952 and 1969, known as the independence era, and the third stage covers the period 1969 to date, known as the revolution era.

4.3.1 The Period Before 1952 (the Colonial Era)

The Italian era started when Italian troops occupied Libya 1911 in after the collapse of the Ottoman Empire. There followed a period of warfare which damaged the Libyan economy. Living conditions were difficult because of the lack of infrastructure, poor health services, and education. The Libyan people continued to fight the Italians for more than twenty years until 1931, by which time Italy controlled most of the Libya.

During the Second World War, the country suffered once again. In 1943 Tripoli (the capital of Libya) fell under Allied administration, while many Italian citizens remained in Libya. However, the Libyan economy did not improve. The Libyan people during that time were generally involved in subsistence agriculture and were breeding animals as a source of living. The problems of poverty, lack of education and health services continued.

4.3.2 The Period between 1952 and 1969 (The Independence Era)

In 1949, the United Nations voted in favour of Libyan independent, and in 1951 Libya became independent as the United Kingdom of Libya. However, political independence was not accompanied by any sort of economic development. The Libyan people were not convinced that Libya had attained real independence and they used to call it "false independence" because Libyan people were still suffering from poverty and hard living conditions. In 1958 oil was discovered in Libya, bringing hope that this would help the Libyan economy flourish. Unfortunately, the domination of the west's oil companies over the exploration, production and export of oil meant that the discovery of oil did not bring any sort of improvement to the Libyan economy but preventing the Libyan people from enjoying the benefits of oil income.

In this period government did not undertake any significant efforts to improve Libyans' living standards or way of life, which remained much the same as during the era of Italian colonisation. The Libyan people continued to depend on subsistence agriculture and livestock as they had done before independence. Moreover, that era witnessed widespread corruption and bribery, favouritism and personal relations carried more

weight than rules and regulations. These problems and others had lage impact on the country's economy.

4.3.3 The Period after 1969 (Revolutionary Era)

On 1st September 1969, the era of the Al-fateh Revolution started (Anderson, 1987). Freeing the country from the domination of foreign countries, the Revolution's primary objectives were to improve the Libyan people's lives by returning to them the country's economic resources, such as oil and other natural resources, the industrial sector, the commercial sector and so on, and freeing them from the domination of western companies.

The Revolutionary regime issued a number of legislations concerning the exploration, production and exportation of oil and other economic activities. In the field of education, a number of schools, colleges, higher institutions, and universities established. As far as the health sector was concerned, the revolutionary regime built a number of hospitals, health centres, and dispensaries which covered all areas of the country. In the field of transportation, a good network of roads was established, connecting the country's cities and production areas.

Regarding the industrial sector, the revolution established a considerable number of factories in different fields such as food industries, petroleum industries, tractors, textile industries and some other industries needed for the Libyan economy. In addition, the government gave the Libyan people short and long-term loans to build their own homes and to improve their standard of living. On 2nd March 1977, the revolution declared that

the Republic of Libya would henceforth be known as the "Socialist People's Libyan Arab Jamahiriya". This marked a significant change in Libya's politics.

Unfortunately, in 1982 and 1986, the United States of America imposed economic sanctions on Libya, which prohibited U.S companies or citizens from engaging in any unauthorised financial transactions with Libya. These sanctions included the export and import of all goods to or from Libya. Also, the sanctions forbade any sort of exchange of services or technology between Libya and the U.S.A. In 1992, the United Nations imposed economic sanctions, claiming that Libya was involved in terrorist actions against western countries. These economic sanctions badly affected the Libyan economy.

Libya suffered greatly from those sanctions for more than fifteen years, and they still affected the daily lives of the people. For example, the people had difficulty meeting their health, education and transport needs. The detrimental effects of these sanctions can be clearly seen in economic indicators. GDP declined from 82.2 billion U. S. Dollars in 1980 to 34.5 in 1995, and per-capita income declined as well, from 29.800 in 1980 to 6.570 in 1995.

In 1997, Libya introduced significant economic legislation. The most important law is the law No. 5 of 1997 concerning encouragement of foreign investors to invest in Libya. Also, the government adopted a policy which gave the private sector more opportunities to establish share companies. In 1999, the UN lifted the economic sanctions on Libya which returned Libya to the international stage. In addition, the rise in the price of oil in the last five years has enabled Libya to improve its economy, resulting in its GDP

growing by 2% in 2000, from 34.5 billion U. S. Dollars in 1995 to 45.5 billion U. S. Dollars in 2000.

In recent years, the ruling regime has paid great attention to the oil sector. Libya's oil industry is run by the state-owned National Oil Corporation (NOC), along with smaller subsidiary companies. Several international oil companies are engaged in exploration/production agreements with the NOC. The leading foreign oil producer in Libya is Italy's Agip-ENI, which has been operating in the country since 1959. Two U.S. oil companies (Exxon and Mobil) withdrew from Libya in 1982, following a U.S. trade embargo which begun in 1981. Five other U.S. companies (Amarada Hess, Conoco, Grace Petroleum, Marathon, and Occidental) remained active in Libya until 1986 when President Reagan ordered them all to cease activities there. In December 1999, U.S. oil company executives from these five companies (except for Grace) travelled to Libya, with U.S. government approval, to visit their old oil facilities in the country.

4.4 Development Plans for the Libyan Economy

Since independence, a number of development plans have been introduced in order to build up the national economy by: (1) reducing the economic dependence on the oil industry in favour of agriculture and manufacturing sectors, (2) achieving a greater degree of self-sufficiency in a wide range of agricultural and industrial products, and (3) building industries based on oil and natural gas and minimising foreign manpower in favour of national manpower (Gzema, 1999).

4.4.1 The first Five Year Development Plan 1963-1968

During this period Libya had its first five-year economic and social development plan (1963-1968). The plan was drafted in 1963 and represented the beginning of Libya's formal development planning attempt. The objectives of the first five-year plan (1963-1968) were;

- To ensure the early improvement of the standard of living of the people.

- To give special consideration to the agricultural sector: this being the source of supply of most of essential consumer goods, besides being the source of income and employment for the majority of the people.

- To permit the public sector to continue its investments in such services as Education, Health, Communication and Housing and with other sectors as required consolidating the basic elements for rapid economic growth.

- To develop rural areas by establishing productive and public projects.

- To take such monetary, financial and commercial measures all in a co-ordinated effort, as may be necessary to ensure increased revenue and to enforce tight control on expenditure.

- To take steps to overcome the need for information and statistical data which are necessary for planning by strengthening the existing statistical organs and by carrying out studies and research work

Figure 4.2 shows the planned and real development spending of the economic

sectors for the first five year plan[2]. Analyses of the data in this table yield the

following information: the plan spent only 12.9% of the total expenditure on directly

productive sectors like agriculture, industry and trade (Ministry of Planning, 1964).

The main results of the plan were apparent in expanded, infrastructure, road

construction, schools, and hospitals construction and an increase in electrical power.

The performance of agriculture and industry was much reduced at 1962-1967. The

average annual growth rate of the agricultural and industrial sectors was only 4.5%

and 9.6% respectively.

Figure 4.2 Development Plan 1963-1968
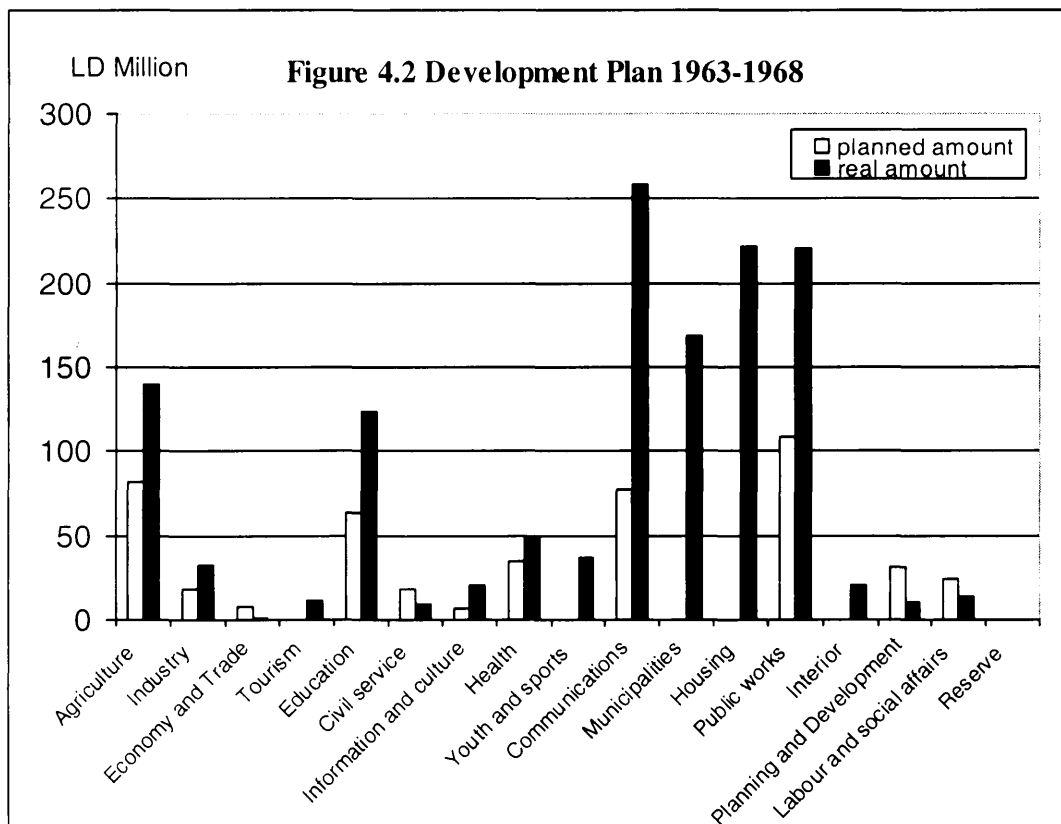
Source: Plotted by the author based on data provided by Table 4.1

[2]- See Table 4.1 in appendix 1

4.4.2 The Second Five-Year Development Plan 1969-1974

The second Five-Year development Plan 1969-1974 was designed to allocate more than three times the actual expenditure of the first five-year plan for the period from April 1969 to March 1974. This plan provided continuity with the first plan in the fields of transportation, agriculture, public services and housing. In addition, it provided for an industrialisation programme with emphasis on petroleum refining and light industries.

However, this plan was abandoned because with the advent of the new revolutionary government in 1969 (Elmaihud, 1981) and was replaced by annual development plans until 1973. During the period 1970-1972, the state spent 791^3 million LD on economic and social development. The highest amount was allocated to housing (30.5% of actual expenditure 241 million), then the agricultural sector and industrial sector (17.1% and 13.8% respectively 135.1, and 109.1 million LD). From 1973 to 1985 the State approved and implemented three economic and social development plans (1973-1975 plan, 1976-1980 plans and 1981-1985 plans). However, from 1985 until now, there were many attempts to prepare development plans but some of were not implemented.

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[3] The currency unit in Libya is the Libyan Dinar (LD) and the average exchange rates between the LD and the USA Dollar($) during the 1962-2005 period ranged from $ 0.357 to $ 1.305 (see Appendix 1 Table 4.2)

4.4.3 The Third Three-Year Economic and Social Development Plan (1973-1975)

The third three-year economic and social development plan 1973-1975 had a development budget of about, 2.6 billion L.D (Libyan Ministry of Planning, 1973).

Figure 4.3 shows the planned and real development spending of the economic sectors for the third year plan[1]

Figure 4.3 Development Plans 1973-1975
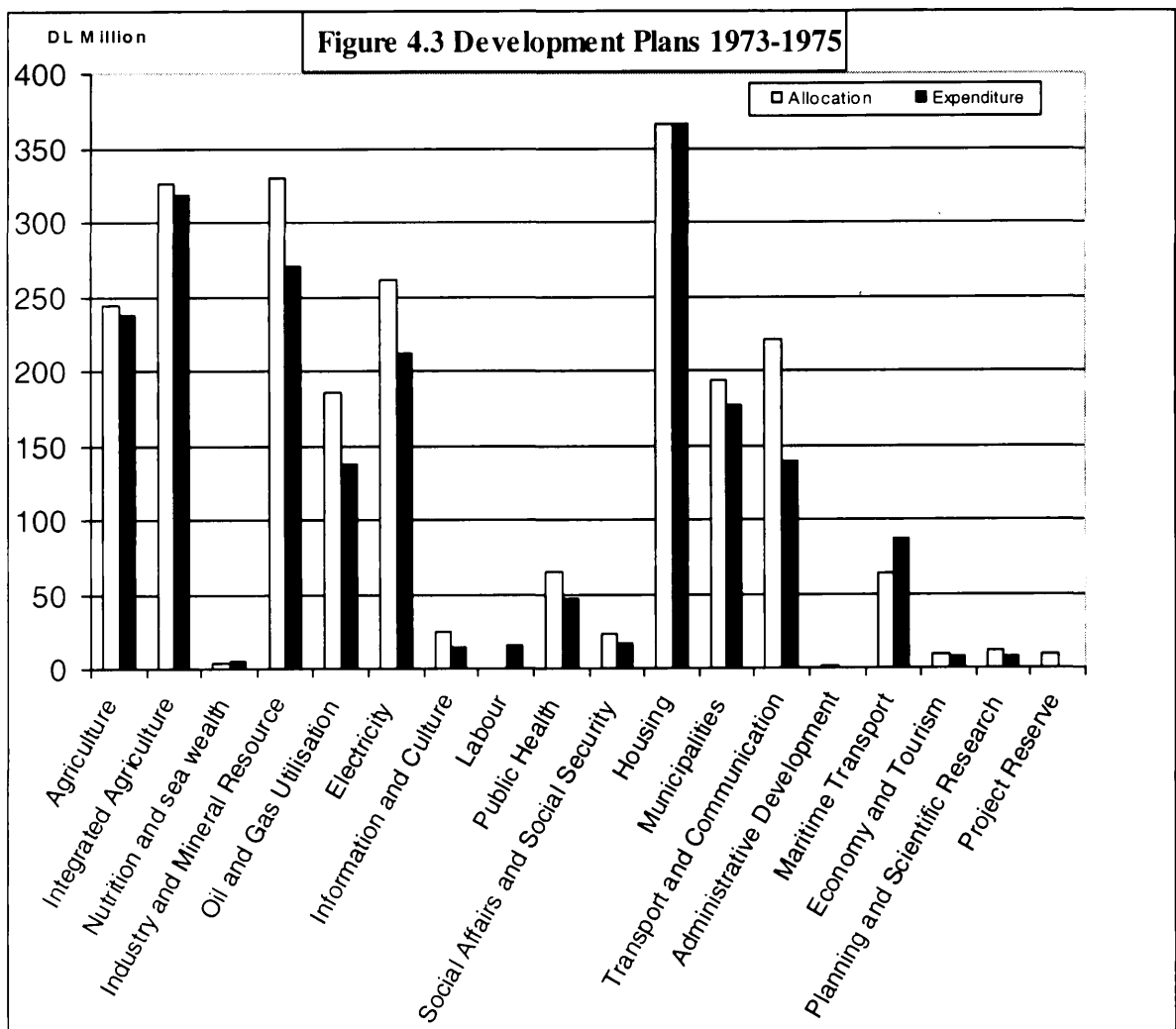
Source: Plotted by the author based on data provided by Table 4.3

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[1] For more information see Table 4.3 in appendix 1

The actual spending amounted to LD 2.2 billion. The main targets of the three year plan 1973-1975 were as follows (Saleh, 2001):

- Decrease the country's dependence on oil.

- Diversify the economy by accelerating the rate of growth of crude oil production

- Increase per capita income from 638.6 million L.D in 1973, to 749.9 million L.D by the end of 1975.

- Raise gross national income at an annual compound rate of 10.4%.

- Raise total employment in the economy from 557.000 in 1972, to 682,900 by the end of 1975.

- Increase the output of the agricultural sector at an annual rate of 14.5%, and the output of the industrial sector by 24.5%.

The best results of the three year plan 1973-1975 were in the sectors of agriculture, manufacturing and construction. Gross Domestic Product (GDP) increased from, 2182.7 million LD in 1973 to, 3674.3 million LD in 1975 at an annual average rate of 31.7%. At the same time as the agricultural sector grew from 60.0 million LD in 1973 to 82.9 million LD in 1975, an annual average of 24.5%. The manufacturing sector also increased from 43.8 million LD in 1973, to 65.5 million LD in 1975 an annual average rate of 27.2%. Also, the Oil and Gas sector grew from 1143.8 million LD in 1973 to 1981.8 million L.D in 1975.

4.4.4 The Fourth Five-Year Development Plan (1975-1980)

This plan was provided with a total planned expenditure of 7.6 billion[5] LD. Table 4.4 shows the breakdown of major allocation by sector and the real expenditure during the period. All the allocations and real expenditure for this period are depicted in Figure 4.4 below.

Figure 4.4 Development Plans 1975-1980
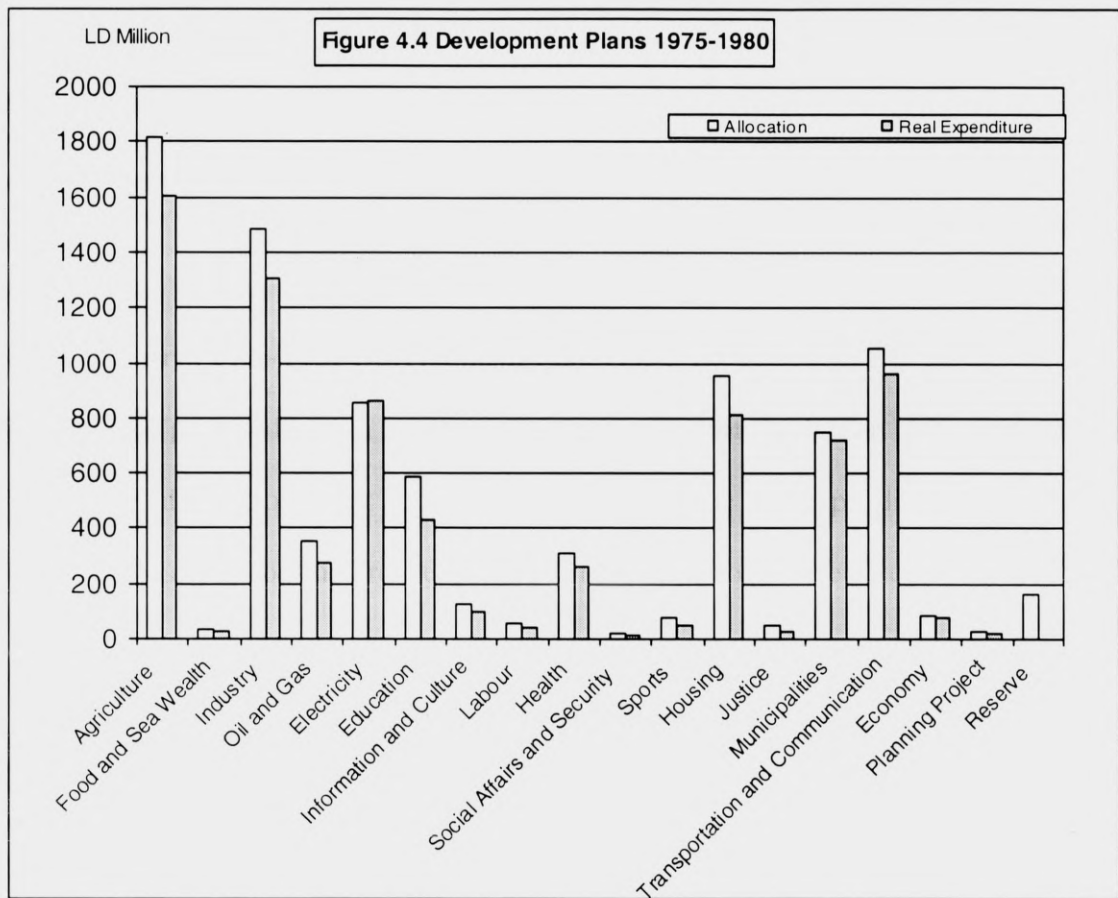
Source: Plotted by the author based on data provided by Table (4.4)

The main objectives of this plan are summarised as follows:

- To raise the total production in all sectors.

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[5] -For more information see Table 4.4 in appendix 1

- To increase the private final consumption at a planned annual compound rate of 9.4%. Public final consumption was planned to grow at an annual compound rate of 9.6%.

- The per capital income was planned to increase from 1678.9 L.D in 1976 to 1939.7 L.D in 1980.

This plan is considered a continuation of the development policies underlying the previous three-year plan. In total, the plan aims at attaining self-sufficiency at least in food products, reducing inequality of incomes and wealth and developing the country's limited manpower through expanding training programmes and improving the Libyan educational system (Libyan Ministry of Planning, 1976). This plan was later revised with more investment going to agriculture rather than industry (Wright, 1981)

4.4.5 The Five-Year Development Plan 1981-1985

In 1981, the 1981-1985 economic and social transformation plan was allocated total funds of 17.000 million LD to different sectors. The highest allocation of 23.1% of plan went to industry, 16.1% to heavy industry, and 7.0% to light industry. Agriculture came second with an allocation of 18.2%. A low oil price caused serious shortages of funds and required a major modification of the 1981-1985 development plan[6] (Abuarrosh, 1996). Consequently, development spending declined since the mid-1980s, with only priority projects such as the Great Man-made River[7] (GMR) continuing to attract funds

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[6] -See Table 4.5 socio-economic plan 1981-1985 in appendix 1

[7]- The GMR is a water supply project aimed at transporting water from the deserts of southern Libya to the northern coast, using about 3,380 km network of pipelines; the total cost is estimated at around $25 billion. For more details see http://www.water-technlogy.net/gmr/gmr

and remaining relatively free of the payment delays experienced by other sectors (Arab Oil Gas Directory, 1996). The main objectives of this plan were as follows:

- Continuation of investments in economic infrastructure.

- Plan emphasis on industrialisation following an extension of advanced production techniques in other fields of economic activity.

- To decrease dependence on foreign countries in meeting basic requirements by increasing the rate of agricultural growth and achieving food stuffs sufficient.

- Creating more equitable income distribution by providing employment, extending social and welfare services and expanding local development programmes, especially in rural areas.

- Diversifying the exportation of goods, expanding existing foreign markets, and penetrating new foreign markets.

- Improving administrative services by introducing basic changes in the administrative system and extending advanced managerial techniques to all ministries and to public as well as private organisations.

4.4.6 Development plans from 1986-1993

No formal long-term plan existed at 1986-1993, but a three-year economic plan covering the period 1994-1996 was initiated. This plan aimed to:

- settle the outstanding debts of former development plans

- complete on-going projects (chiefly in the health, education, public utilities and energy sectors)

- encourage investment in industrial production (whether through public finance or the regeneration of the private sectors)

- Postpone all projects which had not yet started (Ministry of Planning, Trade and Treasury, 1993).

The government's planned investment in the three-year programme was 2400 million LD but, due to a shortage of funds, actual expenditure was only 1451 million LD. The relatively low oil prices existing in the mid 1990s coupled with the impact of UN sanctions in place since 1992 had a severe effect on the actual amounts invested in comparison with original allocations (Ministry of Planning, 1998) which continued macroeconomic difficulties in the country.

4.4.7 Development plans from 1994-2005

At the beginning of 1994, the state launched a three-year programme covering the period 1994-1996. The programme's main goals were: settling the debts of previous development projects; completion of existing projects, especially in health, education, public utilities and energy sectors; encouraging investment in production sectors, especially industry, whether through the public or re-emerging private sectors and stopping all projects that had not yet started (Secretariat of Planning, Trade and Treasury, 1993). However, this programme was abandoned with only a few of its goals achieved[8]. The total amount allocated to the 1994-1996 period was 2,400 million LD of

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[8] - See Table 4.6 Three year Programme 1994-1996 in appendix 1

which only 1,450.556 million LD, or 60.44% of the total allocation, were actually invested (Ministry of Planning, Economy and Trade, 1997).

Increasing the role of the private sector in the Libyan economy and the focus on improving the economic performance became one of the economic policy priorities from the early 1990s. These priorities are evidenced in several areas of the five-year social and economic plan 2001-2005. In 1999, the state started to prepare a five-year economic and social transformation plan for 2001-2005, which was later adjusted to become the 2002-2006 economic and social transformation plans.

This plan was for 36 billion LD, with oil resources contributing 43% of the total, and the contribution of the foreign and national domestic sectors was estimated at 57% of the total (Al-Zini, 2002). The difference between this plan and previous plans is that the latest one apportions a very important role for the national and foreign private sector in financing and implementing the productive and service enterprises, while the state assumes its role of financing and implementing the infrastructure and service projects. The approval and implementation of this plan was delayed for several reasons, the most important being the high level of liabilities of previous development plans, the size of the plan's expenditure and the international and domestic economic developments that the national economy faced (Al-Zini, 2002).

In order to place the role and effect of the development plans in context, it is necessary to understand the general nature of the Libyan budgetary system and so the next section addresses this issue.

4.5 The State's Budget

In the literature there are five different views of defining the government sector in the form of five questions; (A) what resources does the government use? (B) How much does the government spend? (C) What does the government own? (D) What does the government control? And (E) what does the government produce?

The impact of government expenditure depends not just on the size of the public sector, but also on its activities. A large public sector may be helpful to growth if the activities are in the areas of the economy where the market is weak (Gemmel, 1993). Therefore, government expenditure is the main instrument used by the government to affect the Libyan economy. However, oil revenue has been the main source of government finance. Given fluctuations in oil revenue, we would expect to see significant impact on government expenditure and economy performance

The structure of government budget revenue has been classified into four groups: (1) Budget allocation from oil exports, (2) allocation from direct and indirect tax revenue, (3) budget allocation from customs revenue, and (4) other revenue. The discovery and export of oil had a great impact on the government's budget. Libyan budget expenditure is divided into two main parts which are an administrative budget and a development budget.

The administrative budget formulates the revenue and expenditure plans of the ministries as well as any transfers to municipalities and public enterprises. Primary proposals for the administrative budget originate at municipal level, after which the proposals are forwarded to the appropriate ministry for merger and later submitted to the

Finance Ministry, which in turn reviews and forwards the proposals to the GPC[9] for final approval (Morales, 1989, Saleh, 1989). The development budget sets out an annual project expenditure programme. This programme is sometimes set within a framework of a three-year plan (e.g., the 1973-1975 development plans and the 1994-1996 programme) or five year plan (e.g., the 1981-1985 Economic and Social Transformation Plan).

The development budget is initially prepared by corporations seeking to undertake specific projects, with all proposals then being sent to the Secretary of Finance and the Ministry of Economy and Planning for revisions and submission to the GPC. However, the Secretary has the authority to either approve or modify organisations, and companies' budgets if considered appropriate.

Foreign exchange in Libya is strictly controlled by the State through the Central Bank of Libya. As a result of decreases in foreign exchange revenues, the Ministry of Industry does not usually approve companies' budgets without recommending reductions. Consequently, many companies inflate their initial estimates in order to allow for the expected modifications (Kilani, 1998). Oil price changes also have a major influence on the Libyan government's actual expenditure on both the administrative and development budget. Periods of high oil prices increase government revenues (leading to an increase in investment), while periods of low oil prices usually lead to a reduction in the number of projects and investment.

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[9] GPC = General People's Congress.

4.6 Gross Domestic Product (GDP)

This section discusses the growth of GDP, in both oil and non-oil sectors, in the Libyan economy before the discovery of oil and after it discovery during the period from 1962 to 2006.

4.6.1 First Period 1962-1972

The growth of GDP in the Libyan economy from the oil sector and non-oil sectors, are depicted in Figure (4.5). In addition[10] Table 4.7 presents the growth rate of real GDP during the period 1962-1972. During this period GDP increased from 155.5 million LD in 1962 to 1,223 million LD in 1969.

Total GDP in this period was 4,925 million LD. The GDP of the non-oil sector increased from 117.5 million LD in 1962 to 468.3 million LD by the end of this period. But, as a percentage of GDP, it has been decreasing from 75.6 per cent in 1962, to 38.3 per cent in 1969. Also, the GDP of the oil sector grew from 38 million LD in 1962 to 754.7 in 1969. On the other hand, the oil sector's contribution to GDP increased from 24.4 per cent in 1962 to approximately 61.7 per cent by the end of period (African Development Bank, 1995, p.108).

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[10] - See Table 4.7 in appendix 1

Figure 4.5 Gross Domestic Product (GDP)
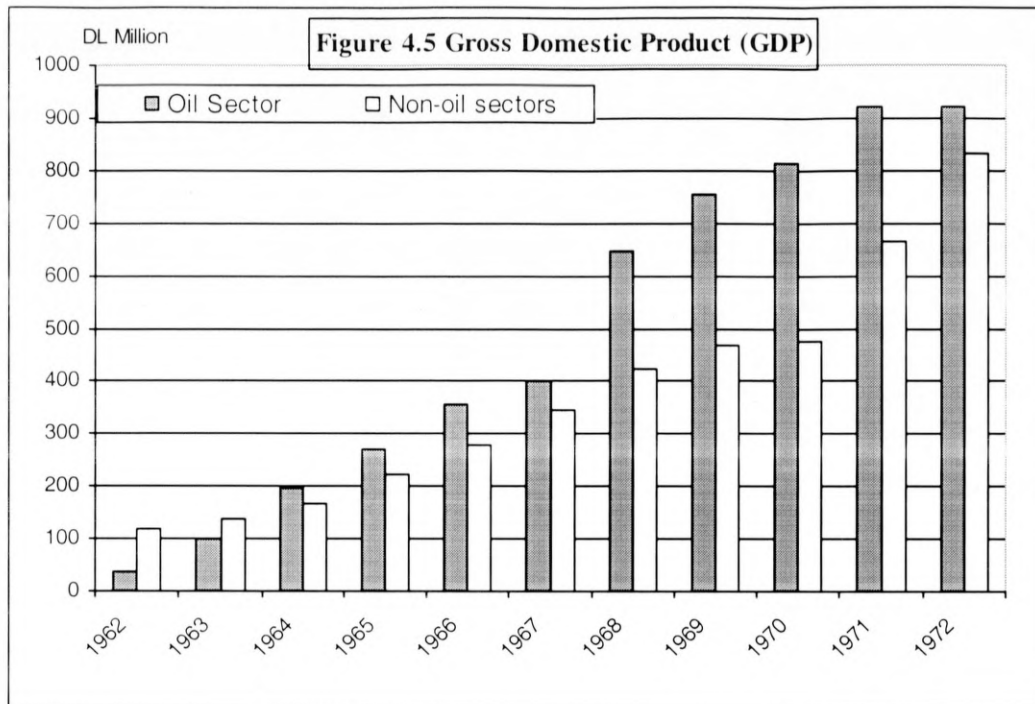
Source: plotted by the author based on data provided by Table 4.7

The conspicuous thing during this period was that, the relationship between the oil and non-oil economic sectors and their contribution to the GDP changed steadily in support of the oil sector.

4.6.2 Second Period 1973-1983

Since 1970, the Libyan economy has witnessed steady and systematic changes. These changes were aimed at reforming the economy from a market to a socialist economy. It is natural that behavioural and institutional changes should follow the structural changes in the economy (Abdussalam, A.1985). Table 4.8 shows the changes in real growth of GDP[11]. This period witnessed a significant investment in all sectors of the Libyan

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[11] - For more details see Table 4.8 in appendix 1

economy, about 21,946 million LD. The total GDP for this period was 7,852.1 million LD.

The oil sector represented 44.57 percent (3,500.4 LD) of GDP and the non-oil sector 4,351.7 million LD (55.43 percent). Moreover, during this period, the average per capita income increased from 656 LD to 2,169 LD. Also, this period witnessed big increases in international crude oil prices which significantly increased GDP at current prices and the average monetary income per capita. GDP per capita increased from 1,288.3 million LD in 1970 to 10,553.8 in 1980 (Libyan Secretariat of Economic and Planning, 1991). In addition, the value of the oil sector and non-oil sectors in GDP during the period 1973-1983, are described in Figure 4.6 below

Figure 4.6 Gross Domestic Product (GDP)
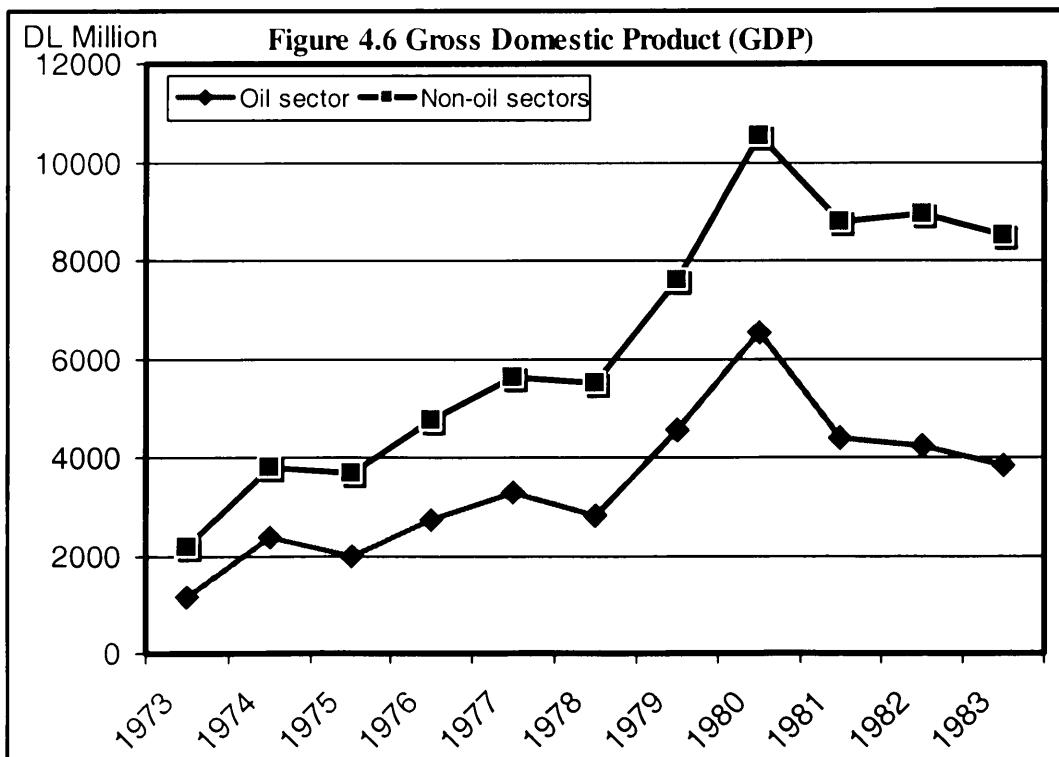
Source: plotted by the author based on data provided by Table 4.8

4.6.3 Third Period 1984-2004

The second period saw witnessed changes in the structure of the Libyan economy. These changes helped the non-oil sector as well as per capita income (Kilani, 1988). Furthermore, these figures confirm that changes in international crude oil prices significantly affected GDP, reflecting the fact that GDP still depended heavily on the oil sector (Bakar, 1998).

This period shows that the oil sector dominates the economy, this sector contributed around 90% of the country's export earnings. Total GDP in the period from 1986 to 2002 was 177,481.2 million LD [12] with a noticeable change in the structure of GDP. Approximately 32 per cent was contributed by the oil sector and 68 per cent by the non-oil which represented a significant development for the Libyan economy. During the period, the number of small private businesses increased, to a total of 5,000 production units (Abobker, 2005).

The relationship between the oil and non-oil economic sectors changed compared to the period (1986-2002). GDP grew by 22.4 percent in 2003 compared with 2002, with the oil sector contributing about 60 percent of total GDP. Whereas, in 2004 the contribution of the oil sector was 64.4 percent, 25958 million LD, and GDP was estimated at 40.307 million LD with a growth rate of about 27 percent compared on 2003, Figure 4.7 below shows the annual contribution of the oil sector and non-oil sectors to GDP.

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[12] - See Tables 4.9 and 4.10 in appendix 1

Figure 4.7 Gross Domestic Product (GDP)
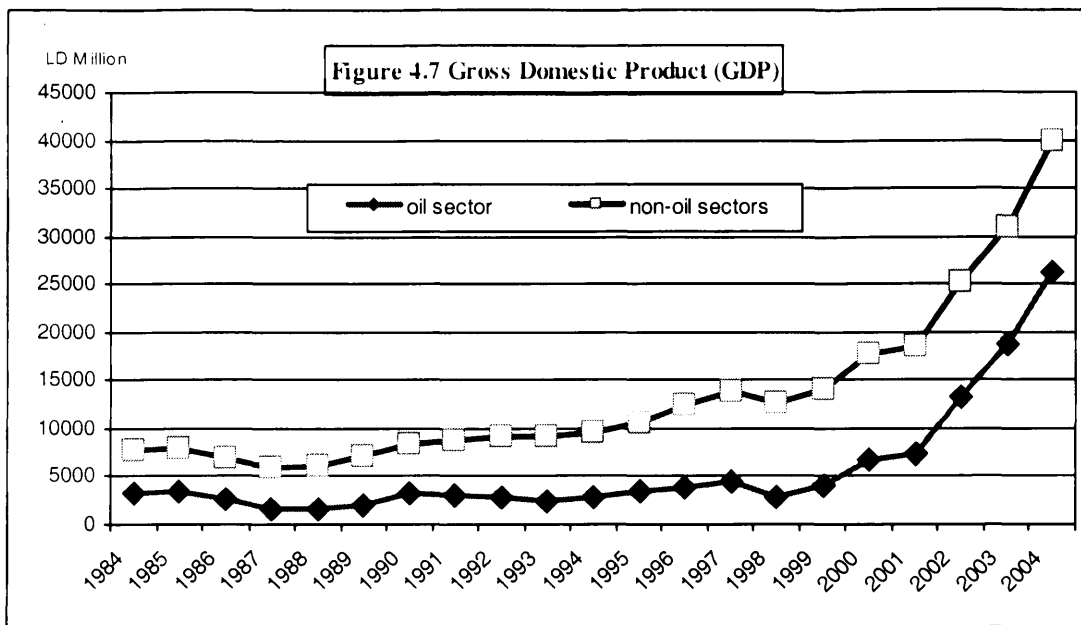
Source: plotted by the author based on data provided by Tables (4.9 and 4.10)

4.7 The Influence of the US and UN Sanctions on Libya

Libya has been subject to a wide range of US and UN sanctions since 1986. The Libyan economy has suffered from these sanctions, especially those imposed by the UN, which were imposed following the Lockerbie bombing in 1988. These sanctions included an air and arms sales embargo, a reduction in the number of Libyan diplomatic personnel serving abroad, the freezing of Libyan funds and financial resources in other countries, and banning of the provision to Libya of equipment for oil refining and transportation.

The US sanctions have been in force since 1985 in response to claims that Libya involved in international terrorism against the United States, other countries and innocent people. The US prohibited almost any kind of transaction. These sanctions

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remain most relevant for US companies and make the return of them to Libya almost impossible. The prohibitions are very wide and cover:

- Exports and Imports to and from Libya.

- Travel restrictions.

- Financing by banks, including foreign branches of the US banks.

- Any contracts, loans or transactions with Libyan entities, or which benefit Libyan entities directly or indirectly.

On August 5th 1996, the US imposed additional sanctions on Libya as part of the Iran-Libya Sanctions act extending the measures to cover foreign companies making new investments of \$40 million or more over a 12-month period in Libya's oil and gas sector. The wide range of US and UN sanctions influenced the health and other aspects of the Libyan people's lives. The growth of the Libyan economy had deteriorated, the number of foreign investments had dramatically decreased and the ability to obtain new manufacturing technologies had been restricted. (Abuseid Dourda)[13] on March 8th 2000, reported that Libyan companies suffered considerable losses as a direct consequence of the UN sanctions.

For instance, Libyan companies operating in the transportation sector suffered total losses of about \$3,713 million, which has forced the closure of a large number of branches and a reduction in the labour force.

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[13] Abuzeid Dourda is the permanent representative of Libya on the United Nations.

The manufacturing sector has also made losses estimated at about $5,851 million, while the losses of the trade and commercial sector have been estimated at about $8,628 million (cited in Alkizza, 2006).

These sanctions cost Libya approximately $34 billion, and caused substantial damage in the humanitarian, economic and social spheres. In addition, all infrastructure development programmes and plans were adversely affected, thereby affecting Libyan's ability to achieve progress, well-being, development, stability, security and peace[14]. The UN secretary council suspended the sanctions against Libya in April 1999 after the Libyan government handed over on trial a special court. Eventually the Court found one of the two suspects guilty. On the 30th of June 1999, the UN Secretary General rendered his report, and on the 9th of July 1999, the secretary Council welcomed Libya's satisfying progress in complying with the UN resolution, but did not formally lift the sanctions (Wallace and Wilknson, 2004).

In 2003, Libya agreed to pay compensation to the victims. Consequently, UN sanctions were completely lifted. On 23rd of April 2004, most of the US sanctions against Libya were lifted and on September of the same year, President Bush lifted the US sanctions, removed all restrictions on commercial air services to Libya and released $1.3 billion in frozen Libyan assets.

With the lifting of sanctions, the Libyan government announced plans to attract foreign investment, especially in its oil and gas exploration and production, and was seeking

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[14] Extracts from the report on the impact of the UN sanctions against Libya which were transmitted by the Libyan mission to the UN Security Council in March 2000.

financing of critical infrastructure improvements in its national highways, railroads, telecommunications networks, and irrigation systems.

4.8 Summary

To sum up, this chapter has discussed the economic performance of the Libyan economy over the period 1962-2005. Libya is a developing country, and it will stay so for some time. It has been established that despite the ambitious development investment in the country, the main objectives of diversifying the economy and accelerating the growth rates of the non-oil sectors.

Furthermore, this chapter began with the summary of the general information on Libya. The discussion then moved to explore the political background before, and especially after, the 1969 revolution when significant changes that took place through the introduction of a new political and economic system, based on socialist philosophy. This new socialist philosophy has affected the economy in terms of the ownership of economic activities and in the way that planning which still depends heavily on the oil revenues.

The State's development plans after the revolution were directed towards reducing the dependency on oil revenues by developing the agricultural and industrial sectors, in order to achieve self-sufficiency in food production. Also, this chapter has given some information of the effects of the UN sanctions on the Libyan economy. The next chapter focuses on the methodology that will be followed in testing Wagner's law in this research project.

CHAPTER FIVE

Methodology and Data

5.1 Introduction

We have mentioned in Chapter One that the present study will adopt a Granger-causality test to examine the causal relationship between various measures of government expenditure and economic growth. The hypothesis tested in this study is Wagner's theory or Wagner's hypothesis. The hypothesis is that the causality runs from gross domestic product (GDP) to the total governmental expenditure (TGX), or in other words, the ratio of total government expenditure to GDP (TGX/GDP) would rise as GDP rises. In other words, an increase in economic activities causes an increase in government activities, which in turn increase public expenditure. Wagner recognized that there is a positive relationship between economic growth and the growth of government activities and thus government expenditure.

Within the framework of Granger-causality analysis, Ram (1989) maintains that the "growth of government is a natural consequence of economic development and that economic development causes a secular enlargement of the public sector". Mehra (1994) tests for Granger-causality using a three-step procedure: testing for the stationarity in the time series, the cointegration test and the Granger-causality test. This chapter is divided into six sections. The following section gives a brief review of the econometric methodologies. Section 5.3 focuses on Wagner's hypothesis with the six versions of this hypothesis using real GDP and non-oil GDP in Libya. Section 5.4 gives some details on data sources and description.

Section 5.5 details the computer software programs and econometric techniques used in the analysis. Section 5.6 provides a summary.

5.2 An Overview

Past studies of government expenditure effectiveness were mostly based on time series data and cross-section data; only a few studies used time series data from individual countries. It is generally believed that single country time's series analysis is more useful. Note though that time-series data may produce spurious relations if the variables under study are linked to common factors. If the variables follow a time trend (that is, their means and variances are not constant over time), they are said to be nonstationary. Two nonstationary variables may be found to be related, while in fact they are not, simply because of the common nature of their time trends. Thus, according to Engle and Granger (1987), the direct application of ordinary least squares or generalised least squares to nonstationary data produces regression results that are misspecified or spurious in nature. These regressions tend to produce performance statistics that are inflated, such as high R^2, F and t-statistics, which often lead researchers to commit Type I errors (Granger and Newbold, 1974)[1]. It is therefore important to test the nature of the time series data. Most macroeconomic time series data are found to be nonstationary or integrated of order 1, denoted by I(1). That is, they can be made stationary by differencing the series once[2]. Earlier researchers who performed single-country analysis used the first difference of the time-series data to avoid spurious regression.

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[1] Type I error means the null hypothesis is rejected when it should not have been.
[2] If a time-series has to be differenced d times, it is integrated of order d or I(d). If d = 0, the resulting I(0) process represents a stationary time series.

However, this creates the problem of losing long-run information on the variables. To deal with this, researchers are increasingly using cointegration and the error correction mechanism (ECM) to estimate time series relationships between GDP growth and government expenditure. In general a linear combination of I(1) series is integrated of order 1. However, there exists a special case where the linear combination of I(1) can be I(0) or stationary. In that case, the series are said to be cointegrated.

It must also be remembered that the effect of government expenditure on economic growth in any one year is likely to be lagged and longer term. So, it is important to search for long-run relationships between GDP growth and whatever the mechanism by which the government expenditure exerts its influence on economic performance. Cointegration allows us to test for the presence of a non-spurious long-run equilibrium relationship between the variables under study in a multivariate setting with and without a time trend. Both cointegration and the error correction mechanism investigate long-run linkages.

Our empirical estimation is composed of four steps. As a prerequisite, we first test the stationarity of the time-series data, that is, we test for the presence of a unit root or I(1) for each variable. Second, we test long-run for the cointegration vectors in the model. Third, we estimate and test short-run using the error correction model (ECM). Finally, we use Granger causality tests. In this chapter, we explain each of these in greater detail.

5.3 Interpretation of Wagner's Hypothesis.

This study investigates and examines the latest versions of Wagner's hypothesis to search for the statistical existence of long-run causality from gross domestic product (GDP) to the share of total government expenditure (TGX) in GDP. To do so, this study will use data for Libya over the period of the data available from 1962 to 2005.

The main contribution of Wagner's hypothesis in this field was that he tried to establish generalizations about government expenditure, not from postulates about the logic of choice, but rather by direct deduction from historical evidence. Wagner's hypothesis has become very popular in academic circles after the publication of English translations of Wagner's works in 1958. It has been analysed and tested by many researchers, for example, Peacock- Wiseman (1967), Gupta (1967), Goffman (1968), Pryor (1969), Musgrave (1969), Mann (1980), Ansari et al (1997), Chletsos and Kollias (1997), Halicioglu (2003), and Florio and Caulatti (2003). Some of these researchers have applied traditional regression analysis, while some others have used causality testing, and more recently co-integration analysis has appeared in the literature. Empirical tests of Wagner's hypothesis have yielded results that differ considerably from country to country and period to period.

There are at least six versions of this hypothesis, which have been empirically investigated. As Henrekson (1992) points out, a test of Wagner's hypothesis should focus on the time series behaviour of public expenditure in a country for as long a time period as possible. Therefore, this study examines whether there is a

long-run relationship between government expenditure and GDP or per capita GDP, along the lines suggested by Wagner's hypothesis, for Libya.

As the study mentioned above, there are at least six version of Wagner's hypothesis. So this study needed to test all six versions of Wagner's hypothesis in the period that is available for Libya. Finally, this study will use Ordinary Least-Squares (OLS) estimation to obtain the estimates of different coefficients.

5.3.1 The Six Versions of Wagner's Hypothesis

This study uses the six different versions of Wagner's hypothesis which are summarized by Mann (1980), and Florio and Caulatti (2003). These interpretations of Wagner's hypothesis came into view as six different versions. During this study, we separated each version of Wagner's hypothesis to observe real GDP (General GDP all sectors) and to observe non-oil based GDP.

5.3.1.1 The Six Versions of Wagner's Hypothesis with Real GDP

In this section, the study tests six versions of Wagner's hypothesis for estimating the relationship between (GDP) growth and government expenditure for Libya, during the period 1962 to 2005. The equations the study will use are shown in Table 5.1.

Table 5.1 Six Versions of Wagner's Law with Real GDP

equation	Functional form	Version
5.1	$\ln TGX = a + b \ln(GDP)$	Peacock-Wiseman [1967]
5.2	$\ln TGXC = a + b \ln(GDP)$	Pryor [1968]
5.3	$\ln TGX = a + b \ln(GDP/POP)$	Goffman [1968]
5.4	$\ln(TGX/GDP = a + b \ln(GDP/POP))$	Musgrave [1969]
5.5	$\ln(TGX/POP) = a + b \ln(GDP/POP)$	Gupta [1967]
5.6	$\ln(TGX/GDP) = a + b \ln(GDP)$	Mann [1980

- The symbol "ln" denotes the natural logarithm,

- "GDP" stands for Real Gross Domestic Product,

- "TGX" stands for Real Total Government Expenditure,

- "TGXC" stands for Real Total Government Expenditure on Consumption,

- "GDP/POP" stands for per capita GDP,

- "TGX/POP" stands for per capita TGX,

- "TGX/GDP" stands for the Share of Real Total Government Expenditure in Real Gross Domestic Product,

- "POP" stands for Population.

For the above six versions, based on Wagner's reasoning, causality in our tests is a hypothesis of contrasting/comparing total real GDP or per capita GDP is the independent variable, which is compared to four dependent variables; TGX, TGXC, TGX/GDP, and per capita TGX.

5.3.1.2 The Six Versions of Wagner's Hypothesis with Real Non-Oil GDP

The six versions of Wagner's hypothesis are used in this section to estimate the relationship between the non-oil GDP growth and government expenditure. The following table details the equations that will be used:

Table 5.2 Six Versions of Wagner's Law with Real non-oil GDP

equation	Functional form	Version
5.7	$\ln TGX = \alpha + \beta \ln$ (nonoil GDP)	Peacock-Wiseman 1967
5.8	$\ln TGXC = \alpha + \beta \ln$ (nonoil GDP)	Pryor [1968]
5.9	$\ln TGX = \alpha + \beta \ln$ (nonoil GDP/POP)	Goffman [1968]
5.10	$\ln(TGX/nonoilGDP) = \alpha + \beta \ln(nonoil GDP/POP)$	Musgrave [1969]
5.11	$\ln(TGX/POP) = \alpha + \beta \ln$ (nonoil GDP/POP)	Gupta [1967
5.12	$\ln(TGX/nonoilGDP) = \alpha + \beta \ln$ (nonoil GDP)	Mann [1980

- The symbol "ln" before a variable denotes its natural logarithm,

- " non-oil GDP" stands for Real Non-Oil Gross Domestic Product,

- " non-oil GDP/POP" stands for per capita Non-Oil GDP,

- TGX/ non-oil GDP" stands for the Share of Real Total Government Expenditure in Real Non-Oil Gross Domestic Product.

For the above six versions, causality in our tests is hypothesised to run from non-oil GDP or per capita GDP to the dependent variables, which take four forms TGX, TGXC, TGX/non-Oil GDP, and per capita TGX.

5.4 Data Sources.

The study covers the time period for which the data is available for Libya from 1962-2005. Therefore, this research uses data from the international sources whenever they are not available by the national sources. The study will use annual data; because only annual data is available that covers this period. The year 1962 is considered as the initial year because the year 1962 is the first complete year of oil exports, and secondly, it is the starting year of the systematic national accounts in Libya (Zarmouh, 1998). The annual data for Libya for 1962 to 2005 are available from:

1- Publications of the Libyan Central Bank (economic bulletin, the annual report, various issues).

2- Libyan government ministries (annual reports from 1962 – 2004).

3- International Monetary Fund (IMF), Report on the Libyan Economy Statistical Appendix Jan 4, 2005.

4- OPEC Annual Statistical Bulletin, 2004 (Data 1960- 2004).

5- Publications of the Arab Monetary Fund (national accounts of Arab countries, and annual Arab economic reports)

5.5 Computer Software Programs and Econometric Techniques.

We have used EViews 4.0 (computer software), available in the Dundee Business School for the unit root tests, cointegration test, the error correction model and Granger causality test.

5.5.1 Unit Root Tests

As a first step of our analyses we checked for unit roots because: (1) Stock and Watson (1989) argue that the causality tests are very sensitive to the stationarity of the series; and (2) Nelson and Plosser (1982), state that many macroeconomic series are nonstationary. We use the Augmented Dickey-Fuller (ADF) and Phillips-Perron (1988) tests to assess the degree of integration of the two series (Ugur and Ramazan, 2003).

Before testing for cointegration, a unit root test is required to test if the variables under study are nonstationary I(1). The cointegration test is only applicable if the variables are of the same order I(1). The first step is to run a unit root test in which we can identify whether the series are stationary or non stationary. Earlier studies of the growth of government expenditure had not looked at the time series properties of the variables examined. There was an implied assumption that the data were stationary.

On the other hand, recent developments in time series analysis show that most macroeconomic time series have a unit root and this property is described as difference stationarity. There are many alternative tests available to examine whether the series are stationary or nonstationary. If the variables under investigation are stationary, which means that the variables do not have unit roots, then the series are said to be I(0). If the variables under investigation are non stationary in its level form but stationary in its first difference form, which means that the variables do have unit roots, then they are said to be I(1).

Many macroeconomic time series are non-stationary which means that they contain unit roots that cause many econometric problems. In general, if the series of Yt is stationary after differencing (d) times, then (Yt) is integrated of order d, or I(d) where d represents the number of unit roots the series (Yt) contains. This study uses the Augmented Dickey Fuller (ADF) statistic test (Dickey and Fuller, 1981). In general, the tests are derived from OLS estimation of the following:

$$\Delta Y_t = a_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \varepsilon_t \qquad (5.13)$$

Where Δ is the first difference of the series and n is the number of lags and (i =1, 2, 3........., n), α_0 is a constant, α_1 and β_i are parameters and ε_t denotes a stochastic error term, Y_t is the relevant time-series.

The study will test the null hypotheses as follows:

HO: $\alpha_1 = 0$ H1: $\alpha_1 \neq 0$

We test the null hypothesis that α_1 is zero against the hypothesis that α_1 is less than zero and statistically significant. If $\alpha_1 = 0$, then the series is said to have a unit root and is nonstationary. Hence, if the hypothesis, $\alpha_1 = 0$, is rejected for the above equation it can be concluded that the time series does not have a unit root and is integrated of order zero I(0). These tests are carried out for all variables by replacing Y_t with the variables under study in both tests (the ADF test and PP test), (Enders, 1995).

5.5.2 Tests for Cointegration

There are two options for running cointegration tests; the Engle and Granger (1987) two-step test and the maximum likelihood method developed by Johansen (1988) and Johansen and Juselius (1990). The second test is preferred when there are more than two time series variables involved, because it can determine the number of cointegration vectors. In this study, Engle-Granger two-step test is used since there are only two variables involved.

If, after carrying out a unit root test, we find that some of the variables contain unit roots, we proceed to test for cointegration between the variables following Engle and Granger (1987). The concept of cointegration was first introduced by Granger (1981) to investigate short-run and long-run or equilibrium relationships between macroeconomic time-series (Ghosh and Gilmore, 1997).

To understand a cointegration relationship between variables, let us consider two time-series, Y_t and X_t, which are both nonstationary or I(1). Let us suppose that Y_t and X_t share the same trend; thus they may be tied together in the long run. If Y_t and X_t are I(1), a regression is run, such as:

$$Y_t = \beta X_{t-1} + \varepsilon_t \tag{5.17}$$

If the residuals (ε_t) from the regression are I(0), then X_t and Y_t are said to be cointegrated. Thus, the series need to be integrated of the same order for cointegration to be possible. In other words, two variables will be cointegrated if they have a long-run or equilibrium relationship between them.

Cointegration tests in this study are conducted using the method developed by Engle and Granger (1987). This procedure is the most reliable test for cointegration. For variables under investigation in this study, cointegration tests are performed for each version of Wagner's hypothesis for Libya to search for the existence of a long-run equilibrium relationship between the two variables TGX and GDP as well as for TGX and non-oil GDP.

In general Engle and Granger (1987) show that if Y_t and X_t are cointegrated there is then a long-run relationship between them. This long-run relationship exists when the residuals ε_t are I(0). The Engle and Granger test for cointegration involves a two step estimation procedure. The first one, after discovering that the time-series are nonstationary in levels, runs the OLS regression of the cointegration variables in their levels. Second, the residuals from this OLS regression are retained to test for the presence of a unit root in the residual, see for example, Engle and Granger (1987), Hall (1986) and Davidson and Mackinnon (1993).

If the time series is generated by a difference stationary process, then the time series need to be differenced to achieve stationarity. However, as Banerjee et. al, (1993) argue, differencing is not without cost. In particular, differencing omits some information pertaining to long-run adjustment inherent in the data. The same concern was raised by Davidson et.al (1978) and Hendry and Mizon (1978). On this, Granger and Newbold (1988) argue that differencing is better than doing nothing.

In summary, cointegration analysis allows us to model the equilibrium relationship among two or more time series, each of which is nonstationary but some linear combination of it is stationary Banerjee et. al (1993) Cointegration, therefore, becomes the platform for "discerning the nonsense correlation and the sensible long- run relationship" (Hatanaka, 1996).

A pre-condition for conducting the Engle-Granger cointegration test is that both the variables concerned must be integrated with the same level of integration (Enders, 1995). Finally, Granger (1988) pointed out that if there is cointegration between two variables, and then there must be Granger causality in at least one direction.

5.5.3 Error Correction Models

If the series are found to be nonstationary I(1) and cointegrated between two variables, there must be Granger causality in at least one direction, but cointegration does not indicate the direction of causality between the variables. To determine causality, Engle and Granger (1987) and Granger (1988) provide a more comprehensive procedure having variables that are found to be cointegrated. This procedure is known as the error correction model (ECM). Therefore, the study specifies an ECM in order to examine the variable in the short-run. The error correction term (ECT) that is embodied in the following error correction model:

$$\Delta \ln TGX_t = \alpha_0 + \beta_0 \Delta \ln GDP_t + \gamma_0 ECT_{t-1} + \varepsilon_t \qquad (5.18)$$

Where Δ denotes the first difference operator, ECT_{t-1} is the error correction term, and γ_0 is the coefficient of the error correction term, which measures the short-run adjustment, to $\hat{\varepsilon}_t$ in equation (5.17), The ECM should be negative and statistically significant if the relevant variables are cointegrated and therefore represents the disequilibrium residual of a cointegration equation. Thus, the coefficients of the ECTs capture the "speed of adjustment" which explains the deviation of a variable from the long-run equilibrium. In addition, in the above equation (5.18) y should respond negatively and in equation (5.19) x should respond positively to positive values of ECT_{t-1}, and λ should be negative for y and positive for x (Anwar et al., 1996), and (Enders, 1995).

5.5.4 Granger Causality Test

Causality is assumed to be "explicit in any economic relationship" (Wold, 1954). The importance of establishing a causal relationship has long been recognised. In economic theory, relationships are often described as causal e.g. the relationship between quantity and price, money and income, government expenditure and national income, and others.

The concept of causality from the economic point of view, and the determination of causal directions only become possible after the operational framework was developed by Granger (1969) and Sims (1972). Their approach is crucially based on the maxim that the past and present may cause the future but the future can not cause the past (Granger, 1980). In econometrics the most widely used operational definition of causality is the Granger definition of causality, which is defined as follows: The variable X is a Granger cause of Y (denoted as $X \rightarrow Y$), if present Y

can be predicted with better accuracy by using past values of X rather than by not doing so, other information being identical (Charemza and Deadman, 1992).

For variables under investigation in this study, we test individually for the causality between the dependent variables, namely: TGX, TGXC, TGX/GDP, and per capita TGX, and gross domestic product (GDP or per capita GDP). However, before undertaking that we have to check for the time series properties and especially cointegration properties of the time series involved (Bahmani-Oskooee and Alse, 1993).

If the null hypothesis of noncointegration between TGX (total government expenditure) at time t and GDP (gross domestic product) at time t can be rejected, then the standard Granger causality test can be employed to examine the causal relationship between the series (using the variables in first differences) (Mahdavi et al.,1994). Following this statement, we can test the hypothesis that GDP growth, labelled (ΔLGDP), causes government expenditure growth, labelled (ΔLTCX), and vice versa, by constructing the following causal models:

$$\Delta LTGX_t = \alpha + \sum_{i=1}^{m} \beta_i LTGX_{t-i} + \sum_{i=1}^{n} \delta_i \Delta LGDP_{t-i} + u_{1t} \qquad (5.19)$$

$$\Delta LGDP_t = a + \sum_{j=1}^{P} b_j \Delta LTGX_{t-i} + \sum_{j=1}^{\tau} c_j \Delta LGDP_{t-j} + u_{2t} \qquad (5.20)$$

Where u_{1t} and u_{2t} are two uncorrelated white-noise series and m, n and P, τ are the maximum number of lags. It is well known that the causality literature assumes stationarity of the time series being examined. Because of that, we will apply Granger causality using the variables if the first differences of logarithms of the variables are stationary I(0). One can use the standard F-test or the probability

value in order to determine the causal relationship between the variables. When testing causality in this study we have four possible findings:

(1)   Neither variable Granger causes the other. In other words, independence is suggested when the sets of GDP and TGX coefficients are not statistically significant in both regressions (no causality)

(2)   Unidirectional causality from GDP to TGX: that is, GDP causes TGX, but not vice versa (in this case Wagner's hypothesis applies) (unidirectional causality)

(3)   Unidirectional causality from TGX to GDP: that is, TGX causes GDP, but not vice versa (Keynesian modelling is valid in this case) (unidirectional causality).

(4)   Bi-directional causality between GDP and TGX: that is, GDP and TGX "Granger cause" each other (feedback effect or bi-directional causality).

If (4) is found to be valid, there is a feedback effect or bidirectional causality between two variables (Miller and Russek, 1990); (Gujarati, 1995). In that case both the Keynes and Wagner approaches are valid. According to the above equations (5.20 and 5.21), the null hypothesis that GDP does not Granger cause TGX is rejected if the coefficients of δ_i's in equation (5.20) are jointly significant (i.e. $\delta_i \neq 0$), based on the standard F- test. The null hypothesis that TGX does not Granger cause GDP is rejected if the b_j's are jointly significant (i.e. $b_j \neq 0$) in equation (5.21), and if both some $\delta_i \neq 0$ and some $b_j \neq 0$ then there is feedback between TGX and GDP.

5.6 Summary

This chapter was about the research methodology used in this study. In this chapter we presented the sequential process in identifying Granger causality in econometrics analysis which involves testing for stationarity or unit roots, cointegration and finally Granger causality. As mentioned in the introduction, these procedures are used in analysing the relationship within the framework of Wagner's hypothesis between government expenditure and economic development in Libya.

The process of testing for unit roots also involves testing for the data generating process to identify whether the data are difference stationary. The Error-Correction Model allows us to combine the short-run dynamics and the long-run equilibrium relationship between the variables. Econometricians relate the short-run dynamics to the changes or the growth of a particular variable or time series. On the other hand, the long-run refers to the level of the variables. Since cointegration implies that there is Granger causality in one direction or another, error correction models will allow us to detect the direction in which Granger causality flows.

The next chapter will concern the test of the long-run equilibrium relationship for cointegration analysis. In this chapter we will be focusing on estimating the relationship between GDP of (total real GDP and total real non-oil GDP) growth and government expenditure in Libya over the period 1962-2005.

CHAPTER SIX

The Long-run Analysis

6.1 Introduction

As discussed in Chapter two, Adolph Wagner (1883) formulated his famous law of increasing state activity for developing countries by linking the growth of government activity to economic development. Although there has been some disagreement among scholars regarding the correct interpretation of the hypothesis, Wagner's law has been generally interpreted as follows; as per capita income increases in industrializing nations, a rising share of an economy's resources will be devoted to public sector activities. Wagner's hypothesis, i.e., the proposal that there exists a long-run propensity for the public sector to grow, has become a stylised fact in public sector economics (Brown and Jackson, 1990).

As explained in Chapter three, many studies have examined the empirical confirmation of Wagner's hypothesis since the early 1960s. As new data sets on the relevant variables have become available, and more advanced econometric techniques have been developed, further tests of the law have been carried out. The discussion about the correct interpretation and validity of Wagner's hypothesis continues today. Most empirical studies have been based on either time series analysis of a single country or cross-sectional analysis of different countries. The empirical results of Wagner's hypothesis are inconclusive. Many time series studies find support for the hypothesis.

The purpose of this chapter is to use the techniques of cointegration analysis to examine the long-run relationship between two variables. Engle and Granger

(1987) pioneered cointegration tests by proposing a residual based two step procedure to identify long-run relationships among stationary variables under study. The short-run relationship will be examined in chapter seven. We extend our analysis in the context of Libya to see the relationship between government expenditure and economic development. It is hoped that our findings will cast some light on explaining the government expenditure and GDP growth experienced by Libya in the period 1962 to 2005 within the framework of Wagner's law.

The outline of this chapter is as follows. In Section 6.2 we present six different interpretations of Wagner's law which lead to six different ways of formulating the law. In section 6.3 we present the econometric problem. In section 6.4 we present the practical aspect of the econometric methodology adopted in this chapter which comprises the unit roots test and the cointegration analysis. Finally, the summary is in Section 6.5.

6.2 The Empirical Models of Wagner's Law

As in all other empirical studies, we need to choose a suitable model for an empirical confirmation of Wagner's law. Due to the complexity of the problems and the vagueness of Wagner's hypothesis, it is difficult to exactly define the empirical form of the relationship between public expenditure and the level of economic development. Different empirical researchers have interpreted the law differently and many different versions of Wagner's law have appeared. Following Gandhi (1971) and Mann (1981), they have provided a useful comparison of the different interpretations of Wagner's law. Based on earlier studies, they proceed to devise six different formulations of the law. We present these different

formulations below. In what follows, TGX is total government expenditure, GDP is the gross domestic product, and TGXC is total government expenditure on consumption, GDP/POP is per capita income and POP is the population. The following six different versions of Wagner's law have been most commonly investigated.

6.2.1 Peacocok and Wiseman Version

They tested the relation between government expenditure and GDP as follows:

$$TGX = f(GDP) \qquad (6.1)$$

Where TGX is total government expenditure in real terms, and GDP is gross domestic product in real terms, used as the standard measure of the country's economic activities. They briefly write Wagner's law as "government expenditure must increase at an even faster rate than output" (Peacock and Wiseman, 1967, p.17). This functional form is called the traditional Peacock-Wiseman version. According to this version, the elasticity of TGX with respect to GDP is expected to exceed unity.

6.2.2 Pryor Version

This version of Wagner's law was represented by (Pryor, 1968). According to, him "Wagner's law asserted that in growing economies the share of public consumption expenditures in the national income increases" (Pryor, 1968, p.451). According to the Pryor version, the elasticity of TGXC with respect to GDP would be expected to exceed unity. The symbolic statement of Wagner's law according to this version is:

$$TGXC = f(GDP) \qquad (6.2)$$

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Where TGXC is total government consumption expenditure in real terms.

6.2.3 Goffman Version

This version of Wagner's law was proposed by Goffman (1968, p.359). According to him, "Essentially, Wagner argued that as a nation experiences economic development and growth, an increase must occur in the activities of the public sector and that ratio of increase, when converted into expenditure terms, would exceed the rate of increase in output per capita". The Goffiman version assumes a functional relationship of the form:

$$TGX = f(GDP/POP) \qquad (6.3)$$

Where POP denotes population and GDP/POP is per capita gross domestic product in real terms. The elasticity of government expenditure (TGX) with respect to per capita gross domestic product (GDP/POP) is greater than unity.

6.2.4 Musgrave Version

Musgrave proposed this version (1969, p.74). According to him, "Ever since Adolph Wagner expounded his law of the expanding scale of state activity, economists have speculated on its validity and the underlying causes. The proportion of expanding scale, obviously, must be interpreted as postulating rising share of public sector or ratio of public expenditure to GDP... of the development of a country, from low to high per capita income". The Musgrave version, the most widely accepted specification of Wagner's law, can be written as follows.

$$TGX/GDP = f(GDP/POP) \qquad (6.4)$$

Where TGX/GDP, denotes the share of total government expenditure in gross domestic product in real terms. According to Musgrave's version, Wagner's law is validated if the ratio elasticity is greater than zero.

6.2.5 Gupta and Michas Version

Gupta (1967) and Michas (1975) have examined another version of Wagner's hypothesis. According to this version, per capita government expenditure of a country rises more than proportionately as its per capita income rises in real terms. It is the traditional version of Wagner's law but in per capita terms. The symbolic statement of Wagner's law according to this version is:

$$TGX/POP = f(GDP/POP) \tag{6.5}$$

Where TGX/POP represents per capita government expenditure in real terms. They tried to verify that the elasticity of public spending per capita with respect to GDP per capita is greater than unity.

6.2.6 Mann Version

The last formulation to test Wagner's law was proposed by Mann (1980), and is a modified version of Peacock-Wiseman, in the sense that it converts the traditional Peacock–Wiseman formulation into a share version. According to the modified P-W version, the share specification most closely approximates the proper perspective of Wagner's hypothesis. The increase in the share of total government expenditure is expected to be at a faster rate than that of gross domestic product. This version is the formulation used most frequently in empirical work (Ram 1987). The law can be written as follows:

$$TGX/GDP = f(GDP) \tag{6.6}$$

Where TGX/GDP is the share of total government expenditure in gross domestic product in real terms. In the relation, if the elasticity is greater than zero, then Wagner's law is validated.

In this study we will be using these formulations of Wagner's hypothesis for estimating the relationship between the total real GDP and total real non-oil GDP growth and government expenditure in Libya. The above formulations can be expressed in log-regression forms as follows:

The six versions of Wagner's law with total real GDP:

$$\ln TGX = \alpha_1 + \beta_1 \ln GDP + u \tag{6.7}$$

$$\ln TGXC = \alpha_2 + \beta_2 \ln GDP + u \tag{6.8}$$

$$\ln TGX = \alpha_3 + \beta_3 \ln(GDP/POP) + u \tag{6.9}$$

$$\ln(TGX/GDP) = \alpha_4 + \beta_4 \ln(GDP/POP) + u \tag{6.10}$$

$$\ln(TGX/POP) = \alpha_5 + \beta_5 \ln(GDP/POP) + u \tag{6.11}$$

$$\ln(TGX/GDP) = \alpha_6 + \beta_6 \ln GDP + u \tag{6.12}$$

Furthermore, the six versions of Wagner's law with total real non-oil:

$$\ln TGX = \alpha_1 + \beta_1 \ln(nonoilGDP) + u \tag{6.13}$$

$$\ln TGXC = \alpha_2 + \beta_2 \ln(nonoilGDP) + u \tag{6.14}$$

$$\ln TGX = \alpha_3 + \beta_3 \ln(nonoilGDP/POP) + u \tag{6.15}$$

$$\ln(TGX/nonoilGDP) = \alpha_4 + \beta_4 \ln(nonoilGDP/POP) + u \tag{6.16}$$

$$\ln(TGX/POP) = \alpha_5 + \beta_5 \ln(nonoilGDP/POP) + u \tag{6.17}$$

$$\ln(TGX/nonoilGDP) = \alpha_6 + \beta_6 \ln(nonoilGDP) + u \tag{6.18}$$

In the above equations, the estimated coefficients of the independent variable stand for the elasticity of demand for government expenditures with respect to GDP

which will produce different values depending on the version used. To validate Wagner's hypothesis the straight GDP elasticity requires to be >1 and the ratio GDP elasticity needs to be >0.

Most previous empirical tests of Wagner's law in a single country over a long period have used time series data and the ordinary least squares (OLS) regression technique to estimate the above elasticity. Most of these empirical studies have found support for the law. However, they have suffered from various methodological flaws and errors. The traditional models have ignored the question of stationarity. In the subsequent section the study will examine these issues.

6.3 The Econometric Problem.

For more than two decades, many researchers have undertaken case studies for their countries with six different versions of Wagner's law. In order to examine the validity of Wagner's law, all of these studies have used time series data and employed the Ordinary Least Squares (OLS) technique to estimate the regression coefficients. Most of these empirical tests of six different versions of the law have found a statistically significant positive relationship between government expenditure and economic growth

In estimating six different equations for Wagner's hypothesis, the previous studies have assumed that the time series data used on government expenditure and gross domestic product are stationary and that the error terms in the equation are serially uncorrelated. Under these assumptions, the method of OLS gives estimators that are unbiased and have constant variance; i.e. the estimated coefficients are consistent and have the usual asymptotic normal distribution.

However, recent advances in time series analysis and available empirical evidence have suggested that many macroeconomic times series are nonstationary in the sense that the mean and variance depend on time, (Nelson and Plosser 1982; Schwert 1987 and Maddala 1992). If a variable tends to return to its mean level through time, the variable will be stationary. A stationary series has a well defined mean which will not vary greatly with the sampling period. If a series has a time varying mean, the time series is said to be nonstationary.

Nonstationarity in time series data gives rise to many econometric problems. Regressions involving such nonstationary variables are likely to produce spurious results. When nonstationary data are used in a regression, the results obtained are likely to be spurious because the variables are actually unrelated. The possibilities of spurious regression also exist if the variables under consideration are not cointegrated.

To overcome the problems of the previous studies dealing with Wagner's law, we need to examine the stationarity of each variable and investigate the long run relationship between government expenditure and GDP in terms of cointegration analysis.

As specified in the six different formulations of Wagner's law, the data under examination consist of the following: gross domestic product (GDP), government expenditure (TGX) and government consumption expenditure (TGXC) in real terms. In addition, the data are also examined in per capita terms: per capita GDP (GDP/POP), per capita government expenditure (TGX/POP) and the share of government expenditure in GDP (TGX/GDP) in real terms. All six series are

measured in real terms and transformed to natural logs. Also, we examined the data for non-oil GDP at the same time.

6.4 Empirical Results and Analysis from Testing Six Versions of Wagner's Law

The main focus of this chapter is to provide the general framework for the analysis. Some description of the econometric technique is presented. All the data are annual and are for calendar years. Econometricians suggest that, "the first step in any empirical analysis should be examining each of the variables individually to check their unit roots and their order of integration," (Holden and Thompson 1992). In our study, the nonstationary property of the time series data must be considered first.

We employ the most widely used methods to test the time series data in our study for unit roots, which are the Augmented Dickey Fuller (ADF) test Dickey-Fuller (1981) and Phillips-Perron (PP) test (1988). Then, by employing the cointegration technique, we test for the existence of a long-run relationship (equilibrium) between the variables. In each sub-section the findings reported include the findings of the different tests for the relationship between the independent variables (GDP) and dependent variables (TGX, TGXC, TGX/POP, TGX/GDP) as well as the findings of the different tests for the relationship between the independent variables (non-oil GDP) and the dependent variables (TGX, TGXC, TGX/POP, TGX/non-oil GDP).

6.4.1 Testing for Stationarity

A time series is considered to be stationary if its mean and variance are independent of time. If the time series is nonstationary, i.e. having a mean and or variance changing over time, it is said to have a unit root. Therefore, the stationarity of a time series is examined by conducting the unit root test. A nonstationary time series can be converted into a stationary time series by differencing. If a time series becomes stationary after differencing once, then the time series is said to be integrated of order one and denoted by I(1). Similarly, if a time series has to be differenced d times to make it stationary, then it is called integrated of order d and written as I (d).

6.4.1.1 Graphs of Variables

The first technique which can be used to check stationarity of the variables is to graph the series. The graphs of these variables in logarithm form with total GDP and non-oil GDP are shown as follows:

Figure 6.1 Graphs of the Variables for six versions with total GDP

— LNGDP

— LNGDPN

— LNTGX

— LNTGXC

— LNTGXGDP

— LNTGXN

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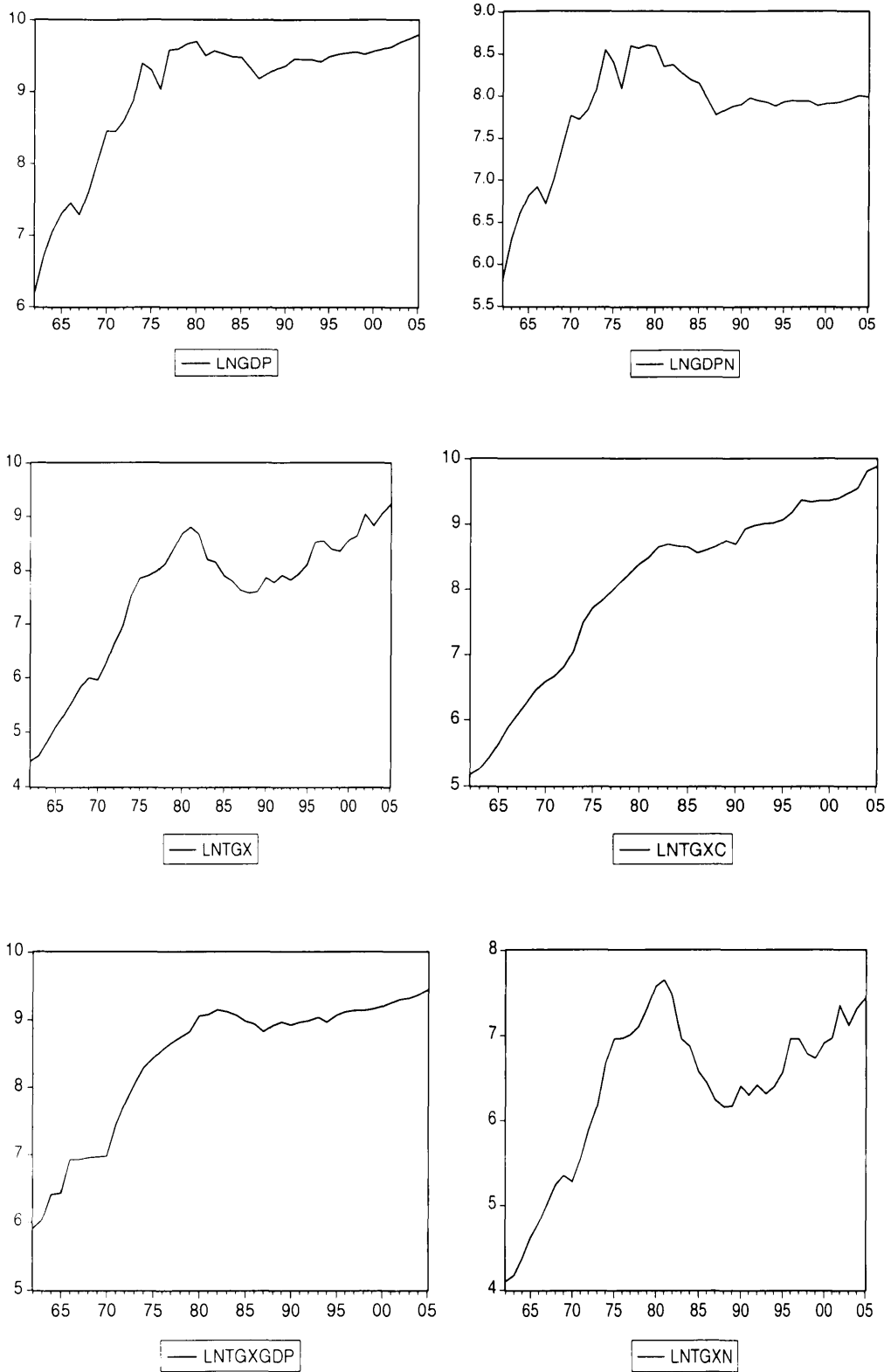
Figure 6.2 Graphs of the Variables for six versions with total non-oil
GDP

125
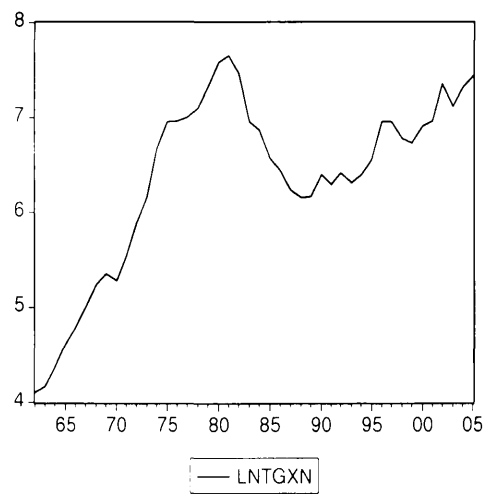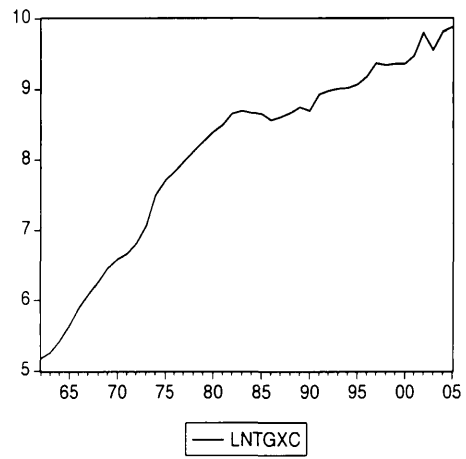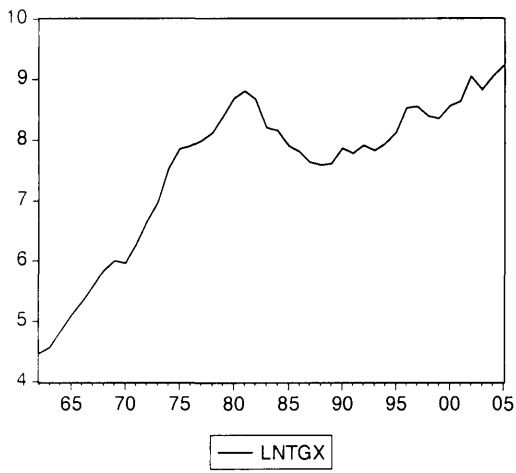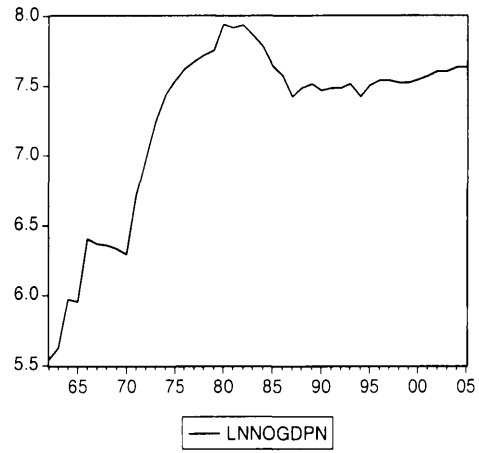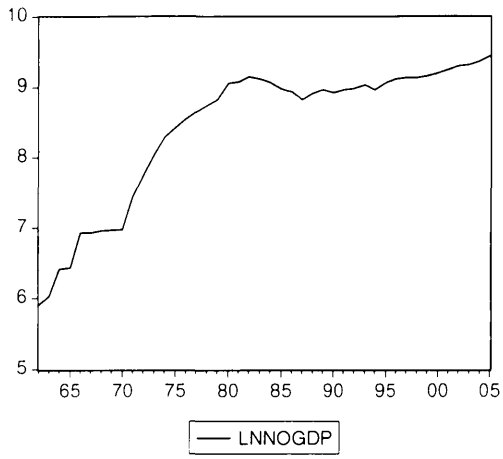
According to the graphs in Figures 6.1 and 6.2, the results indicate that the total GDP and non-oil GDP are possibly stationary in first differences. Hence, the variables are possibly integrated of order one. We can check the time series data for stationarity using the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for unit roots.

6.4.1.2 Unit Root Tests

A useful preliminary step to performing any regression analysis is to uncover the properties and characteristics of the actual data involved. Such an analysis of the individual time series variables is important because the properties of the individual series have to be taken into account in modelling the data generating process of a system of potentially related variables (Lutkepohl and Kratzig 2004). Since all variables under investigation are time series variables, we need first to test the properties of the series. In fact, testing for the properties is important because (1) some time series techniques, cointegration analysis, for example, require that the time series involved be integrated of order greater than zero; (2) a nonstationary regress or invalidates many standard empirical results. For example, Granger and Newbold (1974) found that the F-statistic calculated from a regression involving nonstationary time series does not follow the standard distribution.

Testing for unit roots in time series data has received considerable attention in recent econometric literature. Since there is exists the problem of spurious regression involving the levels of the variables, we need to examine whether each series is stationary or whether the series has a stochastic trend. If a series contains a unit root, the time series data is not stationary and it will be have as a stochastic rather than a deterministic process.

6.4.1.2.1 Augmented Dickey-Fuller Test

Several methods of testing for unit roots have been proposed.[1] The Augmented Dickey-Fuller (ADF) test has been most commonly used. In our examination here we will be adopting the Augmented Dickey-Fuller (ADF) testing method, Dickey and Fuller (1981).

In the ADF test, the null hypothesis is that the variable under investigation has a unit root, against the alternative that it does not. The substantially negative values of the reported test statistic lead to rejection of the null hypothesis (Dickey et. al., 1991). Tables 6.1 and 6.2 report the results of the Augmented Dickey-Fuller (ADF) unit root tests. In the case of the levels of the six variables, the t-values[2] on the level obtained from ADF tests are clearly less negative than the critical values and therefore the null hypothesis of a unit root cannot be rejected for each variable used in all of the six versions of Wagner's law.

Also, Tables 6.1 and 6.2 shows the same test applied to the first differences to see whether we can achieve stationarity of the series by transforming the series. For the first differences of the variables (total GDP and non-oil GDP), the results show that the calculated t-values are greater than the critical t-values at the 5% level of significance. This implies that the null hypothesis that the series have unit roots in their first differences are rejected which means that the variables are stationary in their first differences.

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[1] For example, the Dickey-Fuller (DF) test, the Augmented Dickey-Fuller (ADF) test, the Instrumental Test, and the Phillips-Perron test. For a useful survey of the unit root literure, see Banerjee, et al. (1993).

[2] For more details from the tests see Appendices 2 and 3

**Table 6.1 Augmented Dickey-Fuller Unit Root Tests for
Level and First Differences with total GDP**

Variables	Level	First Difference	Lag Lengths	Order of Integration
	trend	No trend		
ln GDP	-2.533	-4.604*	1	I(1)
ln GDP/POP	-2.554	-4.710*	1	I(1)
Ln TGX	-2.164	-4.158*	0	I(1)
ln TGXC	-2.138	-3.731*	0	I(1)
Ln TGX/GDP	-2.258	-3.359*	3	I(1)
Ln TGX/POP	-2.157	-2.985*	2	I(1)

All regression estimations and test results are obtained by using Eviews 4 econometric software.
* Significant at 5% level.
Critical value in level at 5% is -2.933.

**Table 6.2 Augmented Dickey-Fuller Unit Root Tests for
Level and First Differences (non-oil GDP)**

Variables	Level	First Difference	Lag Lengths	Order of Integration
	trend	No trend		
ln (nonoil GDP)	-2.258	-3.359*	3	I(1)
ln (nonoil GDP/POP)	-2.325	-3.555*	3	I(1)
Ln TGX	-2.164	-4.158*	0	I(1)
Ln TGX	-1.909	-3.160*	1	I(1)
Ln TGX/POP	-2.157	-4.215*	0	I(1)
Ln TGX/nonoil GDP	-1.676	-4.102*	1	I(1)

All regression estimations and test results are obtained by using Eviews 4 econometric software.
* Significant at 5% level.
Critical value in level at 5% is -2.933.

6.4.1.2.2 Phillips-Perron Test

Another test we can use for unit root tests is the Phillips-Perron (PP) test which is a more comprehensive test for a unit root. Although it is similar to ADF tests, it

incorporates an automatic correction to the Dickey-Fuller procedure to allow for auto correlated residuals (Brooks, 2002). The Phillips-Perron test is carried out using the t-statistic following the same procedure as the Augmented Dickey-Fuller approach. The major criticisms of the ADF and PP tests are that their estimation power is low if the process is stationary but with a root close to the nonstationary boundary. They have the tendency to over-reject the null hypothesis of nonstationarity when it is in fact true, and under-reject the null when it is false (Brooks, 2002; Harris, 1995).

Tables 6.3 and 6.4 presented the results for the testing of stationarity for the real total GDP and non-oil real GDP. The results show that the null hypothesis of nonstationarity cannot be rejected when variables are in levels. However, after taking first differences, all variables become stationary.

Table 6.3 Phillips-Perron Test for Level and First Differences with total GDP

Variables	Level	First Difference	Lag Lengths	Order of Integration
	trend	No trend		
ln GDP	-3.348	-5.446*	1	I(1)
ln GDP/POP	-3.331	-5.526*	1	I(1)
ln TGX	-1.848	-4.191*	2	I(1)
ln TGXC	-1.604	-3.744*	2	I(1)
ln TGX/GDP	-1.920	-4.929*	1	I(1)
ln TGX/POP	-1.856	-4.155*	2	I(1)

*, indicate significant at 1%.
Critical value in level at 1%, is -3.593

Table 6.4 Phillips-Perron Test for Level and First Differences (non-oil GDP)

Variables	Level	First Difference	Lag Lengths	Order of Integration
	trend	No trend		
ln (nonoil GDP)	-1.920	-4.929*	2	I(1)
ln (nonoil GDP/POP)	-2.006	-5.094*	2	I(1)
ln TGX	-1.848	-4.191*	2	I(1)
ln TGXC	-1.560	-5.817*	2	I(1)
ln TGX/POP	-1.856	-4.254*	2	I(1)
ln TGX/nonoil GDP	-1.816	-6.732*	2	I(1)

* Significant at 1% level.
Critical value in level at 1% is -3.593

In addition, the results in Tables 6.5 and 6.6 show that the null hypothesis of nonstationarity cannot be rejected when variables are in levels. However, after taking first differences, all variables become stationary. Therefore, we can conclude that all the variables are first difference stationary, that is, each series is characterised as integrated of order one I(1).

Table 6.5 Comparison of ADF and PP tests for total GDP

Variables	ADF test		Phillips-Perron Test (PP)	
	Level	First Difference	Level	First Difference
Ln GDP	-2.533	-4.604**	-3.348	-5.446*
Ln GDP/POP	-2.554	-4.710**	-3.331	-5.526*
Ln TGX	-2.164	-4.158**	-1.848	-4.191*
Ln TGXC	-2.138	-3.731**	-1.604	-3.744*
Ln TGX/GDP	-2.258	-3.359**	-1.920	-4.929*
Ln TGX/POP	-2.157	-2.985**	-1.856	-4.155*

- (*, ** significant at 1% and 5% level at respectively.)
- Critical value in level at 5% is -2.933 and -3.593 at 1% level.

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Table 6.6 Comparison of ADF and PP tests for total non-oil GDP

Variables	ADF test		Phillips-Perron Test (PP)	
	Level	First Difference	Level	First Difference
ln(nonoil GDP)	-2.258	-3.359**	-1.920	-4.929*
ln(non-oil GDP/POP)	-2.325	-3.555**	-2.006	-5.094*
ln TGX	-2.164	-4.158**	-1.848	-4.191*
ln TGXC	-1.909	-3.160**	-1.560	-5.817*
ln TGX/POP	-2.157	-4.215**	-1.856	-4.254*
ln TGX/nonoil GDP	-1.676	-4.102**	-1.816	-6.732*

*, ** significant at 1% and 5% level at respectively.
Critical value in level at 5% is -2.933 and -3.593 at 1%

Therefore, we can conclude that since differencing once produces stationarity, all the six series (total GDP and non-oil GDP) used in the analysis are integrated of order one I(1). Once the order of integration has been established, then we can test whether there is a long-run relationship between all of the variables. Now, this being the case, we can proceed to perform a cointegration test as the next step in our empirical investigation.

6.4.2 Testing for Cointegration

Having established the number of unit roots in the variable, we proceed to test for cointegration. A cointegration test can be applied to determine the existence of a long-run relationship between the variables when the variables are integrated at the same level of integration. The concept of cointegration was first introduced into econometrics by Granger (1981) and further developed by Engle and Granger (1987). The Engle and Granger two-step procedures involve firstly running the following cointegration regression:

$$Y_t = \alpha + \beta X_t + \varepsilon_t \qquad\qquad (6.19)$$

If the residuals (ε_t) from the regression are I(0), then X_t and Y_t are said to be cointegrated. Clearly, the series need to be integrated of the same order for cointegration to be possible. To establish the stationarity of the residuals we can re-write equation (6.19) as follows:

$$TGX_t = \alpha + \beta GDP_t + \varepsilon_t \tag{6.20}$$

The long-run relationship of two variables is examined using the two-step test for cointegration proposed in Engle and Granger (1987). Equation (6.20) can be written in log-linear from for the six versions with total GDP and non-oil GDP of Wagner's law as follows:

Equations with total GDP

Version one (Peacock and Wiseman)

$$\ln TGX = \alpha_1 + \beta_1 \ln GDP + \varepsilon_1 \tag{6.21}$$

Version two (Pryor)

$$\ln TGXC = \alpha_2 + \beta_2 \ln GDP + \varepsilon_2 \tag{6.22}$$

Version three (Goffman)

$$\ln TGX = \alpha_3 + \beta_3 \ln(GDP/POP) + \varepsilon_3 \tag{6.23}$$

Version four (Musgrave)

$$\ln(TGX/GDP) = \alpha_4 + \beta_4 \ln(GDP/POP) + \varepsilon_4 \tag{6.24}$$

Version five (Gupta and Michas)

$$\ln(TGX/POP) = \alpha_5 + \beta_5 \ln(GDP/POP) + \varepsilon_5 \tag{6.25}$$

Version six (Mann)

$$\ln(TGX/GDP) = \alpha_6 + \beta_6 \ln GDP + \varepsilon_6 \tag{6.26}$$

Equations with total non-oil GDP

Version one (Peacock and Wiseman

$$\ln TGX = \alpha_1 + \beta_1 \ln(nonilGDP) + \varepsilon_1 \qquad (6.27)$$

Version two (Pryor)

$$\ln TGXC = \alpha_2 + \beta_2 \ln(nonoilGDP) + \varepsilon_2 \qquad (6.28)$$

Version three (Goffman)

$$\ln TGX = \alpha_3 + \beta_3 \ln(nonoilGDP/POP) + \varepsilon_3 \qquad (6.19)$$

Version four (Musgrave)

$$\ln(TGX/nonoilGDP) = \alpha_4 + \beta_4 \ln(nonoilGDP/POP) + \varepsilon_4 \qquad (6.30)$$

Version five (Gupta and Michas)

$$\ln(TGX/POP) = \alpha_5 + \beta_5 \ln(nonoilGDP/POP) + \varepsilon_5 \qquad (6.31)$$

Version six (Mann)

$$\ln(TGX/nonoilGDP) = \alpha_6 + \beta_6 \ln(nonoilGDP) + \varepsilon_6 \qquad (6.32)$$

These equations can be estimated through cointegration regressions to examine the long-run relationship between government expenditure and gross domestic product, and then testing whether the residual (ε_t) is I(0) or not.

The basic idea of cointegration is that if two or more series move together over time, combinations of these economic variables tend to converge in the long-run, even though they may drift apart in the short-run. If two or more I (1) variables tend to converge, or at least do not drift apart in the long-run, we can regard these variables as defining a long-run equilibrium relationship. Thus the concept of cointegration provides a theoretical foundation for dynamic modelling, and it also gives information about the long-run properties of data.

There are several tests of the cointegrating regression. Mainly, these are: DW which is the cointegration regression Durbin-Watson statistic derived from Sargan and Bhargava (1983), the Dickey-Fuller (DF) test, and the Augmented Dickey-Fuller (ADF) test. All these tests are used by Engle and Granger (1987) and Hall (1986). However, they suggest that in most applications the ADF test for unit roots in the residuals is best. Hence, it was decided to use the Engle and Granger residual based approach.[3]

We found that each of the variables used in all six versions of Wagner's law are I(1) in the real GDP and real non-oil GDP variables. Since all series are integrated of the same order, the series can be tested for the existence of a long-run relationship between them, i.e. cointegration. The procedure used to establish the existence of a cointegrating relationship is as follows: First, the hypothesised long-run relationship is estimated by OLS. This is called the cointegrating regression. Second, we can obtain the residuals ε_t . To test stationarity for the residuals the study applies the ADF and PP tests. In other words, the null hypothesis of the cointegration test is that the residuals formed by the cointegrating regressions are not stationary. It is necessary to emphasise that the residual equation has no intercept or time trend. In this chapter, we will conduct two cointegration tests. The first one is with respect to total real gross domestic product (GDP), and the second one is with respect to real non-oil gross domestic product (non-oil GDP).

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[3] There are other approaches as well, such as Johansen's Full Information Maximum Likelihood (FIML) approach, and Stock and Watson's (1988) approach.

6.4.2.1 Cointegration Tests with Total Real GDP

Since the series here are integrated with the same order I(1), a cointegration test can be conducted in order to examine the existence of a long-run equilibrium relationship among the variables. To test the null hypothesis of nonstationarity against the alternative hypothesis of stationarity of the residuals, the study applied the ADF and PP tests to each of the six cointegrating regressions[4]. Table 6.7 shows the results of the Engle and Granger two step test for cointegration. The results represent the six cointegrating regressions using the ordinary least square (OLS) method[5] and represent the ADF test applied on the residuals obtained from the regressions.

Table 6.7 Cointegration Regressions with Total Real GDP
(The residual-based ADF test)

	Cointegrating Regression	β	Residual coefficient	R^2
1	$LnTGX = f(LnGDP)$	1.35 (22.96)	-0.337 (-2.625*)	0.92
2	$LnTGXC = f(LnGDP)$	1.34 (15.13)	-0.077 ((-1.169)	0.85
3	$LnTGX = f(LnGDP/POP)$	1.78 (9.97)	-0.068 (-0.879)	0.70
4	$(LnTGX/GDP) = f(LnGDP/POP)$	1.35 (9.13)	-0.071 (-1.071)	0.66
5	$(LnTGX/POP) = f(LnGDP/POP)$	1.38 (13.17)	-0.208 (-1.860 ***)	0.80
6	$(LnTGX/GDP) = f(LnGDP)$	1.06 (24.68)	-0.333 (-2.744 *)	0.93

*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively.

Before interpreting the cointegration results, it is necessary to highlight that the Engle and Granger method does not prove whether the relation is really a long-run one. This is a supposition and cannot be statistically confirmed. We need to have a

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[4]- for more results see all tests in appendix (5)
[5]- see appendix (14) for regression models.

strong belief in a long-run equilibrium relationship between the variables that is supported by relevant economic theory where the theory suggests a suitable assumption about a long run relationship (Charemza and Deadman, 1992).

Table 6.7 presents the results of the ADF test for the residual series from the six cointegrating Wagner's law regressions. We conclude that we must reject the null hypothesis of no cointegration in three versions of Wagner's law with respect to real GDP because the ADF statistic values are more negative than the critical values at the 1% or 10% levels with the Peacock-Wiseman version (No.1), the Gupta and Michas version (No.5) and the Mann version (No.6).

The results show evidence that the real total government expenditure and real gross domestic product are subject to an equilibrium relationship in the long run in three versions (1, 5 and 6). Also, we have another technique which can be used to check for cointegration using the residual namely the Phillips-Perron unit root test (PP). The results are presented in Table 6.8 below. We found results if we compare these results with ADF results indicating that the four versions are cointegrated, see Table 6.7.

Table 6.8 Cointegration Regressions with Total Real GDP
(The residual-based PP test)

	Cointegrating Regression	β	Residual coefficient	R^2
1	$LnTGX = f(LnGDP)$	1.35 (22.96)	-0.336 (-3.068*)	0.92
2	$LnTGXC = f(LnGDP)$	1.34 (15.56)	-0.105 (-1.693**)	0.85
3	$LnTGX = f(LnGDP/POP)$	1.78 (9.97)	-0.078 (-0.854)	0.70
4	$(LnTGX/GDP) = f(LnGDP/POP)$	1.35 (9.13)	-0.072 (-0.883)	0.66
5	$(LnTGX/POP) = f(LnGDP/POP)$	1.38 (13.17)	-0.212 (-2.080*)	0.80
6	$(LnTGX/GDP) = f(LnGDP)$	1.06 (24.68)	-0.340 (-3.082*)	0.93

*, ** indicate significance at 1%, 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively.

Two versions show no cointegration in the PP test. The results indicate that the total government expenditure on consumption and gross domestic product are not subject to an equilibrium relationship in the long run in versions 3 and 4. There are two possible reasons for this (1) the oil crises in the 1970s that affected oil revenue in the oil producing countries including Libya, (2) the Libyan economy suffered from US and UN sanctions since 1986[6].

Also Tables 6.7 and 6.8 show the estimated income elasticity (β) in all versions. The elasticity coefficients in the equations are greater than unity in all of the tests. The evidence shows that the estimated income elasticities are greater than unity and support the view that Wagner's law is valid for Libya during the period under consideration.

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[6]- More detailed reviews for these sanctions are included in Chapter 4.

6.4.2.2 Cointegration Tests with Non-oil Real GDP

The same procedure as above is applied to non-oil GDP. Since the variables are I(1), the cointegration technique is applied to different measures of government expenditure and real non-oil gross domestic product (GDP). The residuals from different regressions are then tested for stationarity using the ADF test and Phillips-Perron test (PP). If the residuals are I(0), then a long-run relationship holds between the government expenditure variable and non-oil GDP. Table 6.9 summarises the outcomes of the cointegration test with respect to real non- oil GDP for Libya.

Table 6.9 Cointegration Regressions with Total Real non-oil GDP (the residual – based ADF test)

	Cointegrating Regression	β	Residual coefficient	R^2
1	$\ln TGX = f(\ln(nonoilGDP))$	1.24 (28.93)	-0.180 (-1.67***)	0.95
2	$\ln TGXC = f(\ln(nonoilGDP))$	1.29 (27.19)	-0.11 (-1.329)	0.94
3	$\ln TGX = f(\ln(nonoilGDP / POP))$	1.92 (20.46)	-0.06 (-0.628)	0.90
4	$\ln(TGX / nonoilGDP) = f(\ln(nonoilGDP / POP))$	0.40 (6.11)	-0.19 (-1.61***)	0.47
5	$\ln(TGX / POP) = f(\ln(nonoilGDP / POP))$	1.40 (21.23)	-0.192 (-1.61***)	0.91
6	$\ln(TGX / nonoilGDP) = f(\ln(nonoilGDP))$	0.25 (5.73)	-0.180 (-1.66***)	0.43

*** indicate significance at 10% level.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, and -1.619 respectively.

Table 6.9 shows the Engle-Granger residuals based on the ADF cointegration test[7]. We conclude that we must reject the null hypothesis of no cointegration in

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[7] -for more results see all tests in appendix (6)

four out of six versions of Wagner's law: Peacock-Wiseman version (1), Musgrave version (4), Gupta-Michas version (5) and Mann version (6), because the ADF statistic values are more negative than the critical values at 10% levels. Cointegrated relationships were found for the versions of Wagner's law with respect to real non-oil GDP. In this case, an even stronger result indicates that the real total government expenditure and real non-oil gross domestic product are subject to an equilibrium relationship in the long-run[8].

Another method which can be used to check the cointegration between the variables and the residuals is the (PP) test. The test results can be seen in Table 6.10 below.

Table (6.10) Cointegration Regressions with Total Real non-oil GDP (the residual – based PP test)

	Cointegrating Regression	β	Residual coefficient	R^2
1	$\ln TGX = f(\ln(nonoilGDP))$	1.24 (28.93)	-0.19 (-1.99**)	0.95
2	$\ln TGXC = f(\ln(nonoilGDP))$	1.29 (27.19)	-0.12 (-1.61 ***)	0.94
3	$\ln TGX = f(\ln(nonoil GDP/POP))$	1.92 (20.46)	-0.02 (-0.62)	0.90
4	$\ln(TGX / nonoilGDP) = f(\ln(nonoilGDP/POP))$	0.40 (6.11)	-0.21 (-2.04**)	0.47
5	$\ln(TGX / POP) = f(\ln(nonoILGDP/POP))$	1.40 (21.23)	-0.216 (-2.04**)	0.91
6	$\ln(TGX / nonoilGDP) = f(\ln(nonoilGDP))$	0.24 (5.73)	-0.19 (-1.995**)	0.43

** and*** indicate significance at 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.616, -1.948, and -1.619 respectively.

The Engle and Granger (1987) residual based on (PP) cointegration test results reject the null hypothesis with five versions of Wagner's law at the 5% and 10%

[8]- see appendix (15) for regression models.

level, and they are: Peacock-Wiseman version (1), Pryor version (2), Musgrave version (4), Gupta-Michas version (5) and Mann version (6). Because the PP critical value is more negative than the critical values at the 5% and 10% levels, the results show that there is a long-run relationship between government expenditure and non-oil GDP in these versions.

These results show that the real income elasticities range from 0.25 to 1.92 for real non-oil GDP in the ADF test and 0.24 to 1.85 with the PP test. Most of the elasticity coefficients in the above versions are greater than unity. These results imply that most versions support Wagner's law for Libya during the study period.

In general, the analysis of the results of the Engle-Granger test for cointegration is as follows. These results are mixed and sometimes inconsistent. As stated by Obben (1998) and Cheong (2003), where there is inconsistency between the ADF results and the PP result, the number of cointegrating relationships ranges from three in Table 6.7 to five in Table 6.10. Versions 1, 5 and 6 of Wagner's law are cointegrated in all four tests, and version 3 is non cointegrated in all four tests. β is sometimes less than unity in the PP tests. The conclusion from the PP test is preferred.

Although some of our findings fail to reject the null hypothesis of no long-run relationship between the variables, we have to treat these results with caution. We need to consider the weaknesses and limitations of cointegration analysis. The findings of non-cointegration do not exclude the possibility of cointegration in some higher order system that includes more variables. We will consider some of them in Chapter 8. The omission of important variables may produce the non-

cointegration result. As Muscatelli and Hurn (1992) pointed out "the omission or inclusion of certain variables from the cointegration regression can dramatically affect the results obtained from cointegrating regressions"

6.4.2.3 Cointegration Tests including two Dummies Variables with Total Real GDP

In this section, the study tests the long-run relationship between two variables which are examined using the two step test for cointegration proposed in Engle and Granger (1987). Also, we examine the inclusion of two dummy variables in order to investigate the effect these dummies have on the regression. To establish the stationarity of the residuals we can rewrite the equation as follows:

$$TGX = \alpha_0 + \beta_0 GDP + \lambda_0 Dum_1 + \delta_0 Dum_2 + \varepsilon \tag{6.33}$$

Then we can write equation (6.33) in log-linear form as follows:

$$\ln TGX = \alpha_1 + \beta_1 \ln GDP + \lambda_1 Dum_1 + \delta_1 Dum_2 + \varepsilon_1 \tag{6.34}$$

$$\ln TGXC = \alpha_2 + \beta_2 \ln GDP + \lambda_2 Dum_1 + \delta_2 Dum_2 + \varepsilon_2 \tag{6.35}$$

$$\ln TGX = \alpha_3 + \beta_3 \ln GDP + \lambda_3 Dum_1 + \delta_3 Dum_2 + \varepsilon_3 \tag{6.36}$$

$$\ln(TGX/GDP) = \alpha_4 + \beta_4 \ln GDP + \lambda_4 Dum_1 + \delta_4 Dum_2 + \varepsilon_4 \tag{6.37}$$

$$\ln(TGX/POP) = \alpha_5 + \beta_5 \ln GDP + \lambda_5 Dum_1 + \delta_5 Dum_2 + \varepsilon_5 \tag{6.38}$$

$$\ln(TGX/GDP) = \alpha_6 + \beta_6 \ln GDP + \lambda_6 Dum_1 + \delta_6 Dum_2 + \varepsilon_6 \tag{6.39}$$

After we estimated the equations for all six versions of Wagner's law, the results in Table 6.11 below show that the variables under study are cointegrated at the 1%, 5% and 10% levels a part from the third version of Wagner' law.

Table 6.11 Cointegration Regressions with Total Real GDP
(The residual-based ADF and PP test)

	Cointegrating Regression	ADF Residual	PP Residual	β	λ	δ	R^2
1	$\ln TGX = f(\ln(GDP), Dum_1, Dum_2)$	-0.53 (-3.21*)	-0.58 (-4.59*)	1.69 (13.01)*	-0.94 (-2.97)*	-0.02 (-0.25)	0.93
2	$\ln TGXC = f(\ln(GDP), Dum_1, Dum_2)$	-0.36 (-2.05**)	-0.39 (-3.24*)	1.49 (10.09)*	-0.92 (-2.55)**	0.739 (5.73)*	0.92
3	$\ln TGX = f(\ln(GDP/POP), Dum_1, Dum_2)$	-0.13 (-1.11)	-0.13 (-1.37)	1.59 (4.67)*	0.18 (0.29)	0.76 (3.47)*	0.79
4	$\ln(TGX/GDP) = f(\ln(GDP/POP), Dum_1, Dum_2)$	-0.30 (-1.96**)	-0.25 (-1.98**)	1.23 (5.42)*	0.01 (0.04)	0.88 (6.00)*	0.85
5	$\ln(TGX/POP) = f(\ln(GDP/POP), Dum_1, Dum_2)$	-0.23 (-1.87***)	-0.24 (-2.31**)	1.40 (6.00)*	-0.08 (-0.21)	0.23 (1.53)	0.81
6	$\ln(TGX/GDP) = f(\ln(GDP), Dum_1, Dum_2)$	-0.82 (-4.14*)	-0.80 (-5.65*)	1.24 (15.88)*	-0.69 (-3.63)*	0.28 (4.18)*	0.96

*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively.
β - is the non-oil GDP elasticity. λ - The coefficients of the dum1. δ - The coefficients of the dum2

The elasticity is more than unity, and consistent with Wagner's law. Furthermore, the study estimated the equations with two dummies to see their effect on the six versions of Wagner's law regarding the Libyan economy. The results in Table 6.11 show that the variable dummy 1 was not found to be significant with versions 3, 4 and 5 but significant at the 1% level in version 1 and 6 and 5% level with version 2. This implies that the dummy 1 did not have any effect on these three versions. But the long-run relationship results on the dummy 2 coefficient are significant at the 1% level in versions 2, 3, 4 and 6 and insignificant in versions one and five of Wagner's law[9].

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[9] For more results see all tests in appendix (5).

6.4.2.4 Cointegration Tests including two Dummies Variables with Total Real non-oil GDP

We know that the standard cointegration analysis requires the classification of the variables onto I(1). Now we can test the residuals of our data for non-oil GDP with six versions of Wagner's law on the long-run with two dummy variables as follows:

$$\ln TGX = \alpha_1 + \beta_1 \ln(nonoilGDP) + \lambda_1 Dum_1 + \delta_1 Dum_2 + \varepsilon_1 \tag{6.40}$$

$$\ln TGXC = \alpha_2 + \beta_2 \ln(nonoilGDP) + \lambda_2 Dum_1 + \delta_2 Dum_2 + \varepsilon_2 \tag{6.41}$$

$$\ln TGX = \alpha_3 + \beta_3 \ln(nonoilGDP/POP) + \lambda_3 Dum_1 + \delta_3 Dum_2 + \varepsilon_3 \tag{6.42}$$

$$\ln(TGX/nonoilGDP) = \alpha_4 + \beta_4 \ln(nonoilGDP/POP) + \lambda_4 Dum_1 + \delta_4 Dum_2 + \varepsilon_4 \tag{6.43}$$

$$\ln(TGX/POP) = \alpha_5 + \beta_5 \ln(nonoilGDP/POP) + \lambda_5 Dum_1 + \delta_5 Dum_2 + \varepsilon_5 \tag{6.44}$$

$$\ln(TGX/nonoilGDP) = \alpha_6 + \beta_6 \ln(nonoilGDP) + \lambda_6 Dum_1 + \delta_6 Dum_2 + \varepsilon_6 \tag{6.45}$$

After we estimated the residuals in all the equations, Table 6.12 below summarises the results of the cointegration analysis using the Engle and Granger method. The results show that there exists a long-run relationship between government expenditure and non-oil gross domestic product in five versions of Wagner's law and no cointegration in the third version[10].

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[10]- For more results see all tests in appendixes (6).

Table 6.12 Cointegration Regressions with Total Real non-oil GDP
(The residual-based ADF and PP test)

	Cointegrating Regression	ADF Residual	PP Residual	β	λ	δ	R^2
1	$\ln TGX = f(\ln(nonoilGDP), Dum_1, Dum_2)$	-0.38 (-2.85*)	-0.36 (-3.06*)	1.34 (19.31)*	0.05 (0.29)	-0.40 (-4.62)*	0.96
2	$\ln TGXC = f(\ln(nonoilGDP), Dum_1, Dum_2)$	-0.21 (-1.84***)	-0.21 (-1.85***)	1.236 (15.44)*	-0.14 (-0.74)	0.39 (3.97)*	0.96
3	$\ln TGX = f(\ln(nonoilGDP/POP), Dum_1, Dum_2)$	-0.02 (-0.19)	-0.09 (-0.63)	1.75 (10.55)*	0.22 (0.75)	0.21 (1.64)***	0.91
4	$(\ln TGX/nonoilGDP) = f(\ln(non\ oilGDP/POP), Dum_1, Dum_2)$	-0.24 (-1.98**)	-0.27 (-2.37**)	0.39 (3.50)*	0.17 (0.87)	-0.24 (-2.79)*	0.55
5	$(\ln TGX/POP) = f(\ln(nonoilGDP)/POP, Dum_1, Dum_2)$	-0.24 (-1.98**)	-0.26 (-2.37**)	1.39 (12.45)*	0.17 (0.88)	-0.24 (-2.79)	0.92
6	$(\ln TGX/nooilGDP) = f(\ln(non\ oilGDP), Dum_1, Dum_2)$	-0.38 (-2.84*)	-0.36 (-3.06*)	0.34 (4.91)*	0.05 (0.29)	-0.40 (-4.63)*	0.64

*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively.
β - is the non-oil GDP elasticity. λ - The coefficients of the dum1
δ - The coefficients of the dum2

The dummy 1 coefficient are all insignificant. However, there is an effect from dummy 2 on all six versions because the dummy has a significant and negative coefficient. This implies that there has been an effect of the UN sanctions on the six versions of Wagner's law on Libya's non-oil GDP. In addition, the non-oil GDP elasticity gives a clear indication of the importance and significance of non-oil GDP growth in four of the six versions of Wagner's law.

With evidence of cointegration in all most of the versions of Wagner's law, an error correction procedure to model short-run relationship can not used. It is possible to continue to model the short-term relationship by applying the Granger

causality test to measure for possible causal relationships between variables, (Ansari et al., 1997).

6.5 Summary

The aim of the present chapter was to test the long-run equilibrium relationship between measures of real government expenditure and real gross domestic product to test the validity of Wagner's Law, using annual time series data taken from Libya covering the period 1962-2005. The study included two dummy variables to test this relationship.

Although empirical studies have used a diversity of models to examine the relationship between government expenditure and economic growth, for my study I have used six different formulations of the Law for real total GDP and real total non-oil GDP. The empirical analysis commenced with the examination of the time series properties of the variables. This procedure involved testing for stationarity and cointegration analysis.

Wagner's Law has found much support from many previous time series studies. However, these studies have suffered from frequent methodological problems in their time series analysis. Since they did not test the stationarity of the variables, the empirical results might lead to the problem of spurious regression. To overcome the problems of previous studies, I attempted to test the stationarity of the time series data on real government expenditure and real gross domestic product using Libyan data for the period from 1962-2005.

In specific terms, we tested for the existence of unit roots using the ADF and PP tests for all the variables. The unit root test results showed that all the variables were nonstationary in levels, but stationary in first differences. This means they are integrated of order one I(1).

Since the variables are integrated of I(1), the cointegration test was applied, in order to investigate the long-run relationship on all versions of the regression models (GDP and non-oil GDP) based on the two step Engle-Granger method. Based on the results of the cointegration tests the null hypothesis of no cointegration test was rejected for many of the versions of Wagner's law with total GDP and total non-oil GDP.

In other words, there is some support for the existence of a long-run equilibrium relationship between government expenditure and GDP for the Libyan case. However, we got the best results when the study included two dummy variables to test this relationship with total GDP and total non-oil GDP. In the next chapter the study will be testing the short-run relationship between gross domestic product and government expenditure. The study will use the error correction model to test this relation, and the Granger causality tests will be used in the next chapter.

CHAPTER SEVEN

The Short-run Analysis

7.1 Introduction

The main objective of this chapter is to investigate causality between government expenditure and real total GDP and non-oil GDP in Libya for the period 1962-2005. In this chapter, the study applies the short-run equilibrium relationship, aiming to explain the relation between GDP growth and government expenditure using the Granger causality test for the estimated period. First, using the error correction model analysis with real total GDP and non-oil GDP in section 7.2, we analyse the Granger causality test for real total GDP and non-oil GDP in section 7.3, while section 7.4 is the summary.

7.2 Error Correction Model (ECM)

The error correction model (ECM) is concerned with the short-run of variables in the systems which are influenced by deviation from long-run equilibrium (Enders, 1998). The idea is that disequilibrium in the economic system from one period is corrected in the next period. The concept of error correction is related to cointegration because the cointegration relationship describes the long-run equilibrium. If a set of variables are cointegrated, then there exists an error correction model to describe the short-run adjustment to equilibrium. Following Engle and Granger (1987) Engle and Granger (1988), if two variables are cointegrated then there is an error correction model, or ECM representation, between them. Granger (1988) suggests that if the series are found to be stationary

I(1) and cointegrated, then include an equivalent ECM to re-parameterise the model, (Miller and Russek,1990). According to Engle and Granger (1988), cointegrated variables must have an ECM representation. The main reason for the popularity of cointegration analysis is that it provides a formal background for testing and estimating short-run and long-run relationships among economic variables. Furthermore, the ECM strategy provides an answer to the problem of spurious correlation (Enders, 1998)[1].

For the short-run relationship between government expenditure and gross domestic product, the study utilises an error correction model estimated by Ordinary Least Squares (OLS), and derives this ECM using the residuals from the estimated cointegrating regression for both real total GDP and real total non-oil GDP. In this case the error correction model that links the short-run behaviour of the two variables is given by the estimating equation (7.1) with all variables in first difference form, and the one year lagged residual from the cointegration equation (which represents the error correction term, ECT_{t-1}) as follows:

$$\Delta \ln TGX_t = \alpha_0 + \beta_0 \Delta \ln GDP_t + \gamma_0 ECT_{t-1} + u_t \qquad (7.1)$$

Where Δ denotes the first difference operator, ECT_{t-1} is the error correction term, and γ_0 is the coefficient of the error correction term, which measures the short-run adjustment. The ECM should be negative and statistically significant if the relevant variables are cointegrated. These conditions provide further evidence and confirmation of the long-run and short-run relationships between the variables (Iyare and Troy, 2004). Now we apply equation (7.1) to the relationship between

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[1] For a useful discussion of spurious correlations and ECM strategy, see Enders (1998).

government expenditure and gross domestic product with real total GDP and real non-oil GDP.

7.2.1 Error Correction Model with Real Total GDP

As we mentioned earlier, the specification of error correction models requires the existence of some equilibrium relationship between the variables. This means that if two variables are cointegrated, according to Engle and Granger (1988), there is a long-run equilibrium relationship between these variables. Even if Wagner's law corresponds to a long run model, it is of high interest to examine the short run reactions of government expenditure, (Nikolaos. D and Antonis, A. 2004). In this case the error correction model is given by the following equations.

Peacock-Wiseman model:

$$\Delta \ln TGX_t = \alpha_1 + \beta_1 \Delta \ln GDP_t + \gamma_1 ECT_{t-1} + u_t \tag{7.2}$$

Pryor model:

$$\Delta \ln TGXC_t = \alpha_2 + \beta_2 \Delta \ln GDP_t + \gamma_2 ECT_{t-1} + u_t \tag{7.3}$$

Goffman model:

$$\Delta \ln TGX_t = \alpha_3 + \beta_3 \Delta \ln GDP / POP_t + \gamma_3 ECT_{t-1} + u_t \tag{7.4}$$

Musgrave model:

$$\Delta \ln TGX / GDP_t = \alpha_4 + \beta_4 \Delta \ln GDP / POP_t + \gamma_4 ECT_{t-1} + u_t \tag{7.5}$$

Gupta model:

$$\Delta \ln TGX / POP_t = \alpha_5 + \beta_5 \Delta \ln GDP / POP_t + \gamma_5 ECT_{t-1} + u_t \tag{7.6}$$

Mann model:

$$\Delta \ln TGX / GDP_t = \alpha_6 + \beta_6 \Delta \ln GDP_t + \gamma_6 ECT_{t-1} + u_t \tag{7.7}$$

The estimation results for all six versions of Wagner's law for the Libyan economy

are presented[2] in Table 7.1

Table 7.1 Error Correction Model (ECM) Results with Real Total GDP

	Dependent variable	α	β	γ
1	Δ ln TGX	0.074 (2.383)**	0.398 (2.608)*	-0.243 (-2.895)*
2	Δ ln TGXC	0.086 (6.434)*	0.258 (3.968)**	-0.085 (-3.534)*
3	Δ ln TGX	0.092 (3.104)*	0.288 (1.850)***	-0.107 (-2.515)**
4	Δ ln (TGX/GDP)	0.072 (4.196)*	0.150 (1.669)***	-0.126 (-4.358)*
5	Δ ln (TGX/POP)	0.057 (1.970)**	0.316 (2.093)**	-0.205 (-2.898)*
6	Δ ln (TGX/GDP)	0.061 (3.562)*	0.238 (2.859)*	-0.308 (-5.092)*

The numbers in parentheses are the values of the estimated t-statistic.
*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively.
β is the GDP elasticity. γ is the value of the ECT coefficient.

The results show that there is a short-run relationship in all the versions with

respect to real GDP. We reach this conclusion because the signs for ECT_{t-1} are

negative, and their coefficients are statistically significant at the 1% level. Also this

result is in agreement with the economic theory. The results also show that the

short-run coefficients of GDP (GDP elasticity) are positive and statistically

significant at the 5% level of significance.

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[2] for more results from tests see appendix (8)

7.2.2 Error Correction Model including two dummies with Real Total GDP

In this section we rewrite the six versions of Wagner's law with two dummy variables to test the effect of these dummies on the relationship in the short-run. In this case the error correction model is given by the following equations:

Peacock-Wiseman model: (7.8)

$$\Delta \ln TGX_t = \alpha_1 + \beta_1 \Delta \ln GDP_t + \gamma_1 ECT_{t-1} + \lambda_1 Dum_1 + \delta_1 Dum_2 + u_{1t}$$

Pryor model: (7.9)

$$\Delta \ln TGXC_t = \alpha_2 + \beta_2 \Delta \ln GDP_t + \gamma_2 ECT_{t-1} + \lambda_2 Dum_1 + \delta_2 Dum_2 + u_{2t}$$

Goffman model: (7.10)

$$\Delta \ln TGX_t = \alpha_3 + \beta_3 \Delta \ln GDP / POP_t + \gamma_3 ECT_{t-1} + \lambda_3 Dum_1 + \delta_3 Dum_2 + u_{3t}$$

Musgrave model: (7.11)

$$\Delta \ln TGX / GDP_t = \alpha_4 + \beta_4 \Delta \ln GDP / POP_t + \gamma_4 ECT_{t-1} + \lambda_4 Dum_1 + \delta_4 Dum_2 + u_{4t}$$

Gupta model: (7.12)

$$\Delta \ln TGX / POP_t = \alpha_5 + \beta_5 \Delta \ln GDP / POP_t + \gamma_5 ECT_{t-1} + \lambda_5 Dum_1 + \delta_5 Dum_2 + u_{5t}$$

Mann model: (7.13)

$$\Delta \ln TGX / GDP_t = \alpha_6 + \beta_6 \Delta \ln GDP_t + \gamma_6 ECT_{t-1} + \lambda_6 Dum_1 + \delta_6 Dum_2 + u_{6t}$$

The results for error correction residual coefficients based on the cointegration test results are presented in Tables 6.7 and 6.8 in chapter six. Now, we can see the results for the error correction model in Table 7.2 below[3].

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[3] -Please refer to the appendix (8) for the results of individual version.

Table 7.2 Error Correction Model results with real total GDP and included Dummies

Dependent variable	α	β	γ	λ	δ
1 Δ ln TGX	0.146 (1.79)***	-0.307 (-3.34)*	0.385 (2.31)**	-0.042 (-0.49)	-0.078 (-1.28)
2 Δ ln TGXC	0.130 (4.00)*	-0.131 (-3.73)*	0.236 (3.58)*	-0.015 (-0.45)	-0.069 (-2.83)*
3 Δ ln TGX	0.183 (2.21)**	-0.132 (-2.42)**	0.226 (1.36)	-0.057 (-0.63)	-0.088 (-1.41)
4 Δ ln (TGX/GDP)	0.154 (3.32)*	-0.174 (-3.76)*	0.111 (1.20)	-0.053 (-1.05)	-0.083 (-2.33)**
5 Δ ln (TGX/POP)	0.137 (1.69)***	-0.215 (-2.89)*	02.588 (1.59)	-0.054 (-0.60)	-0.070 (-1.14)
6 Δ ln (TGX/GDP)	0.134 (2.87)*	-0.372 (-4.24)*	0.228 (2.40)**	-0.050 (-1.03)	-0.067 (-1.87)***

The numbers in parentheses are the values of the estimated t-statistic

*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.

Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively

β is the non-oil GDP elasticity. γ is the coefficients of the ECT

λ is the coefficients of dum1. δ Is the coefficient of the dum2

The results show that the dummy 1 variable is not important because the coefficients were not found to be significant at any level with all six versions of Wagner's law. However, the coefficients for dummy 2 were significant in versions 2, 4 and 6.

7.2.3 Error Correction Model with Real non-oil GDP

In this section we report on using the error correction model with real non-oil GDP. Gummell (1990) and Manning and Adriacanos (1993) noted that in the absence of a long-run relationship or cointegrating relationship between variables it is still of interest to examine the short-run linkages between them. The argument is that even though a long-run relationship between two macroeconomic variables may not be established for a given time period, it is still possible that the variables are causally related in the short-run. We estimate the following equations:

Peacock-Wiseman model: (7.14)

$$\Delta \ln TGX_t = \alpha_1 + \beta_1 \Delta \ln(nonoilGDP_t) + \gamma_1 ECT_{t-1} + u_{1t}$$

Pryor model: (7.15)

$$\Delta \ln TGXC_t = \alpha_2 + \beta_2 \Delta \ln(nonoilGDP_t) + \gamma_2 ECT_{t-1} + u_{2t}$$

Goffman model: (7.16)

$$\Delta \ln TGX_t = \alpha_3 + \beta_3 \Delta \ln(nonoilGDP / POP_t) + \gamma_3 ECT_{t-1} + u_{3t}$$

Musgrave model: (7.17)

$$\Delta \ln TGX / nonoilGDP_t = \alpha_4 + \beta_4 \Delta \ln(nonoilGDP / POP_t) + \gamma_4 ECT_{t-1} + u_{4t}$$

Gupta model: (7.18)

$$\Delta \ln TGX / POP_t = \alpha_5 + \beta_5 \Delta l(nnonoilGDP / POP_t) + \gamma_5 ECT_{t-1} + u_{5t}$$

Mann model: (7.19)

$$\Delta \ln TGX / nonoilGDP_t = \alpha_6 + \beta_6 \Delta \ln(nonoilGDP_t) + \gamma_6 ECT_{t-1} + u_{6t}$$

The results from estimating the error correction model for real non-oil GDP are reported[4] in Table 7.3.

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[4] Please refer to the appendix (9) for the results of individual version.

Table 7.3 Error Correction Model results with real non-oil GDP

	Dependent variable	α	β	γ
1	Δ ln TGX	0.036 (1.12)	0.890 (4.23)*	-0.144 (-1.42)
2	Δ ln TGXC	0.076 (4.09)*	0.381 (3.19)*	-0.120 (-2.33)**
3	Δ ln TGX	0.044 (1.38)	0.800 (3.81)*	-0.009 (-0.21)
4	Δ ln (TGX/ nonoil GDP)	0.035 (1.11)	-0.108 (-0.51)	-0.150 (-1.41)
5	Δ ln (TGX/POP)	0.032 (1.11)	0.886 (4.14)*	-0.151 (-1.43)
6	Δ ln (TGX/ nonoil GDP)	0.036 (1.12)	-0.109 (-0.51)	-0.144 (-1.42)

- The numbers in parentheses are the values of the estimated t-statistic.
*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively
β - is the non-oil GDP elasticity. - γ is the values of the ECT

The results show that the error correction coefficients in five equations are negative and statistically insignificant. Only the coefficient in version (2) was significant at the 1% level. However, the short-run coefficients of the non-oil GDP with respect to each variable show that real non-oil GDP has a positive impact in 4 versions and all the coefficients are statistically significant at the 1% level. To sum up, four versions (No.1, 2, 3, and 5) of Wagner's law are found to hold for non-oil GDP in the case of Libya.

7.2.4 Error Correction Model including two Dummies Variables with Real non-oil GDP

In this section, before we examine the error correction model with two dummies for non-oil GDP, we rewrite the six versions of Wagner's law with two dummy variables. In this case the error correction model is given by the following equations:

Peacock-Wiseman model: (7.14)

$$\Delta \ln TGX_t = \alpha_1 + \beta_1 \Delta \ln(nonoilGDP_t) + \gamma_1 ECT_{t-1} + \lambda_1 Dum_1 + \delta_1 Dum_2 + u_{1t}$$

Pryor model: (7.15)

$$\Delta \ln TGXC_t = \alpha_2 + \beta_2 \Delta \ln(nonoilGDP_t) + \gamma_2 ECT_{t-1} + \lambda_2 Dum_1 + \delta_2 Dum_2 + u_{2t}$$

Goffman model: (7.16)

$$\Delta \ln TGX_t = \alpha_3 + \beta_3 \Delta \ln(nonoilGDP / POP_t) + \gamma_3 ECT_{t-1} + \lambda_3 Dum_1 + \delta_3 Dum_2 + u_{3t}$$

Musgrave model: (7.17)

$$\Delta \ln TGX / nonoilGDP_t = \alpha_4 + \beta_4 \Delta \ln(nonoilGDP / POP_t) + \gamma_4 ECT_{t-1} + \lambda_4 Dum_1 + \delta_4 Dum_2 + u_{4t}$$

Gupta model: (7.18)

$$\Delta \ln TGX / POP_t = \alpha_5 + \beta_5 \Delta \ln(nonoilGDP / POP_t) + \gamma_5 ECT_{t-1} + \lambda_5 Dum_1 + \delta_5 Dum_2 + u_{5t}$$

Mann model: (7.19)

$$\Delta \ln TGX / nonoilGDP_t = \alpha_6 + \beta_6 \Delta \ln(nonoilGDP_t) + \gamma_6 ECT_{t-1} + \lambda_6 Dum_1 + \delta_6 Dum_2 + u_{6t}$$

The results of the error correction model test including two dummy variables are presented in Table 7.4 below[5]. The results show the error correction coefficients carry the expected negative sign on all variables but are insignificant. Also, the results for the two dummy coefficients were insignificant with all six versions. In summary, there was no short-run relationship between government expenditure and non-oil gross domestic product when the study includes these two dummies in the analysis

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[5] Please refer to the appendix (9) for the results of individual version

Table 7.4 error correction model results with real non-oil GDP and included dummies

	Dependent variable	α	β	γ	λ	δ
1	$\Delta \ln$ TGX	0.089 (1.05)	-0.167 (-1.34)	0.776 (3.25)*	-0.028 (-0.32)	-0.042 (-0.65)
2	$\Delta \ln$ TGXC	0.129 (2.75)*	-0.151 (-2.28)**	0.288 (2.16)*	-0.018 (-0.39)	-0.069 (-1.92)
3	$\Delta \ln$ TGX	0.125 (1.55)	-0.079 (-0.96)	0.748 (3.19)*	-0.035 (-0.41)	-0.050 (-0.96)
4	$\Delta \ln$ (TGX/ nonoil GDP)	0.080 (1.00)	-0.145 (-1.27)	-0.224 (-0.95)	-0.031 (-0.36)	-0.034 (-0.53)
5	$\Delta \ln$ (TGX/POP)	0.080 (0.99)	-0.146 (-1.27)	0.775 (3.30)*	-0.031 (-0.36)	-0.033 (-0.53)
6	$\Delta \ln$ (TGX/ nonoil GDP)	0.089 (1.05)	-0.168 (-1.34)	-0.223 (-0.93)	-0.028 (-0.32)	-0.042 (-0.65)

The numbers in parentheses are the values of the estimated t-statistic.
*, ** and*** indicate significance at 1%, 5% and 10% levels respectively.
Critical values in level at 1%, 5% and 10% are -2.618, -1.948, -1.619 respectively.
β is the non-oil GDP elasticity. γ is the coefficients of the ECT
λ is the coefficients of the dum1. δ is the coefficients of the dum2

7.3 Granger Causality Tests.

The Granger causality test is used because of its popularity in economic literature and, in particular, in these types of studies (Asserey, Ahmad, 1996). According to Asserey "one important implication of the Granger Causality theorem is the super consistency property that can be used to formulate Granger Causality with I(1) variables". Since we applied cointegration tests earlier in chapter six and found evidence of a cointegrating relationship in most versions of Wagner's law, it is now possible to apply causality testing.

If the null hypothesis of cointegration between Y_t (government expenditure TGX), and X_t (gross domestic product GDP) cannot be rejected then the standard Granger causality test can be employed to examine the causal relationship between the series using the variables in first differences (Mahdavi et al., 1994). Following this

statement we test the hypothesis that GDP growth, labelled $\Delta \ln GDP$ causes

government expenditure, labelled $\Delta \ln TGX$ and vice versa, by constructing the

following regression equations:

$$\Delta \ln TGX = \alpha_0 + \sum_{i=1}^{m} \beta_i \Delta \ln TGX_{t-i} + \sum_{i=1}^{n} \delta_i \Delta \ln GDP_{t-i} + u_t \qquad (7.20)$$

$$\Delta \ln GDP = \alpha_0 + \sum_{i=1}^{s} \delta_i \Delta \ln GDP_{t-j} + \sum_{j=1}^{r} \beta_j \Delta \ln Y_{t-j} + u_t \qquad (7.21)$$

Where u_t are white-noise series and m, n and s, r is the maximum number of lags.

In subsection 6.4.1 in chapter six the study found that the variables were non

stationary in levels, but stationary in first differences. The causality literature

assumes stationarity of the time series being examined. Therefore, we will apply

Granger causality tests using the variables in first differences of the logarithms of

the variables which are stationary I(1).

The findings from the Granger causality tests will examine different possibilities:

(1) neither variable causes the other. In other words, independence is suggested if

the sets of GDP and TGX coefficients are not statistically significant in both

regressions. (2) Unidirectional causality from GDP to TGX. That is GDP causes

TGX, but not vice versa (in this case Wagner's law applies); (3) Unidirectional

causality from TGX to GDP: that is TGX causes GDP, but not vice versa

(Keynesian model), (4) GDP and TGX "Granger cause" each other. If (4) is found

to be true, there is a feedback effect between the two variables (Gujarati, 1995). We

apply the Granger causality test with total real GDP, and with total real non-oil

GDP

7.3.1 Granger Causality Test with Total Real GDP

To test whether government expenditure Granger causes gross domestic product, this study applies the causality test developed by Granger (1969). In order to examine Granger causality involving two variables, the equations are:

Peacock-Wiseman model: (7.22)

$$\Delta \ln TGX_t = \alpha_1 + \sum_{i=1}^{k} \beta_1 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_1 \Delta \ln GDP_{t-j} + u_{1t}$$

$$\Delta \ln GDP_t = \alpha_2 + \sum_{i=1}^{k} \beta_2 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_2 \Delta \ln GDP_{t-j} + u_{2t}$$

Pryor model: (7.23)

$$\Delta \ln TGXC_t = \alpha_3 + \sum_{i=1}^{k} \beta_3 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_3 \Delta \ln GDP_{t-j} + u_{3t}$$

$$\Delta \ln GDP_t = \alpha_4 + \sum_{i=1}^{k} \beta_4 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_4 \Delta \ln GDP_{t-j} + u_{4t}$$

Goffman model: (7.24)

$$\Delta \ln TGX_t = \alpha_5 + \sum_{i=1}^{k} \beta_5 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_5 \Delta \ln(GDP/POP)_{t-j} + u_{5t}$$

$$\Delta \ln(GDP/POP)_t = \alpha_6 + \sum_{i=1}^{k} \beta_6 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_6 \Delta \ln(GDP/POP)_{t-j} + u_{6t}$$

Musgrave model: (7.25)

$$\Delta \ln(TGX/GDP)_t = \alpha_7 + \sum_{i=1}^{k} \beta_7 \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_7 \Delta \ln(GDP/POP)_{t-j} + u_{7t}$$

$$\Delta \ln(GDP/POP)_t = \alpha_8 + \sum_{i=1}^{k} \beta_8 \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_8 \Delta \ln(GDP/POP)_{t-j} + u_{8t}$$

Gupta model:

$$\Delta \ln(TGX/POP)_t = \alpha_9 + \sum_{i=1}^{k} \beta_9 \Delta \ln(TGX/POP)_{t-i} + \sum_{j=1}^{m} \delta_9 \Delta \ln(GDP/POP)_{t-j} + u_{9t}$$

$$\Delta \ln(GDP/POP)_t = \alpha_{10} + \sum_{i=1}^{k} \beta_{10} \Delta \ln(TGX/POP)_{t-i} + \sum_{j=1}^{m} \delta_{10} \Delta \ln(GDP/POP)_{t-j} + u_{10t}$$

Mann model: (7.27)

$$\Delta \ln(TGX/GDP)_t = \alpha_{11} + \sum_{i=1}^{k} \beta_{11} \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_{11} \Delta \ln GDP_{t-j} + u_{11t}$$

$$\Delta \ln GDP_t = \alpha_{12} + \sum_{i=1}^{k} \beta_{12} \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_{12} \Delta \ln GDP_{t-j} + u_{12t}$$

The results from the standard Granger causality tests for the six versions of Wagner's Law with total real GDP are shown[6] in Table 7.5 below.

The empirical results in this study the first step for statistical results for real total GDP as follows. We find unidirectional causality from gross domestic product (ln GDP) to government expenditure (ln TGX) with version No.1 because the hypothesis has rejected the causality between the variable and is statistically significant at the 10% level. Consequently, this version of Wagner's Law (No.1) is found to support Wagner's hypothesis.

The analysis also found that the unidirectional causality runs from gross domestic product (ln GDP) to government expenditure on consumption (ln TGXC). This is for version (No.2) of Wagner's law because the results indicate that there is causality to reject the null hypothesis at the 10% level. This shows support the Wagner's Law

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[6] - Please refer to the appendix (11) for the causality results.

Table 7.5 Results of Granger Causality Tests for Total Real GDP

version	Hypothesis	lag	P-value	Decision	Conclusion
(1.1)	H_0: ln GDP does not cause ln TGX	1	0.063	Reject H_0 at 10%	ln GDP ⟶ ln TGX
(1.2)	H_0: ln TGX does not cause ln GDP	1	0.214	Accept H_0	ln TGX ⇸ ln GDP
(2.1)	H_0: ln GDP does not cause ln TGXC	1	0.060	Reject H_0 at 10%	ln GDP ⟶ ln TGXC
(2.2)	H_0: ln TGXC does not cause ln GDP	1	0.782	Accept H_0	ln TGXC ⇸ ln GDP
(3.1)	H_0: ln GDP/POP does not cause ln TGX	1	0.134	Accept H_0	ln GDP/POP ⇸ ln TGX
(3.2)	H_0: ln TGX does not cause ln GDP/POP	1	0.528	Accept H_0	ln TGX ⇸ ln GDP/POP
(4.1)	H_0: ln GDP/POP does not cause ln TGX/GDP	4	0.00	Reject H_0 at 5%	ln GDP/POP ⟶ ln TGX/GDP
(4.2)	H_0: ln TGX/GDP does not cause ln GDP/POP	4	0.185	Accept H_0	ln TGX/GDP ⇸ ln GDP/POP
(5.1)	H_0: ln GDP/POP does not cause ln TGX/POP	1	0.052	Reject H_0 at 10%	ln GDP/POP ⟶ ln TGX/POP
(5.1)	H_0: ln TGX/POP does not cause ln GDP/POP	1	0.960	Accept H_0	ln TGX/POP ⇸ ln GDP/POP
(6.1)	H_0: ln GDP does not cause ln TGX/GDP	4	0.00	Reject H_0 at 5%	ln GDP ⟶ ln TGX/GDP
(6.2)	H_0: ln TGX/GDP does not cause ln GDP	4	0.286	Accept 5%	ln TGX/GDP ⇸ ln GDP

We using Akaike's Information criterion (AIC) and the Schwarz information criterion (SIC) for the chosen lag lengths.

⟶ Unidirectional causality   ⇸ Non causality

Also, from the Table 7.5 above it could be conclude more results. In the case of version (No.3), we run the standard causality test between the variables and can report that there is no causality running from per capita (ln GDP/POP) and government expenditure (ln TGX). This does not indicate the direction of causality between the variables. By looking at the probability values we conclude that the

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standard Granger causality test for this version of Wagner's Law indicates that there is no causality between the two variables because the probability of rejecting the null hypothesis is more than 5% level.

After running the standard Granger causality test between the variables for version (No.4) among the variables the results indicates that there is unidirectional causality which runs from per capita (In GDP/POP) to government expenditure in real gross domestic product (In TGXGDP) because the probability of rejecting the null hypothesis is less than the 5% level. This version also shows support for Wagner's Law.

The results for version 5 of Wagner's law indicate that there is unidirectional causality that runs from per capita (GDP/POP) to the per capita government expenditure (TGX/POP). We could establish Granger causality between the GDP/POP, TGX/POP because the probability of rejecting the null hypothesis is less than the 10% level. This version also shows support for Wagner's Law.

In the last Wagner's Law version (No.6) with real total GDP. The causality is hypothesised to run from gross domestic product (In GDP) to the real total government expenditure in real gross domestic product (In TGX/GDP). In other words, the hypothesis is that (In GDP) causes the (In TGX/GDP). The test is carried out and the results showed unidirectional causality which run from (GDP) to (TGX/GDP), because the hypothesis has been rejected at the 5% level. This version is also supports Wagner's hypothesis.

7.3.2 Granger Causality Test with Total Real GDP including two Dummies Variables

The following Granger causality test includes two dummy variables. In order to investigate the effects of the two dummies variables the equations are rewritten as follows:

Peacock-Wiseman model: (7.22)

$$\Delta \ln TGX_t = \alpha_1 + \sum_{i=1}^{k} \beta_1 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_1 \Delta \ln GDP_{t-j} + \lambda_1 Dum_1 + \gamma_1 Dum_2 + u_{1t}$$

$$\Delta \ln GDP_t = \alpha_2 + \sum_{i=1}^{k} \beta_2 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_2 \Delta \ln GDP_{t-j} + \lambda_2 Dum_1 + \gamma_2 Dum_2 + u_{2t}$$

Pryor model: (7.23)

$$\Delta \ln TGXC_t = \alpha_3 + \sum_{i=1}^{k} \beta_3 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_3 \Delta \ln GDP_{t-j} + \lambda_3 Dum_1 + \gamma_3 Dum_2 + u_{3t}$$

$$\Delta \ln GDP_t = \alpha_4 + \sum_{i=1}^{k} \beta_4 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_4 \Delta \ln GDP_{t-j} + \lambda_4 Dum_1 + \gamma_4 Dum_2 + u_{4t}$$

Goffman model: (7.24)

$$\Delta \ln TGX_t = \alpha_5 + \sum_{i=1}^{k} \beta_5 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_5 \Delta \ln(GDP/POP)_{t-j} + \lambda_5 Dum_1 + \gamma_5 Dum_2 + u_{5t}$$

$$\Delta \ln(GDP/POP)_t = \alpha_6 + \sum_{i=1}^{k} \beta_6 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_6 \Delta \ln(GDP/POP)_{t-j} + \lambda_6 Dum_1$$
$$+ \gamma_6 Dum_2 + u_{6t}$$

Musgrave model: (7.25)

$$\Delta \ln(TGX/GDP)_t = \alpha_7 + \sum_{i=1}^{k} \beta_7 \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_7 \Delta \ln(GDP/POP)_{t-j} +$$
$$\lambda_7 Dum_1 + \gamma_7 Dum_2 + u_{7t}$$

$$\Delta \ln(GDP/POP)_t = \alpha_8 + \sum_{i=1}^{k} \beta_8 \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_8 \Delta \ln(GDP/POP)_{t-j}$$

$$+ \lambda_8 Dum_1 + \gamma_8 Dum_2 + u_{8t}$$

Gupta model: (7.26)

$$\Delta \ln(TGX/POP)_t = \alpha_9 + \sum_{i=1}^{k} \beta_9 \Delta \ln(TGX/POP)_{t-i} + \sum_{j=1}^{m} \delta_9 \Delta \ln(GDP/POP)_{t-j}$$

$$+ \lambda_9 Dum_1 + \gamma_9 Dum_2 + u_{9t}$$

$$\Delta \ln(GDP/POP)_t = \alpha_{10} + \sum_{i=1}^{k} \beta_{10} \Delta \ln(TGX/POP)_{t-i} + \sum_{j=1}^{m} \delta_{10} \Delta \ln(GDP/POP)_{t-j}$$

$$+ \lambda_{10} Dum_1 + \gamma_{10} Dum_2 + u_{10t}$$

Mann model: (7.27)

$$\Delta \ln(TGX/GDP)_t = \alpha_{11} + \sum_{i=1}^{k} \beta_{11} \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_{11} \Delta \ln GDP_{t-j}$$

$$+ \lambda_{11} Dum_1 + \gamma_{11} Dum_2 + u_{11t}$$

$$\Delta \ln GDP_t = \alpha_{12} + \sum_{i=1}^{k} \beta_{12} \Delta \ln(TGX/GDP)_{t-i} + \sum_{j=1}^{m} \delta_{12} \Delta \ln GDP_{t-j} + \lambda_{12} Dum_1$$

$$+ \gamma_{12} Dum_2 + u_{12t}$$

Table 7.6 below presents the results of Granger causality testing with two dummy variables for the six versions of Wagner's Law with total real GDP[7]. The results from Table 7.6 indicate that there exists bidirectional (feedback) causality between gross domestic product (GDP) and government expenditure (TGX) in one lag length in version one, that is, ln GDP $\leftrightarrow$ ln TGX. The null hypothesis that GDP does not cause TGX, alternatively, TGX does not Granger causes GDP is rejected at the 5% level of significance.

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[7] - Please refer to the appendix (11) for the causality results when included two dummies

Table 7.6 Results of Granger Causality Tests with two Dummies for Total Real GDP

version	Hypothesis	lag	P-value	Decision	Conclusion
(1.1)	H_0: ln GDP does not cause ln TGX	1	0.010	Reject H_0 at 5%	ln GDP $\longrightarrow$ ln TGX
(1.2)	H_0: ln TGX does not cause ln GDP	1	0.036	Reject H_0 at 5%	ln TGX $\longrightarrow$ ln G DP
(2.1)	H_0: ln GDP does not cause ln TGXC	1	0.037	Reject H_0 at 5%	ln GDP $\longrightarrow$ ln TGXC
(2.2)	H_0: ln TGXC does not cause ln GDP	1	0.396	Accept H_0	ln TGXC $\longrightarrow\!\!\!\!\!\times$ ln GDP
(3.1)	H_0: ln GDP/POP does not cause ln TGX	1	0.900	Accept H_0	ln GDP/POP $\longrightarrow\!\!\!\!\!\times$ ln TGX
(3.2)	H_0: ln TGX does not cause ln GDP/POP	1	0.436	Accept H_0	ln TGX $\longrightarrow\!\!\!\!\!\times$ ln GDP/POP
(4.1)	H_0: ln GDP/POP does not cause ln TGX/GDP	4	0.025	Reject H_0 at 5%	ln GDP/POP $\longrightarrow$ ln TGX/GDP
(4.2)	H_0: ln TGX/GDP does not cause ln GDP/POP	4	0.0002	Reject H_0 at 1%	ln TGX/GDP $\longrightarrow$ ln GDP/POP
(5.1)	H_0: ln GDP/POP does not cause ln TGX/POP	1	0.589	Accept H_0	ln GDP/POP $\longrightarrow\!\!\!\!\!\times$ ln TGX/POP
(5.1)	H_0: ln TGX/POP does not cause ln GDP/POP	1	0.156	Accept H_0	ln TGX/POP $\longrightarrow\!\!\!\!\!\times$ ln GDP/POP
(6.1)	H_0: ln GDP does not cause ln TGX/GDP	1	0.006	Reject H_0 at 1%	ln GDP $\longrightarrow$ ln TGX/GDP
(6.2)	H_0: ln TGX/GDP does not cause ln GDP	1	0.0004	Reject H_0 at 1%	ln TGX/GDP $\longrightarrow$ Ln GDP

We using Akaike's Information criterion (AIC) and the Schwarz information criterion (SIC) for the chosen lag lengths.

$\longrightarrow$ Unidirectional causality $\longrightarrow\!\!\!\!\!\times$ Non causality

Also, it can be seen from Table 7.6 above more results, for the version 2 of Wagner's law we reject the null hypothesis that gross domestic product (ln GDP) does not Granger cause government expenditure on consumption (ln TGXC) at the 5% level of significance. However, we can not reject the null hypothesis that government expenditure on consumption (ln TGXC) does not Granger cause gross

domestic product (ln GDP) at any levels. We therefore, conclude that a one way causality relationship exists which flows from GDP to TGXC.

The results are shown that there is no causality in any direction between GDP and government expenditure in the third version, because we accept the null hypothesis. Neither economic growth leads government expenditure to growth (as opposed to Wagner's law) or government expenditure leads economy to growth (as opposed to Keynesian hypothesis).

In addition, the results indicate that there is a bidirectional Granger causality or feedback between government expenditure and gross domestic product, that is (GDP/POP ↔ TGX/GDP) in the version 4. this is because the study reject the null hypothesis at level 5% level of significance that GDP/POP does not Granger cause TGX/GDP and the study reject the other null hypothesis at the 1% level of significance that TGX/GDP does not Granger cause GDP/POP.

In the fifth model the results in Table 7.6 shows that the null hypothesis that ln GDP/POP does not Granger cause ln TGX/POP and cannot be rejected at the 5% level for one lag (p-value: 0.589), and the null hypothesis that ln TGX/POP does not Granger cause ln GDP/POP cannot be rejected at the 5% level for one lag (p-value: 0.156). Therefore, it can be concluded that there is no causality relationship between these variables for this version.

The results for version 6 of Wagner's law are also displayed in Table 7.6. The results indicate that Granger causality runs in both directions that is; there is bidirectional causality or feedback between GDP and TGX/GDP. The empirical investigation results revealed that causality ran from GDP to TGX/GDP in the first

hypothesis at the 1% level so we conclude that there is evidence to support Wagner's law. Also, we reject the null hypothesis that TGX/GDP does not Granger cause GDP at the 1% level. This result therefore shows support for the Keynesian hypothesis.

7.3.3 Granger Causality Test with Total Real non-oil GDP.

The Granger causality test helps in determining the direction of causality between the variables included in the model. The variables in this case are real total government expenditure (TGX), real total government expenditure on consumption (TGXC), per capita government expenditure (TGX/POP), and real total government expenditure in real gross domestic product (TGX/GDP). Real total non-oil GDP and per capita non-oil GDP will also be included. Since the two series are integrated of order one I(1), the Granger causality test is applied using the first differences of the two variables involved as follows:

Peacock-Wiseman model: (7.28)

$$\Delta \ln TGX_t = \alpha_1 + \sum_{i=1}^{k} \beta_1 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_1 \Delta \ln(nonoilGDP_{t-j}) + u_{1t}$$

$$\Delta \ln(nonoilGDP_t) = \alpha_2 + \sum_{i=1}^{k} \beta_2 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_2 \Delta \ln(nonoilGDP_{t-j}) + u_{2t}$$

Pryor model: (7.29)

$$\Delta \ln TGXC_t = \alpha_3 + \sum_{i=1}^{k} \beta_3 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_3 \Delta \ln(nonoilGDP_{t-j}) + u_{3t}$$

$$\Delta \ln(nonoilGDP_t) = \alpha_4 + \sum_{i=1}^{k} \beta_4 \Delta \ln TGXC_{t-i} + \sum_{i=1}^{m} \delta_4 \Delta \ln(nonoilGDP_{t-j}) + u_{4t}$$

Goffman model: (7.30)

$$\Delta \ln TGX_t = \alpha_5 + \sum_{i=1}^{k} \beta_5 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_5 \Delta \ln(nonoilGDP / POP_{t-j}) + u_{4t}$$

$$\Delta \ln(nonoilGDP / POP_t) = \alpha_6 + \sum_{i=1}^{k} \beta_6 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_6 \Delta \ln(nonoilGDP / POP_{t-j}) + u_{6t}$$

Musgrave model: (7.31)

$$\Delta \ln TGX / nonoilGDP = \alpha_7 + \sum_{i=1}^{k} \beta_7 \Delta \ln TGX / nonoilGDP_{-i} + \sum_{j=1}^{m} \delta_7 \Delta \ln(nonoilGDP / POP_{t-j})$$
$$+ u_{74t}$$

$$\Delta \ln(nonoilGDP / POP_t) = \alpha_8 + \sum_{i=1}^{k} \beta_8 \Delta \ln TGX / nonoilGDP_{t-i} + \sum_{j=1}^{m} \beta_8 \Delta \ln(nonoilGDP / POP_{t-j})$$
$$+ U_{8t}$$

Gupta model: (7.32)

$$\Delta \ln TGX / POP_t = \alpha_9 + \sum_{i=1}^{k} \beta_9 \Delta \ln TGX / POP_{t-i} + \sum_{j=1}^{m} \delta_9 \Delta \ln(nonoilGDP / POP_{t-j}) + u_{9t}$$

$$\Delta \ln(nonoilGDP / POP_t) = \alpha_{10} + \sum_{i=1}^{k} \beta_{10} \Delta \ln TGX / POP_{t-i} + \sum_{j=1}^{m} \delta_{10} \Delta \ln(nonoilGDP / POP_{t-j})$$
$$+ u_{10t}$$

Mann model: (7.33)

$$\Delta \ln TGX / nonoilGDP_t = \alpha_{11} + \sum_{i=1}^{k} \beta_{11} \Delta \ln TGX / nonoilGDP_{t-i} + \sum_{j=1}^{m} \delta_{11} \Delta \ln(nonoilGDP_{t-j})$$
$$+ u_{11t}$$

$$\Delta \ln(nonoilGDP_t) = \alpha_{12} + \sum_{i=1}^{k} \beta_{12} \Delta \ln TGX / nonoilGDP_{t-i} + \sum_{j=1}^{m} \delta_{12} \Delta \ln(nonoilGDP_{t-j}) + u_{12t}$$

According to the Granger representation theorem, at least one-way causality is confirmed if two variables are cointegrated. In this situation the null hypothesis of

noncausality has been tested using F-statistics for total real non-oil GDP. The Granger causality test results for the six versions of Wagner's law are presented[8] in Table 7.7 below.

After running the standard Granger causality test for version No.1, the study concluded that there is unidirectional causality that runs from government expenditure (ln TGX) to total real non-oil gross domestic product ln (non-oil GDP), because of the probability of rejecting the null hypothesis at 5% level. Thus, this version of Wagner's Law is not valid, which supports the Keynesian proposition.

In the case of version No. 2 of Wagner's law which test the hypothesis for causality between the variables, the result in Table 7.7 shows causality running from the real total non-oil gross domestic product ln (non-oil GDP) to real total government expenditure on consumption (ln TGXC). Also, the result indicates that there is unidirectional causality from ln (non-oil GDP) to ln TGXC because of the probability of rejecting the null hypothesis at 5% level. So we can conclude that the version (No.2) is supporting the Wagner's law for the period of analysis.

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[8] Please refer to Tables in the Appendix (12) for the results.

Table 7.7 Results of Granger-Causality Tests for Total Real non-oil GDP

version	Hypothesis	lag	P-value	Decision	Conclusion
(1.1)	H_0: ln non-oil GDP does not cause ln TGX	1	0.829	Accept H_0	ln (non-oil GDP) $\nrightarrow$ ln TGX
(1.2)	H_0: ln TGX does not cause ln non-oil GDP	1	0.044	Reject H_0 at 5%	ln TGX $\longrightarrow$ ln (non-oil GDP)
(2.1)	H_0: ln non-oil GDP does not cause ln TGXC	4	0.001	Reject H_0 at 5%	ln (non-oil GDP) $\longrightarrow$ ln TGXC
(2.2)	H_0: ln TGXC does not cause ln non-oil GDP	4	0.880	Accept H_0	ln TGX $\nrightarrow$ ln (non-oil GDP)
(3.1)	H_0: ln non-oil GDP/POP does not cause ln TGX	1	0.948	Accept H_0	ln (non-oil GDP/POP) $\nrightarrow$ ln TGX
(3.2)	H_0: ln TGX does not cause ln non-oil GDP/POP	1	0.588	Accept H_0	ln TGX $\nrightarrow$ ln (non-oil GDP/POP)
(4.1)	H_0: ln non-oil GDP/POP does not cause ln TGX/non-oil GDP.	2	0.011	Reject H_0 at 5%	ln (non-oil GDP/POP) $\longrightarrow$ ln TGX/non-oil GDP
(4.2)	H_0: ln TGX/non-oil GDP does not cause ln (non-oil GDP/POP)	2	0.130	Accept H_0	ln TGX/non-oil GDP $\nrightarrow$ ln (non-oil GDP/POP)
(5.1)	H_0: ln (non-oil GDP/POP) dos not cause ln TGX/POP	1	0.805	Accept H_0	ln (non-oil GDP/POP) $\nrightarrow$ ln TGX/POP
(5.2)	H_0: ln TGX/POP does not cause ln non-oil GDP/POP	1	0.074	Reject H_0 at 10%	ln TGX/POP $\longrightarrow$ ln (non-oil GDP/POP)
(6.1)	H_0: ln non-oil GDP does not cause ln TGX/non-oil GDP.	2	0.006	Reject H_0 at 1%	ln (non-oil GDP) $\longrightarrow$ ln TGX/non-oil GDP
(6.2)	H_0: ln TGX/non-oil GDP does not cause ln (non-oil GDP)	2	0.104	Accept H_0	ln TGX/non-oil GDP $\nrightarrow$ ln (non-oil GDP)

We using Akaike's Information criterion (AIC) and the Schwarz information criterion (SIC) for the chosen lag lengths.

$\longrightarrow$ Unidirectional causality $\nrightarrow$ Non causality

As can be seen the results from Table 7.7 above, we run the standard Granger causality test for version No.3 between the real total per capita non-oil GDP ln (non-oil GDP/POP) and real total government expenditure (ln TGX). Result is

reported in Table 7.7 and indicates that there is no causality that runs from non-oil GDP/POP to (TGX).

To reject the null hypothesis for version No.4 of Wagner's Law, the study run the standard causality test between real total per capita non-oil GDP ln (non-oil GDP/POP) and real total government expenditure in real non-oil gross domestic product (ln TGX/non-oil GDP). The Granger causality result is presented in Table 7.7 and shows that is unidirectional causality running from ln (non-oil GDP/POP) to (ln TGX/ non-oil GDP), because, by looking at the probability values, we can reject the null hypothesis at the 5% level. This version therefore also supports Wagner's Law.

The result of Granger causality for version No.5 for non-oil GDP is also shows in Table 7.7. The causality test runs between the per capita government expenditure (ln TGX/POP) and per capita non-oil gross domestic product ln (non-oil GDP/POP). The result shows as the standard unidirectional causality running from ln TGX/POP) to ln (non-oil GDP/POP because the probability value shows rejection of the null hypothesis at the 10% level. This version therefore shows support for the Keynesian hypothesis.

In the last version of Wagner's law, with respect to non-oil GDP, we run the standard Granger causality test between the non-oil gross domestic product ln (non-oil GDP) and the real total government expenditure in real non-oil gross domestic product (ln TGX/non-oil GDP). Again the results are shows in table 7.7 and demonstrate a unidirectional causality which running from non-oil GDP to TGX/non-oil GDP, because the probability values allow us to reject the null

hypothesis at the 5% level. We can therefore say that this version of Wagner's law is valid and Wagner's hypothesis is supported.

We seat that the Keynesian proposition is supported by versions No.1 and No. 5 for non-oil GDP. When the causality runs from government expenditure to non-oil GDP, this means that the government is heavily spending on investment infrastructure to accelerate the process of development. This type of government expenditure is expected to cause an increase in its national income.

7.3.4 Granger Causality Test with Total Real non-oil GDP including two Dummies Variables.

The following Granger causality test includes two dummies variables; and as such we can now rewrite the equations as follows.

Peacock-Wiseman model: (7.34)

$$\Delta \ln TGX_t = \alpha_1 + \sum_{i=1}^{k} \beta_1 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_1 \Delta \ln(nonoilGDP_{t-j}) + \lambda_1 Dum_1 + \gamma_1 Dum_2 + u_{1t}$$

$$\Delta \ln(nonoilGDP_t) = \alpha_2 + \sum_{i=1}^{k} \beta_2 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_2 \Delta \ln(nonoilGDP_{t-j}) + \lambda_2 Dum_1$$
$$+ \gamma_2 Dum_2 + u_{2t}$$

Pryor model: (7.35)

$$\Delta \ln TGXC_t = \alpha_3 + \sum_{i=1}^{k} \beta_3 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_3 \Delta \ln(nonoilGDP_{t-j}) + \lambda_3 Dum_1$$
$$+ \gamma_3 Dum_2 + u_{3t}$$

$$\Delta \ln(nonoilGDP_t) = \alpha_4 + \sum_{i=1}^{k} \beta_4 \Delta \ln TGXC_{t-i} + \sum_{j=1}^{m} \delta_4 \Delta \ln(nonoilGDP_{t-j}) + \lambda_4 Dum_1$$
$$+ \gamma_4 Dum_2 + u_{4t}$$

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Goffman model: (7.36)

$$\Delta \ln TGX_t = \alpha_5 + \sum_{i=1}^{k} \beta_5 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_5 \Delta \ln(nonoilGDP / POP_{t-j}) + \lambda_5 Dum_1$$

$$+ \gamma_5 Dum_2 + u_{4t}$$

$$\Delta \ln(non-oilGDP / POP_t) = \alpha_6 + \sum_{i=1}^{k} \beta_6 \Delta \ln TGX_{t-i} + \sum_{j=1}^{m} \delta_6 \Delta \ln(non-oilGDP / POP_{t-j})$$

$$+ \lambda_6 Dum_1 + \gamma_6 Dum_2 + u_{6t}$$

Musgrave model: (7.37)

$$\Delta \ln TGX / nonoilGDP = \alpha_7 + \sum_{i=1}^{k} \beta_7 \Delta \ln TGX / nonoilGDP_t + \sum_{j=1}^{m} \delta_7 \Delta \ln(nonoilGDP / POP_{t-j})$$

$$+ \lambda_7 Dum_1 + \gamma_7 Dum_2 + u_{74t}$$

$$\Delta \ln(nonoilGDP / POP_t) = \alpha_8 + \sum_{i=1}^{k} \beta_8 \Delta \ln TGX / nonoilGDP_{t-i} + \sum_{j=1}^{m} \beta_8 \Delta \ln(nonoilGDP / POP_{t-j})$$

$$+ \lambda_8 Dum_1 + \gamma_8 Dum_2 + U_{8t}$$

Gupta model: (7.38)

$$\Delta \ln TGX / POP_t = \alpha_9 + \sum_{i=1}^{k} \beta_9 \Delta \ln TGX / POP_{t-i} + \sum_{j=1}^{m} \delta_9 \Delta \ln(nonoilGDP / POP_{t-j}) + \lambda_9 Dum_1$$

$$+ \gamma_9 Dum_2 + u_{9t}$$

$$\Delta \ln(nonoilGDP / POP_t) = \alpha_{10} + \sum_{i=1}^{k} \beta_{10} \Delta \ln TGX / POP_{t-i} + \sum_{j=1}^{m} \delta_{10} \Delta \ln(nonoilGDP / POP_{t-j})$$

$$+ \lambda_{10} Dum_1 + \gamma_{10} Dum_2 + u_{10t}$$

Mann model: (7.39)

$$\Delta \ln TGX / nonoilGDP_t = \alpha_{11} + \sum_{i=1}^{k} \beta_{11} \Delta \ln TGX / nonoilGDP_{t-i} + \sum_{j=1}^{m} \delta_{11} \Delta \ln(nonoilGDP_{t-j})$$

$$+ \lambda_{11} Dum_1 + \gamma_{11} Dum_2 + u_{11t}$$

$$\Delta \ln(nonoilGDP_t) = \alpha_{12} + \sum_{i=1}^{k} \beta_{12} \Delta \ln TGX / nonoilGDP_{t-i} + \sum_{j=1}^{m} \delta_{12} \Delta \ln(nonoilGDP_{t-j})$$
$$+ \lambda_{12} Dum_1 + \gamma_{12} Dum_2 + u_{12t}$$

We use the standard Granger causality tests for the six versions of Wagner's Law for total real non-oil GDP with two dummies variables. Also, from Table 7.8 we can present the results[9].

The results show that there is no causality in any direction between the variables for versions 1, 3 and 5. This means there is no evidence to supports Wagner's law or the Keynesian hypothesis in these versions.

Also, the results show that we cannot reject the null hypothesis that ln non-oil GDP does not cause ln TGXC at the 5% level for 4 lag (p-value: 0.270). However, causality from government expenditure on consumption to non-oil gross domestic product is observed because the null hypothesis that ln TGXC that does not Granger cause ln non-oil GDP is rejected at the 1% level. This means there is unidirectional causality running from TGXC to non-oil GDP. This supports the Keynesian view that causality runs from government expenditure to growth.

In the fourth version of Wagner's law, the null hypothesis that ln (non-oil GDP/POP) does not Granger cause ln TGX/non-oil GDP, cannot be rejected because we accept this hypothesis at the 5% level. There is therefore no Granger causality between the variables. On the other hand, the study reject the null hypothesis that ln TGX/non-oil GDP does not Granger cause ln (non-oil GDP/POP) at the 5% level. This result gives support for the Keynesian hypothesis because

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[9] - Please refer to the appendix (12) for the results

there is unidirectional causality which runs in one way from TGX/non-oil GDP to non-oil GDP/POP.

The results also indicate that unidirectional causality exists between ln non-oil GDP and ln TGX/non-oil GDP because the null hypothesis that ln (non-oil GDP) does not cause ln TGX/non-oil GDP and cannot be rejected at any level. Moreover, we can reject the second null hypothesis that ln TGX/non-oil GDP does not cause ln non-oil GDP at the 1% level. This means that causality runs from ln TGX/non-oil GDP to ln non-oil GDP and in this case, the results also support the Keynesian hypothesis.

Table 7.8 Results of Granger-Causality Tests with two dummies variables for Total Real non-oil GDP

version	Hypothesis	lag	P-value	Decision	conclusion
(1.1)	H_0: In (non-oil GDP) does not cause In TGX	1	0.241	Accept H_0	In (non-oil GDP) ↛ In TGX
(1.2)	H_0: In TGX does not cause In (non-oil GDP)	1	0.370	Accept H_0	In TGX ↛ In (non-oil GDP)
(2.1)	H_0: In (non-oil GDP) does not cause In TGXC	4	0.270	Accept H_0	In (non-oil GDP) ↛ In TGXC
(2.2)	H_0: In TGXC does not cause In (non-oil GDP)	4	0.0002	Reject H_0 at 1%	In TGX → In (non-oil GDP)
(3.1)	H_0: In (non-oil GDP/POP) does not cause In TGX	2	0.408	Accept H_0	In (non-oil GDP/POP) ↛ In TGX
(3.2)	H_0: In TGX does not cause In (non-oil GDP/POP)	2	0.135	Accept H_0	In TGX ↛ In (non-oil GDP/POP)
(4.1)	H_0: In (non-oil GDP/POP) does not cause In TGX/non-oil GDP.	2	0.399	Accept H_0	In (non-oil GDP/POP) ↛ In TGX/non-oil GDP
(4.2)	H_0: In TGX/non-oil GDP does not cause In (non-oil GDP/POP)	2	0.018	Reject H_0 at 5%	In TGX/non-oil GDP → In (non-oil GDP/POP)
(5.1)	H_0: In (non-oil GDP/POP) dos not cause In TGX/POP	2	0.403	Accept H_0	In (non-oil GDP/POP) ↛ In TGX/POP
(5.2)	H_0: In TGX/POP does not cause In (non-oil GDP/POP)	2	0.178	Accept H_0	In TGX/POP ↛ In (non-oil GDP/POP)
(6.1)	H_0: In (non-oil GDP) does not cause In TGX/non-oil GDP.	2	0.329	Accept H_0	In (non-oil GDP) ↛ In TGX/non-oil GDP
(6.2)	H_0: In TGX/non-oil GDP does not cause In (non-oil GDP)	2	0.005	Reject H_0 at 1%	In TGX/non-oil GDP → In (non-oil GDP)

We using Akaike's Information criterion (AIC) and the Schwarz information criterion (SIC) for the chosen lag lengths.

→ Unidirectional causality   ↛ Non causality

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7.3.5 Summary of Results of the Granger Causality tests without Dummies Variables.

In general, in this section we have studied the possibility of Granger causality between ln GDP (for both total real GDP and non-oil GDP) and ln TGX. We have reported the Granger causality test results obtained by the vector auto regression (VAR) approach applied to the Libyan economy data. We need to check if evidence of causality is observed. It can run from gross domestic product (GDP and non-oil GDP) to government expenditure (TGX) (Wagner's Law), or from government expenditure (TGX) to (GDP and non-oil GDP) (the Keynesian hypothesis).

We know the Granger causality test is very sensitive to the number of lags included in the regression. We have experimented with a lag period up to 4 lag lengths, using Akaike's Information criterion (AIC) and the Schwarz information criterion (SIC)[10], following Afxentiou and Serletis (1992) and Demirbas (1999).

The null hypothesis of non causality has been tested using (P-value) statistics to infer the direction of the causality relationship amongst the variables. We can be summarised of results in Table 7.9.

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[10] - this study uses the Akaike Information Criterion (AIC) in selecting the optimal order of lags in the estimations, and adopted the Schwarz Information Criterion (SIC) as a supplementary measure to the AIC. Importantly, the causality is sensitive to the number of lagged terms included (Khan and Leng, 1997.).

Table 7.9 Summary of Results of Granger-Causality for Total Real GDP and non-Oil

GDP

	Conclusion	
	Total real GDP	**Total real non-oil GDP**
1	ln GDP ⟶ ln TGX	ln TGX ⟶ ln (non-oil GDP)
2	ln GDP ⟶ ln TGXC	ln (non-oil GDP) ⟶ ln TGXC
3	No causality	No causality
4	ln GDP/POP ⟶ ln TGX/GDP	ln (non-oil GDP/POP) ⟶ ln TGX /non-oil GDP
5	ln GDP/POP ⟶ ln TGX/POP	ln TGX/POP ⟶ ln (non-oil GDP/POP)
6	ln GDP ⟶ ln TGX/GDP	ln (non-oil GDP) ⟶ ln TGX/ non-oil GDP

⟶   This is unidirectional causality

From the Table 7.9 above it could be conclude that the majority of the results have

been supported Wagner's law 8 out of 12 results, and 2 out of 12 supports Keynes

hypothesis and there is no support for either Wagner's law or Keynesian hypothesis

for 2 versions.

7.3.6   Summary of the Results of Granger Causality with Dummies Variables.

In this section we summarised the results when the study used two dummy

variables to test for Granger causality. We report the Granger causality test results

obtained by using the vector auto regression (VAR) approach for the Libyan

economy data in Table 7.10 below.

Table 7.10 Summary of Results of Granger-Causality for Total Real GDP and non-Oil GDP with two dummies variables

	Conclusion	
	Total real GDP	Total real non-oil GDP
1	ln GDP ←→ ln TGX	No causality
2	ln GDP ⟶ ln TGXC	ln TGXC ⟶ ln (non-oil GDP)
3	No causality	No causality
4	ln GDP/POP ←→ ln TGX/GDP	ln TGX/ non-oil GDP ⟶ ln (non-oil GDP/POP
5	No causality	No causality
6	ln GDP ←→ ln TGX/GDP	ln TGX/ non-oil GDP ⟶ ln (non-oil GDP)

⟶ This is unidirectional causality.
←→ There is feedback causality between the two variables

According to the results obtained from the equations as stated earlier in Tables 7.6 and 7.8, the standard causality between the variables in terms of the real total GDP and real total non-oil GDP can be summarised in Table 7.10 above. The results has been shown that one out of 12 tests supports Wagner's law and 3 out of 12 tests supports Keynes hypothesis also, 3 out of tests has been supported both Wagner and Keynes, and 5 versions no support for either Wagner's law or Keynesian hypothesis .

7.4 Summary

The aim of this chapter was to investigate the relationship in the short-run for the six versions of Wagner's law on Libyan economy. The study used the Granger causality test to examine these relationships. The error correction model (ECM) was estimated in order to capture the short-run relationship between the government expenditure and gross domestic product (GDP and non-oil GDP)

The study examined the Granger causality test for total real GDP and total real non-oil GDP, the tests showed that 9 out of 24 tests support Wagner's law and 5 out of tests has been supported Keynes hypothesis, also 3 out of 24 tests support both Wagner and Keynes lastly, 7 out of 24 tests has been supported neither Wagner nor Keynes.

These are mixed results. The tests without dummies clearly support Wagner's law see Table 7.9, but the tests with dummies show limited support for Keynes (3 out of 12) or bidirectional causality (3out of 12) see Table 7.10. In general, Wagner's law appears to have more empirical support than Keynes hypothesis.

This Chapter analysed the short-run relationship between GDP and government expenditure for six versions of Wagner's law. The next Chapter will discuss the model of relationship between the Libyan government expenditure on six sectors and gross domestic product: applying of Wagner's law.

CHAPTER EIGHT

Relationship between Government Functional Expenditure and Gross Domestic Product

8.1 Introduction

In the last few decades, the academic literature dealing with explanations for government expenditure and economic growth has expanded greatly and new theories have appeared at a fast rate. Many theoretical studies have attempted to explain the sources of government growth, while others have tried to test these explanations empirically. As far as empirical research on public expenditure growth is concerned, most studies have concentrated on Western developed countries (see Henrekson, 1992; Gemmell, 1993; Albatel, 2000; AL-Hakami, 2002; Chiung 2006).

On the empirical side, a few studies have tried linking particular components of government expenditure to economic growth. Most of these attempts seem to be deficient in not having a rigorous theoretical framework (Diamond, 1989). The expenditure composition issue has been investigated by several authors using theoretical models focused on the productivity of public expenditure in the developed countries (Aschauer, 1989; Morrison and Schwartz, 1991). Other studies focus on the productivity of government expenditure in developing countries (Devarajan et al, 1996). The idea of this chapter is to analyse government functional expenditure on six sectors in the government's desire to satisfy the social needs of its people and to implement its long-term goals.

The study focuses on growth because as growth is one of the objectives of a government, it is useful to know the contribution of different types of expenditure to this objective as a means of assessing the cost of pursuing other goods; gross domestic

product is easier to measure than some of the other objectives of government (Devarajan et al, 1996). Although the public sector played an important role during the development procedure, few studies have been devoted to the time pattern growth of government expenditure in developing countries. Most empirical studies attempting to explain the growth of government expenditure in those countries are based on a cross-section approach.

In this chapter, I will attempt to explain the growth within Libyan government spending through functional expenditure in those sectors. Section 8.2 discusses the econometric model for government functional expenditure within the six sectors. The study tests long-run and short-run equilibrium in section 8.3 using econometric techniques with two dummy variables. Section 8.4 presents the re-estimation without dummies using econometric techniques, and the summary is presented in section 8.5.

8.2 Econometric Model for Functional Expenditure

In this chapter, I used the same approach which was used in chapters six and seven. Therefore we will not discuss the methodology in detail. As Muscatelli and Hurn (1995) have pointed out "there is an increasing trend for researchers to adopt dummy and proxy variables to explain possible structural breaks in the long-run relationship between a number of economic series". In the Libyan case, there are several extraordinary events which may cause structural breaks in the long-run relationship between the variables in question. For this reason, we will include two dummy variables in our functional expenditure regressions. To analyse the government functional expenditure, the study uses annual data[1] over the period 1962-2005 for the six sectors. To estimate the impact

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[1] The data are provided by the General Planning Council (2000), Report of Libyan Economic and Social Indicators 1962-2000, and Central Bank of Libya report (2005)

of gross domestic product on government expenditure, the government functional expenditure is based on the idea that government expenditure is a function of the GDP. Two dummy variables are included to capture special events over the study period. In the usual notation, the government functional expenditure relationship can be written as follows:

$$TGX_{fun_i} = f(GDP, DUM_1, DUM_2) \qquad (8.1)$$

Where:

i = 1, 2,3,4,5 and 6

TGX_{fun_i} is the iih government functional group in real terms (education, health, agriculture, housing and public utilities, manufacturing, and transportation and communication).

GDP= gross domestic product in real terms.

DUM1= dummy variable used to assess the impact of the discovery of oil on economic

   growth (Dum=1 during the stable period from 1969-2005 and zero

   otherwise.)

DUM2= dummy variable used to capture the effects of the UN sanctions on the Libyan

   economy (Dum= zero during 1969-1984 and 2004-2005 when there were

   no sanctions, and one when there was sanctions from 1985-2003)

Following the approach used in chapter six, the study uses the logarithm of the variables in real terms; so the parameters measure the elasticity of each of the variables in the function. In terms of computing these elasticities, the study uses the most popular formulation of Wagner's law given in the following equation:

$$\ln TGX_{fun_i} = \alpha + \beta \ln GDP + \gamma Dum_1 + \lambda Dum_2 + u_t \qquad (8.2)$$

The separate regressions for the six categories of functional government expenditure, for the case of Libya (1962-2005) are as follows:

$$\ln TGXAGR = \alpha_1 + \beta_1 \ln GDP + \lambda_1 Dum_1 + \delta_1 Dum_2 + \varepsilon_{1t} \qquad (8.3)$$

$$\ln TGXEDU = \alpha_2 + \beta_2 \ln GDP + \lambda_2 Dum_1 + \delta_2 Dum_2 + \varepsilon_{2t} \qquad (8.4)$$

$$\ln TGXHEA = \alpha_3 + \beta_3 \ln GDP + \lambda_3 Dum_1 + \delta_3 Dum_2 + \varepsilon_{3t} \qquad (8.5)$$

$$\ln TGXH \& P = \alpha_4 + \beta_4 \ln GDP + \lambda_4 Dum_1 + \delta_4 Dum_2 + \varepsilon_{4t} \qquad (8.6)$$

$$\ln TGXMAN = \alpha_5 + \beta_5 \ln GDP + \lambda_5 Dum_1 + \delta_5 Dum_2 + \varepsilon_{5t} \qquad (8.7)$$

$$\ln TGXT \& C = \alpha_6 + \beta_6 \ln GDP + \lambda_6 Dum_1 + \delta_6 Dum_2 + \varepsilon_{6t} \qquad (8.8)$$

Where

TGXEDU= real government expenditure on education[2]

TGXHEA= real government expenditure on health

TGXAGR= real government expenditure on agriculture

TGXH&P= real government expenditure on housing and public utilities

TGXMAN= real government expenditure on manufacturing

TGXT&C= real government expenditure on transportation and communication

The methodology in this chapter is as follows: in the first step the study analyses the empirical results of a cointegration test and whether it can be applied to determine the existence of a long-run relationship between the variables or not. The analysis is based on Engle and Granger (1987) methods for modelling the relationship between cointegrated variables. The empirical analysis of a cointegration test includes ADF unit root tests in order to know which one of these variables used in all six categories of Wagner's law is stationary.

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[2]- all variables expressed in million LDs

In the second step, the study uses an error correction model estimated by ordinary least squares (OLS), to determine the existence of a short-run relationship between the variables in the government functional expenditure regression. The ECM uses the residuals from the estimated cointegrating regression for all equations.

In the final step, we adopt Granger causality tests to determine the direction of the causality between the variables in the government functional expenditure regressions. If cointegration exists we know that causality should exist in at least one direction in the I(1) variables. The direction of causality between GDP and government functional expenditure is analysed using two dummy variables

8.3   Estimation of Government Functional Expenditure with two Dummies Variables.

In this section the study includes the functional expenditure classification relating to government spending in the economic sectors. Our available data for government expenditure includes data for overall government expenditure and (six) compositional expenditures. Figure 1.1 in Chapter one shows the six categories for government expenditure: TGXEDU (education), TGXHE (health), TGXAGR (agriculture), TGXHOU (housing and public utilities), TGXMAN (manufacturing), and TGXTRA (transportation and communication), and other spending for economic services. Since these categories have some importance in GDP, it is very important to analyse their relationship with the growth of gross domestic product according to Wagner's law.

8.3.1 Testing for Stationarity

8.3.1.1 Graphs for Six Categories

The first technique which can be used to check stationarity of the variables is to graph the series. The graphs of these variables in logarithm for the six categories, all the variables which we used in the study the Figures are shown as following.

Figure 8.1 Graphs of the Variables for Six Categories

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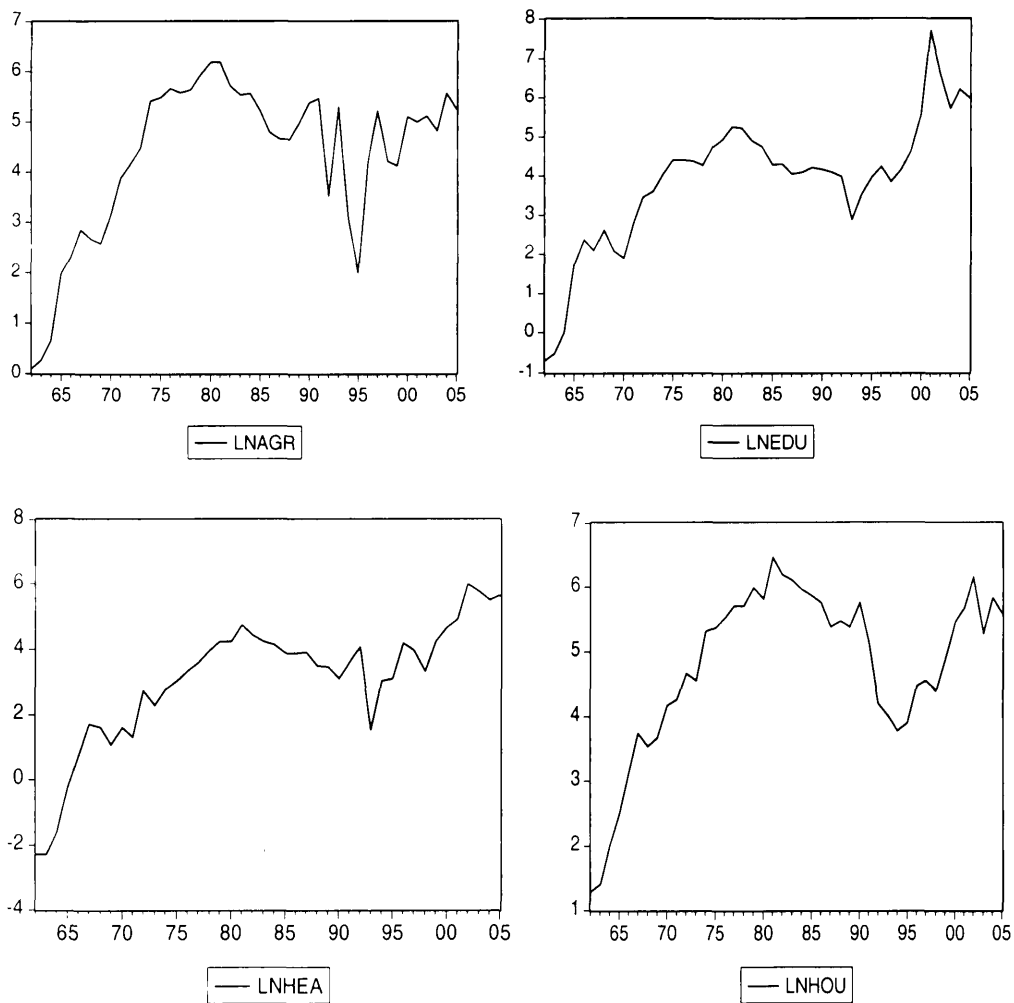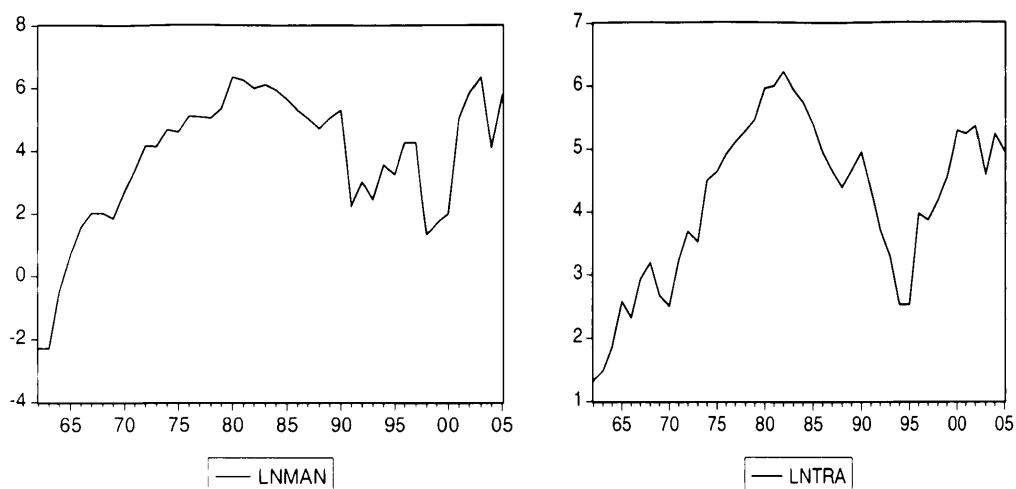
The graphs indicate that all the variables are stationary in first differences. Therefore, the variables seem to be integrated of order one. Now we can check for stationarity using the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for unit roots.

8.3.1.2 Testing Unit Roots For Six Categories

One of the most important characteristics of a time series variable is its order of integration. The study applies the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to test the stationarity of the variables. We test the null hypothesis H0: $\beta = 0$ is tested against H_1: $\beta_1 \neq 0$ by comparing the calculated t- ratio of β_1 with the critical value from tables. If the calculated critical value is less than the t-value, then the null hypothesis of the unit root is nonstationary, hence we accept the null hypothesis of a unit root.

The results of the ADF and PP tests are presented in Table 8.1 and Table 8.2 below. The estimation is based on a total of 44 observations for the period 1962 to 2005. The results show that all variables (ln GDP, ln AGR, ln EDU, ln HEA, ln H&P, ln MAN, and ln T&C) are stationary in the first difference. This is because the ADF test and PP test

statistic is more negative than critical value. Based on the results in these tables we reject the null hypothesis of nonstationarity. That means the variables are integrated of order one I(1).

Table 8.1 Augmented Dickey Fuller Unit Root Tests for Six Categories

Variables	Level	First Difference	Lag Lengths	Order of Integration
ln GDP	-2.533	-4.604*	1	I(1)
ln AGR	-2.639	-6.284*	1	I(1)
ln EDU	-3.074	-5.019*	1	I(1)
ln HEA	-3.060	-4.576*	1	I(1)
ln H&P	-2.641	-3.348**	1	I(1)
ln MAN	-2.999	-4.243*	1	I(1)
ln T&C	-1.989	-3.874*	1	I(1)

* Significant at 1% level
- Critical value in level at 1% is -4.1896, -3.5189 at 5% and -3.1898 at 10%

Table 8.2 Phillips-Perron Unit Root Tests for Six Categories

Variables	Level	First Difference	Lag Lengths	Order of Integration
ln GDP	-3.011	-5.446*	1	I(1)
ln AGR	-2.495	-7.807*	1	I(1)
ln EDU	-2.617	-5.588*	1	I(1)
ln HEA	-2.702	-7.855*	1	I(1)
ln H&P	-2.325	-6.049*	1	I(1)
ln MAN	-2.616	-6.613*	1	I(1)
ln T&C	-1.936	-5.845*	1	I(1)

* indicate significant at 1%
- Critical value in level at 1% is -4.1896, -3.5189 at 5% and -3.1898 at 10%

Since the variables are stationary, the next step is to use the Engle and Granger (1987) two step method to test for cointegration.

8.3.2 Cointegration test for Six Categories

The study tests the Wagner's law for cointegration, for functional government expenditure using the following type of equation:

$$\ln TGX_{fun,} = \alpha + \beta \ln GDP + \lambda Dum_1 + \delta Dum_2 + \varepsilon \tag{8.9}$$

Where, $TGX_{fun,}$ is the individual category of government functional expenditure, GDP is gross domestic product and ε_t is the error term. The cointegration model for the six categories can be written as follows:

- **Agriculture Sector**

$$\ln TGXAGR = \alpha_1 + \beta_1 \ln GDP + \lambda_1 Dum_1 + \delta_1 Dum_2 + \varepsilon_1 \tag{8.10}$$

- **Education Sector**

$$\ln TGXEDU = \alpha_2 + \beta_2 \ln GDP + \lambda_2 Dum_1 + \delta_2 Dum_2 + \varepsilon_2 \tag{8.11}$$

- **Health Sector**

$$\ln TGXHEA = \alpha_3 + \beta_3 \ln GDP + \lambda_3 Dum_1 + \delta_3 Dum_2 + \varepsilon_3 \tag{8.12}$$

- **Housing and Public utilities Sector**

$$\ln TGXH \ \& \ P = \alpha_4 + \beta_4 \ln GDP + \lambda_4 Dum_1 + \delta_4 Dum_2 + \varepsilon_4 \tag{8.13}$$

- **Manufacturing Sector**

$$\ln TGXMAN = \alpha_5 + \beta_5 \ln GDP + \lambda_5 Dum_1 + \delta_5 Dum_2 + \varepsilon_5 \tag{8.14}$$

- **Transportation and Communication**

$$\ln TGXT \ \& \ C = \alpha_6 + \beta_6 \ln GDP + \lambda_6 Dum_1 + \delta_6 Dum_2 + \varepsilon_6 \tag{8.15}$$

Having concluded from the ADF results that each first differenced time series is stationary, i.e it is integrated of order one I(1), the study proceeds to the second step, which requires that the two time series be cointegrated. In other words, to examine whether or not there exists a long-run relationship between the variables (Miguel, 2000). Then we need an estimation of the cointegration regression of the form of equation (8.8) for the individual six sectors.

Engle and Granger (1987) introduced the concept of cointegration, where economic variables in the expenditure functions and GDP might reach a long-run equilibrium that reflects a stable relationship between them. For stationary variables to be cointegrated, they must be integrated of order one I(1) and the residuals must be stationary I(0). The two-step approach to test for cointegration as proposed by Engle and Granger (1987) is used for this.

The null hypothesis of no cointegration between GDP and the functional expenditure variables can be rejected if the unit root test of the residuals turns out to be stationary in level, I(0). The cointegration test results for government functional expenditure are presented in Table 8.3 below[3].

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[3] - for more details see the results in appendix (7).

Table 8.3 Cointegration Regressions with Dummies for Six Categories

Cointegrating Regression	Residual coefficients	β	λ	δ	R^2
ln TGXAGR=f(ln GDP, Dum$_1$, Dum$_2$)	-0.783 (-4.207*)	1.784 (6.45*)	-0.273 (0.41)	-0.943 (-3.92*)	0.81
ln TGXEDU=f(ln GDP, Dum$_1$, Dum$_2$)	-0.451 (-3.346*)	2.294 (7.48*)	-1.733 (-2.32**)	-0.274 (-102)	0.80
ln TGXHEA=f(ln GDP, Dum$_1$, Dum$_2$)	-0.516 (-3.136*)	2.557 (8.31*)	1.668 (-2.22**)	-0.167 (-0.62)	0.85
ln TGXH&P =f(ln GDP, Dum$_1$,Dum$_2$)	-0.328 (-2.826*)	1.377 (5.979*)	-0.098 (-0.175)	-0.665 (-3.32*)	0.80
ln TGXMAN=f(ln GDP, Dum$_1$, Dum$_2$)	-0.581 (-3.726*)	2.206 (4.598*)	-0.093 (-0.080)	-1.287 (-3.08*)	0.70
n TGXT&C=f(ln GDP, Dum$_1$, Dum$_2$)	-0.293 (-2.444**)	1.758 (6.436*)	-1.271 (-1.910)	-0.810 (-3.41*)	0.73

* And** indicate significant at 1% and 5% levels respectively, for Critical Values of the ADF test.
- Critical values in level at 1% and 5% are (-2.618, -1.948) respectively
-The numbers in parentheses are the values of the estimated t-statistic
β - is the elasticity. λ - The coefficients of the dum1
δ - The coefficients of the dum2

The table indicates that there is evidence of a long-run relationship between real gross domestic product (GDP) and all the variables in functional expenditure in the case of Libya. The results indicate that the ADF test value is greater than the critical t-value for all the variables and hence, the null hypothesis of a unit root can be rejected.

The residuals coefficient is negative and significant at 1% for all six relations except the relationship between spending on transportation and communication (ln T&C) and GDP. The results show the residuals for the six categories of functional government expenditure are integrated of order zero in their levels and, hence, the two variables are cointegrated. For spending on the six categories which the study tested (ln TGXAGR, ln TGXEDU, ln TGXHEA, ln TGXH&P, ln MAN, and ln TGXT&C) with real GDP, statistics show that the null hypothesis is rejected, which suggests the existence of a cointegration relationship and significance at both the 1% and 5% levels.

Moreover, for the long-run impact, in this test the coefficients of the GDP variable in all six relations are found to be positive and significant[4]. This indicates a positive relationship between the variables in the government functional expenditure (education, health, agriculture, housing and public utilities, manufacturing, transportation and communication) and real gross domestic product.

Furthermore, in the relevant analysis, the study uses two dummy variables to take into account the structural breaks, the first one being the impact of the discovery of oil on the economic sector's growth, and the other the effect of UN sanctions on the Libyan economy. The estimated value of the coefficients of the two dummy variables show that the coefficient of the dummy regarding the UN sanctions is significant in agriculture, housing and public utilities, manufacturing, transportation, education and health . This implies that there has been a significant effect of the UN sanctions on these economic sectors, which means a decrease in the country's expenditure on these sectors in the long-run. Also, the results show the coefficients of this dummy as insignificant for education and health.

Also, the results had shown that the effect of the discovery the oil on the economic sectors because the dummy sign was negative. This means there is a relationship in the long-run between the dependent variables in the functional expenditure and GDP. Therefore, these sectors contribute to increase the gross domestic product in the long-run. This is because the country spent a lot of money on development expenditure for these sectors as a result of the oil revenue.

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[4] - Please refer to appendix (16) for the results of individual equation.

On the basis of the results, a long-run relationship between the variables (government functional expenditure as a dependent variable and GDP as an independent variable) is found by using Engle and Granger in two stages. This confirms earlier findings but, without evidence of causality, nothing can be said about whether Wagner's or Keynes hypotheses are valid.

8.3.3 Testing Error Correction Model for Six Categories

According to the Engel and Granger theorem (1987), if two variables are integrated of order one I(1) and the residuals are I(0), this indicates that the two variables are cointegrated and must have an ECM representation. In other words, the existence of cointegration between a set of economic variables provides a statistical foundation for the use of error correction models. We can model the error correction model in the following form:

$$\Delta \ln(TGX_{Funt}) = \alpha_0 + \beta_0 \Delta \ln(GDP) + \gamma_0 ECT_{t-1} + \lambda_0 Dum_1 + \delta_0 Dum_2 + u_t \quad (8.16)$$

Where Δ denotes the first difference operator, ECT_{t-1} is the error correction term and γ_0 the coefficient of the error correction term, which measures the speed of adjustment. The study will use the six categories of government expenditure to test the ECM in the equations as follows:

- **Agriculture Sector**

$$\Delta \ln(TGXAGR) = \alpha_1 + \beta_1 \Delta \ln(GDP) + \gamma_1 ECT_{t-1} + \lambda_1 Dum_1 + \delta_1 Dum_2 + u_t \quad (8.17)$$

- **Education Sector**

$$\Delta \ln(TGXEDU) = \alpha_2 + \beta_2 \Delta \ln(GDP) + \gamma_2 ECT_{t-1} + \lambda_2 Dum_1 + \delta_2 Dum_2 + u_t \quad (8.18)$$

- **Health Sector**

$$\Delta \ln(TGXHEA) = \alpha_3 + \beta_3 \Delta \ln(GDP) + \gamma_3 ECT_{t-1} + \lambda_3 Dum_1 + \delta_3 Dum_2 + u_t \quad (8.19)$$

- **Housing and Public utilities Sector**

$$\Delta \ln(TGXH \& P) = \alpha_4 + \beta_4 \Delta \ln(GDP) + \gamma_4 ECT_{t-1} + \lambda_4 Dum_1 + \delta_4 Dum_2 + u_t \quad (8.20)$$

- **Manufacturing Sector**

$$\Delta \ln(TGXMAN) = \alpha_5 + \beta_5 \Delta \ln(GDP) + \gamma_5 ECT_{t-1} + \lambda_5 Dum_1 + \delta_5 Dum_2 + u_t \quad (8.21)$$

- **Transportation and Communication sector**

$$\Delta \ln(TGXT \& C) = \alpha_6 + \beta_6 \Delta \ln(GDP) + \gamma_6 ECT_{t-1} + \lambda_6 Dum_1 + \delta_6 Dum_2 + u_t \quad (8.22)$$

The estimated error correction term coefficient (ECT) should be negative and statistically significant in the short-run equations. With respect to the Granger representation theorem, negative and statistical significant error correction coefficients are necessary conditions for the relevant variables in question to be cointegrated (Jackson, 1998 and Engle and Granger, 1987). The error correction model for the six models was estimated using the OLS method. The results shown in Table 8.4 are the focus of the study, which is the significance of the error correction models[5]

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[5] For more details see the results in appendixes 10.

Table 8.4 Error Correction Models (ECM) with Dummies for Six Categories

Dependent variable	α	β	γ	λ	δ
d(ln AGR)	0.304	0.438	-0.687	-0.133	-0.208
	(1.029)	(0.763)	(-4.656)*	(-0.427)	(-0.948)
d(ln EDU)	0.466	0.288	-0.305	*-0.353*	*-0.077*
	(1.771)	(0.558)	(-2.578)*	*(-1.272)*	*(-0.397)*
d(ln HEA)	0.563	0.173	-0.446	-0.419	-0.090
	(1.982)	(0.310)	(-3.454)*	(-1.401)	(-0.431)
d(ln H&P)	0.316	0.190	-0.281	*-0.176*	*-0.174*
	(1.956)	(0.606)	(2.923)*	*(-1.029)*	*(-1.449)*
d(ln MAN)	0.640	0.096	-0.473	*-0.406*	*-0.244*
	(1.516)	(0.117)	(-3.958)*	*(-0.909)*	*(-0.774)*
d(ln T&C)	0.287	0.088	-0.299	*-0.132*	*-0.205*
	(1.444)	(0.230)	(-2.998)*	*(-0.629)*	*(-2.998*)*

-The numbers in parentheses are the values of the estimated t-statistic.

-the estimation for ECM has included Dum1 and Dum2.

*-statistical significance at 1% level

β - is the elasticity. γ - is the coefficients of the ECM

λ - The coefficients of the dum1. δ - The coefficients of the dum2

The results in this table show that there is a significant short-run relationship in all equations because the error correction term is negative and significant at the one percent level. Also, the results show that the ln GDP coefficient was positive in all six models. This means there is a relationship between gross domestic product and government expenditure in the six sectors under consideration. These results are in agreement with economic theory.

As can be seen from Table 8.4 the null hypothesis of no error correction model (ECM) can be rejected for GDP with functional expenditure for the sectors used in the study in this chapter. Thus, there is evidence of a short-run relationship between Libyan Gross Domestic Product and the functional sectors education, health, agriculture, housing and public utilities, manufacturing, transportation and communication.

8.3.4 Granger Causality Test for Six Categories

Having established that six sectors in the functional expenditure and GDP are cointegrated with the inclusion of the dummies, the representation theorem tells us that causality must exist in at least one direction for the I(1) variables. The causality issue is a very crucial point in the context of bivariate analysis i.e. Wagner's law. It is important to mention that there is evidence of Granger causality from the GDP to government expenditure in the six categories of functional expenditure and not vice versa.

To test whether government expenditure on these sectors Granger causes GDP, this study applies the causality test developed by (Granger, 1969). A simple Granger causality test involving two variables (expenditure variable and GDP) is written as:

$$\Delta \ln TGX_{funi} = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGX_{funi_{t-i}} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + Dum_1 \\ + Dum_2 + \varepsilon_{1t} \tag{8.23}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGX_{funi_{t-i}} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + Dum_1 \\ + Dum_2 + \varepsilon_{1t} \tag{8.24}$$

Where ln TGX_{funi} is the six categories government functional expenditure in the real term, ln GDP is the real gross domestic product in natural log. The parameters β_i and β_j are the corresponding short-run parameters. Then we can write the above models in separate equations for the six sectors (education, health, agriculture, housing and public utilities, manufacturing, transportation and communication) to test the causality as follows:

- **Agriculture Sector**

$$\Delta \ln TGXAGR = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXAGR_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.25}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXAGR_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.26}$$

- **Education Sector**

$$\Delta \ln TGXEDU = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXEDU_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.27}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXEDU_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.28}$$

- **Manufacturing Sector**

$$\Delta \ln TGXMAN = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXMAN_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.29}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXMAN_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.30}$$

- **Housing and Public utilities Sector**

$$\Delta \ln TGXH \& P = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXH \& P_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.31}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXH \& P_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} +$$
$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.32}$$

- **Health Sector**

$$\Delta \ln TGXHEA = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXHEA_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} +$$

$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.33}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXHEA_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} +$$

$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.34}$$

- **Transportation and Communication sector**

$$\Delta \ln TGXT \& C = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXT \& C_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} +$$

$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.35}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXT \& C_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} +$$

$$Dum_1 + Dum_2 + \varepsilon_{1t} \tag{8.36}$$

The study tests the null hypotheses of no causality as follows:

1- H_0: this hypothesis means that government functional expenditure does not Granger cause GDP.

2- H_0: this hypothesis means that GDP does not Granger cause government functional expenditure.

As mentioned earlier in chapter seven, there are four patterns of causality that could be defined based on the relationship between expenditure and GDP in these six categories as follows. If none of the hypotheses are rejected, it means that government functional expenditure in any sector does not Granger causes GDP, and GDP does not Granger cause government functional expenditure in the sectors. It indicates that the two variables are independent of each other. If the first hypothesis is rejected, it shows that government functional expenditure Granger causes GDP. Rejection of the second hypothesis means that there is unidirectional causality from GDP to government

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functional expenditure as in Wagner's law. If all hypotheses are rejected, there is bidirectional causality between the variables (Eita et al, 2008).

In this analysis, the study applied the Granger causality test, conducted using a vector autoregressive (VAR) model (Anoruo et al, 2000). The test used one lag to determine the direction of the relationship between government functional expenditure and GDP for six categories (education, health, agriculture, housing and public utilities, manufacturing, transportation and communication) in terms of logarithms. The results for the Granger test are presented in Table 8.5 below[6].

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[6] -For more details see the causality results in appendixes (13)

Table 8.5 Results of Granger Causality Test on six Categories with Dummies

version	Hypothesis	P-value	Decision	Conclusion
1.1	H_0: ln TGXAGR does not cause ln GDP	0.002*	Reject H_0 at 1%	ln TGXAGR ⟶ ln GDP
1.2	H_0: ln GDP does not cause ln TGXAGR	0.951	Accept H_0	ln GDP ⇸ ln TGXAGR
2.1	H_0: ln TGXEDU does not cause ln GDP	0.025*	Reject H_0 at 5%	ln TGXEDU ⟶ ln GDP
2.2	H_0: ln GDP does not cause ln TGXEDU	0.255	Accept H_0	ln GDP ⇸ ln TGXEDU
3.1	H_0: ln TGXMAN does not cause ln GDP	0.063*	Reject H_0 at 10%	ln TGXMAN ⟶ ln GDP
3.2	H_0: ln GDP does not cause ln TGXMAN	0.867	Accept H_0	ln GDP ⇸ ln TGXMAN
4.1	H_0: ln TGXH&P does not cause ln GDP	0.087*	Reject H_0 at 10%	ln TGXH&P ⟶ ln GDP
4.2	H_0: ln GDP does not cause ln TGXH&P	0.964	Accept H_0	ln GDP ⇸ ln TGXH&P
5.1	H_0: ln TGXHEA dos not cause ln GDP	0.002*	Reject H_0 at 1%	ln TGXHEA ⟶ ln GDP
5.2	H_0: ln GDP does not cause ln TGXHEA	0.216	Accept H_0	ln GDP ⇸ ln TGXHEA
6.1	H_0: ln TGXT&C dos not cause ln GDP	0.004*	Reject H_0 at 1%	ln TGXT&C ⟶ ln GDP
6.2	H_0: ln GDP does not cause ln TGXT&C	0.864	Accept H_0	ln GDP⇸ ln TGXT&CT

Note: the analysis Granger causality has been included Dum1 and Dum2.
- *Rejection of the null hypothesis
- The lag order is 1 in the causality analysis

⟶   Unidirectional causality   ⇸   Non causality

The results of Table 8.5 show P-values which are a standard test for testing the null hypothesis for government functional expenditure. The first null hypothesis tested whether government expenditure in the Agriculture sector (ln TGXAGR) does not

Granger cause (ln GDP). The result shows the null hypothesis is rejected at the 1% level which means (ln TGXAGR) causes (ln GDP) in the period covered by the case study. Our results from this table show the unidirectional causality running from ln TGXAGR to (ln GDP) because the probability for rejecting the second null hypothesis (ln GDP) does not Granger cause (ln TGXAGR) and as such accepting this hypothesis. This means there is no causality between them.

Furthermore, Table 8.5 shows the results regarding Granger causality tested among between functional expenditure in the Educations sector (ln TGXEDU) and gross domestic product (ln GDP). The first null hypothesis, that (ln TGXEDU) does not Granger cause (ln GDP), is rejected at the 1% level, which mean the causality runs in one direction from government expenditure on Education to GDP. In other words, (ln TGXEDU) causes (ln GDP). This is because in other direction, the null hypothesis that (ln GDP) does not Granger cause (ln TGXEDU), is accepted this hypothesis. This means that there is no causality running from (ln GDP) to (ln TGXEDU) in this hypothesis.

In addition, the results in Table 8.5 present the causality test results for testing the null hypothesis between government expenditure on Manufacturing (ln TGXMAN) and (ln GDP). The probability for rejecting the null hypothesis that (ln TGXMAN does not Granger cause ln GDP) is such that we reject this hypothesis at the 10% level. This means that (ln TGXMAN) causes (ln GDP) for the time period in the case study. In the second direction we accepted the null hypothesis that (ln GDP) does not Granger cause (ln TGXMAN), which means that there is no causality between the dependent and independent variable. In general, Granger causality for this sector was unidirectional, the causality running from (ln TGXMAN) to (ln GDP) almost at the 10% level.

Moreover, Table 8.5 has shows the results for the Granger causality test on government expenditure on the Housing and Public utilities (ln TGXH&P) and (ln GDP). The result indicates that the null hypothesis that (ln TGXH&P) does not Granger cause (ln GDP) can be rejected at the 10 % level of significance for one lag. This means that (ln TGXH&P) causes (ln GDP) at the 10% level. This result leads to an acceptance of the major hypothesis. The null hypothesis that (ln GDP) does not Granger cause (ln TGXH&P) cannot be rejected. This means that there is no causality running from (ln GDP) to (ln TGXH&P). In general, in this model, the result shows unidirectional causality running from government expenditure on the Housing and Public utilities to GDP.

The study also applied the Granger causality test to the null hypothesis between the government expenditure on the Health sector (ln TGXHEA) and real gross domestic product (ln GDP). The result is displayed in Table 8.5 and indicates that the null hypothesis that (ln TGXHEA) does not Granger cause (ln GDP) can be rejected at the 1% level for one lag. This means that there is causality running from (ln TGXHEA) to (ln GDP). In other words, (ln TGXHEA) causes (ln GDP) at the 1% level of significance for the time period covered by the case study. On the other hand, the results shown in the same table indicate strong evidence of no causality existing from (ln GDP) to (ln TGXHEA), because the study cannot reject the null hypothesis in the second test. Therefore, we conclude that there is a one way causality relationship which flows from Health sector functional expenditure to GDP.

Another result we can see in Table 8.5 regards Granger causality test between government expenditure on Transportation and Communication (ln TGXT&C) and (ln

GDP). The result indicates that the null hypothesis that (In TGXT&C) does not Granger cause (In GDP) can be rejected at the 1% level for one lag. This means that (In TGXT&C) causes (In GDP) at the 1% level of significance in this case study. In the other direction, when we test the null hypothesis that (In GDP) does not Granger cause (In TGXT&C), the results show that we cannot reject. This means that there is no causality in this direction. Therefore, it can be concluded that there is unidirectional Granger causality running from (In TGXT&C) to (In GDP), significant at the 1% level, in the transportation and communication sector.

8.3.5 Summary of the Granger Causality Tests

The summary of the analysis of the results for the six sectors used to test the direction of causality between the government expenditures and gross domestic product with one lag are presented in Table 8.6 below. The results show Granger causality running in one direction, i.e. unidirectional causality, this for the six categories (education, health, agriculture, housing and public utilities, manufacturing, transportation and communication), from government expenditures (In TGX_{funi}) to gross domestic product (In GDP).

This result is not consistent with Wagner's law, because he said unidirectional causality would run from GDP to government functional expenditure. The main conclusion from the Granger causality test is therefore that there is no support for Wagner's Law. However, the results do support the Keynesian proposition over the period 1962-2005.

Table 8.6 Summary of Results of Granger Causality Test for Six Categories

Hypothesis	Direction	Conclusion
1	ln TGXAGR → ln GDP	There is causality from ln TGXAGR to ln GDP
2	ln TGXEDU → ln GDP	There is causality from ln TGXEDU to ln GDP
3	ln TGXMAN → ln GDP	There is causality from ln TGXMAN to ln GDP
4	ln TGXH&P → ln GDP	There is causality from ln TGXH&P to ln GDP
5	ln TGXHEA → ln GDP	There is causality from ln TGXHEA to ln GDP
6	ln TGXT&C → ln GDP	There is causality from ln TGXT&C to ln GDP

→   Unidirectional causality

8.4 Re-Estimating of Government Functional Expenditure without Dummies

In this case we re-examine the government functional expenditure without the two dummies variables. As the study mentioned earlier for the results from the ADF and (PP) tests, all the variables are stationary in the first difference and are integrated of order one I(1).

8.4.1 Cointegration Test without Dummies Variables for Six Categories.

Since we are now certain that the variables are integrated of order one, the next step is to test if a long-run relationship exists among variables in the six categories of government functional expenditure. The study re-tested for cointegration without dummies for functional government expenditure using the following type of equation:

$$\ln TGX_{jun_i} = \alpha_0 + \beta_0 \ln GDP + \varepsilon \qquad (8.37)$$

Now we can apply this function on all the six categories of cointegration model as follows:

Agriculture Sector

$$\ln TGXAGR = \alpha_1 + \beta_1 \ln GDP + \varepsilon_1 \qquad (8.38)$$

Education Sector

$$\ln TGXEDU = \alpha_2 + \beta_2 \ln GDP + \varepsilon_2 \qquad (8.39)$$

Health Sector

$$\ln TGXHEA = \alpha_3 + \beta_3 \ln GDP + \varepsilon_3 \qquad (8.40)$$

Housing and Public utilities Sector

$$\ln TGXH \ \& \ P = \alpha_4 + \beta_4 \ln GDP + \varepsilon_4 \qquad (8.41)$$

Manufacturing Sector

$$\ln TGXMAN = \alpha_5 + \beta_5 \ln GDP + \varepsilon_5 \qquad (8.42)$$

Transportation and Communication Sector

$$\ln TGXT \ \& \ C = \alpha_6 + \beta_6 \ln GDP + \varepsilon_{6t} \qquad (8.43)$$

The results in Table 8.7 show that the variables are cointegrated, because the Engle-Granger residuals rejected the null hypothesis of no cointegration between government functional expenditure and GDP[7]; the results are significant at 1% or 5% levels for all residuals. This means the residuals coefficients of these variables are significant in the long-run relationship equilibrium and these results are in agreement with economic theory.

Moreover, the results shown in Table 8.7 indicate that the long-run GDP elasticity is more than one and significant at 1% level in agreement with the economic theory. Since the variables are cointegrated, we can investigate the short-run relationship between the variables in the function and GDP.

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[7] -See the appendix (7) for more results from the estimating the variables.

Table 8.7 Cointegration Regressions without dummies for Six Categories

Cointegrating Regression	Residuals coefficient	β	R^2
ln TGXAGR= f (ln GDP)	-0.473 (-3.082*)	1.460 (10.983*)	0.74
ln TGXEDU= f (ln GDP)	-0.410 (-3.315*)	1.608 (11.952*)	0.77
ln TGXHEA= f (ln GDP)	-0.460 (-2.979*)	1.920 (14.373*)	0.83
ln TGXH&P = f (ln GDP)	-0.215 (-2.174**)	1.183 (11.129*)	0.74
ln TGXMAN= f (ln GD)	-0.368 (-2.877*)	1.864 (8.550*)	0.63
ln TGXT&C= f (ln GDP)	-0.216 (-2.210**)	1.109 (8.506*)	0.63

* And** indicate significant at 1% and 5% levels respectively.
- Critical values in level at 1% and 5% are (-2.618, -1.948) respectively
-The numbers in parentheses are the values of the estimated t-statistic

8.4.2 Error Correction Model without Dummies Variables for Six Categories.

In this section we write the function for the error correction model without dummies in the following form:

$$\Delta \ln(TGX_{Finn}) = \alpha_0 + \beta_0 \Delta \ln(GDP) + \gamma_0 ECT_{t-1} + u_t \qquad (8.44)$$

From this equation the study can re-write the six categories of government expenditure to test the ECM in the equations as follows:

Agriculture Sector

$$\Delta \ln(TGXAGR) = \alpha_1 + \beta_1 \Delta \ln(GDP) + \gamma_1 ECT_{t-1} + u_t \qquad (8.45)$$

Education Sector

$$\Delta \ln(TGXEDU) = \alpha_2 + \beta_2 \Delta \ln(GDP) + \gamma_2 ECT_{t-1} + u_t \qquad (8.46)$$

Health Sector

$$\Delta \ln(TGXHEA) = \alpha_3 + \beta_3 \Delta \ln(GDP) + \gamma_3 ECT_{t-1} + u_t \tag{8.47}$$

Housing and Public utilities Sector

$$\Delta \ln(TGXH \ \& \ P) = \alpha_4 + \beta_4 \Delta \ln(GDP) + \gamma_4 ECT_{t-1} + u_t \tag{8.48}$$

Manufacturing Sector

$$\Delta \ln(TGXMAN) = \alpha_5 + \beta_5 \Delta \ln(GDP) + \gamma_5 ECT_{t-1} + u_t \tag{8.49}$$

Transportation and Communication Sector

$$\Delta \ln(TGXT \ \& \ C) = \alpha_6 + \beta_6 \Delta \ln(GDP) + \gamma_6 ECT_{t-1} + u_t \tag{8.50}$$

After estimating the error correction model for six categories of government functional expenditure, we consider the coefficients of the ECT terms, which are presented in Table 8.8. The ECT coefficients for all the six sectors are negative in sign and are significant. These results give support for the relationship between the variables in the short-run, and the results are in agreement with the economic theory.

Table 8.8 Error Correction Models Results for Six Categories

Dependent variable	α	β	γ
d(ln AGR)	0.060	0.747	-0.473
	(0.518)	(1.321)	(-3.569*)
d(ln EDU)	0.111	0.458	-0.287
	(1.160)	(0.974)	(-2.604*)
d(ln HEA)	0..147	0.329	-0.403
	(1.389)	(0.632)	(-3.257*)
d(ln H&P)	0.061	0.468	-0.196
	(0.977)	(1.525)	(-2.184**)
d(ln MAN)	0.132	0.613	-0.333
	(0.801)	(0.761)	(-2.896*)
d(ln T&C)	0.058	0.318	-0.199
	(0.760)	(0.852)	(-2.232**)

-The numbers in parentheses are the values of the estimated t-statistic.
-*and **-statistical significance at 1% and 5% levels respectively.
β - is the elasticity. γ - is the coefficients of the ECM

8.4.3 Granger Causality test without Dummies Variables for Six Categories.

As we mentioned in section 8.3.4 and from the equations (8.22 and 8.23), we will rewrite government functional expenditure to test Granger causality without dummies as follows:

Agriculture Sector

$$\Delta \ln TGXAGR = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXAGR_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.51}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXAGR_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.52}$$

Education Sector

$$\Delta \ln TGXEDU = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXEDU_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.53}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXEDU_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.54}$$

Manufacturing Sector

$$\Delta \ln TGXMAN = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXMAN_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.55}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXMAN_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.56}$$

Housing and Public utilities Sector

$$\Delta \ln TGXH \, \& \, P = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXH \, \& \, P_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.57}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXH \, \& \, P_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.58}$$

Health Sector

$$\Delta \ln TGXHEA = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXHEA_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.59}$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXHEA_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \tag{8.60}$$

Transportation and Communication Sector

$$\Delta \ln TGXT \& C = \alpha_0 + \sum_{i=1}^{k} \alpha_{i1} \Delta \ln TGXT \& C_{t-i} + \sum_{j=1}^{m} \beta_{j1} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \qquad (8.61)$$

$$\Delta \ln GDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{i2} \Delta \ln TGXT \& C_{t-i} + \sum_{j=1}^{m} \beta_{j2} \Delta \ln GDP_{t-j} + \varepsilon_{1t} \qquad (8.62)$$

The main results of the Granger causality test are presented in Table 8.9 below. The results include the six sectors of government functional expenditure[8].

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[8]- For more details see the causality results in appendixes (13)

Table 8.9 Results of Granger-Causality Tests for Six Categories

N	Hypothesis	P-value	Decision	conclusion
1.1	H_0: ln TGXAGR does not cause ln GDP	0.021*	Reject H_0 at 5 %	ln TGXAGR $\longrightarrow$ ln GDP
1.2	H_0: ln GDP does not cause ln TGXAGR	0.733	Accept H_0	ln GDP $\longrightarrow\!\!\!\!\times$ ln TGXAGR
2.1	H_0: ln TGXEDU does not cause ln GDP	0.125	Accept H_0	ln TGXEDU $\longrightarrow\!\!\!\!\times$ ln GDP
2.2	H_0: ln GDP does not cause ln TGXEDU	0.50	Accept H_0	ln GDP $\longrightarrow\!\!\!\!\times$ ln TGXEDU
3.1	H_0: ln TGXMAN does not cause ln GDP	0.151	Accept H_0	Ln TGX MAN $\longrightarrow\!\!\!\!\times$ ln GDP
3.2	H_0: ln GDP does not cause ln TGXMAN	0.736	Accept H_0	ln GDP $\longrightarrow\!\!\!\!\times$ ln TGXMAN
4.1	H_0: ln TGXH&P does not cause ln GDP	0.453	Accept H_0	ln TGXH&P $\longrightarrow\!\!\!\!\times$ ln GDP
4.2	H_0: ln GDP does not cause ln TGXH&P	0.724	Accept H_0	ln GDP $\longrightarrow\!\!\!\!\times$ ln TGXH&P
5.1	H_0: ln TGXHEA dos not cause ln GDP	0.015*	Reject H_0 at 5 %	ln TGXHEA $\longrightarrow$ ln GDP
5.2	H_0: ln GDP does not cause ln TGXHEA	0.362	Accept H_0	ln GDP $\longrightarrow\!\!\!\!\times$ ln TGXHEA
6.1	H_0: ln TGXT&C dos not cause ln GDP	0.261	Accept H_0	ln TGXT&C $\longrightarrow\!\!\!\!\times$ ln GDP
6.2	H_0: ln GDP does not cause ln TGXT&C	0.951	Accept H_0	ln GDP $\longrightarrow\!\!\!\!\times$ ln TGXT&C

- * Rejection of the null hypothesis
- The lag order is 1 in the causality analysis

$\longrightarrow$ Unidirectional causality $\longrightarrow\!\!\!\!\times$ Non causality

The results show that there is unidirectional causality between government expenditure on agriculture and GDP, because the null hypothesis of TGXAGR does not cause GDP and is rejected at the 1% level of significance. On the other side, the causality from

gross domestic product to government expenditure on agriculture is accepted because the null hypothesis of GDP does not causes TGXAGR is accepted. This result supports the Keynesian hypothesis which stipulates that causation runs from government expenditure to gross domestic product.

There is also evidence for Granger causality which runs from government expenditure on health to gross domestic product. The result indicates that the null hypothesis of TGXHEA does not causes GDP can be rejected at the 5 % level for one lag (p-value 0.015). Whereas the null hypothesis that GDP does not Grange cause TGXHEA can not be rejected. This means there is unidirectional causality running from TGXHEA to GDP; this result also supports the Keynesian hypothesis.

Overall, the results from Table 8.9 show that there is no causality between four sectors of government expenditure and gross domestic product: the sectors are TGXEDU, TGXH&P, TGXMAN and TGXT&C because we cannot reject the null hypothesis. The results indicate that there is no evidence to support either Wagner's law or the Keynesian hypothesis in these sectors.

8.4.4 Summary of the Granger Causality Tests without Dummies Variables for Six Categories.

The results in Table 8.10 below show the direction of causality between the government functional expenditures on the six categories and gross domestic product for two categories (agriculture and health), these results show that the causality runs from the government expenditure to GDP. The main conclusion is that there is no support for Wagner's Law, but the results do support the Keynesian hypothesis over the period 1962-2005.

Table 8.10 Summary of Results of Granger Causality Test for Six Categories

Hypothesis	Direction	Conclusion
1	ln TGXAGR ⟶ ln GDP	There is causality from ln TGXAGR to ln GDP
2	ln TGXEDU ⟷ ln GDP	No causality
3	ln TGXMAN ⟷ ln GDP	No causality
4	ln TGXH&P ⟷ ln GDP	No causality
5	ln TGXHEA ⟶ ln GDP	There is causality from ln TGXHEA to ln GDP
6	ln TGXT&C ⟷ ln GDP	No causality

⟶ Unidirectional causality   ⟷ Non causality in both directions

But other results from Table 8.10 show that there is no evidence for unidirectional or bidirectional Granger causality in four sectors (education, housing and public utilities, manufacturing, transportation and communication). This means there is no support for either Wagner's law or the Keynesian hypothesis.

8.5 Summary

This chapter has investigated the relationship between government functional expenditure and gross domestic product using time series data for the period 1962-2005. Four econometric techniques, which were presented in chapters six and seven, have been applied in this chapter. The study applied the unit root test, and used the Dickey-Fuller and Phillips-Perron (PP) methods to test the stationarity and the order of integration of the individual variables. The results from the two tests indicated that most of the variables were stationary in their first difference.

The six categories (education, health, agriculture, housing and public utilities, manufacturing, transportation and communication), were found to be cointegrated with GDP. The long-run cointegration relationship which exists between the variables was estimated using the Engle-Granger two step method. The study also used two dummy variables to capture the effects of the discovery of oil on economic growth and the effects of the UN sanctions on the Libyan economy. The results show that all variables are cointegrated and have a stable relationship in the long-run.

After investigating the cointegration relation in the long-run between the variables, the study moved on to test the relationship in the short-run between the six categories of functional expenditure with GDP. The study also included two dummy variables in the analysis. The Error Correction Model (ECM) was used to examine the short-run relationship. The results from the ECM show that all the error correction term coefficients (ECT) for the government functional expenditures have negative signs and are significant. This means that there is a short-run relationship in the data used in this case study.

Moreover, the study has applied the Granger causality test to determine the casual direction among the variables under study. The estimation results of the causality test with dummies show that a causality relationship runs from the six categories (education, health, agriculture, housing and public utilities, manufacturing, transportation and communication) in the individual equations to GDP, but not from GDP to any variable in the expenditure functions. This means the Granger causality estimation does not support Wagner's law but supports the Keynesian hypothesis for all six expenditure variables.

The study re-examines the cointegration test, error correction term and Granger causality test without two dummy variables. The results show that there is a long-run relationship for all sectors of government expenditure with gross domestic product in the same period.

For the error correction model, the results show that the error correction term coefficient for the six sectors is negative in sign and significant: this means there is a short-run and is consistent with the theory. But the results for the GDP coefficient and the constant are not significant.

The results from the Granger causality test without dummies show that there is causality from two sectors (agriculture and health) to GDP and no causality between the variables and gross domestic product in 4 sectors (education, housing and public utilities, manufacturing, transportation and communication). These results support the Keynesian hypothesis for 2 expenditure variables.

CHAPTER NINE

Summary and Conclusions

9.1 Introduction

The expansion of government spending is one of the most lasting issues in public economics literature. The main objective of this thesis has been to examine the relationship between government expenditure and economic growth in Libya over the period 1962-2005 using modern time series techniques. The economist, Adolph Wagner, was perhaps the first to propose a direct explanation that the growth of government activity share in the economy responds positively to changes in economic development, so that as a country's income increases, the size of that country's public sector relative to the whole economy rises as well. This study has applied empirical tests of Wagner's law on the time series data for Libya from 1962-2005.

The aim of this chapter is to summarise the main findings of the study and to draw some general conclusions. The remainder of the chapter is structured as follows. Section 9.2 the Reconsideration of the research objectives. Section 9.3 provides the main conclusions. The section 9.4 describes the contributions of the research to knowledge. The main limitations of the study are discussed in section 9.5. Section 9.6 recommendations. A number of potential areas for further research are suggested in section 9.7.

9.2 Reconsideration of the Research Objectives

This study has four main objectives, which would demonstrate the relationship between government expenditure and gross domestic product growth attained by Libyan government within the period 1962-2005.

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To achieving these aims, the study has employed four types of econometric tests, thus; Unit root tests, Cointegration test, Error correction models and Granger causality test. Each of these objectives has been tested as follows:

9.2.1 Research Objective: One

This research intends to investigate the existence of long-run and short-run relationship between the six versions of Wagner's law and the Libyan economy.

To achieve this aim, Engle-Granger two-steps approach should be used to estimate cointegration for long-run and error correction model for the short-run; as it has been adopted over the period 1962-2005.

Chapter six give details of the cointegration results for real gross domestic product which are cointegrated (four out of six versions of Wagner's law). Also, the results from testing the real non-oil gross domestic product show the five versions of Wagner's law, found to be cointegrated. Therefore, the test for this aim in the long-run indicates a long-run positive relationship between government expenditure and real gross domestic product and non-oil gross domestic product.

The results in chapter seven for the error correction model show that, there is a short-run relationship in all versions with respect to real GDP and non-oil GDP because the ECM coefficients are all negative and statistically significant. The findings from long-run and short-run have shown that, the objective was achieved.

9.2.2 Research Objective: Two

The study also investigates the long-run and short-run equilibrium between Libyan GDP and six categories of government functional expenditure.

To achieve this aim we can adopt the econometric techniques that were used in the previous objective to examine the long-run and short-run relationship between six government functional expenditures and real total GDP, based on Wagner's law using time series data for the period 1962-2005 for Libyan economy.

The result from chapter eight revealed that; all the variables are stationary in first difference and integrated of order I(1). Also, the results from testing for cointegration between government expenditure on the six categories and gross domestic product show that, the variables are cointegrated, because the residuals are I(0). Also, the estimated results of the short-run relationship shown that, there is a short-run relationship between government expenditure on the six categories and real GDP, because the ECM coefficients for all the six sectors are negative and significant. Best on the findings above, a long-run and short-run test indicate that, the research objective should be achieved.

9.2.3 Research Objective: Three

To examine the Granger causality test between government expenditure and gross domestic product in Libya over the period 1962-2005 and six categories of government functional expenditure.

Granger causality test was also used for testing the causation between the variables in order to achieve this aim.

In chapter seven the results of Granger causality tests for Wagner's law with respect to total real GDP show a strong unidirectional causal relationship running from real GDP to real TGX in five versions of Wagner' law. This revealed that Wagner's law is generally supported by the study period for the Libyan economy in our sample. The results of Granger causality tests also indicate that, Wagner's law with respect to total real non-oil GDP versions 2, 4 and 6 support Wagner's law and versions 1 and 5 support the Keynesian hypothesis. The research objective is said to be achievable best on the result from the test (testing the causality between government expenditure and real gross domestic product and non-oil GDP).

Another results in the subsequent chapter 8; "the Granger causality test", test the six categories of government functional expenditure which show clear evidence on the six cases, that have a unidirectional causality relationship from government expenditure on education, health, agriculture, housing and public utilities, manufacturing, and transportation and communication to GDP.

In general, all the six categories of government expenditure are supporting the Keynesian proposition over the period from 1962-2005, because the causality runs from government expenditure to economic growth, and these results are in line with other studies examining the relationship between government expenditure and gross domestic product in other economies. From the findings, we can justify that the research objectives have been achieved, as it has been demonstrated in the causality test between six categories of government expenditure and real gross domestic product.

9.2.4 Research Objective: Four

To investigate the Libyan economy, as to whether it supports Wagner's law or not by testing Libyan data for the period 1962-2005.

To achieve this aim, the study had analysed time series econometric techniques such as unit root tests, cointegration, error correction models and finally the Granger casualty test. These tests are performed for all six versions of Wagner's law in terms of real GDP, real non-oil GDP and government expenditure for Libyan economy using data for the period 1962-2005. Also, these tests are applied to investigate the long-run, short-run and causation relationship between the six government functional expenditures and GDP based on Wagner's law.

Some researchers used the Granger causality test to see whether government expenditure causes economic growth or economic growth causes government expenditure. However, previous empirical results from other studies gave different conclusions, i.e., several researchers (Jiranyakul, 2007 Ome, (2006) Eita, J.H. and Mbazima, D (2008), found that government expenditure causes economic growth, while others found that economic growth causes government spending to expand. There is also evidence of bidirectional causality between government spending and economic growth.

As per our findings, if we found the causality running from the gross domestic product (GDP) to government expenditure (TGX), this means support "Wagner's law". Conclusively, it analyses that, there is strong support for Wagner's law in relationship between the government expenditure and growth in the real GDP as well as in the non-oil GDP, because the causality was from gross domestic product

to the government expenditure. While, at the disaggregate level it revealed that, there is strong support for the Keynesian hypothesis and no support for Wagner's law. However I can conclude by proving that, the research objectives could be achieved by using the aggregate data and could not be achieve by using disaggregate data.

9.3 Main Conclusions

From the preceding results, we can reach the following conclusions:

1- The results are sensitive to the model specification i.e.

    (i)   total GDP or non-oil GDP

    (ii)   with or without dummies

    (iii)   aggregate or disaggregate government spending

2- The Granger causality tests (GCT) results are particularly sensitive to the aggregate or disaggregate specification:

    (i)   At the aggregate level, there is strong support for Wagner's law, and some limited support for the Keynesian hypothesis.

    (ii)   At the disaggregate level there is strong support for the Keynesian hypothesis, and no support for Wagner's law.

3- Overall, these results are very mixed, and we should be very careful about drawing policy implications from them.

4- One way to reconcile the apparently conflicting results is to consider the distinction between the short-run and the long-run.

(i)   in the short run, the Keynesian hypothesis is supported

(ii)   In the long run, Wagner's law is supported.

Overall in light of the results, the relationship between government expenditure and gross domestic product is shown in Figure 9.1 below.

Figure 9.1 Keynes and Wagner-Reconciliation.
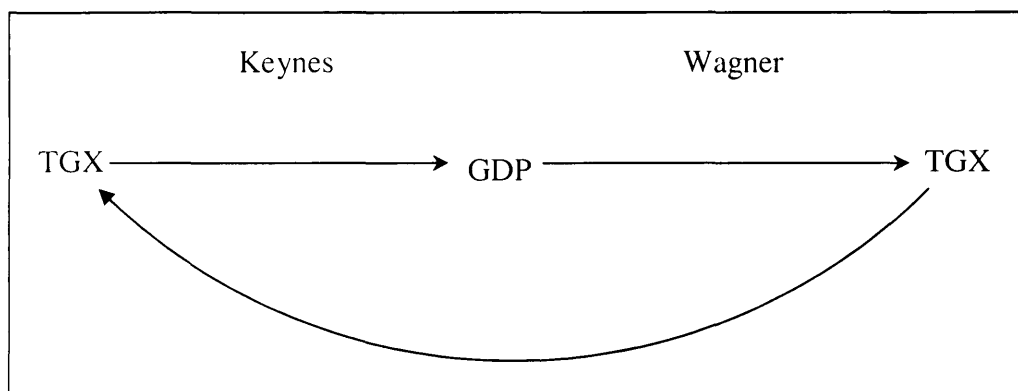
In the short-run, when government spending increases, output will increase. This is the Keynesian hypothesis, which includes a multiplier effect; that is, output increases by a multiple of the original change in spending that caused it. Thus, increased government spending will expand the economy. According to the results, real government expenditure in Libya in the long-run is determined largely by gross domestic product. In other words, these results support the validity of Wagner's hypothesis in the long-run, and imply that government expenditure in Libya is dependent on GDP. Therefore, when gross domestic product increases this means the government revenue will increase as well.

5- Evidence for this distinction is that in the disaggregate models (which support the Keynesian hypothesis) the ECM (which defines the short-run relationship) is always valid (both with and without dummies).

9.4 Contributions of the Study to Knowledge

This sub-section highlights the main contributions of this study to the economic literature.

1 This study has made a significant original contribution to knowledge. Specifically, it fills the gap in the public finance area of Libyan growth studies by testing Wagner's law on the Libyan economy. Also, this study has used the long-run and short-run relationship between government expenditure and total gross domestic product with GDP and non-oil GDP, as well as undertaking a causality analysis between the relevant variables.

2 This study contributes to knowledge in macroeconomics. It improves understanding of the Libyan economy and fills the gaps in economic theory by investigating the relationship between different measures of real government expenditure and real gross domestic product.

3 Another contribution is that not only do we test the relationship between government expenditure and economic growth on the six versions of Wagner's law with aggregate data, but we also test this relationship with disaggregated data on six categories of government expenditure.

9.5 Limitations of the Study

There is no perfect study and this study is no exception. It is subject to the following limitations.

1 Limitations of data were an obstacle faced by the researcher. Data on Libya during the period 1962-1967 and 1992-1996 is very restricted and classified and is therefore not always available. The researcher was forced to attempt to gather this data from different sources.

2 The research study was applied on one country. We could in the future work on a comparative study between Libya and any country with the same economic environment or any oil country such as Saudi Arabia, Bahrain or Kuwait.

3 The problem of data quality is a general problem, particularly for developing countries. The data compiled for a developing country, like Libya, might be less reliable and it appears that nothing can be done about this limitation.

9.6 Recommendations

In the light of what has been presented in this thesis, it is possible to suggest the following recommendations:

1 The economic growth and development are the main objectives of the government expenditure in Libya, especially in terms of human and a capital investment. I recommend that, Libyan government should make a policy to emphasize on investment in human development and provide adequate social infrastructures through modern technology for the sustainable economic growth and development.

2 The relevance of Wagner's law to the Libyan economy is quite recommendable because the government expenditure depends on gross domestic product which is very effective to government policy. Therefore, it can be   suggested

that, the government continue to encourage government expenditure towards non-oil activities.

3   This study gets some results which support Keynesian hypothesis. In this case the total real government expenditure has positive effects on economic growth and development. Therefore, the importance of government spending on economic growth should be recognised and the direction of spending should be towards sectors that have more effect on economic growth and development of the country.

4   Public expenditure on infrastructure that facilitates economic growth is required to put the economy on the path of higher long term growth.

5   For Libya to maintain its economic growth it is important to have effective fiscal and monetary polices tools that will allow these policies to be carried out. In this regard, the development of economic institutions including financial and capital markets is crucial for sustainable economic development.

6   Government expenditures should be re-examined with the view to assess (i) their contribution to an efficient allocation of resources within the economy and (ii) their potential to finance growth and enhance spending categories (such as, infrastructure, development, education, and health).

7   The government should check the relationship between expenditures and revenues in such a ways that are consistent with the country's revenue mobilization potential. This framework could help the government to control its expenditures.

8   When the results show some sings of Wagner's law which can be noticed by

the rapid increase in government size and its influence in the performance of

the economy. We can suggest that there is a need to reduce the government

size to an optimal sector by adopting a policy on privatisation (private public

partnership).

9.7   Suggestions for Future Research

In this regard it is useful to mention some suggestions concerning future studies of

government expenditure and gross domestic product growth in Libya

1 We can in the future attempt to further disaggregate the data to see the

relationship between government expenditure and GDP in more than 6

categories.

2 In particular, I suggest a study of the evaluation of government expenditure on

infrastructure in various sectors. Due to lack of planning and fast development,

the infrastructure in Libya has resulted in overcapacity in some areas, while

others are still underserved. The government could make a comprehensive

evaluation of the existing infrastructure to determine the viability of several

policy options.

3 Because the Libyan environment was the focus of this study, it would be

interesting to duplicate it in other Arab countries or to do a comparative study,

so that comparisons could be drawn, especially as these Arab countries have

many similarities to the Libyan environment.

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Appendix (2)

The results from Augmented Dickey-Fuller Unit Root (ADF) and

Phillips-Perron (PP) Test on real total GDP

Augmented Dickey-Fuller Unit Root Test on D (LN GDP)

ADF Test Statistic	-4.604020	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGDP,2)
Method: Least Squares
Date: 07/07/09   Time: 20:18
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-0.892805	0.193918	-4.604020	0.0000
D(LNGDP(-1),2)	0.048376	0.150223	0.322026	0.7492
C	0.059555	0.032137	1.853175	0.0716

R-squared	0.444122	Mean dependent var	-0.007152
Adjusted R-squared	0.414865	S.D. dependent var	0.236167
S.E. of regression	0.180654	Akaike info criterion	-0.514116
Sum squared resid	1.240156	Schwarz criterion	-0.388733
Log likelihood	13.53938	F-statistic	15.18014
Durbin-Watson stat	2.013718	Prob(F-statistic)	0.000014

Augmented Dickey-Fuller Unit Root Test on D (LN GDPN)

ADF Test Statistic	-4.710785	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGDPN,2)
Method: Least Squares
Date: 07/07/09   Time: 20:21
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDPN(-1))	-0.922351	0.195796	-4.710785	0.0000
D(LNGDPN(-1),2)	0.064739	0.150144	0.431181	0.6688
C	0.031174	0.029487	1.057212	0.2971

R-squared	0.452341	Mean dependent var	-0.007972
Adjusted R-squared	0.423516	S.D. dependent var	0.236307
S.E. of regression	0.179419	Akaike info criterion	-0.527826
Sum squared resid	1.223270	Schwarz criterion	-0.402443
Log likelihood	13.82043	F-statistic	15.69309
Durbin-Watson stat	2.008085	Prob(F-statistic)	0.000011

Augmented Dickey-Fuller Unit Root Test on D (LN TGX)

ADF Test Statistic	-4.158247	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGX,2)
Method: Least Squares
Date: 07/07/09   Time: 20:23
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGX(-1))	-0.605235	0.145550	-4.158247	0.0002
C	0.068096	0.034130	1.995188	0.0529

R-squared	0.301810	Mean dependent var	0.002071
Adjusted R-squared	0.284356	S.D. dependent var	0.231448
S.E. of regression	0.195795	Akaike info criterion	-0.377045
Sum squared resid	1.533434	Schwarz criterion	-0.294299
Log likelihood	9.917945	F-statistic	17.29102
Durbin-Watson stat	2.122950	Prob(F-statistic)	0.000165

Augmented Dickey-Fuller Unit Root Test on D (LN TGXC)

ADF Test Statistic	-3.731570	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGXC,2)
Method: Least Squares
Date: 07/07/09   Time: 20:24
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXC(-1))	-0.517730	0.138743	-3.731570	0.0006
C	0.056733	0.020739	2.735517	0.0092

R-squared	0.258224	Mean dependent var	-0.000350
Adjusted R-squared	0.239679	S.D. dependent var	0.104084
S.E. of regression	0.090757	Akaike info criterion	-1.914811
Sum squared resid	0.329474	Schwarz criterion	-1.832065
Log likelihood	42.21103	F-statistic	13.92462
Durbin-Watson stat	2.031635	Prob(F-statistic)	0.000591

Augmented Dickey-Fuller Unit Root Test on D (LN TGXGDP)

ADF Test Statistic	-3.359395	1% Critical Value*	-3.6067
		5% Critical Value	-2.9378
		10% Critical Value	-2.6069

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGXGDP,2)
Method: Least Squares
Date: 07/07/09   Time: 20:25
Sample(adjusted): 1967 2005
Included observations: 39 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXGDP(-1))	-0.591028	0.175933	-3.359395	0.0019
D(LNTGXGDP(-1),2)	-0.093426	0.182934	-0.510710	0.6129
D(LNTGXGDP(-2),2)	0.190061	0.175401	1.083578	0.2862
D(LNTGXGDP(-3),2)	0.120781	0.136933	0.882048	0.3839
C	0.035802	0.021759	1.645387	0.1091

R-squared	0.465439	Mean dependent var	-0.010680
Adjusted R-squared	0.402549	S.D. dependent var	0.134255
S.E. of regression	0.103773	Akaike info criterion	-1.574021
Sum squared resid	0.366137	Schwarz criterion	-1.360744
Log likelihood	35.69341	F-statistic	7.400885
Durbin-Watson stat	1.508777	Prob(F-statistic)	0.000212

Augmented Dickey-Fuller Unit Root Test on D (LN GDPN)

ADF Test Statistic	-2.985043	1% Critical Value*	-3.6019
		5% Critical Value	-2.9358
		10% Critical Value	-2.6059

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGXN,2)
Method: Least Squares
Date: 07/07/09   Time: 20:27
Sample(adjusted): 1966 2005
Included observations: 40 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXN(-1))	-0.586128	0.196355	-2.985043	0.0051
D(LNTGXN(-1),2)	-0.080746	0.196772	-0.410352	0.6840
D(LNTGXN(-2),2)	0.160689	0.170828	0.940650	0.3532
C	0.041072	0.034743	1.182162	0.2449

R-squared	0.356059	Mean dependent var	-0.003292
Adjusted R-squared	0.302397	S.D. dependent var	0.237026
S.E. of regression	0.197971	Akaike info criterion	-0.306756
Sum squared resid	1.410927	Schwarz criterion	-0.137868
Log likelihood	10.13511	F-statistic	6.635247
Durbin-Watson stat	1.939261	Prob(F-statistic)	0.001105

Phillips-Perron Unit Root on D (LN GDP)

PP Test Statistic	-5.446949	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel:3   (Newey-West suggests: 3)

Residual variance with no correction	0.030628
Residual variance with correction	0.025935

Phillips-Perron Test Equation
Dependent Variable: D(LNGDP,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-0.796093	0.145555	-5.469371	0.0000
C	0.056571	0.030254	1.869848	0.0688

R-squared	0.427869	Mean dependent var		-0.010331
Adjusted R-squared	0.413565	S.D. dependent var		0.234177
S.E. of regression	0.179330	Akaike info criterion		-0.552726
Sum squared resid	1.286375	Schwarz criterion		-0.469980
Log likelihood	13.60725	F-statistic		29.91402
Durbin-Watson stat	2.067722	Prob(F-statistic)		0.000003

Phillips-Perron Unit Root on D (LN GDPN)

PP Test Statistic	-5.526079	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel:3   (Newey-West suggests: 3)

Residual variance with no correction	0.030308
Residual variance with correction	0.025226

Phillips-Perron Test Equation
Dependent Variable: D(LNGDPN,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDPN(-1))	-0.810847	0.146254	-5.544117	0.0000
C	0.030607	0.028538	1.072469	0.2899

R-squared	0.434527	Mean dependent var		-0.011157
Adjusted R-squared	0.420390	S.D. dependent var		0.234317
S.E. of regression	0.178391	Akaike info criterion		-0.563232
Sum squared resid	1.272932	Schwarz criterion		-0.480485
Log likelihood	13.82787	F-statistic		30.73724
Durbin-Watson stat	2.061635	Prob(F-statistic)		0.000002

Phillips-Perron Unit Root on D (LN TGX)

PP Test Statistic	-4.191733	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.036510
Residual variance with correction	0.037860

Phillips-Perron Test Equation
Dependent Variable: D(LNTGX,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGX(-1))	-0.605235	0.145550	-4.158247	0.0002
C	0.068096	0.034130	1.995188	0.0529

R-squared	0.301810	Mean dependent var		0.002071
Adjusted R-squared	0.284356	S.D. dependent var		0.231448
S.E. of regression	0.195795	Akaike info criterion		-0.377045
Sum squared resid	1.533434	Schwarz criterion		-0.294299
Log likelihood	9.917945	F-statistic		17.29102
Durbin-Watson stat	2.122950	Prob(F-statistic)		0.000165

Phillips-Perron Unit Root on D (LN TGXC)

PP Test Statistic	-3.744458	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.007845
Residual variance with correction	0.007948

Phillips-Perron Test Equation
Dependent Variable: D(LNTGXC,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXC(-1))	-0.517730	0.138743	-3.731570	0.0006
C	0.056733	0.020739	2.735517	0.0092

R-squared	0.258224	Mean dependent var	-0.000350
Adjusted R-squared	0.239679	S.D. dependent var	0.104084
S.E. of regression	0.090757	Akaike info criterion	-1.914811
Sum squared resid	0.329474	Schwarz criterion	-1.832065
Log likelihood	42.21103	F-statistic	13.92462
Durbin-Watson stat	2.031635	Prob(F-statistic)	0.000591

Phillips-Perron Unit Root on D (LN TGXGDP)

PP Test Statistic	-4.929359	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.016809
Residual variance with correction	0.020235

Phillips-Perron Test Equation
Dependent Variable: D(LNTGXGDP,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXGDP(-1))	-0.725097	0.151886	-4.773944	0.0000
C	0.058616	0.024008	2.441539	0.0191

R-squared	0.362961	Mean dependent var	-0.001043
Adjusted R-squared	0.347035	S.D. dependent var	0.164405
S.E. of regression	0.132849	Akaike info criterion	-1.152752
Sum squared resid	0.705959	Schwarz criterion	-1.070006
Log likelihood	26.20780	F-statistic	22.79054
Durbin-Watson stat	2.122232	Prob(F-statistic)	0.000024

Phillips-Perron Unit Root on D (LN TGXN)

PP Test Statistic	-4.261527	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 2   (Newey-West suggests: 3)

Residual variance with no correction	0.036486
Residual variance with correction	0.038367

Phillips-Perron Test Equation
Dependent Variable: D(LNTGXN,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXN(-1))	-0.615601	0.146025	-4.215713	0.0001
C	0.048374	0.032204	1.502087	0.1409

R-squared	0.307626	Mean dependent var	0.001245
Adjusted R-squared	0.290316	S.D. dependent var	0.232340
S.E. of regression	0.195730	Akaike info criterion	-0.377716
Sum squared resid	1.532405	Schwarz criterion	-0.294970
Log likelihood	9.932034	F-statistic	17.77223
Durbin-Watson stat	2.125464	Prob(F-statistic)	0.000138

Appendix (3)

The results from Augmented Dickey-Fuller Unit Root (ADF) and

Phillips-Perron (PP) Test on real total non-oil GDP

Augmented Dickey-Fuller Unit Root Test on D (LN non-oil GDP)

ADF Test Statistic	-3.359395	1% Critical Value*		-3.6067
		5% Critical Value		-2.9378
		10% Critical Value		-2.6069

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNNOGDP,2)
Method: Least Squares
Date: 07/07/09   Time: 20:30
Sample(adjusted): 1967 2005
Included observations: 39 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNNOGDP(-1))	-0.591028	0.175933	-3.359395	0.0019
D(LNNOGDP(-1),2)	-0.093426	0.182934	-0.510710	0.6129
D(LNNOGDP(-2),2)	0.190061	0.175401	1.083578	0.2862
D(LNNOGDP(-3),2)	0.120781	0.136933	0.882048	0.3839
C	0.035802	0.021759	1.645387	0.1091

R-squared	0.465439	Mean dependent var	-0.010680
Adjusted R-squared	0.402549	S.D. dependent var	0.134255
S.E. of regression	0.103773	Akaike info criterion	-1.574021
Sum squared resid	0.366137	Schwarz criterion	-1.360744
Log likelihood	35.69341	F-statistic	7.400885
Durbin-Watson stat	1.508777	Prob(F-statistic)	0.000212

Augmented Dickey-Fuller Unit Root Test on D (LN non-oil GDPN)

ADF Test Statistic	-3.555622	1% Critical Value*		-3.6067
		5% Critical Value		-2.9378
		10% Critical Value		-2.6069

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNNOGDPN,2)
Method: Least Squares
Date: 07/07/09   Time: 20:36
Sample(adjusted): 1967 2005
Included observations: 39 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNNOGDPN(-1))	-0.648123	0.182281	-3.555622	0.0011
D(LNNOGDPN(-1),2)	-0.050589	0.184033	-0.274891	0.7851
D(LNNOGDPN(-2),2)	0.227158	0.174305	1.303221	0.2013
D(LNNOGDPN(-3),2)	0.141969	0.135715	1.046083	0.3029
C	0.018671	0.018492	1.009655	0.3198

R-squared	0.480572	Mean dependent var	-0.011508
Adjusted R-squared	0.419463	S.D. dependent var	0.134134
S.E. of regression	0.102201	Akaike info criterion	-1.604547
Sum squared resid	0.355130	Schwarz criterion	-1.391270
Log likelihood	36.28866	F-statistic	7.864158
Durbin-Watson stat	1.502394	Prob(F-statistic)	0.000134

Augmented Dickey-Fuller Unit Root Test on D (LN TGX)

ADF Test Statistic	-4.158247	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGX,2)
Method: Least Squares
Date: 07/07/09   Time: 20:37
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGX(-1))	-0.605235	0.145550	-4.158247	0.0002
C	0.068096	0.034130	1.995188	0.0529

R-squared	0.301810	Mean dependent var	0.002071
Adjusted R-squared	0.284356	S.D. dependent var	0.231448
S.E. of regression	0.195795	Akaike info criterion	-0.377045
Sum squared resid	1.533434	Schwarz criterion	-0.294299
Log likelihood	9.917945	F-statistic	17.29102
Durbin-Watson stat	2.122950	Prob(F-statistic)	0.000165

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Augmented Dickey-Fuller Unit Root Test on D (LN TGXC)

ADF Test Statistic	-3.160229	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGXC,2)
Method: Least Squares
Date: 07/07/09   Time: 20:38
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXC(-1))	-0.666326	0.210848	-3.160229	0.0031
D(LNTGXC(-1),2)	-0.256944	0.160331	-1.602589	0.1173
C	0.072850	0.029701	2.452813	0.0189

R-squared	0.481926	Mean dependent var		-0.002265
Adjusted R-squared	0.454658	S.D. dependent var		0.163750
S.E. of regression	0.120925	Akaike info criterion		-1.316938
Sum squared resid	0.555668	Schwarz criterion		-1.191554
Log likelihood	29.99722	F-statistic		17.67426
Durbin-Watson stat	2.028496	Prob(F-statistic)		0.000004

Augmented Dickey-Fuller Unit Root Test on D (LN TGXN)

ADF Test Statistic	-4.215713	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGXN,2)
Method: Least Squares
Date: 07/07/09   Time: 20:39
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXN(-1))	-0.615601	0.146025	-4.215713	0.0001
C	0.048374	0.032204	1.502087	0.1409

R-squared	0.307626	Mean dependent var		0.001245
Adjusted R-squared	0.290316	S.D. dependent var		0.232340
S.E. of regression	0.195730	Akaike info criterion		-0.377716
Sum squared resid	1.532405	Schwarz criterion		-0.294970
Log likelihood	9.932034	F-statistic		17.77223
Durbin-Watson stat	2.125464	Prob(F-statistic)		0.000138

Augmented Dickey-Fuller Unit Root Test on D (LN TGX/non-oil GDP)

ADF Test Statistic	-4.102466	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTGXNOGDP,2)
Method: Least Squares
Date: 07/07/09   Time: 20:40
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXNOGDP(-1))	-0.965808	0.235421	-4.102466	0.0002
D(LNTGXNOGDP(-1),2)	-0.097077	0.161192	-0.602247	0.5506
C	0.033558	0.029456	1.139272	0.2617

R-squared	0.543531	Mean dependent var		0.006154
Adjusted R-squared	0.519506	S.D. dependent var		0.266254
S.E. of regression	0.184561	Akaike info criterion		-0.471318
Sum squared resid	1.294385	Schwarz criterion		-0.345935
Log likelihood	12.66202	F-statistic		22.62387
Durbin-Watson stat	1.854155	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root on D (LN NO GDP)

PP Test Statistic	-4.929359	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.016809
Residual variance with correction	0.020235

Phillips-Perron Test Equation
Dependent Variable: D(LNNOGDP,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNNOGDP(-1))	-0.725097	0.151886	-4.773944	0.0000
C	0.058616	0.024008	2.441539	0.0191

R-squared	0.362961	Mean dependent var	-0.001043
Adjusted R-squared	0.347035	S.D. dependent var	0.164405
S.E. of regression	0.132849	Akaike info criterion	-1.152752
Sum squared resid	0.705959	Schwarz criterion	-1.070006
Log likelihood	26.20780	F-statistic	22.79054
Durbin-Watson stat	2.122232	Prob(F-statistic)	0.000024

Phillips-Perron Unit Root on D (LN NO GDPN)

PP Test Statistic	-5.094353	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.016372
Residual variance with correction	0.019878

Phillips-Perron Test Equation
Dependent Variable: D(LNNOGDPN,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNNOGDPN(-1))	-0.758510	0.153562	-4.939440	0.0000
C	0.035864	0.021625	1.658445	0.1051

R-squared	0.378863	Mean dependent var	-0.001868
Adjusted R-squared	0.363335	S.D. dependent var	0.164319
S.E. of regression	0.131112	Akaike info criterion	-1.179077
Sum squared resid	0.687618	Schwarz criterion	-1.096331
Log likelihood	26.76061	F-statistic	24.39807
Durbin-Watson stat	2.083485	Prob(F-statistic)	0.000014

Phillips-Perron Unit Root on D (LN TGX)

PP Test Statistic	-4.191733	1% Critical Value*		-3.5930
		5% Critical Value		-2.9320
		10% Critical Value		-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.036510
Residual variance with correction	0.037860

Phillips-Perron Test Equation
Dependent Variable: D(LNTGX,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGX(-1))	-0.605235	0.145550	-4.158247	0.0002
C	0.068096	0.034130	1.995188	0.0529

R-squared	0.301810	Mean dependent var	0.002071
Adjusted R-squared	0.284356	S.D. dependent var	0.231448
S.E. of regression	0.195795	Akaike info criterion	-0.377045
Sum squared resid	1.533434	Schwarz criterion	-0.294299
Log likelihood	9.917945	F-statistic	17.29102
Durbin-Watson stat	2.122950	Prob(F-statistic)	0.000165

Phillips-Perron Unit Root on D (LN TGXC)

PP Test Statistic	-5.817112	1% Critical Value*	-3.5930	
		5% Critical Value	-2.9320	
		10% Critical Value	-2.6039	

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)
Residual variance with no correction   0.014189
Residual variance with correction   0.017820

Phillips-Perron Test Equation
Dependent Variable: D(LNTGXC,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXC(-1))	-0.896192	0.157405	-5.693539	0.0000
C	0.098460	0.025611	3.844484	0.0004

R-squared	0.447639	Mean dependent var	-0.000350
Adjusted R-squared	0.433830	S.D. dependent var	0.162217
S.E. of regression	0.122059	Akaike info criterion	-1.322181
Sum squared resid	0.595933	Schwarz criterion	-1.239435
Log likelihood	29.76581	F-statistic	32.41639
Durbin-Watson stat	2.035283	Prob(F-statistic)	0.000001

Phillips-Perron Unit Root on D (LN TGXN)

PP Test Statistic	-4.254418	1% Critical Value*	-3.5930	
		5% Critical Value	-2.9320	
		10% Critical Value	-2.6039	

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)
Residual variance with no correction   0.036486
Residual variance with correction   0.038076

Phillips-Perron Test Equation
Dependent Variable: D(LNTGXN,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXN(-1))	-0.615601	0.146025	-4.215713	0.0001
C	0.048374	0.032204	1.502087	0.1409

R-squared	0.307626	Mean dependent var	0.001245
Adjusted R-squared	0.290316	S.D. dependent var	0.232340
S.E. of regression	0.195730	Akaike info criterion	-0.377716
Sum squared resid	1.532405	Schwarz criterion	-0.294970
Log likelihood	9.932034	F-statistic	17.77223
Durbin-Watson stat	2.125464	Prob(F-statistic)	0.000138

Phillips-Perron Unit Root on D (LN TGX NO GDP)

PP Test Statistic	-6.732384	1% Critical Value*	-3.5930	
		5% Critical Value	-2.9320	
		10% Critical Value	-2.6039	

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)
Residual variance with no correction   0.031835
Residual variance with correction   0.031601

Phillips-Perron Test Equation
Dependent Variable: D(LNTGXNOGDP,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTGXNOGDP(-1))	-1.064171	0.158090	-6.731413	0.0000
C	0.031683	0.028529	1.110571	0.2734

R-squared	0.531132	Mean dependent var	0.003104
Adjusted R-squared	0.519411	S.D. dependent var	0.263729
S.E. of regression	0.182829	Akaike info criterion	-0.514086
Sum squared resid	1.337054	Schwarz criterion	-0.431340
Log likelihood	12.79580	F-statistic	45.31193
Durbin-Watson stat	1.971467	Prob(F-statistic)	0.000000

Appendix (4)

The results from Augmented Dickey-Fuller Unit Root (ADF) and

Phillips-Perron (PP) tests for six categories

Augmented Dickey-Fuller Unit Root Test on D (Ln AGR) Agriculture Sector

ADF Test Statistic	-6.284926	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNAGR,2)
Method: Least Squares
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNAGR(-1))	-1.510725	0.240373	-6.284926	0.0000
D(LNAGR(-1),2)	0.276297	0.157301	1.756481	0.0871
C	0.174884	0.126026	1.387678	0.1733

R-squared	0.622538	Mean dependent var	-0.016763
Adjusted R-squared	0.602671	S.D. dependent var	1.244816
S.E. of regression	0.784658	Akaike info criterion	2.423217
Sum squared resid	23.39613	Schwarz criterion	2.548600
Log likelihood	-46.67595	F-statistic	31.33618
Durbin-Watson stat	1.883411	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on D (Ln EDU) Education Sector

ADF Test Statistic	-5.019784	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEDU,2)
Method: Least Squares
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNEDU(-1))	-1.063511	0.211864	-5.019784	0.0000
D(LNEDU(-1),2)	0.196614	0.159824	1.230187	0.2262
C	0.155266	0.103321	1.502746	0.1412

R-squared	0.466168	Mean dependent var	-0.017656
Adjusted R-squared	0.438071	S.D. dependent var	0.833505
S.E. of regression	0.624811	Akaike info criterion	1.967621
Sum squared resid	14.83478	Schwarz criterion	2.093004
Log likelihood	-37.33622	F-statistic	16.59169
Durbin-Watson stat	1.861869	Prob(F-statistic)	0.000007

Augmented Dickey-Fuller Unit Root Test on D (Ln GDP)

ADF Test Statistic	-4.604020	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGDP,2)
Method: Least Squares
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-0.892805	0.193918	-4.604020	0.0000
D(LNGDP(-1),2)	0.048376	0.150223	0.322026	0.7492
C	0.059555	0.032137	1.853175	0.0716

R-squared	0.444122	Mean dependent var	-0.007152
Adjusted R-squared	0.414865	S.D. dependent var	0.236167
S.E. of regression	0.180654	Akaike info criterion	-0.514116
Sum squared resid	1.240156	Schwarz criterion	-0.388733
Log likelihood	13.53938	F-statistic	15.18014
Durbin-Watson stat	2.013718	Prob(F-statistic)	0.000014

Augmented Dickey-Fuller Unit Root Test on D (Ln HEA) Health Sector

ADF Test Statistic	-4.576264	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNHEA,2)
Method: Least Squares
Date: 07/24/09   Time: 16:12
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHEA(-1))	-1.154778	0.252341	-4.576264	0.0000
D(LNHEA(-1),2)	-0.047836	0.161911	-0.295445	0.7693
C	0.206548	0.121279	1.703081	0.0967

R-squared	0.610607	Mean dependent var	-0.013391
Adjusted R-squared	0.590113	S.D. dependent var	1.109696
S.E. of regression	0.710454	Akaike info criterion	2.224530
Sum squared resid	19.18030	Schwarz criterion	2.349914
Log likelihood	-42.60287	F-statistic	29.79395
Durbin-Watson stat	1.972814	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on D (Ln HOU) Housing and Public utilities Sector

ADF Test Statistic	-3.348791	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNHOU,2)
Method: Least Squares
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHOU(-1))	-0.713211	0.212976	-3.348791	0.0018
D(LNHOU(-1),2)	-0.256829	0.157822	-1.627336	0.1119
C	0.058933	0.065819	0.895384	0.3762

R-squared	0.514826	Mean dependent var	-0.020553
Adjusted R-squared	0.489291	S.D. dependent var	0.556260
S.E. of regression	0.397525	Akaike info criterion	1.063238
Sum squared resid	6.004992	Schwarz criterion	1.188621
Log likelihood	-18.79637	F-statistic	20.16124
Durbin-Watson stat	2.034798	Prob(F-statistic)	0.000001

Augmented Dickey-Fuller Unit Root Test on D (Ln MAN) Manufacturing Sector

ADF Test Statistic	-4.243202	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNMAN,2)
Method: Least Squares
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNMAN(-1))	-0.993902	0.234234	-4.243202	0.0001
D(LNMAN(-1),2)	-0.068221	0.172489	-0.395510	0.6947
C	0.148730	0.175324	0.848313	0.4016

R-squared	0.534738	Mean dependent var	-0.003104
Adjusted R-squared	0.510250	S.D. dependent var	1.552675
S.E. of regression	1.086595	Akaike info criterion	3.074330
Sum squared resid	44.86613	Schwarz criterion	3.199713
Log likelihood	-60.02376	F-statistic	21.83720
Durbin-Watson stat	1.967062	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on D (Ln TRA) Transportation and Communication

ADF Test Statistic	-3.874262	1% Critical Value*	-3.5973
		5% Critical Value	-2.9339
		10% Critical Value	-2.6048

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTRA,2)
Method: Least Squares
Sample(adjusted): 1965 2005
Included observations: 41 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTRA(-1))	-0.851187	0.219703	-3.874262	0.0004
D(LNTRA(-1),2)	-0.080661	0.165274	-0.488043	0.6283
C	0.063145	0.080208	0.787269	0.4360

R-squared	0.464111	Mean dependent var	-0.015855
Adjusted R-squared	0.435907	S.D. dependent var	0.664758
S.E. of regression	0.499274	Akaike info criterion	1.519031
Sum squared resid	9.472422	Schwarz criterion	1.644414
Log likelihood	-28.14014	F-statistic	16.45513
Durbin-Watson stat	1.996924	Prob(F-statistic)	0.000007

Phillips-Perron Unit Root on D (Ln AGR) Agriculture Sector

PP Test Statistic	-7.807331	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.604019
Residual variance with correction	0.473649

Phillips-Perron Test Equation
Dependent Variable: D(LNAGR,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNAGR(-1))	-1.185641	0.155936	-7.603381	0.0000
C	0.143270	0.124554	1.150264	0.2569

R-squared	0.591050	Mean dependent var	-0.011306
Adjusted R-squared	0.580826	S.D. dependent var	1.230051
S.E. of regression	0.796380	Akaike info criterion	2.428966
Sum squared resid	25.36882	Schwarz criterion	2.511713
Log likelihood	-49.00829	F-statistic	57.81141
Durbin-Watson stat	2.094917	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root on D (Ln EDU) Education Sector

PP Test Statistic	-5.588796	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3   (Newey-West suggests: 3)

Residual variance with no correction	0.370330
Residual variance with correction	0.317735

Phillips-Perron Test Equation
Dependent Variable: D(LNEDU,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNEDU(-1))	-0.889689	0.157853	-5.636185	0.0000
C	0.136845	0.099658	1.373151	0.1774

R-squared	0.442638	Mean dependent var	-0.009414
Adjusted R-squared	0.428703	S.D. dependent var	0.825008
S.E. of regression	0.623575	Akaike info criterion	1.939754
Sum squared resid	15.55385	Schwarz criterion	2.022500
Log likelihood	-38.73483	F-statistic	31.76658
Durbin-Watson stat	1.940139	Prob(F-statistic)	0.000002

Phillips-Perron Unit Root on D (Ln GDP)

PP Test Statistic	-5.446949	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3 (Newey-West suggests: 3)

Residual variance with no correction	0.030628
Residual variance with correction	0.025935

Phillips-Perron Test Equation
Dependent Variable: D(LNGDP,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-0.796093	0.145555	-5.469371	0.0000
C	0.056571	0.030254	1.869848	0.0688

R-squared	0.427869	Mean dependent var	-0.010331
Adjusted R-squared	0.413565	S.D. dependent var	0.234177
S.E. of regression	0.179330	Akaike info criterion	-0.552726
Sum squared resid	1.286375	Schwarz criterion	-0.469980
Log likelihood	13.60725	F-statistic	29.91402
Durbin-Watson stat	2.067722	Prob(F-statistic)	0.000003

Phillips-Perron Unit Root on D (Ln HEA) Health Sector

PP Test Statistic	-7.855105	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3 (Newey-West suggests: 3)

Residual variance with no correction	0.462962
Residual variance with correction	0.488848

Phillips-Perron Test Equation
Dependent Variable: D(LNHEA,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHEA(-1))	-1.217409	0.154200	-7.895027	0.0000
C	0.230103	0.111348	2.066520	0.0453

R-squared	0.609113	Mean dependent var	0.003431
Adjusted R-squared	0.599341	S.D. dependent var	1.101488
S.E. of regression	0.697216	Akaike info criterion	2.163004
Sum squared resid	19.44438	Schwarz criterion	2.245750
Log likelihood	-43.42308	F-statistic	62.33145
Durbin-Watson stat	1.958817	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root on D (Ln HOU) Housing and Public utilities Sector

PP Test Statistic	-6.049211	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3 (Newey-West suggests: 3)

Residual variance with no correction	0.159119
Residual variance with correction	0.195445

Phillips-Perron Test Equation
Dependent Variable: D(LNHOU,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHOU(-1))	-0.949300	0.159308	-5.958906	0.0000
C	0.093995	0.065387	1.437514	0.1583

R-squared	0.470259	Mean dependent var	-0.008781
Adjusted R-squared	0.457015	S.D. dependent var	0.554705
S.E. of regression	0.408749	Akaike info criterion	1.095015
Sum squared resid	6.683017	Schwarz criterion	1.177761
Log likelihood	-20.99532	F-statistic	35.50856
Durbin-Watson stat	1.972013	Prob(F-statistic)	0.000001

Phillips-Perron Unit Root on D (Ln MAN) Manufacturing Sector

PP Test Statistic	-6.613133	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3 (Newey-West suggests: 3)

Residual variance with no correction	1.134264
Residual variance with correction	1.014149

Phillips-Perron Test Equation
Dependent Variable: D(LNMAN,2)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNMAN(-1))	-1.066692	0.161529	-6.603737	0.0000
C	0.202641	0.170194	1.190648	0.2408

R-squared	0.521585	Mean dependent var	0.039631
Adjusted R-squared	0.509624	S.D. dependent var	1.558429
S.E. of regression	1.091319	Akaike info criterion	3.059099
Sum squared resid	47.63907	Schwarz criterion	3.141845
Log likelihood	-62.24108	F-statistic	43.60935
Durbin-Watson stat	1.890732	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root on D (Ln TRA) Transportation and Communication

PP Test Statistic	-5.845619	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.
Lag truncation for Bartlett kernel: 3 (Newey-West suggests: 3)

Residual variance with no correction	0.228966
Residual variance with correction	0.249325

Phillips-Perron Test Equation
Dependent Variable: D(LNTRA,2)
Method: Least Squares
Date: 07/24/09 Time: 16:27
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTRA(-1))	-0.922161	0.158698	-5.810782	0.0000
C	0.075661	0.077082	0.981553	0.3322

R-squared	0.457739	Mean dependent var	-0.010047
Adjusted R-squared	0.444182	S.D. dependent var	0.657679
S.E. of regression	0.490320	Akaike info criterion	1.458933
Sum squared resid	9.616565	Schwarz criterion	1.541679
Log likelihood	-28.63759	F-statistic	33.76519
Durbin-Watson stat	1.990346	Prob(F-statistic)	0.000001

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Appendix (5)

Engle Granger two steps for testing Cointegration with total GDP

the results without dummies and with dummies

Dependent Variable: LNTGX (Peacock-Wiseman model)

Method: Least Squares
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.620703	0.531624	-8.691675	0.0000
LNGDP	1.350530	0.058816	22.96195	0.0000

R-squared	0.926219	Mean dependent var		7.522987
Adjusted R-squared	0.924462	S.D. dependent var		1.306303
S.E. of regression	0.359026	Akaike info criterion		0.833548
Sum squared resid	5.413799	Schwarz criterion		0.914647
Log likelihood	-16.33805	F-statistic		527.2510
Durbin-Watson stat	0.604798	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid01

ADF Test Statistic	-2.625620	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID01)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07(-1)	-0.337623	0.128588	-2.625620	0.0122
D(RESID07(-1))	0.155251	0.151415	1.025333	0.3114

R-squared	0.145376	Mean dependent var		0.011618
Adjusted R-squared	0.124011	S.D. dependent var		0.268394
S.E. of regression	0.251201	Akaike info criterion		0.121324
Sum squared resid	2.524083	Schwarz criterion		0.204070
Log likelihood	-0.547794	Durbin-Watson stat		1.955279

Dependent Variable: LNTGXC (Pryor model)

Method: Least Squares
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.010443	0.780374	-5.139129	0.0000
LNGDP	1.343771	0.086336	15.56437	0.0000

R-squared	0.852243	Mean dependent var		8.072473
Adjusted R-squared	0.848724	S.D. dependent var		1.355003
S.E. of regression	0.527017	Akaike info criterion		1.601222
Sum squared resid	11.66537	Schwarz criterion		1.682321
Log likelihood	-33.22687	F-statistic		242.2496
Durbin-Watson stat	0.185728	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid02

ADF Test Statistic	-1.169403	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID08)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08(-1)	-0.077626	0.066381	-1.169403	0.2492
D(RESID08(-1))	0.120344	0.145591	0.826590	0.4134

R-squared	0.038664	Mean dependent var		0.010860
Adjusted R-squared	0.014631	S.D. dependent var		0.211099
S.E. of regression	0.209549	Akaike info criterion		-0.241267
Sum squared resid	1.756437	Schwarz criterion		-0.158521
Log likelihood	7.066614	Durbin-Watson stat		2.066250

Dependent Variable: LNTGX (Goffman model)

Method: Least Squares
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.405841	1.400636	-4.573522	0.0000
LNGDPN	1.781134	0.178566	9.974651	0.0000

R-squared	0.703167	Mean dependent var	7.522987
Adjusted R-squared	0.696099	S.D. dependent var	1.306303
S.E. of regression	0.720128	Akaike info criterion	2.225614
Sum squared resid	21.78056	Schwarz criterion	2.306714
Log likelihood	-46.96351	F-statistic	99.49365
Durbin-Watson stat	0.224204	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid03

ADF Test Statistic	-0.879210	1% Critical Value*	**-2.6182**
		5% Critical Value	**-1.9488**
		10% Critical Value	**-1.6199**

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID09)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09(-1)	-0.068627	0.078055	-0.879210	0.3845
D(RESID09(-1))	0.041701	0.156919	0.265746	0.7918

R-squared	0.004234	Mean dependent var	0.039294
Adjusted R-squared	-0.020660	S.D. dependent var	0.324605
S.E. of regression	0.327941	Akaike info criterion	0.654481
Sum squared resid	4.301808	Schwarz criterion	0.737227
Log likelihood	-11.74410	Durbin-Watson stat	2.031699

Dependent Variable: LNTGXGDP (Musgrave model)

Method: Least Squares
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.173653	1.164474	-1.866639	0.0689
LNGDPN	1.355513	0.148458	9.130623	0.0000

R-squared	0.664987	Mean dependent var	8.426735
Adjusted R-squared	0.657011	S.D. dependent var	1.022290
S.E. of regression	0.598707	Akaike info criterion	1.856300
Sum squared resid	15.05490	Schwarz criterion	1.937400
Log likelihood	-38.83860	F-statistic	83.36828
Durbin-Watson stat	0.178110	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid04

ADF Test Statistic	-1.071878	1% Critical Value*	**-2.6182**
		5% Critical Value	**-1.9488**
		10% Critical Value	**-1.6199**

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID10)
Method: Least Squares
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID10(-1)	-0.071020	0.066258	-1.071878	0.2902
D(RESID10(-1))	0.041987	0.153801	0.272996	0.7863

R-squared	0.015969	Mean dependent var	0.026541
Adjusted R-squared	-0.008631	S.D. dependent var	0.242261
S.E. of regression	0.243304	Akaike info criterion	0.057442
Sum squared resid	2.367883	Schwarz criterion	0.140188
Log likelihood	0.793724	Durbin-Watson stat	1.985082

Dependent Variable: LNTGXN (Gupta model)

Method: Least Squares
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.491932	0.825280	-5.442918	0.0000
LNGDPN	1.386578	0.105214	13.17861	0.0000
R-squared	0.805263	Mean dependent var		6.351390
Adjusted R-squared	0.800627	S.D. dependent var		0.950281
S.E. of regression	0.424312	Akaike info criterion		1.167696
Sum squared resid	7.561725	Schwarz criterion		1.248795
Log likelihood	-23.68931	F-statistic		173.6757
Durbin-Watson stat	0.447575	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid05

ADF Test Statistic	-1.860824	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID11)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID11(-1)	-0.208378	0.111982	-1.860824	0.0701
D(RESID11(-1))	0.109625	0.156829	0.699011	0.4886
R-squared	0.073615	Mean dependent var		0.021855
Adjusted R-squared	0.050455	S.D. dependent var		0.272549
S.E. of regression	0.265584	Akaike info criterion		0.232676
Sum squared resid	2.821393	Schwarz criterion		0.315423
Log likelihood	-2.886205	Durbin-Watson stat		1.984387

Dependent Variable: LNTGXGDP (Mann model)

Method: Least Squares
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.124330	0.388911	-2.890968	0.0061
LNGDP	1.062198	0.043027	24.68674	0.0000
R-squared	0.935527	Mean dependent var		8.426735
Adjusted R-squared	0.933992	S.D. dependent var		1.022290
S.E. of regression	0.262647	Akaike info criterion		0.208378
Sum squared resid	2.897305	Schwarz criterion		0.289477
Log likelihood	-2.584308	F-statistic		609.4353
Durbin-Watson stat	0.615627	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid06

ADF Test Statistic	-2.744518	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID12)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID12(-1)	-0.333276	0.121433	-2.744518	0.0090
D(RESID12(-1))	0.115467	0.148686	0.776582	0.4420
R-squared	0.159408	Mean dependent var		0.002943
Adjusted R-squared	0.138393	S.D. dependent var		0.198863
S.E. of regression	0.184590	Akaike info criterion		-0.494911
Sum squared resid	1.362940	Schwarz criterion		-0.412165
Log likelihood	12.39312	Durbin-Watson stat		1.924709

Dependent Variable: LNTGX (Peacock-Wiseman model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.918346	0.931568	-7.426559	0.0000
LNGDP	1.695760	0.130284	13.01592	0.0000
DUM1	-0.944403	0.317254	-2.976801	0.0049
DUM2	-0.028816	0.113292	-0.254352	0.8005

R-squared	0.939609	Mean dependent var		7.522987
Adjusted R-squared	0.935080	S.D. dependent var		1.306303
S.E. of regression	0.332839	Akaike info criterion		0.724195
Sum squared resid	4.431283	Schwarz criterion		0.886394
Log likelihood	-11.93229	F-statistic		207.4498
Durbin-Watson stat	0.990683	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid01 with dummies

ADF Test Statistic	**-3.218234**	1% Critical Value*		**-2.6182**
		5% Critical Value		**-1.9488**
		10% Critical Value		**-1.6199**

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID07)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07(-1)	-0.534458	0.166072	-3.218234	0.0026
D(RESID07(-1))	0.016341	0.147493	0.110791	0.9123

R-squared	0.247060	Mean dependent var		0.008658
Adjusted R-squared	0.228237	S.D. dependent var		0.306562
S.E. of regression	0.269315	Akaike info criterion		0.260579
Sum squared resid	2.901226	Schwarz criterion		0.343325
Log likelihood	-3.472157	Durbin-Watson stat		1.995544

Dependent Variable: LNTGXC (Pryor model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.937689	1.061078	-4.653464	0.0000
LNGDP	1.497823	0.148396	10.09342	0.0000
DUM1	-0.924348	0.361360	-2.557969	0.0144
DUM2	0.739502	0.129043	5.730671	0.0000

R-squared	0.927181	Mean dependent var		8.072473
Adjusted R-squared	0.921719	S.D. dependent var		1.355003
S.E. of regression	0.379112	Akaike info criterion		0.984537
Sum squared resid	5.749034	Schwarz criterion		1.146736
Log likelihood	-17.65982	F-statistic		169.7687
Durbin-Watson stat	0.720369	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid02 with dummies

ADF Test Statistic	**-2.051491**	1% Critical Value*		**-2.6182**
		5% Critical Value		**-1.9488**
		10% Critical Value		**-1.6199**

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID08)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08(-1)	-0.361841	0.176379	-2.051491	0.0468
D(RESID08(-1))	0.053817	0.172037	0.312820	0.7560

R-squared	0.113085	Mean dependent var		0.021513
Adjusted R-squared	0.090912	S.D. dependent var		0.300180
S.E. of regression	0.286210	Akaike info criterion		0.382264
Sum squared resid	3.276640	Schwarz criterion		0.465010
Log likelihood	-6.027543	Durbin-Watson stat		2.009030

Dependent Variable: LNTGX (Peacock-Wiseman model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.620703	0.531624	-8.691675	0.0000
LNGDP	1.350530	0.058816	22.96195	0.0000

R-squared	0.926219	Mean dependent var	7.522987
Adjusted R-squared	0.924462	S.D. dependent var	1.306303
S.E. of regression	0.359026	Akaike info criterion	0.833548
Sum squared resid	5.413799	Schwarz criterion	0.914647
Log likelihood	-16.33805	F-statistic	527.2510
Durbin-Watson stat	0.604798	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root Test on Resido1PP

PP Test Statistic	-3.068125	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel:3	(Newey-West suggests: 3)	
Residual variance with no correction		0.062968
Residual variance with correction		0.070084

Phillips-Perron Test Equation
Dependent Variable: D(RESID01PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07PP(-1)	-0.336059	0.113355	-2.964655	0.0050

R-squared	0.173021	Mean dependent var	-0.001708
Adjusted R-squared	0.173021	S.D. dependent var	0.279205
S.E. of regression	0.253905	Akaike info criterion	0.119265
Sum squared resid	2.707636	Schwarz criterion	0.160223
Log likelihood	-1.564188	Durbin-Watson stat	1.626896

Dependent Variable: LNTGXC (Pryor model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.010443	0.780374	-5.139129	0.0000
LNGDP	1.343771	0.086336	15.56437	0.0000

R-squared	0.852243	Mean dependent var	8.072473
Adjusted R-squared	0.848724	S.D. dependent var	1.355003
S.E. of regression	0.527017	Akaike info criterion	1.601222
Sum squared resid	11.66537	Schwarz criterion	1.682321
Log likelihood	-33.22687	F-statistic	242.2496
Durbin-Watson stat	0.185728	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root Test on Resido2PP

PP Test Statistic	-1.693745	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.047482
Residual variance with correction		0.054838

Phillips-Perron Test Equation
Dependent Variable: D(RESID02PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08PP(-1)	-0.105878	0.066060	-1.602761	0.1165

R-squared	0.057486	Mean dependent var	-0.002844
Adjusted R-squared	0.057486	S.D. dependent var	0.227106
S.E. of regression	0.220482	Akaike info criterion	-0.163023
Sum squared resid	2.041711	Schwarz criterion	-0.122065
Log likelihood	4.505004	Durbin-Watson stat	1.584868

Dependent Variable: LNTGX (Goffman model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.405841	1.400636	-4.573522	0.0000
LNGDPN	1.781134	0.178566	9.974651	0.0000

R-squared	0.703167	Mean dependent var		7.522987
Adjusted R-squared	0.696099	S.D. dependent var		1.306303
S.E. of regression	0.720128	Akaike info criterion		2.225614
Sum squared resid	21.78056	Schwarz criterion		2.306714
Log likelihood	-46.96351	F-statistic		99.49365
Durbin-Watson stat	0.224204	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido3PP

PP Test Statistic	-0.854290	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.110742
Residual variance with correction		0.093585

Phillips-Perron Test Equation
Dependent Variable: D(RESID03PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09PP(-1)	-0.078347	0.075726	-1.034617	0.3068

R-squared	0.020693	Mean dependent var		0.021963
Adjusted R-squared	0.020693	S.D. dependent var		0.340257
S.E. of regression	0.336718	Akaike info criterion		0.683839
Sum squared resid	4.761917	Schwarz criterion		0.724797
Log likelihood	-13.70253	Durbin-Watson stat		1.786011

Dependent Variable: LNTGXGDP (Musgrave model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.173653	1.164474	-1.866639	0.0689
LNGDPN	1.355513	0.148458	9.130623	0.0000

R-squared	0.664987	Mean dependent var		8.426735
Adjusted R-squared	0.657011	S.D. dependent var		1.022290
S.E. of regression	0.598707	Akaike info criterion		1.856300
Sum squared resid	15.05490	Schwarz criterion		1.937400
Log likelihood	-38.83860	F-statistic		83.36828
Durbin-Watson stat	0.178110	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido4PP

PP Test Statistic	-0.883743	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.060608
Residual variance with correction		0.046285

Phillips-Perron Test Equation
Dependent Variable: D(RESID04PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID10PP(-1)	-0.072242	0.065579	-1.101598	0.2769

R-squared	0.024839	Mean dependent var		0.014400
Adjusted R-squared	0.024839	S.D. dependent var		0.252253
S.E. of regression	0.249100	Akaike info criterion		0.081057
Sum squared resid	2.606135	Schwarz criterion		0.122015
Log likelihood	-0.742722	Durbin-Watson stat		1.816409

Dependent Variable: LNTGXN (Gupta model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.491932	0.825280	-5.442918	0.0000
LNGDPN	1.386578	0.105214	13.17861	0.0000

R-squared	0.805263	Mean dependent var	6.351390
Adjusted R-squared	0.800627	S.D. dependent var	0.950281
S.E. of regression	0.424312	Akaike info criterion	1.167696
Sum squared resid	7.561725	Schwarz criterion	1.248795
Log likelihood	-23.68931	F-statistic	173.6757
Durbin-Watson stat	0.447575	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root Test on Resido5PP

PP Test Statistic	-2.080203	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.071510
Residual variance with correction		0.072997

Phillips-Perron Test Equation
Dependent Variable: D(RESID05PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID11PP(-1)	-0.212641	0.103423	-2.056023	0.0460

R-squared	0.090665	Mean dependent var	0.008216
Adjusted R-squared	0.090665	S.D. dependent var	0.283748
S.E. of regression	0.270579	Akaike info criterion	0.246477
Sum squared resid	3.074951	Schwarz criterion	0.287436
Log likelihood	-4.299266	Durbin-Watson stat	1.679986

Dependent Variable: LNTGXGDP (Mann model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.124330	0.388911	-2.890968	0.0061
LNGDP	1.062198	0.043027	24.68674	0.0000

R-squared	0.935527	Mean dependent var	8.426735
Adjusted R-squared	0.933992	S.D. dependent var	1.022290
S.E. of regression	0.262647	Akaike info criterion	0.208378
Sum squared resid	2.897305	Schwarz criterion	0.289477
Log likelihood	-2.584308	F-statistic	609.4353
Durbin-Watson stat	0.615627	Prob(F-statistic)	0.000000

Phillips-Perron Unit Root Test on Resido6PP

PP Test Statistic	-3.082082	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.033754
Residual variance with correction		0.032950

Dependent Variable: D(RESID06PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID12PP(-1)	-0.340227	0.109727	-3.100677	0.0034

R-squared	0.185445	Mean dependent var	-0.006482
Adjusted R-squared	0.185445	S.D. dependent var	0.205973
S.E. of regression	0.185897	Akaike info criterion	-0.504272
Sum squared resid	1.451416	Schwarz criterion	-0.463314
Log likelihood	11.84184	Durbin-Watson stat	1.708851

Dependent Variable: LNTGX (Goffman model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.417473	2.260951	-2.396104	0.0213
LNGDPN	1.593081	0.340803	4.674498	0.0000
DUM1	0.180382	0.605323	0.297993	0.7673
DUM2	0.765499	0.220125	3.477560	0.0012

R-squared	0.795529	Mean dependent var	7.522987
Adjusted R-squared	0.780193	S.D. dependent var	1.306303
S.E. of regression	0.612442	Akaike info criterion	1.943782
Sum squared resid	15.00339	Schwarz criterion	2.105981
Log likelihood	-38.76319	F-statistic	51.87545
Durbin-Watson stat	0.402300	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid03 with dummies

ADF Test Statistic	-1.113437	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID09)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09(-1)	-0.137994	0.123935	-1.113437	0.2722
D(RESID09(-1))	0.076568	0.172456	0.443983	0.6594

R-squared	0.017066	Mean dependent var	0.042587
Adjusted R-squared	-0.007507	S.D. dependent var	0.368725
S.E. of regression	0.370107	Akaike info criterion	0.896396
Sum squared resid	5.479154	Schwarz criterion	0.979142
Log likelihood	-16.82432	Durbin-Watson stat	1.998249

Dependent Variable: LNTGXGDP (Musgrave model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.651099	1.513148	-1.091168	0.2817
LNGDPN	1.237797	0.228083	5.426953	0.0000
DUM1	0.018791	0.405114	0.046384	0.9632
DUM2	0.885124	0.147320	6.008189	0.0000

R-squared	0.850461	Mean dependent var	8.426735
Adjusted R-squared	0.839246	S.D. dependent var	1.022290
S.E. of regression	0.409878	Akaike info criterion	1.140595
Sum squared resid	6.720009	Schwarz criterion	1.302794
Log likelihood	-21.09309	F-statistic	75.82977
Durbin-Watson stat	0.592741	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid04 with dummies

ADF Test Statistic	-1.960862	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID10)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID10(-1)	-0.304462	0.155269	-1.960862	0.0569
D(RESID10(-1))	0.153707	0.177423	0.866331	0.3915

R-squared	0.079533	Mean dependent var	0.030843
Adjusted R-squared	0.056521	S.D. dependent var	0.302336
S.E. of regression	0.293668	Akaike info criterion	0.433714
Sum squared resid	3.449634	Schwarz criterion	0.516460
Log likelihood	-7.107986	Durbin-Watson stat	1.938050

Dependent Variable: LNTGXN (Gupta model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.657516	1.551254	-3.002419	0.0046
LNGDPN	1.404359	0.233827	6.005973	0.0000
DUM1	-0.087673	0.415316	-0.211099	0.8339
DUM2	0.232178	0.151030	1.537299	0.1321

R-squared	0.818114	Mean dependent var		6.351390
Adjusted R-squared	0.804472	S.D. dependent var		0.950281
S.E. of regression	0.420200	Akaike info criterion		1.190338
Sum squared resid	7.062736	Schwarz criterion		1.352537
Log likelihood	-22.18744	F-statistic		59.97250
Durbin-Watson stat	0.518232	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid05 with dummies

ADF Test Statistic	-1.871526	1% Critical Value*		**-2.6182**
		5% Critical Value		**-1.9488**
		10% Critical Value		**-1.6199**

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID11)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID11(-1)	-0.237827	0.127077	-1.871526	0.0686
D(RESID11(-1))	0.090256	0.160888	0.560985	0.5779

R-squared	0.075886	Mean dependent var		0.023225
Adjusted R-squared	0.052783	S.D. dependent var		0.284114
S.E. of regression	0.276514	Akaike info criterion		0.313335
Sum squared resid	3.058394	Schwarz criterion		0.396082
Log likelihood	-4.580044	Durbin-Watson stat		1.998242

Dependent Variable: LNTGXGDP (Mann model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.283615	0.559071	-4.084659	0.0002
LNGDP	1.242255	0.078188	15.88798	0.0000
DUM1	-0.692992	0.190397	-3.639725	0.0008
DUM2	0.284810	0.067991	4.188911	0.0001

R-squared	0.964484	Mean dependent var		8.426735
Adjusted R-squared	0.961821	S.D. dependent var		1.022290
S.E. of regression	0.199750	Akaike info criterion		-0.296990
Sum squared resid	1.596006	Schwarz criterion		-0.134791
Log likelihood	10.53378	F-statistic		362.0894
Durbin-Watson stat	1.434926	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid06 with dummies

ADF Test Statistic	-4.148922	1% Critical Value*		**-2.6182**
		5% Critical Value		**-1.9488**
		10% Critical Value		**-1.6199**

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID12)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID12(-1)	-0.826317	0.199164	-4.148922	0.0002
D(RESID12(-1))	0.074762	0.149891	0.498773	0.6207

R-squared	0.374095	Mean dependent var		0.006172
Adjusted R-squared	0.358447	S.D. dependent var		0.223492
S.E. of regression	0.179010	Akaike info criterion		-0.556301
Sum squared resid	1.281784	Schwarz criterion		-0.473555
Log likelihood	13.68233	Durbin-Watson stat		1.984936

Appendix (6)

Engle Granger two steps for testing Cointegration with total non-oil GDP the results without dummies and with dummies

Dependent Variable: LNTGX (Peacock-Wiseman model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.984587	0.365716	-8.160945	0.0000
LNNOGDP	1.246933	0.043091	28.93741	0.0000

R-squared	0.952239	Mean dependent var		7.522987
Adjusted R-squared	0.951102	S.D. dependent var		1.306303
S.E. of regression	0.288863	Akaike info criterion		0.398659
Sum squared resid	3.504552	Schwarz criterion		0.479759
Log likelihood	-6.770504	F-statistic		837.3735
Durbin-Watson stat	0.418698	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test with total non-oil GDP on Resid01

ADF Test Statistic	-1.673694	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID07)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07(-1)	-0.180720	0.107977	-1.673694	0.1020
D(RESID07(-1))	-0.047528	0.162423	-0.292618	0.7713

R-squared	0.082483	Mean dependent var		0.009867
Adjusted R-squared	0.059545	S.D. dependent var		0.188774
S.E. of regression	0.183067	Akaike info criterion		-0.511476
Sum squared resid	1.340548	Schwarz criterion		-0.428730
Log likelihood	12.74100	Durbin-Watson stat		1.935967

Dependent Variable: LNTGXC (Pryor model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.867149	0.405484	-7.070926	0.0000
LNNOGDP	1.299286	0.047776	27.19514	0.0000

R-squared	0.946262	Mean dependent var		8.081594
Adjusted R-squared	0.944983	S.D. dependent var		1.365441
S.E. of regression	0.320274	Akaike info criterion		0.605110
Sum squared resid	4.308170	Schwarz criterion		0.686209
Log likelihood	-11.31241	F-statistic		739.5755
Durbin-Watson stat	0.266711	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test with total non-oil GDP on Resid02

ADF Test Statistic	-1.329134	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID08)
Method: Least Squares
Date: 07/20/09   Time: 18:21
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08(-1)	-0.114760	0.086342	-1.329134	0.1913
D(RESID08(-1))	-0.076242	0.160202	-0.475913	0.6367

R-squared	0.060412	Mean dependent var		0.004358
Adjusted R-squared	0.036922	S.D. dependent var		0.166956
S.E. of regression	0.163845	Akaike info criterion		-0.733345
Sum squared resid	1.073806	Schwarz criterion		-0.650599
Log likelihood	17.40025	Durbin-Watson stat		1.908390

Dependent Variable: LNTGX (Goffman model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.427813	0.684496	-9.390573	0.0000
LNNOGDPN	1.922885	0.093981	20.46032	0.0000
R-squared	0.908819	Mean dependent var		7.522987
Adjusted R-squared	0.906648	S.D. dependent var		1.306303
S.E. of regression	0.399121	Akaike info criterion		1.045286
Sum squared resid	6.690503	Schwarz criterion		1.126385
Log likelihood	-20.99628	F-statistic		418.6246
Durbin-Watson stat	0.329100	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test with total non-oil GDP on Resid03

ADF Test Statistic	-0.628931	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID09)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09(-1)	-0.065147	0.103584	-0.628931	0.5330
D(RESID09(-1))	-0.192240	0.167540	-1.147425	0.2580
R-squared	0.056489	Mean dependent var		0.019099
Adjusted R-squared	0.032902	S.D. dependent var		0.230773
S.E. of regression	0.226945	Akaike info criterion		-0.081771
Sum squared resid	2.060160	Schwarz criterion		0.000976
Log likelihood	3.717182	Durbin-Watson stat		1.861958

Dependent Variable: LNTGXNOGDP (Musgrave model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.832980	0.481026	-7.968348	0.0000
LNNOGDPN	0.403716	0.066045	6.112768	0.0000
R-squared	0.470806	Mean dependent var		-0.903964
Adjusted R-squared	0.458206	S.D. dependent var		0.381052
S.E. of regression	0.280480	Akaike info criterion		0.339760
Sum squared resid	3.304099	Schwarz criterion		0.420860
Log likelihood	-5.474730	F-statistic		37.36593
Durbin-Watson stat	0.478112	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test with total non-oil GDP on Resid04

ADF Test Statistic	-1.611402	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID10)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID10(-1)	-0.192237	0.119298	-1.611402	0.1150
D(RESID10(-1))	-0.082567	0.164723	-0.501247	0.6189
R-squared	0.091466	Mean dependent var		0.010631
Adjusted R-squared	0.068752	S.D. dependent var		0.195841
S.E. of regression	0.188989	Akaike info criterion		-0.447806
Sum squared resid	1.428676	Schwarz criterion		-0.365060
Log likelihood	11.40393	Durbin-Watson stat		1.905045

Dependent Variable: LNTGXN (Gupta model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.830337	0.481455	-7.955753	0.0000
LNNOGDPN	1.403381	0.066104	21.23001	0.0000

R-squared	0.914758	Mean dependent var	6.351390
Adjusted R-squared	0.912728	S.D. dependent var	0.950281
S.E. of regression	0.280730	Akaike info criterion	0.341544
Sum squared resid	3.309998	Schwarz criterion	0.422644
Log likelihood	-5.513970	F-statistic	450.7134
Durbin-Watson stat	0.477238	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test with total non-oil GDP on Resid05

ADF Test Statistic	-1.617105	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID11)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID11(-1)	-0.192749	0.119194	-1.617105	0.1137
D(RESID11(-1))	-0.079603	0.164735	-0.483217	0.6316

R-squared	0.090924	Mean dependent var	0.010612
Adjusted R-squared	0.068197	S.D. dependent var	0.195834
S.E. of regression	0.189039	Akaike info criterion	-0.447280
Sum squared resid	1.429429	Schwarz criterion	-0.364534
Log likelihood	11.39287	Durbin-Watson stat	1.906133

Dependent Variable: LNTGXNOGDP (Mann model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.986356	0.365447	-8.171795	0.0000
LNNOGDP	0.247117	0.043059	5.739041	0.0000

R-squared	0.439526	Mean dependent var	-0.903964
Adjusted R-squared	0.426182	S.D. dependent var	0.381052
S.E. of regression	0.288650	Akaike info criterion	0.397187
Sum squared resid	3.499398	Schwarz criterion	0.478287
Log likelihood	-6.738122	F-statistic	32.93659
Durbin-Watson stat	0.419305	Prob(F-statistic)	0.000001

Augmented Dickey-Fuller Unit Root Test with total non-oil GDP on Resid06

ADF Test Statistic	-1.668536	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID12)
Method: Least Squares
Date: 07/20/09   Time: 18:28
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID12(-1)	-0.180282	0.108048	-1.668536	0.1030
D(RESID12(-1))	-0.050488	0.162413	-0.310864	0.7575

R-squared	0.082849	Mean dependent var	0.009885
Adjusted R-squared	0.059920	S.D. dependent var	0.188774
S.E. of regression	0.183031	Akaike info criterion	-0.511873
Sum squared resid	1.340016	Schwarz criterion	-0.429127
Log likelihood	12.74933	Durbin-Watson stat	1.934808

Dependent Variable: LNTGX (Peacock-Wiseman model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.984587	0.365716	-8.160945	0.0000
LNNOGDP	1.246933	0.043091	28.93741	0.0000

R-squared	0.952239	Mean dependent var		7.522987
Adjusted R-squared	0.951102	S.D. dependent var		1.306303
S.E. of regression	0.288863	Akaike info criterion		0.398659
Sum squared resid	3.504552	Schwarz criterion		0.479759
Log likelihood	-6.770504	F-statistic		837.3735
Durbin-Watson stat	0.418698	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido1PP

PP Test Statistic	-1.996475	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.031266
Residual variance with correction		0.032315

Phillips-Perron Test Equation
Dependent Variable: D(RESID01PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07PP(-1)	-0.192818	0.098399	-1.959551	0.0567

R-squared	0.081801	Mean dependent var		0.008547
Adjusted R-squared	0.081801	S.D. dependent var		0.186714
S.E. of regression	0.178914	Akaike info criterion		-0.580838
Sum squared resid	1.344434	Schwarz criterion		-0.539880
Log likelihood	13.48802	Durbin-Watson stat		2.050716

Dependent Variable: LNTGXC (Pryor model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.867149	0.405484	-7.070926	0.0000
LNNOGDP	1.299286	0.047776	27.19514	0.0000

R-squared	0.946262	Mean dependent var		8.081594
Adjusted R-squared	0.944983	S.D. dependent var		1.365441
S.E. of regression	0.320274	Akaike info criterion		0.605110
Sum squared resid	4.308170	Schwarz criterion		0.686209
Log likelihood	-11.31241	F-statistic		739.5755
Durbin-Watson stat	0.266711	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido2PP

PP Test Statistic	-1.617531	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.025130
Residual variance with correction		0.024747

Phillips-Perron Test Equation
Dependent Variable: D(RESID02PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08PP(-1)	-0.129438	0.079368	-1.630867	0.1104

R-squared	0.059327	Mean dependent var		0.002549
Adjusted R-squared	0.059327	S.D. dependent var		0.165382
S.E. of regression	0.160402	Akaike info criterion		-0.799290
Sum squared resid	1.080606	Schwarz criterion		-0.758332
Log likelihood	18.18473	Durbin-Watson stat		2.121998

Dependent Variable: LNTGX (Goffman model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.427813	0.684496	-9.390573	0.0000
LNNOGDPN	1.922885	0.093981	20.46032	0.0000

R-squared	0.908819	Mean dependent var		7.522987
Adjusted R-squared	0.906648	S.D. dependent var		1.306303
S.E. of regression	0.399121	Akaike info criterion		1.045286
Sum squared resid	6.690503	Schwarz criterion		1.126385
Log likelihood	-20.99628	F-statistic		418.6246
Durbin-Watson stat	0.329100	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido3PP

PP Test Statistic	-0.626607	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.048895
Residual variance with correction		0.054087

Phillips-Perron Test Equation
Dependent Variable: D(RESID03PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09PP(-1)	-0.028957	0.053875	-0.537479	0.5938

R-squared	-0.000673	Mean dependent var		0.019214
Adjusted R-squared	-0.000673	S.D. dependent var		0.223663
S.E. of regression	0.223738	Akaike info criterion		-0.133697
Sum squared resid	2.102474	Schwarz criterion		-0.092739
Log likelihood	3.874480	Durbin-Watson stat		2.016400

Dependent Variable: LNTGXGDP (Musgrave model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.832980	0.481026	-7.968348	0.0000
LNNOGDPN	0.403716	0.066045	6.112768	0.0000

R-squared	0.470806	Mean dependent var		-0.903964
Adjusted R-squared	0.458206	S.D. dependent var		0.381052
S.E. of regression	0.280480	Akaike info criterion		0.339760
Sum squared resid	3.304099	Schwarz criterion		0.420860
Log likelihood	-5.474730	F-statistic		37.36593
Durbin-Watson stat	0.478112	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido4PP

PP Test Statistic	-2.043257	1% Critical Value*	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.033441
Residual variance with correction		0.033669

Phillips-Perron Test Equation
Dependent Variable: D(RESID04PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID010PP(-1)	-0.217041	0.106666	-2.034772	0.0482

R-squared	0.087619	Mean dependent var		0.009226
Adjusted R-squared	0.087619	S.D. dependent var		0.193715
S.E. of regression	0.185034	Akaike info criterion		-0.513574
Sum squared resid	1.437977	Schwarz criterion		-0.472616
Log likelihood	12.04185	Durbin-Watson stat		2.087062

Dependent Variable: LNTGXN (Gupta model)
Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.830337	0.481455	-7.955753	0.0000
LNNOGDPN	1.403381	0.066104	21.23001	0.0000

R-squared	0.914758	Mean dependent var		6.351390
Adjusted R-squared	0.912728	S.D. dependent var		0.950281
S.E. of regression	0.280730	Akaike info criterion		0.341544
Sum squared resid	3.309998	Schwarz criterion		0.422644
Log likelihood	-5.513970	F-statistic		450.7134
Durbin-Watson stat	0.477238	Prob(F-statistic)		0.000000

Phillips-Perron Unit Root Test on Resido5PP

PP Test Statistic	**-2.043764**	**1% Critical Value***		**-2.6168**
		5% Critical Value		**-1.9486**
		10% Critical Value		**-1.6198**

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.033444
Residual variance with correction		0.033729

Phillips-Perron Test Equation
Dependent Variable: D(RESID05PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID011PP(-1)	-0.216669	0.106566	-2.033189	0.0484

R-squared	0.087505	Mean dependent var		0.009196
Adjusted R-squared	0.087505	S.D. dependent var		0.193712
S.E. of regression	0.185043	Akaike info criterion		-0.513481
Sum squared resid	1.438111	Schwarz criterion		-0.472523
Log likelihood	12.03985	Durbin-Watson stat		2.082937

Dependent Variable: LNTGXGDP (Mann model)
Method: Least Squares
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.986356	0.365447	-8.171795	0.0000
LNNOGDP	0.247117	0.043059	5.739041	0.0000

R-squared	0.439526	Mean dependent var		-0.903964
Adjusted R-squared	0.426182	S.D. dependent var		0.381052
S.E. of regression	0.288650	Akaike info criterion		0.397187
Sum squared resid	3.499398	Schwarz criterion		0.478287
Log likelihood	-6.738122	F-statistic		32.93659
Durbin-Watson stat	0.419305	Prob(F-statistic)		0.000001

Phillips-Perron Unit Root Test on Resido6PP

PP Test Statistic	**-1.995753**	**1% Critical Value***		**-2.6168**
		5% Critical Value		**-1.9486**
		10% Critical Value		**-1.6198**

Lag truncation for Bartlett kernel: 3	(Newey-West suggests: 3)	
Residual variance with no correction		0.031262
Residual variance with correction		0.032251

Phillips-Perron Test Equation
Dependent Variable: D(RESID06PP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID012PP(-1)	-0.193085	0.098469	-1.960883	0.0565

R-squared	0.081891	Mean dependent var		0.008578
Adjusted R-squared	0.081891	S.D. dependent var		0.186710
S.E. of regression	0.178902	Akaike info criterion		-0.580975
Sum squared resid	1.344250	Schwarz criterion		-0.540017
Log likelihood	13.49097	Durbin-Watson stat		2.055198

Dependent Variable: LNTGX (Peacock-Wiseman model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.638249	0.460888	-7.893997	0.0000
LNNOGDP	1.340085	0.069367	19.31871	0.0000
DUM1	0.051074	0.173293	0.294726	0.7697
DUM2	-0.403541	0.087167	-4.629499	0.0000

R-squared	0.969394	Mean dependent var	7.522987
Adjusted R-squared	0.967099	S.D. dependent var	1.306303
S.E. of regression	0.236947	Akaike info criterion	0.044546
Sum squared resid	2.245753	Schwarz criterion	0.206746
Log likelihood	3.019977	F-statistic	422.3123
Durbin-Watson stat	0.724503	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test for total non-oil GDP on Resid01 with dummies

ADF Test Statistic	-2.850826	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID07)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07(-1)	-0.387272	0.135846	-2.850826	0.0069
D(RESID07(-1))	0.051292	0.157788	0.325069	0.7468

R-squared	0.184909	Mean dependent var	0.001084
Adjusted R-squared	0.164532	S.D. dependent var	0.199001
S.E. of regression	0.181895	Akaike info criterion	-0.524332
Sum squared resid	1.323425	Schwarz criterion	-0.441585
Log likelihood	13.01096	Durbin-Watson stat	1.952547

Dependent Variable: LNTGXC (Pryor model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.383774	0.531706	-4.483253	0.0001
LNNOGDP	1.236340	0.080026	15.44924	0.0000
DUM1	-0.149439	0.199921	-0.747490	0.4591
DUM2	0.399993	0.100561	3.977612	0.0003

R-squared	0.962718	Mean dependent var	8.081594
Adjusted R-squared	0.959922	S.D. dependent var	1.365441
S.E. of regression	0.273355	Akaike info criterion	0.330419
Sum squared resid	2.988924	Schwarz criterion	0.492618
Log likelihood	-3.269219	F-statistic	344.3003
Durbin-Watson stat	0.513928	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test for total non-oil GDP on Resid02 with dummies

ADF Test Statistic	-1.456730	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID08)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08(-1)	-0.210373	0.144414	-1.456730	0.1530
D(RESID08(-1))	-0.011691	0.180069	-0.064922	0.9486

R-squared	0.068061	Mean dependent var	0.013029
Adjusted R-squared	0.044763	S.D. dependent var	0.192836
S.E. of regression	0.188470	Akaike info criterion	-0.453306
Sum squared resid	1.420841	Schwarz criterion	-0.370559
Log likelihood	11.51942	Durbin-Watson stat	1.935598

Dependent Variable: LNTGX (Goffman model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.507737	1.014991	-5.426392	0.0000
LNNOGDPN	1.757867	0.166470	10.55964	0.0000
DUM1	0.220484	0.292915	0.752724	0.4560
DUM2	0.212457	0.129373	1.642206	0.1084

R-squared	0.916526	Mean dependent var		7.522987
Adjusted R-squared	0.910266	S.D. dependent var		1.306303
S.E. of regression	0.391312	Akaike info criterion		1.047883
Sum squared resid	6.124992	Schwarz criterion		1.210082
Log likelihood	-19.05343	F-statistic		146.3979
Durbin-Watson stat	0.342353	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test for total non-oil GDP on Resid03 with dummies

ADF Test Statistic	-0.197039	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID09)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09(-1)	-0.022112	0.112222	-0.197039	0.8448
D(RESID09(-1))	-0.246571	0.172243	-1.431525	0.1600

R-squared	0.059513	Mean dependent var		0.021750
Adjusted R-squared	0.036000	S.D. dependent var		0.224983
S.E. of regression	0.220896	Akaike info criterion		-0.135801
Sum squared resid	1.951803	Schwarz criterion		-0.053055
Log likelihood	4.851822	Durbin-Watson stat		1.846512

Dependent Variable: LNTGXNOGDP (Musgrave model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.779122	0.680048	-5.557139	0.0000
LNNOGDPN	0.390737	0.111536	3.503239	0.0011
DUM1	0.172519	0.196254	0.879056	0.3846
DUM2	-0.242613	0.086681	-2.798933	0.0079

R-squared	0.559625	Mean dependent var		-0.903964
Adjusted R-squared	0.526597	S.D. dependent var		0.381052
S.E. of regression	0.262181	Akaike info criterion		0.246941
Sum squared resid	2.749545	Schwarz criterion		0.409140
Log likelihood	-1.432704	F-statistic		16.94388
Durbin-Watson stat	0.559699	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test for total non-oil GDP on Resid04 with dummies

ADF Test Statistic	-1.984387	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID10)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID10(-1)	-0.249026	0.125493	-1.984387	0.0541
D(RESID10(-1))	-0.067364	0.162195	-0.415330	0.6801

R-squared	0.123561	Mean dependent var		0.007145
Adjusted R-squared	0.101650	S.D. dependent var		0.193454
S.E. of regression	0.183358	Akaike info criterion		-0.508302
Sum squared resid	1.344809	Schwarz criterion		-0.425556
Log likelihood	12.67435	Durbin-Watson stat		1.924296

Dependent Variable: LNTGXN (Gupta model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.774890	0.680642	-5.546075	0.0000
LNNOGDPN	1.390110	0.111633	12.45247	0.0000
DUM1	0.173250	0.196426	0.882015	0.3830
DUM2	-0.242808	0.086756	-2.798742	0.0079
R-squared	0.929067	Mean dependent var		6.351390
Adjusted R-squared	0.923747	S.D. dependent var		0.950281
S.E. of regression	0.262409	Akaike info criterion		0.248686
Sum squared resid	2.754347	Schwarz criterion		0.410885
Log likelihood	-1.471096	F-statistic		174.6385
Durbin-Watson stat	0.558358	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test for total non-oil GDP on Resid05 with dummies

ADF Test Statistic	-1.988533	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID11)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID11(-1)	-0.249252	0.125344	-1.988533	0.0536
D(RESID11(-1))	-0.064817	0.162196	-0.399620	0.6916
R-squared	0.123025	Mean dependent var		0.007123
Adjusted R-squared	0.101101	S.D. dependent var		0.193388
S.E. of regression	0.183352	Akaike info criterion		-0.508371
Sum squared resid	1.344717	Schwarz criterion		-0.425625
Log likelihood	12.67579	Durbin-Watson stat		1.924668

Dependent Variable: LNTGXNOGDP (Mann model)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.640552	0.460442	-7.906654	0.0000
LNNOGDP	0.340370	0.069300	4.911543	0.0000
DUM1	0.050658	0.173125	0.292609	0.7713
DUM2	-0.403454	0.087083	-4.632990	0.0000
R-squared	0.641010	Mean dependent var		-0.903964
Adjusted R-squared	0.614086	S.D. dependent var		0.381052
S.E. of regression	0.236717	Akaike info criterion		0.042608
Sum squared resid	2.241404	Schwarz criterion		0.204807
Log likelihood	3.062624	F-statistic		23.80792
Durbin-Watson stat	0.726513	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test for total non-oil GDP on Resid06 with dummies

ADF Test Statistic	-2.847854	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID12)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID12(-1)	-0.387451	0.136050	-2.847854	0.0069
D(RESID12(-1))	0.049110	0.157823	0.311171	0.7573
R-squared	0.185163	Mean dependent var		0.001104
Adjusted R-squared	0.164792	S.D. dependent var		0.199087
S E of regression	0.181945	Akaike info criterion		-0.523772
Sum squared resid	1.324166	Schwarz criterion		-0.441025
Log likelihood	12.99920	Durbin-Watson stat		1.952616

Appendix (7)

Engle Granger two steps for testing Cointegration for six

categories with dummies and without dummies

Dependent Variable: LNAGR (Agriculture Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.09853	1.977370	-5.612774	0.0000
LNGDP	1.784376	0.276543	6.452431	0.0000
DUM1	-0.273346	0.673412	-0.405911	0.6870
DUM2	-0.943692	0.240477	-3.924242	0.0003
R-squared	0.813662	Mean dependent var		4.308854
Adjusted R-squared	0.799687	S.D. dependent var		1.578532
S.E. of regression	0.706493	Akaike info criterion		2.229502
Sum squared resid	19.96532	Schwarz criterion		2.391702
Log likelihood	-45.04905	F-statistic		58.22132
Durbin-Watson stat	1.352675	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid01 (Agriculture Sector) with dummies

ADF Test Statistic	-4.207712	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID07)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID07(-1)	-0.783177	0.186129	-4.207712	0.0001
D(RESID07(-1))	0.147773	0.157598	0.937659	0.3540
R-squared	0.349390	Mean dependent var		-0.005945
Adjusted R-squared	0.333125	S.D. dependent var		0.804030
S.E. of regression	0.656590	Akaike info criterion		2.042934
Sum squared resid	17.24442	Schwarz criterion		2.125680
Log likelihood	-40.90161	Durbin-Watson stat		1.947465

Dependent Variable: LNEDU (Education Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.17381	2.191484	-6.923990	0.0000
LNGDP	2.294801	0.306488	7.487412	0.0000
DUM1	-1.733700	0.746330	-2.322965	0.0254
DUM2	-0.274143	0.266517	-1.028613	0.3098
R-squared	0.803311	Mean dependent var		3.884309
Adjusted R-squared	0.788560	S.D. dependent var		1.702804
S.E. of regression	0.782994	Akaike info criterion		2.435125
Sum squared resid	24.52319	Schwarz criterion		2.597324
Log likelihood	-49.57274	F-statistic		54.45570
Durbin-Watson stat	0.773084	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid02 (Education Sector) with dummies

ADF Test Statistic	-3.346658	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID08)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID08(-1)	-0.451997	0.135059	-3.346658	0.0018
D(RESID08(-1))	0.183804	0.153334	1.198714	0.2377
R-squared	0.219347	Mean dependent var		0.027115
Adjusted R-squared	0.199831	S.D. dependent var		0.663330
S.E. of regression	0.593363	Akaike info criterion		1.840426
Sum squared resid	14.08317	Schwarz criterion		1.923172
Log likelihood	-36.64895	Durbin-Watson stat		2.006877

Dependent Variable: LNHEA (Health Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18.46567	2.199780	-8.394325	0.0000
LNGDP	2.557943	0.307648	8.314509	0.0000
DUM1	-1.668382	0.749156	-2.227017	0.0316
DUM2	-0.167498	0.267526	-0.626100	0.5348

R-squared	0.850527	Mean dependent var	3.059550
Adjusted R-squared	0.839317	S.D. dependent var	1.960715
S.E. of regression	0.785958	Akaike info criterion	2.442682
Sum squared resid	24.70921	Schwarz criterion	2.604881
Log likelihood	-49.73900	F-statistic	75.86922
Durbin-Watson stat	1.097985	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid03 (Health Sector) with dummies

ADF Test Statistic	-3.136609	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID09)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID09(-1)	-0.516926	0.164804	-3.136609	0.0032
D(RESID09(-1))	-0.038424	0.155268	-0.247467	0.8058

R-squared	0.272783	Mean dependent var	0.040808
Adjusted R-squared	0.254602	S.D. dependent var	0.788481
S.E. of regression	0.680746	Akaike info criterion	2.115194
Sum squared resid	18.53663	Schwarz criterion	2.197941
Log likelihood	-42.41908	Durbin-Watson stat	2.051630

Dependent Variable: LNHOU (Housing and Public utilities Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.247599	1.647669	-4.398699	0.0001
LNGDP	1.377959	0.230433	5.979864	0.0000
DUM1	-0.098479	0.561129	-0.175501	0.8616
DUM2	-0.665779	0.200381	-3.322568	0.0019

R-squared	0.801559	Mean dependent var	4.772419
Adjusted R-squared	0.786676	S.D. dependent var	1.274589
S.E. of regression	0.588695	Akaike info criterion	1.864689
Sum squared resid	13.86245	Schwarz criterion	2.026888
Log likelihood	-37.02317	F-statistic	53.85714
Durbin-Watson stat	0.562536	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid04 (Housing and Public utilities Sector) with dummies

ADF Test Statistic	-2.826980	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID10)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID10(-1)	-0.328236	0.116108	-2.826980	0.0073
D(RESID10(-1))	0.177792	0.154021	1.154340	0.2552

R-squared	0.166656	Mean dependent var	0.000263
Adjusted R-squared	0.145822	S.D. dependent var	0.427729
S.E. of regression	0.395315	Akaike info criterion	1.028178
Sum squared resid	6.250943	Schwarz criterion	1.110924
Log likelihood	-19.59174	Durbin-Watson stat	2.023777

Dependent Variable: LNMAN (Manufacturing Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.47182	3.431358	-4.508948	0.0001
LNGDP	2.206538	0.479889	4.598015	0.0000
DUM1	-0.093746	1.168581	-0.080222	0.9365
DUM2	-1.287031	0.417304	-3.084157	0.0037

R-squared	0.705286	Mean dependent var		3.734333
Adjusted R-squared	0.683182	S.D. dependent var		2.178118
S.E. of regression	1.225988	Akaike info criterion		3.331879
Sum squared resid	60.12185	Schwarz criterion		3.494078
Log likelihood	-69.30134	F-statistic		31.90821
Durbin-Watson stat	1.005432	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid05 (Manufacturing Sector) with dummies

ADF Test Statistic	-3.726233	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID12)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID12(-1)	-0.581716	0.156114	-3.726233	0.0006
D(RESID12(-1))	0.126546	0.158374	0.799034	0.4290

R-squared	0.280522	Mean dependent var		0.032044
Adjusted R-squared	0.262535	S.D. dependent var		1.201997
S.E. of regression	1.032224	Akaike info criterion		2.947757
Sum squared resid	42.61946	Schwarz criterion		3.030503
Log likelihood	-59.90289	Durbin-Watson stat		2.016539

Dependent Variable: LNTRA (Transportation and Communication)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.22009	1.953957	-5.230458	0.0000
LNGDP	1.758843	0.273269	6.436312	0.0000
DUM1	-1.271038	0.665438	-1.910075	0.0633
DUM2	-0.810909	0.237630	-3.412483	0.0015

R-squared	0.730975	Mean dependent var		4.176079
Adjusted R-squared	0.710798	S.D. dependent var		1.298180
S.E. of regression	0.698128	Akaike info criterion		2.205680
Sum squared resid	19.49532	Schwarz criterion		2.367879
Log likelihood	-44.52496	F-statistic		36.22838
Durbin-Watson stat	0.567914	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid06 (Transportation and Communication) with dummies

ADF Test Statistic	-2.444971	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID11)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID11(-1)	-0.293463	0.120027	-2.444971	0.0190
D(RESID11(-1))	0.082931	0.156122	0.531191	0.5982

R-squared	0.132380	Mean dependent var		-0.016481
Adjusted R-squared	0.110690	S.D. dependent var		0.507237
S.E. of regression	0.478341	Akaike info criterion		1.409462
Sum squared resid	9.152403	Schwarz criterion		1.492208
Log likelihood	-27.59870	Durbin-Watson stat		2.023020

Dependent Variable: LNAGR (Agriculture Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.823302	1.201849	-7.341440	0.0000
LNGDP	1.460459	0.132966	10.98370	0.0000

R-squared	0.741764	Mean dependent var	4.308854
Adjusted R-squared	0.735615	S.D. dependent var	1.578532
S.E. of regression	0.811656	Akaike info criterion	2.464908
Sum squared resid	27.66896	Schwarz criterion	2.546007
Log likelihood	-52.22797	F-statistic	120.6417
Durbin-Watson stat	0.959647	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid01 (agriculture Sector)

ADF Test Statistic	-3.082238	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID13)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID13(-1)	-0.473134	0.153503	-3.082238	0.0037
D(RESID13(-1))	-0.021789	0.156948	-0.138830	0.8903

R-squared	0.246034	Mean dependent var	0.011422
Adjusted R-squared	0.227185	S.D. dependent var	0.800093
S.E. of regression	0.703361	Akaike info criterion	2.180555
Sum squared resid	19.78867	Schwarz criterion	2.263301
Log likelihood	-43.79166	Durbin-Watson stat	2.026610

Dependent Variable: LNEDU (Education Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.57502	1.216063	-8.696108	0.0000
LNGDP	1.608057	0.134539	11.95238	0.0000

R-squared	0.772800	Mean dependent var	3.884309
Adjusted R-squared	0.767391	S.D. dependent var	1.702804
S.E. of regression	0.821255	Akaike info criterion	2.488423
Sum squared resid	28.32730	Schwarz criterion	2.569522
Log likelihood	-52.74530	F-statistic	142.8595
Durbin-Watson stat	0.636810	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid02 (Education Sector)

ADF Test Statistic	-3.315757	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID14)
Method: Least Squares
Date: 07/28/09   Time: 19:27
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID14(-1)	-0.410923	0.123930	-3.315757	0.0020
D(RESID14(-1))	0.271726	0.153797	1.766784	0.0849

R-squared	0.215263	Mean dependent var	0.036455
Adjusted R-squared	0.195644	S.D. dependent var	0.655495
S.E. of regression	0.587886	Akaike info criterion	1.821882
Sum squared resid	13.82442	Schwarz criterion	1.904628
Log likelihood	-36.25952	Durbin-Watson stat	1.934562

Dependent Variable: LNHEA (Health Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-14.20594	1.207468	-11.76506	0.0000
LNGDP	1.920138	0.133588	14.37361	0.0000

R-squared	0.831054	Mean dependent var	3.059550
Adjusted R-squared	0.827032	S.D. dependent var	1.960715
S.E. of regression	0.815451	Akaike info criterion	2.474237
Sum squared resid	27.92831	Schwarz criterion	2.555337
Log likelihood	-52.43322	F-statistic	206.6005
Durbin-Watson stat	0.911362	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid03 (Health Sector)

ADF Test Statistic	-2.979662	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID15)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID15(-1)	-0.460607	0.154584	-2.979662	0.0049
D(RESID15(-1))	0.012338	0.158638	0.077771	0.9384

R-squared	0.222424	Mean dependent var	0.048095
Adjusted R-squared	0.202985	S.D. dependent var	0.772558
S.E. of regression	0.689706	Akaike info criterion	2.141346
Sum squared resid	19.02779	Schwarz criterion	2.224092
Log likelihood	-42.96827	Durbin-Watson stat	2.019427

Dependent Variable: LNHOU (Housing and Public utilities Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.867044	0.960942	-6.105515	0.0000
LNGDP	1.183241	0.106313	11.12975	0.0000

R-squared	0.746792	Mean dependent var	4.772419
Adjusted R-squared	0.740763	S.D. dependent var	1.274589
S.E. of regression	0.648962	Akaike info criterion	2.017502
Sum squared resid	17.68834	Schwarz criterion	2.098602
Log likelihood	-42.38505	F-statistic	123.8712
Durbin-Watson stat	0.409582	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on Resid04 (Housing and Public utilities Sector)

ADF Test Statistic	-2.174292	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID16)
Method: Least Squares
Date: 07/28/09   Time: 19:36
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID16(-1)	-0.215945	0.099317	-2.174292	0.0357
D(RESID16(-1))	0.023665	0.155939	0.151755	0.8801

R-squared	0.111330	Mean dependent var	0.012271
Adjusted R-squared	0.089114	S.D. dependent var	0.414267
S.E. of regression	0.395378	Akaike info criterion	1.028500
Sum squared resid	6.252959	Schwarz criterion	1.111246
Log likelihood	-19.59851	Durbin-Watson stat	1.983602

Dependent Variable: LNMAN (Manufacturing Sector)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.03304	1.971212	-6.611690	0.0000
LNGDP	1.864741	0.218084	8.550557	0.0000
R-squared	0.635138	Mean dependent var		3.734333
Adjusted R-squared	0.626451	S.D. dependent var		2.178118
S.E. of regression	1.331236	Akaike info criterion		3.454483
Sum squared resid	74.43200	Schwarz criterion		3.535582
Log likelihood	-73.99862	F-statistic		73.11202
Durbin-Watson stat	0.676676	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid05 (Manufacturing Sector)

ADF Test Statistic	-2.877770	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID17)
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID17(-1)	-0.368328	0.127991	-2.877770	0.0064
D(RESID17(-1))	0.036174	0.158397	0.228378	0.8205
R-squared	0.187278	Mean dependent var		0.055005
Adjusted R-squared	0.166960	S.D. dependent var		1.097721
S.E. of regression	1.001901	Akaike info criterion		2.888123
Sum squared resid	40.15222	Schwarz criterion		2.970869
Log likelihood	-58.65059	Durbin-Watson stat		1.930394

Dependent Variable: LNTRA (Transportation and Communication)

Sample: 1962 2005
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.798562	1.178716	-4.919389	0.0000
LNGDP	1.109304	0.130407	8.506498	0.0000
R-squared	0.632740	Mean dependent var		4.176079
Adjusted R-squared	0.623996	S.D. dependent var		1.298180
S.E. of regression	0.796033	Akaike info criterion		2.426036
Sum squared resid	26.61406	Schwarz criterion		2.507136
Log likelihood	-51.37280	F-statistic		72.36050
Durbin-Watson stat	0.392718	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on Resid06 (Transportation and Communication)

ADF Test Statistic	-2.210824	1% Critical Value*	-2.6182
		5% Critical Value	-1.9488
		10% Critical Value	-1.6199

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID18)
Method: Least Squares
Date: 07/28/09 Time: 19:43
Sample(adjusted): 1964 2005
Included observations: 42 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID18(-1)	-0.216285	0.097830	-2.210824	0.0328
D(RESID18(-1))	0.113748	0.156758	0.725624	0.4723
R-squared	0.108912	Mean dependent var		0.001132
Adjusted R-squared	0.086635	S.D. dependent var		0.501078
S.E. of regression	0.478881	Akaike info criterion		1.411720
Sum squared resid	9.173088	Schwarz criterion		1.494466
Log likelihood	-27.64611	Durbin-Watson stat		1.994034

Appendix (8)

Results from testing the Error correction model for total GDP

without dummies and with dummies

Version one (Peacock-Wiseman model)

Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.074119	0.031102	2.383066	0.0220
D(LNGDP)	0.398409	0.152752	2.608204	0.0127
RESID01(-1)	-0.243595	0.084119	-2.895836	0.0061
R-squared	0.243991	Mean dependent var		0.110909
Adjusted R-squared	0.206190	S.D. dependent var		0.207912
S.E. of regression	0.185241	Akaike info criterion		-0.467100
Sum squared resid	1.372574	Schwarz criterion		-0.344226
Log likelihood	13.04265	F-statistic		6.454709
Durbin-Watson stat	1.332114	Prob(F-statistic)		0.003720

Version two (Pryor model)

Dependent Variable: D(LNTGXC)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.086211	0.013398	6.434687	0.0000
D(LNGDP)	0.258587	0.065167	3.968039	0.0003
RESID02(-1)	-0.085090	0.024075	-3.534333	0.0010
R-squared	0.401517	Mean dependent var		0.109209
Adjusted R-squared	0.371592	S.D. dependent var		0.101168
S.E. of regression	0.080198	Akaike info criterion		-2.141411
Sum squared resid	0.257272	Schwarz criterion		-2.018536
Log likelihood	49.04033	F-statistic		13.41780
Durbin-Watson stat	1.391653	Prob(F-statistic)		0.000035

Version three (Goffman model)

Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.092974	0.029945	3.104830	0.0035
D(LNGDPN)	0.288059	0.155643	1.850769	0.0716
RESID03(-1)	-0.107682	0.042809	-2.515410	0.0160
R-squared	0.208048	Mean dependent var		0.110909
Adjusted R-squared	0.168451	S.D. dependent var		0.207912
S.E. of regression	0.189594	Akaike info criterion		-0.420653
Sum squared resid	1.437830	Schwarz criterion		-0.297779
Log likelihood	12.04404	F-statistic		5.254069
Durbin-Watson stat	1.402505	Prob(F-statistic)		0.009418

Version four (Musgrave model)

Dependent Variable: D(LNTGXGDP)

Date: 07/21/09   Time: 20:04
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.072245	0.017218	4.196010	0.0001
D(LNGDPN)	0.150539	0.090183	1.669267	0.1029
RESID04(-1)	-0.126475	0.029017	-4.358705	0.0001
R-squared	0.378265	Mean dependent var		0.082091
Adjusted R-squared	0.347179	S.D. dependent var		0.134969
S.E. of regression	0.109051	Akaike info criterion		-1.526781
Sum squared resid	0.475688	Schwarz criterion		-1.403907
Log likelihood	35.82580	F-statistic		12.16806
Durbin-Watson stat	1.990680	Prob(F-statistic)		0.000074

Version five (Gupta model)

Dependent Variable: D(LNTGXN)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.057598	0.029225	1.970839	0.0557
D(LNGDPN)	0.316828	0.151349	2.093363	0.0427
RESID05(-1)	-0.205087	0.070753	-2.898619	0.0061

R-squared	0.239767	Mean dependent var		0.077459
Adjusted R-squared	0.201756	S.D. dependent var		0.206910
S.E. of regression	0.184863	Akaike info criterion		-0.471192
Sum squared resid	1.366969	Schwarz criterion		-0.348318
Log likelihood	13.13064	F-statistic		6.307741
Durbin-Watson stat	1.347412	Prob(F-statistic)		0.004158

Version six (Mann model)

Dependent Variable: D(LNTGXGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.061025	0.017131	3.562329	0.0010
D(LNGDP)	0.238461	0.083385	2.859766	0.0067
RESID06(-1)	-0.308914	0.060661	-5.092419	0.0000

R-squared	0.449484	Mean dependent var		0.082091
Adjusted R-squared	0.421958	S.D. dependent var		0.134969
S.E. of regression	0.102616	Akaike info criterion		-1.648438
Sum squared resid	0.421199	Schwarz criterion		-1.525564
Log likelihood	38.44143	F-statistic		16.32954
Durbin-Watson stat	1.887467	Prob(F-statistic)		0.000007

Version one (Peacock-Wiseman model)
Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.146503	0.081758	1.791910	0.0811
D(LNGDP)	0.385448	0.166464	2.315499	0.0261
DUM1	-0.042720	0.085759	-0.498142	0.6213
DUM2	-0.078040	0.060541	-1.289052	0.2052
RESIDDUM1(-1)	-0.307494	0.091810	-3.349251	0.0018

R-squared	0.343362	Mean dependent var		0.110909
Adjusted R-squared	0.274242	S.D. dependent var		0.207912
S.E. of regression	0.177123	Akaike info criterion		-0.514997
Sum squared resid	1.192161	Schwarz criterion		-0.310207
Log likelihood	16.07244	F-statistic		4.967637
Durbin-Watson stat	1.239554	Prob(F-statistic)		0.002545

Version two (Pryor model
Dependent Variable: D(LNTGXC)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.130339	0.032582	4.000313	0.0003
D(LNGDP)	0.236992	0.066112	3.584698	0.0009
DUM1	-0.015492	0.034242	-0.452433	0.6535
DUM2	-0.069755	0.024629	-2.832251	0.0074
RESIDDUM2(-1)	-0.131277	0.035164	-3.733247	0.0006

R-squared	0.557859	Mean dependent var		0.109209
Adjusted R-squared	0.511318	S.D. dependent var		0.101168
S.E. of regression	0.070723	Akaike info criterion		-2.351157
Sum squared resid	0.190064	Schwarz criterion		-2.146366
Log likelihood	55.54988	F-statistic		11.98635
Durbin-Watson stat	1.552821	Prob(F-statistic)		0.000002

Version three (Goffman model)
Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.183095	0.082897	2.208698	0.0333
D(LNGDPN)	0.226011	0.164993	1.369825	0.1788
DUM1	-0.057567	0.090755	-0.634307	0.5297
DUM2	-0.088982	0.063071	-1.410824	0.1664
RESIDDUM3(-1)	-0.132114	0.054494	-2.424379	0.0202
R-squared	0.266002	Mean dependent var		0.110909
Adjusted R-squared	0.188739	S.D. dependent var		0.207912
S.E. of regression	0.187267	Akaike info criterion		-0.403624
Sum squared resid	1.332612	Schwarz criterion		-0.198833
Log likelihood	13.67791	F-statistic		3.442813
Durbin-Watson stat	1.366763	Prob(F-statistic)		0.016992

Version four (Musgrave model)
Dependent Variable: D(LNTGXGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.154828	0.046545	3.326415	0.0020
D(LNGDPN)	0.111195	0.092620	1.200552	0.2374
DUM1	-0.053789	0.051139	-1.051823	0.2995
DUM2	-0.083370	0.035734	-2.333099	0.0250
RESIDDUM4(-1)	-0.174553	0.046349	-3.766066	0.0006
R-squared	0.450508	Mean dependent var		0.082091
Adjusted R-squared	0.392667	S.D. dependent var		0.134969
S.E. of regression	0.105183	Akaike info criterion		-1.557278
Sum squared resid	0.420415	Schwarz criterion		-1.352487
Log likelihood	38.48147	F-statistic		7.788702
Durbin-Watson stat	2.206774	Prob(F-statistic)		0.000110

Version five (Gupta model)
Dependent Variable: D(LNTGXN)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.137646	0.081408	1.690819	0.0991
D(LNGDPN)	0.258883	0.162409	1.594014	0.1192
DUM1	-0.054222	0.089045	-0.608929	0.5462
DUM2	-0.070755	0.061820	-1.144539	0.2596
RESIDDUM5(-1)	-0.215653	0.074567	-2.892070	0.0063
R-squared	0.286055	Mean dependent var		0.077459
Adjusted R-squared	0.210903	S.D. dependent var		0.206910
S.E. of regression	0.183800	Akaike info criterion		-0.440988
Sum squared resid	1.283739	Schwarz criterion		-0.236197
Log likelihood	14.48124	F-statistic		3.806353
Durbin-Watson stat	1.305537	Prob(F-statistic)		0.010670

Version six (Mann model)
Dependent Variable: D(LNTGXGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.134267	0.046653	2.877980	0.0065
D(LNGDP)	0.228242	0.094933	2.404236	0.0212
DUM1	-0.050772	0.049231	-1.031305	0.3089
DUM2	-0.067246	0.035493	-1.894628	0.0658
RESIDDUM6(-1)	-0.372334	0.087665	-4.247247	0.0001
R-squared	0.487590	Mean dependent var		0.082091
Adjusted R-squared	0.433652	S.D. dependent var		0.134969
S.E. of regression	0.101572	Akaike info criterion		-1.627146
Sum squared resid	0.392044	Schwarz criterion		-1.422355
Log likelihood	39.98364	F-statistic		9.039836
Durbin-Watson stat	1.869239	Prob(F-statistic)		0.000031

Appendix (9)

Results from testing the Error correction model for total non-oil GDP without dummies and with dummies

Version one (Peacock-Wiseman model)

Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.036298	0.032223	1.126473	0.2667
D(LNNOGDP)	0.890636	0.210552	4.230010	0.0001
RESID01(-1)	-0.144482	0.101360	-1.425434	0.1618
R-squared	0.309911	Mean dependent var		0.110909
Adjusted R-squared	0.275406	S.D. dependent var		0.207912
S.E of regression	0.176981	Akaike info criterion		-0.558332
Sum squared resid	1.252894	Schwarz criterion		-0.435458
Log likelihood	15.00414	F-statistic		8.981751
Durbin-Watson stat	1.807400	Prob(F-statistic)		0.000600

Version two (Pryor model

Dependent Variable: D(LNTGXC)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.076585	0.018710	4.093213	0.0002
D(LNNOGDP)	0.381211	0.119382	3.193213	0.0027
RESID02(-1)	-0.120866	0.051702	-2.337733	0.0245
R-squared	0.277346	Mean dependent var		0.109209
Adjusted R-squared	0.241213	S.D. dependent var		0.119850
S.E. of regression	0.104399	Akaike info criterion		-1.613972
Sum squared resid	0.435969	Schwarz criterion		-1.491097
Log likelihood	37.70039	F-statistic		7.675764
Durbin-Watson stat	2.234178	Prob(F-statistic)		0.001509

Version three (Goffman model)

Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.067954	0.029259	2.322508	0.0254
D(LNNOGDPN)	0.848037	0.210258	4.033316	0.0002
RESID03(-1)	-0.074709	0.075272	-0.992525	0.3269
R-squared	0.293953	Mean dependent var		0.110909
Adjusted R-squared	0.258651	S.D. dependent var		0.207912
S.E. of regression	0.179016	Akaike info criterion		-0.535472
Sum squared resid	1.281865	Schwarz criterion		-0.412598
Log likelihood	14.51265	F-statistic		8.326744
Durbin-Watson stat	1.824757	Prob(F-statistic)		0.000948

Version four (Musgrave model)

Dependent Variable: D(LNTGXNOGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.032430	0.029080	1.115203	0.2714
D(LNNOGDPN)	-0.112765	0.213850	-0.527310	0.6009
RESID04(-1)	-0.151939	0.105534	-1.439715	0.1577
R-squared	0.067926	Mean dependent var		0.028864
Adjusted R-squared	0.021322	S.D. dependent var		0.178934
S.E. of regression	0.177016	Akaike info criterion		-0.557938
Sum squared resid	1.253388	Schwarz criterion		-0.435063
Log likelihood	14.99566	F-statistic		1.457526
Durbin-Watson stat	1.777331	Prob(F-statistic)		0.244910

Version five (Gupta model)

Dependent Variable: D(LNTGXN)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.032398	0.029081	1.114051	0.2719
D(LNNOGDPN)	0.886983	0.213843	4.147828	0.0002
RESID05(-1)	-0.151742	0.105427	-1.439318	0.1578

R-squared	0.302840	Mean dependent var		0.077459
Adjusted R-squared	0.267982	S.D. dependent var		0.206910
S.E. of regression	0.177028	Akaike info criterion		-0.557802
Sum squared resid	1.253559	Schwarz criterion		-0.434927
Log likelihood	14.99273	F-statistic		8.687813
Durbin-Watson stat	1.773130	Prob(F-statistic)		0.000736

Version six (Mann model)

Dependent Variable: D(LNTGXNOGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.036320	0.032223	1.127160	0.2664
D(LNNOGDP)	-0.109085	0.210560	-0.518069	0.6073
RESID06(-1)	-0.144666	0.101443	-1.426085	0.1616

R-squared	0.068395	Mean dependent var		0.028864
Adjusted R-squared	0.021815	S.D. dependent var		0.178934
S.E. of regression	0.176972	Akaike info criterion		-0.558441
Sum squared resid	1.252758	Schwarz criterion		-0.435566
Log likelihood	15.00647	F-statistic		1.468322
Durbin-Watson stat	1.811809	Prob(F-statistic)		0.242459

Version one (Peacock-Wiseman model)

Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.089327	0.084923	1.051863	0.2995
D(LNNOGDP)	0.776209	0.238625	3.252847	0.0024
DUM1	-0.028015	0.086422	-0.324169	0.7476
DUM2	-0.042294	0.064932	-0.651363	0.5187
RESIDDUM1(-1)	-0.167618	0.125014	-1.340800	0.1879

R-squared	0.320259	Mean dependent var		0.110909
Adjusted R-squared	0.248708	S.D. dependent var		0.207912
S.E. of regression	0.180212	Akaike info criterion		-0.480419
Sum squared resid	1.234105	Schwarz criterion		-0.275628
Log likelihood	15.32901	F-statistic		4.475920
Durbin-Watson stat	1.651133	Prob(F-statistic)		0.004622

Version two (Pryor model

Dependent Variable: D(LNTGXC)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.129846	0.047180	2.752138	0.0090
D(LNNOGDP)	0.288910	0.133412	2.165549	0.0367
DUM1	-0.018690	0.047748	-0.391433	0.6977
DUM2	-0.069819	0.036296	-1.923628	0.0619
RESIDDUM2(-1)	-0.151121	0.065748	-2.298481	0.0271

R-squared	0.366189	Mean dependent var		0.109209
Adjusted R-squared	0.299472	S.D. dependent var		0.119850
S.E. of regression	0.100312	Akaike info criterion		-1.652128
Sum squared resid	0.382371	Schwarz criterion		-1.447338
Log likelihood	40.52076	F-statistic		5.488697
Durbin-Watson stat	2.239759	Prob(F-statistic)		0.001374

Version three (Goffman model)

Dependent Variable: D(LNTGX)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.125398	0.080611	1.555592	0.1281
D(LNNOGDPN)	0.748406	0.234268	3.194660	0.0028
DUM1	-0.035724	0.086387	-0.413534	0.6815
DUM2	-0.050215	0.063170	-0.794925	0.4316
RESIDDUM3(-1)	-0.079481	0.082422	-0.964318	0.3410

R-squared	0.313349	Mean dependent var		0.110909
Adjusted R-squared	0.241070	S.D. dependent var		0.207912
S.E. of regression	0.181126	Akaike info criterion		-0.470304
Sum squared resid	1.246651	Schwarz criterion		-0.265513
Log likelihood	15.11153	F-statistic		4.335266
Durbin-Watson stat	1.737926	Prob(F-statistic)		0.005498

Version four (Musgrave model)
Dependent Variable: D(LNTGXNOGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.080760	0.080721	1.000472	0.3234
D(LNNOGDPN)	-0.224352	0.234898	-0.955105	0.3456
DUM1	-0.031792	0.086682	-0.366769	0.7158
DUM2	-0.034035	0.063341	-0.537330	0.5942
RESIDDUM4(-1)	-0.146034	0.114751	-1.272616	0.2109

R-squared	0.073729	Mean dependent var		0.028864
Adjusted R-squared	-0.023774	S.D. dependent var		0.178934
S.E. of regression	0.181049	Akaike info criterion		-0.471159
Sum squared resid	1.245586	Schwarz criterion		-0.266368
Log likelihood	15.12992	F-statistic		0.756173
Durbin-Watson stat	1.681153	Prob(F-statistic)		0.560262

Version five (Gupta model)

Dependent Variable: D(LNTGXN)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.080626	0.080734	0.998652	0.3243
D(LNNOGDPN)	0.775467	0.234920	3.300982	0.0021
DUM1	-0.031707	0.086697	-0.365720	0.7166
DUM2	-0.033975	0.063352	-0.536284	0.5949
RESIDDUM5(-1)	-0.145641	0.114654	-1.270269	0.2117

R-squared	0.307047	Mean dependent var		0.077459
Adjusted R-squared	0.234105	S.D. dependent var		0.206910
S.E. of regression	0.181078	Akaike info criterion		-0.470832
Sum squared resid	1.245993	Schwarz criterion		-0.266041
Log likelihood	15.12289	F-statistic		4.209453
Durbin-Watson stat	1.677340	Prob(F-statistic)		0.006427

Version six (Mann model)
Dependent Variable: D(LNTGXNOGDP)
Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.089432	0.084909	1.053278	0.2989
D(LNNOGDP)	-0.223520	0.238606	-0.936777	0.3548
DUM1	-0.028080	0.086406	-0.324977	0.7470
DUM2	-0.042357	0.064920	-0.652455	0.5180
RESIDDUM6(-1)	-0.168166	0.125126	-1.343977	0.1869

R-squared	0.082585	Mean dependent var		0.028864
Adjusted R-squared	-0.013985	S.D. dependent var		0.178934
S.E. of regression	0.180181	Akaike info criterion		-0.480767
Sum squared resid	1.233676	Schwarz criterion		-0.275976
Log likelihood	15.33648	F-statistic		0.855183
Durbin-Watson stat	1.654811	Prob(F-statistic)		0.499498

Appendix (10)

Results from testing the error correction model for six categories

with dummies and without dummies

Dependent Variable: D(LNAGR) (Agriculture Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.304656	0.296002	1.029237	0.3099
D(LNGDP)	0.438262	0.573788	0.763805	0.4497
DUM1	-0.133928	0.313120	-0.427721	0.6713
DUM2	-0.208918	0.220284	-0.948402	0.3489
RESID01AGR(-1)	-0.687187	0.147575	-4.656522	0.0000
R-squared	0.395235	Mean dependent var		0.120184
Adjusted R-squared	0.331576	S.D. dependent var		0.790870
S.E. of regression	0.646593	Akaike info criterion		2.074744
Sum squared resid	15.88712	Schwarz criterion		2.279535
Log likelihood	-39.60700	F-statistic		6.208593
Durbin-Watson stat	1.984433	Prob(F-statistic)		0.000603

Dependent Variable: D(LNEDU) (Education Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.466594	0.263444	1.771129	0.0846
D(LNGDP)	0.288992	0.517807	0.558107	0.5800
DUM1	-0.353205	0.277643	-1.272153	0.2110
DUM2	-0.077403	0.194746	-0.397455	0.6933
RESID02EDU(-1)	-0.305504	0.118494	-2.578233	0.0139
R-squared	0.211030	Mean dependent var		0.155615
Adjusted R-squared	0.127980	S.D. dependent var		0.612265
S.E. of regression	0.571745	Akaike info criterion		1.828698
Sum squared resid	12.42192	Schwarz criterion		2.033489
Log likelihood	-34.31701	F-statistic		2.541011
Durbin-Watson stat	1.621281	Prob(F-statistic)		0.055456

Dependent Variable: D(LNMAN) (Manufacturing Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.640717	0.422492	1.516518	0.1377
D(LNGDP)	0.096512	0.818520	0.117911	0.9068
DUM1	-0.406802	0.447329	-0.909402	0.3689
DUM2	-0.244007	0.314946	-0.774759	0.4433
RESID03MAN(-1)	-0.473070	0.119495	-3.958912	0.0003
R-squared	0.324593	Mean dependent var		0.187974
Adjusted R-squared	0.253498	S.D. dependent var		1.067689
S.E. of regression	0.922487	Akaike info criterion		2.785457
Sum squared resid	32.33730	Schwarz criterion		2.990247
Log likelihood	-54.88732	F-statistic		4.565600
Durbin-Watson stat	1.868109	Prob(F-statistic)		0.004141

Dependent Variable: D(LNHEA) (Health Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.563842	0.284384	1.982676	0.0547
D(LNGDP)	0.173942	0.560915	0.310103	0.7582
DUM1	-0.419495	0.299386	-1.401182	0.1693
DUM2	-0.090224	0.209141	-0.431400	0.6686
RESID04HEA(-1)	-0.446397	0.129217	-3.454624	0.0014
R-squared	0.299510	Mean dependent var		0.185213
Adjusted R-squared	0.225774	S.D. dependent var		0.697715
S.E. of regression	0.613920	Akaike info criterion		1.971039
Sum squared resid	14.32210	Schwarz criterion		2.175829
Log likelihood	-37.37733	F-statistic		4.061940
Durbin-Watson stat	2.215215	Prob(F-statistic)		0.007729

Dependent Variable: D(LNHOU) (Housing and Public utilities Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.316665	0.161829	1.956788	0.0577
D(LNGDP)	0.190042	0.313580	0.606041	0.5481
DUM1	-0.176160	0.171162	-1.029200	0.3099
DUM2	-0.174414	0.120341	-1.449329	0.1554
RESID05HOU(-1)	-0.281155	0.096159	-2.923871	0.0058
R-squared	0.292131	Mean dependent var		0.100195
Adjusted R-squared	0.217619	S.D. dependent var		0.399430
S.E. of regression	0.353305	Akaike info criterion		0.865973
Sum squared resid	4.743324	Schwarz criterion		1.070764
Log likelihood	-13.61843	F-statistic		3.920566
Durbin-Watson stat	1.997780	Prob(F-statistic)		0.009234

Dependent Variable: D(LNTRA) (Transportation and Communication)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.287034	0.198742	1.444257	0.1569
D(LNGDP)	0.088908	0.385520	0.230618	0.8188
DUM1	-0.132167	0.210090	-0.629098	0.5330
DUM2	-0.205840	0.147965	-1.391140	0.1723
RESID06TRA(-1)	-0.299968	0.100032	-2.998724	0.0048
R-squared	0.259827	Mean dependent var		0.084377
Adjusted R-squared	0.181915	S.D. dependent var		0.480039
S.E. of regression	0.434186	Akaike info criterion		1.278256
Sum squared resid	7.163661	Schwarz criterion		1.483047
Log likelihood	-22.48251	F-statistic		3.334846
Durbin-Watson stat	1.840353	Prob(F-statistic)		0.019538

Dependent Variable: D(LNAGR) (Agriculture Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.060263	0.116231	0.518472	0.6070
D(LNGDP)	0.747436	0.565746	1.321150	0.1940
RESID13(-1)	-0.473505	0.132662	-3.569268	0.0009
R-squared	0.261040	Mean dependent var		0.120184
Adjusted R-squared	0.224092	S.D. dependent var		0.790870
S.E. of regression	0.696643	Akaike info criterion		2.182126
Sum squared resid	19.41244	Schwarz criterion		2.305000
Log likelihood	-43.91571	F-statistic		7.065048
Durbin-Watson stat	1.967706	Prob(F-statistic)		0.002357

Dependent Variable: D(LNEDU) (Education Sector

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.111879	0.096432	1.160183	0.2529
D(LNGDP)	0.458594	0.470400	0.974903	0.3355
RESID14(-1)	-0.287237	0.110275	-2.604736	0.0128
R-squared	0.154458	Mean dependent var		0.155615
Adjusted R-squared	0.112181	S.D. dependent var		0.612265
S.E. of regression	0.576902	Akaike info criterion		1.804924
Sum squared resid	13.31261	Schwarz criterion		1.927798
Log likelihood	-35.80586	F-statistic		3.653470
Durbin-Watson stat	1.588527	Prob(F-statistic)		0.034890

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.147828	0.106357	1.389927	0.1722
D(LNGDP)	0.329054	0.520057	0.632727	0.5305
RESID15(-1)	-0.403437	0.123850	-3.257467	0.0023

R-squared	0.210322	Mean dependent var		0.185213
Adjusted R-squared	0.170838	S.D. dependent var		0.697715
S.E. of regression	0.635327	Akaike info criterion		1.997861
Sum squared resid	16.14563	Schwarz criterion		2.120736
Log likelihood	-39.95402	F-statistic		5.326771
Durbin-Watson stat	2.018194	Prob(F-statistic)		0.008892

Dependent Variable: D(LNHOU) (Housing and Public utilities Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.061718	0.063115	0.977864	0.3340
D(LNGDP)	0.468741	0.307227	1.525715	0.1349
RESID16(-1)	-0.196751	0.090069	-2.184442	0.0349

R-squared	0.145834	Mean dependent var		0.100195
Adjusted R-squared	0.103125	S.D. dependent var		0.399430
S.E. of regression	0.378274	Akaike info criterion		0.960817
Sum squared resid	5.723642	Schwarz criterion		1.083692
Log likelihood	-17.65757	F-statistic		3.414642
Durbin-Watson stat	1.830807	Prob(F-statistic)		0.042741

Dependent Variable: D(LNMAN) (Manufacturing Sector)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.132578	0.165356	0.801776	0.4274
D(LNGDP)	0.613269	0.804860	0.761958	0.4506
RESID17(-1)	-0.333706	0.115207	-2.896588	0.0061

R-squared	0.179971	Mean dependent var		0.187974
Adjusted R-squared	0.138969	S.D. dependent var		1.067689
S.E. of regression	0.990727	Akaike info criterion		2.886459
Sum squared resid	39.26160	Schwarz criterion		3.009333
Log likelihood	-59.05886	F-statistic		4.389367
Durbin-Watson stat	1.843403	Prob(F-statistic)		0.018906

Dependent Variable: D(LNTRA) (Transportation and Communication)

Sample(adjusted): 1963 2005
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.058324	0.076740	0.760029	0.4517
D(LNGDP)	0.318184	0.373252	0.852464	0.3990
RESID18(-1)	-0.199100	0.089181	-2.232537	0.0312

R-squared	0.125623	Mean dependent var		0.084377
Adjusted R-squared	0.081904	S.D. dependent var		0.480039
S.E. of regression	0.459960	Akaike info criterion		1.351862
Sum squared resid	8.462544	Schwarz criterion		1.474736
Log likelihood	-26.06503	F-statistic		2.873422
Durbin-Watson stat	1.731604	Prob(F-statistic)		0.068230

Appendix (11)

The results from Granger causality results for total real GDP

without dummies and with dummies

Results without dummies
Version one Peacock-Wiseman model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNGDP	3.451302	1	0.0632
All	3.451302	1	0.0632

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTGX	1.538605	1	0.2148
All	1.538605	1	0.2148

Version two Pryor model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGXC

Exclude	Chi-sq	df	Prob.
LNGDP	3.519794	1	0.0606
All	3.519794	1	0.0606

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTGXC	0.076171	1	0.7826
All	0.076171	1	0.7826

Version three Goffman model

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNGDPN	2.239502	1	0.1345
All	2.239502	1	0.1345

Dependent variable: LNGDPN

Exclude	Chi-sq	df	Prob.
LNTGX	0.396819	1	0.5287
All	0.396819	1	0.5287

Version four Musgrave model

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 40

Dependent variable: LNTGXGDP

Exclude	Chi-sq	df	Prob.
LNGDPN	27.48833	4	0.0000
All	27.48833	4	0.0000

Dependent variable: LNGDPN

Exclude	Chi-sq	df	Prob.
LNTGXGDP	6.193774	4	0.1851
All	6.193774	4	0.1851

Version five Gupta model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGXN

Exclude	Chi-sq	df	Prob.
LNGDPN	3.761420	1	0.0524
All	3.761420	1	0.0524

Dependent variable: LNGDPN

Exclude	Chi-sq	df	Prob.
LNTGXN	0.002427	1	0.9607
All	0.002427	1	0.9607

Version six Mann model

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 40

Dependent variable: LNTGXGDP

Exclude	Chi-sq	df	Prob.
LNGDP	32.33900	4	0.0000
All	32.33900	4	0.0000

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTGXGDP	5.010209	4	0.2863
All	5.010209	4	0.2863

Granger causality test fro total GDP with dummies

Version one Peacock-Wiseman model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNGDP	4.393035	1	0.0361
All	4.393035	1	0.0361

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTGX	6.642029	1	0.0100
All	6.642029	1	0.0100

Version two Pryor model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGXC

Exclude	Chi-sq	df	Prob.
LNGDP	0.717789	1	0.3969
All	0.717789	1	0.3969

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTGXC	4.316523	1	0.0377
All	4.316523	1	0.0377

Version three Goffman model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNGDPN	0.606571	1	0.4361
All	0.606571	1	0.4361

Dependent variable: LNGDPN

Exclude	Chi-sq	df	Prob.
LNTGX	0.015537	1	0.9008
All	0.015537	1	0.9008

Version four Musgrave model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 40

Dependent variable: LNTGXGDP

Exclude	Chi-sq	df	Prob.
LNGDPN	21.77216	4	0.0002
All	21.77216	4	0.0002

Dependent variable: LNGDPN

Exclude	Chi-sq	df	Prob.
LNTGXGDP	11.05671	4	0.0259
All	11.05671	4	0.0259

Version five Gupta model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGXN

Exclude	Chi-sq	df	Prob.
LNGDPN	2.011996	1	0.1561
All	2.011996	1	0.1561

Dependent variable: LNGDPN

Exclude	Chi-sq	df	Prob.
LNTGXN	0.290552	1	0.5899
All	0.290552	1	0.5899

Version six Mann model

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGXGDP

Exclude	Chi-sq	df	Prob.
LNGDP	12.65020	1	0.0004
All	12.65020	1	0.0004

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTGXGDP	7.432086	1	0.0064
All	7.432086	1	0.0064

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Appendix (12)

The results from Granger causality results for total real non-oil

GDP without dummies and with dummies

Granger causality test fro total non-oil GDP without dummies

Version one (Peacock-Wiseman model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNNOGDP	0.046537	1	0.8292
All	0.046537	1	0.8292

Dependent variable: LNNOGDP

Exclude	Chi-sq	df	Prob.
LNTGX	4.035765	1	0.0445
All	4.035765	1	0.0445

Version two (Pryor model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 40

Dependent variable: LNTGXC

Exclude	Chi-sq	df	Prob.
LNNOGDP	23.10766	4	0.0001
All	23.10766	4	0.0001

Dependent variable: LNNOGDP

Exclude	Chi-sq	df	Prob.
LNTGXC	1.184879	4	0.8806
All	1.184879	4	0.8806

Version three (Goffman model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests

Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNNOGDPN	0.004139	1	0.9487
All	0.004139	1	0.9487

Dependent variable: LNNOGDPN

Exclude	Chi-sq	df	Prob.
LNTGX	0.292460	1	0.5886
All	0.292460	1	0.5886

Version four (Musgrave model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 42

Dependent variable: LNTGXNOGDP

Exclude	Chi-sq	df	Prob.
LNNOGDPN	8.881847	2	0.0118
All	8.881847	2	0.0118

Dependent variable: LNNOGDPN

Exclude	Chi-sq	df	Prob.
LNTGXNOGDP	4.069764	2	0.1307
All	4.069764	2	0.1307

Version five Gupta model (Gupta model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGXN

Exclude	Chi-sq	df	Prob.
LNNOGDPN	0.060673	1	0.8054
All	0.060673	1	0.8054

Dependent variable: LNNOGDPN

Exclude	Chi-sq	df	Prob.
LNTGXN	3.191004	1	0.0740
All	3.191004	1	0.0740

Version six Mann model
VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 42

Dependent variable: LNTGXNOGDP

Exclude	Chi-sq	df	Prob.
LNNOGDP	10.10758	2	0.0064
All	10.10758	2	0.0064

Dependent variable: LNNOGDP

Exclude	Chi-sq	df	Prob.
LNTGXNOGDP	4.516416	2	0.1045
All	4.516416	2	0.1045

Granger causality test fro total non-oil GDP with dummies

Version one (Peacock-Wiseman model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNNOGDP	0.802005	1	0.3705
All	0.802005	1	0.3705

Dependent variable: LNNOGDP

Exclude	Chi-sq	df	Prob.
LNTGX	1.373914	1	0.2411
All	1.373914	1	0.2411

Version two (Pryor model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 40

Dependent variable: LNTGXC

Exclude	Chi-sq	df	Prob.
LNNOGDP	21.80117	4	0.0002
All	21.80117	4	0.0002

Dependent variable: LNNOGDP

Exclude	Chi-sq	df	Prob.
LNTGXC	5.171041	4	0.2702
All	5.171041	4	0.2702

Version three (Goffman model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests

Sample: 1962 2005
Included observations: 42

Dependent variable: LNTGX

Exclude	Chi-sq	df	Prob.
LNNOGDPN	4.001768	2	0.1352
All	4.001768	2	0.1352

Dependent variable: LNNOGDPN

Exclude	Chi-sq	df	Prob.
LNTGX	1.793111	2	0.4080
All	1.793111	2	0.4080

Version four (Musgrave model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 42

Dependent variable: LNTGXNOGDP

Exclude	Chi-sq	df	Prob.
LNNOGDPN	7.943575	2	0.0188
All	7.943575	2	0.0188

Dependent variable: LNNOGDPN

Exclude	Chi-sq	df	Prob.
LNTGXNOGDP	1.836172	2	0.3993
All	1.836172	2	0.3993

Version five (Gupta model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 42

Dependent variable: LNTGXN

Exclude	Chi-sq	df	Prob.
LNNOGDPN	3.448440	2	0.1783
All	3.448440	2	0.1783

Dependent variable: LNNOGDPN

Exclude	Chi-sq	df	Prob.
LNTGXN	1.815158	2	0.4035
All	1.815158	2	0.4035

Version six (Mann model)

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 42

Dependent variable: LNTGXNOGDP

Exclude	Chi-sq	df	Prob.
LNNOGDP	10.50559	2	0.0052
All	10.50559	2	0.0052

Dependent variable: LNNOGDP

Exclude	Chi-sq	df	Prob.
LNTGXNOGDP	2.221041	2	0.3294
All	2.221041	2	0.3294

Appendix (13)

The results from Granger causality results for six categories with

dummies and without dummies

Granger causality test with dummies

Agriculture Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNAGR

Exclude	Chi-sq	df	Prob.
LNGDP	9.350323	1	0.0022
All	9.350323	1	0.0022

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNAGR	0.003666	1	0.9517
All	0.003666	1	0.9517

Education Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNEDU

Exclude	Chi-sq	df	Prob.
LNGDP	4.985984	1	0.0256
All	4.985984	1	0.0256

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNEDU	1.291136	1	0.2558
All	1.291136	1	0.2558

Health Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNHEA

Exclude	Chi-sq	df	Prob.
LNGDP	9.243847	1	0.0024
All	9.243847	1	0.0024

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNHEA	1.527801	1	0.2164
All	1.527801	1	0.2164

Housing and Public utilities Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNHOU

Exclude	Chi-sq	df	Prob.
LNGDP	2.920315	1	0.0875
All	2.920315	1	0.0875

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNHOU	0.001938	1	0.9649
All	0.001938	1	0.9649

Manufacturing Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNMAN

Exclude	Chi-sq	df	Prob.
LNGDP	3.443607	1	0.0635
All	3.443607	1	0.0635

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNMAN	0.027750	1	0.8677
All	0.027750	1	0.8677

Transportation and Communication

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTRA

Exclude	Chi-sq	df	Prob.
LNGDP	8.089283	1	0.0045
All	8.089283	1	0.0045

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTRA	0.028959	1	0.8649
All	0.028959	1	0.8649

Granger causality test without dummies
Agriculture Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNAGR

Exclude	Chi-sq	df	Prob.
LNGDP	5.260079	1	0.0218
All	5.260079	1	0.0218

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNAGR	0.115528	1	0.7339
All	0.115528	1	0.7339

Education Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Date: 07/29/09 Time: 17:45
Included observations: 43

Dependent variable: LNEDU

Exclude	Chi-sq	df	Prob.
LNGDP	2.349109	1	0.1254
All	2.349109	1	0.1254

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNEDU	0.454537	1	0.5002
All	0.454537	1	0.5002

Health Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNHEA

Exclude	Chi-sq	df	Prob.
LNGDP	5.816402	1	0.0159
All	5.816402	1	0.0159

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNHEA	0.829564	1	0.3624
All	0.829564	1	0.3624

Housing and Public utilities Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNHOU

Exclude	Chi-sq	df	Prob.
LNGDP	0.560792	1	0.4539
All	0.560792	1	0.4539

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNHOU	0.124012	1	0.7247
All	0.124012	1	0.7247

Manufacturing Sector

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNMAN

Exclude	Chi-sq	df	Prob.
LNGDP	2.060174	1	0.1512
All	2.060174	1	0.1512

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNMAN	0.113666	1	0.7360
All	0.113666	1	0.7360

Transportation and Communication

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1962 2005
Included observations: 43

Dependent variable: LNTRA

Exclude	Chi-sq	df	Prob.
LNGDP	1.263054	1	0.2611
All	1.263054	1	0.2611

Dependent variable: LNGDP

Exclude	Chi-sq	df	Prob.
LNTRA	0.003631	1	0.9519
All	0.003631	1	0.9519