TRADE OPENNESS, MACROECONOMIC DYNAMICS AND ECONOMIC GROWTH OF OPEC COUNTRIES (1990-2018)

BY

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BEING A DISSERTATION SUBMITTED TO THE DEPARTMENT OF ECONOMICS, FACULTY OF SOCIAL SCIENCES, BAYERO UNIVERSITY, KANO IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS (M. Sc) DEGREE IN ECONOMICS

AUGUST, 2019

DECLARATION

I, Musa Mohammed Auwal, declare that this dissertation is my own work and all the sources that I used or quoted have been indicated and acknowledged by means of completed references under the supervision of Prof. Mustapha Mukhtar. This dissertation has not, either in whole or part, been submitted for a degree or certificate at another university.

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CERTIFICATION

I Musa Mohammed Auwal certify that dissertation work was conducted, written and complied by me, I also certify that to the best of my knowledge this work has never been presented wholly or partially for the award of any degree or for publication elsewhere.

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APPROVAL PAGE

This dissertation has been examined and found to have met the requirement for the award of the degree of Masters of Science in Economics (M.Sc.) at the Department of Economics, Bayero University Kano, Nigeria.

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DEDICATION

This dissertation is dedicated to my father; Alhaji Abdulkarim Musa, for all the support he gave me to continue with my studies at the postgraduate level.

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ABSTRACT

The idea that openness is one of the most important determinants of economic growth has gained wide acceptance since the 1980s among international economists. Conventionally, it is expected that openness promotes economic growth. However, while various theoretical models predict that openness to international trade accelerates economic growth, the empirical evidence has been mixed or imprecise. This study empirically tests whether openness leads to economic growth in Organization of Petroleum Exporting Countries (OPEC) countries and if trade openness induces macroeconomic dynamics. The study employed panel data cointergrating long-run estimators of Pooled Ordinary Least Square (POLS), Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) to examine the relationship between trade openness and economic growth in OPEC countries. Also, the panel data Autoregressive Distributed Lags (ARDL) models were used to examine the dynamic impact of trade openness on economic growth in OPEC countries. Likewise, a panel Vector Autoregression (VAR) technique was used to examine the transmission of trade shocks and macroeconomic dynamics in OPEC countries. While, the Dumitrescu-Hurlin (2012) Granger causality test was employed to examine the causal relationship between selected macroeconomic variables. The study sampled ten (10) OPEC countries based on the availability of data and seven macroeconomic variables were selected based on theory and empirical literature. The study made use of annual panel data series dating from 1990 – 2018 sourced from United Nation Conference on Trade and Development (UNCTAD) and World Bank Development Indicator (WDI) data base. The study reveals that openness has a significant negative relationship with economic growth in OPEC countries. The results from the panel ARDL pool mean group (PMG) estimation suggest that in the long-run, an increase in trade openness by 1% will lead to significant decrease in economic growth by 0.88%. Also, in the short-run the results suggest that a 1% increase in trade openness will lead to 32.7% significant decrease in economic growth. The study further revealed that trade openness shocks can induce macroeconomic dynamics in OPEC countries. The study therefore recommends that, trade openness must be accompanied by complementary policies aimed at encouraging the financing of new investment towards enhancing accumulation of capital and trade policies that ability to improve labour skills. These policies would then allow resources to be reallocated away from less productive activities and toward more promising ones. Policies that encourage exports and diversification, and that reduce barriers to openness, can boost economic performance.

Keywords: Trade Openness, Macroeconomic Dynamics, Economic Growth

CHAPTERONE
GENERAL INTRODUCTION

1.1 Background to the Study

With globalization and trade liberalization the world has become a global village. Economic integration has been seen as the major driver of globalization and this is as result of increase in global trade. The fact that no country is completely economically independent is the reason for the increase in world trade. Trade has become vital to economic growth and development which is the reason why most countries engaged in different types of trade relations be it bilateral or multilateral trade relations.

Literature on international trade recognizes trade as a vital catalyst for economic development. The theoretical literature have argued that trade openness leads to economic growth (see, Dollar 1992; Sachs & Warner 1995; Rodríguez & Rodrik 2001, Winters, 2004; and Rodríguez, 2007). From empirical literature studies such as that of Jan and Awudu (2017); Jamilah, Zulkornain and Muzarar (2016); Marjan andKarim (2016) concluded that trade openness lead to economic growth as recent studies is concerned. Others such as, Ryan (2012) and Gries and Redlin (2012), concluded that trade openness does not lead to growth. The relationships between these two are still debated till date and the conclusions are mixed. One of the major aims of this study; is to empirically investigate the dynamic relationship between trade openness and economic growth among OPEC countries as part of its contribution to empirical literature.

According to World Trade Organization (2017), trade has continued to support economic growth and development, helping to reduce poverty around the world. Statistics from World Trade Organization (2017) indicate that world merchandise exports have increased in value by about 32 per cent since 2006, reaching $ 16 trillion in 2016. At the same time, world exports of commercial services have accelerated by about 64 per cent, reaching a total of $ 4.77 trillion (WTO, 2017). However, the Dwindling world trade growth is both a contributing factor and a symptom of the global economic slowdown. The global trade growth has been volatile over the past four decades, (WTO, 2017); the volatility of trade growth has resulted to macroeconomic fluctuation across various economies especially among OPEC countries. OPEC has contributed to global trade through production and export of crude oil.

Furthermore, macroeconomists have been concerned with the structure of business cycle fluctuations caused by international trade. Literature on international business cycles is limited; however, due to the failure of standard models to account for the dynamics of international trade, several econometric models have been used to investigate the interaction between trade shocks and macroeconomic instability. Few studies have tried to identify the channels of international transmission of trade shocks (see eg Kose & Reizman, 2000; Canova, 2005; Cakir & Kabundi 2013; Du, Ju, Ramirez, Carlos, & Yao, 2017; Blagrave & Vesperoni, 2018)

The knowledge of the patterns of inter-country propagation of economic shocks and the degree of vulnerability of a particular country to shocks originating from other countries is crucial for sound macroeconomic management (Canova, 2005). The recent global economic crisis which has affected majority of the oil exporting countries due to the fall in international crude oil prices has made a lot of countries to revisit their trade policies. This situation has renewed interest in understanding both the determinants of the cyclical fluctuations of international trade and the role of international trade in transmitting business cycles across integrated economies.

Furthermore, according to Francisco and Luis (2002) international trade can induce macroeconomic fluctuations in a small open economy. These fluctuations in emergent countries exhibit a high volatility of the terms of trade. This volatility is particularly intense in petroleum exporting countries most especially members of the OPEC. Indeed, an important fraction of trade in these economies comes from oil exports and associated with oil price change. Moreover, a narrow range of non-oil commodities constitutes a less significant fraction of their exports, and their main import items are intermediate inputs, consumable goods and capital goods. Their export revenues are highly unstable due to recurrent and sharp fluctuations in crude oil prices. These countries are extremely vulnerable to changes in the world oil market. A thorough understanding of the sources of macroeconomic fluctuations in OPEC economies requires a good grasp of the impact of external shocks, namely fluctuations in the prices of exported primary commodities, import of both consumable and capital goods.

To achieve a stable macroeconomic environment and achieve growth, OPEC member countries implement several trade policies such as trade restrictive measures which include the establishment of import or export tariffs or increases in these tariffs. The average tariff in Algeria is 18.7%, high rates at a level of 30% are applied to food, beverages, tobacco and consumers goods (WTO, 2017). Algeria has applied three levels of basic tariff since 2002 which include; 5% rate on raw materials, 15% on semi-finished products and 30% rate on finished products. In 2008, Angola eliminated tariffs on import of raw materials, equipment and intermediate goods for industries. The Angola Government established a tax import of luxury products, which are now subject to a one percent surcharge (WTO, 2016). Ecuador's import policies are increasingly restrictive and results to an uncertain environment for traders in many sectors (WTO, 2015). Since 2011, Ecuador has pursued a strategic policy of import substitution (WTO, 2016). According to the WTO trade policy review (TPR), Ecuador's tariff structure has been more complex. Ecuador generally apply a simple four-tiered tariff structure with levels of 5% for most raw materials and capital goods, 10% or 5% for intermediate goods, and 20% for most consumer goods (WTO 2013). The products subject to selective import substitution measures include; fertilizers, agrichemicals, pesticides and fungicides, soaps, detergents and cosmetics, other chemicals, ceramic tiles and floors, textiles, clothing, footwear, leather, radios, television, telephones, electronics, and electrical appliances (WTO, 2016). As a member of the Gulf Cooperation Council (GCC), Kuwait started applying the GCC common external tariff since 2003 (WTO, 2011). As a result, the simple average tariff declined from 7.7% in 2002 to 4.8% in 2011. According to WTO (2017), Kuwait tariffs averages 5.7% on agricultural products and 4.6% on non-agricultural products; 98.6% of all tariff lines are ad valorem, with 19 mixed tariff lines on tobacco and tobacco products. Kuwait bound all tariff lines, except on oil, petroleum, and petrochemicals (WTO, 2017). The tariff rate in Saudi Arabia averages 5%. Saudi Arabia applies free trade policy to general products, placing no quantitative or price controls on imports (WTO, 2011). However, Saudi law prohibits importation of the following products; weapons, alcohol, narcotics, pork, pornographic materials, distillery equipment, and certain sculptures. Imported foods are subject to health and sanitation requirements, as well as point of origin labeling (WTO, 2011). These policies are implemented for several reasons, one of it is to manage the level of macroeconomic fluctuation associated with increased in transmission of trade shocks and promote economic growth.

As panel data econometrics is concerned, the study of trade openness and economic growth, trade shocks and macroeconomic instability had been done for sample countries that are classified into regions, e.g., European Zone, Asian, Sub-Saharan Africa, West Africa, Latin America, and East Asia. Other studies based it on international organizations such as OECD countries, ECOWAS, and very few on OPEC Countries. While others classified the countries on the rate of development, i.e. developing or developed economies, or low income, middle income or high income earning economies.

The technique employed by researchers on panel data econometrics includes; the Generalized Method of Moments (GMM) technique, (Rubert & Mahabir 2018; Jan & Audu

2017, Jamilah, Zulkornain & Muzarar 2016; Marjan & Karim 2016) they concluded that trade openness lead to economic growth. The Panel Linear Regression Techniques was also employed to investigate the relationship between trade openness and economic growth. Notably, they employed Fully Modified OLS (FMOLS), Pooled OLS (POLS), and Dynamic OLS (DOLS). The studies that employed either of these techniques include, (Ghulan, Marian & David 2017; Rudra Mak, John & Neville, 2017;2015; Bulent, 2014; Sakyi, Villaverde, & Maza, 2014; Nowbutsing 2014). Their results were inconclusive; some concluded that openness leads to growth as others concluded otherwise. Some studies employed either 3 stage or 2 stage least square regression technique, they include, Ghulan Marian and David, (2017); Tian and Yang, (2017); and Hang (2010) among others. They concluded that openness leads to economic growth. Others studies employed the Panel ARDL (Bashir, Hafeez, Imran, & Abou, 2016), Bulent (2014) employed Baysian Model of Averaging, while, Sakyi, Villaverde, Maza and Peddy (2012) employed Common Correlated Effects Mean Group (CCEMG). Their studies came up with different conclusions, however, majority of these studies concluded that trade openness leads to economic growth.

Hence to contribute empirically to literature, this study explores the interaction between trade shocks and macroeconomic dynamics in OPEC countries. The study employed the Panel Vector Autoregression (PVAR) of Abrigo and Love (2015) to investigate the transmission of trade shocks and macroeconomic fluctuations among OPEC countries and employed the dynamic panel data models to examine the relationship between trade openness and economic growth in OPEC countries. This study was motivated by considering the nature of the economy of OPEC countries that are highly imported dependent, and one commodity (oil) export dependent.

1.2 Statement of the Problem

The issues of economic growth and macroeconomic stability have been the major concern among economic policy makers around the world. The global economy is becoming more and more integrated and this is as a result of trade liberalization. The growing integration of these economies through trade has led to economic imbalances among countries. This is due to the fact that there is transmission of macroeconomic shocks among trading economies.

The growing concern on the relationship between trade openness and economic growth has taken relevance in both theoretical and empirical literature. Studies on oil exporting countries have been centered on the volatility of oil prices and its effects on economic growth and most studies look at oil price volatility as the major cause of macroeconomic fluctuation in most of the oil exporting countries. However, it seems that researchers have ignored the fact that trade shocks may lead to macroeconomic fluctuation in oil exporting countries especially the developing oil exporting countries and most of these countries are members of Organization of Petroleum Exporting Countries (OPEC).

The nature of small open economy such as that of developing oil exporting countries most especially OPEC countries, are characterized by high importation and low level of exportation mainly one commodity exports which is crude oil export, are more likely to exhibit a high volatility of the terms of trade. The imbalances between advance economies and small open economies have seen the later experience macroeconomic fluctuations induced by external trade shocks.

The nature of the economy of OPEC countries is that they are highly imported dependent, and one commodity (oil) export dependent. The major source of revenue is mainly from oil revenue and crude export constitutes majority share of their export commodities. The major source of foreign earnings is crude oil export and the non-oil sectors have contributed less to foreign earnings. The transmission mechanism from trading partners of OPEC countries are due to the fact that they import heavily from other larger economies. As such, fluctuation in commodity prices and volatility of trade will directly induce these economies as the economies of OPEC are very open. This was noted by Francisco and Luis (2002) who posited that high volatility of the terms of trade in a small open economy such as that of OPEC are induced by imbalances in terms of trade. This is because, important fraction of trade in these economies comes from oil exports and associated with oil price change. This was also the case of most African countries which exhibit similar characteristics of OPEC countries as small open economy. Kose and Riezman (2000) indicated that trade had cause adverse economic fluctuation in African countries; this is because African countries import heavily from larger economies and this has caused macroeconomic fluctuation in most African economies.

The fact that OPEC countries are small open economy who import virtually everything they consume including agricultural produce, their economy had been vulnerable to so many macroeconomic shocks from other economies. Failure on the part of governments amongst OPEC countries to fully diversify their economies has led to consistent economic fluctuation.

The slump in global crude oil prices in 2014 had pushed majority of OPEC countries into recession. This is due to the fact that, foreign earnings had dropped and subsequently depreciation of their currencies to other foreign currencies. Since these countries are import dependent, the depreciation of the currencies to foreign currencies saw that imports became very expensive as a result lead to persistent hyperinflation and other economic instability within the OPEC economy.

Within these periods of oil slum we have seen that OPEC countries face tremendous macroeconomic challenges. The drop in foreign earnings had led to continue depreciation of OPEC members' currencies to other foreign currencies. By mid-2014 for instance the Algerian dinar depreciated 27% against the US dollar by the end of 2015 (World Bank 2015). The same situation with the naira, the naira exchanged to the dollar at $1 to N400 within the same period. Unlike Algeria, the Nigerian currency continued to drop all through to the end of 2016 before it began to stabilize (CBN, 2017). The situation in Angola wasn't different either has the Kwanza depreciated by 22% against the US dollar, the currency was devalued by 11% in 2017 against the US dollar in 2017 (IMF, 2018)

Within the same period, inflation had been on the rise in most of these OPEC economies. For instance, Nigeria's consumer prices increased to 16.25% in May 2017, easing from a 17.24% in early 2017 after reaching an all-time high of 18.30% in 2016 (CBN, 2017). In Venezuela inflation has soared above +1000% in 2016 the highest rates in the world (World Bank, 2017). In Iran the services price index increased by 11.5% between the years 2014 to 2015 and slightly fell down 11% in October 2016 (World Bank, 2017). Furthermore, still on Iran, the annual price of commodities increased to about 17.1% and 11.2% between the year 2016 to 2017 respectively (World Bank, 2017). The Consumer price index (CPI) increased to 2.9% within the period of economic crisis in Kuwait (QNB, 2017). In Angola, inflation fell to an annual average of 30.4% in 2018 from 32.4% in 2017 easing from 37.2% in 2016 (IMF, 2018). The annual average CPI in Ecuador stood at 0.29% in 2018 easing from 0.42% from the previous year, while inflation in Algeria fell from an average of 6.4% in 2016 to 5.5% in 2017. However, inflation rose to 7.5% in 2018 (IMF, 2018)

Likewise, during economic meltdown experience by Kuwait, the government embarked on subsidy cuts which push up domestic inflation, particularly in 2015, which was partly offset by lower temporary inflation (WTO, 2017), inflation fell off by 4.2% in 2015, 4.1% in 2016 and 3.8% in 2017in Kuwait (World Bank 2017). Likewise, Iran government adopted policies to promote and encourage exports in non-oil sectors. As such non-oil exports grew by 10% in 2014, led by agricultural goods (World Bank, 2017). Due to Prudent economic policies by the Iranian government, this allowed the economy to maintain a stable rate of inflation at around 10% in October 2015 (World Bank, 2017).

These situations showed a slump in Gross Domestic Product among OPEC countries, as Nigeria recorded four consecutive negative growths in GDP in form of -0.36% in 2016Q_1 to -2.06% in 2016Q_2 , -2.24% in 2016Q_3 and -1.30% in 2016Q_4 (NBS, 2017). However, the Nigerian economy experienced growth early 2017. The economy grew by 0.72% in the second quarter of 2017 by the fourth quarter of 2017 is real gdp growth stood at 2.1% however, growth ease to 1.9% in 2018 (NBS, 2018). In addition, Kuwait also recorded 1.0% slow growth rate in 2015 before recovering to 1.8% growth path in 2016 (World Bank, 2017). Likewise, Venezuela economy also shrank by -18% in 2016, after -6.5% in 2015, however, real GDP further fell to 36.3% in 2018 (World Bank, 2018). The Libyan economy grew strongly by 27% 2017 coming from a slow growth in 2016. This was driven by recovery in the oil production while the Iranian economy also grew by 20.1% (World Bank, 2018).

Furthermore, due to poor economic policies and failure of the governments of OPEC countries to diversify trade especially export and review their import policies, OPEC economies faced such economic distortions.

As such it is necessary to empirically investigate the relationship between trade openness and economic growth and to examine channel of transmission of trade shocks and macroeconomic dynamics in OPEC countries. This is very important because majority of studies conducted on trade openness and economic growth didn't observe the interaction of transmission of trade shocks and macroeconomic dynamics in OPEC countries. However, the study that used OPEC as a case study is that of Marjan and Karim (2016) but they focused on financial development and environmental quality and economic growth among OPEC countries. Trade openness here was used as a control variable and the channels of transmission of trade shocks were not examined. Their study used the GMM model which fell short of some important findings (i.e shocks transmission/propagations) that will be relevant for policy making.

This study filled the gap left in the literature by employing the Panel Vector Autoregression (PVAR) technique and panel dynamic models to examine the transmission of Trade Shocks and macroeconomic dynamics and the relationship between trade openness and economic growth among OPEC countries.

1.3 Research Questions

For the purpose of this study on the relationship between trade openness, macroeconomic dynamic and economic growth in OPEC countries, the following research questions have been drawn.

i) Is there any long-run relationship between trade openness and economic growth among OPEC countries?

ii) Are there any long-run and short-run dynamic effects between trade openness on economic growth among OPEC countries?

iii) What are the channels of transmission of trade shocks to macroeconomic dynamics in OPEC countries?

iv) Are there any causal relationships among trade openness, economic growth and some macroeconomic variables (i.e Exchange Rates, and Inflation) among OPEC countries?

1.4 Objectives of the Study

The broad objective of this study is to assess how trade openness and macroeconomic dynamic characterize economic growth in OPEC countries. This broad objective had been subdivided into the following specific objectives:

i) To access the long-run relationship between trade openness and economic growth among OPEC countries.

ii) To examine the long-run and short-run dynamic effect of trade openness on economic growth among OPEC countries.

iii) To determine the channel of transmission of trade shocks to macroeconomic dynamics in OPEC countries.

iv) To evaluate the causal relationship among trade openness, economic growth and selected macroeconomic variables (i.e Exchange Rates, and Inflation,) among OPEC countries.

1.5 Research Hypotheses

In view of the foregoing study, with respect to trade openness and macroeconomic dynamic characterize economic growth in OPEC countries; the following research hypotheses are being presented.

Ho_1: There is no long-run relationship between trade openness and economic growth among OPEC countries.

Ho_2: There are no long-run and short-run dynamic effects of trade openness on economic growth among OPEC countries.

Ho_3: There is no channel of transmission of trade shocks to macroeconomic dynamics in OPEC countries.

Ho_4: There is no causal relationship among trade openness, economic growth and selected macroeconomic variables (i.e Exchange Rates, and Inflation) among OPEC countries

1.6 Significance of the Study

The role of international trade and economic growth cannot be over emphasized, especially with the current trend of globalization and economic integration. Empirical studies on trade openness and economic growth is not new in literature. A lot of works had been done on time series analysis, cross-sectional analysis and panel data analysis. The panel data analysis had taken shape compared to other methodologies used in this area of research. As recent development in econometrics analysis is concern, panel data econometric techniques had been used to investigate the relationship between trade openness and economic growth.

This study is motivated considering the nature of the economy of OPEC countries that are highly import dependent, and one commodity (oil) export dependent. Considering the fluctuation of commodity prices (Oil Prices) and Oil production glut in the oil market which has caused considerable economic distortion especially imported inflation and forex instability among OPEC member countries. This situation has led most of these countries into recession and above all contributed to severe economic hardship in these countries a case of Angola, Nigeria, Saudi Arabia, Venezuela, among others. Most of the major economic distortion had been attributed to the imbalance in trade relationship. Where by the developed larger economies benefit more than the developing small open economies such as that of OPEC countries

This study is also significant to students of international trade economics and researchers in international trade; in a view that it explores an area that most researchers have ignored when it comes to literature on international trade. This study identified how trade shocks cause macroeconomic fluctuation especially in OPEC countries. The study is an immense benefit to majority of developing oil exporting countries to uncover how trade openness has influenced the economy of OPEC countries in the presence of other macroeconomic shocks.

The findings of this research work transcend beyond mere academic brainstorming, but it is an immense benefit to policy makers who prescribe economic policies for OPEC countries on trade related issue, it is beneficial for the executives of OPEC to understand the fact that is not only volatility of crude oil prices that can cause macroeconomic dynamics among OPEC countries, but rather trade shocks may also contribute to macroeconomic dynamic.

This study further serves as a guide and provides insight for future research on this topic and related field for students who are willing to improve on it. It also educates the public on various government policies as related to trade issues.

1.7 Scope and Limitation of the Study

The study examines the relationship between trade openness and economic growth among OPEC countries. The study further examines the channel of transmission of trade shocks and macroeconomic dynamic in OPEC countries. The study made use of annual time series data from 1990 to 2018. The time scope was used based on data availability and consistency of the data of the countries sampled for analysis.

The analysis was conducted using seven (7) variables namely; Gross Domestic Product per capita (GDPc), Total Labour Force (LBF), Capital Stock per unit of labour {Gross capital formation as capital stock (CPT)}, Trade openness {degree of openness (TO)},Consumer Price Index (CPI), Exchange Rates (EX), and Annual Crude Oil Production (COP) covering the period of 1990 to 2018 was used.

The researcher would have used all fourteen (14) OPEC countries However, due to the inconsistencies in data series of some OPEC countries limited the choice of ten (10) OPEC countries used in this study which includes; Algeria, Angola, Ecuador, Gabon, Islamic Republic of Iran, Kuwait, Libya, Nigeria, Saudi Arabia, and Venezuela.

1.8 Organization of the Study

The study contains five (5) chapters, chapter one is the introductory part of this study, the chapter contains the general background to the study, statement of the problem, research question and objectives of the study, significance of the study, scope and organization of the study. Likewise in chapter two (2) the study present the literature review and theoretical frame work, as well as the empirical reviews. Chapter three (3) contains the methodology and model specifications of the study. Chapter four (4) includes data presentation and the empirical result of the models, analysis of the result and policy implications of the findings. Finally, Chapter five (5) basically contains summary, conclusion and recommendations of the study.

CHAPTER TWO
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter reviewed conceptual issues related to trade openness, macroeconomic dynamic and economic growth. The chapter also reviews empirical works done by other researchers who undertook similar research. The chapter also discusses theories of trade and business cycles.

2.2 Conceptual and Theoretical Review

2.2.1 Trade Openness

For a long time, economists have attempted to find comparative measures of trade openness but this has proven to be controversial and difficult. As Winters (2004) posited, the definition and measure the degree of trade openness of an economy is indeed a tough task and is a common problem associated with most studies (Winters, 2004). According to Alcala and Ciccone (2003), trade openness can be measured in different ways. It is difficult to construct a universally acceptable measure of trade openness. Various contending measures of openness such as trade intensity, tariff and non-tariff barriers, the indices constructed by Dollar (1992) and Sachs and Warner (1995) are available to potential researchers.

To investigate this measurement, this study acknowledges that openness is a multidimensional concept. However, some studies choose openness measures due to data availability and some other researchers have constructed indices that measure the degree one country exports and imports goods, such as Dollar (1992), Sachs and Warner (1995) and Leamer (1998).

Further arguments suggest that, trade dependency ratios are the most popular of these measures. Their main advantage is that the data required to compute them are available for nearly all countries and over a rather long period (Bourdon, Chantal & Mariana, 2014). Their main weakness is that they are mainly outcome-based measures, and as such, are the result of very complex interactions between numerous factors so that it is not clear what such measures exactly capture. Another limitation of these trade dependency ratios as pointed out by Bourdon, Chantal and Mariana (2014) lies in their endogeneity in growth regressions, which requires specific estimation techniques (such as instrumental variables techniques as in Frankel and Romer, 1999, and Irwin and Tervio, 2002, or identification through heteroskedasticity techniques as in Lee, Ricci, & Rigobon, 2004).

For the purpose of this study, the study will use the trade dependency ratio i.e the ratio of exports and import to GDP as measure for trade openness. This is because of availability of data and it is most widely used trade openness measure in recent literatures. The nature of the study necessitate the use of this trade openness measure since the study will try to ascertain the external shocks that causes macroeconomic dynamics in the economy of OPEC member countries.

2.2.2 Macroeconomic dynamic (Instability)

Macroeconomic dynamic is usually understood as a situation of economic malaise where the economy does not seem to have settled in a steady position and where, eventually, something needs to be done for putting it back on track (Azam, 2001).

According to Joya (2011), the concept of "macroeconomic dynamic (instability)" is not necessarily associated with economic crises. Although volatility usually appears during the periods of crisis in developed countries, it is an endemic phenomenon in developing countries and must not be confined to instances of crisis (Malik & Temple, 2009 cited in Joya, 2011). Moreover, a period of macroeconomic dynamic (instability) is not necessarily a period of recession. A country can well suffer from macroeconomic volatility without "formally" being into an economic recession (Joya, 2011).

According to Ahmad, Mukaramah and Siti (2012), macroeconomic dynamic refers to phenomena that make the domestic macroeconomic environment less predictable and it can take the form of volatility of key macroeconomic variables.

According to Sameti (2012), Macroeconomic dynamic describes a situation of national economy in which the vulnerability caused by the foreign shocks has reached a minimum.

The Norwegian Agency for Development Corporation also defines the short run fluctuation in the macroeconomic variables such as the gross domestic product, inflation, budget deficit as the macroeconomic instability. In this viewpoint, the macroeconomic instability can weaken the potential long run growth through decrease of tendency to investment. (Norwegian Agency for Development Corporation, n.d. cited in Sameti, 2012)

Montiel and Servén (2004) cited in Joya (2011), refer macroeconomic dynamic to "phenomena that decrease the predictability of the domestic macroeconomic environment." Some other economists, however, define macroeconomic instability in a much broader sense, as "a situation of economic malaise, where the economy does not seem to have settled in a steady position." (Azam, 2001cited in Joya, 2011) Thus, macroeconomic instability is a situation where: (i) unsustainable imbalances appear in the economy; (ii) variability in key macroeconomic variables is large (i.e. exceeding a certain threshold); and/or (iii) macroeconomic environment is highly uncertain.

Macroeconomic dynamic (instability) can take the form of *volatility* of key macroeconomic variables or of *unsustainability* in their behavior (Montiel and Servén, 2004). Thus, macroeconomic instability could also include "unsustainable" performances in macroeconomic variables (such as low and unstable growth rate, high inflation, large unemployment, unsustainable fiscal and current-account deficits, etc.), while macroeconomic volatility refers uniquely to large fluctuations in macro variables and to the uncertainty associated with them. There can well be a situation which would qualify as of macroeconomic instability, but not as macroeconomic volatility; for example, a country which suffers from low economic growth, high inflation and large deficit, but their respective rates and levels are stable and non-volatile (Joya, 2011).

On the standpoint of theoretical point of view, macroeconomic instability is as a result of fluctuation in the economy which is ascribed as business circle. The business cycle theoretical models vary in terms of their choice of what contributes to the fluctuation in the economic. Many economists offer a wide range of theoretical models which share some common properties to look at the nature, sources and propagation mechanisms of business cycle fluctuations. One of this is the fact that there is always a major driving force behind these fluctuations, some sort of shocks or disturbance that causes the cycle.

The choice of shocks, that is, which shocks are most important in disturbing an aggregate economic activity and their propagation mechanisms had been debated by economist. In this regards, various kinds of shocks have been historically documented. Some business cycle studies report that external shocks, such as terms of trade shocks, oil price shocks, interest rate fluctuations, stock markets crashes, climate shocks and natural disaster represent main sources to the business cycle fluctuations (e.g Kose& Riezman, 2001, Broda, 2004; Edwards, 2006; Calderon & Levy-yeyati, 2009; Sosa & Cashin, 2009).

In contrast, some other studies reveal that internal shocks, such as domestic supply shocks, monetary policy shocks, investment specific technology shocks, weak institutions and political instability have lager impact relative to that of external shocks in driving business cycle dynamics (Dejong et al, 2000; Aisen et al, 2006; Fisher, 2006; Hirata et al, 2007; Klomp & de Haan, 2009; Allegret et al, 2012).

On the other hand, business cycle theory and some empirical studies has highlighted several channels through which these shocks transmit across countries such as; international trade, financial integration, and industrial structure(e.g see Edward, 2006; Funke, Granziera & Imam, 2008; Sosa & Cashin 2009; Ali & Anwar, 2017; and Blagrave & Vesperoni, 2018). Understanding these transmission mechanisms provide useful information for policy purposes (Kose & Riezman, 2000; Clark & van Wincoop, 2001; Baxter & Kouparistsas, 2005; Rana, 2007; Funke, Granziera & Imam 2008; Flood & Rose, 2010; Erden & Ozkan, 2014; Ali & Anwar, 2017).

Few economists have tried to define the precise conditions for macroeconomic instability but they do not have theoretical underpinning for precise policy implications (Suliman, 2016).

Empirical studies have identified numerous factors which may induce volatility in macroeconomic aggregates. A large part of these studies use econometric models and techniques to identify the causes of macroeconomic volatility. Nonetheless, other studies are based on the calibration of theoretical models (e.g. general equilibrium models, dynamic stochastic models, etc.).For example, most studies have used inflation as a proxy for macroeconomic instability e.g Fischer (1991), Shigoka (1994), Ramey and Ramey (1994), Drugeon and Wignolle (1996), Azam (1997), Azam (1999), Yiheyis (2000), Ocampo (2005), Caballero (2007), Iqbal and Nawaz (2010), Mustapha, Monnet and René (2010), Nenbee and Madume (2011), Ahmad, Mukaramah and Siti (2012), Shahbaz (2013), Ali (2015) and Eneji, Dimis and Rose (2017).

Azam (2001), Ismihan (2003), Ogbuagu and Ewubare (2015), Eneji, Dimis and Rose (2017) used both exchange rate and inflation rate as proxy to macroeconomic instability. While some studies such as that of Azam (2001), Ismihan (2003), Sanchez-Robles (2006), Sirimaneetham and Jonathan (2008), Iqbal and Nawaz (2010) and Ali, Shah and Shahid (2015)developed a macroeconomic instability index using principal component analysis to capture instability in the economy with a mixture of inflation rates, interest rates and exchange rates.

The above discussions as clearly shown that the concept of macroeconomic dynamic (instability) had over the year's generated voluminous literature, scholars have not precisely tied it to one economic situation. However, for the purpose of this study, the business cycle studies that reported that external shocks, such as terms of trade shocks constitute macroeconomic distortions in an economy will be adapted as the main line of argument and investigation. The study adapts the explanation given by Kose and Riezman (2001), Kose (2002), Razin et al. (2003), Broda (2004), Loayza and Raddatz (2006), Kose et al. (2006), Giovanni and Levchenko (2006), Edward (2006), Funke, Granziera and Imam (2008),Collier (2008), Sosa and Cashin (2009), Bandinger (2010), Ali and Anwar (2017), and Blagrave and Vesperoni (2018) among others. In their view nature, sources and propagation mechanisms of business cycle fluctuations and macroeconomic instability are transmitted from external shocks.

2.3 Theoretical Literature Review

2.3.1 Trade Theory

The concepts of trade openness and economic growth are embedded in microeconomics and macroeconomics respectively. Trade openness can be traced back to mercantilism, the classical economists and Heckscher-Ohlin trade theories. The mercantilists viewed economic activity as a zero-sum game in which one country's economic gain was at the expense of another. The mercantilists stressed the need to maintain an excess of exports over imports (Hassan 2007).

Other trade theories include; Adam smith theory of trade (Absolute advantage trade theory), David Ricardo comparative Advantage theory, Theory of Customs Unions and Free Trade Area, and Hecksher-ohlin trade theory. This study would build its argument under theoretical framework of Hecksher-ohlin trade theory because it is widely used as the theoretical framework for analysis by scholars and it is one of the most recent among other trade theories.

2.3.2. Hecksher – Ohlin (HO) Trade Theory

The Heckscher-Ohlin (HO) model was developed by two Swedish economists; Eli Heckscher (in a 1919 article) and his student Bertil Ohlin (developed Heckscher's ideas further in his 1924 dissertation).

The Hecksher-Ohlin theory focuses on the differences in relative factors endowments and factors prices between nations as the most determinants of trade (On the assumption of equal or similar technology and tastes). Hecksher Ohlin maintained that the sources of the factors endowments determine a nation's comparative advantage. On this basis the theory is referred to as the Factor Endowment Theory. The theory analyzed the differences in factors endowment on international specialization. The model was based on two main prepositions; firstly, a country with specialization in the production and export of a commodity whose production requires intensive use of abundant resources. This implies that goods differ in factor requirement. Secondly, countries differ in factor endowment. Some countries have mush capital per worker and some have less. Countries could be ranked by factor abundance (Hassan 2007).

Hassan (2007) explained that the model assumed two countries, two commodities and two factors. There is perfect competition in both factor and product market. It assumed that factor inputs; labour and capital in the two countries are homogeneous. Production function also exhibits constant return to scale. Production possibility curve is concave to the origin.

On Heckscher-Ohlin theorem,a capital-abundant country will export a capital-intensive good and a labour-abundant country will export a labour-intensive good is well explained by Dung (2015). Consider two countries, Japan and Nigeria for example, and the assumptions applied to the Heckscher-Ohlin theory include a similarity in production functions (identical technology) and aggregate preferences across the two countries. The difference in resource endowments between two countries is sufficient to generate different PPFs, such that equilibrium price ratios would be different in autarky.

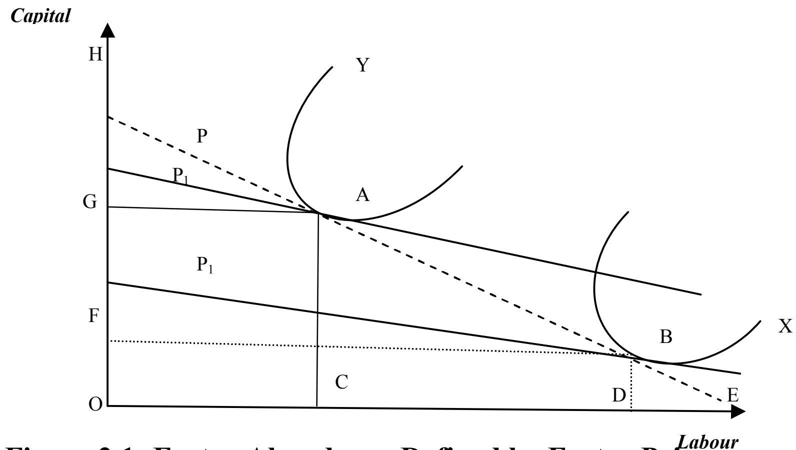


Figure 2.1: Factor Abundance Defined by Factor Prices
Source: adopted from Dung (2015)

Since the Heckscher-Ohlin theorem assumes identical constant-returns-to-scale production technologies in both countries, the relationship between factor price ratio and commodity price ratio should be examined. Figure 2.1 shows the unit isoquant curve for the labour-intensive good X(Agric produce) and the capital-intensive good Y (steel). Japan is relatively capital abundant and has a factor price ratio represented by the line P, while that of Nigeria is represented by the line P1. One unit of capital-intensive good Y is produced by OG units of capital and OC units of labour.

However, capital and labour can be exchanged for each other, therefore OC units of labour can be exchanged for GH units of capital, and OG units of capital are worth CE units of labour. Thus, the cost of producing one unit of the capital intensive good Y in Japan, measured in units of capital, is OH; and measured in units of labour is OE. Similarly, the cost of producing one unit of the labour-intensive good X is OE when measured in units of labour, and OH when measured in units of capital.

The factor price ratio P1 of Nigeria is tangent to the unit isoquant curve for good Y (steel) at point A, which means capital is relatively more expensive in Nigeria than in Japan. A parallel shift of P1 to P'1 is tangent to the unit isoquant curve for good X (Agric produce) at point B, certainly below P1.Therefore, in Nigeria, it is relatively more expensive to produce good Y (steel) than X (Agric Produce).

All of the above implied that any difference in autarky prices between the Japan and Nigeria is sufficient to induce profit seeking firms to trade. The higher price of the capital-intensive good Y (steel) in Nigeria will induce firms in the Japan to export steel to Nigeria to take advantage of the higher price. Likewise, the higher price of the labour-intensive good X (Agric Produce) in Japan will induce Nigerian firms to export agric products to Japan. For that reason, if the price definition of factor abundance used, a country is relatively more capital abundant than the other if the price of capital is relatively cheaper in that country. So, in conclusion, we can say that the capital-abundant country will export the capital-intensive good, and the labour-abundant country will export the labour-intensive good.

2.3.3 Business Cycle Theory

The concept of business cycles has its origins as a distinct phenomenon in the observation of significant indicators that describe the economic process. This process is not constant and is characterized by cumulative upward and downward movement in which observers claim to discern certain regularities (Suliman, 2016).

One of the most critical challenges facing macroeconomic policy makers today is the need to understand why do world's economies go through cycles of recession and recovery, or boom and bust. Different schools of macroeconomic thoughts offer differing views to answer this question.

Keynes's (1936) General Theory of Employment, Interest and Money shifted the problem of fluctuations in aggregate output to the centre of economic interest. Soon after the publication of the General Theory and the first mathematical business cycle models were developed by Hicks, Kalecki, Metzler, Samuelson and others (Suliman, 2016). Ever since, the explanation of business cycles has been used to describe fluctuations in an economy; an upturn ends at an upper turning point (boom), followed by a downturn which leads to a lower turning point (recession). Then the upturn starts again.

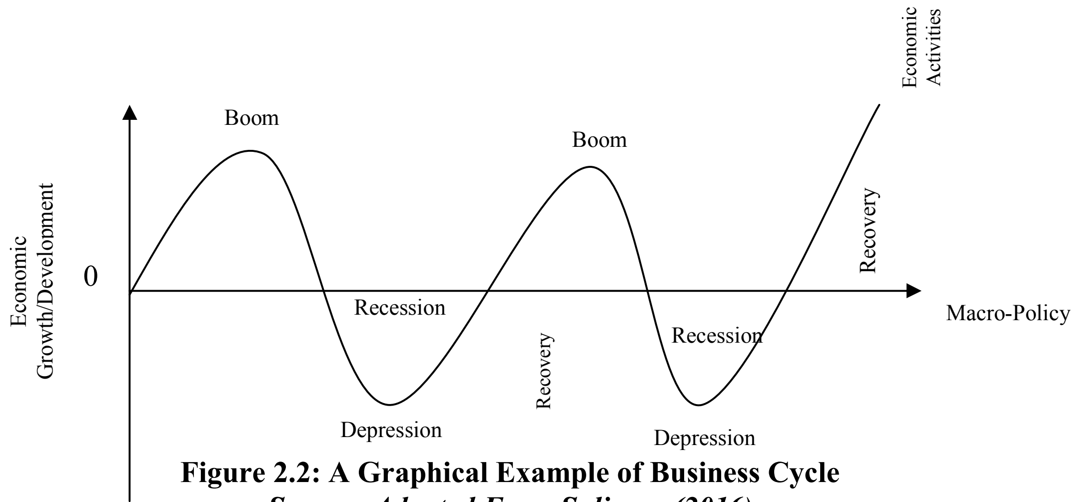


Figure 2.2: A Graphical Example of Business Cycle
Source: Adopted From Suliman (2016)

In macroeconomic literature, business cycle is widely recognized as the periodic fluctuations of aggregate economic activity. The terms business cycle, short-run macroeconomics, and economic fluctuations (preferred) are used synonymously. Example of business cycle theories that explain economic fluctuations include; Traditional/Keynesian Theory, New Classical Theory, New Keynesian Theory and Real Business Cycle (RBC) Theory.

2.3.4 Real Business Cycle Theory

Traditional macroeconomic theory suggested that transitory shocks do not have irreversible and permanent effects. Therefore, analysis of fluctuations was done in the context of aggregate supply/aggregate demand model, while evolution of long term variables was analyzed through growth models. This dichotomy between the theoretical analysis of fluctuations and of growth relates to the static decomposition between *cycle* and *trend;* it therefore assumes that shocks do not have permanent effect on the level of a series (Joya, 2011).

The dichotomy between cycle and trend was challenged by several empirical and theoretical researches during the 1970s and 1980s (Joya, 2011). These studies showed that short-term movements in all macroeconomic aggregates have an impact on the long-run level of their series (i.e. their trends). In other words, transitory shocks which are at the basis of cyclical phenomenon persist in the long run. Macroeconomic time series are, thus, composed of permanent (trend) and cyclical components. However, the acknowledgement of this fact has serious implications. At the statistical level, it makes the traditional dichotomy between cycle and trend unmeaningful. In fact, the trend cannot be considered independent of and unaffected from transitory shocks. And at the theoretical sphere, it requires analysing the fluctuations and the growth in a unified way. This latest methodology constitutes the principals of the *real business cycle (RBC) theory*.

The RBC model extends the Neo-classical growth model in three main ways: First, it adds a *labour-leisure choice* which allows for the possibility of variable employment over time, and thus flexible wages (Joya, 2011). The RBC theory further assumes that prices in other markets are also flexible and that markets always clear out. Secondly, it allows for *random shocks* to exogenous real variables. In particular, it allows for variations in "technology" and/or government spending. As a result, households and firms face uncertainty regarding future variables. Finally, it assumes that economic agents make *rational expectations* about the future and operate in competitive markets (Joya, 2011).

In general, RBC theory models the economy using dynamic general equilibrium models (DGEM). A simple RBC model is based on the same aggregate function as that in a neoclassical growth model with constant return to scales: vowed

$$Y_t = F(K_t, A_t, L_t) \tag{2.1}$$

where A_t is an exogenous process of technology which evolves according to a *trend stationary* model, such as:

$$\ln A_t = \ln\bar{A} + gt + Z_t \tag{2.2}$$

$\ln\bar{A}$ is a constant, g is the trend growth rate (assumed to be known with certainty) and Z_t represents deviations around the trend. These deviations from trend are further assumed to follow a first-order autoregressive process:

$$Z_t = P_z Z_{t-1} + \varepsilon_t \qquad (2.3)$$

Where P_z is a persistence parameter and ε_t represents a "technology shock."

Hence, according to RBC theory, shocks which induce fluctuations and cyclical behaviour are induced by *stochastic variations in technology* and these technological and productivity shocks are persistent over some period of time (depending on the value of P_z). Movements in output and employment are thus seen as the efficient responses of a perfectly competitive economy to a productivity shock.

2.4 Empirical Literature Review

Providing conclusive empirical evidence on the effect of trade on growth as well as the relationship with macroeconomic dynamic has been a challenging endeavor. Hence this study reviewed the following studies and ascertains the empirical relationship between trade openness, economic growth and macroeconomic dynamics.

2.4.1 Trade Openness and Economic Growth

Ghulam, Marian and David (2017) examined the tree-way relationship between Economic Growth, Human Development and Openness to Trade. They based their empirical analysis on the Cobb-Douglass Production Theory. They employed Pooled OLS, 2 stage Least Square and 3 Stage least Square to estimate the relationship between Trade Openness, FDI, and Market Size among 12 developing ASIAN Countries from 1970-2011 (42 years). The countries are Bangladesh, India, Nepal, Pakistan, Sri Lanka, Indonesia, Malaysia, Philippines, Singapore, South Korea, Thailand, and China. The three sets of results were comparable; less comparable but still qualitatively similar are the results from fixed effects estimations which are available from the authors. Their study concluded that Trade Liberalization policies lead to higher growth as well as higher human development.

Furthermore, Iyoha and Okim (2017), investigated the relationship between trade and economic growth in ECOWAS countries from 1990 to 2013, they made use of 15 ECOWAS countries to estimate the relationship between per capita real income, total exports (a proxy for trade), real gross domestic capital formation, human capital, proxied by number years in school, growth rate of population, nominal exchange rate and inflation rate. They reported that all the 4 estimated regression equations had high coefficients of determination and F-statistic. In all the equations, exports, exchange rate and investment were significant determinants of per capita real income growth. Exports were consistently positively related to growth, thus confirming the hypothesis of trade having a significant positive impact on economic growth in ECOWAS countries. The study concluded that there is positive long run relationship between trade openness and economic growth in ECOWAS countries.

Jamilah, Zulkornain and Muzarar (2016), investigated the relationship between openness and economic growth in 87 selected countries which includes Organization of Economic Co-operation and Development Countries (OECD) from 1977 to 2011, using GMM estimation, they examine the relationship between GDP per capita, Trade Openness. The results indicated that Openness yields a significant positive impact on economic growth. And Bidirectional causality between openness and economic growth was found.

In addition, Marjan and Karim (2016), examined the relationship between trade openness, economic growth, financial development and quality of environment in OPEC member countries from 1990-2010. They used simultaneous equations and GMM estimation to examine the relationship between Carbon Dioxide Emission, Trade Openness, Squared GDP, Financial Development, GDP, Capital, Foreign Direct Investment, Inflation and Energy UR in percentage of Urban Population. They concluded that there is a bidirectional relationship between variables.

Also, Karman, Haider, Mushtaq, Mustafa and Bano (2016), examined the realistic relationship between trade openness and economic growth of 20 different countries (no justification for selecting these countries was given by the authors). The study employed fixed effects and random effects to explore the relationship between GDP, Trade Share, Import penetration ratio and export penetration ratio. The study concluded that there is lack of statistically robust association between trade openness and long-run growth.

Adolfo and Mário (2015), examined the relationship between inflation and trade openness using 152 countries from the period of 1950 to 1992 examine the relationship between inflation and trade openness using Fixed Effects, Random Effects and GLS techniques, the result showed that there is negative relationship between inflation and openness are neither restrict to a subset of countries or a time period.

Farshid, Akhoondzadeh, and Reza (2014), investigated the interactions between trade liberalization, economic growth, and income inequality using the observations in 30 developed and developing countries within the period 2000–2011 using the econometric model of generalized method of moments (GMM) for dynamic panel models. The results showed that there is a positive correlation between trade liberalization and economic growth.

Nowbutsing (2014) analyzed the relationship between openness and economic growth for Indian Ocean Rim Countries in a panel data framework. The panel consists of 15 countries over the time period 1997 to 2011. Three measures of openness are used namely trade as a percentage of GDP, exports as a percentage of GDP and imports as a percentage of GDP. The study estimates a Panel unit root and panel cointegration technique. Fully Modified Ordinary Least Square (FMOLS). The results showed that the three measures of openness positively affect economic growth. However, imports as a percentage of GDP has the highest impact on economic growth in terms of size.

Mercan, Gocer, Bulut, and Dam (2013), examined the effect of trade openness on economic growth in BRIC-T countries from 1989 to 2010. They employed thefixed effects model and random effect model to estimate the relationship between trade openness variable, the rate of external trade (Export-import) to GDP. It was found that the effect of openness on economic growth was positive, and statistically significant in line with theoretical expectations.

2.4.2 Review on Trade shocks and Macroeconomic dynamics

Blagrave and Vesperoni (2018), examined the cross-border spillovers from China's growth slowdown onto partner country exports from 2002Q_1 to 2016Q_4 for 48 advanced and emerging market economies. The study employed the Panel VAR technique to examine the contemporaneous relationship between GDP, real exchange rates, and export-intensity. The study suggests that spillovers to different trading partners will depend on their sectoral linkages with the Chinese economy. At the regional level, the analysis indicates that countries whose trade linkages with China are strongest such as those in Asia would be most affected.

Ali and Anwar (2017), examined the impact of anticipated and unanticipated Terms of Trade (ToT) shocks on aggregate output, inflation and the trade balance (TB). The study used Dynamic Stochastic General Equilibrium (DSGE) model to examine the contemporaneous relationship between GDP, real exchange rates, inflation and monetary policy instruments based on taylor rule. The study found out that, concerning the *J*-curve phenomenon, continues to hold even if the assumption of rational expectations about the ToT is relaxed. Further analysis reveals that the presence of a cost channel of monetary policy increases the intensity of the *J*-curve effect.

Fatih and Sevda (2014), analyzed the impacts of institutions, openness and macroeconomic stability on economic growth: a panel data analysis on middle income countries, the study conclude though the positive effects of the indirect determinants on economic growth are small, that the indirect determinants in middle income countries catch the trend of a continuous and steady growth together with the direct determinants are among the important cases which can approach middle income countries to high income countries.

Ghironi and Meltiz (2014), develop a stochastic, general equilibrium, two-country model of trade and macroeconomic dynamics. Productivity differs across individual, monopolistically competitive firms in each country. Firms face a sunk entry cost in the domestic market and both fixed and per-unit export costs. Only relatively more productive firms export. Exogenous shocks to aggregate productivity and entry or trade costs induce firms to enter and exit both their domestic and export markets, thus altering the composition of consumption baskets across countries over time. In a world of flexible price, the model generates endogenously persistent deviations from PPP that would not exist absent our microeconomic structure with heterogeneous firms. Finally, the model successfully matches several moments of U. S. and international business cycles.

Cakir and Kabundi (2013), studied the trade linkages between South Africa and the BRIC (Brazil, Russia, India and China) countries. The study applied a global vector autoregressive model (GVAR) to investigate the degree of trade linkages and shock transmission between South Africa and the BRIC countries over the period 1995Q1–2009Q4. Their model contains 32 countries and has two different estimations: the first one consists of 24 countries and one region, with the 8 countries in the euro area treated as a single economy; and the second estimation contains 20 countries and two regions, with the BRIC and the euro area countries respectively treated as a single economy. The results suggest that trade linkages exist between these economies; however the magnitude differs between countries. Shocks from each BRIC country are shown to have considerable impact on South African real imports and output.

Cacciatore and Montréal (2012), studied how labor market frictions affect the consequences of trade integration in a two-country, stochastic, general equilibrium model of trade and macroeconomic dynamics with heterogeneous .firms, endogenous producer entry, and frictional labor markets. The model successfully reproduces important empirical regularities that characterize trade integration both in the long run and over the business cycle. Two key results emerge. First, trade integration is always beneficial for welfare by inducing higher productivity, but unemployment can temporarily rise as trade barriers are lowered. Gains from trade are smaller in countries with more rigid labor markets, as production gradually shifts toward more flexible economies. Second, trade integration has important business cycle consequences.

Haddad et al. (2010) noted that the effect of trade openness on growth volatility reduces with the degree of export diversification, both across products and markets. According to them, not only product diversification (number of goods exported) but also market diversification (number of destination markets) plays an important role in moderating the volatility effects of trade openness on growth.

Funke, Granziera and Imam (2008), examined the macroeconomic impact of negative terms of trade shocks and tries to identify factors that contribute to a fast recovery in growth after persistent negative shocks with a sample of 159 countries for 1970–2006. They used probit model to analyze what economic policies differentiated countries that successfully recovered from those that did not. The analysis focuses on shocks above the 10 percent threshold, given that relative few numbers of observations take place in the thresholds above 30 percent; there are only five cases of countries recovering from the 30 percent level seven if we bring the threshold down to 20 percent. They explore the relationship between GDP, Real exchange rate, budget balance, trade, aid, and Law. The results suggest that policies matter. Fast recoveries are fairly robustly related to real exchange rate depreciation and improvements in government stability and the institutional environment. A timely increase in aid may also support recovery.

Giovanni and Levchenko (2006) studied an industry-level panel dataset of 59 countries, with 28 manufacturing sectors, over the period 1970-99, and analyzed the mechanisms through which trade can affect the volatility of production. They found that trade openness is positively correlated with volatility at the industry level. Once exports and imports are treated separately, their results show that importing in a sector increases volatility more than exporting. Quantitatively, they estimated that a one-standard-deviation increase in trade openness raises aggregate volatility by about 15 percent of the average aggregate variance. In fact, when an economy is open to international trade, an industry is more vulnerable to world supply and demand shocks. Trade openness increases overall volatility because it leads to specialization and thus a less diversified production structure.

Loayza and Raddatz (2006) found that larger trade openness magnifies the output impact of external shocks, particularly the negative ones. They observed that "larger trade openness appears to increase the cumulative impact of terms-of-trade shocks." More trade openness means larger trade volume and, in turn, translates into a magnifying mechanism for terms-of-trade shocks. The authors estimated that the output impact of a one-standard-deviation terms-of-trade shock is 1.4 percentage point higher at the third quartile of trade openness than at the first quartile. Nevertheless, the impact is considerably smaller when the expansion in openness occurs in a country with well developed local financial markets.

Canova (2005) studied the transmission of US shocks to Latin America. The study used a bivariate block VAR model to examine the extent and the features of the transmission of US shocks to Mexico, Panama, Brazil, Chile, Ecuador, Argentina, Uruguay and Peru. The US shocks are identified using sign restrictions and treated as exogenous with respect to Latin American economies. The Posterior estimates for individual and average effects are constructed. US monetary shocks produce significant fluctuations in Latin America, but real demand and supply shocks do not. Floaters and currency boarders display similar output but different inflation and interest rate responses. The financial channel plays a crucial role in the transmission. US disturbances explain important portions of the variability of Latin American macro variables, producing continental cyclical fluctuations and, in two episodes, destabilizing nominal exchange rate effects.

Francisco and Luis (2002), analyzed the role of trade shocks in shaping aggregate fluctuations in Venezuela from 1950 to 1995. The study employed a dynamic stochastic general equilibrium (DSGE) model for a small open economy augmented to incorporate the income of the oil sector. The study found out that this approach gives predictions that are consistent with the time series properties of Venezuela when; the income effect of consumption more than compensates the substitution effect that generates the oil transfer and there is imperfect capital mobility.

Razin et al. (2003) evaluated the impact of trade openness through the adjustment costs of investment. They emphasized that, in the presence of economies of scale trade, openness may cause volatility in the setup cost of investment, through changes in the terms of trade, and thereby may generate instability in the form of "boom-bust investment cycles," supported by self-fulfilling expectations. In a period of 'good' terms of trade with lower setup costs of investment, the country will experience a boom in the investment cycle, while in a period of 'bad' terms of trade the investment cycle will see a decline due to increasing higher setup costs. In developing countries, firms face relatively higher setup costs due to inadequate infrastructure (communication, transportation, etc.) and scarce skilled labour. Trade openness in such countries will, thus, generate more pronounced oscillations in the investment cycles, compared to the developed countries.

Kose and Riezman (2000) examined the role of external shocks in explaining macroeconomic fluctuations in African countries. They construct a quantitative, stochastic, dynamic, multi-sector equilibrium model of a small open economy calibrated to represent a typical African economy. The framework of the analysis was based on external shocks consist of trade shocks, modeled as fluctuations in the prices of exported primary commodities, imported capital goods and intermediate inputs, and a financial shock, modeled as fluctuations in the world real interest rate. They further examine the cyclical behavior of trade shocks and their comovement with aggregate output and the trade balance using annual data of twenty-two non-oil exporting African countries for the 1970-1990 periods. The results indicate that while trade shocks account for roughly 45 percent of economic fluctuations in aggregate output, financial shocks play only a minor role. Their study also finds that adverse trade shocks induce prolonged recessions.

2.4.3 Empirical Literature Gap

Base on the review of relevant theoretical and empirical literature, this study have identified the following research gaps.

i) No attempts were done to explore the dynamic relationship between trade openness and economic growth across oil developing economics especially on OPEC countries. However, the study that used OPEC as a case study is that of Marjan and Karim (2016) but their study was based on Financial Development and Environmental Quality and Economic Growth, trade openness was a control variable in their study. They also failed to examine the transmission of trade shocks to macroeconomic dynamics in OPEC countries.

ii) In addition, Panel data analyses on transmission of trade shocks to macroeconomic dynamics are mostly micro-panel data analysis. And others studies were mainly time series econometric analysis.

2.5 Theoretical Framework

The objective of this study is to investigate the exact effect of trade openness on economic growth and transmission of trade shocks as a cause of macroeconomic dynamics in OPEC countries.

Based on the business cycle theories and trade theories, the study is built on the neoclassical growth model. The Cobb-Douglas production function is mostly used to examine the relationship between aggregate production and economic growth in trade openness literature as well as business cycle literature (see Balanika, 2013, Marjan& Karim, 2016,). The Cobb-Douglas production function represents an economic outlook in which production output is determined by the amount of labour involved and the amount of capital invested. The general function of the Cobb-Douglas function as presented by Balanika, (2013) has the form of;

$$Y_t = K_t^{a} (AL_t)^{1-a} \quad 0 < a < 1 \tag{2.4}$$

Where **Y** is the aggregate output at **t** time, **K** is capital, **L** is labour, and **A** the level of technology. Labour and technology are assumed to grow exogenously at rates **n** and **g** respectively (Balanika, 2013). One part of the output is invested at a constant rate ***s*** and the existing capital depreciates at an exogenous rate **δ**. The model defines **k**, the capital stock per unit of labour, k= K/AL and **y**, the output per unit of effective labour, y= Y/AL. The equations are presented as follows;

$K(t)=sY(t)-\delta K(t)$, equation of capital accumulation (2.5)

by dividing both inputs by AL; this will give use k

$k=sf(k)-(n+g+\delta)k$, basic equation of solow (2.6)

$k^*=\left(\frac{s}{n+g+\delta}\right)^{1/(1-a)}$, steady state capital labour ratios (k=0) (2.7)

Substituting equation (4) into the production function and taking logs, the steady state of income per capita (empirical specification):

$$ln\frac{Y}{L} = a + \frac{a}{1-a} lns - \frac{a}{1-a} ln(n + g + \delta) + \varepsilon \tag{2.8}$$

By making the above analysis, it is evidence that the central predictions of solow model concern in the impact of capital stock (s) and growth of labour force on aggregated per capita output. Hence, these two variables are included in the basic empirical specification. This analysis follows the Heckscher-Ohlin theorem that states that, for two countries should have effective trade relationship, capital-abundant country will export a capital-intensive good and a labour-abundant country will export a labour-intensive good.

Furthermore, it is assumed that **g** and **δ** are constant across countries. Based on the model developed by Balanika, (2013), measuring **n** as the labour growth rate and **s** as the capital stock per unit of labour (Gross capital formation as capital stock). The study gradually augments the model, by incorporating: a) Trade Openness. b) The control variables. The set of control variables are selected based on empirical literature and the nature of the economy of OPEC countries. These variables include exchange rate and annual crude oil production per day.

The functional specification of a model is based on the available information relevant to the study in question which is specified as follows,

$$Y_{i,t} = f(TO_{i,t}EX_{i,t}, COP_{i,t}, CPT_{i,t}LBF_{i,t}, \quad) \qquad (2.9)$$

While the mathematical specification of the model is expressed as follows;

$$GDPc_{it} = \beta_0 + \beta_1 TO_{it} + \beta_2 EX_{it} + \beta_3 COP_{it} + \beta_4 CPT_{it} + \beta_5 LBF_{it} \qquad (2.10)$$

In order to allow for the inexact relationship among the variables as in the case of most economic variables, the stochastic error term "ε_{it}" is added the equation.

$$\text{GDPc}_{it} = \beta_{i,t} + \beta_{1,t}\ TO_{i,t} + \beta_{2,t}\ EX_{i,t} + \beta_{3,t}\ COP_{i,t} + \beta_{4,t}\text{CPT}_{i,t} + \beta_{5,t}LBF_{i,t} + \varepsilon_{i,t} \qquad (2.11)$$

Where, GDPc_{it} is Gross Domestic Product (GDP) per capita, TO is trade openness (degree of openness), EX is Exchange Rates, COP is annual crude oil production per day, CPT is capital stock per unit of labour (Gross capital formation as capital stock), and LBF is Labour force growth. However, i and t denote number of cross sections and time, respectively, β_{it} coefficient of the variables and ε_{it} is the stochastic error term.

CHAPTERTHREE
METHODOLOGY

3.1 Introduction

The methodological aspect of this study is presented here and the models for specifications are also presented here. The models specifications are guided by relevant economic and econometric theories. This chapter has several subsections which include, model specification, measurement, definition of variables and sources of data, panel econometric techniques which includes, panel unit root test, panel cointegration tests, panel data dynamic estimators, panel Vector Autrogression, and Panel Causality.

Economic theory and some empirical research argue that trade shocks contribute to economic growth and macroeconomic instability while others see this as an ambiguous situation. In order to contribute empirically to this argument, this study will employ panel data dynamic econometric models and Panel VAR technique as the research techniques. The choice of method is necessitated by the nature of the study which in this case is an analysis of relationship among variables.

3.2 Sources of Data and Variables

The variables that was used in this study was an annual data series that was sourced from the United Nation Conference on Trade and Development (UNCTAD) website data base, World Bank Development Indicator (WDI) website Data base, U.S Energy Information Administration (EIA) Website, and International Monetary Funds (IMF) website data base. seven (7) variables namely; Gross Domestic Product per capita (GDPc), Total Labour Force (LBF), Capital Stock per unit of labour {Gross capital formation as capital stock (CPT)}, Trade openness {degree of openness (TO)},Consumer Price Index (CPI), Exchange Rates (EX), and Annual Crude Oil Production (COP) covering the period of 1990 to 2018 was used. The choice of time period is dictated-by data availability. Based on the available data and consistency of the their data, a total of 10 OPEC countries was sampled for the study and they include Algeria, Angola, Ecuador, Gabon, Islamic Republic of Iran, Kuwait, Libya, Nigeria, Saudi Arabia, and Venezuela.

3.3 Model Specification

In achieving the objectives of this study especially its first and second specific objectives, the study used an augmented Cobb-Douglas production function framework as suggested by Balanika (2013) and Marjan and Karim (2016).

However, the model used in this study followed the work of Balanika (2013) who investigated the relationship between trade openness and economic growth using a sample of 71 developing countries over the period 1990-2005. The model was specified as

$$GDPc_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 INV_{it} + \beta_3 TO_{it} + \beta_4 DCR_{it} + \beta_5 IND_{it} + \beta_6 INFL_{it} + \beta_7 GDPc_{it-1} \qquad (3.1)$$

Where; $GDPc_{it}$ is gdp per capita, POP_{it} is population growth, INV_{it} Investment level, TO_{it} trade openness, DCR_{it}, is Domestic Credit, IND_{it} is industry share to GDP, $INFL_{it}$ is inflation and $GDPc_{it-1}$ is the lagged value of gdp per capita.

For this study, the general model of this study would be derived within the context of the theoretical link between trade openness and economic growth, However based on the objectives of this study, it shall drop population growth, Investment level, Domestic Credit, industry share to GDP and inflation as used by Balanika (2013) and include labour force, capital stock, exchange rates and crude oil production as control variables to be in line with the first and second specific objectives of the study

Hence, the empirical specification can be specified as follows;

$$GDPc_{it} = \beta_0 + \beta_1 TO_{it} + \beta_2 EX_{it} + \beta_3 COP_{it} + \beta_4 LBF_{it} + \beta_5 CPT_{it} + \varepsilon_{i,t} \qquad (3.2)$$

Where, $GDPc_{it}$ is Gross Domestic Product (GDP) per capita, LBF is Labour force growth, CPT is capital stock per unit of labour (Gross capital formation as capital stock), TO is trade openness (degree of openness), EX is Exchange Rates and COP is Crude oil production, However, i and t denote number of cross sections and time, respectively, ε_{it} is the error term and β represents the estimated coefficients of all independent variables.

In order to properly estimate the parameters of the postulated model, we rescale the variables by taking the logarithms form; the panel model can be written as follows:

$$log(GDPc)_{i,t} = a_{i,t}\, \beta_{1,t}TO_{i,t} + \beta_{2,t}EX_{i,t} + \beta_{3,t}\, log(COP)_{i,t} + \beta_{6,t}\, log(CPT)_{i,t} + \beta_{5,t}log(LBF)_{i,t} + \varepsilon_{i,t} \quad (3.3)$$

In this case, the log sign represents the logarithm of GDPc, COP, CPT, and LBF (note; the log of TO and EX wasn't taken as the series are in rates and smaller units) respectively.

However, for the third specific objective of the study, the study employs the Panel VAR approach to examine the channel of transmission of trade shocks across OPEC countries. The impulse-response functions (IRFs) and variance decomposition (VDCs) deduced from the PVAR estimation was useful in analyzing how trade shocks cause macroeconomic dynamics among OPEC countries.

The reduced form of a PVAR model is defined as follows:

$$Y_{i,t} = a_i + \Gamma(L)Y_{i,t} + \mathcal{E}_{i,t} \quad (3.4)$$

where i (i=1,…,N) denotes the country, and t (t=1,…,T) the time. $Y_{i,t}$ is the vector of endogenous stationary variables, Γ(L) represents the matrix polynomial in the lag operator L, α_i denotes the vector of country-fixed effects and $\mathcal{E}_{i,t}$ is a vector of errors. The vector $Y_{i,t}$ is composed by the four (4) macroeconomic variables that may be associated to macroeconomic dynamic. The variables included in this model are Gross Domestic Product (GDP) per capita, Trade openness (TO) index, Consumer Price Index (CPI), and Real Effective Exchange Rates (EX),

The fourth specific objective of the study; the aim is to evaluate the causal relationship among variables. The Dumitrescu-Hurlin Panel Causality test designed to detect the causality in panel data was used and the underlying regression model is presented as follows,

$$y_{i,t} = a_i + \sum_{k=1}^{K} y_{ik}\, y_{i,t-k} + \sum_{k=l}^{K} \beta_{ik}\, x_{i,t-k} + \varepsilon_{i,t} \quad (3.5)$$

With i = 1,…, N and t = 1,…, T

Where x_1, and y_1, are the observations of two stationary variables for individual I in period t. Coefficients are allowed to differ across individuals but are assumed time- invariant. The lag order K is assumed to be identical for all individuals and the panel must be balanced.

3.4 Techniques for Data Analysis

3.4.1 Panel Unit Root Tests

Panel unit root tests are traditionally used to test for the order of integration (stationarity) in the variables of the data set. There are two groups of panel unit root tests. The first assumes a common unit root process, that is, it assumes homogenous autoregressive coefficients between the cross- sections. These include the tests developed by Hadri (2000); Breitung (2000); and Levin, Lin and Chu (LLC, 2002). The other group assumes individual unit roots, with the assumption that the first order autoregressive parameter varies with cross-sections. This second group includes the Im, Pesaran and Shin (IPS, 2003); Madala and Wu (MW, 1999). All the other tests test the null hypothesis of non-stationarity (or unit root) except Hadri (2000) which tests the null hypothesis of stationarity. The Panel Unit root test will be conducted to test the stationary process of the series and to see if there are an I(2) variable(s) in the series and also to determine the order of integration of the variables in the panel.

3.4.2 Panel Cointegration Tests

In order to achieve the first and second objective of this study, the panel cointergration test was employed. The concept of cointegration is a useful statistical tool to test for the long-run relationship between non-stationary time-series. The basic idea behind cointegration is that if, in the long-run, two or more series move closely together, even though the series themselves are trended, the difference between them is constant. The reason for testing cointegration, therefore, is to test whether two or more integrated variables deviate significantly from a certain relationship. In other words, if the variables are cointegrated, they move together over time so that short-term disturbances will be corrected in the long-term. This study made use the following panel cointegration tests which are, Kao (1999) residual-based panel cointegration test, Pedroni (2000, 2004) test for cointergration and Larsson, Lyhagen and Lothgren (2001) presented a likelihood-based (LR) panel test of co integrating rank in heterogenous. It was necessary to estimate the four unit root test to ensure consistency and reliability of decision taken to estimate a long-run relationship for the model.

3.5 Dynamic Panel Model and Estimating Long-Run Co-Integrating Parameters

In order to achieve the first and second objective of the study, the dynamic estimators of both long-run co-integrating estimators and the panel ARDL models where estimated.

According to Roodman (2006), who states that when the data feature a large numbers of countries (N) relative to the time period (T), the GMM-difference estimator proposed by Arellano and Bond (1991) and the GMM system estimator by Arellano and Bover (1995) and Blundell and Bond (1998) work well. These two estimators are typically used to analyze micro panel datasets (Eberhardt, 2012). However, a wide range of recent literature have applied GMM techniques to macro panel data, including in the area of Trade Openness and growth (e.g Jan & Audu 2017, Marjan & Karim 2016, Jamilah, Zulkornain & Muzarar 2016, Kimura 2016, Bernard & Mandal 2016, Thai, Jungsuk & Minsoo 2016, Farshid, Akhoondzadeh, & Reza 2014 among others).

Roodman (2006) argues that in the small N and large T case, the GMM estimators are likely to produce spurious results for two reasons. First, small N might lead to unreliable autocorrelation test. Second, as the time span of the data gets larger, the number of instruments will get larger too. This affects the validity of the Sargan test of over identification restriction and cause the rejection of the null hypothesis of the exogeneity of instruments (Roodman 2006). As such, the limitation of the GMM estimators requires that the study should explore the other dynamic estimators to achieve its objectives of the study. The estimators employed in the study are discussed below.

3.5.1 Fully Modified Ordinary Least Squares (FMOLS) Estimation

Fully modified OLS (FMOLS) introduced by Pedroni (2000, 2004) and Phillips and Moon (1999) ensures a consistent estimate in panel series, non-exogeneity and serial correlation problems are taken cared off in this model. This framework will be employed only if the explanatory variables are cointegrated, and thus a long-run equilibrium relationship exists among these variables through the panel unit root test and panel cointegration test. This methodology is highly relevant for heterogeneous cointegrated panels. It is also a framework that allows for consistent and efficient estimation of cointegration vector as well as also addressing the problem of non-stationary regressors, coupled with the problem of simultaneity biases. It is well known that OLS estimation yields biased results because the regressors are endogenously determined in the I (1) case

3.5.2 Panel Dynamic OLS (DOLS) Estimator

Mark and Sul (2003) proposed the Panel DOLS estimator. It is used as a homogeneous cointegration vector for a balanced panel of N individuals observed over T time periods. It is a technique that allows for heterogeneity across individuals and these include individual specific time trends, individual-specific fixed effects and time-specific effects (Mark and Sul, 2003). The estimator is entirely parametric and more precise than the panel FMOLS estimator proposed by Pedroni (2000, 2004) and Phillips and Moon (1999).

The Panel DOLS technique allows the long run regression to be augmented by lead and lagged differences of the explanatory variables to control for endogenous feedback. This is because lead and lagged differences of the dependent variable can be incorporated to account for serial correlation. In addition, DOLS estimator uses parametric adjustment to the errors by including the past and the future values of the differenced I (1) regressors in order to obtain an unbiased estimator of the long-run parameters and to achieve the endogeneity correction.

3.5.3 Mean Group (MG) Estimators and Pooled Mean Group (PMG) Estimators

Based on Pesaran et al. (1999), the dynamic heterogeneous panel regression can be incorporated into the error correction model using the autoregressive distributed lag ARDL (p,q) technique and stated as follows (Loayza and Ranciere, 2006):

$$\Delta(y_i)_t = \sum_{j=1}^{p-1} \gamma_j^i \, \Delta(y_i)_{t-j} + \sum_{j=0}^{q-1} \delta_j^1 \Delta(y_i)_{t-j} + \varphi^i[(y_i)_{t-1} - \{\beta_0^i + \beta_1^i \, (X_i)_{t-1}\}]\epsilon_{it} \qquad (3.6)$$

Where **y** is the GDP per capita, **X** is a set of independent variables including the trade openness indicator, **γ** and **δ** represent the short-run coefficients of lagged dependent and independent variables respectively, **β** are the long-run coefficients, and **φ** is the coefficient of speed of adjustment to the long run- equilibrium. The subscripts **i** and **t** represent country and time, respectively.

The term in the square brackets contains the long-run growth regression. Equation (3.10) can be estimated by two different estimators: the mean group (MG) model of Pesaran and Smith (1995), the pooled mean group (PMG) estimator developed by Pesaran et al. (1999). The estimators consider the long-run equilibrium and the heterogeneity of the dynamic adjustment process and are computed by maximum likelihood (Demetriades and Law, 2006).

Pesaran and Smith (1995), Pesaran (1997) and Pesaran and Shin (1999) present the autoregressive distributed lag (ARDL) model in error correction form as a relatively new cointegration test. However, here the emphasis is on the need to have consistent and efficient estimates of the parameters in a long run relationship. According to Johansen (1995); Philipps and Hansen (1990), the long-run relationship exist only in the context of cointegration among variables with the same order of integration.

Nevertheless, Pesaran and Shin (1999) argue that panel ARDL can be used even with variables with different order of integration irrespective of whether the variables under study are I (0) or I (1). In addition, both the short-run and long-run effects can be estimated simultaneously from a data set with large cross-section and time dimensions. Finally, the

ARDL model, especially PMG and MG, provides consistent coefficients despite the possible presence of endogeneity because it includes lags of dependent and independent variables (Pesaran et al, 1999).

3.5.3.1 Hausman-Test

The Hausman test is used to test whether there is a significant difference between these estimators. The null of this test is that the difference between PMG and MG estimation is not significant. If the null is not rejected, the PMG estimator is recommended since it is efficient. The alternative is that there is a significant difference between PMG and MG and the null is rejected. If there are outliers the average estimator may have a large variance and in that case the Hausman test would have little power. The PMG will be used if the P-value is insignificant at the 5% level. On the other hand, if it happens to have a significant P-value, then the use of a MG estimator is appropriate

3.6 Panel Vector Autoregressive Model (PVAR)

The third objective of this study was achieved using the Panel VAR model. The Vector Autoregressive (VAR) models are powerful tool to analyze the dynamic behavior of endogenous and interdependent macroeconomic variables (Lennman, 2016). Recently, due to increase in availability of internationally standardized datasets and the gradual increase of global economic interdependencies have led to the use of a panel dimension in a VAR framework (Lennman, 2016)

Macroeconomic Frameworks mostly revolves around VAR-models. In recent studies VAR models are applied to panel data analysis. Panel VAR are becoming increasingly popular among researchers (Lennman, 2016). Panel VARs have been used to address a variety of issues of interest to applied macroeconomists and policymakers. Within the realm of the business cycle literature, Canova, Ciccarelli and Ortega (2007) have employed a panel VAR to study the similarities and convergences among G7 cycles, while Canova and Ciccarelli

(2012) employ them to examine the cross-sectional dynamics of Mediterranean business cycles.

In trade literature, Blagrave and Vesperoni (2018) used Panel VAR to examine the contemporaneous relationship between gdp, real exchange rates, and export-intensity. Also, Du, et al, (2017) used Panel VAR to investigate the effects of political relations on trade. The VAR model shows that although political shocks influence exports to China, the effects largely vanish within two months. Also, Cakir and Kabundi (2013) the Panel VAR model to investigate the degree of trade linkages and shock transmission between South Africa and the BRIC countries. In addition to this Canova (2005) also employed the Panel VAR model to examine to examine the extent and the features of the transmission of US shocks to Mexico, Panama, Brazil, Chile, Ecuador, Argentina, Uruguay and Peru**.**

Hence this study will be employing the Panel VAR technique to examine and analyze the transmission of trade openness shocks on macroeconomic variables across OPEC countries. The Impulse response function and the Forecast Error Variance Decomposition will be used to determine the channels of shock transmission.

3.6.1 Econometric Panel VAR (PVAR) Model

The PVAR approach on a system of linear equations based on a panel VAR of lag order p as specify below;

$$y_{it} = A_1 y_{it-1} + A_2 y_{it-2} + \ldots\ldots + A_{p-1} y_{it-p+1} + A_p y_{it-p} + \beta x_{it} + c_i + \varepsilon_{i,t} \tag{3.7}$$

The dynamic form presented by Lennman (2016) is as follow

$$y_{it} = \rho y_{i,t-1} + \beta x_{it} + c_i + \varepsilon_{i,t} \tag{3.8}$$

When considering multiplier dependent variables, the dynamic model is transformed into the panel VAR model of lag order p with k variables. The study exemplify this in (3.8) which is a panel VAR model representation just like (3.9) but in matrix form, with k variables but only 1 lag length. Presenting the matrix form with longer lag lengths is space-consuming and redundant it basically just adds extra rho matrixes and a y_{t-p} matrix.

$$\begin{pmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ y_{k,t} \end{pmatrix} = \begin{bmatrix} \rho_{11} & \rho_{12} \cdots & \rho_{1k} \\ \rho_{21} & \rho_{22} \cdots & \rho_{2k} \\ \vdots & \vdots \ddots & \vdots \\ \rho_{k1} & \rho_{k2} \cdots & \rho_{kk} \end{bmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ \vdots \\ y_{k,t-1} \end{pmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \cdots & \beta_{1k} \\ \beta_{21} & \beta_{22} \cdots & \beta_{2k} \\ \vdots & \vdots \ddots & \vdots \\ \beta_{k1} & \beta_{k2} \cdots & \beta_{kk} \end{bmatrix} (x_{1,t}, x_{2,t}, \ldots, x_{j,t}) + \begin{pmatrix} c_i \\ c_i \\ \vdots \\ c_i \end{pmatrix} + \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \vdots \\ \varepsilon_{k,t} \end{pmatrix} \quad (3.9)$$

In (3.9) we have a vector of dependent variables on the left-hand side, which are also included with a lag on the right-hand side. x_{it} is a column vector of the exogenous variables, c_i and ε_{it} are the panel fixed effects and the error term respectively. Which is simply a way to present a panel VAR model in matrix form where there are a different number of lags on the dependent variable list and a list of exogenous variables.

3.6.2 Abrigo and Love (2015) Panel VAR Technique

This study made use of Abrigo and Love (2015) panel VAR technique to examine the shocks transmission among variables.

Analysis is based on a panel data vector autoregressive (panel VAR) model of Love and Zicchino (2006). The method combines the traditional VAR approach, which treats all the variables in the system as endogenous, with the panel data approach, which allows for unobserved individual heterogeneity. This technique was improved by Abrigo and Love (2015)

Abrigo and Love (2015) are describing the following *k*-variate panel VAR of order *p*, with panel specific fixed effects represented by the following system of linear equations:

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + \ldots + Y_{it-p+1}A_{p-1} + Y_{it-p}A_p + X_{it}B + u_{it} + e_{it} \quad (3.10)$$

$i \in \{1,2,\ldots N\}$, $t \in \{1,2\ldots T_i\}$

where Y_{it} is a (lxK) vector of dependent variables; X_{it} is a (lxl) vector of exogenous covariates; u_{it} and e_{it} are (lxk) vectors of dependent variable-specific fixed-effects and idiosyncratic errors. The (kxk) matrices $A_{1,2,\ldots,}A_{p-1},A_p$ and the (lxk) matrix B are parameters to be estimated. The authors are assuming that the innovations have the following characteristics $E[e_{it}]=0, E[e'it, e_{it}]=\Sigma$ and $E[e'_{it}, e_{is}]= 0$, for all $t>s$.

The parameters above may be estimated jointly with the fixed effects, or alternatively, without, after some transformations, through OLS. However, with the lagged variables on the right side of the equation, for a large number of N, the results would be biased (Abrigo & Love, 2015). Abrigo and Love (2015), are describing in the above-mentioned paper, the estimating methodology, through GMM (Belingher, 2015),

3.6.3 Impulse Response Functions

An impulse response function (IRF) is simply an illustrative procedure as to show how a stable model in equilibrium reacts to an innovated shock to any of the included regressors (Lennman, 2016). The impulse, be it temporary or permanent dissipates through the model and shows how the response variable returns to equilibrium after the disturbance. This is simply a method of making the output of the regressions intuitively understandable and furthermore enabling us to calculate the long run multiplier effect (Lennman, 2016).

3.6.3 Eigenvalue Stability Condition

To state that a VAR model is stable it is necessary to test if all eigen values from the resulting output has a modulus less than 1 (Pattersson, 2000).This essentially means that the model is stable in the sense that there exists a point that the dynamics of the model converges against. If any of the modulus on the eigenvalues would be greater than 1, then consequently there would be no long run equilibrium and the values in the future would just continue to increase.

3.7 Panel Granger Causality Analysis

To specify the causal direction of the transmission mechanism between imbalances, we rely on the panel non-causality test developed by Dumitrescu-Hurlin (2012). This is a simple extension of the Granger (1969) test to heterogeneous panel data models. By preserving the heterogeneity of cross-sectional units, it allows us to test the direction of the relationship between macroeconomic imbalances without imposing the same dynamic model for all the countries of the sample. The starting point consists in the following heterogeneous autoregressive model:

$$y_{it} = \theta_i + \sum_{k=1}^{K} \gamma_1^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \delta_1^{(k)} x_{i,t-k} + \mathcal{E}_{i,t} \qquad (3.11)$$

where x and y are two stationary variables, observed on T periods for N countries. The individual effects are assumed to be fixed and the lag-order K is supposed to be common. $\gamma_1^{(k)}$ denote the autoregressive parameters, and $\delta_1^{(k)}$ are the regression coefficients' slopes; both parameters differing across countries. By definition, x causes y if and only if the past values of the variable x observed on the i^{th} country improve the forecasts of the variable y for this country i only. The test is based on the null hypothesis of homogeneous non-causality (HNC), i.e., there is no causal relationship from x to y for all the countries of the panel ($\delta_i = (\delta_i^{(1)} \ldots, \delta_i^{(k)})' = 0 \ \forall i = 1 \ldots N$).

Under the alternative hypothesis, there exists a causal relationship from x to y for at least one country of the sample. The test statistic is given by the cross-sectional average of individual Wald statistics defined for the Granger non-causality hypothesis for each country (W_{HNC}), and converges to a chi-squared distribution with K degrees of freedom. Two standardized statistics have been defined by the authors: the first one is based on the exact asymptotic moments of the individual Wald statistics (Z_{HNC}), and the second one on approximated moments for finite *T* samples ($\hat{Z}_{HNC}$).

This test is very flexible for both a eases asymptotic (T > N) or semi-asymptotic (T <N) distributions as well as in emphasizing the simulated critical values from thousands of replications It also is a test specially designed for mixed 1(0) and 1(1) variables with nonlinear estimates Other advantages of this test is that it can be used for panel data in the presence of cross-sectional dependence.

3.8 Diagnostics Test

To determine the robustness of the models estimated, various post estimation tests was carried out in order to verify whether the model is robust and good for policy prescriptions. Post estimation test that were carried out were, serial correlation test in panel, heteroskedasticity test in panel as well as multicollinearity test in panel.

3.8.1 Serial correlation/Autocorrelation

This test is used to verify the randomness of the error term between members of the same series of observations. This study made use of the Wooldridge test for autocorrelation in panel data to test the presence of serial correlation in the model.

3.8.2 Heteroskedasticity Test

This test is used to verify the assumption of equal spread of the error variance (homoscedastic) between members of the same series of observations. The study employs modified wald test for group wise heteroskedasticity in cross-sectional time-series FGLS regression model in panel data to test for the presence of heteroskedasticity in panels.

3.8.3 Multicollinearity Test

Multicollinearity occurs when two or more predictors in the model are correlated and provide redundant information about the variables in the model. Multicollinearity is a situation where two or more independent variables in a model are correlated. The study will employ the correlation matrix or Pearson correlation matrix to check for the presence of collinearity in the panel model.

3.9 Description and Measurement of Variables

This aspect gives a proper definition of variables and measurement of variables used in this study. This is necessary because of proper understanding of interpretation of results from the estimations as concern to the variables used in the study. The description and measurement of the variable used in this study is presented below;

3.9.1 Descriptions of variables

This aspect gives a gives the definition and description of the variables used in the study. This is necessary because of proper understanding of interpretation of results from the estimations as concern to the variables used in the study. The description of each of the variables used in this study is presented below;

3.9.1.1 Gross Domestic Product Per Capita (GDPc): The Gross Domestic Product per capita was used to measure economic growth. GDPc is calculated by dividing the annual total Gross Domestic Product of a country by the total annual population of the country at a specific period of time. This measure is well used in Trade literature; their justification is that it is a good proxy to make comparative analysis among panel. This measure was used by Jan and Audu, (2017); Rudra, Mak, John and Neville (2017); Jamilah, Zulkornain and Muzarar (2016),; among the most recent literature. The GDP per capita is measured using annual data series on constant prices (2010) per capita in US dollars. The data was sourced from United Nation Conference on Trade and Development (UNCTAD) website data base

3.9.1.2 Trade Openness {degree of openness (TO)}: The Trade Openness measure is well debated in both theoretical and empirical literature. However, due to availability of data and based on empirical studies the trade shares of GDP, measured as exports plus imports divided by each country's GDP was used in this study. However, the logarithm of this measure wasn't taken as the series will be in small units. The set of data for export, import and total annual GDP was sourced from United Nation Conference on Trade and Development (UNCTAD) website data base.

3.9.1.3 Consumer Price Index (CPI): The Consumer Price Index of all items is a measure of inflation in an economy. It is a control variable used to measure the cause of macroeconomic dynamic in an economy. It is widely used in empirical literature on business cycles as well as literature on macroeconomic dynamics. The variable was used in this study because it is supported by both theoretical and empirical literature as a major variable that causes macroeconomic dynamic in an economy e.g Blagrave and Vesperoni (2018), Ali and Anwar (2017), Ewubare (2015), Ali (2015), Ali, Shah and Shahid (2015), Ahmad, Mukaramah and Hadijah (2012), Cakir and Kabundi (2013), Iqbal and Nawaz (2010), Ocampo (2005), Kose and Riezman (2000), among others. This data was sourced from the World Bank Development Indicator (WDI) data base and International Monetary Funds (IMF) website data base to complete the data set.

3.9.1.4 Real Exchange Rates (EX): This is the real effective exchange rate, is the rate at which the domestic currency is being exchanged for a foreign currency with adjustment for relative price index. The real effective exchange rate was measured as country's unit currency to a US dollar adjusted by relative price level. This variable was used in this study because it is supported by both theoretical and empirical literature as a major variable that causes macroeconomic dynamic in an economy e.g Azam (2001), Ewubare (2015), Ali (2015), Blagrave and Vesperoni (2018) among others. The real effective exchange rate index (2010=100) was used for this study. This data was sourced from the World Bank Development Indicator (WDI) data base and International Monetary Funds (IMF) website data base to complete the data set.

3.9.1.5 Crude Oil Production (COP): This variable was included based on current global macroeconomic situations, especially when it comes to economic situations concerning developing oil exporting countries. It is well observed in current trends that increase crude oil production in the global market may lead to fall in global oil prices and vise versa. This situation lead to fall in foreign earnings for developing oil exporting countries leading to so many macroeconomic instability in their economy such as forex crisis and persistent high inflations as the case of Angola, Nigeria, Venezuela, among others. Hence this variable is very important to this study based on the nature of the study. This data was sourced from the U.S Energy Information Administration (EIA) Website data centre.

3.9.1.6 Labour Force (LBF): Total Labour Force was used as a control variable which is embedded in the theoretical framework based on the Solow Growth Model. Labour force is the total labour force of a country measured in thousands of workers. This data was sourced from the World Bank Development Indicator (WDI) data base.

3.9.1.7 Capital Stock per unit of labour {Gross capital formation as proxy to capital stock (CPT)}: Capital Stock per Unit of labour was used as a control variable which is embedded in the theoretical framework based on the Solow Growth Model. However in respect to this study, it is measured as the Capital Stock per unit of labour force, this implies that total annual capital stock is divided by the total annual labour force. The capital stock is measured by the Gross Capital Formation in US dollars. This data was sourced from the World Bank Development Indicator (WDI) data base.

NB: Although interest rate is one macroeconomic variable that can cause macroeconomic dynamics; this study omitted interest rate due to the fact that majority of the literature reviewed on trade openness and macroeconomic dynamics caused by trade did not use interest rates. Likewise, the study did not explore any investment decisions or financial shocks in its models and analysis. However, it can be recommended for further research in related studies the inclusion of interest rates as a variable that can cause macroeconomic dynamics.

3.9.2 Measurement and Sources of Variables

This aspect gives a proper measurement of the variables used in this study. This is necessary because of proper understanding of interpretation of results from the estimations as concern to the variables used in the study. The measurements of the variables used in this study are presented in table 3.1 below;

Table 3.1: Measurement of Variables and Sources

Variables	Measure	Sources of Data
GDPc	GDP Per capita in thousands of US dollars	United Nation Conference on Trade and Development (UNCTAD) website data base and World Bank Development Indicator (WDI)
TO	Trade openness {degree of openness} in index form	United Nation Conference on Trade and Development (UNCTAD) website data base and World Bank Development Indicator (WDI)
CPI	Consumer Price Index. Country's all price index.	World Bank Development Indicator (WDI) website data base to complete the data set and International Monetary Funds (IMF) website data base.
EX	Real Effective Exchange Rates. In country's currency units after relative price adjustments	World Bank Development Indicator (WDI) data base and and International Monetary Funds (IMF) website data base.
COP	Crude Oil Production, in thousands of barrel	U.S Energy Information Administration (EIA) Website data centre
LBF	Labor force participation rate, total (% of total population ages 15+) (modeled ILO estimate)	World Bank Development Indicator (WDI) website data base
CPT	Capital Stock per unit of labour {Gross capital formation as capital stock. In billions of US dollars	World Bank Development Indicator (WDI) website data base

Source: Prepared by Author (2019)

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATIONS AND DISCUSSIONS OF RESULTS

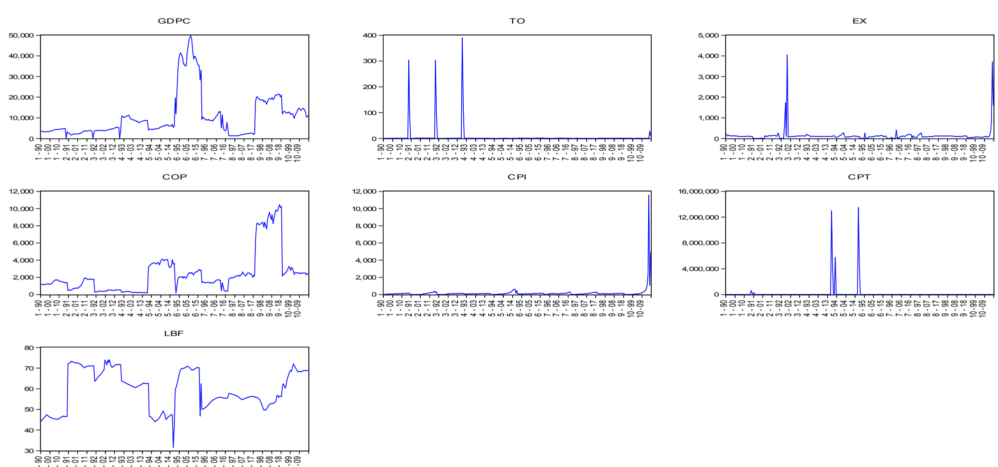
4.1 Introduction

The purpose of this chapter is for presentation, evaluation and analysis of estimated results of the models postulated as well as verification of the various working hypotheses of this research which is drawn from the objective of the study. The analyses of the results were used to draw some policy implications of the findings. The parameters estimates will be subjected to various economic, statistical and econometric tests, using STATA 14 and E-view 10 versions. The data used for the work dates from 1990 to 2018.

4.2 Graphical Analysis

It is paramount as the first step in economic analysis of data to visually inspect some important features in the data being examined. These features can influence the behavior of the series and equally give an insight into the appropriate technique for the analysis.

Figure 4.1; $GDPc_{ti}$= Gross Domestic Product per capita, TO_t = Trade Openness, EX_t = Real Exchange Rate, COP_t = Crude Oil Production, CPI_t = Consumer Price Index, CPT_t = Capital Stock and LBF_t = Labour Force



Source: Generated by the Author using E-views version 10 (2019)

In figure 4.1 above, we can see that GDPc which is the dependent variable had been trending upward in cyclical way showing evidence of business circle in the series. Likewise, TO shows a high rate of volatility in the series, the series have series of spikes and evidence of business circle. Also, EX shows a steady trend in the series, however, the series has some presence of spikes and elements of business circle, while as the graph of CPI shows steady trend in the series but with series of spikes, just as COP series is oscillating with evidence of business circle in the series, CPT and LBF series shows element of oscillating with double spike in CPT. This is an evidence that majority of macroeconomic variables are not stationary. To further prove this assertion, panel unit root test was conducted to examine the stationarity of the series and order of integration.

4.3 Descriptive Statistics

It is necessary to examine the descriptive characteristics of the variables used in this study. The descriptive statistics of the variables is presented below in table 4.1

Table 4.1 Descriptive Statistics

	GDPc	TO	EX	CPI	COP	CPT	LBF
Mean	10615.09	0.660256	270.6648	715.6826	2389.884	4411.056	59.56156
Maximum	49589.27	30.064	450.58	1151.5	10460.71	13494296	74.1
Minimum	3.944693	0	0.006027	0.4806	190	0.003848	31.6
Std. Dev.	1026.13	0.245913	120.464	160.388	262.236	374.056	9.395173
Skewness	1.901416	0.562329	12.25255	15.11263	1.87973	1.55061	-0.08451
Kurtosis	6.088603	2.896823	170.6966	239.7267	5.919494	5.367929	1.638911
Observations	290	290	290	290	290	290	290

Source computed by the researcher using E-views version 10 (2019)

Table 4.1 above shows the descriptive statistics of the variables. The series have a total of 290 observations with seven (7) time series variables. GDPc has a mean of $10615.1 with a standard deviation of $10726.13 which is the highest among the variables. The maximum GDPc value is $49589.27 with a minimum value of $390.064. The mean of TO is 0.6603 with a standard deviation of 0.246, while the maximum TO value is 30.06 with a minimum value of 0 while the mean of EX is $270.7 to a local currency with a standard deviation of $120.4 while the maximum EX value is $450.6 with a minimum value of $0.006 Also, average consumer price index is $715.7 with a standard deviation of $160.4 while maximum CPI value is $1151.5 with a minimum value of $160.4, the average annual crude oil production is 2389.9 barrel per day with a standard deviation of 2362.2 while maximum COP value is 10460.7 with a minimum value of 190 as the mean annual capital stock is $4411.1 with a standard deviation of 374.1 while maximum CPT value is $13494296 with a minimum value of $0.003848. Likewise, the mean annual average labour input is 59.6 with a standard deviation of 9.4. While maximum LBF value is 74.1 with a minimum value of 31.6 With the exception of labour inputs, all other variables are positively skewed. Meanwhile all the kurtosis showed that the variables are positively skewed. This implies that the variables are flatter to the left as compared to the normal distribution and they are of a leptokurtic distribution (i.e. flat or short-tailed).

4.4 Panel Unit Root

One prerequisite in panel data analysis is the test of stationarity of variables within the panel. The panel unit root test is conducted to test presence of unit root and stationary process of the variables. This study made use of four different panel unit root tests namely, Levin, Lin and Chu (LLC), Im, Pesaran and Shin (IMPS), Breitung test, and Hadri Z-stat. However, LLC, IMPS and Breitung tests assumes the null hypothesis of individual series is non-stationary with alternative hypothesis that suggest existence of stationarity in the series. While, Hadri unit root test assumes the null hypothesis of stationarity with the alternative hypothesis that suggest non-existence of stationarity. The result derived from the panel unit root tests conducted can be easily concluded.

In both table 4.2 and table 4.3, the panel unit root test suggests seven (7) variables were used namely; Log of Gross Domestic Product per capita (LOGGDPc), Trade Openness (TO), Exchange Rates (EX), Crude Oil Production (COP), Capital Stock (LOGCPT), Log Labour Force (LOGLBF), and Log Consumer Price Index (LOGCPI). The aim here is not only to test the stationarity process of the variable but to also determine the order of integration either at level or at first difference. The panel unit root statistics reported are for the level and first difference series in table 4.2 and table 4.3 respectively.

Table 4.2: Results of Panel Unit Root Tests in Level

Variables	Test Type	Calculated Statistics	Prob-Value	Status	Order of integration
GDPc	Levin, Lin & Chu t	-1.04083	0.1490	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	-1.27028	0.1020	Not stationary	Unknown
	Breitung t-stat	1.44363	0.9256	Not stationary	Unknown
	Hadri Z-stat	7.23331	0.0000	Not stationary	Unknown
TO	Levin, Lin & Chu t	0.80022	0.7882	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	2.03044	0.9788	Not stationary	Unknown
	Breitung t-stat	1.49064	0.9320	Not stationary	Unknown
	Hadri Z-stat	7.62423	0.0000	Not stationary	Unknown
EX	Levin, Lin & Chu t	-0.49037	0.3119	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	0.85773	0.8045	Not stationary	Unknown
	Breitung t-stat	-0.20422	0.4191	Not stationary	Unknown
	Hadri Z-stat	3.59535	0.0002	Not stationary	Unknown
CPI	Levin, Lin & Chu t	0.40159	0.6560	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	0.23282	0.5921	Not stationary	Unknown
	Breitung t-stat	-0.34063	0.3667	Not stationary	Unknown
	Hadri Z-stat	7.18457	0.0000	Not stationary	Unknown
COP	Levin, Lin & Chu t	-0.03757	0.0518	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	-0.88257	0.1887	Not stationary	Unknown
	Breitung t-stat	-1.07327	0.1416	Not stationary	Unknown
	Hadri Z-stat	4.92990	0.0000	Not stationary	Unknown
CPT	Levin, Lin & Chu t	1.57373	0.9422	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	2.74426	0.9970	Not stationary	Unknown
	Breitung t-stat	3.61662	0.9999	Not stationary	Unknown
	Hadri Z-stat	7.08673	0.0000	Not stationary	Unknown
LBF	Levin, Lin & Chu t	-0.13427	0.4466	Not stationary	Unknown
	Im, Pesaran and Shin W-stat	1.83136	0.9665	Not stationary	Unknown
	Breitung t-stat	0.88134	0.8109	Not stationary	Unknown
	Hadri Z-stat	6.94791	0.0000	Not stationary	Unknown

Source computed by the researcher using E-views version 10 (2019)

The results of the four panel unit root test in the table 4.2 above suggest that there is strong evidence that the null hypothesis of the presence of unit roots cannot be rejected in level form for all the variables. In other words, the results suggest all the series in level are non-stationary. This is not surprising, because it is noted in econometric literature that macroeconomic variables in essence are not stationary.

Table 4.3: Results of Panel Unit Root Tests in First Difference

Variables	Test Type	Calculated Statistics	Prob-Value	Status	Order of integration
ΔLOGGDPc	Levin, Lin & Chu t	-5.11620	0.0000	stationary	I(1)
	Im, Pesaran and Shin W-stat	-3.72035	0.0001	stationary	I(1)
	Breitung t-stat	-1.84572	0.0325	stationary	I(1)
	Hadri Z-stat	0.97070	0.1658	stationary	I(1)
ΔTO	Levin, Lin & Chu t	-6.33657	0.0000	stationary	I(1)
	Im, Pesaran and Shin W-stat	-4.75946	0.0000	stationary	I(1)
	Breitung t-stat	-1.57142	0.0239	stationary	I(1)
	Hadri Z-stat	1.41268	0.0789	stationary	I(1)
ΔEX	Levin, Lin & Chu t	-2.98135	0.0000	stationary	I(1)
	Im, Pesaran and Shin W-stat	-7.29531	0.0000	stationary	I(1)
	Breitung t-stat	-6.30909	0.0000	stationary	I(1)
	Hadri Z-stat	1.37402	0.0847	stationary	I(1)
ΔLOGCPI	Levin, Lin & Chu t	-4.22782	0.0098	stationary	I(1)
	Im, Pesaran and Shin W-stat	-3.53454	0.0002	stationary	I(1)
	Breitung t-stat	3.16594	0.0429	stationary	I(1)
	Hadri Z-stat	-0.23468	0.5928	stationary	I(1)
ΔLOGCOP	Levin, Lin & Chu t	-10.4502	0.0000	stationary	I(1)
	Im, Pesaran and Shin W-stat	-10.7842	0.0000	stationary	I(1)
	Breitung t-stat	-5.02999	0.0000	stationary	I(1)
	Hadri Z-stat	-1.19524	0.7363	stationary	I(1)
ΔLOGCPT	Levin, Lin & Chu t	-7.50378	0.0000	stationary	I(1)
	Im, Pesaran and Shin W-stat	-4.94130	0.0000	stationary	I(1)
	Breitung t-stat	-6.86040	0.0000	stationary	I(1)
	Hadri Z-stat	1.40808	0.0796	stationary	I(1)
ΔLOGLBF	Levin, Lin & Chu t	-4.45383	0.0250	stationary	I(1)
	Im, Pesaran and Shin W-stat	-2.67548	0.0037	stationary	I(1)
	Breitung t-stat	-2.98085	0.0014	stationary	I(1)
	Hadri Z-stat	1.34268	0.0889	stationary	I(1)

Source computed by the researcher using E-views version 10 (2019)

As observed from the results obtained in table 4.2, it seemed necessary to test the stationarity of the variables at their first difference since the variables were not stationary at levels. The results of these difference series is presented in the four panel unit root tests in table 4.3 above. The results suggests after differencing the series, the null hypothesis of non-statioanrity in each of the series can be rejected at 1% level of significance. Thus, the series are now integrated of order 1, that is they are I(1). These results are consistent with the general notion that most macroeconomics variables are non-stationary at level, but are mostly stationary after first difference. It is therefore possible to conclude that these series follow a stochastic trend and can be cointergrated as well.

4.5 Panel Cointergration Results

In order to examine the long-run equilibrium relationships among variables, it is required to examine the existence of cointergration among the variables. There are several different panel cointergration tests for testing the presence of long-run equilibrium among variables of interest in any study. For consistency, this study employed three types of panel cointegration tests, namely; Kao (1999), Pedroni (2004), and Johansen-Fisher cointegration tests.

4.5.1 Kao (1999) Panel Cointegration Test

The Kao (1999) test of cointegration is a homogeneous panel cointegration test with the no assumption of cross section dependence. The test follows an assumption of null hypothesis of no panel cointegration against the alternative hypothesis of cointegration. The test is presented in the table 4.4 below.

Table 4.4: Results of Kao (1999) Panel Cointegration Tests

Series: LOGGDPC TO EX LOGCOP LOGCPT LOGLBF		
	t-Statistic	Prob.
ADF	-2.243681	0.0168

Source computed by the researcher using E-views version 10 (2019)

The Kao (1999) panel cointergration test is built on Augumented Dickey Fuller (ADF) statistics as presented in the table 4.4 above. From the results, the null hypothesis of no cointegration is strongly rejected at 5% level of significance. This confirm the existence of a long-run cointegration in the homogenous part of the data series that consist of economic growth, trade openness, exchange rate, crude oil production, labour force, and capital stock.

4.5.2 Pedroni (2004) Panel Cointegration Test

The Pedroni (2004), panel cointegration test is based on two categories of cointegration test and seven statistics. The first category is founded on four statistics (panel statistics) namely v-statistics, rho-statistics, PP-statistics and ADF-statistics. These statistics are classified on the within-dimension and take into account common autoregressive coefficient across countries. That is, it presumes a common value for the unit root coefficient. The second category is based on three statistics (group statistics) namely rho-statistics, PP-statistics and ADF-statistics. These tests are classified on the between-dimension and are based on individual autogressive coefficient for the each country in the panel the result of Pedroni's (2004) cointegration tests is presented in table 4.5

Table 4.5: Results of Pedroni (2004) Panel Cointegration Test

Series: LOGGDPC TO EX LOGCOP LOGCPT LOGLBF				
Null Hypothesis: No cointegration Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.048148	0.1473	0.716375	0.2369
Panel rho-Statistic	-2.756196	0.0029	0.124471	0.5495
Panel PP-Statistic	-10.66622	0.0000	-3.890115	0.0001
Panel ADF-Statistic	-4.018009	0.0000	-1.726764	0.0421
Alternative hypothesis: individual AR coefs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	1.226472	0.8900		
Group PP-Statistic	-3.570495	0.0002		
Group ADF-Statistic	-1.773018	0.0479		

Source computed by the researcher using E-views version 10 (2019)

The Pedroni (2004) conintegration test in table 4.5 above indicated two statistics of PP-statistics and ADF-statistics suggest that at 5% the null hypothesis of no cointegration is rejected and there is presence of cointegrating relationship among the variables. Meanwhile two group statistics of PP-statistics and ADF statistics with values of -3.571 and -1.773 respectively with corresponding probability values of 0.0002 and 0.0479 suggest that at 5% level of significance, there is a presence of cointegrating relationship among variables. Hence, from the above results, there is enough evidence to accept the existence of cointegration relationships in the panel data set.

4.5.3 Johasen's Fisher Panel Cointegration Test

The study further employed Johasen's Fisher panel cointegration test developed by Maddala and Wu (1999) to test for existence of cointegration between series that consist of LOGGDPC, TO, EX, LOGCOP, LOGCPT, and LOGLBF. The cointegration test is one that uses Fisher's (1932) and underlying Johasen methodology to propose an alternative approach to testing for cointegration in panel data by combining test from individual cross-section in full panel. The results of Johansen-Fisher test is reported in table 4.6 below;

Table 4.6: Results of Johasen's Fisher Panel Cointegration Test

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	354.3	0.0000	184.4	0.0000
At most 1	193.3	0.0000	138.4	0.0000
At most 2	85.17	0.0000	59.81	0.0000
At most 3	41.85	0.0029	27.16	0.1309
At most 4	29.73	0.0744	19.37	0.4982
At most 5	39.84	0.0052	39.84	0.0052

Source computed by the researcher using E-views version 10 (2019)

The results of the Johasen's Fisher panel cointegration using both trace test and maximum eigenvalue statistics suggest presence of strong cointegrating relationship among the six (6) variables of interest at 1% level of significance. The Trace statistics at none is given as 354.3 with a probability value of 0.0000 while the maximum eigenvalue value at none is given as 184.4 with a probability values of 0.000 which are less than 0.05 suggesting rejection of the null hypothesis of no cointegration and suggest the presence of cointegration among the variables. Consequently, it is possible to conclude from the result that, there is a panel long-run equilibrium relationship among variables of interest in case of sample OPEC countries.

4.6 Panel Long-Run Parameter Estimates

The analysis of cointegration earlier proved the existence of long-run cointegrating relationship among variables in the panel. Based on the cointegration test and for consistency, the long-run parameter estimate is computed using pooled OLS, fully modified OLS and dynamic ordinary least square (DOLS) regression. The results for the three estimators are presented in table 4.7 below.

Table 4.7: OLS-FMOLS DOLS Long-Run Estimates

Variable	POLS	FMOLS	DOLS
TO	-0.0098*** (0.0005) [0.0000]	-0.0087*** (0.0002) [0.0000]	-0.0341 (0.0726) [0.6395]
EX	5.26E-05 (5.26E-05) [0.3182]	7.87E-06 (1.86E-05) [0.6720]	-0.000106** (4.42E-05) [0.0188]
LOGCOP	0.3839*** (0.0452) [0.0000]	0.5603*** (0.050) [0.0000]	0.482279*** (0.066255) [0.0000]
LOGCPT	0.2245*** (0.0219) [0.0053]	0.0244** (0.00932) [0.0169]	0.104970*** (0.020263) [0.0000]
LOGLBF	0.0560*** (0.0199) [0.0000]	0.411 (0.3240) [0.2064]	0.053376 (0.485021) [0.9126]

*Source computed by the researcher using Eviews 10 (2019). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. Figures in parenthesis ( ) are standard errors while figures in brackets [ ] are probability values.*

The long-run parameters estimate using pooled OLS, FMOLS, and DOLS are reported in table 4.7 above. Since some of the variables used in this study are measured in logarithms, the coefficients obtained from the long-run cointegration relationship can be considered as long-run elasticities for some variables. However, from the estimated techniques, the finding suggests rather mixed results in terms of signs, significant and magnitudes.

The results estimated shows the elasticity coefficient of trade openness (TO) indicated a unit change in TO on an average decrease economic growth (LOGGDPc) in different percentages depending on the estimation technique. The sign is negative and statistically significant when POLS and FMOLS are considered since the probability values are less than 0.05, however, in respect to DOLS, the sign is negative but statistically insignificant since the probability values are greater than 0.05. The estimation from pooled OLS, FMOLS, suggests that at 1% increase in trade openness will lead to 0.98%, 0.87% decrease economic growth respectively.

This results doesn't conforms with the apriori expectation since in theory trade openness leads to economic growth and most empirical studies such as Iyoha and Okim (2017), Farshid, Akhoondzadeh, and Reza (2014), Nowbutsing (2014), and Mercan, Gocer, Bulut, and Dam (2013), which are not in line with the findings of this study concluding that trade openness does not lead to economic growth. However, the finding is consistent with the study of Karman, Haider, Mushtaq, Mustafa and Bano (2016) and Rubert and Mahabir (2015), whom concluded that trade openness, have negative effect on economic growth.

In addition, in respect to exchange rate (EX), the results from the three estimators showed mixed results in sign, magnitudes and significant in the relationship between exchange rate with economic growth in OPEC countries. From the results, in respect to sign, the results indicated a negative relationship with respect to DOLS and positive with respect to POLS and FMOLS. However, exchange rates were found to statistically significant in respect to DOLS only since the probability value are less than 0.05. The result implies that a unit change in exchange rates by 1% will lead to 0.0106% decrease in economic growth in the long-run in respect to DOLS. However, the from Pool OLS and FMOLS estimations, exchange rate will lead to 0.00526% and 0.00078% increase in economic growth in the long-run. In theory favourable exchange rate regime should enhance economic growth; however this is not the case in this finding. This suggests the exchange rate regime in OPEC countries is not favourable and does not boost economic growth. This findings is consistent with the studies of Azam (2001), Ewubare (2015), Ali (2015),Blagrave and Vesperoni (2018) and Kose and Riezman (2000), however inconsistent with the studies of Ali, Shah and Shahid (2015), Ahmad, Mukaramah and Hadijah (2012), and Cakir and Kabundi (2013).

In addition, the results showed that in the long-run crude oil production has a significant positive relationship economic growth. The empirical evidence indicates mixed results in terms of magnitude. The results showed that a 1% increase in LOGCOP will lead to 38.3%, 56.03% and 48.2% increase in economic growth in pool OLS, FMOLS and DOLS respectively. This is expected because; crude oil is the major source of revenue for most OPEC countries and this revenue are channeled to development programmes within their economy.

Also, on the effect of capital stock on economic growth, the results indicated a positive and significant relationship in all the three estimators. But there is a mixed result in magnitude of the coefficient of the variables. From the results an increase in capital stock by 1% will lead to 22.5%, 2.44% and 10.5% increase in economic growth in the long-run in pool OLS, FMOLS and DOLS respectively. This finding is consistent with economic theory of trade and economic growth. Capital stock is expected to enhance economic growth. This was the case in the studies of Balanika (2013), Marjan and Karim, (2016), and Jozefina, (2016).

The estimated long-run coefficients for labour input (LOGLBF) when using pooled OLS, FMOLS and DOLS shows similarities in sign but differences in magnitude and significance. The signs suggest; that a 1% increase in labour force will lead to an increase in economic growth by 5.6%, 41.1% and 5.3% respectively. However, it is statistically insignificant at 5% in respect to FMOLS and DOLS while statistically significant in POLS. This finding is consistent with economic theory of trade and economic growth. Labour input is expected to enhance economic growth. This was the case in the studies of Balanika (2013) and Jozefina, (2016).

4.7 Panel ARDL Models

To further examine the long-run and short-run dynamic relationship between trade openness and economic growth in OPEC countries, this was achieved by employing the Panel ARDL model of Panel Mean Group (PMG), Mean Group (MG) and Dynamic Fixed Effect (DFE) estimators. The main benefit of the panel ARDL approach is that, it is flexible and be applied irrespective of whether variables are purely I(0), purely I(1) or mixture of I(0) and I(1) series. Other advantages include the argument that it holds under different situation such as serial correlation in errors, unit roots in the variables and possible contemporaneous dependence of the observed regressors with the unobserved factors. It has an advantage of taken sufficient numbers of lags to captures appropriate number of lags in general-to-specific modeling process.

The ARDL used in the study is estimated using three estimators of PMG, MG and DFE proposed by Pesaran et al (1999). All three estimators are presented in the table 4.8 below.

4.7.1 Panel ARDL Long-Run Coefficients

Panel ARDL models provides the long-run estimates. The table 4.8 below presents the Long-run estimates of variables.

Table 4.8: Panel ARDL Long-Run Coefficients

Estimators	Pooled Mean Group	Mean Group	Dynamic Fixed Effect
Variable			
TO	-0.0088***	0.3732	-0.0088***
	(0.0006)	(0.5534)	(0.0003)
	[0.0000]	[0.500]	[0.0000]
EX	-0.1860***	0.0019	9.15e-06
	(0.19)	(0.0011)	(0.00003)
	[0.0001]	[0.081]	[0.758]
LOGCOP	0.3663***	0.05665	0.5568***
	(0.0692)	(1.5424)	(0.0654)
	[0.0000]	[0.713]	[0.0000]
LOGCPT	0.1112**	0.0323	0.0273*
	(0.00343)	(0.8272)	(0.014)
	[0.0001]	[0.696]	[0.047]
LOGLBF	1.0476***	1.895	0.389
	(0.1801)	(17.180)	(0.4352)
	[0.0000]	[0.912]	[0.371]

*Source computed by the researcher using Eviews 10 (2019). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. Figures in parenthesis ( ) are standard errors while figures in brackets [ ] are probability values. . The lag structure is ARDL (1, 1, 1, 1, 1, 1)*

The table 4.8 above shows the long-run coefficients of the panel ARDL estimates of PMG, MG and DFE. LOGGDPc is the dependent variable as a proxy to economic growth, and set of independent variables is represented as TO as trade openness, EX as real effective exchange rates, LOGCPT as capital stock, LOGLBF, labour force and LOGCOP as crude oil production.

The dynamic long-run estimation results showed that the effect of Trade Openness (TO) on Economic Growth (LOGGDPc) is negative and statistically significant in PMG and DFE since the probability values are less than 0.05, but positive and insignificant in MG since the probability values are greater than 0.05. Based on the results, the coefficients suggest that in the long-run, an increase in TO by 1% will lead to decrease in economic growth by 0.88% and 0.88% when PMG and DFE are used. When MG is used, the estimate shows an increase TO by 1% will lead to 37.3% increase in economic growth. This is further shows inconsistency with the theories which suggest that trade openness enhance economic growth. Also these findings is inconsistent with most empirical studies such as Iyoha and Okim (2017), Farshid, Akhoondzadeh, and Reza (2014), Nowbutsing (2014), and Mercan, Gocer, Bulut, and Dam (2013), who concluded that trade openness lead to economic growth. However, the finding is consistent with the study of Karman, Haider, Mushtaq, Mustafa and Bano (2016) and Rubert and Mahabir (2015), whom concluded that trade openness, have negative effect on economic growth.

The estimates from the results in respect to real effective exchange rate (EX), suggest that it negative in PMG only while it is positive in MG and DFE estimators. However, the results show that exchange rate is insignificant in MG and DFE since the probability values are greater than 0.05 but statistically significant in PMG since the probability value are less than 0.05. This result implies that 1% change EX will lead to 18.6% decrease in LOGGDPc in PMG. However, when MG and DFE are used 1% increase EX will lead to 0.19% and 0.00092% increase in economic growth. This finding corroborate with the finding in the long run cointegrating estimators that exchange rates had not promote economic growth in OPEC countries.

In addition, the results showed that in the long-run crude oil production has a significant positive impact on economic growth in PMG and MG since the probability values are less than 0.05; the empirical evidence indicates mixed results in terms of magnitude. The results showed that a 1% increase in LOGCOP will lead to 36.6%, 5.66% and 56.7% increase in economic growth in PMG, MG, and DFE respectively. This is expected because; crude oil is the major source of revenue for most OPEC countries and this revenue are channeled to development programmes within their economy.

The long-run coefficients of LOGCPT in all the estimation techniques suggest that capital stock is positive and statistically significant in PMG since the probability value is less than 0.05, however positive and insignificant in MG and DFE since the probability values are greater than 0.05. The results shows that a 1% increase in capital stock will lead to 11.1%, 3.2% and 2.7% increase in economic growth. The results are consistent with growth theory which says more capital accumulation ensures economic growth. This result is consistent with Balanika (2013) and Jozefina, (2016).

The coefficient of labour input is found to be positive in all the three estimators. However, labour input was found to be statistically significant in PMG and insignificant in MG and DFE estimators. From the result, at 1% increase in LOGLBF will lead to 1.47%, 1.89%, and 3.9% in PMG, MG and DFE. The results are consistent with growth theory which says more in labour inputs ensures economic growth. This result is consistent with the finding of Balanika (2013) and Jozefina, (2016).

4.7.2 Panel ARDL Short-Run Coefficients

After analyzing the long-run effects among the variables, the study further estimates the short-run effects among the variables. The short run results are illustrated in Table 4.9 below with delta sign showing the short run effect on the dependent variable.

Table 4.10: Panel ARDL Short-Run Coefficients

Variable	Pooled Mean Group	Mean Group	Dynamic Fixed Effect
ECT	-0.1024**	-0.2610**	-0.453***
	(0.481)	(0.1079)	(0.0518)
	[0.033]	[0.012]	[0.0000]
ΔTO	-0.3273***	-0.01001	-0.0088***
	(0.0671)	(0.0492)	(0.0001)
	[0.0000]	[0.838]	[0.0000]
ΔEX	-0.0195**	-0.000062	-0.00016
	(0.0089)	(0.0000604)	(0.0065)
	[0.026]	[0.303]	[0.145]
ΔLOGCOP	0.3763***	0.3338***	0.4840***
	(0.0709)	(0.0558)	(0.044)
	[0.0000]	[0.0000]	[0.0000]
ΔLOGCPT	0.01838	0.02008	0.00045
	(0.0179)	(0.0177)	(0.0056)
	[0.305]	[0.256]	[0.0418]
ΔLOGLBF	1.861	-0.1654	0.2933
	(1.92)	(2.103)	(0.1960)
	[0.073]	[0.937]	[0.135]
C	-0.093*	-1.4630	-0.6004
	(0.049)	(1.193)	(0.364)
	[0.057]	[0.220]	[0.099]

*Source computed by the researcher using Eviews 10 (2019). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. Figures in parenthesis ( ) are standard errors while figures in brackets [ ] are probability values. The lag structure is ARDL (1, 1, 1, 1, 1, 1)*

From the results in table 4.9 above, trade openness has a negative impact on economic growth using all three estimators. However, TO was found to be statistically significant at 5% in PMG and DFE since the probability values are less than 0.05, but insignificant in MG since the probability values are greater than 0.05. The sign of the coefficients suggest that a 1% increase in TO will lead to 32.7%, 0.010% and 0.88% decrease in economic growth in the short-run using PMG, MG and DFE respectively. This implies that trade openness is doesn't ensures growth in the short-run in OPEC countries over the period of this study. This finding is inconsistent with that of Rudra et al (2017), Pam (2016), Nabiza and Zakir (2014) and Nowbutsing (2014).

The results also reveal that the short-term effect of the coefficient of real effective exchange rate (EX) on economic growth is negative in all three estimators. However, exchange rate is found to be statistically significant in PMG only since the probability value is less than 0.05. This means an increase in EX by 1% will lead to a decrease in LOGGDPc by 1.9%, 0.0062% and 0.016% in PMG, MG and DFE respectively. As evidence in the long-run estimation exchange rate had a negative effect on economic growth in the short-run as well. This further implies that exchange regimes in OPEC countries had not been favourable. This finding is consistent with that of Rudra et al (2017), Pam (2016), Nabiza and Zakir (2014) and Nowbutsing (2014). However, this finding is inconsistent with the studies of Kojo, Saban and Yemane (2014) and Gries and Redlin (2012).

In addition, crude oil production was found to be positive and statistically significant in all three estimators. The coefficients of the estimators suggest that in the short-run an increase in crude oil production by 1% will lead to 34.7%, 33.4% and 49.4% increase in economic growth in PMG, MG and DFE respectively. This is expected because; crude oil is the major source of revenue for most OPEC countries and this revenue are channeled to developmental programmes within their economy.

The results further showed that, the coefficient of capital stock is positive but insignificant in all three estimators. The signs of the coefficient suggest that, an increase in capital stock (LOGCPT) by 1% will lead to 1.86%, 2.01% and 0.045% increase in economic growth in the short-run. This is in line with the theories of trade and economic growth that capital stock will increase economic growth. This was the case in the studies of Balanika (2013), Marjan and Karim, (2016), and Jozefina, (2016).

The coefficient of the labour input is positive but insignificant at 5% in all estimators but negative in MG. The results showed that an increase in labour input by 1% will lead 1.86%, and 29.3% increase in economic growth in PMG and DFE respectively. This is in line with the theory of trade and economic growth which stipulate labour ensure economic growth.

This was the case in the studies of Balanika (2013), Marjan and Karim, (2016), and Jozefina, (2016).

The estimates of *ECT−1* terms in the three estimators are negative and significant at 5% level corroborating the proven long run association between Trade Openness, Real Exchange Rates, Capital Stock, Labour input, Crude oil production and Economic Growth. The estimate of ECM_{t-1} terms are -0.1024, -0.2610 and -0.453 for PMG, MG and DFE respectively. This implies that the deviations from short-run towards long-run are corrected by 10.2%, 26.1% and 45.3% in each year respectively and it would take almost nine years and eight months to reach the stable long-run equilibrium path in real growth model in case of PMG. Also, almost three years and eight months and two years and two months to reach the stable log-run equilibrium path in real growth model in case of MG and DFE respectively. This empirically implies that for any disequilibrium in the system, the system will automatically adjust itself back to the equilibrium on the average after 5 years and 3 months in OPEC countries.

4.7.3 Hausman Test

The Hausman test is used to test whether there is a significant difference between these estimators. The null of this test is that the difference between PMG and MG estimation is not significant.

Table 4.10: Hausman Test Result

PMG*MG
Ho: PMG estimator is efficient and consistent but MG is not efficient
P-value = 0.9019
Since it is not possible to reject Ho, the PMG estimator is selected because it is efficient and consistent.

Source computed by the researcher using STATA 14 (2019)

From the table 4.10 above, Hausman test and the corresponding p-value suggests, it is not possible to reject the long-run homogeneity restriction at the conventional levels of significance. This implies, one can conclude that the PMG is more efficient and appropriate than the MG estimates. Thus, this study will be relying more on the results of PMG estimator.

4.7.4 PMG Estimation Country Specific

The Hausman Test suggests that the Pooled Mean Group (PMG) estimator is more appropriate compared to Mean Group (MG) estimator. The advantage of the PMG is that it imposes homogeneity in the long-run parameters and allow short-run dynamic to be heterogeneous. This estimator provides country specific coefficient for individual countries for a short-run analysis. The result in table 4.11 below shows the impact of trade openness on economic growth in OPEC countries.

Table 4.11: Panel PMG Estimation Country Specific

PMG RESULTS							
Dependent Variable: LOGGDPc							
Countries	ECT	TO	EX	LOGCOP	LOGCPT	LOGLBF	C
Algeria	-0.0462***	-0.01066***	-0.9304***	0.303***	0.0734***	-0.908**	-0.0189
	(0.01864)	(0.0002)	(0.0332)	(0.0332)	(0.0316)	(0.409)	(0.0176)
Angola	-0.134**	-0.0098***	-0.1183**	0.096	0.0054	-16.341***	0.0493
	(0.0782)	(0.00008)	(0.04829)	(0.1516)	(0.0051)	(3.2035)	(0.118)
Ecuador	-0.1182**	-0.0075***	0.0028	0.1288	0.0048	-0.0643	0.0248
	(0.048)	(0.000034)	(0.0034)	(0.0918)	(0.0357)	(0.3014)	(0.0029)
Gabon	-0.397***	0.01423	-0.3212**	0.3851***	0.0038	7.586	-0.4066**
	(0.1372)	(0.1170)	(0.1171)	(0.1176)	(0.0047)	(2.702)	(0.198)
Iran	-0.405***	0.1519***	-0.0271	0.4397***	-0.0027	0.1440	0.0184
	(0.142)	(0.0541)	(0.0272)	(0.1037)	(0.0029)	(0.0820)	(0.0177)
Kuwait	-0.1788***	0.0067	-0.2300***	0.3550***	0.1301***	0.1717	-0.229*
	(0.0655)	(0.0422)	(0.0662)	(0.06125)	(0.0612)	(0.2576)	(0.113)
Libya	-0.7187***	-0.2919***	-0.0354***	0.8178***	-0.0911	-2.985	-0.0182
	(0.1896)	(0.1056)	(0.0120)	(0.0832)	(0.0840)	(7.365)	(0.072)
Nigeria	-0.0670***	-0.1167***	-0.0890**	0.1555*	0.0330***	-5.54322**	0.0040
	(0.0205)	(0.034)	(0.0352)	(0.0905)	(0.0027)	(1.596)	(0.0226)
Saudi Arabia	-0.337***	0.013	-0.0264	0.4958***	0.0032	0.1722	-0.2882
	(0.0881)	(0.0176)	(0.076)	(0.0393)	(0.0013)	(0.181)	(0.1428)
Venezuela	-0.721***	-0.0167**	-0.0856***	0.5868***	0.0243	-0.8477	0.0014
	(0.091)	(0.0046)	(0.0319)	(0.1290)	(0.0256)	(0.5377)	(0.0045)

*Source computed by the researcher using STATA 14 (2019). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. The figures in parenthesis () are standard errors. The lag structure is ARDL (1, 1, 1, 1, 1, 1)*

As it can be observed from the table above, ten OPEC countries were sampled out for this study, namely; Algeria, Angola, Ecuador, Gabon, Iran, Kuwait, Libya, Nigeria, Saudi Arabia and Venezuela. The PMG estimate the relationship between economic growth (LOGGDPc) and Trade Openness (TO), Real Effective Exchange Rate (EX), Capital Stock (LOGCPT), Labour input (LOGLBF), and Crude Oil Production (LOGCOP). The results indicate that Trade Openness has positive impact on economic growth in relation to Gabon, Iran, Kuwait and Saudi Arabia. However, the effect is negative in relation Algeria, Angola, Ecuador, Libya, Nigeria and Venezuela. The effect of trade openness on economic growth is statistically significant in relation to Algeria, Angola, Ecuador, Gabon, Iran, Libya, Nigeria, and Venezuela. The interesting thing in this results is that Trade Openness is negative and statistically significant in relation to Algeria, Angola, Ecuador, Libya, Nigeria and Venezuela, this implies that trade openness had not been favorable for the economy of these countries within the of period this study. In other words, increase in trade openness lead to decrease in economic growth in Algeria, Angola, Ecuador, Libya, Nigeria and Venezuela. However, trade openness had been favourable for to Gabon and Iran. This implies an increase in trade openness leads to economic growth in these countries.

In addition, the coefficient of exchange rate was found to be negative in all the countries except for Ecuador. However, the effect is found to be significant in all the countries except of Ecuador, Iran and Saudi Arabia. In the nut shell this implies that an increase in real exchange rate lead to a decrease in economic growth in OPEC countries. This may be that the exchange rate policies had not been favourable in OPEC countries. The fluctuation in forex had slow down the economy in OPEC countries.

The result also indicates that crude oil production has a positive impact on economic growth in OPEC countries. The relationship between the two is statistically significant in relation to Algeria, Gabon, Iran, Kuwait, Libya, Nigeria, Saudi Arabia and Venezuela. This implies that increase in crude oil production lead to an increase in economic growth in OPEC. This is not surprising, because crude oil had been the major source of revenue to almost all OPEC countries. The increase in output implies increase in sales of oil and increase in revenue to

OPEC countries. The revenue is channeled to developmental projects which ensure economic growth. However, glut in the world crude oil market had slow down the economies of most OPEC countries due to fluctuation in global crude oil prices.

The results also show that, with the exception of Angola and Iran, Capital Stock has a positive impact on economic growth in OPEC countries. However, the relationship between the two is statistically significant in relation to Algeria, Kuwait and Nigeria. This fit into the theory of trade and economic growth which stipulate that increase in capital input ensures economic growth. Likewise, the coefficient of labour input is found to have positive impact on economic growth in OPEC countries except for Algeria, Angola, Ecuador and Nigeria. The result shows that, the relationship between the two is significant in relation to Algeria, Angola and Nigeria. This implies increase in labour input stimulate economic growth in OPEC countries. This fit into the theory of trade and economic growth which stipulate that increase in labour input ensures economic growth.

The result shows the error correction term (ECT) which are statistically significant with negative sign in all countries. This finding consolidates the presence of a long-run relationship between the variable of interest in all the countries. The coefficient of the error terms which are -0.0462, -0.134,-0.1182 -0.397, -0.405, -0.1788, -0.7187, -0.0670, -0.337, and -0.721 this implies that the deviations from short-run towards long-run are corrected each year by nearly 4.62% in 13.4%, 11.82%,39.7%,40.5, 17.88%,71.87%,6.70%,33.7% and 72.1%for Algeria, Angola, Ecuador, Gabon, Iran, Kuwait, Libya, Nigeria, Saudi Arabia and Venezuela respectively.

4.8 Panel Vector Autoregression (PVAR) Analysis

The second objective of this study was achieved using the Panel VAR technique. The Panel VAR estimation technique employed in this study enables us to examine the channel of shocks transmission from one macroeconomic variable to another. The contemporaneous relationships between variables enable us to examine how each macroeconomic variable slow down an economy with aid of impulse response functions and forecast variance decomposition. The analysis of the panel VAR is presented below.

4.8.1 Lag Selection Criteria

In order to estimate the PVAR framework, it is necessary to examine the optimal lag in the model selection. The second phase was to estimate the optimal moment and model selection, according to Andrews and Lu (2001). The output of the test is very similar to the one built on likelihood-based criteria (AIC, BIC and HQIC values): the preferred model is the one with the lowest values. Their model selection criterion is based on Hansen's (1982) J statistic of over-identifying restrictions. The results of the tests are presented in Table 4.12

Table 4.12: Order of Lag Selection Criteria Table

Lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.9959125	44.63637	.6114692	-218.4343	-51.36363	-118.6809
2	.9992821	30.59728	.5375281	-144.7832	-33.40272	-78.28091
3	.9986075	28.1343	.0304712	-59.55592	-3.865695	-26.30479

Source computed by the researcher using STATA 14 (2019).

Based on the three model selection criteria by Andrews and Lu (2001) and the over-all coefficient of determination, first-order panel VAR is the preferred model, since this has the smallest MBIC, MAIC and MQIC. While we also want to minimize Hansen's J statistic, it does not correct for the degrees of freedom in the model like the model and moment selection criteria by Andrews and Lu. Based on the selection criteria, we fit a first-order panel VAR model with the same specification of instruments as above using GMM estimation implemented by PVAR.

4.8.2 Impulse Response Function

To examine the response of one variable in a system to another variable, the impulse response function is applied to examine the response of shocks transmission from one variable to another variable.

The estimation was done using one lag of the dependent variable given the relative size of our sample as suggested from the lag selection criterion. The GMM estimates of the panel VAR are presented in table 4.13. We also present the graph of the impulse response functions and the 5% error bands generated by Monte Carlo simulation to show the response of each variable to shocks on itself and those of other endogenous variables over time. Figure 4.2 reports the impulse response functions.

Table 4.13: PVAR impulse response table

Response to	Response of LOGGDPc	TO	EX	LOGCPI
LOGGDPc	0.610***	-0.115***	-0.012***	0.031***
	(0.061)	(0.0145)	(0.003)	(0.004)
TO	0.065	0.948***	0.032***	-0.022***
	(0.124)	(0.042)	(0.005)	(0.007)
EX	-0.880*	0.038	0.679***	0.216***
	(0.532)	(.212)	(0.0678)	(0.044)
LOGCPI	2.238***	0.580***	0.062***	0.756***
	(0.584)	(0.107)	(0.021)	(0.054)

*Source computed by the researcher using STATA 14 (2019). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. The figures in parenthesis () are standard errors.*

As seen the table above the response to shocks of LOGGDPc to its own shocks was significant. However, the response of LOGGDPc to shocks from trade openness is negative and statistically significant 5% as seen from the chart we can see curve sloped slightly downward by the first horizon. This indicate that trade shocks has negatively affect the economy in OPEC countries. This implies that trade shocks have slow down OPEC economy from the 1st period to the 10th period. Likewise, the response of TO to shocks from LOGGDPc is positive and statistically insignificant at 5%. This finding suggests that trade openness although slightly being supported by economic growth, but the long adverse effect will slow down the economy for 10 periods. This further indicates that trade shocks account for about 11.5% fluctuation in the economy. This is consistent to the findings of Kose and Riezman (2000) who examined the role of external shocks in explaining macroeconomic fluctuations in African countries. They examine the cyclical behavior of trade shocks and their comovement with aggregate output and the trade balance using annual data of twenty-two non-oil exporting African countries. Their study indicates that while trade shocks account for roughly 45 percent of economic fluctuations in aggregate output. Their study also finds that adverse trade shocks induce prolonged recessions. This could be seen recently when majority of OPEC countries fell in to recession.

Further analysis showed that the response of EX to shocks from LOGGDPc is negative and statistically significant at 5% as seen from the chart we can see curve sloped slightly downward from the last horizon. Ironically, LOGCPI response positively to shocks from LOGGDPc, statistically significant at 10%, as seen from the chart we can see curve sloped slightly upward from the first horizon to the fifth horizon.

In addition, the response of EX to shocks from trade openness is positive and statistically insignificant at 5% as seen from the chart, we can see the curve sloped slightly upward from the first horizon to the fifth horizon. But trade shocks response to exchange rates shocks was negative in the 10th period. Likewise, the response of LOGCPI to shocks from trade openness is negative and statistically insignificant at 5% as seen from the chart we can see curve sloped slightly downward from the first horizon to the fifth horizon.

Also, the response of LOGGDPc to shocks from EX is positive from the 1st to the 5th period, however it became negative and statistically significant at 5% from the 6th period to the 10th period. The response of trade openness to shocks from LOGCPI and statistically significant at 5% is negative from the 2nd period to the 10th period. In addition, the response of EX to shocks from LOGCPI is positive and statistically insignificant at 5% as seen from the chart. We can see the curve sloped slightly upward from the first horizon to the fifth horizon. Likewise, the response of LOGCPI to shocks to own shocks is positive and statistically insignificant at 5% as seen from the chart we can see curve sloped slightly upward from the first horizon to the fifth horizon.

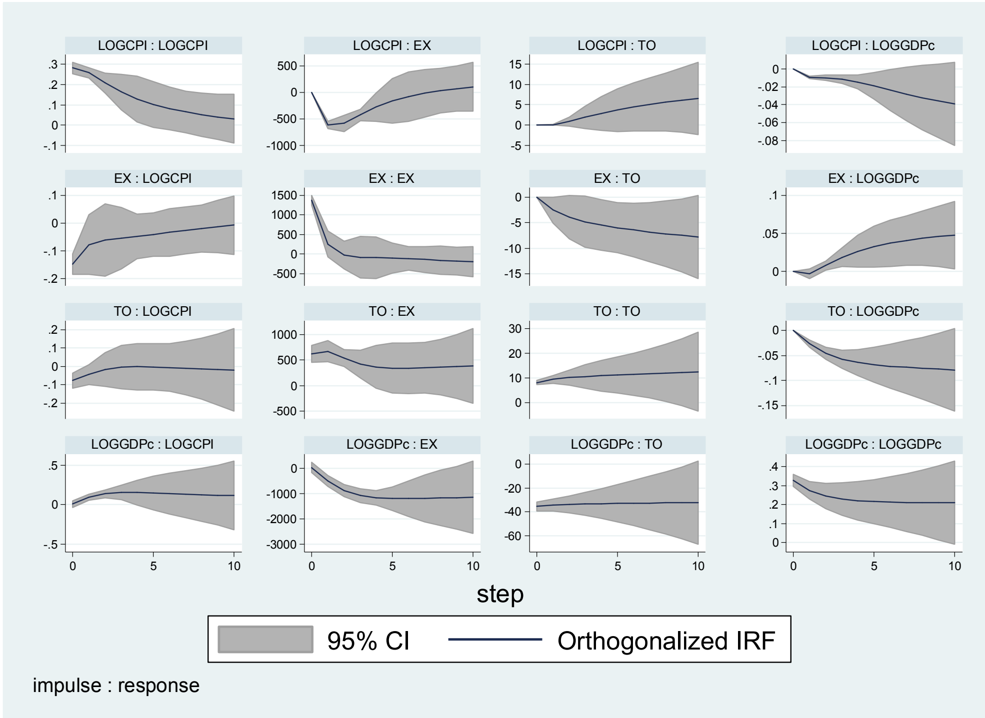


Figure 4.2: PVAR Impulse Response Graphs

Source: Generated by the Author using STATA 14 (2019)

4.8.3 Forecast-Error Variance Decomposition

The essence of using forecast variance decomposition technique is to measure the fraction of forecast error variance for each of the variables under investigation to its shocks and also to shocks of other variables. The table 4.14 below is the results of the PVAR forecast variance decomposition with both the direct and indirect effects of the shocks.

Table 4.14: PVAR Forecast-Error Variance Decomposition

Response to	Response of			
	LOGGDPc	TO	EX	LOGCPI
LOGGDPc	5038754	.2662888	.0508888	.1789469
TO	.0422969	.8544728	.0921548	.0110756
EX	.0209559	.0895766	.7589799	.1304875
LOGCPI	.3109341	.025404	.0163886	.6472734

Source computed by the researcher using STATA 14 (2019)

The variance decompositions shows the percent of the variation in one variable that is explained by the shock to another variable, accumulated over time. The variance decomposition is an indication of the magnitude of the total effect from the tenth period of observation. From the table above, TO explain a total of 26.6% variation in LOGGDPc while, EX explain a total of 5.1% variation in LOGGDPc, likewise, LOGCPI explains a total of 17.9% variation in LOGGDPc in the tenth period.

Furthermore, LOGGDPc explain a total of 4.2% variation in TO while, EX explain a total of 9.2% variation in TO, likewise, LOGCPI explains a total of 11% variation in TO. Likewise, LOGGDPc explain a total of 2.1% variation in EX while, TO explain a total of 8.9% variation in EX, likewise, LOGCPI explains a total of 13% variation in EX. In addition, LOGGDPc explain a total of 31.1% variation in LOGCPI while, TO explain a total of 2.5% variation in LOGCPI, likewise, EX explains a total of 1.6% variation in LOGCPI in the tenth period.

4.8.4 PVAR Diagnostics Test

In this section, we conducted the most important diagnostics test associated with PVAR estimation which includes PVAR stability test, Serial Correlation test, and multicolinearity test. These test are carried out to ensure the PVAR models is robust and good for policy analysis and policy prescription.

4.8.4.1 PVAR Stability Test

The PVAR stability test is necessary to see if the PVAR model is stable. A stable PVAR model is appropriate for estimation and analysis. If the PVAR framework is not stable one is required to jettison the model and formulate another model. The figure 4.3 below shows the PVAR model which is reported in a graphical form of the eigenvalues.

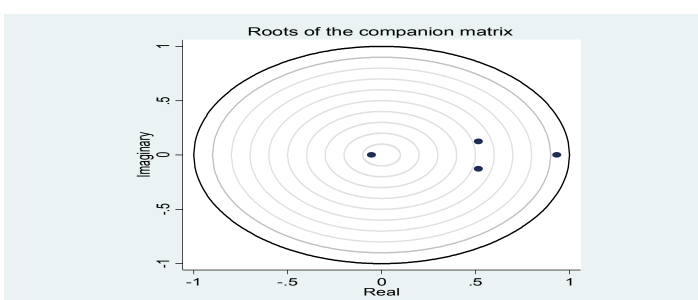


Figure 4.3: PVAR Stability Graph

Source: Generated by the Author using STATA 14 (2019)

It is required that all points are in the modulus, this means the impacts of the shocks are callable and finite. From our model we can see all the points are within the modulus; this means our PVAR model is stable and good for analysis. To corroborate this fact from the AR table we can see all medullae are all less than one (1) hence it justifies our AR graph that our VAR model is good for analysis and we can use it.

4.8.4.2 Serial Correlation Test

It is necessary to test for the presence of autocorrelation in the model. This is because if a model has autocorrelation, the model is not good for analysis and policy prescription. This study made use of Wooldridge test for autocorrelation in panel data. The test follows the null hypothesis of no first-order autocorrelation.

Table 4.15: Wooldridge test for Autocorrelation in Panel Data

F(1, 9)	0.051
Prob > F	0.8258

Source computed by the researcher using STATA 14 (2019).

From the table 4.15 above, given the F-statistics of 1.565 and a probability value of 0.2425, this signifies the acceptance of the null hypothesis at 5% level of significance. This implies that the model does not suffer from serial correlation.

4.8.4.3 Heteroskedasticity

Beside the test of serial correlation/autocorrelation, it is necessary to test for heteroskedasticity in the model. This is because if a model has a problem of heteroskedasticity, the model is not good for analysis and policy prescription. This study made use of modified wald test for group wise heteroskedasticity in cross-sectional time-series FGLS regression model in panel data. The test follows the null hypothesis of no heteroskedasticity.

Table 4.16: Wald Test for Group Wise Heteroskedasticity in Panel Data

Chi2(10)	13.84
Prob > F	0.5452

Source computed by the researcher using STATA 14 (2019).

From the table 4.16 above, given the chi-square statistics is given as 13.84 and a probability value of 0.5452, this signifies the acceptance of the null hypothesis at 5% level of significance. This implies that the model does not suffer from heteroskedasticity.

4.8.4.4 Correlation Analysis

The correlation matrix is computed to analyze the relationship between the variables and examine the level of collinearity among the variables. The table below presence the correlation matrix of the variables used in the PVAR framework.

Table 4.17: Correlation Matrix

	LOGGDPC	TO	EX	LOGCPI
LOGGDPC	1	-0.65183	-0.01529	0.186167
TO	-0.65183	1	0.033948	0.064345
EX	-0.01529	0.033948	1	0.122249
LOGCPI	0.186167	0.064345	0.122249	1

Source computed by the researcher using STATA 14 (2019).

From the table above, the correlation matrix shows that Trade Openness and Real Exchange Rates are negatively correlated with economic growth, while Consumer Price Index is positively correlated with economic growth. With exception of trade openness, the correlation between the variables and economic growth is very low or weak, this indicate a low presence of collinearity.

4.9 Panel Granger Causality Analysis

The fourth objective of this study is to analyze the causal relationship between trade openness, Economic Growth and selected macroeconomic variables in OPEC countries. This was achieved using the panel granger causality estimation developed by Dumitrescu and Hurlin (2012).

The panel Granger causality analysis is used to test whether two different variables used in this study has mutual links or not. The Dumitrescu and Hurlin (2012) panel causality test was employed in this study to test the causal relationship of the variables used in this study. To examine is there is a one-way Granger causal relationship (unidirectional), two-way causal relationship (bi-directional causality), and no mutual relationship (neutral causality). In this context, this study text the causal relationship between Gross Domestic Product per capita (LOGGDPc, proxy to economic growth), Trade Openness (TO), Exchange Rate (EX), and Consumer price index (LOGCPI). The table below presents the Dumitrescu and Hurlin (2012) Granger causality test.

Table 4.18: PVAR Granger Causality Analysis

The Null Hypothesis	$Z_{\text{bar stat}}$	Decision
H0:TO does not Granger-cause LOGGDPc	3.8480***	Rejected
H0: LOGGDPc does not Granger-cause TO	2.9889**	Rejected
H0: LOGCPI does not Granger-cause LOGGDPc	8.2669***	Rejected
H0: LOGGDPc does not Granger-cause LOGCPI.	0.4598	Accepted
H0: LOGGDPc does not Granger-cause EX	5.1536***	Rejected
H0: EX does not Granger-cause LOGGDPc	4.2613***	Rejected
H0: EX does not Granger-cause TO	-1.1345	Accepted
H0: TO does not Granger-cause EX	7.3346***	Rejected
H0: LOGCPI does not Granger-cause TO	0.8474	Accepted
H0: TO does not Granger-cause LOGCPI	3.6049***	Rejected
H0: EX does not Granger-cause LOGCPI	8.8307***	Rejected
H0: LOGCPI does not Granger-cause EX	4.2609***	Rejected

*Source computed by the researcher using STATA 14 (2019). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. The figures in parenthesis () are standard errors*

The results of Dumitrescu and Hurlin (2012) Granger causality test in the table 4.18 above suggest that it is possible to reject the null hypothesis that TO does not homogenously cause LOGGDPc and the same as LOGGDPc does not homogenously cause TO. The presence of bi-directional causality between TO and LOGGDPc lends support for the feedback hypothesis whereby TO and LOGDPc are interdependent. This interdependency suggests that trade openness leads to influence economic growth and economic growth will have influence on trade openness. Thus, TO has a strong influence on LOGGDPc and visa-visa. This result is consistent with, Rudra, et al (2017), Nowbutsing (2014), Mercan, Gocer, Bulut, and Dam (2013),and Gries and Redlin (2012) who found out that there is a bidirectional relationship between trade openness and economic growth. However, the finding is inconsistent with the findings of Kojo, Saban and Yemane (2014) who revealed that there is no causal relationship between trade openness and economic growth.

As regards to the causal relationship between LOGCPI and LOGGDPc, it is not possible to reject the null hypothesis that LOGCPI does not homogenously cause LOGGDPc, but accept the null in the opposite direction. This means that there is an evidence of uni-directional causality running from consumer price index to economic growth, meaning that any changes in LOGCPI will affect LOGGDPc. In other words, at 5% level of significance, LOGCPI could be considered as a significant factor in promoting economic growth. This suggests that an increase in LOGCPI could cause an expansion to economic growth. This result is consistent with the findings of Pam (2016),

The panel causality results also suggest that it is possible to reject the null hypothesis that EX does not homogenously cause LOGGDPc and the same as LOGGDPc does not homogenously cause EX. The presence of bidirectional causality between EX and LOGGDPc lends support for the feedback hypothesis whereby EX and LOGDPc are interdependent. This interdependency suggests that exchange rates leads to increase in economic growth and economic growth will have influence on exchange rates. Thus, exchange rates have a strong influence on LOGGDPc and visa-visa. This result is consistent with respect to the findings of Blagrave and Vesperoni (2018) and Ali and Anwar (2017).

With respect to the causal relationship between EX and TO, it is not possible to reject the null hypothesis that EX does not homogenously cause TO, but reject the null in the opposite direction. This means that there is an evidence of uni-directional causality running from trade openness to exchange rates, meaning that any changes in TO will affect EX. In other words, at 5% level of significance, TO could be considered as a significant factor influencing exchange rates. However, exchange rates have negative but insignificant influence on TO, which suggest that exchange rates had not been favorable to trade in OPEC countries. This suggests that an increase in LOGCPI could cause an expansion to economic growth. This result is consistent with respect to the findings of Blagrave and Vesperoni (2018), and Ali & Anwar (2017).

The findings also indicated by the causal relationship test between LOGCPI and TO, it is not possible to reject the null hypothesis that LOGCPI does not homogenously cause TO, but reject the null in the opposite direction. This means that there is an evidence of uni-directional causality running from consumer price index to trade openness, meaning that any changes in LOGCPI will affect TO. In other words, at 5% level of significance, LOGCPI could be considered as a significant factor influencing TO. This suggests that an increase in LOGCPI could cause an expansion to economic growth. This result is consistent with respect to the findings of Blagrave and Vesperoni (2018), Ali & Anwar (2017) and Kose and Riezman (2000).

As suggest panel causality results, it is possible to reject the null hypothesis that EX does not homogenously cause LOGCPI and the same as LOGCPI does not homogenously cause EX. The presence of bi-directional causality between EX and LOGCPI lends support for the feedback hypothesis whereby EX and LOGCPI are interdependent. This interdependency suggests that exchange rates influence consumer price index and consumer price index have influence on exchange rates. Thus, exchange rates have a strong influence on Consumer price index and visa-visa. This result is consistent with respect to the findings of Blagrave and Vesperoni (2018), Ali & Anwar (2017) Pam (2016), and Kose and Riezman (2000).

4.10 Evaluation of the Working Hypotheses

In order to evaluate the working hypothesis of this study we need to recap the hypothesis. They include the following:

Ho_1: There is no long-run relationship between trade openness and Economic Growth among OPEC countries.

Ho_2: There are no long-run and short-run dynamic effects of trade openness on Economic Growth among OPEC countries.

Ho_3: There is no channel of transmission of trade shocks and macroeconomic dynamics in OPEC countries.

Ho_4: There is no causal relationship among trade openness, Economic Growth and selected macroeconomic variables (i.e Exchange Rates, and Inflation) among OPEC countries

After subjecting these hypotheses to various economic, statistical and econometric tests, we hereby present following findings

1) The results obtained from long-run cointergrating models of POLS and FMOLS invalidates the first hypothesis. Trade openness in real sense; actually have significant negative relationship on economic growth. The t-values and probability values (P-values) of the coefficient of trade openness in the two of POLS and FMOLS estimators suggest that trade openness is statistically significant in long-run.
2) The results obtained from panel ARDL estimators of PMG invalidate the second hypothesis. Trade openness in real sense; actually have significant negative effect on economic growth in both the short-run and long-run. The probability values (P-values) of the coefficient of trade openness in the PMG ARDL estimator suggest that trade openness is statically significant in both short-run and long-run.
3) In respect to the third hypothesis, the results obtained panel VAR estimation as seen from the impulse response functions graphs and table invalidate the third hypothesis. Trade openness shocks in real sense; actually have significant adverse impact on economic growth. The impulse response shows that trade shocks adversely slow down the economy.
4) In respect to the fourth hypothesis, the results obtained panel granger causality analysis invalidates the fourth hypothesis. However, the relationship between trade

openness and economic is bi-directional. However, there is at least a one directional relationship between macroeconomic variables and trade openness.

4.11 Policy Implication of the Findings

This study examined the relationship between trade openness, macroeconomic dynamic and economic growth in OPEC countries. The study made use of four panel data dynamic estimation techniques of long-run cointegrating estimators of POLS, FMOLS, and DOLS. Also, the panel ARDL model of PMG was also employed as well as the panel VAR framework. The panel VAR framework was used to examine shocks transmission among macroeconomic variables. The analysis concluded by employing the panel granger causality analysis to examine the causal relationship among macroeconomic variables used in the study.

The study found out that there is long-run negative relationship between trade openness and economic growth in OPEC countries. Also, the study found out that trade openness has both short-run and long-run negative significant effect on economic growth in OPEC countries. This result doesn't conform with the apriori expectation since in theory trade openness leads to economic growth. This finding has revealed the current nature of most OPEC countries. The finding implies that most OPEC countries had not benefited massively from a wider open economy; this has brought the bare the truth that OPEC countries had been operating at unfavourable terms of trade. The true picture is that OPEC countries had long been importing virtually almost everything they consume and export mainly crude oil in large quantities. In addition to the fact that, most of the crude oil exported by these countries are unrefined, as such they turn to import more oil product which by implication widening the import base and lessen the export. This situation has seen that OPEC countries had been less competitive in the international market when it comes to trade as such despite their contribution to trade of crude oil they find it difficult to benefit from open trade in the international economy.

Just like the estimation in cointegrating regressors crude oil production was found to have significant short-run and long-run positive impact on economic growth in OPEC countries. In OPEC countries whose main source of revenue is crude oil and the major export had been crude oil suggest the fact that the economy had benefited from trade in crude oil export. This is supported by the fact that crude oil production had in the long-run increase economic growth in OPEC countries. However, exchange rate was found to have long-run negative relationship with economic growth in OPEC countries. Also, exchange rate was found to have both short-run and long-run negative effect on the economic growth in OPEC countries supporting the findings from the long-run cointegrating estimators. This is evident in recent times has most OPEC countries has faced with forex crisis due to low returns from crude oil sales since the fall of global crude oil prices.

Capital stock and labour inputs were found to have significant positive long-run relationship with economic growth in OPEC countries. Likewise, Capital stock and labour inputs were found to have significant positive short-run and long-run effect on economic growth in OPEC countries. This finding is consistent with economic theory of trade and economic growth. Factor inputs are expected to enhance economic growth.

The error correction term were found to be statistically significant. This implies that the deviations from short-run towards long-run are corrected by 10.2% in each year and it would take almost nine years and eight months to reach the stable long-run equilibrium path in real growth model in case of PMG. This empirically implies that for any disequilibrium in the system, the system will automatically adjust itself back to the equilibrium on the average after 5 years and 3 months in OPEC countries.

The study further examines transmission of trade openness shocks to macroeconomic dynamics and how it slows down the economy. The result from the panel VAR shows that trade openness shocks has a significant adverse effect to macroeconomic dynamics. This shocks transmission from trade shocks as well as other macroeconomic variables is evidence that trade shocks has a significant relationship in causing macroeconomic dynamics in OPEC countries. This finding is consistent to the study of Kose and Riezman (2000) who examined the role of external shocks in explaining macroeconomic fluctuations in African countries. They examine the cyclical behavior of trade shocks and their comovement with aggregate output and the trade balance using annual data of twenty-two non-oil exporting African countries. Their study also finds that adverse trade shocks induce prolonged recessions.

The causal relationship between trade openness and economic growth among other macroeconomic variables shows at lease a bi-directional relationship. This suggests that there is a causal relationship between these macroeconomic variables associated with economic growth and macroeconomic dynamics. This result is consistent with, Rudra, et al (2017), Pam (2016), Nowbutsing (2014), and Gries and Redlin (2012) who found out that there is a bidirectional relationship between trade openness and economic growth. However, the finding is inconsistent with the findings of Kojo, Saban and Yemane (2014) who revealed that there is no causal relationship between trade openness and economic growth.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter includes the summary of the major findings is discussed in this chapter. This chapter concludes the work and provides some effective policy recommendation to policy makers and governments on the issues discussed in this study.

5.2 Summary of the Findings

This study examined the relationship between trade openness, macroeconomic dynamic and economic growth in OPEC countries. To achieved the main objective of the study; the study specify four specific objectives which includes; to assess the long-run relationship between trade openness on economic growth among OPEC countries, to examine the long-run and short-run dynamic effect of trade openness on economic growth among OPEC countries, to determine the channel of transmission of trade shocks to macroeconomic dynamics in OPEC countries and to evaluate the causal relationship among trade openness, economic growth and selected macroeconomic variables (i.e exchange rates, and inflation) among OPEC countries

The analysis began by examining the graphical trend of the variables used in the study. The graphical display as expected showed that macroeconomic variables are non-stationary. The panel unit root test was conducted and showed that the series were non-stationary. However, as expected in most econometric analysis, the variables used in this study were stationary after first differences which suggest that the variables are integrated of order one. In other words they are I(1) variables. The study further proved that the variables are cointegrated by employing the panel cointegration test of Kao (1999), Pedroni (2004), and Johansen-Fisher cointegration tests.

Having proved the existence of cointegration among the variables, the study estimated the long-run cointegrating regression using POLS, FMOLS and DOLS estimators and the results revealed that there is long-run significant negative relationship between trade openness and economic growth in OPEC countries. This doesn't conform with the apriori expectation since in trade theory openness leads to economic growth.

The study made use of panel ARDL models to examine the short-run and the long-run effect of trade openness on economic growth in OPEC countries. The results revealed that in both short-run and long-run trade openness has a significant negative effect on economic growth in OPEC countries. This does not conform to the apriori expectation since in the theory; trade openness leads to economic growth. The finding also was not consistent with economic theory of trade and economic growth. The error correction term were found to be statistically significant. This implies that the deviation from short-run towards long-run are corrected by 10.2% in each year and it would take almost nine years and eight months to reach the stable log-run equilibrium path in real growth model in the case of PMG. This empirically implies that for any disequilibrium in the system, the system will automatically adjust itself back to the equilibrium on the average after 5 years and 3 months in OPEC countries.

The analysis on how trade shocks causes macroeconomic dynamic using the panel VAR framework revealed that trade openness shocks has a significant adverse impact on economic growth. This shocks transmission from trade shocks as well as other macroeconomic variables is evidence that trade shocks has a significant relationship in causing macroeconomic dynamics in OPEC countries.

The granger causality analysis revealed that there is a bidirectional relationship between trade openness and macroeconomic variables associated with economic growth cause macroeconomic dynamics.

5.3 Conclusions

The study has drawn a number of conclusions based on the findings from the research.

The study concluded that there is long-run negative relationship between trade openness and economic growth in OPEC countries. This result does not conform with the apriori expectation since in theory trade openness leads to economic growth. Also, the study further concludes that both short-run and long-run trade openness has a significant negative effect on economic growth in OPEC countries. This basically implies that most OPEC countries had not benefited massively from a wider open economy; this has brought the bare the truth that OPEC countries had been operating at unfavourable terms of trade.

Furthermore, exchange rate was found to have negative long-run relationship with economic growth. Likewise, exchange rate was found to have both short-run and long-run negative impact on the economic in OPEC countries supporting the findings from the long-run cointegrating estimators. This is evident in recent times has most OPEC countries has faced with forex crisis due to low returns from crude oil sales due to fluctuation in global crude oil prices.

In addition, crude oil production, capital stock and labour input are all found to have long-run positive relation with economic growth. Capital stock and labour inputs were found to have significant positive short-run and long-run effect on economic growth in OPEC countries. This finding is consistent with economic theory of trade and economic growth. Factor inputs are expected to enhance economic growth.

The study proved that trade openness shocks has a significant adverse impact on economic growth. This shocks transmission from trade shocks as well as other macroeconomic variables is evidence that trade shocks has a significant relationship in causing macroeconomic dynamics in OPEC countries.

The study further concluded that there is a causal relationship between trade openness and economic growth among other macroeconomic variables shows at lease a uni-directional relationship. This suggests that there is a causal relationship between these macroeconomic variables associated with economic growth and macroeconomic dynamics.

5.4 Recommendations

Based on the findings of this research work, it is necessary to provide a set of policy recommendations that would be applicable to OPEC countries.

Trade Openness was found to have negative and significant impact on economic growth in OPEC countries. It can be recommended that policy makers in OPEC countries should implement trade policies that will moderate the extent at which the economy will be open to trade. Such policies may include implementing a policy that will allow trade openness to be accompanied by complementary policies aimed at encouraging the financing of new investment towards enhancing accumulation of capital goods and trade policies that have the ability to improve labour skills. Also, trade policies that will reduce the importation of consumable goods such as food items and encourage the export of refined product should be considered. Towards diversifying the economy there should be more investment in technology and manufacturing industries in order to reduce the importation of refined products and encourage the exportation of refined products, this will make OPEC countries more competitive in international trade.

Having observed that trade openness can cause economic dynamics among other macroeconomic variables, it is relevant for OPEC countries when formulating policies should consider the adverse effect of increase in openness of the economy. These will enable OPEC countries to control the rate at which trade openness shocks can induce fluctuation in their economy. OPEC countries policy markers especially on trade and investment should look at the possibilities of moderating how open the economy is to trade by restricting imports of consumable goods. Most of these goods are brought in with imported inflation. Also, large chunk of forex earnings of most OPEC countries goes to these imported commodities and this puts lots of pressure to the local currencies of these countries. Likewise, the diversification of the imports and exports OPEC member countries will also reduce fluctuations caused by trade. If OPEC countries will increase the exports of non-oil commodities and refined oil commodities, this will go a long way to increase the returns from trade. Also, imports of machineries instead of consumables goods will reduce imported inflation and forex crisis.

Exchange rate was found have to negative effect on economic growth in OPEC countries. Likewise, exchange rate shocks were found to contribute to macroeconomic dynamics in OPEC countries. Therefore, an exchange rate policy, which is favorable to export expansion and consistent with the status of these countries as small open economies, is recommended. The monetary policies makers in OPEC countries should come together and examine how to adopt exchange policies that will be line with crude oil export and other commodity trade to boost economic. One area that crude oil trade directly affects the economy of OPEC countries is forex returns. However, forex instability caused by oil price fluctuation can be controlled since OPEC countries used chunk of their forex to import commodities. Supply of forex should be regulated in line with the crude oil sales. Although demand of forex cannot be regulated effectively because of the "black market" factors; but with reduction of restriction in forex influx and increase remittances will boost the supply of forex which will go a long way to match the demand for forex. Likewise, monetary policy authorities should work with fiscal policy authorities to fine tune way to increase domestic production of consumable products to reduce the pressure on foreign reserves and forex which will ensure the stability of the local currency and the forex market.

Crude Oil Production was found to have an influence in economic growth in OPEC countries. As such it is recommended that policies makers in OPEC should formulate policies that will encourage an even level field for crude oil production for OPEC countries which will enable all members to profit from the oil market. This can be done through equity in crude oil production quota assigned to member countries to enable each country benefit from the global oil market. This will reduce fluctuation in oil production in the global market and help in stabilizing crude oil prices. Equity of crude oil production quota can be done by giving a quota that will commiserate with the growth rate of member countries. OPEC countries that are more resourced endowed and have favourable GDP growth rate or GDP per capita should be given a quota that will maintain and sustain the growth of their economy. On the other hand, OPEC countries with declining GDP growth rate or GDP per capita income should be given a quota that will boost the country's economic growth to a favourable level. The policy marker among OPEC countries can invite the non-OPEC countries to the table to bring about modalities to regulate the global production of crude oil to prevent crude oil glut and global oil price fluctuations.

Consumer price index proxy of inflation is found to have significant impact in causing macroeconomic dynamic in OPEC economy. As such it is recommended that economic policies markers in OPEC countries should come up with relevant policies that will reduce price fluctuations in the economy. This can be done by reducing importation of consumable commodities. Reduction in importation of consumable commodities can be done by investment in the production of these commodities that are identified to be largely consumed. The increase productions of these commodities will match the demand gap that will lead to the reduction in prices of such commodities and import of such commodities will reduce and forex stability will be ensured. As such, imported inflation can be cub out.

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APPENDIX

Country	Code	Year	GDPc	CPI	TO	EX	CPT	LBF	COP	LOGGDPc	LOGCPI	LOGCPT	LOGLBF	LOGCOP
Algeria	1	1990	3551.129	18.96623	0.381663	11.49217	3670.798	44.3	1180.068	3.550366	1.277981	3.56476	1.646404	3.071907
	1	1991	3423.696	23.87598	0.445571	5.444606	3182.056	44.9	1170	3.534495	1.377961	3.502708	1.652246	3.068186
	1	1992	3404.955	31.43737	0.451884	4.24191	2786.754	45.4	1201.612	3.532111	1.497446	3.445099	1.657056	3.079764
	1	1993	3260.85	37.8947	0.405334	4.222873	2506.223	45.9	1167.315	3.513331	1.578578	3.39902	1.661813	3.067188
	1	1994	3165.876	48.90223	0.488062	2.825415	2505.693	46.4	1155	3.500494	1.689329	3.398928	1.666518	3.062582
	1	1995	3224.553	63.46516	0.549182	1.825246	2414.619	46.9	1161.795	3.50847	1.802535	3.382849	1.671173	3.06513
	1	1996	3298.882	75.31986	0.538258	1.571154	2232.026	47.4	1227.145	3.518367	1.87691	3.348699	1.675778	3.088896
	1	1997	3282.115	79.63835	0.523628	1.604525	2094.332	47	1258.74	3.516154	1.901122	3.321046	1.672098	3.099936
	1	1998	3398.459	83.58055	0.451964	1.604418	2466.19	46.7	1226.411	3.531282	1.922105	3.392027	1.669317	3.088636
	1	1999	3458.205	85.79173	0.506068	1.445357	2355.059	46.4	1177.301	3.538851	1.933445	3.372002	1.666518	3.070888
	1	2000	3541.494	86.08272	0.626888	1.372898	2139.034	46.1	1213.907	3.549187	1.934916	3.330218	1.663701	3.084185
	1	2001	3600.573	89.72049	0.579766	1.359221	2393.035	45.9	1265	3.556372	1.952892	3.378949	1.661813	3.102091
	1	2002	3754.326	90.99308	0.607189	1.243302	2639.842	45.7	1349	3.574532	1.959008	3.421578	1.659916	3.130012
	1	2003	3973.905	94.87748	0.623012	1.074203	2821.312	45.6	1516.041	3.599217	1.977163	3.450451	1.658965	3.180711
	1	2004	4090.802	98.63636	0.655073	1.037138	3062.355	45.4	1581.776	3.611808	1.994037	3.486055	1.657056	3.199145
	1	2005	4272.641	100	0.712038	0.977568	3227.305	45.4	1692.315	3.630696	2	3.50884	1.657056	3.228481
	1	2006	4282.308	102.3145	0.70634	0.955178	3303.967	45.3	1699.068	3.631678	2.009937	3.519036	1.656098	3.230211
	1	2007	4360.499	106.0733	0.715707	0.909112	3455.908	45.3	1708.397	3.639536	2.025606	3.538562	1.656098	3.232589
	1	2008	4393.342	111.2317	0.767435	0.905292	3318.052	45.3	1705	3.642795	2.046228	3.520883	1.656098	3.231724
	1	2009	4387.485	117.61	0.708308	0.84595	4151.479	45.4	1584.877	3.642216	2.070444	3.618203	1.657056	3.199996
	1	2010	4463.396	122.2122	0.690581	0.818249	4530.894	45.7	1540	3.649665	2.087115	3.656184	1.659916	3.187521
	1	2011	4505.277	127.7386	0.679494	0.778478	4556.942	46	1540	3.653722	2.106322	3.658674	1.662758	3.187521
	1	2012	4565.911	139.1007	0.658755	0.753868	4772.69	46.3	1532.243	3.659527	2.143329	3.678763	1.665581	3.185328
	1	2013	4599.154	143.6262	0.655957	0.719515	5077.555	46.5	1461.781	3.662678	2.157234	3.705655	1.667453	3.164882
	1	2014	4679.36	147.8144	0.641111	0.713619	5285.922	46.8	1420	3.670186	2.169717	3.723121	1.670246	3.152288
	1	2015	4760.219	154.8881	0.828732	0.651883	5049.007	46.5	1429	3.677627	2.190018	3.703206	1.667453	3.155032
	1	2016	4828.357	164.797	0.7086	0.6039	5137.495	46.6	1348.361	3.683799	2.216949	3.710751	1.668386	3.129806
	1	2017	4.011135	140.25	303.4038	0.722282	616816.9	46.63	1399.12	0.603267	2.146903	5.790156	1.668696	3.145855
	1	2018	3197.529	153.3117	101.647	0.656157	209001.1	46.57	1392.16	2.654898	2.184623	4.401371	1.668178	3.143564
Angola	2	1990	2634.01	0.051877	0.539687	0.15078	5157.475	72.1	475	3.420617	-1.28503	3.712437	1.857935	2.676694
	2	1991	2579.174	0.088743	0.420458	0.067915	280387.3	72.2	500	3.411481	-1.05187	5.447758	1.858537	2.69897
	2	1992	2350.896	0.066883	0.430742	52.45533	344.6604	72.5	526.32	3.371233	-1.17468	2.537391	1.860338	2.72125
	2	1993	1729.022	4.48E-06	0.447789	783118.3	47.56658	73.3	509	3.237801	-5.34836	1.677302	1.865104	2.706718
	2	1994	1696.788	0.199341	0.446138	19.61773	123.8238	73.2	536	3.229628	-0.7004	2.092804	1.864511	2.729165
	2	1995	1892.819	0.001303	1.107283	31.26324	105.013	73.1	646	3.277109	-2.88491	2.021243	1.863917	2.810233
	2	1996	2088.692	0.055333	1.126136	0.848879	87.80263	72.8	708.784	3.319874	-1.25702	1.943508	1.862131	2.850514
	2	1997	2180.237	0.176609	1.011827	0.273905	509.9412	72.7	714	3.338504	-0.75299	2.70752	1.861534	2.853698
	2	1998	2221.37	0.366083	0.972321	0.501214	370.5289	72.6	735.082	3.346621	-0.43642	2.568822	1.860937	2.866336
	2	1999	2206.436	1.274687	1.338627	13.95487	422.892	72.5	745	3.343691	0.105404	2.626229	1.860338	2.872156
	2	2000	2205.906	5.417388	1.140866	0.48571	317.3961	72.5	746.404	3.343587	0.73379	2.501602	1.860338	2.872974
	2	2001	2202.516	13.68219	1.124327	0.256419	201.6584	72.5	742.384	3.342919	1.136156	2.304616	1.860338	2.870629
	2	2002	2437.936	28.5818	1.021668	0.000297	202.2223	72.1	896.37	3.387022	1.45609	2.305829	1.857935	2.952487
	2	2003	2423.831	56.65576	1.039175	2.379772	758.3971	72.1	902.548	3.384502	1.753244	2.879897	1.857935	2.95547
	2	2004	2594.897	81.32488	1.037373	1.073272	854.2254	71.8	1051.721	3.41412	1.910223	2.931572	1.856124	3.021901
	2	2005	2880.039	100	1.066526	1	1113.816	71.3	1239.126	3.459398	2	3.046813	1.85309	3.093115
	2	2006	3100.071	113.3033	0.310968	1.026102	1519.046	70.9	1398.014	3.491372	2.054243	3.181571	1.850646	3.145512
	2	2007	3410.4	127.1815	1.088027	0.992249	1773.972	70.4	1723.524	3.532805	2.104424	3.248947	1.847573	3.236417
	2	2008	3658.481	143.0457	1.212632	0.994915	2367.524	70.2	1950.695	3.563301	2.155475	3.374294	1.846337	3.290189
	2	2009	3547.96	162.6879	1.190359	0.77143	3699.565	70.5	1876.808	3.549979	2.211355	3.568151	1.848189	3.27342
	2	2010	3585.905	186.2298	1.036678	0.672155	4005.073	70.8	1908.521	3.554599	2.270049	3.60261	1.850033	3.280697
	2	2011	3580.269	211.3094	1.001352	141.5452	3046.863	70.9	1755.616	3.553916	2.324919	3.483853	1.850646	3.24443

	2	2012	3750.209	233.061	0.919208	147.9984	3799.091	71	1787.049	3.574055	2.36747	3.57968	1.851258	3.252136
	2	2013	3799.429	253.5146	0.881414	147.3069	4339.577	71.1	1802.658	3.579718	2.404003	3.637447	1.85187	3.255913
	2	2014	3819.45	271.9681	0.800999	141.7082	3680.271	71.1	1741.616	3.582001	2.434518	3.56588	1.85187	3.240952
	2	2015	3725.041	299.9249	1.027476	116.1042	3938.183	71.1	1801.863	3.571131	2.477013	3.595296	1.851666	3.255722
	2	2016	3577.722	404.1075	1.108394	110.1554	3982.337	71.1	1769.615	3.553607	2.606497	3.600138	1.851802	3.247879
	2	2017	3.944693	237.11	302.7914	255.6	789.673	71.1	1771.031	0.596013	2.37495	2.897447	1.851779	3.248226
	2	2018	2435.569	313.7141	101.6424	160.6198	2903.398	71.1	1780.836	2.573584	2.486153	3.364294	1.851749	3.250609
Ecuador	3	1990	3720.937	1.651494	0.379531	1.304758	929.9006	63.6	285	3.570652	0.217877	2.968437	1.803457	2.454845
	3	1991	3790.509	2.457487	0.383686	0.887397	980.2943	64.1	299	3.578698	0.390491	2.991356	1.806858	2.475671
	3	1992	3782.189	3.792914	0.372349	1.721155	918.507	64.7	321	3.577743	0.578973	2.963082	1.810904	2.506505
	3	1993	3770.346	5.499715	0.411176	1.380891	1074.923	65.4	343.67	3.576381	0.74034	3.031377	1.815578	2.536142
	3	1994	3844.784	7.008974	0.418823	1.735458	1038.403	65.8	365	3.584872	0.845654	3.016366	1.818226	2.562293
	3	1995	3847.507	8.613061	0.446508	582.0946	970.5177	66.4	392.027	3.585179	0.935158	2.987003	1.822168	2.593316
	3	1996	3832.763	10.71233	0.4256	1729.055	1149.914	66.9	395.79	3.583512	1.029884	3.060665	1.825426	2.597465
	3	1997	3917.656	13.99491	0.431476	97.80694	1306.573	67.3	388.241	3.593026	1.14597	3.116134	1.828015	2.589101
	3	1998	3966.173	19.0468	0.418472	4050.58	723.211	67.8	375.482	3.598372	1.279822	2.859265	1.83123	2.574589
	3	1999	3706.65	28.99743	0.486547	71.95457	708.3821	68.7	372.6	3.568982	1.46236	2.850268	1.836957	2.571243
	3	2000	3678.902	56.86211	0.591348	67.08701	906.7704	69.2	394.921	3.565718	1.754823	2.957497	1.840106	2.59651
	3	2001	3759.895	78.28663	0.502491	86.77612	1115.135	73.9	412.184	3.575176	1.893688	3.047327	1.868644	2.615091
	3	2002	3848.267	88.06	0.486923	96.87133	1042.41	72.8	392.529	3.585265	1.944779	3.018038	1.862131	2.593872
	3	2003	3888.342	95.04266	0.472292	100.6797	1151.809	71.6	411.014	3.589764	1.977919	3.06138	1.854913	2.613857
	3	2004	4139.081	97.6489	0.509215	98.14144	1389.676	73.9	528.245	3.616904	1.989667	3.142913	1.868644	2.722835
	3	2005	4286.515	100	0.5621	100	1562.352	72.7	531.976	3.632104	2	3.193779	1.861534	2.725892
	3	2006	4400.86	103.0349	0.597444	102.9702	1733.919	74.1	535.68	3.643538	2.012984	3.239029	1.869818	2.728905
	3	2007	4421.902	105.3803	0.621257	103.2556	2424.898	71.9	511.088	3.645609	2.022759	3.384693	1.856729	2.708496
	3	2008	4624.197	114.2331	0.67723	110.9688	2343.153	70.7	504.728	3.665036	2.057792	3.369801	1.849419	2.703057
	3	2009	4573.247	120.1252	0.521999	113.0083	2772.205	70.3	485.62	3.660225	2.079634	3.442825	1.846955	2.686297
	3	2010	4657.302	124.397	0.607417	116.1241	3097.059	70.9	486.087	3.668134	2.09481	3.49095	1.850646	2.686714
	3	2011	4943.423	129.9638	0.644106	118.1314	3312.635	71.1	499.513	3.694028	2.113822	3.520174	1.85187	2.698547
	3	2012	5140.263	136.5916	0.617178	121.898	3608.473	71.4	503.592	3.710985	2.135424	3.557323	1.853698	2.702079
	3	2013	5311.212	140.3335	0.607432	123.9133	3743.726	71.6	526.112	3.725194	2.147161	3.573304	1.854913	2.721078
	3	2014	5439.376	145.3467	0.531524	126.8097	3558.216	71.9	556.358	3.735549	2.162405	3.551232	1.856729	2.745354
	3	2015	5366.544	151.1175	0.553757	129.4292	3637.594	71.6	543.094	3.729695	2.179315	3.560814	1.855115	2.734875
	3	2016	5173.077	153.7236	0	126.041	3647.209	71.7	548.421	3.713749	2.18674	3.561961	1.855586	2.739114
	3	2017	6.051389	105.53	390.064	110.3	2063.464	71.8	549.291	0.781855	2.023376	3.314597	1.855811	2.739802
	3	2018	3515.224	136.7903	130.2059	121.9234	3116.089	71.7	546.9353	2.741766	2.12981	3.479124	1.855504	2.737931
Gabon	4	1990	10511.65	73.27135	0.752057	207.563	3704.563	63.8	270	4.021671	1.864934	3.568737	1.804821	2.431364
	4	1991	10857.58	64.70882	0.714147	161.6234	4018.418	63.5	294	4.035733	1.810963	3.604055	1.802774	2.468347
	4	1992	10245.02	58.53363	0.709773	145.9319	3441.387	63.4	297.65	4.010513	1.767405	3.536734	1.802089	2.473706
	4	1993	10216.78	58.84609	0.748749	141.4884	2632.422	63.2	312.5	4.009314	1.769718	3.420356	1.800717	2.49485
	4	1994	10499.98	80.09907	0.897896	95.5085	2405.205	62.9	328.548	4.021189	1.903627	3.381152	1.798651	2.516599
	4	1995	10743.41	87.82586	0.845682	105.5873	2965.276	62.6	365	4.031142	1.943622	3.472065	1.796574	2.562293
	4	1996	10854.49	88.43162	0.859581	104.347	3548.886	62.4	368.361	4.035609	1.946608	3.550092	1.795185	2.566274
	4	1997	11192.72	91.94543	0.881921	102.6232	4008.53	62.2	370.411	4.048936	1.96353	3.602985	1.79379	2.568684
	4	1998	11239.4	93.27741	0.853785	103.4159	4237.047	62	352	4.050743	1.969776	3.627063	1.792392	2.546543
	4	1999	9798.801	91.47105	0.882765	98.61062	2841.856	61.8	331	3.991173	1.961284	3.453602	1.790988	2.519828
	4	2000	9431.485	91.93292	0.907929	92.98846	2524.155	61.5	315	3.97458	1.963471	3.402116	1.788875	2.498311
	4	2001	9415.324	93.89805	0.837448	93.12556	2535.119	61.3	270	3.973835	1.972657	3.403998	1.78746	2.431364
	4	2002	9016.622	93.93253	0.802302	93.02849	2890.667	61.1	251.2	3.955044	1.972816	3.460998	1.786041	2.40002
	4	2003	9006.684	96.03221	0.798107	97.55903	3118.191	61	241.416	3.954565	1.982417	3.493903	1.78533	2.382766
	4	2004	8838.276	96.42422	0.813678	97.70574	3450.06	60.8	239.052	3.946368	1.984186	3.537827	1.783904	2.378492
	4	2005	8687.147	100	0.83626	98.64953	3773.504	60.6	266.317	3.938877	2	3.576745	1.782473	2.425399
	4	2006	8172.801	98.5906	0.634029	95.18748	4304.566	60.8	237.22	3.912371	1.993836	3.633929	1.783904	2.375151
	4	2007	8431.52	103.55	0.561014	99.76169	5882.683	61	244.221	3.925906	2.01515	3.769575	1.78533	2.387783

	4	2008	7890.085	109.0012	0.462779	103.242	7159.875	61.2	248.137	3.897082	2.037431	3.854905	1.786751	2.394692
	4	2009	7601.557	111.0566	0.590166	103.8995	6377.668	61.5	242.129	3.880903	2.045544	3.804662	1.788875	2.384047
	4	2010	7853.875	112.6797	0.544809	100	7409.231	61.7	245.877	3.895084	2.051846	3.869773	1.790285	2.390718
	4	2011	8129.526	114.1096	0.414109	98.64423	8183.774	62	241.353	3.910065	2.057322	3.912954	1.792392	2.382653
	4	2012	8269.414	117.1475	0.958804	96.54477	7589.301	62.2	230	3.917475	2.068733	3.880202	1.79379	2.361728
	4	2013	8442.003	117.7098	0.574781	98.35354	8177.719	62.5	220	3.926445	2.070812	3.912632	1.79588	2.342423
	4	2014	8587.922	123.1905	0.615054	102.7625	7485.719	62.8	220	3.933888	2.090577	3.874234	1.79796	2.342423
	4	2015	8680.499	122.822	0.873758	98.82053	7983.598	62.5	213.329	3.938545	2.089276	3.902199	1.79588	2.32905
	4	2016	8732.292	125.4103	0.687864	100.6543	7750.913	62.6	210.82	3.941128	2.098333	3.889353	1.796574	2.323912
	4	2017	8674.843	142.4	0.120341	102.4	12991829	62.6	214.7163	3.938262	2.15351	7.11367	1.796806	2.331865
	4	2018	8695.878	130.2108	0.560654	100.6249	4335854	62.6	212.9551	3.939312	2.113706	4.968407	1.79642	2.328276
Iran	5	1990	4040.682	6.019353	0.436192	137.4661	7882.345	62.6	3088	3.606455	0.77955	3.896655	1.796806	3.489677
	5	1991	4463.262	7.050392	0.477913	123.1828	7740.076	46.7	3312	3.649652	0.848213	3.888745	1.669317	3.52009
	5	1992	4540.413	8.869932	0.451105	67.7702	5783767	46.6	3429.098	3.657095	0.94792	6.762211	1.668386	3.53518
	5	1993	4418.226	10.75059	0.369433	51.14143	1312.844	46.1	3540	3.645248	1.031432	3.118213	1.663701	3.549003
	5	1994	4289.823	14.13134	0.312263	63.07973	1118.003	45.7	3618	3.632439	1.150183	3.048443	1.659916	3.558469
	5	1995	4331.145	21.14835	0.297872	84.90023	1909.316	45.2	3643.219	3.636603	1.325277	3.280878	1.655138	3.561485
	5	1996	4607.566	27.2682	0.329155	110.166	2910.137	44.6	3685.71	3.663472	1.435656	3.463913	1.649335	3.566521
	5	1997	4616.998	31.99888	0.317053	137.1904	2472.925	44	3664.178	3.66436	1.505135	3.393211	1.643453	3.563977
	5	1998	4618.22	37.71594	0.282623	169.8267	2175.535	44.3	3633.767	3.664475	1.576525	3.337566	1.646404	3.560357
	5	1999	4679.529	45.28589	0.323058	206.2117	2055.958	44.6	3557	3.670202	1.655963	3.313014	1.649335	3.551084
	5	2000	4792.026	51.84168	0.43427	244.86	2031.59	44.9	3696.3	3.680519	1.714679	3.307836	1.652246	3.567767
	5	2001	4818.049	57.68641	0.398712	278.5036	2242.43	45.4	3723.701	3.682871	1.761073	3.350719	1.657056	3.570975
	5	2002	5135.46	65.9563	0.413802	105.63	2382.531	46	3444.301	3.710579	1.819256	3.377039	1.662758	3.537101
	5	2003	5500.029	76.81815	0.507606	66.26956	2904.03	46.8	3742.795	3.740365	1.885464	3.463001	1.670246	3.573196
	5	2004	5619.005	88.15754	0.511357	65.93258	3425.04	47.5	4001.434	3.749659	1.945259	3.534666	1.676694	3.602216
	5	2005	5731.984	100	0.546451	68.423	3229.816	48.4	4138.575	3.758305	2	3.509178	1.684845	3.616851
	5	2006	5950.461	111.9395	0.539721	71.77138	3784.197	49.2	4027.808	3.774551	2.048983	3.577974	1.691965	3.605069
	5	2007	6364.001	131.2077	0.509295	75.26237	5091.385	48.3	3911.89	3.80373	2.117959	3.706836	1.683947	3.592387
	5	2008	6308.635	164.7311	0.477736	85.55842	6513.475	47.3	4050.273	3.799935	2.216775	3.813813	1.674861	3.607484
	5	2009	6299.373	186.9702	0.440212	97.03048	6201.441	45.1	4037.038	3.799297	2.271772	3.792493	1.654177	3.606063
	5	2010	6585.96	205.9236	0.439814	100	6930.075	45.6	4080.419	3.818619	2.313706	3.840738	1.658965	3.610705
	5	2011	6677.456	248.4015	0.412204	109.2814	8092.561	46.1	4054	3.824611	2.395154	3.908086	1.663701	3.607884
	5	2012	6102.584	316.3584	0.306393	123.2154	8581.521	46.5	3386.85	3.785514	2.500179	3.933564	1.667453	3.529796
	5	2013	6013.515	440.5818	0.401077	122.4165	6161.622	46.8	3113.299	3.779128	2.644027	3.789695	1.670246	3.493221
	5	2014	6212.069	516.5161	0.487621	92.00864	5234.094	47.2	3239.068	3.793236	2.713084	3.718841	1.673942	3.51042
	5	2015	6056.695	587.3085	0.523267	103.9255	6638.305	47.5	3300	3.782236	2.768866	3.822057	1.676694	3.518514
	5	2016	6789.617	637.6404	0.500492	106.602	6006.575	47.2	4067.678	3.831845	2.804576	3.778627	1.673635	3.609347
	5	2017	5321.893	153.6	0.316018	82.7	13494296	31.6	3535.582	3.726066	2.186391	7.13015	1.499076	3.548461
	5	2018	6056.069	459.5163	0.446593	97.7425	4502314	42.1	3634.42	3.780049	2.586611	4.910278	1.616468	3.558774
Kuwait	6	1990	19657.55	73.24298	0.835773	4.301167	4133.083	59.7	1175	4.293529	1.864766	3.616274	1.775974	3.070038
	6	1991	11960.74	79.87747	1.110827	2.925328	5791.52	60.5	190	4.077758	1.902424	3.762793	1.781755	2.278754
	6	1992	23220.3	79.44172	1	5.673829	5724.336	62.1	1058	4.365868	1.900049	3.757725	1.793092	3.024486
	6	1993	33500.1	79.74567	0.961529	3.296525	5295.019	64.3	1852.363	4.525046	1.901707	3.723867	1.808211	3.267726
	6	1994	38867.09	81.76675	0.958566	1.239493	5102.75	66.4	2025	4.589582	1.912577	3.707804	1.822168	3.306425
	6	1995	40705.02	83.96366	1.010386	265.1644	5253.225	68.2	2057.411	4.609648	1.924091	3.720426	1.833784	3.313321
	6	1996	41380.51	86.94772	0.935453	6.59305	6083.572	69.3	2061.652	4.616796	1.939258	3.784159	1.840733	3.314215
	6	1997	40348.22	87.54077	0.952754	6.370012	5086.252	69.8	2007.1	4.605824	1.94221	3.706398	1.843855	3.302569
	6	1998	39067.29	87.65431	0.949842	2.925328	5591.424	69.9	2085.342	4.591813	1.942773	3.747522	1.844477	3.319177
	6	1999	36002.39	90.27593	0.851975	66.2257	4864.219	69.9	1897.7	4.556331	1.955572	3.687013	1.844477	3.278228
	6	2000	35967.43	91.91251	0.866266	78.67589	4258.106	70	2078.5	4.555909	1.963375	3.629216	1.845098	3.31775
	6	2001	35043.54	93.10742	0.868534	77.03102	5092.637	70.3	1997.5	4.544608	1.968984	3.706943	1.846955	3.300487
	6	2002	35520.74	93.93465	0.812096	81.04451	6436.608	70.6	1894.16	4.550482	1.972826	3.808657	1.848805	3.277417
	6	2003	41187.53	94.8377	0.865474	79.9908	7578.119	70.9	2136	4.614766	1.976981	3.879561	1.850646	3.329601

	6	2004	44606.71	96.02183	0.886138	84.25906	9935.717	70.8	2375.697	4.6494	1.98237	3.997199	1.850033	3.375791
	6	2005	47850.55	100	0.913953	100	11727.33	70.4	2529.178	4.679887	2	4.069199	1.847573	3.402979
	6	2006	49268.77	103.057	0.903672	113.6712	13639.44	70	2535.342	4.692572	2.013077	4.134796	1.845098	3.404037
	6	2007	49589.27	108.7096	0.924676	114.7506	18270.7	69.5	2464.096	4.695388	2.036268	4.261755	1.841985	3.391658
	6	2008	47965.5	120.214	0.933764	138.779	18947.89	69.1	2585.749	4.680929	2.079955	4.277561	1.839478	3.412586
	6	2009	41937.25	125.7554	0.927309	108.6187	12898.55	69.2	2350	4.6226	2.099527	4.110541	1.840106	3.371068
	6	2010	38496.62	131.4098	0.966015	113.7912	12894.46	69.2	2300.411	4.585423	2.118628	4.110403	1.840106	3.361805
	6	2011	39651.15	137.8555	1.003387	129.6258	12413.16	69.5	2530.137	4.598256	2.139424	4.093882	1.841985	3.403144
	6	2012	39732.27	142.2669	0.998684	136.3599	12481	69.8	2634.945	4.599143	2.153104	4.096249	1.843855	3.420772
	6	2013	37923.6	146.112	0.971472	139.8045	13164.31	70.1	2650	4.57891	2.164686	4.119398	1.845718	3.423246
	6	2014	36258.56	150.3618	1.019695	129.851	12982.49	70.4	2642.055	4.559411	2.177137	4.113358	1.847573	3.421942
	6	2015	35489.48	155.2804	1.487169	94.33726	12885.25	70.1	2803.671	4.5501	2.191117	4.110093	1.845718	3.447727
	6	2016	35314	160.2477	1.524549	87.93204	13010.33	70.2	2923.825	4.547947	2.204792	4.114288	1.846337	3.465951
	6	2017	28367.29	113.4	0.730055	116.48	4014.485	46.8	2789.85	4.452818	2.054613	3.60363	1.669936	3.445581
	6	2018	33056.92	142.9761	1.247258	99.5831	9970.019	62.4	2839.115	4.516955	2.150174	3.94267	1.787331	3.453086
Libya	7	1990	9201.826	18.949	0.657111	0.936102	4355.707	50.1	1375	3.963874	1.277586	3.639059	1.699838	3.138303
	7	1991	10390.32	23.179	0.625829	0.636666	3279.488	50.1	1483.151	4.016629	1.365095	3.515806	1.699838	3.171185
	7	1992	9876.578	28.762	0.522442	1.234847	3083.837	50.4	1433	3.994606	1.458819	3.489091	1.702431	3.156246
	7	1993	9296.458	42.298	0.552017	0.717453	3588.722	50.7	1361	3.968317	1.62632	3.55494	1.705008	3.133858
	7	1994	9281.696	63.446	0.494572	0.269762	3221.844	50.9	1377.589	3.967627	1.802404	3.508105	1.706718	3.13912
	7	1995	8903.594	80.365	0.46898	57.71014	2054.494	51.4	1390	3.949565	1.905067	3.312705	1.710963	3.143015
	7	1996	8936.351	111.666	0.465828	1.434906	2738.767	51.8	1400.847	3.95116	2.047921	3.437555	1.71433	3.146391
	7	1997	9252.641	115.686	0.448262	1.386364	2306.016	52.3	1445.918	3.966266	2.063281	3.362862	1.718502	3.160144
	7	1998	8789.589	119.966	0.368969	0.636666	1903.33	52.8	1390	3.943969	2.079058	3.279514	1.722634	3.143015
	7	1999	8723.407	123.085	0.375318	1.434906	1918.584	53.3	1318.959	3.940686	2.090205	3.282981	1.726727	3.120231
	7	2000	8791.401	117.423	0.44798	417.6253	2454.119	53.8	1410.027	3.944058	2.069753	3.389896	1.730782	3.149227
	7	2001	8698.635	105.446	0.489617	0.717453	1915.534	54.2	1366.548	3.939451	2.02303	3.28229	1.733999	3.135625
	7	2002	8454.759	97.538	0.876389	46.72165	1395.794	54.6	1318.521	3.927101	1.989174	3.144821	1.737193	3.120087
	7	2003	9403.438	96.27	0.843005	4.957599	2483.882	54.8	1420.521	3.973287	1.983491	3.395131	1.738781	3.152448
	7	2004	9664.642	97.187	0.857364	81.25728	1827.393	55.1	1515.219	3.985186	1.987608	3.261832	1.741152	3.180475
	7	2005	10497.34	100	0.943996	100	2076.168	55.3	1633.11	4.021079	2	3.317262	1.742725	3.213015
	7	2006	11033.26	101.516	0.97582	104.883	5200.296	55.5	1681.041	4.042704	2.006534	3.716028	1.744293	3.225578
	7	2007	11421.8	107.862	1.076226	108.2003	7736.784	55.7	1701.808	4.057735	2.032868	3.88856	1.745855	3.230911
	7	2008	12914.19	119.037	0.924824	119.075	11186.78	55.8	1735.833	4.111067	2.075682	4.048705	1.746634	3.239508
	7	2009	12675.43	121.949	0.937053	85.99683	7803.008	55.9	1650	4.102963	2.086178	3.892262	1.747412	3.217484
	7	2010	13120.54	124.966	0.988746	110.7205	8698.755	55.9	1650	4.117952	2.096792	3.939457	1.747412	3.217484
	7	2011	5061.826	144.838	0.854618	153.9943	9126.244	55.8	465.397	3.704307	2.160883	3.960292	1.746634	2.667824
	7	2012	11365.66	153.622	0.926839	180.928	8587.566	55.7	1366.803	4.055595	2.186453	3.93387	1.745855	3.135706
	7	2013	5442.994	157.617	0.923401	178.1298	8913.795	55.6	918.329	3.735838	2.197603	3.950063	1.745075	2.962998
	7	2014	4129.54	171.4	0.901619	182.4597	8875.868	55.4	470.836	3.615902	2.234011	3.948211	1.74351	2.67287
	7	2015	3858.801	192.1	0.917286	202.3202	8792.409	55.5	403.973	3.586452	2.283527	3.944108	1.744814	2.606352
	7	2016	3898.439	240.1	0.914102	194.1738	8860.691	55.5	384.686	3.590891	2.380392	3.947468	1.744467	2.585106
	7	2017	7794.168	318.7	0.583366	1.385	4665.16	55.4	419.8317	3.89177	2.503382	3.668867	1.744264	2.623075
	7	2018	5183.802	250.3	0.804918	132.6264	7439.42	55.53	402.8302	3.689704	2.389101	3.853481	1.744515	2.604845
Nigeria	8	1990	1362.234	3.932173	0.314056	70.01963	144.1313	57.7	1810	3.134252	0.594633	2.158758	1.761176	3.257679
	8	1991	1328.15	4.443639	0.365653	59.21573	119.4361	57.7	1891.8	3.123247	0.647739	2.077136	1.761176	3.276875
	8	1992	1329.146	6.424997	0.375939	49.07171	115.3062	57.6	1943	3.123573	0.807873	2.061853	1.760422	3.288473
	8	1993	1316.475	10.09788	0.361077	53.68439	64.3184	57.5	1960	3.119413	1.00423	1.808335	1.759668	3.292256
	8	1994	1294.137	15.85687	0.411061	99.27245	58.96366	57.3	1930.9	3.11198	1.200217	1.770584	1.758155	3.28576
	8	1995	1289.441	27.40623	0.513619	158.0263	57.45395	57.2	1992.753	3.110401	1.437849	1.75932	1.757396	3.299453
	8	1996	1309.723	35.42765	0.540796	204.8953	70.79708	57	2000.532	3.117179	1.549342	1.850015	1.755875	3.301146
	8	1997	1314.458	38.44951	0.555213	233.1972	81.11619	56.9	2132.452	3.118747	1.584891	1.909108	1.755112	3.328879
	8	1998	1318.219	42.29321	0.410861	269.7771	72.70069	56.7	2153.458	3.119988	1.626271	1.861539	1.753583	3.333136
	8	1999	1291.824	45.09229	0.449353	68.41337	64.69622	56.4	2129.86	3.111203	1.654102	1.810879	1.751279	3.328351

	8	2000	1326.887	48.21859	0.44217	69.40543	82.30461	56.2	2165	3.122834	1.683215	1.915424	1.749736	3.335458
	8	2001	1351.06	57.31919	0.498492	77.36889	82.79552	55.9	2256.156	3.130675	1.7583	1.918007	1.747412	3.353369
	8	2002	1598.661	64.70004	0.356965	77.64803	100.6793	55.5	2117.863	3.203756	1.810905	2.00294	1.744293	3.325898
	8	2003	1718.107	73.77852	0.453295	72.9306	159.4494	55.2	2275	3.23505	1.86793	2.202623	1.741939	3.356981
	8	2004	1850.194	84.84391	0.418263	74.77777	150.3279	54.7	2328.962	3.267217	1.928621	2.177039	1.737987	3.367162
	8	2005	1920.384	100	0.496509	85.40739	138.0265	54.9	2627.438	3.283388	2	2.139962	1.739572	3.419532
	8	2006	1983.738	108.2395	0.406848	90.67548	263.5235	55	2439.863	3.297484	2.034386	2.420819	1.740363	3.387365
	8	2007	2056.838	114.0653	0.426352	89.73682	327.7612	55.2	2349.644	3.3132	2.057154	2.515558	1.741939	3.371002
	8	2008	2128.666	127.2716	0.454939	99.23479	358.6038	55.4	2165.44	3.328108	2.104731	2.554615	1.74351	3.335546
	8	2009	2216.499	141.9558	0.395769	92.02913	412.3822	55.5	2208.311	3.345668	2.152153	2.6153	1.744293	3.34406
	8	2010	2327.32	161.4325	0.403077	100	1247.158	55.7	2455.26	3.366856	2.207991	3.095922	1.745855	3.390097
	8	2011	2376.638	178.9334	0.449128	100.3823	1269.033	55.9	2550.345	3.375963	2.252691	3.103473	1.747412	3.406599
	8	2012	2412.86	200.793	0.380713	111.5409	1267.873	56	2520	3.382532	2.302748	3.103076	1.748188	3.401401
	8	2013	2475.948	217.8128	0.331156	118.989	1375.834	56.2	2367.37	3.393741	2.338083	3.138566	1.749736	3.374266
	8	2014	2563.092	235.3621	0.311937	127.3962	1657.482	56.3	2423.205	3.408764	2.371737	3.219449	1.750508	3.38439
	8	2015	2562.522	256.5856	0.352729	126.4838	1433.165	56.2	2279.811	3.408668	2.409232	3.156296	1.749479	3.357899
	8	2016	2455.918	296.863	0.430269	116.1859	1487.557	56.2	1999.885	3.390214	2.472556	3.172474	1.749908	3.301005
	8	2017	1884.073	214.2	0.21554	105.5	0.042308	56.23	2234.3	3.275098	2.330819	-1.37358	1.749965	3.349142
	8	2018	2300.838	255.8829	0.332846	116.0566	973.5879	56.2	2171.332	3.357993	2.404203	1.65173	1.749784	3.336015
Saudi Arabia	9	1990	18002.74	90.31717	0.776868	124.9092	3437.335	55.7	6410	4.255339	1.95577	3.536222	1.745855	3.806858
	9	1991	20040.5	94.70758	0.873305	124.9806	4846.129	55.7	8115	4.301908	1.976385	3.685395	1.745855	3.909289
	9	1992	20226.85	94.63469	0.848241	117.806	5636.845	55.8	8332	4.305928	1.97605	3.751036	1.746634	3.920749
	9	1993	19413.78	95.6338	0.722098	121.0808	5828.299	55.4	8197.81	4.28811	1.980611	3.765542	1.74351	3.913698
	9	1994	19041.06	96.17356	0.633835	116.839	4673.403	55	8120	4.279691	1.983056	3.669633	1.740363	3.909556
	9	1995	18648.86	100.8557	0.686846	113.243	4846.356	54.3	8231.233	4.270652	2.0037	3.685415	1.7348	3.915465
	9	1996	18744.78	102.0882	0.713177	115.3913	4786.784	53.3	8218.075	4.27288	2.008976	3.680044	1.726727	3.91477
	9	1997	18588.3	102.1466	0.706918	120.64	4983.043	52	8362.033	4.26924	2.009224	3.697495	1.716003	3.922312
	9	1998	18763.59	101.7819	0.59853	126.5008	5328.83	50.7	8388.904	4.273316	2.00767	3.726632	1.705008	3.923705
	9	1999	17690.92	100.41	0.621916	121.2376	5475.798	49.6	7833.39	4.24775	2.001777	3.738447	1.695482	3.89395
	9	2000	18263.23	99.28041	0.713355	122.7415	5408.179	49.9	8403.799	4.261578	1.996864	3.733051	1.698101	3.924476
	9	2001	17585.39	98.17579	0.656403	124.8213	5128.593	49.7	8031.096	4.245152	1.992004	3.709998	1.696356	3.904775
	9	2002	16619.43	98.40171	0.671104	121.1745	5236.489	50.2	7634.396	4.220616	1.993003	3.71904	1.700704	3.882775
	9	2003	17954.95	98.97914	0.712125	110.9485	5670.069	51	8775	4.254184	1.995544	3.753588	1.70757	3.943247
	9	2004	18822.73	99.3054	0.767543	103.4006	6481.383	51.7	9100.82	4.274683	1.996973	3.811668	1.713491	3.959081
	9	2005	19309.31	100	0.851966	100.4221	7954.894	52.3	9550.137	4.285767	2	3.900634	1.718502	3.98001
	9	2006	19304.55	102.2073	0.899446	98.89061	9586.808	52.7	9152.329	4.28566	2.009482	3.981674	1.721811	3.961532
	9	2007	19136.16	106.468	0.948566	96.02	12112.68	52.8	8721.507	4.281855	2.027219	4.08324	1.722634	3.940592
	9	2008	19792.72	116.9751	0.961027	93.68486	15093.71	52.9	9261.251	4.296505	2.068094	4.178796	1.723456	3.96667
	9	2009	18861.11	122.9018	0.848583	100.1049	14052.3	52.8	8250.112	4.275567	2.089558	4.147748	1.722634	3.91646
	9	2010	19259.59	129.4686	0.825499	100	16089.5	53.2	8900	4.284647	2.112164	4.206542	1.725912	3.94939
	9	2011	20575.5	137.0089	0.855435	96.60873	17164.85	53.5	9458.356	4.31335	2.136749	4.23464	1.728354	3.975816
	9	2012	21056.35	140.9628	0.835118	99.69602	17812.08	53.9	9832.322	4.323383	2.149105	4.250715	1.731589	3.992656
	9	2013	21005.01	145.9046	0.827723	102.4567	16622.02	56.5	9693.151	4.322323	2.164069	4.220684	1.752048	3.986465
	9	2014	21183.46	149.8017	0.796299	105.4895	17087.29	56.9	9735.342	4.325997	2.175517	4.232673	1.755112	3.988351
	9	2015	21507.96	153.0733	0.93845	118.6925	17156.35	55.8	10168.25	4.332599	2.1849	4.234425	1.746375	4.007246
	9	2016	21323.13	158.467	0.954706	123.4557	16955.68	56.4	10460.71	4.328851	2.199939	4.229315	1.751194	4.019561
	9	2017	20130.61	95.87	0.538315	118.2	0.003848	56.3	10121.43	4.303857	1.981683	-2.41477	1.750908	4.005242
	9	2018	20987.23	135.8034	0.810491	120.1161	11370.68	56.2	10250.13	4.321769	2.122174	2.016322	1.749492	4.010683
Venezuela	10	1990	11849.15	1.071	0.600747	35.72915	734.4466	61.1	2137	4.073687	0.029789	2.86596	1.786041	3.329805
	10	1991	12701.43	1.437	0.581483	38.26567	629.3797	62.4	2375	4.103852	0.157457	2.798913	1.795185	3.375664
	10	1992	13168.73	1.888	0.558579	39.85882	1245.419	61.7	2371	4.119544	0.276002	3.095316	1.790285	3.374932
	10	1993	12916.61	2.608	0.553345	41.91584	1786.237	60.2	2450	4.111149	0.416308	3.251939	1.779596	3.389166
	10	1994	12344.39	4.194	0.539387	40.53478	1337.307	61.5	2588	4.09147	0.622628	3.126231	1.788875	3.412964
	10	1995	12564.84	6.707	0.502851	50.21024	918.8404	64	2750.137	4.099157	0.826528	2.96324	1.80618	3.439354

	10	1996	12284.51	13.407	0.586896	41.64237	1477.29	65.6	2938	4.089358	1.127332	3.169466	1.816904	3.468052
	10	1997	12807.01	20.115	0.512874	53.18766	1174.494	67.2	3280	4.107448	1.30352	3.069851	1.827369	3.515874
	10	1998	12594.36	27.313	0.437469	65.5127	2369.244	68.3	3167.014	4.100176	1.436369	3.37461	1.834421	3.50065
	10	1999	11616.08	33.751	0.418463	74.74033	2697.189	68.9	2825.8	4.06506	1.528287	3.430911	1.838219	3.451141
	10	2000	11818.29	39.22	0.478128	77.65119	2456.064	68.4	3155	4.072555	1.593508	3.39024	1.835056	3.498999
	10	2001	11994.07	44.135	0.422541	82.74272	2531.746	70.5	3010	4.078967	1.644783	3.40342	1.848189	3.478566
	10	2002	10733.9	54.036	0.485265	65.282	2883.971	72.1	2603.945	4.030758	1.732683	3.459991	1.857935	3.415632
	10	2003	9725.461	70.836	0.504051	56.67914	1654.78	71.3	2335.192	3.98791	1.850254	3.21874	1.85309	3.368323
	10	2004	11303.47	86.241	0.554017	54.76502	1057.323	70.4	2556.94	4.053212	1.935714	3.024208	1.847573	3.407721
	10	2005	12257.01	100	0.593793	53.74593	2014.876	69.5	2564.658	4.088385	2	3.304248	1.841985	3.409029
	10	2006	13242.09	113.654	0.58132	56.91451	2725.963	68.7	2510.548	4.121957	2.055585	3.43552	1.836957	3.399769
	10	2007	14165.79	134.911	0.556892	62.46324	3969.815	68.1	2490.301	4.151241	2.130047	3.59877	1.833147	3.396252
	10	2008	14675.11	175.883	0.50735	75.53118	5471.025	68.4	2510	4.166581	2.245224	3.738069	1.835056	3.399674
	10	2009	13983.72	223.514	0.343629	98.7177	6499.055	68.4	2520	4.145623	2.349305	3.81285	1.835056	3.401401
	10	2010	13566.39	286.517	0.30268	100	6421.196	68.2	2410	4.132464	2.45715	3.807616	1.833784	3.382017
	10	2011	13924.21	361.27	0.497047	71.19011	6411.319	68.4	2500	4.14377	2.557832	3.806947	1.835056	3.39794
	10	2012	14496.11	437.385	0.464344	86.10373	5301.311	68.6	2500	4.161251	2.640864	3.724383	1.836324	3.39794
	10	2013	14484.98	615.136	0.448162	85.27018	7217.679	68.8	2500	4.160918	2.788971	3.858398	1.837588	3.39794
	10	2014	13730.43	997.558	0.459492	133.1029	6080.921	68.9	2500	4.137684	2.998938	3.783969	1.838219	3.39794
	10	2015	12703.97	2211.966	0.494028	328.162	6205.144	68.8	2500	4.103939	3.344778	3.792752	1.837378	3.39794
	10	2016	10474.58	11551.5	0.575974	780.3361	6498.777	68.8	2276.967	4.020137	4.062638	3.812832	1.837729	3.357357
	10	2017	10409.39	1087.5	28.25906	3707.7	35.50821	68.8	2425.656	4.017425	3.036429	1.550329	1.837775	3.384829
	10	2018	11195.98	4950.322	9.776354	1605.399	4246.476	68.8	2400.874	4.047167	3.481282	3.051971	1.837627	3.380042

UNIT ROOT TEST
@LEVELS
GDPc

Panel unit root test: Summary
Series: GDPC
Date: 03/18/19 Time: 00:50
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.04083	0.1490	10	270
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.27028	0.1020	10	270
ADF - Fisher Chi-square	31.1894	0.0527	10	270
PP - Fisher Chi-square	38.9281	0.0068	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: GDPC
Date: 03/18/19 Time: 00:57
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	1.44363	0.9256

** Probabilities are computed assuming asympotic normality

Intermediate regression results on GDPC

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	905.334	1	1	27
2	753.164	1	1	27
3	1013.52	1	1	27
4	375.065	1	1	27
5	340.717	1	1	27
6	3578.02	1	1	27
7	2097.04	1	1	27
8	153.216	1	1	27
9	675.515	1	1	27
10	789.549	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.04227	1.444	0.029	260

Null Hypothesis: Stationarity
Series: GDPC
Date: 03/18/19 Time: 01:02
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	7.23331	0.0000
Heteroscedastic Consistent Z-stat	4.53078	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on GDPC

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1448	947955.1	1.0	29
2	0.1199	961320.5	2.0	29
3	0.1243	904077.2	0.0	29
4	0.1225	1310946.	4.0	29
5	0.1219	426238.6	4.0	29
6	0.1696	1.59E+08	3.0	29
7	0.1173	14212713	4.0	29
8	0.1101	97835.82	3.0	29
9	0.1472	2932064.	4.0	29
10	0.0877	4264224.	3.0	29

TO

Panel unit root test: Summary
Series: TO
Date: 03/18/19 Time: 00:57
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.80022	0.7882	10	270
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	2.03044	0.9788	10	270
ADF - Fisher Chi-square	16.7387	0.6699	10	270
PP - Fisher Chi-square	71.3549	0.0000	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: TO
Date: 03/18/19 Time: 01:04
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	1.49064	0.9320

** Probabilities are computed assuming asympotic normality

Intermediate regression results on TO

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	54.8605	1	1	27
2	54.7159	1	1	27
3	70.6578	1	1	27
4	0.18957	1	1	27
5	0.06851	1	1	27
6	0.19254	1	1	27
7	0.12115	1	1	27
8	0.06774	1	1	27
9	0.10971	1	1	27
10	5.02713	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.10347	4.034	0.026	260

Null Hypothesis: Stationarity
Series: TO
Date: 03/18/19 Time: 01:04
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	7.62423	0.0000
Heteroscedastic Consistent Z-stat	5.27723	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on TO

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1678	2829.560	0.0	29
2	0.1674	2811.623	0.0	29

3	0.1674	4686.882	0.0	29
4	0.0946	0.030089	3.0	29
5	0.0885	0.013071	3.0	29
6	0.1665	0.032523	3.0	29
7	0.1043	0.080379	4.0	29
8	0.1605	0.007862	3.0	29
9	0.1036	0.020139	3.0	29
10	0.1435	28.31031	1.0	29

EX

Panel unit root test: Summary
Series: EX
Date: 04/13/19 Time: 02:40
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.49037	0.3119	10	270
Breitung t-stat	-0.20422	0.4191	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.85773	0.8045	10	270
ADF - Fisher Chi-square	40.4209	0.0044	10	270
PP - Fisher Chi-square	375.878	0.0000	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: EX
Date: 04/13/19 Time: 02:40
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-0.20422	0.4191

** Probabilities are computed assuming asympotic normality

Intermediate regression results on EX

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	9.26562	1	1	27
2	38.6597	1	1	27

3	886.448	1	1	27
4	9.15839	1	1	27
5	40.4794	1	1	27
6	65.4195	1	1	27
7	107.164	1	1	27
8	44.3854	1	1	27
9	4.88393	1	1	27
10	585.447	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	-0.00626	-0.204	0.031	260

Null Hypothesis: Stationarity
Series: EX
Date: 04/13/19 Time: 02:40
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	3.59535	0.0002
Heteroscedastic Consistent Z-stat	7.26335	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on EX

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1947	390.3648	3.0	29
2	0.0969	1453.763	2.0	29
3	0.0773	627129.0	2.0	29
4	0.1721	986.6738	3.0	29
5	0.0699	6467.244	3.0	29
6	0.1750	1047.795	11.0	29
7	0.5000	512.2296	28.0	29
8	0.0728	5182.884	2.0	29
9	0.1164	298.2828	4.0	29
10	0.1514	626846.7	2.0	29

CPI

Panel unit root test: Summary
Series: CPI
Date: 03/18/19 Time: 01:05
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.40159	0.6560	10	270
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.23282	0.5921	10	270
ADF - Fisher Chi-square	15.7467	0.7322	10	270
PP - Fisher Chi-square	39.6134	0.0056	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: CPI
Date: 03/18/19 Time: 01:06
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-0.34063	0.3667

** Probabilities are computed assuming asympotic normality

Intermediate regression results on CPI

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	6.54601	1	1	27
2	35.1966	1	1	27
3	12.7723	1	1	27
4	6.11338	1	1	27
5	104.653	1	1	27
6	10.0618	1	1	27
7	23.6568	1	1	27
8	18.7090	1	1	27
9	12.8993	1	1	27
10	2241.68	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	-0.07482	-2.553	0.029	260

Null Hypothesis: Stationarity

Series: CPI
Date: 03/18/19 Time: 01:06
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	7.18457	0.0000
Heteroscedastic Consistent Z-stat	5.16497	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on CPI

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1027	180.4393	3.0	29
2	0.1660	5297.839	4.0	29
3	0.1365	712.2203	3.0	29
4	0.1145	34.78115	0.0	29
5	0.1481	19919.52	3.0	29
6	0.1172	214.2589	3.0	29
7	0.1280	2920.533	3.0	29
8	0.1626	1564.444	4.0	29
9	0.1119	321.5122	3.0	29
10	0.1617	4478664.	2.0	29

COP

Panel unit root test: Summary
Series: COP
Date: 03/18/19 Time: 01:06
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.03757	0.0518	10	270
Breitung t-stat	-1.07327	0.1416	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.88257	0.1887	10	270
ADF - Fisher Chi-square	32.2593	0.0406	10	270
PP - Fisher Chi-square	25.2973	0.1903	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.
Null Hypothesis: Unit root (common unit root process)
Series: COP

Date: 03/18/19 Time: 01:07
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-1.07327	0.1416

** Probabilities are computed assuming asympotic normality

Intermediate regression results on COP

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	54.4137	1	1	27
2	92.3768	1	1	27
3	26.0085	1	1	27
4	15.6048	1	1	27
5	257.661	1	1	27
6	225.985	1	1	27
7	273.767	1	1	27
8	135.238	1	1	27
9	448.496	1	1	27
10	177.819	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	-0.02482	-1.073	0.023	260

Null Hypothesis: Stationarity
Series: COP
Date: 03/18/19 Time: 01:07
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	4.92990	0.0000
Heteroscedastic Consistent Z-stat	4.48677	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on COP

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1319	77762.52	4.0	29
2	0.0891	128664.0	4.0	29
3	0.1028	1933.504	2.0	29
4	0.0807	2505.064	3.0	29

5	0.1407	189104.3	3.0	29
6	0.1782	97244.60	0.0	29
7	0.1503	384918.1	4.0	29
8	0.1700	54285.45	3.0	29
9	0.1087	213429.8	0.0	29
10	0.1072	194373.0	4.0	29

CPT

Panel unit root test: Summary
Series: CPT
Date: 03/18/19 Time: 01:08
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	1.57373	0.9422	10	270
Breitung t-stat	3.61662	0.9999	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	2.74426	0.9970	10	270
ADF - Fisher Chi-square	8.19667	0.9905	10	270
PP - Fisher Chi-square	6.99773	0.9967	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: CPT
Date: 03/18/19 Time: 01:08
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	3.61662	0.9999

** Probabilities are computed assuming asympotic normality

Intermediate regression results on CPT

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	110816.	1	1	27
2	33705.4	1	1	27
3	418.335	1	1	27
4	2353957	1	1	27
5	2858159	1	1	27

6	2654.06	1	1	27
7	1626.10	1	1	27
8	354.889	1	1	27
9	3594.03	1	1	27
10	1516.84	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.10441	3.617	0.029	260

Null Hypothesis: Stationarity
Series: CPT
Date: 03/18/19 Time: 01:08
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	7.08673	0.0000
Heteroscedastic Consistent Z-stat	4.32296	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on CPT

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1694	1.16E+10	0.0	29
2	0.1213	2.00E+09	2.0	29
3	0.1107	839356.7	4.0	29
4	0.1681	5.21E+12	0.0	29
5	0.1553	8.15E+12	1.0	29
6	0.1175	26777508	3.0	29
7	0.1038	12950779	4.0	29
8	0.1142	297420.8	3.0	29
9	0.0962	28700693	3.0	29
10	0.0814	4384411.	3.0	29

LBF

Panel unit root test: Summary
Series: LBF
Date: 03/18/19 Time: 01:09
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				

Levin, Lin & Chu t*	-0.13427	0.4466	10	270
Breitung t-stat	0.88134	0.8109	10	260

Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.83136	0.9665	10	270
ADF - Fisher Chi-square	10.2204	0.9640	10	270
PP - Fisher Chi-square	25.5540	0.1811	10	280

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: LBF
Date: 03/18/19 Time: 01:09
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 260
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	0.88134	0.8109

** Probabilities are computed assuming asympotic normality

Intermediate regression results on LBF

Cross Section	S.E. of Regression	Lag	Max Lag	Obs
1	0.21429	1	1	27
2	0.24148	1	1	27
3	1.18636	1	1	27
4	0.15449	1	1	27
5	3.46945	1	1	27
6	4.16478	1	1	27
7	0.10786	1	1	27
8	0.14846	1	1	27
9	0.70184	1	1	27
10	0.89720	1	1	27

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.00639	0.881	0.007	260

Null Hypothesis: Stationarity
Series: LBF
Date: 03/18/19 Time: 01:09
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 290
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	6.94791	0.0000

Heteroscedastic Consistent Z-stat	6.16377	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on LBF

Cross Section	LM	Variance HAC	Bandwidth	Obs
1	0.0905	1.503928	4.0	29
2	0.0996	0.888230	4.0	29
3	0.1608	13.42710	4.0	29
4	0.1774	2.813865	4.0	29
5	0.1081	20.57102	2.0	29
6	0.1813	44.77277	3.0	29
7	0.1788	3.086991	4.0	29
8	0.1668	1.958428	4.0	29
9	0.1641	18.26733	4.0	29
10	0.1537	20.50817	4.0	29

UNIT ROOT AT FIRST DIFFERENCE
GDPc

Panel unit root test: Summary
Series: D(LOGGDPC)
Date: 03/18/19 Time: 01:12
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.11620	0.0000	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.72035	0.0001	10	260
ADF - Fisher Chi-square	69.4991	0.0000	10	260
PP - Fisher Chi-square	231.613	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(LOGGDPC)
Date: 03/18/19 Time: 01:12
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-1.84572	0.0325

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(LOGGDPC)

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	0.56887	1	1	26
2	0.54634	1	1	26
3	0.53996	1	1	26
4	0.02041	1	1	26
5	0.03258	1	1	26
6	0.04538	1	1	26
7	0.17024	1	1	26
8	0.03492	1	1	26
9	0.02189	1	1	26
10	0.03674	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.08816	2.801	0.031	250

Null Hypothesis: Stationarity
Series: D(LOGGDPC)
Date: 03/18/19 Time: 01:13
Sample: 1990 2018
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	0.97070	0.1658
Heteroscedastic Consistent Z-stat	1.25117	0.1054

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(LOGGDPC)

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.4091	0.039088	22.0	28
2	0.3483	0.042357	19.0	28
3	0.3919	0.037175	21.0	28
4	0.1636	0.000314	2.0	28
5	0.2241	0.000379	8.0	28
6	0.2213	0.006067	2.0	28
7	0.1669	0.005847	6.0	28
8	0.1294	0.001026	0.0	28
9	0.0930	0.000209	4.0	28
10	0.1090	0.001171	2.0	28

TO

Panel unit root test: Summary
Series: D(TO)
Date: 03/18/19 Time: 01:14
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.33657	0.0000	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.75946	0.0000	10	260
ADF - Fisher Chi-square	110.019	0.0000	10	260
PP - Fisher Chi-square	276.428	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(TO)
Date: 03/18/19 Time: 01:14
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-1.57142	0.0239

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(TO)

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	55.7004	1	1	26
2	55.5330	1	1	26
3	71.8170	1	1	26
4	0.29797	1	1	26
5	0.09125	1	1	26
6	0.29385	1	1	26
7	0.15001	1	1	26
8	0.09685	1	1	26
9	0.15726	1	1	26
10	5.10154	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.12547	4.346	0.029	250

Null Hypothesis: Stationarity
Series: D(TO)
Date: 03/18/19 Time: 01:14
Sample: 1990 2018
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	1.41268	0.0789
Heteroscedastic Consistent Z-stat	2.75106	1.22654

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(TO)

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.4074	383.7083	22.0	28
2	0.4074	380.7940	22.0	28
3	0.4074	634.9670	22.0	28
4	0.0421	0.025431	1.0	28
5	0.1253	0.001980	8.0	28
6	0.5000	0.002416	27.0	28
7	0.1294	0.010659	2.0	28
8	0.3724	0.001284	20.0	28
9	0.1646	0.002715	11.0	28
10	0.4074	3.276168	22.0	28

REX

Panel unit root test: Summary
Series: D(EX)
Date: 04/13/19 Time: 02:39
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.98135	0.0014	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.29531	0.0000	10	260
ADF - Fisher Chi-square	139.960	0.0000	10	260
PP - Fisher Chi-square	201.724	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(EX)
Date: 04/13/19 Time: 02:40
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-6.30909	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(EX)

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	13.3590	1	1	26
2	56.1057	1	1	26
3	1355.77	1	1	26
4	12.1215	1	1	26
5	49.6230	1	1	26
6	98.3178	1	1	26
7	160.256	1	1	26
8	56.1798	1	1	26
9	5.94649	1	1	26
10	546.537	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	-0.02468	-0.578	0.043	250

Null Hypothesis: Stationarity
Series: D(EX)
Date: 04/13/19 Time: 02:40
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	1.37402	0.0847
Heteroscedastic Consistent Z-stat	12.0765	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(EX)

Cross section	LM	Variance HAC	Bandwidth	Obs

1	0.1632	135.2609	9.0	28
2	0.5000	99.11925	27.0	28
3	0.1692	132073.8	9.0	28
4	0.1566	141.0487	4.0	28
5	0.0545	1886.269	2.0	28
6	0.2489	331.2795	14.0	28
7	0.3161	751.8735	17.0	28
8	0.0706	1418.632	4.0	28
9	0.1012	28.00468	1.0	28
10	0.4821	23178.47	26.0	28

CPI

Panel unit root test: Summary
Series: D(LOGCPI)
Date: 03/18/19 Time: 01:16
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.22782	0.0098	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.53454	0.0002	10	260
ADF - Fisher Chi-square	55.3906	0.0000	10	260
PP - Fisher Chi-square	177.775	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(LOGCPI)
Date: 03/18/19 Time: 01:17
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	3.16594	0.0429

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(LOGCPI)

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	0.02817	1	1	26
2	1.52220	1	1	26
3	0.07308	1	1	26

4	0.04025	1	1	26
5	0.13816	1	1	26
6	0.03560	1	1	26
7	0.06072	1	1	26
8	0.06192	1	1	26
9	0.04453	1	1	26
10	0.29943	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.08545	2.450	0.035	250

Null Hypothesis: Stationarity
Series: D(LOGCPI)
Date: 03/18/19 Time: 01:17
Sample: 1990 2018
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	-0.23468	0.5928
Heteroscedastic Consistent Z-stat	2.46570	0.0068

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(LOGCPI)

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.4352	0.004854	4.0	28
2	0.1207	0.431518	5.0	28
3	0.5407	0.019908	4.0	28
4	0.2718	0.000189	14.0	28
5	0.2728	0.009154	5.0	28
6	0.1044	0.000527	5.0	28
7	0.2557	0.009014	3.0	28
8	0.4696	0.010056	3.0	28
9	0.0990	0.000824	6.0	28
10	0.2590	0.009144	13.0	28

COP

Panel unit root test: Summary
Series: D(LOGCOP)
Date: 03/18/19 Time: 01:18
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Cross-

Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.4502	0.0000	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-10.7842	0.0000	10	260
ADF - Fisher Chi-square	117.363	0.0000	10	260
PP - Fisher Chi-square	185.804	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(LOGCOP)
Date: 03/18/19 Time: 01:18
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-5.02999	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(LOGCOP)

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	0.01872	1	1	26
2	0.03651	1	1	26
3	0.03159	1	1	26
4	0.02619	1	1	26
5	0.03935	1	1	26
6	0.06901	1	1	26
7	0.20827	1	1	26
8	0.03416	1	1	26
9	0.03303	1	1	26
10	0.03739	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	-0.30127	-5.030	0.060	250

Null Hypothesis: Stationarity
Series: D(LOGCOP)
Date: 03/18/19 Time: 01:18
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**

Hadri Z-stat	-1.19524	0.7363
Heteroscedastic Consistent Z-stat	10.0935	1.08751

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(LOGCOP)

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1041	0.000551	3.0	28
2	0.1042	0.001719	3.0	28
3	0.0699	0.000411	5.0	28
4	0.1150	0.000990	3.0	28
5	0.2867	0.000131	12.0	28
6	0.5000	0.001965	27.0	28
7	0.1001	0.005405	6.0	28
8	0.5000	3.49E-05	27.0	28
9	0.0939	0.000575	3.0	28
10	0.1266	0.000609	2.0	28

CPT

Panel unit root test: Summary
Series: D(LOGCPT)
Date: 03/18/19 Time: 01:19
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-Sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.50378	0.0000	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.94130	0.0000	10	260
ADF - Fisher Chi-square	82.9447	0.0000	10	260
PP - Fisher Chi-square	272.239	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(LOGCPT)
Date: 03/18/19 Time: 01:19
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**

Breitung t-stat	-6.86040	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(LOGCPT)

Cross section	S.E. of Regression	Lag	Max Lag	Obs
1	0.40289	1	1	26
2	0.51274	1	1	26
3	0.12372	1	1	26
4	0.60259	1	1	26
5	1.38924	1	1	26
6	0.15243	1	1	26
7	0.18891	1	1	26
8	0.85352	1	1	26
9	1.23159	1	1	26
10	0.52697	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.11365	4.134	0.027	250

Null Hypothesis: Stationarity
Series: D(LOGCPT)
Date: 03/18/19 Time: 01:19
Sample: 1990 2018
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	1.40808	0.0796
Heteroscedastic Consistent Z-stat	1.30393	0.0961

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(LOGCPT)

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.3689	0.027614	19.0	28
2	0.1743	0.184952	5.0	28
3	0.1167	0.005412	2.0	28
4	0.5000	0.039795	27.0	28
5	0.5000	0.080140	27.0	28
6	0.1395	0.011476	2.0	28
7	0.1706	0.016336	2.0	28
8	0.3034	0.107366	17.0	28
9	0.3829	0.209706	20.0	28
10	0.2306	0.055410	9.0	28

LBF

Panel unit root test: Summary
Series: D(LOGLBF)
Date: 03/18/19 Time: 01:19
Sample: 1990 2018
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.45383	0.0250	10	260
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.67548	0.0037	10	260
ADF - Fisher Chi-square	49.3346	0.0003	10	260
PP - Fisher Chi-square	114.861	0.0000	10	270

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (common unit root process)
Series: D(LOGLBF)
Date: 03/18/19 Time: 01:20
Sample: 1990 2018
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 250
Cross-sections included: 10

Method	Statistic	Prob.**
Breitung t-stat	-2.98085	0.0014

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(LOGLBF)

Cross Section	S.E. of Regression	Lag	Max Lag	Obs
1	0.23017	1	1	26
2	0.27213	1	1	26
3	1.59656	1	1	26
4	0.16274	1	1	26
5	4.80610	1	1	26
6	4.25866	1	1	26
7	0.11420	1	1	26
8	0.15754	1	1	26
9	0.83627	1	1	26
10	1.02445	1	1	26

	Coefficient	t-Stat	SE Reg	Obs
Pooled	0.00531	0.129	0.041	250

Null Hypothesis: Stationarity
Series: D(LOGLBF)
Date: 03/18/19 Time: 01:20
Sample: 1990 2018
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 280
Cross-sections included: 10

Method	Statistic	Prob.**
Hadri Z-stat	1.34268	0.0889
Heteroscedastic Consistent Z-stat	3.26893	1.12654

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on D(LOGLBF)

Cross section	LM	Variance HAC	Bandwidth	Obs
1	0.1516	0.254628	4.0	28
2	0.1398	0.127923	2.0	28
3	0.2833	1.133225	2.0	28
4	0.4442	0.165047	4.0	28
5	0.2170	12.89410	3.0	28
6	0.3311	7.606330	9.0	28
7	0.4389	0.178682	4.0	28
8	0.3036	0.123296	4.0	28
9	0.3149	1.271576	3.0	28
10	0.2808	1.521994	2.0	28

PANEL COINTEGRATION TEST

Pedroni Residual Cointegration Test
Series: LOGGDPC TO EX LOGCOP LOGCPT LOGLBF
Date: 04/13/19 Time: 02:45
Sample: 1990 2018
Included observations: 290
Cross-sections included: 10
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.048148	0.1473	0.716375	0.2369
Panel rho-Statistic	-2.756196	0.0029	0.124471	0.5495
Panel PP-Statistic	-10.66622	0.0000	-3.890115	0.0001
Panel ADF-Statistic	-4.018009	0.0000	-1.726764	0.0421

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	1.226472	0.8900
Group PP-Statistic	-3.570495	0.0002
Group ADF-Statistic	-1.773018	0.0479

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
1	0.516	0.000128	0.000139	2.00	28
2	0.089	0.000457	0.000613	3.00	28
3	0.357	0.000184	0.000159	4.00	28
4	0.241	0.000309	0.000294	2.00	28
5	0.830	0.000828	0.000818	1.00	28
6	0.396	0.000921	0.001316	2.00	28
7	0.098	0.003174	0.003049	3.00	28
8	0.402	0.002149	0.002149	0.00	28
9	0.421	5.49E-05	5.86E-05	1.00	28
10	0.145	0.000637	0.000655	1.00	28

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
1	0.559	0.000104	1	--	27
2	0.462	0.000365	1	--	27
3	0.191	0.000178	1	--	27
4	0.194	0.000308	1	--	27
5	0.803	0.000735	1	--	27
6	0.694	0.000665	1	--	27
7	0.134	0.003234	1	--	27
8	0.521	0.002162	1	--	27
9	0.319	5.27E-05	1	--	27
10	0.068	0.000585	1	--	27

Kao Residual Cointegration Test
Series: LOGGDPC TO EX LOGCOP LOGCPT LOGLBF
Date: 04/13/19 Time: 02:48
Sample: 1990 2018
Included observations: 290
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	-2.243681	0.0168
Residual variance	0.004187	
HAC variance	0.000993	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID)

Method: Least Squares
Date: 04/13/19 Time: 02:48
Sample (adjusted): 1992 2018
Included observations: 270 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.231110	0.066647	-3.467672	0.0006
D(RESID(-1))	-0.405380	0.076205	-5.319610	0.0000

R-squared	0.299507	Mean dependent var	0.000116
Adjusted R-squared	0.296893	S.D. dependent var	0.066648
S.E. of regression	0.055886	Akaike info criterion	-2.923635
Sum squared resid	0.837022	Schwarz criterion	-2.896980
Log likelihood	396.6908	Hannan-Quinn criter.	-2.912932
Durbin-Watson stat	2.016895		

Johansen Fisher Panel Cointegration Test
Series: LOGGDPC TO EX LOGCOP LOGCPT LOGLBF
Date: 04/13/19 Time: 02:43
Sample: 1990 2018
Included observations: 290
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 1

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	354.3	0.0000	184.4	0.0000
At most 1	193.3	0.0000	138.4	0.0000
At most 2	85.17	0.0000	59.81	0.0000
At most 3	41.85	0.0029	27.16	0.1309
At most 4	29.73	0.0744	19.37	0.4982
At most 5	39.84	0.0052	39.84	0.0052

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
1	184.5170	0.0000	61.9446	0.0001
2	202.2847	0.0000	107.3213	0.0000
3	102.9736	0.0145	31.5144	0.3302
4	125.1090	0.0001	44.8941	0.0133
5	142.9963	0.0000	63.4477	0.0000
6	251.2608	0.0000	122.4920	0.0000
7	142.9426	0.0000	60.5253	0.0001
8	129.5613	0.0000	40.5373	0.0444
9	156.6909	0.0000	58.6402	0.0002
10	206.9267	0.0000	79.5340	0.0000

Hypothesis of at most 1 cointegration relationship				
1	122.5724	0.0000	54.4942	0.0001
2	94.9634	0.0002	55.2668	0.0000
3	71.4592	0.0368	28.0721	0.2102
4	80.2149	0.0059	28.1371	0.2073
5	79.5486	0.0068	39.5690	0.0094
6	128.7688	0.0000	67.5951	0.0000
7	82.4173	0.0035	47.6713	0.0006
8	89.0240	0.0007	33.7371	0.0520
9	98.0507	0.0001	36.1927	0.0260
10	127.3927	0.0000	64.7497	0.0000
Hypothesis of at most 2 cointegration relationship				
1	68.0782	0.0002	39.1513	0.0011
2	39.6966	0.2335	22.7574	0.1841
3	43.3872	0.1234	23.5265	0.1521
4	52.0778	0.0190	22.8235	0.1811
5	39.9796	0.2232	21.4671	0.2490
6	61.1737	0.0017	28.2442	0.0411
7	34.7460	0.4615	13.0134	0.8842
8	55.2870	0.0086	26.0142	0.0783
9	61.8580	0.0014	26.7788	0.0631
10	62.6430	0.0011	41.6753	0.0004
Hypothesis of at most 3 cointegration relationship				
1	28.9269	0.0627	17.4073	0.1536
2	16.9392	0.6445	12.7997	0.4708
3	19.8607	0.4323	11.8911	0.5585
4	29.2542	0.0577	17.6837	0.1421
5	18.5125	0.5284	12.6122	0.4885
6	32.9296	0.0211	15.5523	0.2521
7	21.7326	0.3136	11.4575	0.6016
8	29.2727	0.0574	20.2126	0.0668
9	35.0793	0.0112	17.0626	0.1691
10	20.9677	0.3596	15.3722	0.2637
Hypothesis of at most 4 cointegration relationship				
1	11.5196	0.1815	9.0275	0.2839
2	4.1394	0.8920	4.0850	0.8503
3	7.9696	0.4687	7.4389	0.4386
4	11.5705	0.1787	7.7234	0.4075
5	5.9003	0.7073	5.6637	0.6567
6	17.3773	0.0257	10.1068	0.2050
7	10.2751	0.2602	8.2615	0.3527
8	9.0602	0.3598	6.6716	0.5287
9	18.0167	0.0204	12.9567	0.0796
10	5.5956	0.7427	5.1481	0.7230
Hypothesis of at most 5 cointegration relationship				
1	2.4921	0.1144	2.4921	0.1144
2	0.0544	0.8155	0.0544	0.8155
3	0.5307	0.4663	0.5307	0.4663
4	3.8471	0.0498	3.8471	0.0498
5	0.2366	0.6266	0.2366	0.6266
6	7.2704	0.0070	7.2704	0.0070
7	2.0136	0.1559	2.0136	0.1559
8	2.3886	0.1222	2.3886	0.1222
9	5.0600	0.0245	5.0600	0.0245
10	0.4474	0.5036	0.4474	0.5036

**MacKinnon-Haug-Michelis (1999) p-values

PANEL LONG-RUN PARAMETERS

Dependent Variable: LOGGDPC
Method: Panel Least Squares
Date: 04/13/19 Time: 02:41
Sample: 1990 2018
Periods included: 29
Cross-sections included: 10
Total panel (balanced) observations: 290

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TO	-0.009888	0.000510	-19.37239	0.0000
EX	5.26E-05	5.26E-05	0.999967	0.3182
LOGCOP	0.389853	0.044650	8.731221	0.0000
LOGCPT	0.227748	0.021906	10.39661	0.0000
LOGLBF	0.056024	0.019928	2.811320	0.0053
C	-1.952746	0.569422	-3.429346	0.0007

R-squared	0.654952	Mean dependent var	3.805975
Adjusted R-squared	0.648877	S.D. dependent var	0.518376
S.E. of regression	0.307167	Akaike info criterion	0.497622
Sum squared resid	26.79583	Schwarz criterion	0.573550
Log likelihood	-66.15513	Hannan-Quinn criter.	0.528042
F-statistic	107.8147	Durbin-Watson stat	0.404548
Prob(F-statistic)	0.000000		

Dependent Variable: LOGGDPC
Method: Panel Fully Modified Least Squares (FMOLS)
Date: 04/13/19 Time: 02:41
Sample (adjusted): 1991 2018
Periods included: 28
Cross-sections included: 10
Total panel (balanced) observations: 280
Panel method: Pooled estimation
Cointegrating equation deterministics: C
Coefficient covariance computed using default method
Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TO	-0.008717	0.000181	-48.28623	0.0000
EX	7.87E-06	1.86E-05	0.423883	0.6720
LOGCOP	0.526518	0.049654	10.60365	0.0000
LOGCPT	0.022429	0.009328	2.404438	0.0169
LOGLBF	0.410446	0.324012	1.266764	0.2064

R-squared	0.982526	Mean dependent var	3.806580
Adjusted R-squared	0.981603	S.D. dependent var	0.523002
S.E. of regression	0.070938	Sum squared resid	1.333539
Long-run variance	0.010572		

Dependent Variable: LOGGDPC
Method: Panel Dynamic Least Squares (DOLS)
Date: 04/13/19 Time: 02:42
Sample (adjusted): 1992 2017
Periods included: 26
Cross-sections included: 10
Total panel (balanced) observations: 260
Panel method: Pooled estimation
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=1, lag=1)
Coefficient covariance computed using default method
Long-run variance (Bartlett kernel, Newey-West fixed bandwidth) used for
coefficient covariances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TO	-0.034127	0.072637	-0.469835	0.6395
EX	-0.000106	4.42E-05	-2.390219	0.0188
LOGCOP	0.482279	0.066255	7.279099	0.0000
LOGCPT	0.104970	0.020263	5.180281	0.0000
LOGLBF	0.053376	0.485021	0.110049	0.9126

R-squared	0.998126	Mean dependent var	3.816868
Adjusted R-squared	0.994891	S.D. dependent var	0.519758
S.E. of regression	0.037152	Sum squared resid	0.131128
Long-run variance	0.000876		

PANEL ARDL

```
import excel "C:\Users\RABI\Desktop\UNI\corrected peace\uni\Musa OPEC 2018.xlsx",
sheet("Sheet1") first row

xtset Code Year
       panel variable:  Code (strongly balanced)
        time variable:  Year, 1990 to 2018
                delta:  1 unit

. xtpmg d.LOGGDPc d.TO d.EX d.LOGCOP d.LOGCPT d.LOGLBF if Year>=1990, lr(LOGGDPc TO EX
LOGCOP LOGCPT LOGLBF) ec(ECT) replace mg

------------------------------------------------------------------------------
Mean Group Estimation: Error Correction Form
(Estimate results saved as mg)
------------------------------------------------------------------------------
------------------------------------------------------------------------------
   D.LOGGDPc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ECT          |
          TO |   .3732739   .5534073     0.67   0.500    -.7113844    1.457932
          EX |   .0018517   .0010602     1.75   0.081    -.0002262    .0039297
      LOGCOP |   .5665217   1.542432    -0.37   0.713    -3.589633     2.45659
      LOGCPT |   .0323702   .0827251     0.39   0.696     -.129768    .1945084
      LOGLBF |   1.894482   17.18013     0.11   0.912    -31.77795    35.56691
-------------+----------------------------------------------------------------
SR           |
         ECT |  -.2699479   .1079162     2.50   0.012      .058436    .4814598
             |
          TO |
         D1. |  -.0100448   .0492199    -0.20   0.838    -.1065139    .0864244
             |
          EX |
         D1. |  -.0000615   .0000604    -1.02   0.309    -.0001798    .0000569
             |
```

```
      LOGCOP |
         D1. |   .3338309   .0557951     5.98   0.000     .2244744    .4431873
             |
      LOGCPT |
         D1. |   .0200756   .0176848     1.14   0.256     -.014586    .0547373
             |
      LOGLBF |
         D1. |  -.1653651   2.103147    -0.08   0.937    -4.287457    3.956726
             |
       _cons |  -1.463075   1.192569    -1.23   0.220    -3.800467    .8743174
------------------------------------------------------------------------------

. xtpmg d.LOGGDPc d.TO d.EX d.LOGCOP d.LOGCPT d.LOGLBF if Year>=1990, lr(LOGGDPc TO EX
LOGCOP LOGCPT LOGLBF) ec(ECT) replace pmg


Pooled Mean Group Regression
(Estimate results saved as pmg)

Panel Variable (i): Code                         Number of obs      =       280
Time Variable (t): Year                          Number of groups   =        10
                                                 Obs per group: min =        28
                                                                avg =      28.0
                                                                max =        28

                                                 Log Likelihood     =   805.839
------------------------------------------------------------------------------
   D.LOGGDPc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ECT          |
          TO |  -.0087718   .0006039   -14.53   0.000    -.0099554   -.0075882
          EX |  -.1860695   .0194479    -9.43   0.001    -.1047267   -.0284923
      LOGCOP |   .3662547   .0691882     5.29   0.000     .2306483     .501861
      LOGCPT |   .0111592   .0034254     3.26   0.001     .0044456    .0178728
      LOGLBF |   1.047562   .1801212     5.82   0.000     .6945312    1.400593
-------------+----------------------------------------------------------------
SR           |
         ECT |  -.1024102   .0480641     2.13   0.033     .0082064    .1966141
             |
          TO |
         D1. |  -.3272913   .0670858    -4.88   0.000     .1958055    .4587771
             |
          EX |
         D1. |  -.0194958   .0087806    -2.22   0.026    -.0367054   -.0022862
             |
      LOGCOP |
         D1. |   .3763422     .07087     5.31   0.000     .2374395    .5152448
             |
      LOGCPT |
         D1. |   .0183814   .0179381     1.02   0.305    -.0167767    .0535395
             |
      LOGLBF |
         D1. |   1.861539   1.918309     0.97   0.332    -5.621356    1.898278
             |
       _cons |  -.0929797   .0489382    -1.90   0.057    -.1888968    .0029374
------------------------------------------------------------------------------


xtpmg d.LOGGDPc d.TO d.EX d.LOGCOP d.LOGCPT d.LOGLBF if Year>=1990, lr(LOGGDPc TO EX
LOGCOP LOGCPT LOGLBF) ec(ECT) replace dfe
------------------------------------------------------------------------------
Dynamic Fixed Effects Regression: Estimated Error Correction Form
(Estimate results saved as DFE)
------------------------------------------------------------------------------
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ECT          |
          TO |  -.0087777   .0002853   -30.77   0.000    -.0093369   -.0082186
          EX |   9.15e-06   .0000296     0.31   0.758    -.0000489    .0000672
```

```
      LOGCOP |   .5468353   .0654223     8.36   0.000       .41861    .6750606
      LOGCPT |   .0273321   .0142822     1.91   0.056    -.0006605    .0553247
      LOGLBF |   .3893353   .4352255     0.89   0.371     -.463691    1.242362
-------------+----------------------------------------------------------------
SR           |
         ECT |  -.4526363   .0516716     8.76   0.000     .3513617    .5539108
             |
          TO |
         D1. |   -.008849   .0001088   -81.35   0.000    -.0090622   -.0086358
             |
          EX |
         D1. |   .0000159   .0000109     1.46   0.145    -5.48e-06    .0000373
             |
      LOGCOP |
         D1. |   .4840253   .0439557    11.01   0.000     .3978737    .5701768
             |
      LOGCPT |
         D1. |   .0045667   .0056369     0.81   0.418    -.0064815    .0156149
             |
      LOGLBF |
         D1. |    .293326   .1960718     1.50   0.135    -.0909676    .6776197
             |
       _cons |  -.6003597   .3642195    -1.65   0.099    -1.314217    .1134973
------------------------------------------------------------------------------

.
```

```
. hausman mg pmg, sigmamore

Note: the rank of the differenced variance matrix (4) does not equal the number of
coefficients being
        tested (5); be sure this is what you expect, or there may be problems computing
the test.
        Examine the output of your estimators for anything unexpected and possibly
consider scaling your
        variables so that the coefficients are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       mg          pmg         Difference          S.E.
-------------+----------------------------------------------------------------
          TO |    .3732739    -.0087718        .3820457        .9196964
          EX |    .0018517     -.1860692        .1879209        .0017271
      LOGCOP |   -.5665217     .3662547       -.9327764        2.562404
      LOGCPT |    .0323702     .0111592         .021211        .1374365
      LOGLBF |    1.894482     1.047562        .8469195        28.55074
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtpmg
            B = inconsistent under Ha, efficient under Ho; obtained from xtpmg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        1.05
                Prob>chi2 =      0.9019

. xtpmg d.LOGGDPc d.TO d.EX d.LOGCOP d.LOGCPT d.LOGLBF if Year>=1990, lr(LOGGDPc TO EX
LOGCOP LOGCPT LOGLBF) ec(ECT) replace pmg full

Pooled Mean Group Regression
(Estimate results saved as PMG)

Panel Variable (i): Code                        Number of obs      =       280
Time Variable (t): Year                         Number of groups   =        10
```

Obs per group: min = 28
avg = 28.0
max = 28

Log Likelihood = 805.839

D.LOGGDPc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ECT						
TO	-.0087718	.0006039	-14.53	0.000	-.0099554	-.0075882
EX	-.1860695	.0194479	-9.43	0.001	-.1047267	-.0284923
LOGCOP	.3662547	.0691882	5.29	0.000	.2306483	.501861
LOGCPT	.0111592	.0034254	3.26	0.001	.0044456	.0178728
LOGLBF	1.047562	.1801212	5.82	0.000	.6945312	1.400593
Code_1						
ECT	-.0461982	.0186425	2.48	0.013	.0096595	.0827369
TO						
D1.	-.0106606	.0002207	-48.30	0.000	-.0110931	-.010228
EX						
D1.	-.093035	.0331607	2.81	0.005	.0280412	.1580289
LOGCOP						
D1.	.3028501	.0611959	4.95	0.000	.1829082	.4227919
LOGCPT						
D1.	.0734448	.0316183	2.32	0.020	.011474	.1354156
LOGLBF						
D1.	-.9083863	.4096653	-2.22	0.027	-1.711316	-.1054571
_cons	-.018911	.017676	-1.07	0.285	-.0535552	.0157333
Code_2						
ECT	-.1337471	.0782012	-1.71	0.047	-.2870187	.0195245
TO						
D1.	-.0097967	.0000778	-126.00	0.000	-.0099491	-.0096443
EX						
D1.	-.1182026	.0482881	-2.45	0.014	.0235596	.2128456
LOGCOP						
D1.	.096035	.1516458	0.63	0.527	-.2011852	.3932553
LOGCPT						
D1.	.005373	.0051013	1.05	0.292	-.0046255	.0153714
LOGLBF						
D1.	-16.34109	3.203542	-5.10	0.000	-22.61992	-10.06226
_cons	.004938	.0117861	0.42	0.675	-.0181624	.0280384
Code_3						
ECT	-.1182026	.0482881	-2.45	0.014	.0235596	.2128456
TO						
D1.	-.0075277	.0000323	-233.02	0.000	-.007591	-.0074644
EX						
D1.	.0028406	.0032925	0.86	0.388	-.0036125	.0092937
LOGCOP						
D1.	.1287491	.0918076	1.40	0.161	-.0511905	.3086886
LOGCPT						
D1.	.0048322	.0357663	0.14	0.893	-.0652685	.0749329
LOGLBF						

D1.	-.0642557	.3014028	-0.21	0.831	-.6549944	.526483
_cons	.0024791	.0028569	0.87	0.386	-.0031203	.0080784
Code_4						
ECT	-.3974645	.1371817	2.90	0.004	.1285933	.6663357
TO						
D1.	.0142331	.0173342	0.82	0.412	-.0197413	.0482075
EX						
D1.	-.3212031	.1170077	-2.75	0.006	-.5505339	-.0918723
LOGCOP						
D1.	.385151	.117599	3.28	0.001	.1546612	.6156407
LOGCPT						
D1.	.0038128	.004867	0.78	0.433	-.0057263	.0133519
LOGLBF						
D1.	7.586183	2.701916	2.81	0.005	2.290526	12.88184
_cons	-.4066695	.1983138	-2.05	0.040	-.7953574	-.0179817
Code_5						
ECT	-.4047231	.1419484	-2.85	0.004	.1265095	.6829368
TO						
D1.	.1518751	.0541266	2.81	0.005	.0457889	.2579614
EX						
D1.	-.0271212	.0271574	-1.00	0.318	-.0803488	.0261064
LOGCOP						
D1.	.4397721	.1036842	4.24	0.000	.2365547	.6429894
LOGCPT						
D1.	-.0027136	.0029763	-0.91	0.362	-.0085471	.0031199
LOGLBF						
D1.	.1439597	.0820801	1.75	0.079	-.0169143	.3048337
_cons	.0183988	.0177264	1.04	0.299	-.0163443	.053142
Code_6						
ECT	-.1787185	.0654827	2.73	0.006	.0503749	.3070622
TO						
D1.	.0066911	.0421397	0.16	0.874	-.0759011	.0892834
EX						
D1.	-.2300627	.0662271	3.47	0.001	.1002601	.3598654
LOGCOP						
D1.	.355007	.0228009	15.57	0.000	.3103181	.3996959
LOGCPT						
D1.	.1300484	.0612519	2.12	0.034	.0099969	.2500999
LOGLBF						
D1.	.1716728	.2576387	0.67	0.505	-.3332898	.6766354
_cons	-.2289855	.1131188	-2.02	0.043	-.4506943	-.0072766
Code_7						
ECT	-.7186736	.1896204	3.79	0.000	.3470245	1.090323
TO						
D1.	-.2919001	.1056301	-2.76	0.006	-.4989314	-.0848689
EX						

```
         D1. |  -.0354337    .012015    -2.95   0.003    -.0589828   -.0118847
             |
      LOGCOP |
         D1. |   .8177699   .0831906     9.83   0.000     .6547194    .9808205
             |
      LOGCPT |
         D1. |  -.0910697    .084038    -1.08   0.279    -.2557811    .0736418
             |
      LOGLBF |
         D1. |  -2.984732   7.365151    -0.41   0.685    -17.42016     11.4507
             |
       _cons |   -.018244    .071627    -0.25   0.799    -.1586303    .1221423
-------------+----------------------------------------------------------------
Code_8       |
         ECT |  -.0669874   .0204525     3.28   0.001     .0269012    .1070735
             |
          TO |
         D1. |  -.1166908   .0339973    -3.43   0.001    -.1833243   -.0500573
             |
          EX |
         D1. |   -.0890546   .0352427    -2.53   0.012     -.158129   -.0199802
             |
      LOGCOP |
         D1. |   .1554869   .0904577     1.72   0.086    -.0218069    .3327807
             |
      LOGCPT |
         D1. |   .0325713   .0026952    12.08   0.000     .0272888    .0378539
             |
      LOGLBF |
         D1. |  -5.543228   1.595694    -3.47   0.001     -8.67073   -2.415725
             |
       _cons |   .0040342   .0226369     0.18   0.859    -.0403334    .0484018
-------------+----------------------------------------------------------------
Code_9       |
         ECT |  -.3373246   .0880842     3.83   0.000     .1646827    .5099664
             |
          TO |
         D1. |   .0129432   .0176092     0.74   0.462    -.0215702    .0474567
             |
          EX |
         D1. |  -.0264227   .0758922    -0.35   0.728    -.1751687    .1223233
             |
      LOGCOP |
         D1. |   .4958003   .0392795    12.62   0.000     .4188139    .5727868
             |
      LOGCPT |
         D1. |   .0031575   .0013297     2.37   0.018     .0005514    .0057637
             |
      LOGLBF |
         D1. |   .1722317   .1812523     0.95   0.342    -.1830162    .5274797
             |
       _cons |  -.2882799   .1427857    -2.02   0.043    -.5681347   -.0084251
-------------+----------------------------------------------------------------
Code_10      |
         ECT |  -.7208147   .0912794    -7.90   0.000     .5419105     .899719
             |
          TO |
         D1. |  -.0166491   .0045748     3.64   0.000     .0076826    .0256156
             |
          EX |
         D1. |  -.0856295   .0319183    -2.68   0.007    -.1481882   -.0230708
             |
      LOGCOP |
         D1. |   .5868004   .1290171     4.55   0.000     .3339316    .8396692
             |
      LOGCPT |
         D1. |   .0243571   .0256389     0.95   0.342    -.0258942    .0746083
             |
      LOGLBF |
         D1. |  -.8477432   .5377145    -1.58   0.115    -1.901644    .2061579
             |
```

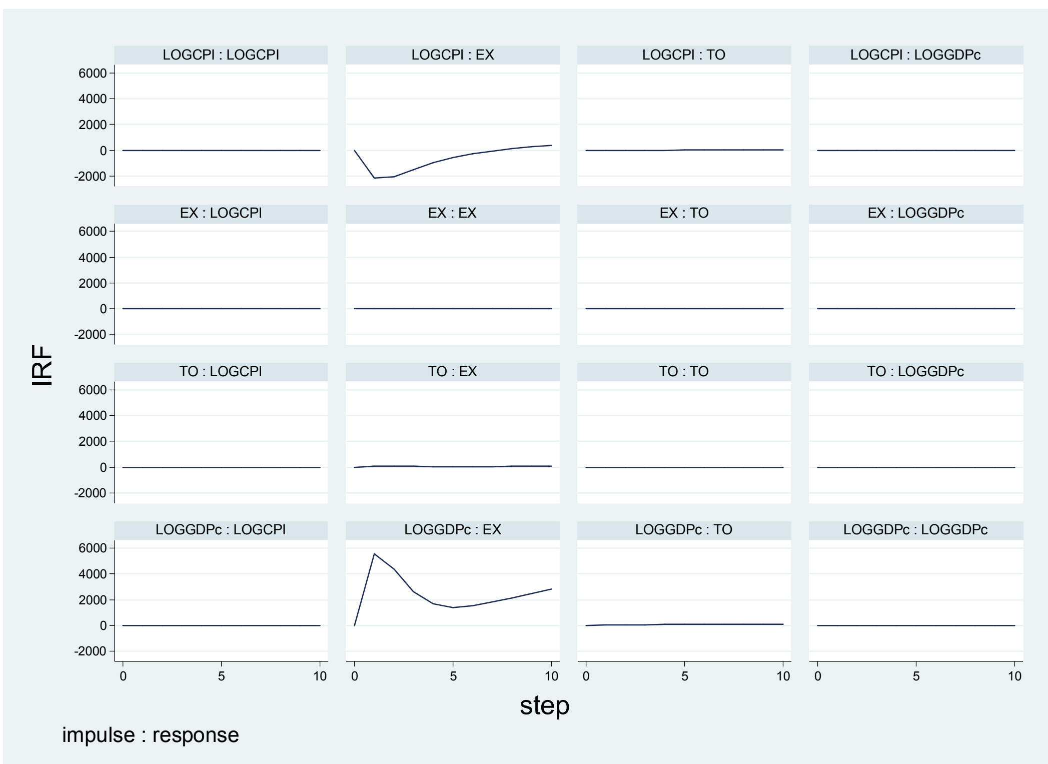
```
      _cons |   .0014428   .0044447     0.32   0.745    -.0072685    .0101542
------------------------------------------------------------------------------
```

PANEL VAR

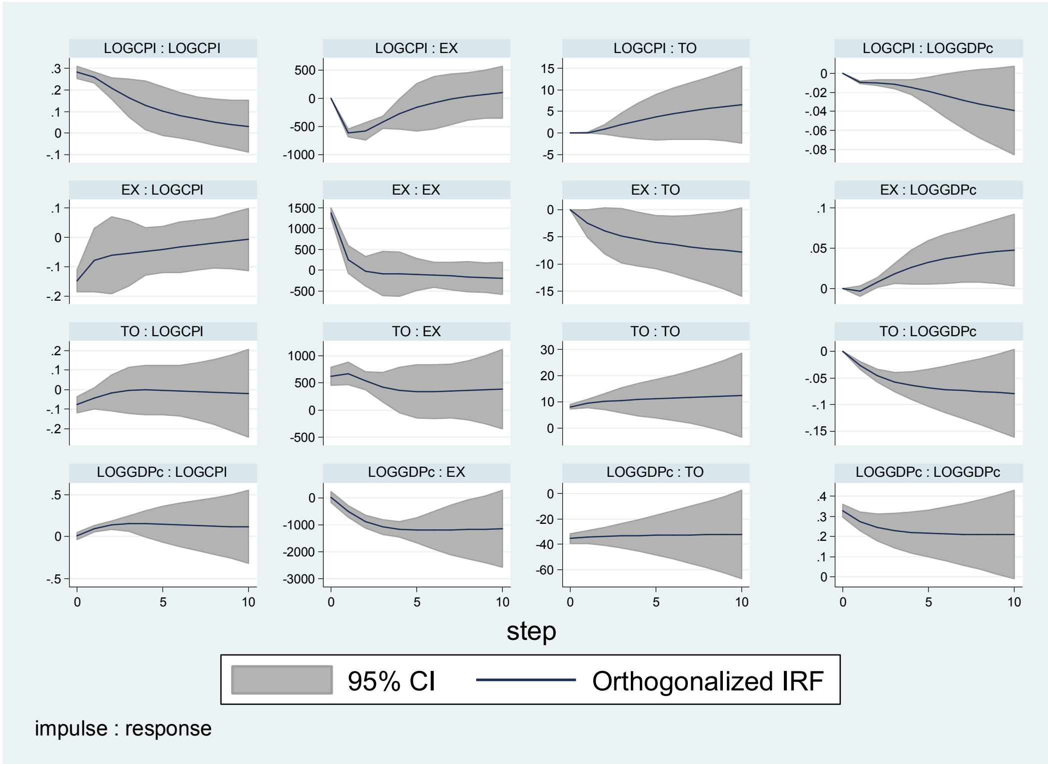
```
pvarsoc LOGGDPc TO EX LOGCPI, maxlag(3) pvaropts(instl(1/4))
Running panel VAR lag order selection on estimation sample
...

 Selection order criteria
 Sample:  1994 - 2017                                 No. of obs      =       240
                                                      No. of panels   =        10
                                                      Ave. no. of T   =    24.000

  +--------------------------------------------------------------------------+
  |   lag |    CD          J      J pvalue     MBIC       MAIC       MQIC    |
  |-------+------------------------------------------------------------------|
  |     1 |  .9959125   44.63637   .6114692  -218.4343  -51.36363  -118.6809 |
  |     2 |  .9992821   30.59728   .5375281  -144.7832  -33.40272  -78.28091 |
  |     3 |  .9986075    28.1343   .0304712  -59.55592  -3.865695  -26.30479 |
  +--------------------------------------------------------------------------+
```

```
pvar LOGGDPc TO EX LOGCPI, instl(1/4)

Panel vector autoregresssion


GMM Estimation

Final GMM Criterion Q(b) =      .186
Initial weight matrix: Identity
GMM weight matrix:     Robust
                                                      No. of obs      =       240
                                                      No. of panels   =        10
                                                      Ave. no. of T   =    24.000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
LOGGDPc      |
     LOGGDPc |
         L1. |   .6996478   .0607505    11.52   0.000      .580579    .8187165
             |
          TO |
         L1. |   -.115053   .0144462    -7.96   0.000     -.143367   -.0867391
             |
          EX |
         L1. |  -.0121557   .0028127    -4.32   0.000    -.0176686   -.0066429
             |
      LOGCPI |
         L1. |   .0306082   .0034648     8.83   0.000     .0238173    .0373991
-------------+----------------------------------------------------------------
TO           |
     LOGGDPc |
         L1. |   .0651052   .1237985     0.53   0.599    -.1775353    .3077457
             |
          TO |
         L1. |   .9481677   .0416571    22.76   0.000     .8665213    1.029814
             |
          EX |
```

```
         L1. |   .0316905   .0048142     6.58   0.000     .0222548    .0411261
             |
      LOGCPI |
         L1. |  -.0219141   .0069814    -3.14   0.002    -.0355974   -.0082307
-------------+----------------------------------------------------------------
   EX        |
     LOGGDPc |
         L1. |  -.8797857   .5315921    -1.66   0.098    -1.921687    .1621157
             |
          TO |
         L1. |   .0379035   .2116018     0.18   0.858    -.3768284    .4526354
             |
          EX |
         L1. |    .679384   .0677421    10.03   0.000     .5466119     .812156
             |
      LOGCPI |
         L1. |   .2157303     .04374     4.93   0.000     .1300014    .3014592
-------------+----------------------------------------------------------------
LOGCPI       |
     LOGGDPc |
         L1. |   2.238242    .583904     3.83   0.000     1.093811    3.382672
             |
          TO |
         L1. |   .5796769   .1072142     5.41   0.000      .369541    .7898128
             |
          EX |
         L1. |   .0619232   .0205293     3.02   0.003     .0216867    .1021598
             |
      LOGCPI |
         L1. |   .7565317   .0540314    14.00   0.000     .6506322    .8624313
------------------------------------------------------------------------------
Instruments : l(1/4).(LOGGDPc TO LOGEX LOGCPI)
```



.




```
pvarfevd, mc(200)
```

Forecast-error variance decomposition

Response variable and Forecast horizon	LOGGDPc	TO	EX	LOGCPI
		Impulse variable		
LOGGDPc				
0	0	0	0	0
1	1	0	0	0
2	.9185578	.0389208	.0062867	.0362347
3	.8172193	.0887368	.0148341	.0792098
4	.7321419	.1320926	.0227293	.1130362
5	.6669863	.1667777	.0294122	.1368238
6	.617525	.1944492	.0350209	.1530049
7	.5793023	.2170055	.0397958	.1638964
8	.5490084	.2358871	.0439398	.1711648
9	.5243762	.2520896	.047602	.1759323
10	.5038754	.2662888	.0508888	.1789469
TO				
0	0	0	0	0
1	.0198449	.9801551	0	0
2	.0175822	.9694806	.0096469	.0032903
3	.0184458	.9521304	.0232592	.0061645
4	.0209766	.9339108	.0370878	.0080248
5	.0243867	.9166527	.0498058	.0091548
6	.0281637	.9009708	.0610176	.0098478
7	.0319844	.8870122	.0707073	.010296
8	.0356644	.8747161	.0790072	.0106123

9	.0391129	.8639306	.0860962	.0108603
10	.0422969	.8544728	.0921548	.0110756
EX				
0	0	0	0	0
1	.0049892	.0010979	.9939129	0
2	.0139648	.0013706	.9647722	.0198924
3	.0174073	.0046231	.9334655	.0445041
4	.0172502	.0124814	.9040742	.0661941
5	.016043	.0244201	.8759726	.0835643
6	.0152447	.0386612	.8489477	.0971464
7	.0153825	.0533589	.8233799	.1078787
8	.0164885	.0671733	.7997241	.116614
9	.0184085	.0793478	.7782438	.1239998
10	.0209559	.0895766	.7589799	.1304875
LOGCPI				
0	0	0	0	0
1	.002518	.0000133	.0054367	.992032
2	.0491791	.0156185	.0135033	.921699
3	.1027504	.0294278	.0190267	.8487951
4	.1500299	.0363619	.0217682	.79184
5	.1894238	.0379123	.0225286	.7501354
6	.2221773	.0363375	.0220609	.7194242
7	.2497384	.0333617	.0209056	.6959944
8	.2732296	.0301218	.0194271	.6772215
9	.2934441	.0273278	.0178682	.66136
10	.3109341	.025404	.0163886	.6472734

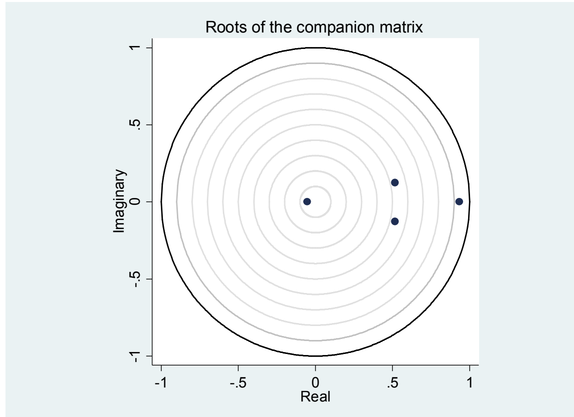
FEVD standard errors and confidence intervals are not saved. Use option save

pvarstable, graph

Eigenvalue stability condition

Eigenvalue Real	Eigenvalue Imaginary	Modulus
.9320527	0	.9320527
.5164678	.1265049	.5317354
.5164678	-.1265049	.5317354
-.0550696	0	.0550696

All the eigenvalues lie inside the unit circle.
pVAR satisfies stability condition.




```
xtserial LOGGDPc TO  EX LOGCPI,

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
F(  1,       9) =      0.051
Prob > F =  0.8258

xttest3

Modified Wald test for groupwise heteroskedasticity
in cross-sectional time-series FGLS regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (10)  =     13.84
Prob>chi2 =      0.5452
```

PANEL CAUSALITY ESTIMATION

```
xtgcause LOGGDPc TO

Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          2.7209
Z-bar =          3.8480   (p-value = 0.0001)
Z-bar tilde =    3.0844   (p-value = 0.0020)
--------------------------------------------------------------
H0: TO does not Granger-cause LOGGDPc.
H1: TO does Granger-cause LOGGDPc for at least one panelvar (Code).

xtgcause TO LOGGDPc

Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          2.3367
Z-bar =          2.9889   (p-value = 0.0028)
Z-bar tilde =    2.3554   (p-value = 0.0185)
--------------------------------------------------------------
H0: LOGGDPc does not Granger-cause TO.
H1: LOGGDPc does Granger-cause TO for at least one panelvar (Code).
```

```
xtgcause LOGGDPc LOGCPI


Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          4.6971
Z-bar =          8.2669   (p-value = 0.0000)
Z-bar tilde =    6.8338   (p-value = 0.0000)
--------------------------------------------------------------
H0: LOGCPI does not Granger-cause LOGGDPc.
H1: LOGCPI does Granger-cause LOGGDPc for at least one panelvar (Code).

xtgcause LOGCPI LOGGDPc


Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          1.2056
Z-bar =          0.4598   (p-value = 0.6457)
Z-bar tilde =    0.2094   (p-value = 0.8341)
--------------------------------------------------------------
H0: LOGGDPc does not Granger-cause LOGCPI.
H1: LOGGDPc does Granger-cause LOGCPI for at least one panelvar (Code).

. xtgcause LOGGDPc  EX


Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          2.9057
Z-bar =          4.2613   (p-value = 0.0000)
Z-bar tilde =    3.4351   (p-value = 0.0006)
--------------------------------------------------------------
H0:  EX does not Granger-cause LOGGDPc.
H1:  EX does Granger-cause LOGGDPc for at least one panelvar (Code).

. xtgcause  EX LOGGDPc


Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          3.3048
Z-bar =          5.1536   (p-value = 0.0000)
Z-bar tilde =    4.1922   (p-value = 0.0000)
--------------------------------------------------------------
H0: LOGGDPc does not Granger-cause EX.
H1: LOGGDPc does Granger-cause EX for at least one panelvar (Code).

xtgcause TO  EX


Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          0.4926
Z-bar =         -1.1345   (p-value = 0.2566)
Z-bar tilde =   -1.1434   (p-value = 0.2529)
--------------------------------------------------------------
H0:  EX does not Granger-cause TO.
H1:  EX does Granger-cause TO for at least one panelvar (Code).



Xtgcause EX TO
```

```
Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          4.2801
Z-bar =          7.3346   (p-value = 0.0000)
Z-bar tilde =    6.0428   (p-value = 0.0000)
--------------------------------------------------------------
H0: TO does not Granger-cause EX.
H1: TO does Granger-cause EX for at least one panelvar (Code).

xtgcause TO LOGCPI

Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          1.3790
Z-bar =          0.8474   (p-value = 0.3968)
Z-bar tilde =    0.5383   (p-value = 0.5904)
--------------------------------------------------------------
H0: LOGCPI does not Granger-cause TO.
H1: LOGCPI does Granger-cause TO for at least one panelvar (Code).


xtgcause LOGCPI TO

Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          2.6121
Z-bar =          3.6049   (p-value = 0.0003)
Z-bar tilde =    2.8781   (p-value = 0.0040)
--------------------------------------------------------------
H0: TO does not Granger-cause LOGCPI.
H1: TO does Granger-cause LOGCPI for at least one panelvar (Code).




xtgcause LOGCPI  EX

Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          4.9492
Z-bar =          8.8307   (p-value = 0.0000)
Z-bar tilde =    7.3123   (p-value = 0.0000)
--------------------------------------------------------------
H0:  EX does not Granger-cause LOGCPI.
H1:  EX does Granger-cause LOGCPI for at least one panelvar (Code).

. xtgcause EX LOGCPI


Dumitrescu &Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Lag order: 1
W-bar =          2.9055
Z-bar =          4.2609   (p-value = 0.0000)
Z-bar tilde =    3.4347   (p-value = 0.0006)
--------------------------------------------------------------
H0: LOGCPI does not Granger-cause EX.
H1: LOGCPI does Granger-cause EX for at least one panelvar (Code).
```