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Investigating the Relationship between Oil Exports, Non-Oil Sector GDP and Foreign Direct Investment in OPEC member Countries Using Extended Panel Time Series Models

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A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN OIL AND GAS ECONOMICS

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جهت حفظ و دفاع از حقوق مادی و معنوی تولیدات علمی

دانشگاه صنعت نفت

احتراماً، اینجانب محمد مریوانی دانشجوی دوره کارشناسی ارشد رشته اقتصاد نفت وگاز به شماره دانشجویی ۹۳۰۳۵۰۹ متعهد می‌گردم کلیـه تولیدات علمی حاصل از موضوع پایان نامـه خود تحت عنوان بررسی رابطه صادرات نفت، تولید ناخالص داخلی بخش غیر نفتی و سرمایه گذاری مستقیم خارجی در کشورهای عضو اوپک : رویکرد مدل‌های سری زمانی تلفیقی تعمیم یافته ، اعم از پایان نامه، مقاله، رساله، کتب، ثبت اختراع و ... را به نام دانشگاه صنعت نفت، دانشکده نفت تهران منتشر نمایم. بدیهی است در صورت عدم رعایت مورد فوق مطابق قوانین و مقررات دانشگاه با اینجانب بر خورد خواهد شد.

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امضاء:

فرم تعهد (شماره ٤)

Declaration of originality

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all materials and results that are not original to this work.

Name: Mohammad Marivani **Date:2018/18/June**

Signature

ABSTRACT

Investigating the Relationship between Oil Exports, Non-Oil Sector GDP and Foreign Direct Investment in OPEC member Countries Using Extended Panel Time Series Models

By:

Mohammad Marivani

The main purpose of this thesis is to investigate the short-term and long-term relationships between macroeconomic variables including oil exports, foreign direct investment, non-oil GDP and productivity in OPEC member countries with an emphasis on the presence of structural break and cross-sectional dependence. Also, the sub-objectives of this study are to examine the short-term and long-term relationships between all variables and different pairs of variables for OPEC member states during the period 1980-2015 by using Extended Panel Time Series that takes into account structural breaks and cross-section dependence when analyzing the relationship between research model variables. The Long-run estimations; Fixed Effects (EF), Mean Group (MG), Common Correlated Effects Pooled (CCEP) and Common Correlated Effects Mean Group (CCEMG) are then used to estimate a long run relationship and Vector Error Correction Model (VECM) applied to investigate a short run dynamic relationship among the research model variables. Dynamic panel causality test based on vector error correction model (VECM) is utilized to realize a causal-effect relationship between different pairs of variables. The results of this research indicate that the research model variables are non-stationary in level and stationary at first difference. The results of Cointegration tests and estimates the Long-run estimations show that there exists a long-run equilibrium relationship between oil export, non-oil GDP, foreign direct investment, and productivity, and for all estimators, the impact of non-oil GDP on dependent variables is larger than others independent variables. In

addition, the results of Dynamic panel causality for all variables shows that; For the short-run causality, (i) unidirectional causality run from non-oil GDP, oil export and Productivity to foreign direct investment, (ii) bidirectional causality run from Productivity to non-oil GDP. The significance of all error correction terms (ECT) for short-run and long- run indicates that all four variables readjust towards a common equilibrium relationship (except for LLPRO as a dependent variable in short -run), so there are mutual causal relationships between LNGDP, LOER, LFDI and LLPRO in long-run. The results of Panel Granger non- causality tests for two by two variables in the long-run reveal that there is a bi-directional causality between variables two by two for OPEC member countries. Due to existing a long-run relationship between oil exports and non-oil sector GDP, we can say that the OPEC member Countries still in a high need to pursue an appropriate economic policy for utilizing the crude oil export revenues. This policy ought to be emphasized on redirecting surplus revenues to be invested in non-oil sectors for reducing the negative shocks that occur in oil sectors and its export prices.

Keywords: oil export; non-oil GDP; foreign direct investment; productivity; panel unit roots and cointegration; structural break; cross-section dependence; panel error-correction model; Granger causality

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This dissertation was written while I was studying in the Petroleum University of Technology. To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which

has been accepted for the award of any other degree or diploma in any university.

Table of Contents

NOMENCLATURE

ADF= Augmented Dickey Fuller

AIC= Akaike Information Criterion

CD = Cross-Section Dependence

CCEP= Common Correlated Effects Pooled

CCEMG= Common Correlated Effects Mean Group

ECT = Vector Error Term

FE = Fixed Effects

FDI= Foreign Direct Investment

IPS= Im, Pesaran and Shin

LNGDP= Natural logarithm of Non-Oil Sector GDP

LOER= Natural logarithm of Oil Export Revenue

LFDI= Natural logarithm of Foreign Direct Investment

LPRO= Natural logarithm of Productivity

LLC= Levin, Lin and Chu

MG= Mean Group

NGDP= Non-Oil Sector GDP

OPEC= the Organization of the Petroleum Exporting Countries

OER= Oil Export Revenue (as a proxy for Oil Export)

PRO= Productivity

PMG= Pooled Mean Group

SIC= Schwarz Information Criterion

VECM = Vector Error Correction Model

Chapter 1: Introduction and Overview

1.1 Introduction

The main purpose of this study is to examine the short-term and long-term relationship between macroeconomic variables, including oil exports, Non-Oil Sector GDP, Foreign Direct Investment, and Productivity Non-Oil Sector GDP in OPEC member countries with emphasis on the Cross-Section Dependence and Structural Breaks. Therefore, in this chapter at first, the research problem and its importance clearly would be reviewed. Then the main questions and purpose of the research are explained. The hypotheses of study in line with the questions are expressed then the principles clearly would be discussed. Also, the methodology and contribution of the study are explained. At the end of a chapter, the research structure and summary of this chapter are explained.

1.2 Statement of Problem

An increase in production and economic growth leads to more and better opportunities for economic prosperity and enter to the new scope. Exports, as one of the sources of national income, can lead to the GDP growth, and foreign direct investment as the largest source of external finance in developing countries with positive spillover effects provides economic growth conditions. Achieving economic growth and development due to the direct impact on social prosperity is one of the important macroeconomic objectives

of each country. Economic growth is increased production capacities over time, and a factor in moving towards more production, and this increase in production, will lead to economic growth and development. Many factors have been emphasized to achieve the goal of economic growth and economic development, and economic analysts emphasize the issue of export development as a successful strategy for achieving high economic growth rates. Export revenues are of great importance not only for developing countries but also for developed countries. Developed countries mainly export capital and final goods, while the main part of export of developing countries consists of mining-industry goods especially natural resources[1]*. Among the OPEC countries are developing countries, the vast majority of their export income comes from oil exports. Because of significant fluctuations in oil prices, foreign exchange earnings from these exports face major fluctuations, and instability in revenues from crude oil exports has had a negative impact on the economy as a whole, which impeded the implementation of economic growth and development programs Followed by countries. For this reason, the development of non-oil sector can be considered one of the most important economic goals. Following the adverse economic consequences of fluctuations in foreign exchange earnings, as well as the focus of trade in the growth and development process, developing countries prioritize the inflow of foreign capital to address their economic problems due to lack of capital. A number of economic experts also believe that, because FDI is one of the most important ways of transferring knowledge and technology of the day, expanding its scope can increase the long-run economic growth Following*[2]*. Considering the importance and*

[1] *Hasanov and Samadova (2010)*

[2] *(Zenuz and Kamali Dekordi, 2009: Pages 115-116)*

impact of oil exports and foreign direct investment on GDP and the impact of all three variables on economic growth, the relationship between these three variables is examined. Therefore, the main issue of this study is to investigate the relationship between oil exports, foreign direct investment and gross domestic product in terms of structural break and cross-sectional dependence. Regardless of these two issues, one can still see a meaningful relationship between these three variables.

1.3 Importance of the Research

Gross domestic product and economic growth are important macroeconomic variables. Improving GDP and economic growth are one of the main goals of any economy, which is influenced by many factors, including investment and exports. In an open economy, technology and knowledge can be transmitted through exports and imports, which itself improves production and moves towards productive, productive productivity, which in turn leads to economic growth; In turn, it affects exports and imports. From the classical point of view, capital is the main source of growth that comes from saving itself. In the view of neoclassical, investment and, as a result, growth, are not due solely to domestic capital, as some countries have faced a shortage of capital, they, therefore, seek to attract foreign capital.

The effect of the direct foreign investment on improving and expanding exports and interaction of the country's economy with the outside world is obvious and undeniable. The most important role of direct foreign investment is in transforming the economy of the host country from the exporter of raw materials to the exporter of industrial and industrial goods, and in some cases even exports high-tech goods. On the other hand, the

effect of the foreign direct investment on the host country is not limited to the growth of exports and the restructuring of exports, but the transfer of global knowledge and the entry of the host country to the global product network is also one of the most important effects of foreign direct investment. In view of the above, to determine and implement successful policies on foreign direct investment and oil exports, and the impact of these two variables on GDP, and the effect of all three of these variables on economic growth, determining the type of relationship between these Variables appear to be necessary.

1.4 Purpose of the Research

A review of the literature on the subject of research shows that in most of the mentioned studies is rarely discussed on the effects of oil exports on non-oil GDP, especially for OPEC member countries. Given that the majority of OPEC countries have single-product economies based on oil and/ or gas exports, so there are many potentials for attracting foreign investment in the OPEC region. The main purpose of this study is to investigate the short-term and long-term relationships between macroeconomic variables including oil exports, foreign direct investment, non-oil GDP and productivity in OPEC member countries with an emphasis on the presence of structural break and cross-sectional dependence. Also, the sub-objectives of this study are to examine the short-term and long-term relationships between two of these variables for OPEC member states during the period 1980-2015 by *using* ***Extended Panel Time Series that takes into account structural breaks and cross-section dependence when analyzing the relationship between research model variables.***

The expected results of the research indicate that non-oil Gross Domestic Product (GDP) and foreign direct investment (FDI) have a more coordinated move that oil exports in the short and long-term and the long-term trend of these variables is different from that of oil exports. In general, there is no significant long-term relationship between oil exports and other variables.

1.5 Research Questions

Considering that economic growth is one of the most important objectives in any economy and it is influenced by several factors, we intend to study this study considering the cross-section dependence and structural break in the research model and unit tests and cointegration tests in the form of time series studies, we answer the following questions:

- *i. Is there a positive and significant effect of oil Export (OER) on the non-oil gross domestic product (NGDP) in OPEC member countries?*
- *ii. Is there a positive and significant effect of foreign direct investment (FDI) on oil Export (OER) in OPEC member countries?*
- *iii. Is there a positive and significant effect of oil Export (OER) on productivity (PRO) in OPEC member countries?*
- *iv. Is there a positive and significant effect on foreign direct investment (FDI) on a non-oil gross domestic product (NGDP) in OPEC member countries?*
- *v. Is there a positive and significant effect of foreign direct investment (FDI) on productivity (PRO) in OPEC member countries?*

1.6 Research Hypotheses

The research hypotheses of this thesis can be stated as follows:

- ***i.*** ***There is a positive and significant effect of oil Export (OER) on the non-oil gross domestic product (NGDP) in OPEC member countries.***
- ***ii.*** ***There is a positive and significant effect of foreign direct investment (FDI) on oil Export (OER) in OPEC member countries.***
- ***iii.*** ***There is a positive and significant effect of oil Export (OER) on productivity (PRO) in OPEC member countries.***
- ***iv.*** ***There is a positive and significant effect on foreign direct investment (FDI) on the non-oil gross domestic product (NGDP) in OPEC member countries.***
- ***v.*** ***There is a positive and significant effect of foreign direct investment (FDI) on productivity (PRO) in OPEC member countries.***

1.7 The Principles of Hypotheses

GDP and its growth rate reflect a country's macroeconomic situation and a country's economic performance. While it is rather intuitively clear that FDI and exports may promote the growth of GDP, and that exports and FDI are somehow related, when all three variables are combined, it is rather obscure how they are related in the context of an economic model. The general practice in the literature routinely takes the relations as given in an ad hoc manner[3], or expands a production function linearly to make connections. However, here we show that the theoretical underpinning of the econometric method can be very simple. It is the national income model.

[3] A sophisticated ad hoc argument is that when testing the effects of "openness" on growth, both exports (and trade) and FDI should be considered for the true sense of "openness." Omitting one will commit the omission of variable error, rendering the causality relations ambiguous. See Ahmad, Alam, and Butt (2004), Cuadros, Orts, and Alguacil (2004).

For simplicity, we assume equilibrium in the money sector and the government sector. Then the equilibrium condition of the Keynesian model of aggregate demand and aggregate supply is

$$Y = C(Y) + I(Y + r) + F + X + M(Y + e) \qquad (1.1)$$

where Y, C, I, F, X, M, r, and e are real GDP, real consumption, real domestic investment, real FDI inflows, real exports, real imports, interest rate, and an exchange rate of foreign currency in term of the domestic currency, respectively. X–M (Y, e) is the current account surplus in domestic currency of the domestic country.

There have been the relationship oil and GDP. As such, an earnest investigation into the relationship between oil and GDP can be done through world oil prices. According to many researchers and scholars, oil prices and GDP are negatively related. This means that an increase in oil prices leads to a reduction in the GDP or output growth. A conventional justification for the negative relationship between GDP and oil prices is that high oil prices increase the production costs. Alternatively, fluctuations in oil prices delay investments by facilitating uncertainties or expensive resource/production input allocations. This is because investors try to reallocate resources from sectors that are highly affected to the sectors that are lowly adversely affected. In this light, the aggregate output is adversely affected. However, the opposite is true in Libya [30]. Being an oil-producing country, an increase in oil prices means more oil earnings from exports, As such, the country's GDP increases.

Exports can play an important role in promoting economic growth through supplying the state budget with earnings and foreign currency that can be used for improving infrastructure and creating an attractive investment

climate. Moreover, Exports growth leads firms to increase their output and reduce their cost of production, which increases the productivity of these firms and achieve economies of scale. Besides, it plays an important role in expanding the size of the local market and increasing the degree of competition that leads the country to improve its production and use new technology in its production process. According to [59], exports will encourage technical knowledge transfer through suggestions and experiences shared by foreign buyers. In addition, exports will enhance the efficiency of the factors of production by increasing the level of international competition [29] and Error! Reference source not found.. Exports will increase the effect of economies of scale, industrialization, and import of capital goods and intermediate goods Error! Reference source not found.and [63]. Ultimately, exports will also increase foreign exchange earnings and create more employment opportunities in the domestic market.

Since the early 1990s, FDI became the largest single source of external finance for developing countries. This important source of private external financing has grown at a phenomenal rate, and the world market for it has become more competitive. Indeed, the rapid growth of FDI and its overall magnitude had aroused many studies relating to the determinants, the transmission channels and the effects of FDI on economic growth in developed and developing countries. FDI influences growth by raising total factor productivity and, more generally, the efficiency of resource use in the recipient economy, also most empirical studies conclude that FDI contributes to both factor productivity and income growth in host countries. Host countries' ability to use FDI as a means to increase exports in the short and medium term depends on the context. The clearest examples of FDI boosting exports are found where inward investment helps host countries that had been financially constrained make use either of their resource

endowment (e.g. foreign investment in mineral extraction) or their geographical location (e.g. investment in some transition economies).

1.8 Methodological Framework

The fourth chapter is devoted to the research methodology. The empirical research methodology is based on applied panel framework. Time series data of the research model is applied for OPEC member countries. Research model variables; non-oil sector GDP, oil export, foreign direct investment, and productivity spanned from 1980 to 2015 for OPEC member countries. The data for the variables are gathered from the World Bank Database, OPEC, and The United Nations Conference on Trade and Development. All data deflated by using local Consumer Price Index (CPI, 2010 constant) and converted into logarithms to facilitate modeling process. After collecting data, the research model would be designed and estimated. In this research, the relationship between non-oil sector GDP, oil export, foreign direct investment, and productivity spanned from 1980 to 2015 for OPEC member countries is being modeled. The techniques that are used in this study to analyze the relationship between our research model variables can be stated as follows:

First, the test for cross-sectional independence proposed by Error! Reference source not found. is briefly presented. Second, this study describes the panel unit root test developed by [26]which allows for structural breaks and cross-sectional dependence. Third, the panel cointegration test suggested by [115], which also considers structural breaks and dependence across countries, is introduced. Fourth, Sub-section 4.3.4 discusses Pesaran (2006)'s common correlated effects (CCE) estimators that are used to estimate the long run

relationship between variables. Finally, the pooled mean group estimator for non-stationary heterogeneous panels suggested by [96] is used to establish dynamic panel causality.

1.9 Research Contribution

Given that in previous studies, the relationship between Non-Oil GDP, Oil Exports Revenue (as a proxy for oil exports), Foreign Direct Investment and Non-Oil GDP per worker (as a proxy for Productivity) in OPEC member countries have not been made, this research contributes with existing literature to enhance the knowledge about the relationship between research model variables by using the application of panel econometric techniques that consider both structural breaks and cross-sectional dependence to provide more accurate and reliable results.

1.10 Organization of the Research

The dissertation is structured as follows:

Chapter 1 contains a general overview and introduction to research. In this chapter, the Problem Statement, research questions and hypotheses of the study, the importance of research, research objectives, and methodology were presented.

The chapter 2 reviews literature and previous studies for the relationship between Non-oil sectors GDP, oil export, foreign direct investment, and productivity. This chapter reports the results of studies in this field.

In chapter 3 the current state of variables in the research for OPEC member countries are reviewed.

Theoretical framework and methodology of the research are subject the fourth Chapter. In this chapter econometric method for studying short-run and long-run relationship between research model variables are presented. Also, data sources and variable structure are introduced in this Chapter.

Chapter 5 contains the model and empirical results analysis of Non-oil sector GDP, oil export, foreign direct investment and productive relationship with OPEC member countries.

Finally, key findings, conclusions, and policy recommendations have been brought in chapter 6.

1.11 Summary and Conclusion

In this chapter, the first I have explained the state of the problem followed by the importance of the research. Then I have stated the questions, purpose of the research and the research questions and hypotheses. Next, I brought the principles of the research hypotheses on economic theory and empirical studies. Finally, after explaining the methodological framework, I have discussed the research contribution and overall structure of the dissertation. The next chapter will review relevant literature and the research theoretical background.

CHAPTER 2: Literature Review and Theoretical Foundation

2.1 Introduction

In the previous chapter importance, questions and necessity of this dissertation are stated. In this chapter, at the first, research theoretical foundation is stated. Then, a literature of the earlier investigations is studied. According to the literature of the earlier studies, there are lots of researchers that have examined the relationship between economic growth, Exports, and FDI. Most of the studies differ in the use of econometric methodologies, time periods, states and findings. As a result, there are different empirical findings with respect to the direction of causalities between the variables. There are some findings that bidirectional causality is true about them while about some of them the neutrality hypothesis is true. For some findings, unidirectional causality exists running from one variable to another with no feedback and vice versa.

2.2 Relationship between Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity

GDP and its growth rate reflect a country's macroeconomic situation and a country's economic performance. While it is rather intuitively clear that FDI and exports may promote the growth of GDP, and that exports and FDI are somehow related, when all three variables are combined, it is rather obscure

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$$Y = C(Y) + I(Y + r) + F + X + M(Y + e) \qquad (2.1)$$

where Y, C, I, F, X, M, r, and e are real GDP, real consumption, real domestic investment, real FDI inflows, real exports, real imports, interest rate, and an exchange rate of foreign currency in term of the domestic currency, respectively. X–M (Y, e) is the current account surplus in domestic currency of the domestic country.

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[4] A sophisticated ad hoc argument is that when testing the effects of "openness" on growth, both exports (and trade) and FDI should be considered for the true sense of "openness." Omitting one will commit the omission of variable error, rendering the causality relations ambiguous. See Ahmad, Alam, and Butt (2004), Cuadros, Orts, and Alguacil (2004).

input allocations. This is because investors try to reallocate resources from sectors that are highly affected to the sectors that are lowly adversely affected. In this light, the aggregate output is adversely affected. However, the opposite is true in Libya Error! Reference source not found.. Being an oil-producing country, an increase in oil prices means more oil earnings from exports, As such, the country's GDP increases.

Exports can play an important role in promoting economic growth through supplying the state budget with earnings and foreign currency that can be used for improving infrastructure and creating an attractive investment climate. Moreover, Exports growth leads firms to increase their output and reduce their cost of production, which increases the productivity of these firms and achieve economies of scale. Besides, it plays an important role in expanding the size of the local market and increasing the degree of competition that leads the country to improve its production and use new technology in its production process. According to [59], exports will encourage technical knowledge transfer through suggestions and experiences shared by foreign buyers. In addition, exports will enhance the efficiency of the factors of production by increasing the level of international competition [29]and [73]. Exports will increase the effect of economies of scale, industrialization, and import of capital goods and intermediate goods Error! Reference source not found.and [63]. Ultimately, exports will also increase foreign exchange earnings and create more employment opportunities in the domestic market.

Since the early 1990s, FDI became the largest single source of external finance for developing countries. This important source of private external financing has grown at a phenomenal rate, and the world market for it has become more competitive. Indeed, the rapid growth of FDI and its overall magnitude had aroused many studies relating to the determinants, the *transmission channels and the effects of FDI on economic growth in developed and developing countries. FDI influences growth by raising total factor productivity and, more generally, the efficiency of resource use in the recipient economy, also most empirical studies conclude that FDI contributes to both factor productivity and income growth in host countries. Host countries' ability to use FDI as a means to increase exports in the short and medium term depends on the context. The clearest examples of FDI boosting exports are found where inward investment helps host countries that had been financially constrained make use either of their resource endowment (e.g. foreign investment in mineral extraction) or their geographical location (e.g. investment in some transition economies).*

2.3 Review of Previous Studies in Iran and Foreign Countries

The role of the foreign trade and FDI have largely increased particularly in countries that follow a policy to encourage export and attracting more FDI for enhancing the level of economic growth Error! Reference source not found.and Error! Reference source not found.. This policy leads to increasing the gross domestic product GDP and improved terms of trade. Therefore, many studies emerged in that respect, which emphasize on a positive relation between foreign trade and economic growth Error! Reference source not found., Error! Reference source not found.. As well as, the capital movement across countries encouraged the continued flow of foreign direct investment (FDI) as a key mechanism for achieving an economic growth [36], [101]and Error! Reference source not found.. However, there is a consensus that the foreign trade and FDI have a positive impact on the host economies particularly for physical investment [48]and

Error! Reference source not found.. Therefore, the role of FDI has a link to foreign trade and economic growth in host economies through the exploitation of comparative advantage of these countries for increasing levels of foreign trade in terms of two sides, import and export. In this study our contribution will be differentiated from other studies via measuring the influence of the said variables—FDI, oil export, Non-Oil GDP and Productivity—on each other, as well as forecasting how much each variable studied could affect other variables in the short-run and long-run. The main purpose for that is to empirically extrapolate the conjunction amongst the variables studied in order to specify the key variable that leads to economic growth over the period of the study. In this dissertation, the investigated studies are separated in five main subjects that first group focused on relationship between oil and non-oil exports and economic growth. Second group focused on relationship between exports and economic growth. The third group focused on relationship between oil exports and the trade of oil-producing countries. The fourth group focused on relationship between FDI and economic growth. The last group of investigations focused on the relationship between GDP and exports, GDP and FDI, or exports and FDI.

2.3.1 Oil and Non-Oil Exports and Economic Growth

Many studies have examined the effect of oil and non-oil exports on economic growth of different countries. The findings from these studies tend to vary from one country to another. Some of these studies are: Aljarrah (2008)[16], Olurankinse and Bayo (2012)Error! Reference source not found., Ude and Agodi (2014)Error! Reference source not found.[112] , Ifeacho et al. (2014)[69], Adenugba (2013)[7], Merza (2007)Error!

Reference source not found.[83], Hosseini and Tang (2014)[65], Mehrabadi et al. (2012)Error! Reference source not found.[81] , Esfahani et al. (2013)Error! Reference source not found.[54] and Esfahani et al. (2014)[55].

Aljarrah (2008) [16]examined the impact of oil and non-oil exports on economic development in Saudi Arabia using Ordinary Least Square on time series data sourced from Saudi Arabia database. The result revealed that non-oil export has a positive effect on economic development in Saudi Arabia. Hence, the study recommended that government should increase non-oil exports in order to achieve economic development in Saudi Arabia.

Olurankinse and Bayo (2012) [88] examined the impact of non-oil export on economic growth in Nigeria using Ordinary Least Square on time series data sourced from CBN Statistical Bulletin. Based on the result, it was revealed that non-oil export has a significant positive relationship with the economic growth of Nigeria, which indicates that the rise in the non-oil export leads to a significant improvement in the Nigerian level of economic growth.

Ude and Agodi (2014) Error! Reference source not found.[112] examined the impact of non-oil export on economic growth in Nigeria using Ordinary Least Square on time series data sourced from CBN Statistical Bulletin. Based on the result, it was revealed that non-oil export has a significant positive relationship with the economic growth of Nigeria, which indicates that the rise in the non-oil export leads to a significant improvement in the Nigerian level of economic growth.

Ifeacho et al. (2014) Error! Reference source not found.[69] examined the impact of non-oil export on economic growth in Nigeria using Ordinary Least Square on time series data sourced from CBN Statistical Bulletin.

Based on the result, it was revealed that non-oil export has a significant positive relationship with the economic growth of Nigeria, which indicates that the rise in the non-oil export leads to a significant improvement in the Nigerian level of economic growth.

Adenugba (2013) Error! Reference source not found.[7] examined the impact of non-oil exports on economic growth in Nigeria using Ordinary Least Square on time series data sourced from CBN Statistical Bulletin. The result revealed that non-oil exports have a positive effect on the economic growth of Nigeria, but it has performed below expectations.

Akeem (2011) [12] examined the relationship between non-oil exports and economic growth in Nigeria using Ordinary Least Square on time series data sourced from CBN Statistical Bulletin. The result revealed that the relationship between non-oil exports and economic growth in Nigeria is positive and insignificant.

Abogan (2014) Error! Reference source not found.[6] examined the relationship between non-oil exports and economic growth in Nigeria using Ordinary Least Square on time series data sourced from CBN Statistical Bulletin. The result revealed that the relationship between non-oil exports and economic growth in Nigeria is positive and insignificant.

Merza (2007) [83] examine the casual relationship between non-oil exports and economic growth in Kuwait using Granger causality test on time series data sourced from Kuwait database. The result of his findings revealed that there is a bidirectional causality relationship between oil exports and economic growth, and there is a unidirectional causality relationship running from non-oil exports to economic growth in Kuwait.

Hosseini and Tang (2014) Error! Reference source not found.[65] examined the casual relationship between oil and non-oil exports to economic growth in Iran using Granger causality test on time series data sourced from Iran database. The result of their findings revealed that there is a unidirectional causality relationship moving from oil and non-oil exports to economic growth, but oil export has a negative effect on the economic growth of Iran.

Mehrabadi et al. (2012) Error! Reference source not found.[81] examined the impact of oil and non-oil exports on economic growth in Iran using Ordinary Least Square on time series data sourced from Iran database. The result revealed that both oil and non-oil exports have positive effect on the economic growth of Iran.

Esfahani et al. (2013) [54]examined the effect of oil revenues on the Iranian economy using Ordinary Least Square on time series data sourced from Iran database. The result revealed that both oil revenues have positive effect on the Iranian economy.

Esfahani et al. (2014) Error! Reference source not found.[55]surveyed a long-run output relation for a major oil exporting economy where the oil income to output ratio remains sufficiently high over a prolonged period. The long-run theory is tested using quarterly data on nine major oil economies. Overall, the test results supported the long-run theory, with the existence of long-run relations between real output, foreign output and real oil income established for six of the nine economies considered.

The review above of previous studies shows that the empirical finding on the impact of oil and non-oil exports on economic growth is not uniform while some studies find significant impact of the oil and non-oil exports on economic growth, other studies agreed on insignificant and weak impact of

the oil and non-oil exports on economic growth. Also, there is a controversy on the nature of the relationship between non-oil sectors on economic growth. While some of the studies agree on a positive relationship subsisting between non-oil sector and economic growth, other studies put forward a negative relationship. The reason for these discrepancies may be linked to the methodologies employed in these previous studies.

2.3.2 Exports and Economic Growth

Some other researchers focused on the relationship between the exports and economic growth. Some of these studies concluded that there is a positive relationship between exports and economic growth. These investigations have assayed to analyze the causal nexus between related variables as noted in fallowing researchers like Tyler, W. (1981)[111], Balassa, B. (1985)Error! Reference source not found.[29] , Sengupta et al. (1994)[106], Al-yousif, Y.K. (1997)[18], Husein, J. (2009)Error! Reference source not found.[66] , Hamuda et al. (2010)[61], Temiz et al. (2010)[110], Safdari et al. (2011)Error! Reference source not found.[103] ,Sharazi and Manap (2004)[108], Abbas, S. (2012)[5], Xu, Z (2000)Error! Reference source not found.[118] , Bouoiyour, J. (2003)[34], Bahmani-Oskooee et al. (2005)[2], Mehrara, M. (2014)[82].

Tyler, W. (1981) [111]analyzed the empirical relationship between economic growth and export expansion in developing countries as observed through an inter-country cross-section. Employing data from 55 middle income developing countries for the period 1960–1977, bivariate tests revealed significant positive associations between growth and various other economic *variables including the growth of manufacturing output, investment, total exports, and manufacturing exports. A production function model was also specified and estimated with the cross-sectional data. The results indicated that export performance was important, along with capital formation, in explaining the inter-country variance in GDP growth rates during the 1960–1977 period.*

Balassa, B. (1985) [29] In a study of 43 developing countries in the 1973–78 period of external shocks, the author has shown that inter-country differences in the rate of economic growth are affected by differences in investment rates and by the rate of growth of the labor force, by the initial trade policy stance and by the adjustment policies applied, as well as by the level of economic development and the product composition of exports. The results showed that the policies adopted have importantly influenced the rate of economic growth in developing countries. In particular, an outward-oriented policy stance at the beginning of the period and reliance on export promotion in response to these shocks, appear to have favorably affected growth performance. The results further indicated the possibilities for low-income countries to accelerate their economic growth through the application of modern technology in an appropriate policy framework as well as the advantages of relying on manufactured exports.

Sengupta et al. (1994) [106] discussed the sources of rapid growth in Asian newly industrializing countries (NICs) in recent times by applying some econometric tests of new growth theory. The Korean economy is considered as an example of the successful NICs in Asia, where three types of empirical tests are applied based on the modern theory of cointegration, the dominical role of demand and the existence of significant scale economies due to *human capital. The empirical growth profile of Korea in recent times seems to indicate the broad tenets of the new growth theory.*

Al-yousif, Y.K. (1997) [18]investigated the relationship between exports and economic growth in four of the Arab Gulf countries, namely, Saudi Arabia, Kuwait, UAE, and Oman for the period 1973-93. The estimates presented indicated a positive and significant relationship between the two variables. Also, the statistical adequacy of the models used is supported by the following diagnostic tests. The Bruesch-Godfrey statistic suggested the absence of serial correlation. The Farely-Hinich test failed to reject the null hypothesis that the models are structurally stable. And both the White and Hausman specification tests showed that the models are correctly specified.

Husein, J. (2009) Error! Reference source not found.examined the ELG hypothesis for eight the Middle East and North Africa (MENA) countries in a multivariate framework by including terms of trade as a third variable. They utilized Johansen and Juselius cointegration procedure and error correction modeling to test the ELG hypothesis. The empirical evidence supported the existence of a "stable" long-run equilibrium relationship among real output, real exports, terms of trade, and found strong support for the ELG hypothesis in all but one of the MENA countries analyzed

Hamada et al. (2010) [61]investigated the relationships between export and economic growth in Libya. An econometric model has been developed and estimated in order to determine the direction of causality in both, short and long run. The annual time series used for the estimation cover the time period 1980 – 2007. The findings indicated that the income, exports, and relative prices are cointegrated. The long-run bidirectional causality between the exports and income growth has been also proved. The study result *indicated that the export promotion policy contributes to the economic growth in Libya.*

Temiz et al. (2010) [110]surveyed the relationship of real export with economic growth (represented by real GDP) by using annual time series data for the Turkish economy over the period 1950-2006. The study applied a number of econometric techniques: ADF unit root test, Johansen cointegration test, vector error correction model (VECM), and Granger causality test. The results of this dissertation show that all the variables are stationary in the first difference. Moreover, the Johansen cointegration test confirmed the existence of the long run relationship among the two variables. The Granger test showed one-way causality from economic growth to real net exports. The causality results were consistent with the results reported by the Vector Error Correction Model (VECM). There is a long run and also short-run causality relationship between the real export and the economic growth. The direction of this causality is from economic growth (real GDP) to real export.

Safdari et al. (2011) Error! Reference source not found. explored causal relationship between export and economic growth for 13 developing countries, for the period of 1988-2008, using panel VECM. This study results depicted unidirectional reverse causality running from economic growth to exports.

Sharazi and Manap (2004) [108] determined the impact of export on economic growth of Pakistan, using multivariate Granger causality for the period of 1960 to 2003. Their results confirmed the validity of export-led growth hypothesis for the economy of Pakistan.

Abbas, S. (2012) Error! Reference source not found. investigated the relationship between export, import and economic growth using annual time series data for the Moroccan economy over the period 1980-2013. The cointegration technique had been employed to see the long run equilibrium relationship among variables. For this end, Granger causality test based on vector error correction model (VECM) had been adopted to see both short and long-run causality among the variables. The cointegration results confirmed the existence of the long-run relationship among these variables. For the short-run causality, the findings suggested (i) bi-directional causality between economic growth and import, (ii) unidirectional causality that run from export to import, and (iii) no-directional causality between economic growth and export.

Xu, Z. (2000) [118]analyzed the effects of the growth of nonfuel primary exports on the growth of industrial exports and GDP in 74 economies between 1965 and 1992. There was clear evidence of positive effects, both in the short term and in the long term, of the growth of primary exports on the growth of industrial exports and GDP in more than two-thirds of the economies. Therefore, governments in developing countries should not discriminate against the export of primary products, as some earlier studies suggest. Instead, they should adhere to policies that aim at export promotion.

Bouoiyour, J. (2003) [34] utilized cointegration and Granger-causality tests to examine the relationship between trade and economic growth in Morocco over the period 1960-2000 using the VEC model. The result indicated that both exports and imports enter with positive signs in the cointegration equation. The results showed that imports and exports Granger caused GDP and imports Granger caused exports. These results could be interpreted as a causality from the foreign sector to the domestic growth of Morocco.

Bahmani-Oskooee et al. (2005) [1] re-examined the ELGH for Nigeria. They utilized time series data for the period 1963 to 2013. Applying the framework of cointegration and causality, the following findings were made. First is that manufacturing export has a strong positive long-run impact on growth, in contrast, the primary product component generates negative impacts on growth. Similarly, the Granger causality test result also supported the ELGH for the case of manufacturing product. On the overall, the estimation result confirmed to the prediction of the ELGH while at the same time points out the differentiated impacts of these two components of exports on growth. In view of this result, they recommended that economic policy reforms particularly should be aimed at designing mechanisms to replace primary product export dependence with manufacturing export promotion through intensified economic diversification.

Mehrara, M. (2014) [82] investigated the causal relationship between non-oil international trade and the GDP in a panel of 11 selected oil exporting countries by using panel unit root tests and panel cointegration analysis. A three-variable model is formulated with oil revenues as the third variable. The results showed a strong causality from oil revenues and economic growth to trade in the oil exporting countries. Yet, the non-oil trade does not have any significant effects on GDP in short- and long-run. It means that it is the oil and GDP that drives the trade in mentioned countries, not vice versa. According to the results, decision makings should be employed to achieve sustainable growth through higher productivity and substantially be enlarging the economic base diversification in the future.

The review above of previous studies indicates that the empirical finding on exports and economic growth is same.

2.3.3 Oil Exports and Trade of Oil-Producing Countries

Some studies on the nexus between the oil exports and the trade of oil-producing countries concerned simultaneously in a modeling framework. Some of these studies are Salvatore (1983) [104], Tamascke (1990) and Metwally (1993b)[84].

Salvatore (1983) [104] on his part discovered the positive link between trade and growth. He was not as pessimistic his conclusion as some of the views that considered the trade to be a retarding force in terms of development. But his views, on the other hand, are not as optimistic as the views of those who considered trade as an engine of growth.

Tamascke (1990) conducted a study that tested the link between exports and income of Queensland and Alberta for the period lasting from 1961 to 83 with

results concluding that a strong relationship existed between exports and income.

The study also discovered that growth in services a very delicate issue when it comes to export growth. Both cases had no evidence of feedback effects.

Metwally (1993b) [84] conducted a study of ten Asian countries where he looked into their trade interdependent and economic development from 1974 to 88. The result of his study indicated that to some extent, these countries under study had some degree of interdependence with each other and with the rest of the world in terms of economics.

The review above of previous studies reveals that the empirical finding on the impact of oil exports on the trade is same.

2.3.4 FDI and Economic Growth

Some other researchers focused on the relationship between FDI and economic growth. In the economic literature, there is a large body of studies on the impact of foreign direct investment (FDI) on economic growth. This literature explores various aspects of the spillover effects of FDI such as (i) technology transfer (ii) introduction of new processes (iii) productivity gains and (iv) opening of new market opportunities. FDI is usually viewed as a channel through which technology is able to spread from developed to developing countries. According to Chen (1992) [42], the positive developmental role of FDI, in general, is well documented. He argues that FDI produces a positive effect on growth in host countries. Moreover, Blomström and Kokko (1997) [32] reveal that economic theory provides two approaches to studying the effects of FDI on host countries. One is rooted in the standard theory of international trade and dates back to MacDougall (1960) [78]. This is a partial equilibrium comparative-static approach intended to examine how marginal increments in investment from abroad are distributed. The main prediction of this model is that inflows of foreign capital -whether in the form of FDI or portfolio capital- will raise the marginal product of labor and reduce the marginal product of capital in the host country. The other approach departs from the theory of industrial organization and was pioneered by Hymer (1960) [68][5]. This approach suggests that to be able to invest in production in foreign markets, a firm must possess some asset (for example, product and process technology or management and marketing skills) that can be used profitably in the foreign

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5 ***Other important contributions have made by Buckley and Casson (1976), Caves (1971), Dunning (1973), Kindleberger (1969), and Vernon (1966).***

affiliate. Firms investing abroad, therefore, represent a distinctive kind of enterprise. Some of these studies are Blomström M et al. (1997)Error! Reference source not found., Chen, E. K.Y. (1992)[42], Dess, S. (1998)[51], Aitken B. J et al. (1999)[11], Bosworth and al. (1999), Chakraborty C et al. (2002)[40], Alfaro L. (2003)[13], Furthermore, Kohpaiboon (2003)[72].

Blomström and Kokko (1997) [32] suggest that foreign direct investment may promote economic development by helping to improve productivity growth and exports.

Dess (1998) [51] examined the Foreign Direct Investment in China. He found that the FDI affects Chinese growth through the diffusion of ideas. Indeed, FDI presents a significant positive effect on Chinese long-term growth through its influence on technical change.

Aitken B. J et al. (1999) [11]investigated that Do Domestic Firms Benefit from Direct Foreign Investment? Using panel data on Venezuelan plants, the authors found that foreign equity participation is positively correlated with plant productivity (the 'own-plant' effect), but this relationship is only robust for small enterprises. They then tested for spillovers from joint ventures to plants with no foreign investment. Foreign investment negatively affects the productivity of domestically owned plants. The net impact of foreign investment, taking into account these two offsetting effects, is quite small. The gains from foreign investment appear to be entirely captured by joint ventures.

Bosworth and al. (1999) used panel regression techniques to evaluate the impact of capital inflows on investment on a group of 58 developing countries for the period 1978-95. They found that FDI flows have a positive *(and almost one for one) impact on investment, whereas portfolio flows have no discernible effect.*

Chakraborty C. et al. (2002) [40], examined the foreign direct investment and growth in India. That the two-way link between foreign direct investment and growth for India is explored using a structural cointegration model with vector error correction mechanism. The existence of two cointegrating vectors between GDP, FDI, the unit labor cost and the share of import duty in tax revenue is found, which captures the long run relationship between FDI and GDP. A parsimonious vector error correction model (VECM) is then estimated to find the short run dynamics of FDI and growth. Our VECM model reveals three important features: (a) GDP in India is not Granger caused by FDI; the causality runs more from GDP to FDI; (b) trade liberalization policy of the Indian government had some positive short-run impact on the FDI flow; and (c) FDI tends to lower the unit labor cost suggesting that FDI in India is labor displacing.

Alfaro (2003) [13]has made a sectorial panel LOS analysis, using cross-country data over the period 1981-1999. Alfaro affirmed that, although it may seem natural to argue that FDI can convey great advantages to host countries, the benefits of FDI vary greatly across sectors by examining the effect of the foreign direct investment on growth in the primary, manufacturing, and services sectors. The main results indicated that FDI in the primary sector tend to have a negative effect on growth, while investment in manufacturing a positive one, and the effect of the investment on growth in the service sector is ambiguous.)

Furthermore, Kohpaiboon (2003) [72] studied Thailand's case (over the period 1970-1999) to examine the causal link between FDI and economic growth. By introducing an exports variable in the growth-FDI equation, he *found that the growth impact of FDI tends to be greater under an exports promotion trade regime compared to an import-substitution regime. These results have been affirmed by Balamurali and Bogahawatte (2004) [28]in a study elaborated for the case of Sri Lanka.*

The review above shows that the empirical finding on the link between FDI and economic growth is not uniform, while some studies find a significant impact of the FDI on economic growth, other studies agreed on the insignificant and weak impact of FDI on economic growth.

2.3.5 GDP and Exports, GDP and FDI, or Exports and FDI

Some other researchers focused on the relationship between GDP and exports, GDP and FDI, or exports and FDI. A few published works deal with the causality relations among these three variables. There are several papers on an individual country study examining Granger causality of these three variables. Some of these studies are Liu, et al. (2002)[77], Kohpaiboon (2003)[72], Alici and Ucal (2003)[15], Dritsaki, et al (2004)[53], Ahmad, et al (2004)[8], Nair-Reichert and Weinhold (2000)[87], Makki and Somwaru (2004)[80], Cuadros, et al. (2004)[47] and Cho (2005)[45].

Liu, et al. (2002) [77]found bidirectional causality[6] between each pair of real GDP, real exports, and real FDI for China using seasonally adjusted quarterly data from 1981:1 to 1997:4.

[6] In their paper China's quarterly inward FDI and exports were deflated by the GDP deflator (1990=1), monthly GDP was approximated by monthly gross industrial output, and quarterly EXs are taken from IMF.

Kohpaiboon (2003) [72] found that, under exports promotion (EP) regime, there is a unidirectional causality from FDI to GDP for Thailand using annual data[7] from 1970 to1999.

Alici and Ucal (2003) [15] found only unidirectional causality from exports to output[8] for Turkey using seasonally unadjusted quarterly data from 1987.1 to 2002.4.

Dritsaki, et al (2004) [53] found a bidirectional causality between real GDP and real exports, unidirectional causalities from[9] FDI to real exports, and FDI to real GDP, for Greece using annual IMF data from 1960 to 2002.

Ahmad, et al (2004) [8] found unidirectional causalities from exports to GDP and FDI to GDP for Pakistan using undeflated annual data from 1972 to 2001.

Nair-Reichert and Weinhold (2000)[87] found that the Holtz-Eakin causality tests show FDI, not exports, causes GDP using data[10] from 24 developing countries from 1971 to 1995 applying mixed fixed and random (MFR) model

Makki and Somwaru (2004) [80]found a positive impact of exports and FDI on GDP using World Development Indicators database of 66 developing countries averaged over ten-year periods .

Cuadros, et al. (2004)[47] found unidirectional causalities from real FDI and real exports to real GDP in Mexico and Argentina, and unidirectional causality from real GDP to real exports in Brazil using seasonally adjusted quarterly data from Mexico, Brazil, and Argentina from the late 1970s to

[7] There is no indication that the data were deflated.
[8]They use Turkish industrial production index as GDP, export price index as EX, along with real FDI.
[9] There is no indication that FDI data were deflated in their paper.
[10] The paper does not specify the sources of data, whether the data were deflated and does not check stationary.

2000; 1971-1980, 1981- 1990, and 1991-2000 and the instrumental variable method.

Cho (2005) [45]found only a strong unidirectional causality from FDI to exports, using annual data from nine economies (the same economies as ours plus Indonesia) from 1970 to 2001. In Cho's model, GDP is taken as the Malmquist productivity index.

In general, our survey of the fifth strand of the literature shows that the causality relations vary with the period studied, the econometric methods used, treatment of variables (nominal or real), one-way or two-way linkages, and the presence of other related variables or inclusion of interaction variables in the estimation equation. The results may be bidirectional, unidirectional, or no causality relations. Thus, it is very important that the assumptions, the treatment of variables, the sample period, estimation models and methods should be clearly indicated in the analysis. In any case, the above brief survey also seems to indicate that there may be some causality relations among exports, FDI, and GDP.

According to existing literature; there are five strands of literature.

The First Strand: focuses on oil and non-oil exports on economic growth. Aljarrah (2008) [16] found that non-oil exports have a positive effect on economic development in Saudi Arabia. Olurankinse and Bayo (2012)[88], Ude and Agodi (2014)[112] and Ifeacho et al. (2014)[69] found that non-oil exports have a significant positive relationship with the economic growth of Nigeria, which indicates that the rise in the non-oil exports leads to a significant improvement in the Nigerian level of economic development; Adenugba (2013)[7] also found that non-oil exports have a positive effect on the economic growth of Nigeria, but it has performed below expectations;

However, Akeem (2011)[12] and Abogan (2014)[6] concluded that the relationship between non-oil exports and economic growth in Nigeria is positive and insignificant. Besides; Mehrara (2014)[82] found that non-oil trade does not have any significant effects on economic growth of 11 oil exporting countries; Merza (2007)[83] found that there is a bidirectional causality relationship between oil exports and economic growth, and there is a unidirectional causality relationship running from non-oil exports to economic growth in Kuwait; Hosseini and Tang (2014)[65] concluded unidirectional causality relationship moving from oil and non-oil exports to economic growth, but oil exports have a negative effect on the economic growth of Iran; Although, Mehrabadi et al. (2012)[81] found that both oil and non-oil exports have a positive effect on the economic growth of Iran; Esfahani et al. (2013)[54] also found a positive effect of oil revenues on the Iranian economy; Similar results are reported by Esfahani et al. (2014)[55] for major oil exporting countries. However, Delacroix (1977) [50] supposed that the exports of raw materials do not help in economic growth. If the country does not use the raw materials in the industrial process it will stay underdeveloped. So, using raw materials in the industry will help in economic growth and will lead to developing the country.

The Second Strand: deals with exports and economic growth. Some of these studies concluded that there is a positive relationship between exports and economic growth. This result is supported by Tyler (1981)[111], Balassa (1985)[29], Ram (1987)[100], Krueger (1990)[73], Sengupta and Espana (1994)[106], Al-Yousif (1997)[18], Shirazi and Abdul-Manap (2004)[108], Alhajhoj (2007)[14], Hye and Bel Haj Brubaker (2011)[67], and Saad (2012)[102]. Some other researchers such as Husein (2009)[66] and Hamuda et al. (2010)[61], and Hye (2012) [67]concluded that there is a *bidirectional causality relationship between exports and economic growth; However, Al-Suwaidi and Al-Shamsi (1997)[17], Temiz and Gokmen (2010)[110], Safdari et al. (2011)[103], and Abbas (2012)[5] found that there is a positive and unidirectional causality relationship running from economic growth to exports. Other researchers including Holman and Graves (1995)[64], Xu (2000)[118], Bouoiyour (2003)[34], Bahmani-Oskooee et al. (2005)[23], Cetintas and Barisik (2009)[38], and Mehrara and Firouzjaee (2011)[82] found that exports lead growth.*

The third strand shows the impact of oil exports on the trade of oil-producing countries. Salvatore (1983) [104] on his part discovered the positive link between trade and growth; Tamascke (1990) found that a strong relationship exists between exports and income; Metwally (1993b) [84]indicated that to some extent, ten Asian countries under study had some degree of interdependence with each other and with the rest of the world in terms of economics.

The Fourth Strand: emphasizes the link between FDI and economic growth. In the economic literature, there is a large body of studies on the impact of foreign direct investment (FDI) on economic growth. Blomström and Kokko (1997) [32] suggested that foreign direct investment may promote economic development by helping to improve productivity growth and exports; Dess (1998)[51] finds that the FDI affects Chinese growth through the diffusion of ideas. Indeed, FDI presents a significant positive effect on Chinese long-term growth through its influence on technical change; Aitken and Harrison (1999) [11]show that the net effect of FDI on firm-level productivity is negligible;

Bosworth and al. (1999) found that FDI flows have a positive (and almost one for one) impact on investment, whereas portfolio flows have no *discernible effect; Additionally, Ogutucu (2002) argued that the foreign direct investment is a major catalyst for the development and the integration of developing countries in the global economy; Chakraborty and Basu (2002) [39]suggested that FDI does not cause India's GDP; In the same perspective, Alfaro (2003)[13] affirmed that, although it may seem natural to argue that FDI can convey great advantages to host countries, the benefits of FDI vary greatly across sectors by examining the effect of the foreign direct investment on growth in the primary, manufacturing, and services sectors. The main results indicate that FDI in the primary sector tend to have a negative effect on growth, while investment in manufacturing a positive one, and the effect of the investment on growth in the service sector is ambiguous; Furthermore, Kohpaiboon (2003) [72] found that the growth impact of FDI tends to be greater under an exports promotion trade regime compared to an import-substitution regime. These results have been affirmed by Balamurali and Bogahawatte (2004) [28]in a study elaborated for the case of Sri Lanka.*

The Fifth Strand: examines bivariate relations either theoretically or empirically between GDP and exports, GDP and FDI, or exports and FDI, relatively few published works deal with the causality relations among these three variables. There are several papers on an individual country study examining Granger causality of these three variables. Liu, Burridge, and Sinclair (2002)[77] found bidirectional causality[11] between each pair of real GDP, real exports, and real FDI for China ;Kohpaiboon (2003) [72]found that, under exports promotion (EP) regime, there is a unidirectional causality from FDI to GDP for Thailand; Alici and Ucal (2003)[15] found only unidirectional causality from exports to output[12] for Turkey; Dritsaki,

[11] In their paper China's quarterly inward FDI and exports were deflated by the GDP deflator (1990=1), monthly GDP was approximated by monthly gross industrial output, and quarterly EXs are taken from IMF.
[12]They use Turkish industrial production index as GDP, export price index as EX, along with real FDI.

Dritsaki, and Adamopoulos (2004) [53]found a bidirectional causality between real GDP and real exports, unidirectional causalities from[13] FDI to real exports, and FDI to real GDP, for Greece;in addition, Ahmad, Alam, and Butt (2004)[8] found unidirectional causalities from exports to GDP and FDI to GDP for Pakistan. For studies of a group of countries, Nair-Reichert and Weinhold (2000)[87] found that the Holtz-Eakin causality tests show FDI, not exports, causes GDP; Makki and Somwaru (2004)[80] found a positive impact of exports and FDI on GDP; Cuadros, Orts, and Alguacil (2004)[47] found unidirectional causalities from real FDI and real exports to real GDP in Mexico and Argentina, and unidirectional causality from real GDP to real exports in Brazil; in addition, Cho (2005)[45] find only a strong unidirectional causality from FDI to exports.

According to the observations and surveys, is used several approaches to investigate the long-term and short-term relationship between macroeconomic variables (Exports, FDI, GDP, Economic Growth) such as Exports Led Growth hypothesis, Panel Data technique, VAR model, Impulse response analysis and variance decompositions, simultaneous equations model. The most studies achieved the same results that the economic literature says that FDI inflows can promote exports in the host countries and that FDI is attracted to countries with a higher trade potential. It also says that export promotion can enhance economic growth and that economic growth can in turn promote exports. It further says that FDI inflows can promote economic growth in the host countries and that economic growth can be a determinant of FDI inflows. We thus reviewed what the proponents advance to support those possible relationships between FDI, exports and economic growth. We reviewed as well the empirical literature of the studies

[13] There is no indication that FDI data were deflated in their paper.

that have assessed the "FDI-led exports", "Export-led growth" and "FDI-led growth" hypotheses, for several countries. Though our review has not been exhaustive, we realized that no study has been carried out to assess "foreign direct investment-led oil export", "oil export-led non-oil GDP" and "foreign direct investment-led non-oil GDP" hypotheses, also "foreign direct investment-led productivity", "productivity -led oil export" and "foreign direct investment-led oil export" hypotheses, in OPEC member countries as a Panel, most of those carried out were country-specific studies, and even Panel data studies carried out including some of the OPEC member countries which neglect the presence of both structural breaks and cross-section dependence. The closest works to the current paper are Liu, et al. (2002)[77], Kohpaiboon (2003)[72], Alici and Ucal (2003)[15], Dritsaki, et al (2004)[53], Ahmad, et al (2004)[8], Nair-Reichert and Weinhold (2000)[87], Makki and Somwaru (2004)[80], Cuadros, et al. (2004)[47] and Cho (2005)[45], that focused on the relationship between GDP and exports, GDP and FDI, or exports and FDI. Liu, Burridge, and Sinclair (2002)[77] found bidirectional causality between each pair of real GDP, real exports, and real FDI for China ;Kohpaiboon (2003)[72] found that, under exports promotion (EP) regime, there is a unidirectional causality from FDI to GDP for Thailand; Alici and Ucal (2003) [15]found only unidirectional causality from exports to output for Turkey; Dritsaki, Dritsaki, and Adamopoulos (2004)[53] found a bidirectional causality between real GDP and real exports, unidirectional causalities from FDI to real exports, and FDI to real GDP, for Greece; in addition, Ahmad, Alam, and Butt (2004)[8] found unidirectional causalities from exports to GDP and FDI to GDP for Pakistan. For studies of a group of countries, Nair-Reichert and Weinhold (2000)[87] found that the Holtz-Eakin causality tests show FDI, not exports, causes GDP; Makki and Somwaru (2004)[80] found a positive impact of *exports and FDI on GDP; Cuadros, Orts, and Alguacil (2004)[47] found unidirectional causalities from real FDI and real exports to real GDP in Mexico and Argentina, and unidirectional causality from real GDP to real exports in Brazil; in addition, Cho (2005) [45]find only a strong unidirectional causality from FDI to exports. In general, causality relations vary with the period studied, the econometric methods used, treatment of variables (nominal or real), one-way or two-way linkages, and the presence of other related variables or inclusion of interaction variables in the estimation equation. The results may be bidirectional, unidirectional, or no causality relations. Thus, it is very important that the assumptions, the treatment of variables, the sample period, estimation models and methods should be clearly indicated in the analysis. In any case, the above brief survey also seems to indicate that there may be some causality relations among exports, FDI, and GDP. Due to those studies have not taken into account both structural breaks and cross-section dependence when testing for unit roots and cointegration, respectively. Then in this study for achieving more reliable and accurate results, we have three innovations in our research than previse studies:*

The first innovation: One of the reasons failed to reach more accurate and reliable results of studies in order to investigate the Granger-causes relationship between variables, especially macroeconomic variables, may be that almost all of them neglect the presence of structural breaks. It is well-known that inappropriately omitting breaks can lead to misleading inference in time series testing Error! Reference source not found..

The second innovation: the second reason failed to reach more accurate and reliable results of studies may be that almost all of them neglect the presence of cross-section dependence.

The third innovation:* *Given that the panel econometric methods for all OPEC countries over longer period applied in the present study are recently developed and less used in the empirical literature.

Hence, the innovative contribution of the present paper is the application of panel econometric techniques that consider both structural breaks and cross-sectional dependence to provide more accurate and reliable results.

2.4 Summary and Conclusion

On one side a review some of the related works in the body of literature shows that most of the mentioned studies have rarely discussed the impact oil export on non-oil sector GDP, foreign direct investment and productivity especially in OPEC countries. On the other side, OPEC country's economy is a single-product economy that is based on oil exports, also there are a lot of potentials to attract foreign investment in the OPEC countries. then our survey of the recent empirical literature shows that the causality relations vary with the period studied, the econometric methods used, treatment of variables (nominal or real), one-way or two-way linkages, and the presence of other related variables or inclusion of interaction variables in the estimation equation. The results may be bidirectional, unidirectional, or no causality relations. There are two major objectives and two secondary objectives in this study. The first major objective is to investigate the short-term relationship between macroeconomic variables, and the second major objective is to investigate the long-term relationship between macroeconomic variables, including oil export, non-oil sector GDP, foreign direct investment

and productivity in OPEC member countries with emphasis on the Cross-Section Dependence and Structural Breaks over the period 1980 – 2015.

Also, the first secondary objective is to investigate the short-term relationship between two by two variables and the second secondary objective is to investigate the long-term relationship between two by two variables including oil export and non-oil sector GDP, foreign direct investment and productivity, non-oil sector GDP and foreign direct investment, oil export and productivity, and oil export and foreign direct investment for OPEC countries over the period 1980 – 2015 using Extended Panel Time Series Models with emphasis on the Cross-Section Dependence and Structural Breaks.

Chapter3: An Overview and Comparison of Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity across the Selected OPEC Member Countries

3.1 Introduction

This chapter to show the relationship between research model variables; provides a brief overview of the trends in OER (as a proxy for Oil Export), NGDP, NGDP per worker (as a proxy for productivity[14]), aggregate Foreign Direct Investment, and aggregate Foreign Direct Investment per worker[15] in the OPEC Member Countries between 1980 and 2015.

3.2 Descriptive Statistics Analysis

Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data. With Descriptive statistics, you are simply describing what is or what the data shows. Each descriptive statistic reduces lots of data into a simpler summary. We wanted to use Average Annual Growth Rate in our study; this does not take into account the effect of compounding although gives an analyst some useful information, then often it is not enough. Depending on the

[14] We understand that this is not the perfect measure for productivity. Data needed to calculate productivity is rarely available in those countries. To obtain productivity, non-oil GDP was divided by total labor force
[15] It was divided by total labor force to consider the amount of investment per worker.

situation, it may be more useful to calculate the compound annual growth rate (CAGR). The CAGR shows how much an investment needs to grow each year to get from the initial value to the ending value, assuming that compounding occurs.

The formula for the CAGR is:

$$CAGR = (Ending\ Value/Beginning\ Value) \wedge (1/n)-1$$

As we know our study is based on panel econometric techniques that consider both structural breaks and cross-sectional dependence to provide more accurate and reliable results; then we divide the periods to 5 parts 1980-1989, 1990-1999, 2000-2009, 2010-2015 and 1989-2015. Table 3-1 presents the compound annual growth rate for OER, non-oil GDP, non-oil GDP per worker (as a proxy for productivity[16]), aggregate foreign direct investment, and foreign direct investment per worker[17] in the OPEC Member Countries between 1980 and 2015. It shows that Foreign Direct Investment annual growth was on average higher than NGDP (except for Ecuador and Angola). The large growth of OER during the period 2000-2009 was accompanied by a larger growth in NGDP and Foreign Direct Investment (except for Kuwait and Saudi Arabia). We note, on the other hand, that labor force growth rate was fluctuating as much as the other variables. Moreover, Foreign Direct Investment per worker annual growth was on average higher than Productivity growth (except for Ecuador, Iran, and Kuwait).

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[16] We understand that this is not the perfect measure for productivity. Data needed to calculate productivity is rarely available in those countries. To obtain productivity, non-oil GDP was divided by total labor force.
[17] It was divided by total labor force to consider the amount of investment per worker.

Table 3- 1: NGDP, Oil Export, FDI and Productivity Average Growth Rates for 11 OPEC Member over the Period 1980-2015(Million US Dollars, 2010 Constant)

Country	period	Aggregate				Per Worker	
		Labor Force	Oil-Export Revenue	Non-Oil GDP	GCF	Productivity	GCF
Algeria	1980-1989	3.4%	-15.3%	4.0%	-0.3%	0.1%	-3.6%
	1990-1999	2.8%	1.5%	1.5%	-1.0%	-1.3%	-3.7%
	2000-2009	7.0%	7.0%	2.8%	9.1%	-4.0%	2.0%
	2010-2015	2.1%	-8.7%	4.0%	4.7%	1.8%	2.6%
	1980-2015	4.3%	0.6%	3.0%	2.9%	-1.2%	-1.3%
Angola	1980-1989	-17.8%	5.2%	7.1%	-0.3%	30.2%	21.3%
	1990-1999	3.2%	2.1%	0.2%	-1.0%	-2.9%	-4.1%
	2000-2009	3.0%	19.3%	3.8%	9.1%	0.8%	5.9%
	2010-2015	3.0%	-6.9%	13.1%	5.6%	9.8%	2.5%
	1980-2015	-2.9%	8.5%	4.5%	3.2%	7.7%	6.3%
Ecuador	1980-1989	2.7%	-2.3%	2.4%	-0.7%	-0.3%	-3.3%
	1990-1999	2.1%	0.3%	2.0%	-1.8%	1.0%	-3.8%
	2000-2009	31.6%	12.7%	3.1%	8.3%	-21.6%	-17.7%
	2010-2015	1.5%	-3.4%	4.7%	3.3%	3.1%	1.8%
	1980-2015	10%	4.9%	2.9%	2.6%	-6.3%	-6.6%
Iran	1980-1989	1.7%	2.6%	0.8%	-6.0%	-0.9%	-7.6%
	1990-1999	1.4%	-2.1%	3.0%	0.3%	1.6%	-1.1%
	2000-2009	38.5%	7.8%	4.1%	7.7%	-24.7%	-22.2%
	2010-2015	1.2%	-19.7%	-6.7%	-3.4%	-7.8%	-4.6%
	1980-2015	10.7%	1.1%	6.4%	7.8%	-6.5%	-9.4%
Iraq	1980-1989	-6.0%	-7.8%	8.6%	-1.4%	15.5%	1.3%
	1990-1999	5.9%	0.5%	4.0%	4.9%	-1.8%	-0.3%
	2000-2009	-9.1%	7.5%	0.8%	16.4%	10.9%	28.0%
	2010-2015	3.0%	0.3%	7.6%	9.4%	4.5%	5.8%
	1980-2015	0.0%	1.5%	6.5%	8.5%	6.5%	8.5%

Kuwait	***1980-1989***	***5.6%***	***-7.9%***	***3.3%***	***-4.1%***	***-2.1%***	***-9.6%***
	1990-1999	***5.0%***	***-2.1%***	***0.5%***	***1.2%***	***-2.6%***	***-1.9%***
	2000-2009	***-2.2%***	***9.2%***	***3.8%***	***2.2%***	***6.1%***	***4.5%***
	2010-2015	***3.8%***	***-2.1%***	***5.6%***	***4.8%***	***1.8%***	***0.9%***
	1980-2015	***5.5%***	***4.8%***	***6.1%***	***7.6%***	***1.3%***	***2.8%***
Libya	***1980-1989***	***1.4%***	***-12.9%***	***-13.0%***	***6.0%***	***-14.1%***	***4.6%***
	1990-1999	***1.8%***	***-3.3%***	***0.0%***	***6.3%***	***0.0%***	***4.7%***
	2000-2009	***21.7%***	***9.9%***	***1.8%***	***11.7%***	***-16.3%***	***-8.2%***
	2010-2015	***-0.9%***	***-28.4%***	***0.0%***	***3.0%***	***0.0%***	***4.0%***
	1980-2015	***6.5%***	***-4.5%***	***-4.5%***	***7.7%***	***-10.3%***	***1.1%***
Qatar	***1980-1989***	***9.9%***	***-10.5%***	***4.3%***	***-2.5%***	***-5.1%***	***-11.9%***
	1990-1999	***2.1%***	***6.1%***	***2.3%***	***5.6%***	***0.3%***	***3.5%***
	2000-2009	***-15.8%***	***8.7%***	***11.7%***	***17.4%***	***32.6%***	***39.4%***
	2010-2015	***2.9%***	***-9.9%***	***6.5%***	***6.2%***	***3.5%***	***3.2%***
	1980-2015	***6.6%***	***1.10%***	***7.80%***	***19.02%***	***-1.50%***	***22%***
Saudi Arabia	***1980-1989***	***6.7%***	***-15.9%***	***3.7%***	***-3.5%***	***-2.8%***	***-9.8%***
	1990-1999	***5.9%***	***-0.01%***	***2.6%***	***4.8%***	***-3.2%***	***1.9%***
	2000-2009	***18.79%***	***8.25%***	***3.5%***	***3.4%***	***-12.9%***	***-13.1%***
	2010-2015	***3.72%***	***-6.0%***	***8.2%***	***4.1%***	***4.3%***	***0.4%***
	1980-2015	***9.70%***	***0.2%***	***3.8%***	***9.2%***	***-5.4%***	***-0.5%***
U A E	***1980-1989***	***4.5%***	***-7.5%***	***-0.01%***	***29.6%***	***-4.3%***	***24.0%***
	1990-1999	***3.6%***	***-1.6%***	***4.1%***	***35.2%***	***0.5%***	***30.5%***
	2000-2009	***-7.0%***	***9.0%***	***3.0%***	***9.3%***	***10.7%***	***18.0%***
	2010-2015	***2.2%***	***-4.8%***	***5.7%***	***7.2%***	***3.5%***	***4.9%***
	1980-2015	***1.0%***	***2.0%***	***3.4%***	***21.4%***	***2.4%***	***20.1%***
Venezuela	***1980-1989***	***0.8%***	***-9.4%***	***0.7%***	***-7.1%***	***-0.5%***	***-8.2%***
	1990-1999	***1.2%***	***2.0%***	***1.7%***	***6.5%***	***0.5%***	***11.6%***
	2000-2009	***1.4%***	***5.9%***	***3.1%***	***5.7%***	***1.6%***	***4.3%***
	2010-2015	***0.2%***	***-3.5%***	***-14.1%***	***-1.4%***	***-14.2%***	***-2.2%***
	1980-2015	***1.2%***	***2.1%***	***-1.0%***	***2.7%***	***-2.2%***	***1.3%***

Source: Author's calculations, using data from 1980 -2015

The major characteristic of the GCC economies (Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates (UAE)) is their low national population and indigenous labor force. High investments have been hence accompanied by large inflows of expatriate workers from all across the world especially from surrounding more populated countries: Egypt, Iran, Syria, and Indian subcontinent. Even if all five countries depended heavily on expatriate labor force, we can still observe that Saudi Arabia had less relied on foreigners than Kuwait, Qatar and UAE. This led to a high proportion of expatriate workers in the latter group than in the former as it is obvious in Table 3-2. It is expected then that the educational policies of the local governments do not have a significant effect on the majority of the labor force. Therefore, we expect that investment plays the major role in productivity rather than education.

Table 3- 2: Percentage of Foreigners in the GCC Labor force

	1985*	1997*	2000**	2010***
Kuwait	82	84	81.3	83
Qatar	82	82	81.6	94
Saudi Ariba	72	64	55.8	55
UAE	91	90	89.8	96

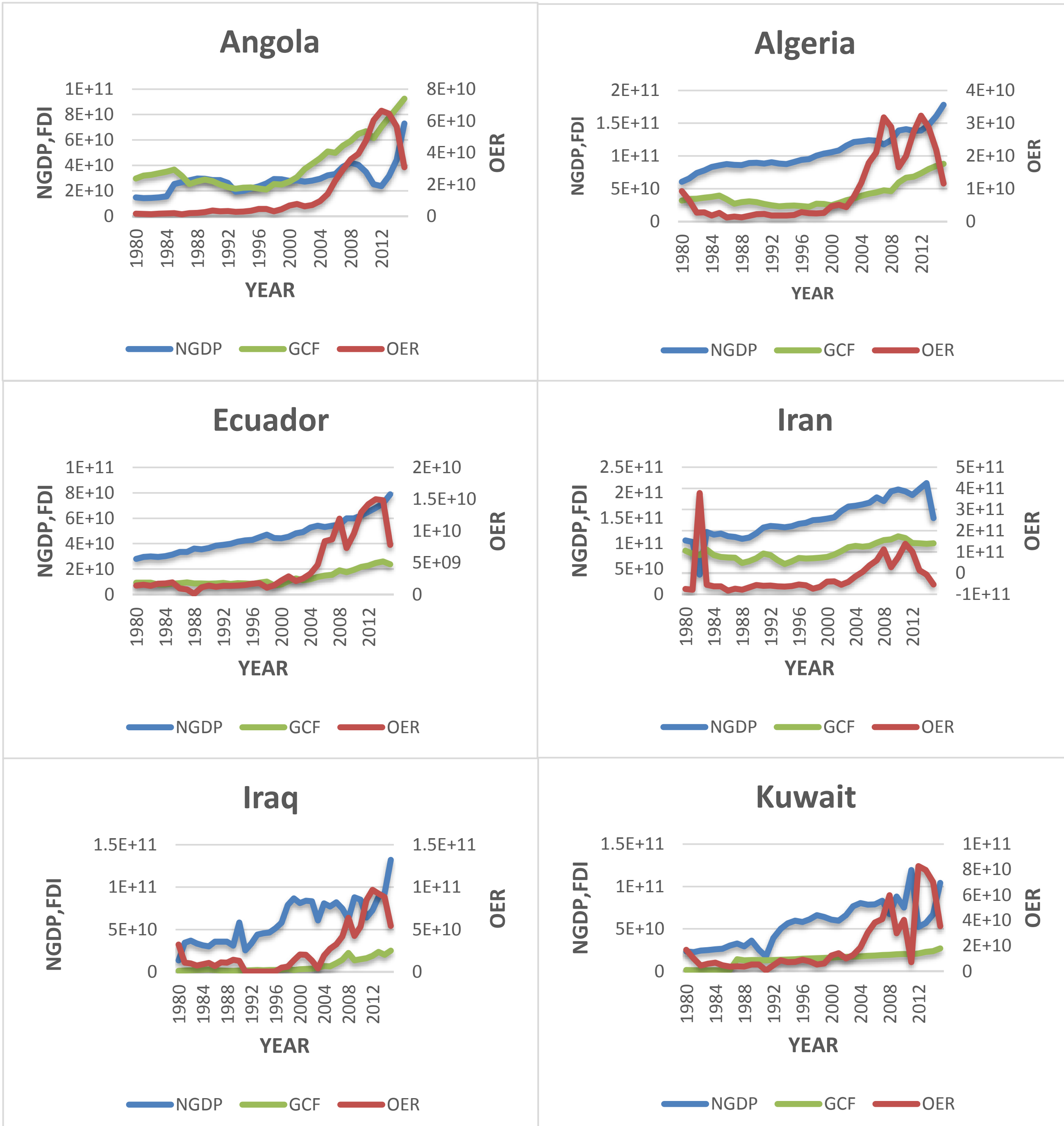
Sources: * Error! Reference source not found., ** Error! Reference source not found., ***Error! Reference source not found.

Table 3-1 shows that in most cases, the growth of labor force was higher than investment. There have been no studies on the skills and productivity of this labor force to assess the productivity effects of the oil exports. But with the easy access to the low-cost labor force, we can expect that producers shift towards the cheaper factor of production which may explain the observed low productivity of labor.

Figure 3-1 displays the path of OER (as a proxy for oil export), NGDP and foreign direct investment between 1980 and 2015. All variables are real. The visual inspection shows that NGDP and FDI have more harmonious movements together than with OER. In general, OER has witnessed large and continuous fluctuations since 1980[18]. NGDP has been less volatile, and so has FDI. In the eighties, oil revenues where at low levels and witnessed much fluctuations. GDP continued to grow slowly (except for Iran and Iraq),

[18] ***We also all know that the first shock of oil prices has started since 1970, but data to measure trends during the period 1970-2015 are rarely available in OPEC member Countries, then we collected our data from 1980.***

while investment appears to slowdown in that period in all countries discouraged for the sake of low oil revenue caused by the Iran-Iraq war (1980-1988). In the nineties, OER experienced higher growth along with higher investment growth. However, NGDP growth was higher. In most cases, the average growth of NGDP in the nineties was more than in the eighties (except for Qatar and Libya). With higher oil revenue in the early years of the 21st century, investment do not seem to respond promptly. But again, GDP grew at even higher rates (except for Iraq, Kuwait and Venezuela).


Angola
NGDP,FDI
1E+11
8E+10
6E+10
4E+10
2E+10
0
8E+10
6E+10
4E+10
2E+10
0
OER
1980
1984
1988
1992
1996
2000
2004
2008
2012
YEAR
NGDP
GCF
OER
Algeria
NGDP,FDI
2E+11
1.5E+11
1E+11
5E+10
0
4E+10
3E+10
2E+10
1E+10
0
OER
1980
1984
1988
1992
1996
2000
2004
2008
2012
YEAR
NGDP
GCF
OER
Ecuador
NGDP,FDI
1E+11
8E+10
6E+10
4E+10
2E+10
0
2E+10
1.5E+10
1E+10
5E+09
0
OER
1980
1984
1988
1992
1996
2000
2004
2008
2012
YEAR
NGDP
GCF
OER
Iran
NGDP,FDI
2.5E+11
2E+11
1.5E+11
1E+11
5E+10
0
5E+11
4E+11
3E+11
2E+11
1E+11
0
-1E+11
OER
1980
1984
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2004
2008
2012
YEAR
NGDP
GCF
OER
Iraq
NGDP,FDI
1.5E+11
1E+11
5E+10
0
1.5E+11
1E+11
5E+10
0
OER
1980
1984
1988
1992
1996
2000
2004
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2012
YEAR
NGDP
GCF
OER
Kuwait
NGDP,FDI
1.5E+11
1E+11
5E+10
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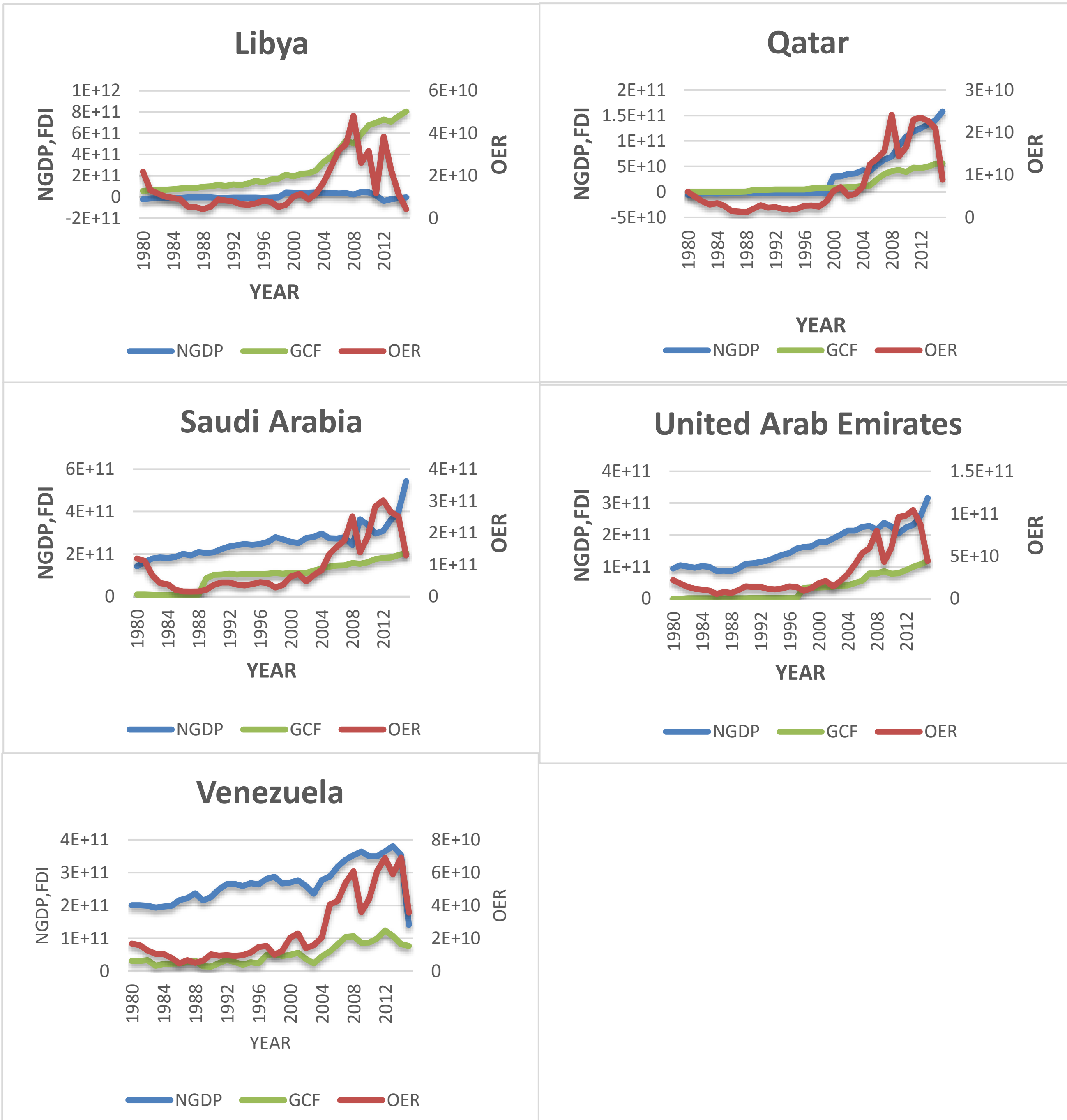
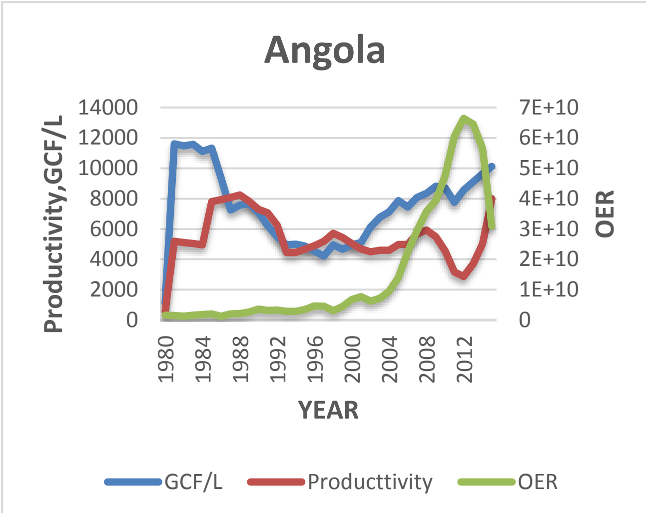


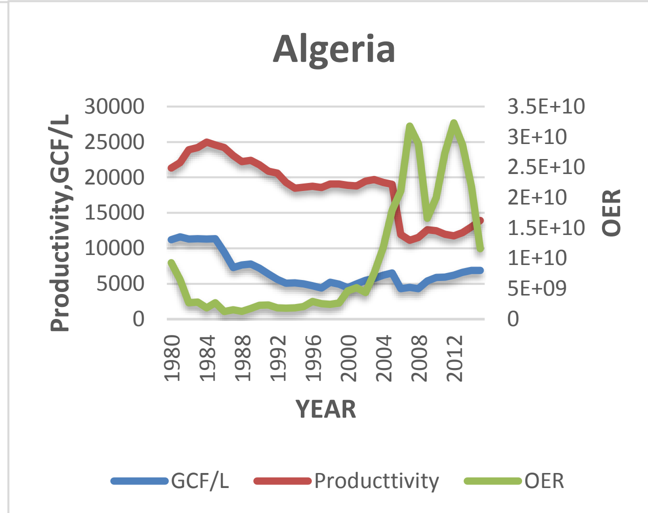
Figure 3-1: A Comparison of Oil Export Revenue, NGDP and Foreign Direct Investment for 11 OPEC Member Countries over the Period 1980-2015 (Million US Dollars, 2010 Constant)

Source: Research Findings, using sample data (1980-2015)

In Figure 3-2, we show productivity and foreign direct investment per worker. It is evident that the movements of productivity and investment per worker differ from their aggregate counterpart (Non-Oil GDP and FDI). This is probably due to the large variations in labor force (Table 3-1). Therefore, fluctuations in aggregate production or investment do not necessarily match them per worker levels. Note that we keep comparing the per-worker variables with aggregate OER because oil revenue movements do not reflect changes in productivity or in labor force. Rather, they reflect mainly world market stance. Moreover, oil revenues end up as government revenues and reflect, therefore, a public tool and a major source for public finance[19]. We observe that despite the increase of OER over the long run, productivity has not been steadily growing (except for Libya). Saudi Arabia and Algeria showed the worst performance with a continuous decreasing productivity over the whole period. Apparently, productivity was closely following the movement of investment per worker. It is also clear that oil exports follow a different stochastic trend that is apparently different from the trend of productivity and investment per worker. From the above discussion, it appears that there is no strong long-run relationship between OER and the macro variables, and that NGDP and investment are more linked to each other - at the aggregate or at the per worker level - than to OER. This may suggest a smoothing behavior of NGDP and investment.

[19] *Nasri Harb(2008)*


Angola
Productivity,GCF/L
0
2000
4000
6000
8000
10000
12000
14000
OER
0
1E+10
2E+10
3E+10
4E+10
5E+10
6E+10
7E+10
1980
1984
1988
1992
1996
2000
2004
2008
2012
YEAR
GCF/L
Producttivity
OER


Algeria
Productivity,GCF/L
0
5000
10000
15000
20000
25000
30000
OER
0
5E+09
1E+10
1.5E+10
2E+10
2.5E+10
3E+10
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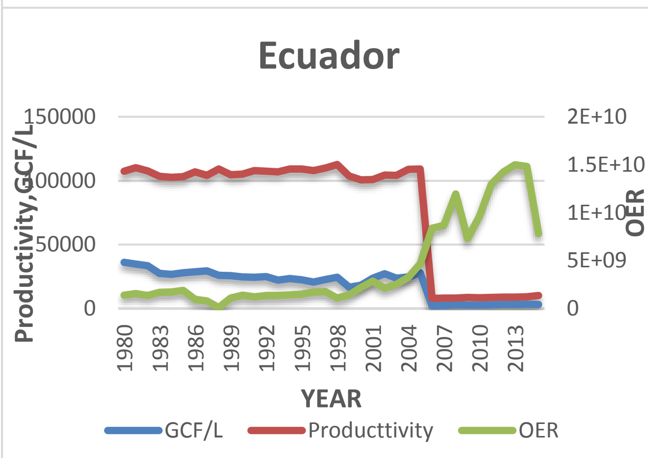
Ecuador
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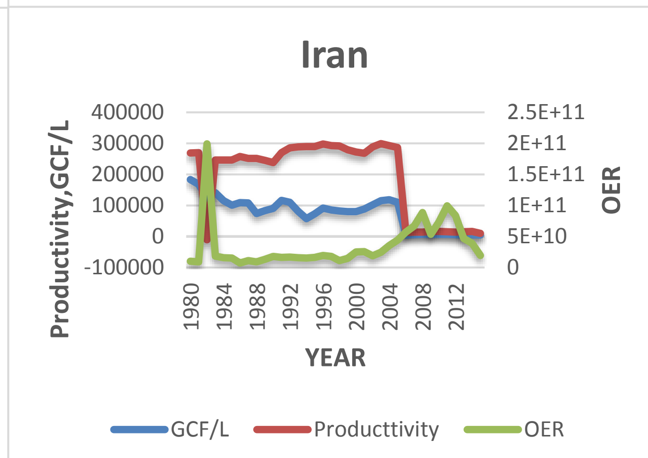
Iran
Productivity,GCF/L
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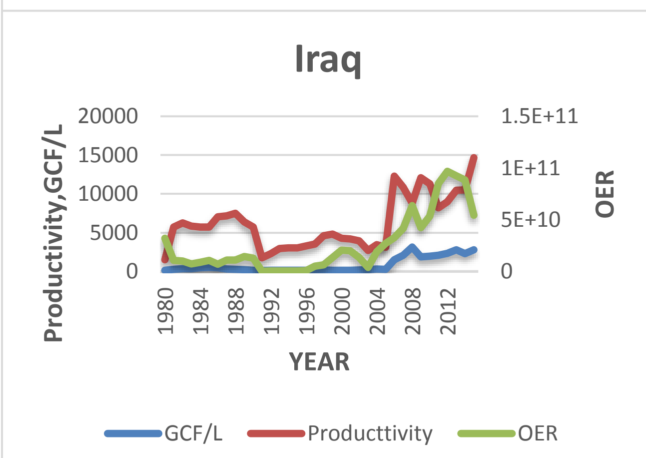
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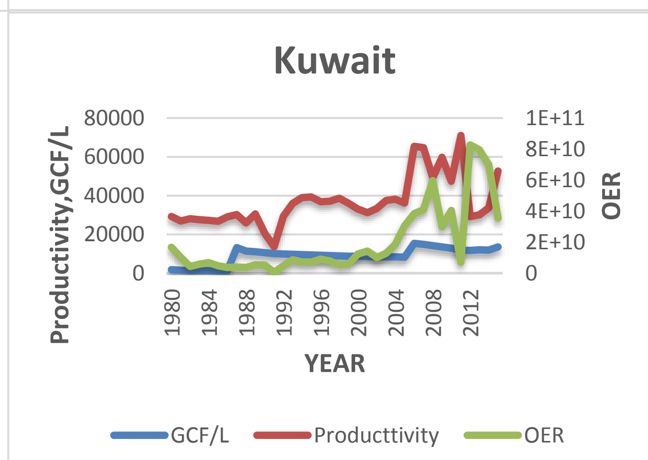
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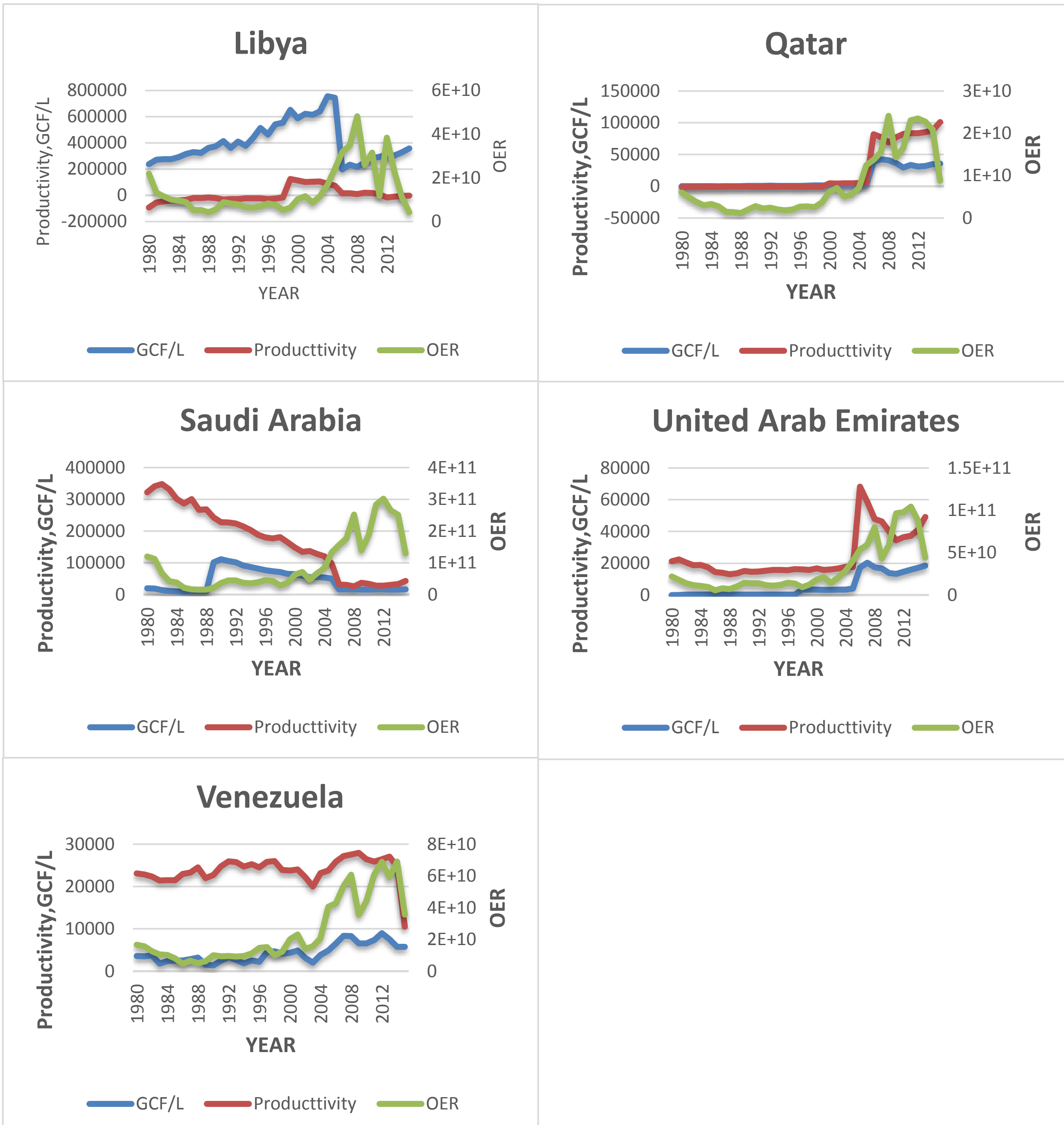

Figure 3-2: A Comparison of Oil Export Revenue, Productivity and Foreign Direct Investment Per Worker for 11 OPEC Member Countries Over the Period 1980-2015 (Million US Dollars,2010 Constant) Source: Authors calculations, using sample data (1980-2015)

3.3 Summary & Conclusion

The objective of this chapter was to provide a brief overview of the trends in oil exports, non-oil GDP, foreign direct Investment, productivity in the selective number of OPEC countries. The evidence indicates that NGDP and FDI have more harmonious movements together than with OER and productivity was closely following the movement of investment per worker. It is also clear that oil exports follow a different stochastic trend that is apparently different from the trend of productivity and investment per worker. The next chapter explores the definitions and the sources of data and methodologies in details.

Chapter 4: Methodology

4.1 Introduction

The present study analyses the relationship between non-oil GDP, oil export, foreign direct investment and productivity in OPEC member Countries over the period from 1980 to 2015. The purpose of this paper is to overcome several shortcomings of previous and frequently used econometric methods to intervene convincingly in the discussion about the direction of causation between our research variables.

4.2 Theoretical Framework

Most studies have analyzed single countries on the basis of annual data and failed to reach a consensus on this causal relationship. As for many countries there are only annual data available, the span usually covers no more than 20-30 years. However, it is well-known that standard time series tests, such as the augmented Dickey-Fuller unit root test Error! Reference source not found.and the Johansen (1991, 1995) cointegration test, have low statistical power, especially when the span of data is short, [37]. In response, recent studies have used panel data to extend the time series dimension by the cross-sectional dimension and, hence, exploit additional information. As panel-based tests rely on a broader information set, the power can substantially be increased and tests are more accurate and reliable. Studies using panel data, however, also provide ambiguous results. One reason may be that almost all of them neglect the presence of structural breaks. It is well-

known that inappropriately omitting breaks can lead to misleading inference in time series testing Error! Reference source not found.. That is also true for panel tests since panel data also include the time series dimension as mentioned by [74]. The importance of taking into account structural breaks when analyzing our search variables can be confirmed by several past events. According to Figure 4-1; First of all, the first oil crisis in 1973 occurred when the Arab oil embargo was proclaimed. The Iranian revolution followed in 1978, accompanied by exploding oil prices and a period of high inflation during the late 1970s. Furthermore, the global economic recession in the early 1980s may represent a potential structural break. Further critical events are: The 1986s oil glut caused by decreasing demand following the 1970s energy crisis, the stock market crash in the United States in 1987, the periods of moderate economic growth and low inflation in Western industrialized countries in the late 1980s and early 1990s, the oil price increase after Iraq's invasion of Kuwait 1990, and, finally, the 1997-1999 Asian financial crisis. Since all those mentioned events occurred within the period covered in this analysis, the consideration of structural breaks is strongly advisable. Hence, the present study makes a substantial contribution to the existing literature by doing so in a panel framework.

A second explanation for the failure to reach a consensus on the direction of causation between Oil Exports, Non-Oil GDP, Foreign Direct Investment and productivity may be the neglect of dependence across the countries in a panel by using first generation panel unit root and cointegration tests. First generation panel tests are characterized by the assumption of independent cross-section members. This condition is unrealistic in view of the strong inter-economy linkages and therefore, is likely to be violated often, for instance, because of common oil price shocks, but most existing residual-

based tests use the assumption of cross-sectional independence to be able to get a convenient asymptotic distribution for the test statistic. The independence of the cross-section members allows for the use of standard asymptotic tools, such as the Central Limit Theorem. However, Banerjee et al. (2004) showed by means of simulations experiments that inappropriately assuming cross-sectional independence in the presence of cross-member cointegration can have distortionary impacts on the panel inference. Thus, they argued that the conclusions of many empirical studies may be based upon misleading inference since the assumption of independent panel members is usually not valid Error! Reference source not found.. Until recently, only few so-called second-generation panel tests have been proposed that take into account the existence of cross-sectional dependency relations (see Error! Reference source not found., for a recent survey).

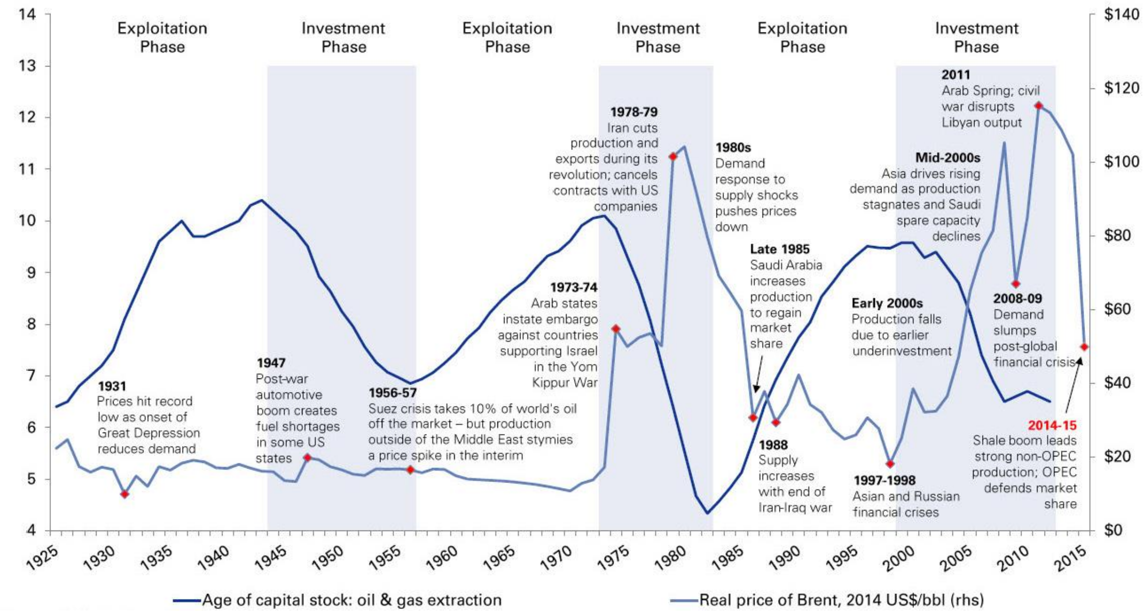

Figure 4.1 Historical Price Shocks of Crude Oil (1925-2015)

Source: Error! Reference source not found.

4.3 Estimation Techniques

This research uses recently developed panel techniques that accommodate both structural breaks and cross-sectional dependence simultaneously rather than neglecting both or tackling only one of these issues at a time. Since these econometric methods have yet been rarely applied in the empirical literature, this section discusses the techniques that are used in this study to analyses the relationship between our research variables model. First, the test for cross-sectional independence proposed by Error! Reference source not found.is briefly presented. Second, this study describes the panel unit root test developed by [26]which allows for structural breaks and cross-

sectional dependence. Third, the panel cointegration test suggested by [116], which also considers structural breaks and dependence across countries, is introduced. Fourth, Sub-section 4.3.4 discusses Pesaran (2006)'s common correlated effects (CCE) estimators that are used to estimate the long run relationship between variables. Finally, the pooled mean group estimator for non-stationary heterogeneous panels suggested by [96] to establish dynamic panel causality is briefly presented

4.3.1 Cross-section dependence

The cross-section dependence (CD) test proposed by [94] tests the null hypothesis of zero dependence across the panel members and is applicable to a variety of panel data models such as stationary and unit root dynamic heterogeneous panels with structural breaks, with small T and large N Error! Reference source not found.. The CD test is based upon an average of all pair-wise correlations of the ordinary least squares (OLS) residuals from the individual regressions in the panel data model.

$$y_{it} = \alpha_i + \beta_i x_{it} + u_{it}, \tag{4.1}$$

where i = 1, ..., N represents the cross-section member, t = 1, ..., T refers to the time period, and x_{it} is a (k×1) vector of observed regressors. The intercepts, α_i, and the slope coefficients, β_i, are allowed to vary across the panel members.

The CD test statistic is defined as

$$CD = \sqrt{2T/N(N-1)} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \rho_{ij} \right) \rightarrow N(0,1) \tag{4.2}$$

where $\hat{\rho}_{ij}$ is the sample estimate of the pair-wise correlation of the OLS residuals, $\hat{u}_{it}$, associated with Equation (4.1);

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} \hat{u}_{it}\hat{u}_{jt}}{\left(\sum_{t=1}^{T} \hat{u}_{it}^{2}\right)^{1/2} \left(\sum_{t=1}^{T} \hat{u}_{jt}^{2}\right)^{1/2}} \qquad \textbf{(4.3)}$$

4.3.2 Panel unit root tests

As a starting point of the integration analysis, this study applies the first-generation panel unit root tests which neglect the presence of both structural breaks and cross-section dependence but are commonly used in the panel data literature on the most variables in our study. Specifically, the Levin et al. (2002) (LLC), Breitung (2000), Im et al. (2003) (IPS), the Fisher-type ADF and Fisher-type PP test. Then, this study applies the second-generation panel unit root test proposed by [26]as a second step. This test allows for structural breaks in the level, slope or both, which can occur at different dates for different countries and may have different magnitudes of shift. Furthermore, the common factor approach enables the common shocks to affect countries differently via heterogeneous factor loadings.

4.3.2.1 Levin, Lin and Chu (LLC) Test

Levin, Lin and Chu (2002) found that when the deviations from equilibrium are very tenacious, individual unit toot tests have low powerful against alternative hypotheses. Therefore, they made a test that it has more power

than individual unit root tests for every cross-section. LLC is restrictive that should be homogeneous.

$$\Delta y_{it} = \rho y_{i,t-1} \sum_{t-1}^{\rho} \theta_{iL} \Delta y_{i,t-L} + \alpha_{mi} d_{mt} + \epsilon_{it} \quad i = 1, 2, \dots, N; \; t = 1,2, \dots, T; \; m = 1,2,3$$

(4.4)

where i is the number of countries; t indicates time variable; α_{mi} is the corresponding vector of coefficients for model m=1,2,3; d_{mt} indicates the vector of deterministic variables (intercept or trend), $d_{1,t}$= {0}, d_{2t}= {1}, d_{3t}= {1, t}; ϵ_{it} i.i.d(0,δ^2_i), means random error has no serial correlation for all the i and t.

H_0: $p_i = p = 0$, for all i, the null hypothesis is that each individual time series is stationary.

H_1: $p_i = p < 0$, for all i, the alternative hypothesis is that each time series does not have a unit root.

To perform LLC test three steps are needed. In the first step ADF (augmented Dickey-Fuller) regression will be performed for each cross-section. In the second, the ratio of long-run to short-run standard deviations will be performed. Third, the panel test statistics will be computed.

The conventional test statistics:

$$t_p = \frac{\hat{p}}{\hat{\sigma}(\hat{p})} \tag{4.5}$$

the adjusted test statistics: $t_p^* = \frac{t_p - N\bar{T}S_N\hat{\sigma}_{\hat{\varepsilon}}^2\hat{p}\mu_{m\bar{T}}^*}{\sigma_{m\bar{T}}^*}$ ***is asymptotically distributed as N (0, 1).***

The power of the test may decrease when exogenous regresses exist. It is necessary to check whether constant terms and trend should be adopted before test. Furthermore, LLC has its limitations. The test crucially depends upon the independence assumption across cross-sections and is not applicable if cross-sectional correlation is present. Second, the assumption that all cross-sections have or do not have a unit root is restrictive.

4.3.2.2 Im, Pesaran and Shin (IPS) Test

Based on the augmented Dickey-Fuller (ADF), IPS test uses separate unit root tests for all the cross-sections and average the ADF tests. Follows is the formula of $\bar{t}$:

$$\bar{t} = \frac{1}{N \sum_{i=1}^{N} t_{pi}} \quad \text{(4.6)}$$

Its null hypothesis is like LLC, that each series has a unit root. But the alternative hypothesis for IPS is that all the individual series don't have unit roots.

H_0: $p_i = p = 0$, for all i; H_1: $p_i < 0$, f or i = 1, 2, 3 …N_1, $p_i = 0$ for i=N_1… N;

The average of ADF statistics can be used to compute tips:

$$t_{IPS} = \frac{\sqrt{N}(\bar{t} - E(\bar{t}))}{\sqrt{var(\bar{t})}} \approx N\,(0, 1) \quad (4.7)$$

where $\bar{t}$ is the average of individual ADF statistics; shows the mean of t_{pi}; $\sqrt{var(\bar{t})}$ is the variance of individual specific test statistics (t_{pi}). And IPS is asymptotically distributed as N (0, 1).

4.3.2.3 Breitung Test

Breitung (2000) researched the power of LLC and IPS and made comparison with other alternative tests. The null and alternative hypotheses are same with Levin, Lin and Chun test. So, the null hypothesis is that each individual time series is stationary. But, the alternative hypothesis is that each time series does not have a unit root. Then Breitung found that the power of LLC and IPS tests will be decrease a lot with individual specific trends. This is due to the bias correction that also removes the mean under the sequence of local alternatives. Breitung suggests a test statistic without adopting a bias adjustment. The experimental results show that the power of LLC and IPS tests is very sensitive to the specification of the deterministic terms.

There is slight difference between LLC and Breitung test. The difference lies in two ways. Only auto-regression portion is removed when constructing standardize proxies. That is:

$$\tilde{e}_{it} = \Delta\tilde{y}_{it-1} = \frac{\Delta y_{it} - \sum_{j=1}^{p_j} \beta_{ij}\Delta y_{i,t-j}}{\sigma_i} \tag{4.8}$$

$$\tilde{v}_{i,t-1} = \tilde{y}_{it-1} = (y_{it-1} - \sum_{j=1}^{p_j} \beta_{ij}\Delta y_{i,t-j})/\sigma_i \tag{4.9}$$

Running the following regression:

$$e^*_{it} = \rho v^*_{i,t-1} + \mu_{i,t} \tag{4.10}$$

where

$$e_{it}^{*} = \sqrt{\frac{T-t}{T-t+1}}\left(\tilde{e}_{it}.\frac{\tilde{e}_{it}+\cdots+\tilde{e}_{it+T}}{T-t}\right) \quad \text{and} \quad v_{i,t-1}^{*} = \tilde{v}_{i,t-1} - C_{it}$$

4.3.2.4 Fisher ADF Test

Fisher ADF test was created by [79]. When a number of lags exist, Pλ in Fisher ADF is not affected. Then, it can cover shortage of LLC and IPS. Based on the model:

$$\Delta y_{it} = py_{i,t-1} + \sum_{L=1}^{pi} \theta_{it}\Delta y_{i,t-L} + a_{mi}d_{mt} + \epsilon_{it} \; i = 1,2,\ldots,N; t = 1,2,3 \tag{4.11}$$

P statistics:

$$p_{\lambda} = -2\sum_{i=1}^{N} lnp_i \sim x^2(2N) \tag{4.12}$$

The null hypothesis and alternative hypothesis of Fisher ADF are the same with IPS's.

H_0: $p_i = p = 0$, for all I

H_1: $p_i < 0$, f or i = 1, 2, 3 … N_1, $p_i = 0$ for i=N_1, N;
(4.13)

4.3.2.5 Modified Sargan and Bhargava Test

Bai and Carrion-i-Silvestre (2009) developed panel unit root statistics which pool modified Sargan and Bhargava (1983) (MSB) tests for individual time series, taking into account both multiple structural breaks and cross-section dependence through a common factors model proposed by [27]. They allow

for structural breaks in the level, slope or both at different dates for different countries and may have different magnitudes of shift. Additionally, each series can have a different number of breaks and within each series the number of breaks in the level and the slope can also be different. Hence, the test approach proposed by [26] takes into account a high degree of heterogeneity across countries. Furthermore, the common factors may be stationary, non-stationary or a combination of both. The common factor approach allows the common shocks to affect countries differently via heterogeneous factor loadings. Bai and Carrion-i-Silvestre (2009) modified the Bai and Ng (2004) PANIC procedure to achieve a robust decomposition into common and idiosyncratic components in the presence of structural breaks. They developed an iterative estimation procedure that is appropriate to deal with heterogeneous breaks in the deterministic components.

In summary, their overall procedure consists of the following steps:

- ***Difference the variables and estimate the number and locations of structural breaks for each time series.***
- ***Given the locations of the structural breaks, estimate the common factors, factor loadings, and the magnitudes of changes via the iteration procedure mentioned above.***
- ***Calculate the residuals for each time series based on the estimated quantities in the second step and then obtain the cumulative sum of residuals as described in [24].***
- ***Determine the modified unilabiate MSB test for each residual series[20].***
- ***Construct the panel MSB test by pooling the individual ones.***

[20] The univariate MSB test for unit root was originally introduced by Stock (1999), who generalized the procedure of Sargan and Bhargava (1983) to non-i.i.d. and non-normal errors.

These steps are based on the following general panel data model:

$$X_{i,t} = D_{i,t} + F_t'\pi_i + e_{i,t} \quad (4.14)$$

$$\left(I - L\right)F_t = C\left(L\right)u_t \quad (4.15)$$

$$\left(1 - \rho_i L\right)e_{i,t} = H - i\left(L\right)\varepsilon_{i,t} \quad (4.16)$$

where the index i = 1, ..., N represents panel members and t = 1, ..., T denotes the time period. $C\left(L\right) = \sum_{j=0}^{\infty} C_j L^j$ ***and*** $H_i\left(L\right) = \sum_{j=0}^{\infty} H_{i,j} L^j$ ***where L is the lag operator and*** ρ_i ***is the autoregressive parameter. The component*** $D_{i,t}$ ***represents the deterministic part of the model,*** F_t ***is a (r × 1) vector of common factors, and*** $e_{i,t}$ ***denotes the idiosyncratic disturbance term.***

Despite the operator (1 − L) in Equation 4.16, F_t ***need not to be I (1). The integration property of the Ft depends on the rank of C (1). If C (1) = 0, the Ft is I (0). If C (1) is of full rank, then each component of Ft is I (1). If C (1) = 0 but not full rank, then some components of Ft are I (1) and some are I (0).[21] With regard to the deterministic component*** $D_{i,t}$***, Bai and Carrion-i-Silvestre (2009) propose the following two models:***

Model1: $$D_{i,t} = \mu_i + \sum_{j=1}^{l_i} \theta_{i,j} DU_{i,j,t} \quad (4.17)$$

Model2: $$D_{i,t} = \mu_i + \beta_i t + \sum_{j=1}^{l_i} \theta_{i,j} DU_{i,j,t} + \sum_{j=1}^{m_i} \gamma_{i,k} DT_{i,k,t} \quad (4.18)$$

where l_i ***and*** m_i ***denote the structural breaks affecting the mean and the trend of a series, respectively, which are not necessarily equal. The dummy variables are defined as*** $DU_{i,j,t}$ ***= 1 for*** $t \succ T_{a,j}^i$ ***and 0 otherwise, and***

[21] For a detailed description of the underlying set of assumptions, see Bai and Carrion-i-Silvestre (2009)

$DT_{i,k,t} = (t - T^i_{b,k})$ for $t \succ T^i_{b,k}$ and 0 otherwise. $T^i_{a,j}$ and $T^i_{b,k}$ represent the jth and kth dates of the breaks in the level and trend, respectively, for the ith individual with j = 1, ..., l_i and k = 1, ..., m_i.

The introduced common factors capture the co-movement of the time series as well as cross-section correlation. Since those factors are unobserved, they need to be consistently estimated. Following Bai and Ng (2004), Bai and Carrion-i-Silvestre (2009) estimate these un-observed common factors by applying the principal components analysis to the differenced-detrended model. They provide separate analyses for the two deterministic models as the limiting distribution of the MSB statistic depends on the specification.[22]

Bai and Carrion-i-Silvestre (2009) pool the individual MSB test statistics to increase the statistical power. The standard approach to pooling described in Levin et al. (2002) requires cross-sectionally independent panel members, a condition that is not fulfilled in this framework. However, the combination of individual MSB test statistics is appropriate since the $e_{i,t}$ are independent across the panel units. This follows from the fact that the limiting distributions are free from the common factors. Bai and Carrion-i-Silvestre (2009) provide two approaches for pooling the individual test statistics so as to test the null hypothesis H0: $\rho_i = 1$ for all i = 1, ..., N against the alternative H1: $|\rho_i| < 1$ for some i. The first approach is to use the average of individual statistics:

$$Z = \sqrt{N}\,\frac{\overline{MSB(\lambda)} - \bar{\xi}}{\bar{\zeta}} \to N(0,1), \tag{4.19}$$

[22] See Bai and Carrion-i-Silvestre (2009) for details.

with $\overline{MSB(\lambda)} = N^{-1}\sum_{i=1}^{N} MSB_i(\lambda i)$, $\overline{\xi} = N^{-1}\sum_{i=1}^{N}\xi_i$ ***,and*** $\zeta^2 = N^{-1}\sum_{i=1}^{N}\zeta_i^2$, ***where*** ξ_i ***and*** ζ_i^2 ***denote the mean and the variance of the individual modified*** $MSB_i(\lambda i)$ ***statistic, respectively, and*** $\lambda_i = T_i^b / T$ ***represents the break fraction parameter.***[23] ***The individual MSB statistics are asymptotically invariant to mean breaks, but not to breaks in the linear trend. Hence, Bai and Carrion-i-Silvestre (2009) introduced a second approach based on simplified test statistics which are invariant to both mean and trend breaks:***

$$Z^* = \sqrt{N}\,\frac{\overline{MSB^*(\lambda)} - \overline{\xi}^*}{\overline{\zeta}^*} \rightarrow N(0,1), \qquad (4.20)$$

with $\overline{MSB^*(\lambda)} = N^{-1}\sum_{i=1}^{N} MSB_i^*(\lambda_i)$, $\overline{\xi}^* = N^{-1}\sum_{i=1}^{N}\xi_i^*$ ***,and*** $\zeta^{*2} = N^{-1}\sum_{i=1}^{N}\zeta_i^{*2}$, ***where*** ξ_i^* ***and*** ζ_i^{*2} ***denote the mean and the variance of the individual modified*** $MSB_i^*(\lambda_i)$ ***statistic, respectively, and*** $\lambda_i = T_i^b / T$ ***represents the break fraction parameter.***[24]

To yield satisfactory results when pooling, Bai and Carrion-i-Silvestre (2009) consider the second approach proposed by Error! Reference source not found.and [46]that pools the p-values of the individual tests:

$$P = -2\sum_{i=1}^{N} lnp_i \rightarrow \chi^2_{2N} \qquad (4.21)$$

$$P_m = \frac{-2\sum_{i=1}^{N} lnp_i - 2N}{\sqrt{4N}} \rightarrow N(0,1) \qquad (4.22)$$

[23] See Bai and Carrion-i-Silvestre (2009) for a description of the individual MSB statistics.
[24] See Bai and Carrion-i-Silvestre (2009) for a description of the individual simplified MSB statistics

where pi, i = 1, ..., N, is the individual p-value. Bai and Carrion-i-Silvestre (2009) denote the corresponding P and Pm statistic that are computed by means of the p-values of the simplified MSB statistic as P^* and p_m^*, respectively.

4.3.3 Panel cointegration tests

When it is established that all variables are integrated of same order, the co-integration relationship among variables in the next step will be examined. To examine the existence of a cointegration relationship this study repeats both types of tests, with and without structural breaks and cross-sectional dependence. In first step, the first-generation panel cointegration tests proposed by [70], [89]and [91]. In a second step, this study applies the LM-based tests proposed by [116] that simultaneously consider cross-section dependence and structural breaks, which may be located at different dates for different panel members. Additionally, this test allows for heteroskedastic and serially correlated errors, and cross unit-specific time trends.

4.3.3.1 Pedroni Residual Based Panel Cointegration

Pedroni (1999) derives seven panel cointegration test statistics. Of these seven statistics, four are based on within-dimension, and three are based on between-dimension. For the within-dimension statistics the null hypothesis of no cointegration for the panel cointegration test is

$$H_0 : \gamma_i = 1 \text{ for all } i$$
$$H_0 : \gamma_i = \gamma \prec 1 \text{ for all } i \tag{4.23}$$

For the between-dimension statistics the null hypothesis of no cointegration for the panel cointegration test is

$$H_0 = \gamma_i = 1 \text{ for all } i$$
$$H_0 = \gamma_i \prec 1 \text{ for all } i \tag{4.24}$$

First, we compute the regression residuals from the hypothesized cointegration regression. In the most general case, this may take the from

$$y_{it} = \alpha_i + \sigma_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + ... + \beta_{Mi} x_{Mi,t} + e_{i,t} \tag{4.25}$$

where T refers to the number of observation over time, N refers to the number of the individual members in the panel, and M refers to the number of regression variables. Here x and y are assumed to be integrated of order one. The slope coefficients $\beta_{1i}, \beta_{2i}, ..., \beta_{Mi}$ ***and specific intercept*** α_i ***vary across individual member of the panel.***

To estimate the residuals from equation (4.25), the seven Pedroni's statistics are:

1. ***Panel*** ν ***-statistics:***

$$T^2 N^{3/2} Z_{\hat{\nu}_{N,T^{-1}}} \equiv T^2 N^{3/2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \tag{4.26}$$

2. ***Panel*** ρ ***-statistics:***

$$T\sqrt{N}Z_{\hat{\rho}_{N,T^{-1}}} \equiv T\sqrt{N}\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}-\hat{\lambda}_{i}\right) \quad \textbf{(4.27)}$$

3. ***Panel t-statistics (Non-parametric):***

$$Z_{t_{N,T}} \equiv \left(\tilde{\sigma}_{N,T}^{2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^{2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}-\hat{\lambda}_{i}\right) \quad \textbf{(4.28)}$$

4. ***Panel t-statistics (parametric):***

$$Z^{*}_{t_{N,T}} \equiv \left(\tilde{s}_{N,T}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^{*2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{i,t-1}^{*}\Delta\hat{e}_{i,t}^{*}\right) \quad \textbf{(4.29)}$$

5. ***Group ρ -statistics:***

$$TN^{-1/2}\tilde{Z}_{\tilde{\rho}_{N,T^{-1}}} \equiv TN^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{e}_{i,t-1}^{2}\right)^{-1}\sum_{t=1}^{T}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}-\hat{\lambda}_{i}\right) \quad \textbf{(4.30)}$$

6. ***Group t-statistics (Non-parametric):***

$$N^{-1/2}\tilde{Z}_{t_{N,T}} \equiv N^{-1/2}\left(\hat{\sigma}_{i}^{2}\sum_{t=1}^{T}\hat{e}_{i,t-1}^{2}\right)^{-1/2}\sum_{t=1}^{T}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}-\hat{\lambda}_{i}\right) \quad \textbf{(4.31)}$$

7. ***Group t-statistics (parametric):***

$$N^{-1/2}\tilde{Z}^{*}_{t_{N,T}} \equiv N^{-1/2}\sum_{i=1}^{N}\left(\hat{s}_{i}^{*2}\sum_{t=1}^{T}\hat{e}_{i,t-1}^{*2}\right)^{-1}\sum_{t=1}^{T}\hat{e}_{i,t-1}^{*}\Delta\hat{e}_{i,t}^{*} \quad \textbf{(4.32)}$$

where

$$\hat{\lambda}_{i}=1/T\sum_{s=1}^{K_i}\left(1-\frac{s}{K_i+1}\right)\sum_{t=s+1}^{T}\hat{\mu}_{i,t}\hat{\mu}_{i,t-s},\hat{S}_{i}^{2}\equiv 1/T\sum_{t=1}^{T}\hat{\mu}_{i,t}^{2},\hat{\sigma}_{i}^{2}=\hat{s}_{i}^{2}+2\hat{\lambda}\tilde{\sigma}_{N,T}^{2}\equiv 1/N\sum_{i=1}^{N}\hat{L}_{11i}^{-2}\hat{\sigma}_{i}^{2}$$

$$\hat{s}_{i}^{*2}\equiv 1/t\sum_{t=1}^{T}\hat{\mu}_{i,t}^{*2},\tilde{s}_{N,T}^{*2}\equiv 1/N\sum_{i=1}^{N}\hat{s}_{i}^{*2},\hat{L}_{11i}^{-2}=1/T\sum_{T}^{1}\hat{\eta}_{i,t}^{2}+2/T\sum_{s=1}^{K_i}\left(1-\frac{s}{K_i+1}\right)\sum_{t=s+1}^{T}\hat{\eta}_{i,t}\hat{\eta}_{i,t-s}$$

and where the residual $\hat{u}_{i,t}$, $\hat{\mu}_{i,t}^{*}$ and $\hat{\eta}_{i,t}$ are obtained from the following regressions[25]:

$$\hat{e}_{i,t}=\hat{\gamma}_{i}\hat{e}_{i,t-1}+\hat{u}_{i,t},\hat{e}_{i,t}=\hat{\gamma}_{i}\hat{e}_{i,t-1}+\sum_{k=1}^{K_i}\hat{\rho}_{i,k}\Delta\hat{e}_{i,t-k}+\hat{\mu}_{i,t}^{*},\Delta y_{i,t}=\sum_{m=1}^{M}\hat{b}_{mi}\Delta x_{mi,t}+\hat{\eta}_{i,t}\hat{\eta}_{i,t-s} \quad \textbf{(4.33)}$$

---

[25] Notes: All statistics are from Pedroni (1997a)

The first four statistics are within-dimension based statistics and the rest are between-dimension based statistics. In his paper Pedroni (1999) describe the seven test statistics, "The first of the simple panel cointegration statistics is a type of non-parametric variance ρ-statistics. The second is a panel version of a non-parametric statistics that is analogous to the familiar Phillips Perron ρ-statistics. The third statistics is also non-parametric and is analogous to the Phillips and Perron t-Statistics. The fourth statistics is the simple panel cointegration statistics which is corresponding to augmented Dickey-Fuller t-statistics" [90]. "The rest of the statistics are based on a group mean approach. The first of these is analogous to the Phillips and Perron ρ-statistics, and the last two analogous to the Phillips and Perron t-statistics and the augmented Dickey-Fuller t-statistics respectively" [90].

To compute any of these desired statistics in his paper Pedroni (1999) write a short summary.

1. ***Estimate the panel cointegration regression from equation (4.26), make sure to include any desired intercepts, time trends or common time dummies in the regression and collect the residual $\hat{e}_{i,t}$ for later use.***
2. ***Difference the original series for each member, and compute the residual for the differenced regression;***

$$\Delta y_{it} = \beta_{1i}\Delta x_{1i,t} + \beta_{2i}\Delta x_{2i,t} + \ldots + \beta_{Mi}\Delta x_{Mi,t} + \eta_{i,t} \tag{4.34}$$

3. ***Calculate $\hat{L}_{11i}^{2}$ as the long-run variance of $\hat{\eta}_{i,t}$ using any Kernel estimator such as the Newey-West (1987) estimator.***

4. ***Using the residuals*** $\widehat{e}_{i,t}$ ***of the original cointegration regression, estimate the appropriate auto- regression, choosing either of the following from (a) or (b):***

(a); For the non-parametric statistics all except number four and number seven estimate $\widehat{e}_{i,t} = \widehat{\gamma}_i \widehat{e}_{i,t-1} + \widehat{u}_{i,t}$ ***and use the residuals to compute the long-run variance of*** $\widehat{u}_{i,t}$ ***,denoted*** $\widehat{\sigma}_i^2$ ***.***

(b); for the parametric statistics number four and seven estimates $\widehat{e}_{i,t} = \widehat{\gamma}_i \widehat{e}_{i,t-1} + \sum_{k=1}^{K_i} \widehat{\rho}_{i,k} \Delta \widehat{e}_{i,t-k} + \widehat{\mu}_{i,t}^*$ ***and use the residuals to compute the simple variance of*** $\widehat{\mu}_{i,t}^*$ ***, denoted*** $\widehat{s}_i^{*2}$ ***Error! Reference source not found.***

After the calculation of the panel cointegration test statistics, Pedroni shows that the standardized statistic is asymptotically normally distributed

$$\frac{\aleph_{N,T} - \mu\sqrt{N}}{\sqrt{y}} \overset{d}{\to} N(0,1) \tag{4.35}$$

where $\aleph_{N,T}$ ***is the standardized form of the test statistics with respect to N and T. Here*** μ ***and*** ν ***are Monte Carlo generated adjustment terms.***

4.3.3.2 Kao (1999) Cointegration Tests

Kao (1999) in his paper describes two tests under the null hypothesis of no cointegration for panel data. One is a Dickey-Fuller type test and another is an Augmented Dickey-Fuller type test. For the Dickey-Fuller type test Kao presents two sets of specification. In the bivariate case Kao consider the following model

$$y_{it} = \alpha_i + \beta x_{it} + e_{it}, \qquad \mathrm{t} = 1, \ldots, \mathrm{T};\ \mathrm{i} = 1, \ldots, \mathrm{N} \tag{4.36}$$

where

$$y_{it} = y_{it-1} + u_{it}$$
$$x_{it} = x_{it-1} + \varepsilon_{it}$$

α_i ***are the fixed effect varying across the cross-section observations,*** β ***is the slope parameter,*** y_{it} ***and*** x_{it} ***are independent random walks for all i .The residual series*** e_{it} ***should be I(1) series.***

Now Kao define a long run covariance matrix of $w_{it} = (u_{it}, e_{it})'$ ***is given by***

$$\Omega = \lim_{T\to\infty} \frac{1}{T} E\left(\sum_{t=1}^{T} w_{it}\right)\left(\sum_{t=1}^{T} w_{it}\right)' = \Sigma + \Gamma + \Gamma' \equiv \begin{pmatrix} \sigma_{0u}^2 & \sigma_{0u\varepsilon} \\ \sigma_{0u\varepsilon} & \sigma_{0\varepsilon}^2 \end{pmatrix}, \qquad \textbf{(4.37)}$$

where

$$\Gamma = \lim_{T\to\infty} \frac{1}{T} \sum_{K=1}^{T-1} \sum_{t=k+1}^{T} E\left(w_{it} w'_{it-K}\right) \equiv \begin{pmatrix} \Gamma_u & \Gamma_{\varepsilon u} \\ \Gamma_{\varepsilon u} & \Gamma_u \end{pmatrix}$$

and

$$\Sigma = \lim_{T\to\infty} \frac{1}{T} \sum_{t=1}^{T} E\left(w_{it} w'_{it}\right) \equiv \begin{pmatrix} \sigma_u^2 & \sigma_{u\varepsilon} \\ \sigma_{u\varepsilon} & \sigma_\varepsilon^2 \end{pmatrix}$$

The Dickey-Fuller test can be applied to the estimated residual using

$$\hat{e}_{it} = \rho \hat{e}_{it-1} + v_{it} \qquad (4.38)$$

Now the null and alternative hypothesis may be written as

$$\begin{aligned} H_0 &: \rho = 1 \\ H_1 &: \rho \prec 1 \end{aligned} \qquad (4.39)$$

The OLS estimate of ρ ***is given by***

$$\widehat{\rho}=\frac{\sum_{i=1}^{N}\sum_{t=2}^{T}\widehat{e}_{it}\widehat{e}_{it-1}}{\sum_{i=1}^{N}\sum_{t=2}^{T}\widehat{e}_{it-1}^{2}} \tag{4.40}$$

Further calculation for Dickey-Fuller, Kao shows the following statistics

$$\begin{cases} DF_{\rho}^{*}=\dfrac{\sqrt{N}T(\widehat{\rho}-1)+3\sqrt{N}\widehat{\sigma}_{\upsilon}^{2}/\widehat{\sigma}_{0\upsilon}^{2}}{\sqrt{3+36\widehat{\sigma}_{\upsilon}^{4}/\widehat{\sigma}_{0\upsilon}^{4}}}\sim N(0,1) \\ DF_{t}^{*}=\dfrac{t_{\rho}+\sqrt{6N}\widehat{\sigma}_{\nu}/(2\widehat{\sigma}_{0\nu})}{\sqrt{\widehat{\sigma}_{0\upsilon}^{2}/(2\widehat{\sigma}_{\upsilon}^{2})+3\widehat{\sigma}_{\upsilon}^{2}/(10\widehat{\sigma}_{0\upsilon}^{2})}}\sim N(0,1) \end{cases} \tag{4.41}$$

where

$$t_{\rho}=\frac{(\widehat{\rho}-1)\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{e}_{it-1}^{*2}}{s_{e}},s_{e}^{2}=\frac{1}{NT}\sum_{i=1}^{N}\sum_{t=2}^{T}\left(\widehat{e}_{it}^{*}-\rho\widehat{e}_{it-1}^{*}\right)^{2},\widehat{e}^{*}=y_{it}^{*}-\widehat{\alpha}_{i}-\widehat{\beta}^{*}x_{it}^{*},$$

$$\widehat{\beta}^{*}=\frac{1}{N}\sum_{i=1}^{N}\sum_{t=1}^{T}\frac{1}{T^{2}}\left(x_{it}^{*}-\overline{x}_{it}^{*}\right)^{2}.$$

In the case of strong erogeneity and no serial correlation ($\sigma_{u}^{2}=\sigma_{0u}^{2}=\sigma_{\nu}^{2}=\sigma_{0\nu}^{2}$ ***), the test statistics become***

$$\begin{cases} DF_{\rho}=\dfrac{T\sqrt{N}(\widehat{\rho}-1)+3\sqrt{N}}{\sqrt{10.2}}\sim N(0,1) \\ DF=\sqrt{1.25}t_{\rho}+\sqrt{1.8775N}\sim N(0,1) \end{cases} \tag{4.42}$$

These tests do not required estimate of the long-run variance-covariance matrix. For the Augmented Dickey-Fuller test, estimated residual is

$$\widehat{e}_{it}=\rho\widehat{e}_{it-1}+\sum_{j=1}^{\rho}\varphi_{i}\Delta\widehat{e}_{it-j}+\nu_{it\rho} \tag{4.43}$$

Under the null of no cointegration, the ADF test take the from

$$t_{ADF} = \frac{(\hat{\rho}-1)\left[\sum_{i=1}^{N}\left(e_i' Q_i e_i\right)\right]^{1/2}}{s_v} \qquad \textbf{(4.44)}$$

Further calculation Kao shows the following statistics

$$ADF = \frac{t_{ADF} + \sqrt{6N}\hat{\sigma}_v / \left(2\hat{\sigma}_{0v}\right)}{\sqrt{\hat{\sigma}_{0\upsilon}^2 / \left(2\hat{\sigma}_{\upsilon}^2\right) + 3\hat{\sigma}_{\upsilon}^2 / \left(10\hat{\sigma}_{0\upsilon}^2\right)}} \sim N\left(0,1\right) \qquad \textbf{(4.45)}$$

For estimation of long run parameter when we obtain the estimates of $\hat{\omega}_{it}$ ***and*** $\hat{\omega}_{it}'$ ***then we get,***

$$\hat{\Sigma} = \begin{pmatrix} \sigma_u^2 & \sigma_{u\varepsilon} \\ \sigma_{u\varepsilon} & \sigma_{\varepsilon}^2 \end{pmatrix} = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{\omega}_{it}\hat{\omega}_{it}' \qquad \textbf{(4.46)}$$

and

$$\hat{\Omega} = \begin{pmatrix} \hat{\sigma}_{0u}^2 & \hat{\sigma}_{0u\varepsilon} \\ \hat{\sigma}_{0u\varepsilon} & \hat{\sigma}_{0\varepsilon}^2 \end{pmatrix} = \frac{1}{NT}\sum_{t=1}^{N}\left[\sum_{t=1}^{T}\hat{\omega}_{it}\hat{\omega}_{it}' + \frac{1}{T}\sum_{\tau=1}^{l}\bar{\omega}_{\tau l}\sum_{t=\tau+1}^{l}\left(\hat{\omega}_{it}\hat{\omega}_{it-\tau}' + \hat{\omega}_{it-\tau}\hat{\omega}_{it}'\right)\bar{\omega}_{\tau l}\right] \qquad \textbf{(4.47)}$$

where $\bar{\omega}_{\tau l}$ ***is a weight function or a kernel.***

4.3.3.3 Westerlund and Edgerton (2008) test

A panel cointegration test that considers both structural breaks and cross-section dependence was developed by [116]. Apart from cross sectional dependence and unknown structural breaks in both the intercept and slope, their test allows for heteroskedastic and serially correlated errors, as well as cross unit-specific time trends. Moreover, the structural breaks may be

located at different dates for different panel members. Westerlund and Edgerton (2008) propose two versions to test for the null hypothesis of no cointegration which can be used under those general conditions. Their test is derived from the Lagrange multiplier (LM)-based unit-root tests developed by Error! Reference source not found., Error! Reference source not found.and Error! Reference source not found.. The model under consideration is

$$y_{it} = \alpha_i + \eta_{it} + \delta_i D_{it} + x_{it}'\beta_i + (D_{it} x_{it})'\gamma_i + z_{it}, \tag{4.48}$$

$$x_{it} = x_{it-1} + w_{it}, \tag{4.49}$$

where the indices i = 1, ..., N and t = 1, ..., T denote panel members and the time period, respectively. The k-dimensional vector x_{it} contains the regressors and is specified as a random walk. The variable D_{it} is a scalar break dummy such that $D_{it} = 1$ if $t > T_i$ and zero otherwise. Hence, α_i and β_i represent the cross unit-specific intercept and slope coefficient before the break, while δ_i and γ_i represent the change in these parameters after the break. Wit is an error term with mean zero and independent across i.[26] the disturbance term z_{it} is generated by the following model that allows cross-sectional dependence through unobserved common factors

$$z_{it} = \lambda_i' F_t + \upsilon_{it} \tag{4.50}$$

$$F_{jt} = \rho_j F_{jt-1} + u_{jt} \tag{4.51}$$

$$\varphi_i(L)\Delta\upsilon_{it} = \varphi_i \upsilon_{it-1} + e_{it}, \tag{4.52}$$

[26] For notational simplicity, the model is restricted to allow for only one break

where $\varphi_i(L) := 1 - \sum_{j=1}^{p_i} \varphi_{i\,j} L^j$ ***is a scalar polynomial in the lag operator L, F_t is a dimensional vector of unobservable common factors F_{jt} with j = 1, ..., r, and λ_i is the corresponding vector of factor loading parameters. The error term u_t is independent of e_{it} and wit for all i and t, and e_{it} is mean zero and independent across both i and t. Under the assumption that ρ_j < 1 for all j, it is assured that F_t is stationary involving that the order of integration of the composite regression error z_{it} depends only on the degree of integration of the idiosyncratic disturbance term υ_{it}. Hence, the relationship in Equation 4.48 is cointegrated if φ_i < 0 and spurious if φ_i = 0.[27] Westerlund and Edgerton (2008) test the null hypothesis that all N cross-section units are spurious (H0: N_1 = 0 with N_0:= N−N_1) against the alternative that the first N_1 cross-section units are cointegrated while the remaining N_0:= N − N_1 units are spurious (H_1: N_1 > 0).[28] For testing purposes the LM principle is used that the score vector has zero mean when evaluated at the vector of true parameters under the null. Westerlund and Edgerton (2008) therefore consider the following pooled log-likelihood function***

$$log(L) = constant - 1/2\sum_{i=1}^{N}\left(T\,log\left(\sigma_i^2\right) - 1/\sigma_i^2\sum_{t=1}^{T}e_{it}^2\right) \tag{4.53}$$

Their test can be derived by first concentrating the log-likelihood function with respect to σ_i^2 and then evaluating the resulting score at the restricted maximum likelihood estimates.

[27] Further assumptions that are made to develop the test can be found in Westerlund and Edgerton (2008).
[28] Westerlund and Edgerton (2008) argue that the assumption that the cointegrated units lie first is only for Notational simplicity and is by no means restrictive.

Let $\hat{\sigma}_i^2 := 1/T\sum_{t=1}^{T} e_{it}^2$***, then the score contribution for unit i is given by***

$$\frac{\partial logL}{\partial \varphi_i} = \frac{1}{\hat{\sigma}_i^2} \sum_{t=2}^{T} (\Delta\hat{S}_{it} - \Delta\hat{S}_i)(\hat{S}_{it} - \hat{S}_i), \tag{4.54}$$

where $\hat{S}_{it}$ ***is a certain residual defined below, while*** $\Delta\hat{S}_i$ ***and*** $\hat{S}_i$ ***are the mean values of*** $\Delta\hat{S}_{it}$ ***and*** $\hat{S}_{it}$***, respectively. The score vector is proportional to the numerator of the least squares estimate of*** φ_i ***in the regression***

$$\Delta\hat{S}_{it} = constant + \varphi_i \hat{S}_{it-1} + error. \tag{4.55}$$

It follows that a test of the null of no cointegration for cross-section unit i can be formulated equivalently as a zero-slope restriction in Equation (4.55), which can be tested by means of either the least squares estimate of φ_i ***or its t-ratio. Hence, by considering the form of the log-likelihood function, a panel test of*** H_0 ***vs.*** H_1 ***can be constructed by using the cross-sectional sum of these statistics for each i.***

In the presence of cross-sectional dependence, the variable $\hat{S}_{it}$ ***can be computed as***

$$\hat{S}_{it} := y_{it} - \hat{\alpha}_{it} - \hat{\eta}_i t - \hat{\delta}_i D_{it} - x_{it}'\hat{\beta}_i - (D_{it}x_{it})'\hat{\gamma}_i - \hat{\lambda}_i'\hat{F}_t, \tag{4.56}$$

where the common factor $\hat{F}_t$ ***is the accumulated sum of the principal component estimates*** $\Delta\hat{F}$ ***of*** ΔF***. This de-factoring makes the test robust to cross-sectional dependence generated by common factors, while the test regression can additionally be augmented to also make it robust to serial correlation***

$$\Delta\widehat{S}_{it} = constant + \varphi_i \widehat{S}_{it-1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta\widehat{S}_{it-j} + error. \qquad (4.57)$$

To obtain the new panel test, Westerlund and Edgerton (2008) define

$$LM_{\varphi}(i) := T\widehat{\varphi}_i \left(\frac{\widehat{\omega}_i}{\widehat{\sigma}_i} \right), \qquad (4.58)$$

where $\widehat{\varphi}_i$ ***is the least squares estimate of*** φ_i ***in Equation (4.57) with*** $\widehat{\sigma}_i$ ***as the estimated standard error from the same regression, and*** $\widehat{\omega}^2$ ***is the estimated long-run variance of*** Δv_{it} ***based on*** $\widehat{S}_{it}$***. To obtain the second test statistic, Westerlund and Edgerton (2008) introduce the t-ratio of*** $\widehat{\varphi}_i$ ***given by***

$$LM_{\tau}(i) := \frac{\widehat{\varphi}_i}{SE(\widehat{\varphi}_i)}, \qquad (4.59)$$

where $SE(\widehat{\varphi}_i)$ ***is the estimated standard error of*** $\widehat{\varphi}_i$***. Based on*** $LM_{\varphi}(i)$ ***and*** $LM_{\tau}(i)$***, Westerlund and Edgerton (2008) propose the two panel LM-based test statistics for the null of no cointegration as***

$$\overline{LM}_{\varphi}(N) := \frac{1}{N} \sum_{i=1}^{N} LM_{\varphi}(i),$$

$$\overline{LM}_{\tau}(N) := \frac{1}{N} \sum_{i=1}^{N} LM_{\tau}(i). \qquad \textbf{\textit{(4.60)}}$$

Finally, in consideration of the asymptotic properties of $LM_{\varphi}(i)$ and $LM_{\tau}(i)$, Westerlund and Edgerton (2008) obtain the following normalized test statistics[29]

$$Z_{\varphi}(N) = \sqrt{N}(\overline{LM}_{\varphi}(N) - E(B_{\varphi})), \tag{4.61}$$

$$Z_{\tau}(N) = \sqrt{N}(\overline{LM}_{\tau}(N) - E(B_{\tau})). \tag{4.62}$$

4.3.3.4 Estimation of Breaks

Westerlund and Edgerton (2008) follow the strategy of Bai and Perron (1998) to determine the location of structural breaks. The approach developed by Error! Reference source not found.allows for general forms of serial correlation and heteroskedasticity in the errors, lagged dependent variables, trending regressors, as well as different distributions for the errors and the regressors across the segments that are separated by the breaks. Moreover, they consider the case of a partial structural change model meaning that not all parameters are necessarily subject to shifts. In line with this approach Westerlund and Edgerton (2008) individually estimate the break point(s) for each panel member i by minimizing the sum of squared residuals from the regression in Equation (4.48) in first differences. The break point estimator is defined as

$$\hat{\tau}_i = \underbrace{arg\ min}_{0<\tau i<1} \frac{1}{T-1} \sum_{t=2}^{T} (\Delta \hat{z}_{it})^2 . \tag{4.63}$$

[29] The complete analysis of the asymptotic properties of the newly developed tests and the explicit derivation of $Z_{\varphi}(N)$ and $Z_{\tau}(N)$ are explained in Westerlund and Edgerton (2008).

4.3.4 Long-Run Estimators

Pesaran (2006) proposed common correlated effects (CCE) estimators to estimate heterogeneous panel data models with a multifactor error structure. The basic idea is to filter the cross-unit specific regresses by means of cross-section averages of the dependent variable and the observed regresses. Thus, cross-sectional dependence can be eliminated since the unobserved common factors can be well approximated by those cross-section averages. Therefore, the number of the stationary factors need not to be estimated. The CCE procedure can be computed by running standard panel regressions where the observed regresses are augmented with cross-sectional averages of the dependent variable and the cross unit -specific regresses. Pesaran (2006) developed two CCE estimators, the pooled and mean group CCE estimator, to consider two different but related estimation and inference problems: one that concerns the coefficients of the cross unit-specific regressors and the other that focuses on the means of the individual coefficients. Kapetanios et al. (2011) extend the work of Pesaran (2006) to the case where the unobserved common factors are non-stationary. They show that the CCE estimators are consistent even in the presence of unit roots in the unobserved common factors and are also robust to structural breaks in the mean of those unobserved factors.

Pesaran (2006) assumed the heterogeneous panel data model with y_{it} ***as the observation on the i-th panel member at time t for i = 1... N and t = 1... T***

$$y_{it} = \alpha_i' d_t + \beta_i' x_{it} + e_{it} , \qquad (4.64)$$

where d_t ***represents a (n × 1) vector of observed common effects including, on the one hand, deterministic components such as intercepts or seasonal***

dummies and, on the other hand, non-stationary observed common effects such as the oil price. The observed cross unit-specific regresses are denoted by the (k × 1) vector x_{it}, while the error term e_{it} is specified by a multifactor structure

$$e_{it} = \gamma_i' f_t + \varepsilon_{it} , \tag{4.65}$$

where f_t denotes the (m × 1) vector of unobserved common factors and ε_{it} are the cross unit-specific (idiosyncratic) disturbance terms, which are assumed to be independently distributed of (d_t, x_{it}). Since the unobserved factors f_t could be correlated with (d_t, x_{it}), a general specification of the cross unit-specific regresses is adopted

$$x_{it} = A_i' d_t + \Gamma_i' f_t + v_{it} , \tag{4.66}$$

where A_i and Γ_i denote (n × k) and (m × k) factor loading matrices with fixed components, and v_{it} are the specific components of x_{it} distributed independently of the common effects and across i but assumed to follow general covariance stationary processes.

Combining Equations 4.64 - 4.66 yields the system

$$\underset{((k+1)\times 1)}{z_{it}} = \begin{pmatrix} y_{it} \\ x_{it} \end{pmatrix} = \underset{((k+1)\times n)}{B_i'} \underset{(n\times 1)}{d_t} + \underset{((k+1)\times m)}{C_i'} \underset{(m\times 1)}{f_t} + \underset{((k+1)\times 1)}{u_{it}} , \tag{4.67}$$

where

$$u_{it} = \begin{pmatrix} \varepsilon_{it} + \beta_i' v_{it} \\ v_{it} \end{pmatrix} = \begin{pmatrix} 1 & \beta_i' \\ 0 & I_k \end{pmatrix} \begin{pmatrix} \varepsilon_{it} \\ v_{it} \end{pmatrix}, B_i = \begin{pmatrix} \alpha_i & A_i \end{pmatrix} \begin{pmatrix} 1 & 0 \\ \beta_i & I_k \end{pmatrix}, C_i = \begin{pmatrix} \gamma_i & \Gamma_i \end{pmatrix} \begin{pmatrix} 1 & 0 \\ \beta i & Ik \end{pmatrix} ,$$

with I_k as the identity matrix of order k. The rank of C_i is determined by the rank of the (m × (k + 1)) matrix of the unobserved factor loadings $\tilde{\Gamma}_i = \left(\gamma i \quad \Gamma i\right)$.[30]

Pesaran (2006) suggested the use of cross-section averages of the dependent variable, y_{it}, and the regressors, x_{it}, as proxies for the unobserved common factors. For illustration purposes of the elimination of those factors, consider the simple cross-section averages of the Equations in 4.67[31]

$$\bar{Z}_t = \bar{\beta}' d + \bar{C}' f_t + \bar{u}_t \,, \tag{4.68}$$

where $\bar{z} = 1/N \sum_{i=1}^{N} z_{it}\,,\ \bar{v}_t = 1/N \sum_{i=1}^{N} u_{it}\,, \bar{B} = 1/N \sum_{i=1}^{N} B_i$ ***and***

$\bar{C} = 1/N \sum_{i=1}^{N} C_i$ ***. Suppose that Rank*** $(\bar{C}) = m \le k+1$ ***for all N, so that*** $f_t = (\bar{C}\bar{C}')^{-1}\bar{C}(\bar{z}_t - \bar{B}'d_t - \bar{u}_t)$***. if $u_t \to 0$ and*** $\bar{C} \xrightarrow{P} C$ ***as*** $N \to \infty$ ***then***

$$f_t - (CC')^{-1} C(\bar{z}_t - \bar{d}) \xrightarrow{P} 0, as N \to \infty. \tag{4.69}$$

This suggests that it is valid to use $\bar{h}_t = (d_t', \bar{z}_t')$ as observable proxies for the unobservable common factors f_t, and justified the basic idea of the common correlated effects (CCE) estimators proposed by Error! Reference source not found..

[30] ***See Pesaran (2006) for details on the underlying assumptions.***
[31] ***Pesaran (2006) applied more general weighted cross-section averages. To simplify the illustration, this study restricts the discussion about the CCE estimators to simple averages (see Kapetanios et al., 2011).***

Pesaran (2006) presents two estimators of the means of the cross unit-specific slope coefficients. One is the mean group (MG) estimator developed in Pesaran and Smith (1995) and the other is a generalization of the fixed effects (FE) estimator that considers potential cross-sectional dependence. First, the common correlated effects mean group (CCEMG) estimator is a simple average of the individual CCE estimators, $\hat{b}_i$ *of* β_i*, defined as*

$$\hat{b}_{CCEMG} = \frac{1}{N}\sum_{i=1}^{N}\hat{b}_i , \tag{4.70}$$

$$\hat{b}i = (X_i'\bar{M}X_i)^{-1} X_i'\bar{M}y_i , \tag{4.71}$$

where $X_i = (x_{i1}, \ldots, x_{iT})'$, $y_i = (y_{i1}, \ldots, y_{iT})$,*and* $\bar{M} = I_T - \bar{H}(\bar{H}'\bar{H})^{-1}\bar{H}'$ *with* $\bar{H} = (D, \bar{Z})$,*where D and* $\bar{Z}$ *denote the (T × n) and (T × (k + 1)) matrices of observations on* d_t *and* $\bar{z}_t$*,respectively.*

Second, if the individual slope coefficients, βi, are the same, efficiency could be gained by pooling. Hence, Pesaran (2006) developed the common correlated effects pooled (CCEP) estimator given by

$$\hat{b}_{CCEP} = \left(\sum_{i=1}^{N} X_i'\bar{M}X_i\right)^{-1} \sum_{i=1}^{N} X_i'\bar{M}y_i . \tag{4.72}$$

4.3.5 Panel Causality

Cointegration implies that causality exists between the series but it does not indicate the direction of the causal relationship. With an affirmation of a long run relationship among Oil Exports Revenues (OER), Non-Oil GDP(NGDP), and Foreign Direct Investment (FDI) and Productivity we test for Granger causality in the long run relationship at the final step of

estimation. Granger causality itself is a two-step procedure. The first step relates to the estimation of the residual from the long run relationship. Incorporating the residual as a right-hand side variable, the short run error correction model is estimated at the second step. Defining the error term from equation (4.45) to be ECT$_{it}$, the dynamic error correction model of our interest by focusing on NGDP, OER, FDI and PRO is specified as follows:

$$\Delta LNGDP_{it} = a_{1j} + \sum_{k=1}^{q} \delta_{1ik}\Delta LNGDP_{it-k} + \sum_{k=1}^{q} \lambda_{1ik}\Delta LOER_{it-k} + \sum_{k=1}^{q} \emptyset_{1ik}\Delta GCF_{it-k} + \sum_{k=1}^{q} \psi_{1ik}\Delta LPRO_{it-k} + \alpha_{1i}ECT_{it-1} + \varepsilon_{1it}$$

$$\Delta LOER_{it} = \alpha_{2j} + \sum_{k=1}^{q} \delta_{2ik}\Delta LNGDP_{it-k} + \sum_{k=1}^{q} \lambda_{2ik}\Delta LOER_{it-k} + \sum_{k=1}^{q} \emptyset_{2ik}\Delta LFDI_{it-k} + \sum_{k=1}^{q} \psi_{2ik}\Delta LPRO_{it-k} + \alpha_{2i}ECT_{it-1} + \varepsilon_{2it}$$

$$\Delta LFDI_{it} = \alpha_{3j} + \sum_{k=1}^{q} \delta_{3ik}\Delta LNGDP_{it-k} + \sum_{k=1}^{q} \lambda_{3ik}\Delta LOER_{it-k} + \sum_{k=1}^{q} \emptyset_{3ik}\Delta LFDI_{it-k} + \sum_{k=1}^{q} \psi_{3ik}\Delta LPRO_{it-k} + \alpha_{3i}ECM_{it-1} + \varepsilon_{3it}$$

$$\Delta LPRO_{it} = \alpha_{4j} + \sum_{k=1}^{q} \delta_{4ik}\Delta LNGD_{it-k} + \sum_{k=1}^{q} \lambda_{4ik}\Delta LOER_{it-k} + \sum_{k=1}^{q} \emptyset_{4ik}\Delta LFDI_{it-k} + \sum_{k=1}^{q} \psi_{4ik}\Delta LPRO_{it-k} + \alpha_{4i}ECM_{it-1} + \varepsilon_{4it}$$

(4.73)

where Δ is a difference operator; ECT is the lagged error-correction term derived from the long-run cointegration relationship; the α_{1i} , α_{2i}, α_{3i} and α_{4i} ***are adjustment coefficients and the*** ε_{1it}, ε_{2it}, ε_{3it} ***and*** ε_{4it} ***are disturbance terms assumed to be uncorrelated with mean zero.***

The direction of causality can be determined by testing for the significance of the coefficients of each dependent variable in Equations (4.45). For short-run causal relationships, we test H$_0$: $\lambda_{1ik} = 0\ \forall i,k$, $\emptyset_{1ik} = 0\ \forall i,k$ ***and H$_0$:*** $\psi_{1ik} = 0\ \forall i,k$ ***to determine short-run Granger causality from oil export, foreign direct investment and productivity to non-oil GDP, respectively; H$_0$:*** $\delta_{2ik} = 0\ \forall i,k$, $\emptyset_{2ik} = 0\ \forall i,k$ ***and H$_0$:*** $\psi_{2ik} = 0\ \forall i,k$ ***to determine short-run Granger causality from non-oil GDP, foreign direct investment and productivity to oil export , respectively;*** $\delta_{3ik} = 0\ \forall i,k$, $\lambda_{3ik} = 0\ \forall i,k$ ***and H$_0$:***

$\psi_{3ik} = 0\ \forall i, k$ ***to determine short-run Granger causality from non-oil GDP, oil export and productivity to foreign direct investment; and*** $\delta_{4ik} = 0\ \forall i, k$***,*** $\lambda_{4ik} = 0\ \forall i, k$ ***and H₀:*** $\emptyset_{4ik} = 0\ \forall i, k$ ***to determine short-run Granger causality from non-oil GDP, oil export and foreign direct investment to productivity. For long-run causal relationships, the same test methods can be used. That is to say, it can be used the Wald test and likelihood ratio test to test the null hypothesis*** $\alpha_{1i}=0$, $\alpha_{2i}=0$, $\alpha_{3i}=0$ ***and*** $\alpha_{4i}=0$***. Causal relationship exists if the hypothesis is rejected.***

4.3.6 Granger Non-Causality

Granger (1969) developed a methodology for analyzing the causal relationships between time series. Suppose x_t ***and*** y_t ***are two stationary series. Then the***

$$y_t = \alpha + \sum_{k=1}^{k} \beta_k y_{t-k} + \sum_{k=1}^{k} \gamma_k x_{t-k} + \varepsilon_t \tag{4.74}$$

Equation (4.67) can be used to test whether x causes y. The basic idea is that if past values of x are significant predictors of the current value of y even when past values of y have been included in the model, then x exerts a causal influence on y. using above equation, one might easily test this causality based on an F-test with the following null hypothesis:

$$H_0: \gamma_1 = \cdots = \gamma_k = 0$$

If H_0 ***is rejected, one can conclude that causality from x to y exists. The x and y variables can of course be interchanged to test for causality in the other direction, and it is possible to observe bidirectional causality.***

Dumitrescu and Hurlin (2012) (DH) provide an extended test designed to detect causality in panel data. The underlying regression is as follows:

$$y_{i,t} = a_i + \sum_{k=1}^{k} \beta_{ik} y_{i,t-k} + \sum_{k=1}^{k} \gamma_{ik} x_{i,t-k} + \varepsilon_t \qquad (4.75)$$

where x_{it}***and*** y_{it}***are the observations of two stationary variables for individual i in period t. Coefficients are allowed to differ across individuals (note the i subscripts attached to the parameters) but are assumed time invariant. The lag order K is assumed to be identical for all individuals and the panel must be balanced. As in Granger (1969), the idea to determine the existence of causality is to test for significant effect of past values of x on the present value of y. The null hypothesis is therefore defined as:***

$$\mathrm{H_0}: \gamma_{\mathrm{i1}} = \cdots = \gamma_{\mathrm{ik}} = 0 \quad \forall \ \mathrm{i} = 1, \dots, \mathrm{N} \qquad (4.76)$$

which corresponds to the absence of causality for all individuals in the panel. The test assumes there can be causality for some individuals but not necessarily for all. The alternative hypothesis thus writes:

$$\mathrm{H_1}: \gamma_{\mathrm{i1}} = \cdots = \gamma_{\mathrm{ik}} = 0 \quad \forall \ \mathrm{i} = 1, \dots, \mathrm{N_1}$$

$$\gamma_{\mathrm{ik}} \neq 0 \text{ or} \dots \gamma_{\mathrm{ik}} \neq 0 \quad \forall \ \mathrm{i} = \mathrm{N_1} + 1, \dots, \mathrm{N} \qquad \textit{(4.77)}$$

Where $N_1 \in [0, N-1]$ ***is unknown. If*** $N_1 = 0$***, there is causality for all individuals in the panel. N1 is strictly smaller than N, otherwise there is no causality for all individuals and*** H_1 ***reduces to*** H_0***.***

Against this backdrop, DH propose the following procedure: run the N individual regressions implicitly enclosed in (3), perform Wald tests of the K linear hypotheses $\gamma_{i1} = \dots = \gamma_{iK} = 0$***, and finally compute*** $\overline{W}$ ***as the average of the N individual Wald statistics:***

$$\overline{w} = \frac{1}{N}\sum_{i=1}^{N} w_i \qquad \textbf{(4.78)}$$

where W_i is the standard adjusted Wald statistic for individual i observed during T periods.3 Using Monte Carlo simulations, DH show that W is asymptotically well-behaved and can genuinely be used to investigate panel causality.

Under the assumption that Wald statistics W_i are independently and identically distributed across individuals, it can be showed that the standardized statistic $\overline{Z}$ when T→∞ first and then N→∞ follows a standard normal distribution

$$\bar{z} = \sqrt{\frac{N}{2k}}.(\overline{w} - k) \ \overrightarrow{T, N \to \infty} \ N(0,1) \qquad \textbf{(4.79)}$$

Also, for a fixed T dimension with T > 5+2K, the standardized statistic $\tilde{Z}$ follows a standard normal distribution:

$$\tilde{z} = \sqrt{\frac{N}{2k}.\frac{T-2k-5}{T-k-3}}.\left[\frac{T-2k-3}{T-2k-1}.\overline{w} - k\right]\overrightarrow{N \to \infty}\, N(0,1) \qquad (4.80)$$

The testing procedure of the null hypothesis is finally based on $\bar{Z}$ and $\tilde{Z}$. If these are larger than the corresponding normal critical values, then one should reject H_0 and conclude that there is Granger causality. For large N and T panel datasets $\bar{Z}$ can be reasonably considered. For large N but relatively small T datasets $\tilde{Z}$ should be favored. Using Monte Carlo simulations, DH have shown that the test exhibits very good finite sample properties, even with both T and N small.

4.3.7 Summary and Conclusion

The methodological framework of the study was reviewed in this chapter. This research uses recently developed panel techniques that accommodate both structural breaks and cross-sectional dependence simultaneously rather than neglecting both or tackling only one of these issues at a time. First, the test for cross-sectional independence proposed by[91][94]is briefly presented. Second, as a starting point of the integration analysis, this study applies the first-generation panel unit root tests which neglect the presence of both structural breaks and cross-section dependence but are commonly used in the panel data literature on the most variables in our study. Specifically, the Levin et al. (2002) (LLC), Breitung (2000), Im et al. (2003) (IPS), the Fisher-type ADF and Fisher-type PP test. Then, this study applies the second-generation panel unit root test proposed by [26] as a second step. This test allows for structural breaks in the level, slope or both, which can occur at different dates for different countries and may have different magnitudes of shift. Furthermore, the common factor approach enables the common shocks to affect countries differently via heterogeneous factor loadings.

Third, when it is established that all variables are integrated of same order, the co-integration relationship among variables in the next step will be examined. To examine the existence of a cointegration relationship this study repeats both types of tests, with and without structural breaks and cross-sectional dependence. In first step, the first-generation panel cointegration tests proposed by Error! Reference source not found., [89]and [91]. In a second step, this study applies the LM-based tests proposed by [116]that simultaneously consider cross-section dependence and structural breaks, which may be located at different dates for different panel members.

Additionally, this test allows for heteroskedastic and serially correlated errors, and cross unit-specific time trends.

Fourth, Sub-section 4.3.4 discusses Pesaran (2006)'s common correlated effects (CCE) estimators that are used to estimate the long run relationship between non-oil GDP, oil exports, foreign direct investment and productivity. Finally, the application of the pooled mean group (PMG) estimator is used to identify the possibility of a causal relationship between the research model variables.

Chapter 5: Empirical Results and Discussions

5.1 Introduction

As the methodology of the research studied in the previous chapter, in this chapter, at the first, I state sources of data and their definition. Then, the research methodology (as Extended Panel Time Series Models) is presented as fallow: First, the test for cross-sectional independence proposed by [94] is briefly presented. Second, this study applies the first-generation panel unit root tests which neglect the presence of both structural breaks and cross-section dependence but are commonly used in the panel data literature on the most variables in our study. Specifically, the Levin et al. (2002) (LLC), Breitung (2000), Im et al. (2003) (IPS), the Fisher-type ADF and Fisher-type PP test. Then, this study describes the panel unit root test developed by Error! Reference source not found.which allows for structural breaks and cross-sectional dependence. Third, to examine the existence of a cointegration relationship this study repeats both types of tests, with and without structural breaks and cross-sectional dependence. In first step, the first-generation panel cointegration tests proposed by [70], [89]and [91]; the second-generation panel cointegration test suggested by [116], which also considers structural breaks and dependence across countries, is introduced. Fourth, Sub-section 3.4 discusses Pesaran (2006)'s common correlated effects (CCE) estimators that are used to estimate the long run relationship between energy consumption and GDP. Finally, the pooled mean group estimator for non-stationary heterogeneous panels suggested by Error!

Reference source not found.to establish dynamic panel causality is briefly presented.

5.2 Data

This study uses annual data from 1980 to 2015 (Million US dollars, 2010 constant) for OPEC member Countries; Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, United Arab Emirate and Venezuela. The variables considered in the study are as follows:

OER: Oil Export Revenue that was obtained by multiplying Oil Export in Average price of oil. The data on this variable has been obtained for Arabian countries from the Arab Monetary Fund (AMF) and for anther countries from OPEC.

NGDP: Nominal non-oil GDP was obtained by subtracting oil Export from Nominal GDP. We obtained the data on this variable from OPEC and World Bank data base.

Productivity: To obtain Nominal productivity, non-oil GDP was divided by total labor force. The data on this variable has been obtained from OPEC and World Bank data base.

FDI: foreign direct investment has been obtained from The United Nations Conference on Trade and Development.

We deflated our data using local Consumer Price Index (CPI, 2010 constant). GDP deflator tends to over deflate the non-oil output because of the heavy weight of oil in the GDP. On the other hand, deflating oil revenues by the GDP deflator will not reflect their real impact on the economy as the terms of trade effect is removed. All variables are transformed in natural *logarithms because it helps to rescale and minimize the fluctuations in the data series.*

5.3 Cross-section dependence tests results

As a first step, this study applies the cross-section dependence (CD) test developed by Error! Reference source not found.to verify the consideration of cross-section dependence in the analysis of the relationship between Oil Export, Non-Oil GDP, Foreign Direct Investment and Productivity. Thus, all research variables model is initially tested for dependence across the OPEC member Countries under investigation. The pair-wise correlations which are necessary to compute the CD statistics are obtained from the residuals of the regression of each variable on a constant, a linear trend and a lagged dependent variable for each country.

The results of the CD tests based on these correlations indicate that NGDP, OER, FDI and Productivity are highly dependent across countries (although correlation for productivity is negative). Table 5-1 indicates that the null hypothesis of cross-section independence can be clearly rejected by a value of 31.59 for Non-Oil GDP (ρ[32]= 0.71), 36.99 for OER (ρ= 0.83), 31.84 for CGF (ρ = 0.72) and -2.56 for Productivity (ρ= -0.06).[33] This finding underlines the already mentioned importance of taking into account cross-section dependence when analyzing the relationship between Oil Export Revenue, Non-Oil GDP, Foreign Direct Investment and Productivity.

[32] ρ is the sample estimate of the pair-wise correlation of the OLS residuals.
[33] The CD test are performed using the Stata routine "xtcd" proposed by Pesaran (2004). The routine performs the same CD test as the xtcsd varname, pesaran command by De Hoyos and Sarafidis (2006).

Table 5-1: Results of Cross Section Dependence Tests for All Research Variables Model over the Period 1980-2015(Million US Dollars, 2010 Constant)

Variable	*CD-test*	ρ	*P-Value*
LNGDP	***31.59***	***0.71***	***0.000***
LOER	***36.99***	***0.83***	***0.000***
LFDI	***31.84***	***0.72***	***0.000***
LPRO	***-2.56***	***-0.06***	***0.010***

Source: Research Findings, using sample data (1980-2015). Under the null hypothesis of cross-section independence CD ~ N (0,1)

5.4 Unit Root Tests Results

As a starting point of the integration analysis, this study applies the first-generation panel unit root tests which neglect the presence of both structural breaks and cross-section dependence but are commonly used in the panel data literature on the most variables in our study. Specifically, the Levin et al. (2002) (LLC) test and the t-statistic proposed by [35]which both tests for a common unit root process as well as the W-statistic suggested by Im et al. (2003) (IPS), the Fisher-type ADF and Fisher-type PP test (see [46] and Error! Reference source not found.) that assume individual unit root processes are applied. Without exception, all unit root tests assume non-stationary under the null hypothesis. All of the unit root tests find out that the maximum order of integration for all four research model variables is

one. The optimal lag length is determined by the Schwarz information criteria (SIC). All tests have been implemented without trend.[34]

5.4.1 Levin, Lin and Chu (LLC) Test Results

The null hypothesis in Levin, Lin and Chu (2002) test is that each individual time series has a unit root. But, the alternative hypothesis is that each time series is stationary. Based on LLC test, we fail to reject the null hypothesis of a unit root for four series at the levels. But, the null hypothesis is rejected at the first differences for all variables in OPEC member countries at 1% level of significance. Therefore, it reveals that all four variables in OPEC member countries are integrated of order one.

Table 5-2: The Result of Levin, Lin And Chu (LLC) Unit Root Test Without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over the Period 1980-2015(Million US Dollars,2010 Constant)

Variable	Level	First Difference	Conclusion
	t-stat* (P-value)	t-stat* (P-value)	
LNGDP	2.4984 (0.9938)	-3.1199 (0.0009)	Stationary at first difference
LOER	0.7963 (0.7871)	-4.9357 (0.0000)	Stationary at first difference
LCGF	1.4998 (0.9332)	-9.3131 (0.0000)	Stationary at first difference
LPRO	1.8705 (0.9693)	-3.4153 (0.0003)	Stationary at first difference

Source: Research Findings, using sample data (1980-2015). t * -stat is adjusted t

[34] ***The results of all noted first generation panel unit root tests are implemented using STATA 15.***

5.4.2 Breitung Test Results

Breitung test (2000) test also is in line with other tests. The null and alternative hypotheses are same with Levin, Lin and Chun test. So, the null hypothesis is that each individual time series is non-stationary. But, the alternative hypothesis is that each time series don't have a unit root. As Table 5-3 shows in this case also at the levels for four variables the null hypothesis cannot be rejected. On the other hand, at the first difference for OPEC member countries are stationary.

Table 5-3: The Results of Breitung (2000) Unit Root Test Without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over 1980-2015(Million US Dollars,2010 Constant)

Variable	*Level*	*First Difference*	*Conclusion*
	t-stat (P-value)*	*t-stat* (P-value)*	
LNGDP	*5.2429 (1.0000)*	*-7.1271 (0.0000)*	*Stationary at first difference*
LOER	*-1.0376 (0.1497)*	*-9.8003 (0.0000)*	*Stationary at first difference*
LCGF	*4.0984 (1.0000)*	*-11.1249 (0.0000)*	*Stationary at first difference*
LPr	*-0.2675 (0.3946)*	*-4.3836 (0.0000)*	*Stationary at first difference*

Source: Research Findings, using sample data (1980-2015). t * -stat is adjusted t

5.4.3 Im, Pesaran and Shin (IPS) Test Results

According to findings of this test in Table 5-3 it is obvious that in term of first differences, the variables are integrated of order one at 1% level of significance. The first, it is failed to reject the null hypothesis at levels for all variables. When the test is applied at the first differences for four panels, the null hypotheses is rejected at 1% level of significance. Thus, all variables for OPEC member countries are stationary in their first differences.

Table 5-4: The Results of Im, Pesaran And Shin (IPS) Unit Root Test Without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over the Period 1980-2015(Million US Dollars,2010 Constant)

Variable	Level	First Difference	Conclusion
	W-stat* (P-value)	W-stat* (P-value)	
LNGDP	3.2949 (0.9995)	-8.3875 (0.0000)	Stationary at first difference
LOER	1.9991 (0.9772)	-8.4623 (0.0000)	Stationary at first difference
LCGF	3.5495 (0.9998)	-10.0422 (0.0000)	Stationary at first difference
LPRO	1.4660 (0.9287)	-8.9238 (0.0000)	Stationary at first difference

Source: Research Findings, using sample data (1980-2015).

5.4.4 Fisher ADF Test Results

In Fisher ADF Test the null hypothesis is like LLC, that each series has a unit root. But the alternative hypothesis for IPS is that all the individual series don't have unit roots. According to the results in Table 5-5, Fisher ADF fails to reject the null hypothesis at 1% significance level of a unit root for all variables at levels of the series. On the other side, the testing in the first differences at the 5% significance level in each panel supports the rejection of the hypothesis. The variables are integrated of order one.

Table 5-5: The Result of Fisher ADF Unit Root Test Without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over the Period 1980-2015(Million US Dollars,2010 Constant)

Variable	Level Chi-Squared * (P-value)	First Difference Chi-Squared * (P-value)	Conclusion
LNGDP	-2.1907 (0.9783)	19.3696 (0.0000)	Stationary at first difference
LOER	-2.0717 (0.9809)	16.9240 (0.0000)	Stationary at first difference
LCGF	-2.1944 (0.9859)	22.4823 (0.0000)	Stationary at first difference
LPRO	-1.7292 (0.9581)	20.8945 (0.0000)	Stationary at first difference

Source: Research Findings, using sample data (1980-2015). Note: Probabilities for Fisher-type tests are computed using an asymptotic Chi-square distribution.

5.4.5 Phillips-Perron ADF Test Results

In Phillips-Perron ADF Test the null hypothesis is like Fisher ADF test, that each series has a unit root. But the alternative hypothesis for IPS is that all the individual series don't have unit roots. According to the results in Table 5-6, Phillips-Perron ADF fails to reject the null hypothesis at 1% significance level of a unit root for all variables at levels of the series (except for LPRO). On the other side, the testing in the first differences at the 5% significance level in each panel supports the rejection of the hypothesis. The variables are integrated of order one.

Table 5-5: The Result of Phillips-Perron ADF Unit Root Test Without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over the Period 1980-2015(Million US Dollars,2010 Constant)

Variable	Level	First Difference	Conclusion
	Chi-Squared * (P-value)	Chi-Squared * (P-value)	
LNGDP	-1.4975 (0.9329)	38.2113 (0.0000)	Stationary at first difference
LOER	-1.8973 (0.9711)	38.6520 (0.0000)	Stationary at first difference
LCGF	-2.4081 (0.9920)	38.8298 (0.0000)	Stationary at first difference
LPRO	6.0487 (0.0000)	53.7315 (0.0000)	Stationary at level and first difference

Source: Research Findings, using sample data (1980-2015).

5.4.6 Modified Sargan and Bhargava Test Results

The failure of the first-generation panel unit root tests to reject the null of non-stationarity for the levels of the variables may be due to the omission of structural breaks [92] Thus, the consideration of structural breaks and, additionally, cross-section dependence should provide more reliable results. Consequently, this study applies the second-generation panel unit root test proposed by Error! Reference source not found. as a second step. This test allows for structural breaks in the level, slope or both, which can occur at different dates for different countries and may have different magnitudes of shift. Furthermore, the common factor approach enables the common shocks to affect countries differently via heterogeneous factor loadings. The Bai and Carrion-i-Silvestre test produces two sets of three statistics; Bai and Carrion-i-Silvestre (2009) claim that the simplified set are most appropriate for the level and trend break model and suggest that the Z and P statistics have the best small sample properties; hence, we focus on those two (simplified) statistics in 5-11; The results of the test developed by Error! Reference source not found.are presented in Table 5-11 and confirm the finding of non-stationary in some of variables. Due to the Z statistic we can't be rejected the null hypothesis of a unit root for LNGDP, LOER and LPRO at 5% significance, while for P statistics we can't be rejected the null hypothesis of a unit root for LOER and LFDI at 1% significance in the model with a break in the level and trend.[35]

[35] ***The results of second generation panel unit root tests is implemented using the Gauss 18 software.***

Table 5-7. Bai And Carrion-I-Silvestre (2009) Panel Unit Root Test with Endogenous Breaks (In Level and Trend) And Cross-Sectional Dependence.

variable	Simplified tests statistic	
	Z*	P*
In level		
LNGDP	-1.755	43.599
LOER	-2.078	33.015
LFDI	6.849	11.382
LPRO	0.063	74.577
In first difference		
D.LNGDP	-0.688	60.737
D.LOER	1.932	129.844
D.LFDI	-2.797	75.857
D.LPRO	-2.380	63.249

***Source:** Research Findings, using sample data (1980-2015). Note: The z statistic follows the standard normal distribution; whereas, the P statistic follows the Chi-square distribution. The null hypothesis of a unit root is rejected at 1% and 5% significance level, denoted by * and **, respectively.*

According to the results of the panel unit root tests for four variables presented for OPEC member countries, most of variables are non-stationary in level. In the other hand, all variables are stationary at the first difference. It means that all variables are integrated of order one. The failure of the first-generation panel unit root tests to reject the null of non-stationary for the levels of the variables may be due to the omission of structural breaks [98]. Thus, the consideration of structural breaks and, additionally, cross-section dependence should provide more reliable results. Consequently, it is required to examine the long-run equilibrium relationship doing panel

cointegration tests can be performed. Below we performed most common panel cointegration tests.

5.5 Panel Cointegration Test Results

When a panel unit root is conducted, for at least two variables and they have unit roots, it should be studied that whether there is a long-run equilibrium relationship among the variables. A stationary variable has a time-invariant mean and a time-invariant variance. By contrast, a non-stationary variable has a time-varying mean, a time-varying variance, or both. A non-stationary variable may wander arbitrarily over time. When the first difference of a non-stationary variable is stationary, the variable is said to be integrated of order one, denoted I (1). When a linear combination of two or more I (1) series is stationary, the series are said to be cointegrated. Thus, we should test for panel cointegration implying whether I (1) variables are in a long-run equilibrium or move together. To examine the existence of a cointegration relationship this study repeats both types of tests, with and without structural breaks and cross-sectional dependence. Firstly, the first-generation panel cointegration tests proposed by [70], [89]and [91] are applied[36]. Cointegration tests show that variables are cointegrated. The results of these panels have been brought below.

5.5.1 The Pedroni Panel Cointegration Tests Results

Given that each variable is integrated of order one, next step is to test for cointegration. As the panel variables are integrated of order one, I (1), then

[36] ***The results of first generation panel cointegration tests are implemented using the Eveiws 9.0 software.***

we would test for the existence of panel cointegration. Pedroni assume the null hypothesis of no cointegration and use the residuals determined by a panel regression to construct the test statistics and determine the asymptotically normal distribution. Pedroni proposes seven test statistics that can be distinguished in two types of residual based tests. Four tests are based on pooling the residuals of the regression along the within-dimension of the panel (panel tests), while three are based on pooling the residuals along the between-dimension (group tests). Table 5-8 reports the empirical realizations of Pedroni's panel cointegration tests. With the exception of the panel υ-statistic in the case without trend and group PP-statistic and group ρ-statistic in the case with trend, the null hypothesis of no cointegration among the variables in panel certainly is rejected at 10% significance level. Therefore, according to Pedroni's panel cointegration test the variables have a long-run relationship.

Table 5-8: Pedroni's Panel Cointegration Test Results Without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over 1980-2015(Million US Dollars,2010 Constant)

with trend			without trend		
Test statistics	**Panel statistics**	**probability**	**Test statistics**	**Panel statistics**	**probability**
Panel υ-Statistic	**2.246739**	**0.0123**	**Panel υ-Statistic**	**-1.378450**	**0.9160**
Panel ρ-Statistic	**-2.037980**	**0.0208**	**Panel ρ-Statistic**	**-3.162721**	**0.0008**
Panel PP-Statistic	**-2.389476**	**0.0084**	**Panel PP-Statistic**	**-3.976986**	**0.0000**
Panel ADF-Statistic	**-2.627518**	**0.0043**	**Panel ADF-Statistic**	**-4.273636**	**0.0000**
Group ρ-Statistic	**-0.839193**	**0.2007**	**Group ρ-Statistic**	**-1.405769**	**0.0799**
Group PP-Statistic	**-1.040747**	**0.1490**	**Group PP-Statistic**	**-3.252031**	**0.0006**
Group ADF-Statistic	**-2.179473**	**0.0146**	**Group ADF-Statistic**	**-4.012571**	**0.0000**

Source: Research Findings, using sample data (1980-2015). Notes: The null hypothesis is that the variables are not cointegrated Under the null hypothesis, all the statistics are distributed as standard normal distributions. The finite sample distribution for the seven statistics has been tabulated in Pedroni (2004).

5.5.2 Kao (1999) Panel Cointegration Test Results

Kao (1999)'s test is a generalization of the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests in the context of panel data. In Kao Test the null hypothesis is like Pedroni. The null hypothesis is that the variables are not cointegrated. Kao use the residuals determined by a panel regression to construct the test statistics and determine the asymptotically normal distribution. According to p-values presented in the Table 5-9 the results of the Kao's panel cointegration test among four variables indicates the presence of panel cointegration at 1% significance level.

Table 5-9: Kao's Panel Cointegration Test Results without Structural Breaks and Cross-Section Dependence for All Research Model Variables Over 1980-2015(Million US Dollars, 2010 Constant)

	Without trend	
Test statistics	*t- statistic*	*probability*
ADF-statistic	*-2.931126*	*0.0017*

Source: Research Findings, using sample data (1980-2015)

5.5.3 Hatemi-J's (2008) Cointegration Test Results

the results of these first-generation panel cointegration tests that neither allow for structural breaks nor cross-section dependence suggest evidence for a long-run equilibrium relationship between LNGDP, LOER, LFDI and LPRO, contrary to the first-generation unit root tests, the first-generation panel cointegration tests are able to reject the null although it doesn't consider structural breaks. Hence, in a second step, this study applies Hatemi-J's (2008) test, that reveal evidence in favor of a long-run relationship between non-oil GDP, oil export revenue, foreign direct investment and productivity, when allowing for breaks in the level and the slope of this relationship. The results of Hatemi-J's (2008) Test tests are reported in Table 5-10. We find that modified ADF* fails to reject the null hypothesis of no cointegration at 1% level of significance, while Z_t^* ***and*** Z_a^* ***tests reject the null hypothesis of no cointegration at 1% level of significance. So, there exists a long-run relationship between non-oil GDP, oil export***

revenue, foreign direct investment and productivity with two endogenous structural breaks for the period 1980-2015[37].

Table 5-10: Hatemi-J's (2008) Test for Cointegration With Two Unknown Structural Breaks

test	test Statistic	First break point / Second break point	reject null hypothesis of no cointegration
ADF*	*-4.153*	*2010* *2010*	*no*
Z_t^*	*-22.892**	*1986* *1997*	*yes*
Z_a^*	*-430.558**	*1986* *1997*	*yes*

Source: Authors calculations, using sample data (1980-2015). *, ** and *** denote significance at the 1%, 5% and 10% levels, respectively. The critical values for HJ tests are available in HJ (2008, pp 501).

5.6 Long-Run Estimations Results

As a next step, the present research explicitly estimates the long-run relationships[38] between Non-Oil GDP, Oil Export Revenue, Foreign Direct Investment and Productivity:

$$LNGDP_{i,t} = \alpha_i^{LNGDP} + \delta_{it}^{LNGDP} + \beta_i^{LNGDP} LOER_{i,t} + \beta_i^{LNGDP} LFDI_{i,t} + \beta_i^{LNGDP} LPRO_{i,t} + \varepsilon_{it}^{LNGDP}$$

$$LOER_{i,t} = \alpha_i^{LOER} + \delta_{it}^{LOER} + \beta_i^{LOER} LNGDP_{i,t} + \beta_i^{LOER} LFDI_{i,t} + \beta_i^{LOER} LPRO_{i,t} + \varepsilon_{it}^{LOER}$$

$$LFDI_{i,t} = \alpha_i^{LFDI} + \delta_{it}^{LFDI} + \beta_i^{LFDI} LNGDP_{i,t} + \beta_i^{LFDI} LOER_{i,t} + \beta_i^{LFDI} LPRO_{i,t} + \varepsilon_{it}^{LFDI}$$

$$LPRO_{i,t} = a_i^{LPRO} + d_{it}^{LPRO} + b_i^{LPRO} LNGDP_{i,t} + b_i^{LPRO} LOER_{i,t} + b_i^{LPRO} LFDI_{i,t} + e_{it}^{LPRO} \quad (4.71)$$

[37] ***The results of second generation panel cointegration tests are implemented using the Gauss software.***
[38] ***The results of long-run estimates are implemented using the Stata 15 software.***

where i = 1, ..., N refers to each country in the panel and t = 1, ..., T denotes the time period, α_i and δ_i are country-specific fixed effects and time trends, respectively. For this purpose, this study uses not only the fixed effects (FE) and mean group (MG) estimator proposed by Error! Reference source not found.but also Pesaran's (2006) common correlated effects (CCE) estimators to consider the presence of common factors which cause cross-section dependence. The first group of estimates is associated with the assumption of errors are weakly cross-sectional dependent, while the latter group assumes cross section error independence.

The results of the long-run estimates are reported in Table 5-11and 5-12. The Table 5-11 gives the fixed effects (EF) and mean group (MG) estimates, Table 5-12 gives the common correlated effects pooled (CCEP) and common correlated effects mean group (CCEMG) estimates. Moving from EF and MG to CCEP and CCEMG chances the results significantly: As the CD test statistics shows, the fixed effects (EF) and mean group (MG) estimates exhibit considerable cross-section dependence. In contrast, the common correlated effects pooled (CCEP) and common correlated effects mean group (CCEMG) estimates in the other two columns have a purged and, hence, greatly reduced cross-section dependence. First, we survive the results of FE and MG estimators in Table 5-11. In the first column of Table 5-11, the results of the FE estimates show that:

- *LOER, LFDI, and LPRO have a positive and significant effect on LNGDP at 5% level, implying that if LOER, LFDI, and LPRO increase by 1%, then LNGDP raises by 0.82% - 0.98% - 1.93% for the same respectively.*

- ***LNGDP, LFDI have a positive and significant effect on LOER at 5% level, although LPRO has a negative and significant effect on LOER at 5% level. It means, if LNGDP and LFDI increase by 1%, then LOER raises by 0.2% - 0.26% for the same respectively, while 1% increase in LPRO leads to decrease in LOER of 0.28%.***
- ***LNGDP, LOER have a positive and significant effect on LFDI at 5% level, also LPRO has a negative and significant effect on LFDI at 5% level. It means, if LNGDP and LOER increase by 1% LFDI raises by 0.23% - 0.3% for the same respectively, whereas 1% increase in LPRO leads to decrease in LFDI of 0.12%.***
- ***LFDI, LOER have a negative and significant effect on LPRO at 5% level, while LPRO has a positive and significant effect on LPRO at 5% level. This is, if LOER and LFDI increase by 1%, then LPRO raises by 0.36% - 0.13% for the same respectively, but 1% increase in LNGDP lead to increase in LPRO of 0.28%.***

In the second column of Table 5-11, the results of the MG estimates indicate that:

- ***LOER, LFDI have a positive and significant effect on LNGDP at 5% level, but LPRO has a positive and insignificant effect on LNGDP at 5% level. It means, if LOER, LFDI and LPRO increase by 1%, then LNGDP raises by 0.59% - 1.5% - 0.45%. For the same respectively.***
- ***LNGDP, LFDI have a positive and significant effect on LOER at 5% level, also LPRO has a negative and insignificant effect on LOER at 5% level. This is, if LNGDP and LFDI increase by 1%, then LOER raises by 0.14% - 0.17% for the same respectively, while 1% increase in LPRO leads to decrease in LOER of 0.22%.***

- ***LNGDP has a positive and significant effect on LFDI at 5% level, although LOER has a positive and insignificant effect and LPRO has a negative and insignificant effect on LFDI at 5% level. It means, if LNGDP and LOER by increase 1%, then LFDI raises by 0.23% - 0.47% for the same respectively, whereas 1% increase in LPRO leads to decrease in LFDI of 0.32%.***
- ***LNGDP has a positive and insignificant effect on LPRO at 5% level, also LOER and LPRO have a negative and insignificant effect on LPRO at 5% level. This is, if LOER and LFDI increase by 1%, then LPRO raises by 0.46% - 0.37% for the same respectively, but 1% increase in LNGDP lead to increase in LPRO of 0.34%.***

Table 5-11 The Estimation Results of Long-Run Dynamic Relationship among Research Model Variables Over the Period 1980-2015(Million US Dollars,2010 Constant).

Variable	EF				MG			
	β^{LNGDP}	β^{LOER}	β^{LFDI}	β^{LPRO}	β^{LNGDP}	β^{LOER}	β^{LFDI}	β^{LPRO}
LNGDP	-	0.815** (.0950933) [8.57]	0.98** (.0934445) [10.51]	1.193** (.085087) [14.02]	-	0.589** (.2918835) [2.02]	1.49** (.4047196) [3.70]	.445 (.2419186) [1.84]
LOER	0.197** (.0230929) [8.57]	-	0.262** (.050539) [5.18]	-0.283** (.0495245) [-5.72]	0.141** (.0586045) [2.41]	-	0.087** (.0886916) [0.98]	-0.215 (.1706458) [-1.26]
LFDI	0.228** (.0217289) [10.51]	0.25** (.0483931) [5.18]	-	-0.122** (.0501057) [-2.44]	0.231** (.0567459) [4.08]	0.467 (.2054731) [2.27]	-	-0.324 (.1662659) [-1.95]
LPRO	0.283** (.0203137) [14.02]	-0.279** (.0486876) [-5.72]	-0.125** (.0514433) [-2.44]	-	0.252 (.1478454) [1.71]	-0.461 (.3660986) [-1.26]	-0.372 (.2250022) [-1.66]	-

*Source: Research Findings, using sample data (1980-2015). Notes: Numbers in parentheses are standard errors and numbers in brackets represent the t-statistics (EF) and z-statistics (MG). *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. FE and MG stands for Fixed-effects and Mean Group estimates respectively and CCEMG and CCEP are the Common Correlated Effects Mean Group and Pooled estimated respectively. CD denotes the cross-section dependence test proposed by Pesaran (2004) which assumes cross-section independence under the null hypothesis.*

The results of EF and MG estimates suggest that both estimator have a same result on the other hand, we survive the results of CCEP and CCEMG estimators in Table 5-12.

In first column of Table 5-12, the results show that:

- *LPRO has a positive and significant effect on LNGDP at 5% level, also LOER and LFDI have a negative and insignificant effect on LPRO at 5% level. It means, if LOER and LFDI increase by 1%, then LNGDP decreases by 0.034% - 0.075% for the same respectively, while 1% increase in LPRO lead to increase in LNGDP of 0.93%.*
- *LPRO has a positive and insignificant effect on LOER at 5% level, although LNGDP and LFDI have a negative and insignificant effect on LOER at 5% level. It means, if LNGDP and LFDI increase by 1%, then LOER decreases by 0.06% - 0.043% for the same respectively, whereas 1% increase in LPRO lead to increase in LOER of 0.131%.*
- *LPRO has a positive and insignificant effect on LFDI at 5% level, although LNGDP and LOER have a negative and insignificant effect on LPRO at 5% level. Implying that if LNGDP and LOER increase by 1%, then LFDI decrease by 0.14% - 0.46% for the same respectively, while 1% increase in LPRO lead to increase in LFDI of 0.76%.*
- *LNGDP, LOER, and LFDI have a positive and significant (expect LOER and LFDI) effect on LPRO at 5% level. It means, if LNGDP, LOER and LFDI increase by 1%, then LPRO raises by 0.59% - 0.49% - 0.26% for the same respectively.*

In second column of Table 5-12, the results indicate that:

- ***LPRO and LOER have a positive and insignificant (expect LPRO) effect on LNGDP at 5% level, while LFDI has a negative and insignificant effect on LNGDP at 5% level. This is, if LOER and LPRO increase by 1%, then LNGDP raises by 0.02% - 1.28% for the same respectively, but 1% increase in LFDI lead to decrease in LNGDP of 0.35%.***
- ***LNGDP, LFDI have a positive and insignificant effect on LOER at 5% level, although LPRO has a negative and insignificant effect on LOER at 5% level. It means, if LNGDP and LFDI increase by 1% LOER raises by 0.05% - 0.08% for the same respectively, whereas 1% increase in LPRO leads to decrease in LFDI of 0.06%.***
- ***LNGDP, LOER, and LPRO have a positive and insignificant effect on LFDI at 5% level. This is, if LNGDP, LOER and LPRO increase by1%, then LFDI raises by 0.04% - 0.12% - 0.07% for the same respectively.***
- ***LNGDP, LOER, and LFDI have a positive and insignificant (expect LNGDP) effect on LPRO at 5% level. It means, if LNGDP, LOER and LFDI increase by 1%, then LPRO raises by 0.64% - 0.23% - 0.68% for the same respectively.***

As mentioned above, the results obtained from the CCEP and CCEMG estimators are completely different from the results of the EF and MG estimators, then results indicate, regardless of the yet to be determined direction of causation, in 2 table LNGDP has a stronger impact on dependent variables in the long run than other variables.

Table 5-12 The Estimation Results of Long-Run Dynamic Relationship among Research Model Variables Over the Period 1980-2015(Million US Dollars,2010 Constant)

Variable	CCEP				CCEMG			
	β^{NGDP}	β^{LOER}	β^{LFDI}	β^{LPRO}	β^{NGDP}	β^{LOER}	β^{LFDI}	β^{LPRO}
LNGDP	-	-0.034 (.310321) [-0.11]	-0.075 (.236337) [-0.32]	0.926** (.183087) [5.06]	-	0.02 (.450384) [0.04]	-0.35 (.599244) [-0.58]	1.28** (.250629) [5.1]
LOER	-.006 (.074723) [-0.08]	-	-0.043 (.122406) [-0.35]	.131 (.118267) [1.11]	0.05 (.037258) [1.40]	-	0.08 (.127283) [0.63]	-0.06 (.0789) [-0.78]
LFDI	-.014 (.057197) [-0.25]	-.046 (.089942) [-0.51]	-	.076 (.042182) [1.79]	0.04 (.038829) [0.93]	0.12 (.086047) [0.14]	-	0.068 (.08078) [0.85]
LPRO	0.59** (.120659) [4.92]	.49 (.41412) [1.17]	.26 (.192603) [1.35]	-	0.64** (.090698) [7.09]	0.23 (.312065) [0.75]	0.68 (.646585) [1.05]	-

Source: Research Findings, using sample data (1980-2015). Notes: Numbers in parentheses are standard errors and numbers in brackets represent the Z-statistics. EF and MG stands for Fixed-effects and Mean Group estimates respectively and CCEMG and CCEP are the Common Correlated Effects Mean Group and Pooled estimated respectively. CD denotes the cross-section dependence test proposed by Pesaran (2004) which assumes cross-section independence under the null hypothesis

5.7 Dynamic panel causality Results

Confirming the existence of cointegration among Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity implies the existence of Granger causality, at least in one direction. However, it does not show the direction of

temporal causal relationship among the variables. Hence, to detect to the direction of causality, we examined short-run and long-run Granger causality by the application of the pooled mean group (PMG) estimator proposed by Pesaran et al. (1999) to the dynamic panel error-correction specification in Equations (4.68), and Wald chi-squared tests to evaluate the various Granger causality relationships.[39] When LNGDP is a dependent variable, estimation of PMG in Table 5-13 denotes that the p-value of the Error Correction Term(ECT) is 0.000 (0%), which is < than 10%,5% and 1% we reject the null of no correlation. ECT is the long-term combination of all variables. This means that with a 95% confidence interval, in the long run, oil export revenue (OER), foreign investment direct (FDI) and productivity (PRO) are significantly affecting the non-oil GDP (NGDP). In the output also, the estimated long-run oil export revenue, foreign investment direct and productivity elasticity's are significantly positive. However, in the short run (SR), we can see the elasticity of LNGDP as against LOER, LFDI and LLPRO. The p-value for ECT is 0%, which is < than 10%, 5% and 1% we reject the null hypothesis of no correlation. This means that in short run (short term), ECT is significantly affecting LNGDP. We can safely say that LNGDP depends on the long run equilibrium of the combination between the four variables (LNGDP, LOER, LFDI and LLPRO). Intuitively, we can say that, LNGDP will return to equilibrium because of the long run interaction between LNGDP, LOER, LFDI and LLPRO. The ECT coefficient in the short-run of -0.067, reflects the period of which LNGDP will return to equilibrium. Here, in the long run, it will take roughly 7 periods, or 7 years (referring to our data time scale), for LNGDP to return to equilibrium if it deviates from regression line (taken as 1 / 0.067). For the D1

[39] ***This study uses the Stata routine "xtpmg" proposed by Blackburne and Frank (2007) to estimate the dynamic panel error-correction model by means of the pooled mean group estimator and test for significance.***

LOER and D1 LFDI, the p-value of 71% and 16% respectively, which is >than 10%, we can't reject the null of no correlation, while for D1 LLPRO we can reject the null of no correlation. Thus, we can conclude that in the short run, LNGDP is significantly affected by LLPRO. LFDI and LLPRO have a positive effect on LNGDP at 10% level, although LOER has a negative effect on LNGDP at 5% level. It means, if LFDI and LLPRO increase by 1% LNGDP raises by 0.089% - 0.35% for the same respectively, whereas 1% increase in LOER leads to decrease in LNGDP of 0.015%. Then our empirical result reveals that, the significance of all error correction terms (ECT) for short-run and long- run indicates that all four variables readjust towards a common equilibrium relationship (except for LLPRO as a dependent variable in short -run), so there are mutual causal relationships between LNGDP, LOER, LFDI and LLPRO in long-run. Oil export revenue Granger-causes non-oil GDP, foreign direct investment and vice versa in the long run, which implies that increase in Oil export revenue leads to an increase in non-oil GDP, foreign direct investment and vice versa. In contrast, a rise in Oil export revenue has a negative effect on productivity. Non-oil GDP and foreign direct investment also have a positive impact on productivity. This implying that oil Export and foreign direct investment and productivity could play an important adjustment role as the system departs from the long-run equilibrium.

Table5 -13: The Results of Dynamic panel causality Tests for All Research Model Variables Over 1980 - 2015(Million US Dollars,2010 Constant)

Dependent Variable	Sources of Causation (independent variables)								
	Short-run				Strong causality (long-run)				
	D_1 LNGDP	D_1 LOER	D_1 LFDI	D_1 LLPRO	ECT (-1)	ΔLNGDP, ECT (-1)	ΔLOER, ECT (-1)	ΔLFDI, ECT (-1)	ΔLLPRO, ECT (-1)
ΔLNGDP	-	-.015 (0.707)	.089 (0.167)	.35* (0.001)	-0.067* (0.007)	-	.503* (0.000)	.397* (0.001)	.203* (0.001)
ΔLOER	.76 (0.740)	-	.111 (0.450)	-2.19 (0.326)	-.194* (0.000)	1.121* (0.000)	-	.468* (0.001)	-0.140* (0.021)
ΔLFDI	-3.055 (0.000)	.065 (0.000)	-	3.77 (0.000)	-0.141* (0.000)	.158* (0.267)	.383 (0.000)	-	-.011 (0.783)
ΔLLPRO	1.122* (0.000)	-0.106 (0.220)	-0.010 (0.940)	-	-.133 (0.130)	.812* (0.000)	-.307* (0.000)	.314* (0.000)	-

*Source: Research Findings, using sample data (1980-2015).Notes: Numbers in parentheses are P-value. ECT represents the coefficient of the error-correction terms e^{LNGDP} ,e^{LOER},e^{LFDI} and e^{LPRO}., respectively. ***, ** and* indicate that the null hypothesis of no causation is rejected at the 1%, 5% and 10% levels, respectively.*

5.8 Panel Granger Non-Causality Test Results

At the last stage of the analyses we use Dumitrescu-Hurlin (2012) panel causality test to determine causality relationship between variables. It is also

possible utilize from test when T>N or T<N situations. Another advantage of test is it considers cross section dependence and provides efficient result even in cases where we have unbalanced panel data. Dumitrescu and Hurlin (2012) proposed a similar bivariate testing procedure to Granger (1969) causality test in a panel setting. This test makes an extreme opposite assumption to Granger Causality test, allowing all coefficients to be different across cross-sections. The null hypothesis in Dumitrescu-Hurlin (2012) test is that independent variable does not Granger-cause dependent variable[40]*. The results of Dumitrescu-Hurlin panel granger non-causality test are reported in Tables 5-19. As it is obvious,*

- *When non-oil GDP is dependent variable; the null hypothesis is rejected for LFDI, LOER and LPRO. Hence, foreign direct investment, oil Export and productivity cause non-oil GDP.*
- *When foreign direct investment is dependent variable; the null hypothesis is rejected for LNGDP, LOER and LPRO. Therefore, non-oil GDP, oil Export and productivity cause foreign direct investment.*
- *When productivity is dependent variable; the null hypothesis is rejected for LNGDP, LFDI and LOER. So, there is a causality from non-oil GDP, foreign direct investment and oil Export to productivity.*
- *When oil Export are dependent variable; the null hypothesis is rejected for LNGDP, LFDI and LPRO. Then, non-oil GDP, foreign direct investment and productivity are causation of oil Export.*

Therefore, the Granger non-causality results confirm that there is a bi-directional causality between variables two by two.

[40] *This study uses the Stata routine "xtgcause" proposed by Dumitrescu-Hurlin (2012) to determine causality relationship between variables.*

Table 5-14: Results of Dumitrescu-Hurlin Panel Granger Non-Causality Test for all research model variables over 1980-2015(Million US Dollars,2010Constant)

Null Hypothesis	*W-bar Statistic*	*Z-bar Statistic*	*p-value*	*Conclusion*
LFDI does not Granger-cause LNGDP	*2.6992*	*3.9850*	*0.0001*	*LFDI → LNGDP*
LNGDP does not Granger-cause LFDI	*2.6808*	*3.9419*	*0.0001*	*LNDGP → LFDI*
LOER does not Granger-cause LNGDP	*3.1856*	*5.1257*	*0.0000*	*LOER → LNGDP*
LNGDP does not Granger-cause LOER	*5.2620*	*9.9952*	*0.0000*	*LNGDP → LOER*
LPRO does not Granger-cause LNGDP	*58.4745*	*35.9497*	*0.0000*	*LPRO → LNGDP*
LNGDP does not Granger-cause LPRO.	*3.1988*	*5.1565*	*0.0000*	*LNGDP → LPRO*
LOER does not Granger-cause LFDI	*5.9554*	*11.6214*	*0.0000*	*LOER → LFDI*
LFDI does not Granger-cause LOER	*3.5204*	*5.9108*	*0.0000*	*LFDI → LOER*
LFDI does not Granger-cause LPRO	*3.4721*	*5.7975*	*0.0000*	*LFDI → LPRO*
LPRO does not Granger-cause LFDI	*1.7269*	*1.7047*	*0.0882*	*LPRO → LFDI*
LOER does not Granger-cause LPRO	*6.4827*	*12.8581*	*0.0000*	*LOER → LPRO*
LPRO does not Granger-cause LOER	*2.0337*	*2.4242*	*0.0153*	*LPRO → LOER*

Source: Authors calculations, using sample data (1980-2015). Note: Test statistic is significant at 1% level. The optimal lag length for the variables is 1 and determined by the Schwarz Baysian Information (SBC) Criteria.

5.9 Discussing the Empirical Results Considering the Research Questions and Hypotheses

This research would intend to test and prove hypotheses and answer questions as follows:

First hypothesis, is there a positive and significant effect of oil Export (OER) on the non-oil gross domestic product (NGDP) in OPEC member countries?

The results of panel granger causality tests in table 5-13 indicate that in short-run the impact of oil Export (OER) on NGDP is negative and insignificant, while in long-run the effect is negative and insignificant. Then there isn't any causality between OER and NGDP in short-run. in the long run, oil export revenue (OER) is significantly affecting the non-oil GDP, due to Table 5-14 the results of Dumitrescu-Hurlin panel granger non-causality test there is a bidirectional causality between OER and NGDP in long-run.

Second hypothesis, is there a positive and significant effect of foreign direct investment (FDI) on oil Export (OER) in OPEC member countries?

Our results indicate that FDI has a positive and insignificant effect on OER in short-run and has a negative and significant effect on OER in long-run. Due to the results of panel granger causality tests in table 5-13, we find that there is not any causality between FDI and OER in short-run and there is a bidirectional causality between FDI and OER in long-run, that the results of Dumitrescu-Hurlin panel granger non-causality test in Table 5-14 support our results.

Third hypothesis, is there a positive and significant effect of oil Export (OER) on productivity (PRO) in OPEC member countries?

The results of panel granger causality tests in table 5-13 show that OER has a negative and insignificant effect on PRO in short-run and has a negative and significant effect in long-run. Due to the result there is not any causality between OER and PRO in short-run in short-run, also there is a bidirectional causality from productivity to oil Export in long-run. The results of Dumitrescu-Hurlin panel granger non-causality test in Table 5-14 confirm it.

Forth hypothesis, is there a positive and significant effect on foreign direct investment (FDI) on non-oil gross domestic product (NGDP) in OPEC member countries?

According to the results of panel granger causality tests in table 5-13, it is clear that in short -run FDI has a positive and insignificant effect on NGDP, and in long -run FDI has a positive and significant effect of NGDP. So, the results show that there is a bidirectional causality between non-oil gross domestic product and foreign direct investment in long-run. The results of Dumitrescu-Hurlin panel granger non-causality test in Table 5-14 confirm this finding.

Fifth hypothesis, is there a positive and significant effect of foreign direct investment (FDI) on productivity (PRO) in OPEC member countries?

According to empirical results, we expected that FDI could have had a positive impact on PRO, according to the results of panel granger causality tests in table 5-13 it can be seen that there is a negative and insignificant effect of FDI on PRO in short-run, while in long-run FDI has a positive and significant effect on PRO. The results show that there is a unidirectional

causality from productivity to foreign direct investment in short-run, whereas there is a unidirectional causality from foreign direct investment to productivity in long-run against the results of Dumitrescu-Hurlin panel granger non-causality test.

5.10 Summary and Conclusion

In this chapter, I started a brief description sources of data used in this study. Then, we presented empirical methodology in the following steps. to verify the consideration of cross-section dependence in the analysis of the relationship between variables we applied the cross-section dependence (CD) test developed by [94], then to find the variables whether are stationary or not we used the first-generation panel unit root tests ; Levin, Lin and Chu (LLC, 2002), Im, Pesaran and Shin (IPS), Breitung's test (2000), Fisher (ADF, 1999) and Fisher (PP,1999), which neglect the presence of both structural breaks and cross-section dependence, after that we applied the second generation panel unit root test proposed by Error! Reference source not found.as a second step. This test allows for structural breaks in the level, slope or both, which can occur at different dates for different countries and may have different magnitudes of shift; To examine the existence of a cointegration relationship this study repeated both types of tests, with and without structural breaks and cross-sectional dependence ,the first generation panel cointegration tests proposed by [70], [89]and [91], the second generation panel cointegration tests ,the LM-based tests proposed [116]that simultaneously consider cross-section dependence and structural breaks, the long-run relationships between variables were estimated using the fixed effects (FE) and mean group (MG) estimator proposed by Error!

Reference source not found. but also Pesaran's (2006) common correlated effects (CCE) estimators to consider the presence of common factors which cause cross-section dependence. then, to examine the short-run and long-run Granger causality between variables we used the application of the pooled mean group (PMG) estimator proposed by [96] to the dynamic panel error-correction specification in Equations (4.68), and the test results proved a bidirectional and unidirectional causal relationship among the research model variables in long-run. Finally, Dumitrescu-Hurlin test is performed and estimated to find the Granger non-causality among three variables. The next chapter concludes the thesis and some policy recommendation and suggestions will be given at the end.

Chapter 6: Conclusions and Policy Recommendations

6.1 Introduction

At first, in this chapter, the summary of the chapters is overviewed. Then, findings & conclusions are stated. In next section, research limitations are explained and followed by research contribution. In the next step policy recommendations are declared. Finally, Suggestion for future researchers is stated.

6.2 Summary of the Chapters

To derive the dissertation, in Chapter 1, research objectives and importance introduced. Then, questions and hypotheses of research explained. The methodology of the research is stated in next step. Finally, the overall structure of the thesis explained. At first, research Theoretical Foundation explained. Then, the whole investigation in the literature is studied. At last, the model of this thesis and its difference with literature is explained. In chapter 3, four variables of the thesis, including Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity with their trends in the past 36 years are illustrated by using calculate the compound annual growth rate (CAGR) method. In chapter 4, the details of research methodology and econometric models have discussed to determine an appropriate and efficient model. Chapter 5 presented an estimation of the model. First to verify the consideration of cross-section dependence in the analysis of the relationship between research variables model, we applied the cross-section dependence

(CD) test developed by [94], second to find the variables whether are stationary or not we used the first-generation panel unit root tests which neglect the presence of both structural breaks and cross-section dependence, after that we applied the second-generation panel unit root test proposed by [26]as a second step. This test allows for structural breaks in the level, slope or both, which can occur at different dates for different countries and may have different magnitudes of shift; Third to examine the existence of a cointegration relationship this study repeated both types of tests, with and without structural breaks and cross-sectional dependence ,the first generation panel cointegration tests proposed by Error! Reference source not found., [89]and [91];the second generation panel cointegration tests ,the LM-based tests proposed by Error! Reference source not found.that simultaneously consider cross-section dependence and structural breaks, fourth the long-run relationships between variables were estimated using the fixed effects (FE) and mean group (MG) estimator proposed by [96] but also Pesaran's (2006) common correlated effects (CCE) estimators to consider the presence of common factors which cause cross-section dependence. Fifth, to examine the short-run and long-run Granger causality between variables, we used the application of the pooled mean group (PMG) estimator proposed by [96] to the dynamic panel error-correction specification in Equations (4.68), and the test results proved a bidirectional and unidirectional causal relationship among the research model variables in long-run. Finally, Dumitrescu-Hurlin test is performed and estimated to find the Granger non-causality among three variables.

6.3 Findings and Conclusions

The general objective of this study was thus to examine the causal links between Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity in OPEC members countries.

The specific objectives were:

- ***To explore the causal relationship between oil export and non-oil GDP for the case of OPEC member Countries.***
- ***To examine the causal link between oil export and foreign direct investment for the case of OPEC member Countries.***
- ***To survey the causal link between oil export and productivity for the case of OPEC member Countries.***
- ***To examine the causal link between foreign direct investment and productivity for the case of OPEC member Countries.***
- ***To investigate the causal link between productivity and non-oil GDP for the case of OPEC member Countries.***
- ***To explore the causal link between foreign direct investment and non-oil GDP for the case of OPEC member Countries.***

This thesis used annual data for a panel of 11 OPEC member Countries: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, United Arab Emirate and Venezuela for the period 1980-2015.The following variables were involved Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity.

As a first step to verify the consideration of cross-section dependence in the analysis of the relationship between research variables model, we applied the cross-section dependence (CD) test developed by Error! Reference source not found. . According to the results of CD test, the null hypothesis of cross-section independence cloud be clearly rejected for all research variables model, so there was dependence across the OPEC member Countries for all variables. For next step, first-generation panel unit root tests applied to find the variables whether are stationary or not, which neglect the presence of both structural breaks and cross-section dependence. Results of panel unit root tests of Levin, Lin and Chu (LLC, 2002), Im, Pesaran and Shin (IPS), Breitung's test (2000), Fisher (ADF, 1999) and Fisher (PP, 1999) indicated that findings of the tests had the same results and confirmed each other. Therefore, all of the variables under investigation were integrated of order one, provided that it has failed to reject the null hypothesis in levels (except productivity). Hence, all variables were stationary at the first difference, meaning that all variables are integrated of order one. After that, we applied the second-generation panel unit root test proposed by [26]as a second step. This test allows for structural breaks in the level, slope or both, which can occur at different dates for different countries and may have different magnitudes of the shift. The results have showed, that the null hypothesis of a unit root cannot be rejected for all tests in the model without any break, with a break in the mean and with a break in the trend.

Afterwards, to examine the existence of a cointegration relationship this study repeated both types of tests, with and without structural breaks and cross-sectional dependence, the first generation panel cointegration tests proposed by [70], [89]and [91]; the second generation panel cointegration tests , Hatemi-J's (2008) test that simultaneously consider cross-section *dependence and structural breaks, the results of the first generation panel cointegration; Kao (1999) test revealed that the variables for OPEC member countries are cointegrated. Also, Pedroni's (1999, 2004) findings verified Kao's (1999) results in OPEC member countries. The results of second generation panel cointegration tests, Hatemi-J's (2008) test showed that research variables model are cointegrated. It means that exist a strong long-run relationship between Non-Oil GDP, Oil Export, Foreign Direct Investment and Productivity in OPEC members countries.*

Empirical evidence suggests that research variables model is cointegrated. To further explore the sustainability condition, we estimated the long-run relationships between Non-Oil GDP, Oil Export Revenue (as a proxy for oil export), Foreign Direct Investment and Productivity by using Long-run estimations, then we analyze the effects of independent variables on a dependent variable, according to the results obtained from Long-run estimations.

When LNGDP is a dependent variable; the results of EF and MG estimators revealed; if LOER, LFDI and LPRO increase by 1%, then LNGDP raises by 0.82% - 1.49% - 1.19% for the same respectively, while the results of CCEP and CCEMG estimators indicated; if LOER and LFDI increase by 1%, so LNGDP decreases by 0.034% - 0.075% for the same respectively, and 1% increase in LPRO lead to increase in LNGDP of 0.93%.

When LOER is a dependent variable; the results of EF and MG estimators showed; if LNGDP and LFDI increase by 1%, then LOER raises by 0.141% - 0.26% for the same respectively, and 1% increase in LPRO lead to decrease in LOER of 0.22%, whereas the results of CCEP and CCEMG estimators *indicated; if LNGDP, LFDI, and LPRO increase by 1%, so LOER decrease by 0.06% - 0.043% - 0.06% **for the same respectively.***

*When LFDI is a dependent variable; the results of EF and MG estimators indicated; if LNGDP and LOER increase by 1%, then LFDI raises by 0.23% - 0.47% **for the same respectively**, and 1% increase in LPRO lead to decrease in LFDI of 0.122%, while the results of CCEP and CCEMG estimators revealed; if LNGDP and LOER increase by 1%, then LFDI decreases by 0.014% - 0.46% **for the same respectively**, and 1% increase in LPRO lead to increase in LFDI of 0.68%.*

*When LPRO is a dependent variable; the results of EF and MG estimators showed; if LOER and LFDI increase by 1%, then LPRO decreases by 0.279% - 0.125% **for the same respectively**, also 1% increase in LNGDP lead to increase in LPRO of 0.28%, while the results of CCEP and CCEMG estimators revealed; if LNGDP, LOER and LFDI increase by 1%, so LPRO raises by 0.59% - 0.23% - 0.26% **for the same respectively.***

the results of Dynamic panel causality for all variables shows that; For the short-run causality, (i) unidirectional causality run from non-oil GDP, oil export and Productivity to foreign direct investment, (ii) bidirectional causality run from Productivity to non-oil GDP.** The significance of all error correction terms (ECT) for short-run and long- run indicates that all four variables readjust towards a common equilibrium relationship (except for LLPRO as a dependent variable in short -run), so there are mutual causal relationships between LNGDP, LOER, LFDI and LLPRO in long-run. **Oil export revenue Granger-causes non-oil GDP, foreign direct investment and vice versa in the long run, which implies that increase in Oil export revenue leads to an increase in non-oil GDP, foreign direct investment and vice

versa. In contrast, a rise in Oil export revenue has a negative effect on labor productivity. Non-oil GDP and foreign direct investment also have a positive impact on productivity. Panel Granger non- causality results showed that in long-run there is a bidirectional causal relationship between the pair of the research variables model.

6.4 Policy Recommendations

The role of FDI inflows in the OPEC member countries is empirically a significant factor that affects non-oil sector GDP more than crude oil export. While the linkage between crude oil export and GDP is still highly related. However, the result pertains to crude oil export implies that its obtained revenues are not invested crucially in enhancing the level of non-oil sectors and increase value added. It indicates that the OPEC member Countries' open trade policy has not led to reorienting factors of productions. Due to existing a long-run relationship between oil exports and non-oil sector GDP, we can say that the OPEC member Countries still in a high need to pursue an appropriate economic policy for utilizing the crude oil export revenues. This policy ought to be emphasized on redirecting surplus revenues to be invested in non-oil sectors for reducing the negative shocks that occur in oil sectors and its export prices. However, this policy could enhance the interaction between the whole local economy and oil sector, as well as improving levels of economic growth and mitigate impacts of crude oil price fluctuations on the local economy of OPEC member Countries. On the contrary, this policy will lead to reinforcement macroeconomic stability in the long -run, which consider an important factor that stimulates attracting more FDI to OPEC member Countries' economies.

6.5 Research Contribution

Given that in previous studies, the relationship between Non-Oil GDP, Oil Exports Revenue (as a proxy for oil exports), Foreign Direct Investment and Non-Oil GDP per worker (as a proxy for Productivity) in OPEC member countries have not been made, this research contributes with existing literature to enhance the knowledge about the relationship between research model variables by using the application of panel econometric techniques that consider both structural breaks and cross-sectional dependence to provide more accurate and reliable results.

6.6 Research Limitations

Although it has been tried to use as most observations as possible and also apply the latest modified econometric techniques and models, this research may still suffer from some limitations. The sample size is one of the limitations of this study that was mostly due to unavailability of data on the variables (especially Productivity).

6.7 Suggestions for Future Researchers

The existence of a vast amount of data could possibly result in more precise results. However, if such data could be found, such a project would be a useful topic for future research. This study was based on panel data for OPEC member countries. Therefore, this study could have done for one country to be cleared the relationship between the four variables in a specific country. As mentioned above, there are other factors that affect economic

growth such as the quality of education, investment, and the institutionalism. These might be the subjects of further investigation.

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Appendix 1: Variable Description and Sources

Variable	*Description*	*Source*	*Years of coverage*
NGDP	***Non-Oil Sector GDP***	***World Bank Data Base***	***1980-2015***
OER	***As a proxy for Oil Export***	***Arab Monetary Fund***	***1980-2015***
FDI	***Foreign Direct Investment***	***United Nations Conference on Trade and Development.***	***1980-2015***
PRO	***As a proxy for Productivity***	***OPEC and World Bank Data Base***	***1980-2015***

Appendix 2: Descriptive Statistics

	Variable	Mean	Std. Dev.	Min	Max	Observations
LNGDP	Overall	11.1137	1.270578	7.020013	13.20454	N=396
	between	-	1.14125	9.28501	12.4709	n=11
	within	-	.6537002	8.848708	13.79968	T=36
LOER	overall	9.34588	1.319835	5.57994	12.61784	N=396
	between	-	.8735225	7.908491	11.10324	n=11
	within	-	1.023002	5.673205	12.12717	T=36
LFDI	overall	10.07237	1.6454	4.588429	13.59934	N=396
	between	-	1.271841	8.309729	12.19502	n=11
	within	-	1.110447	6.351074	12.69733	T=36
LPRO	overall	3.829156	1.526618	-8.369675	-1.055554	N=396
	between	-	1.216211	-5.808827	-2.087223	n=11
	within	-	.9911912	-6.507113	-.3113754	T=36

Appendix 3: Variable Correlation Matrix

. corr LNGDP LOER LFDI LPRO

(obs=396)

	LNGDP	*LOER*	*LFDI*	*LPRO*
LNGDP	*1.0000*			
LOER	*0.5724*	*1.0000*		
LFDI	*0.3932*	*0.4680*	*1.0000*	
LPRO	*0.5943*	*0.2824*	*0.4065*	*1.0000*

Appendix 4: Computer Results

Results of Cross Section Dependence Tests:

```
. xtset id year
       Panel variable:  id (strongly balanced)
        Time variable:  year, 1980 to 2015
                Delta:  1 unit

xtcd LNGDP
 Average correlation coefficients & Pesaran (2004) CD test
 Variables series tested: LNGDP
                              Group variable: id
                            Number of groups: 11
                   Average # of observations: 39.60
                                    Panel is: unbalanced
-------------------------------------------------------
    Variable |    CD-test    p-value corr    abs(corr)
-------------+-----------------------------------------
       LNGDP |     31.59    0.000    0.710    0.710
-------------------------------------------------------
 Notes: Under the null hypothesis of cross-section
        Independence CD ~ N (0,1)

. xtcd LOER
 Average correlation coefficients & Pesaran (2004) CD test
 Variables series tested: LOER
```

Group variable: id

Number of groups: 11

Average # of observations: 39.60

Panel is: unbalanced

Variable	CD-test	p-value	corr	abs (corr)
LOER	36.99	0.000	0.831	0.831

Notes: Under the null hypothesis of cross-section Independence CD ~ N (0, 1)

. xtcd LFDI

Average correlation coefficients & Pesaran (2004) CD test

Variables series tested: LFDI

Group variable: id

Number of groups: 11

Average # of observations: 39.60

Panel is: unbalanced

Variable	CD-test	p-value	corr	abs (corr)
LFDI	31.84	0.000	0.715	0.715

Notes: Under the null hypothesis of cross-section Independence CD ~ N (0,1)

. xtcd LPRO

Average correlation coefficients & Pesaran (2004) CD test

Variables series tested: LPRO

Group variable: id

Number of groups: 11

Average # of observations: 39.60

Panel is: unbalanced

Variable	CD-test	p-value	corr	abs (corr)
LPRO	-2.55	0.011	-0.057	0.521

Notes: Under the null hypothesis of cross-section Independence CD ~ N (0,1)

Results of Unit Root with Structural Break and Cross-Section Dependence:

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: LNGDP- SAMPLE: 11 Countries; PERIOD: 1980-2015

MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	4.000	0.000
2.000	34.000	0.000
3.000	3.000	6.000
4.000	4.000	0.000
5.000	4.000	6.000
6.000	0.000	0.000
7.000	33.000	0.000
8.000	0.000	0.000
9.000	34.000	0.000
10.000	0.000	0.000
11.000	33.000	0.000

Country:

1	2	3	4	5	6	7	8	9	10	11
ECU	IRN	IRQ	KWT	LBY	QAT	SA	UAE	VEN	ALG	AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: -1.417

Pval (normal): 1.598

Pval (Chi-square): 32.599

Simplified tests

Z test: -1.755

Pval (normal): 3.256

Pval (Chi-square): 43.599

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: d.LNGDP- SAMPLE: 11 Countries; PERIOD: 1980-2015

VAR: 1st Diff; MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	0.000	0.000
2.000	33.000	0.000
3.000	3.000	0.000
4.000	32.000	0.000
5.000	0.000	0.000
6.000	0.000	0.000
7.000	0.000	0.000
8.000	0.000	0.000
9.000	33.000	0.000
10.000	0.000	0.000
11.000	5.000	31.000

Country:

1 2 3 4 5 6 7 8 9 10 11

ECU IRN IRQ KWT LBY QAT SA UAE VEN ALG AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: -2.040

Pval (normal): 3.262

Pval (Chi-square): 43.635

Simplified tests

Z test: -0.688

Pval (normal): 5.840

Pval (Chi-square): 60.737

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: LOER; SAMPLE: 11 Countries; PERIOD: 1980-2015

MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	0.000	0.000
2.000	33.000	0.000
3.000	0.000	0.000
4.000	0.000	0.000
5.000	33.000	0.000
6.000	0.000	0.000
7.000	6.000	0.000
8.000	0.000	0.000
9.000	0.000	0.000
10.000	0.000	0.000
11.000	0.000	0.000

Country:

1	2	3	4	5	6	7	8	9	10	11
ECU	IRN	IRQ	KWT	LBY	QAT	SA	UAE	VEN	ALG	AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: -1.834

Pval (normal): 1.007

Pval (Chi-square): 28.680

Simplified tests

Z test: -2.078

Pval (normal): 1.661

Pval (Chi-square): 33.015

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: d.LOER; SAMPLE: 11 Countries; PERIOD: 1980-2015

VAR: 1st Diff; MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	0.000	0.000
2.000	0.000	0.000
3.000	0.000	0.000
4.000	32.000	0.000
5.000	32.000	0.000
6.000	33.000	0.000
7.000	0.000	0.000
8.000	0.000	0.000
9.000	0.000	0.000
10.000	0.000	0.000
11.000	0.000	0.000

Country:

1	2	3	4	5	6	7	8	9	10	11
ECU	IRN	IRQ	KWT	LBY	QAT	SA	UAE	VEN	ALG	AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: -3.029

Pval (normal): 14.994

Pval (Chi-square): 121.457

Simplified tests

Z test: 1.932

Pval (normal): 16.258

Pval (Chi-square): 129.844

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

VARIABLE: LFDI; SAMPLE: 11 Countries; PERIOD: 1980-2015

MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	0.000	0.000
2.000	0.000	0.000
3.000	0.000	0.000
4.000	0.000	0.000
5.000	0.000	0.000
6.000	0.000	0.000
7.000	0.000	0.000
8.000	0.000	0.000
9.000	21.000	32.000
10.000	6.000	21.000
11.000	18.000	0.000

Country:

1	2	3	4	5	6	7	8	9	10	11
ECU	IRN	IRQ	KWT	LBY	QAT	SA	UAE	VEN	ALG	AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: 0.730

Pval (normal): -1.535

Pval (Chi-square): 11.816

Simplified tests

Z test: 6.849

Pval (normal): -1.601

Pval (Chi-square): 11.382

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: d.LFDI- SAMPLE: 11 Countries; PERIOD: 1980-2015

VAR: 1st Diff; MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	0.000	0.000
2.000	0.000	0.000
3.000	0.000	0.000
4.000	0.000	0.000
5.000	0.000	0.000
6.000	0.000	0.000
7.000	0.000	0.000
8.000	0.000	0.000
9.000	0.000	0.000
10.000	0.000	0.000
11.000	0.000	0.000

Country:

1 2 3 4 5 6 7 8 9 10 11

ECU IRN IRQ KWT LBY QAT SA UAE VEN ALG AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: -2.797

Pval (normal): 8.119

Pval (Chi-square): 75.857

Simplified tests

Z test: -2.797

Pval (normal): 8.119

Pval (Chi-square): 75.857

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: LPRO; SAMPLE: 11 Countries; PERIOD: 1980-2015
MODEL: 3; TEST: UR with Breaks; Max Breaks = 2
Estimated break points

1.000	34.000	0.000
2.000	3.000	5.000
3.000	34.000	0.000
4.000	0.000	0.000
5.000	34.000	0.000
6.000	0.000	0.000
7.000	33.000	0.000
8.000	0.000	0.000
9.000	34.000	0.000
10.000	33.000	0.000
11.000	3.000	34.000

Country:
1 2 3 4 5 6 7 8 9 10 11
ECU IRN IRQ KWT LBY QAT SA UAE VEN ALG AGO
Year:
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
-2146827284

Z test: -1.612
Pval (normal): 1.232
Pval (Chi-square): 30.169
Simplified tests
Z test: 0.063
Pval (normal): 7.926
Pval (Chi-square): 74.577

Bai & Carrion-i-Silvestre 2009; Panel UR Tests with Breaks & CSD

Variable: d.LPRO; SAMPLE: 11 Countries; PERIOD: 1980-2015

VAR: 1st Diff; MODEL: 3; TEST: UR with Breaks; Max Breaks = 2

Estimated break points

1.000	0.000	0.000
2.000	3.000	5.000
3.000	3.000	0.000
4.000	32.000	0.000
5.000	0.000	0.000
6.000	0.000	0.000
7.000	0.000	0.000
8.000	0.000	0.000
9.000	33.000	0.000
10.000	0.000	0.000
11.000	3.000	31.000

Country:

1	2	3	4	5	6	7	8	9	10	11
ECU	IRN	IRQ	KWT	LBY	QAT	SA	UAE	VEN	ALG	AGO

Year:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

-2146827284

Z test: -1.430

Pval (normal): 2.008

Pval (Chi-square): 35.320

Simplified tests

Z test: -2.380

Pval (normal): 6.219

Pval (Chi-square): 63.249

Results of Cointegration tests with Structural Break and Cross-Section Dependence:

Pedroni Residual Cointegration Test

Series: LNGDP LOER LFDI

Date: 01/20/18   Time: 12:17

Sample: 1980 2015

Included observations: 396

Cross-sections included: 11

Null Hypothesis: No cointegration

Trend assumption: Deterministic intercept and trend

Automatic lag length selection based on SIC with a max lag of 8

Newey-West automatic bandwidth selection and Bartlett kernel

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

			Weighted	
	Statistic	*Prob*	*Statistic*	*Prob*
Panel v-Statistic	*2.246739*	*0.0123*	*5.695693*	*0.0000*
Panel rho-Statistic	*-2.037980*	*0.0208*	*-2.157114*	*0.0155*

Panel PP-Statistic	*-2.389476*	*0.0084*	*-2.063502*	*0.0195*
Panel ADF-Statistic	*-2.627518*	*0.0043*	*-2.773564*	*0.0028*

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

	Statistic	*Prob.*
Group rho-Statistic	*-0.839193*	*0.2007*
Group PP-Statistic	*-1.040747*	*0.1490*
Group ADF-Statistic	*-2.179473*	*0.0146*

Pedroni Residual Cointegration Test

Series: LNGDP LOER LFDI LPRO

Date: 01/20/18 Time: 12:22

Sample: 1980 2015

Included observations: 396

Cross-sections included: 11

Null Hypothesis: No cointegration

Trend assumption: No deterministic intercept or trend

Automatic lag length selection based on SIC with a max lag of 8

Newey-West automatic bandwidth selection and Bartlett kernel

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

			Weighted	
	Statistic	*Prob.*	*Statistic*	*Prob.*
Panel v-Statistic	*-1.378450*	*0.9160*	*-2.208357*	*0.9864*
Panel rho-Statistic	*-3.162721*	*0.0008*	*-2.207698*	*0.0136*

Panel PP-Statistic	*-3.976986*	*0.0000*	*-0.535190*	*0.2963*
Panel ADF-Statistic	*-4.273636*	*0.0000*	*-0.605000*	*0.2726*

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

	Statistic	*Prob.*
Group rho-Statistic	*-1.405769*	*0.0799*
Group PP-Statistic	*-3.252031*	*0.0006*
Group ADF-Statistic	*-4.012571*	*0.0000*

Kao Residual Cointegration Test
Series: LNGDP LOER LFDI LPRO
Date: 01/20/18 Time: 12:55
Sample: 1980 2015
Included observations: 396
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Automatic lag length selection based on SIC with a max lag of 9
Newey-West automatic bandwidth selection and Bartlett kernel

	T-Statistic	*Prob.*
ADF	*-2.931126*	*0.0017*

Results of Cointegration tests with Structural Break and Cross-Section Dependence:

Hatemi-J's (2008) test

*********** Modified ADF Test ***************

T-statistic = -4.153

AR lag = 11.000000

First break point (ADF) = 0.67

Second break point (ADF) = 0.67

*********** Modified Phillips Test ***********

Zt = -22.892

First breakpoint (Zt) = 0.43

Second breakpoint (Zt) = 0.54

Za = -430.558

First breakpoint (Za) = 0.18

Second breakpoint (Za) = 0.54

```
if model==3;
    x1=ones(n,1) ~dummy1~dummy2~seqa (1,1, n) ~x;
  elseif model==4;
    x1=ones(n,1) ~dummy1~dummy2~(dummy1). *x~(dummy2). *x;
  elseif model==2;
    x1=ones(n,1) ~dummy1~dummy2~x;
```

b,se,t

6.350 0.841 7.553

2.219 4.895 0.453

0.221 4.870 0.045

-0.005 0.000 -29.951

0.507 0.087 5.824

0.001 0.000 2.924

0.001 0.001 2.699

-0.261	*0.514*	*-0.509*
-0.001	*0.001*	*-0.708*
0.001	*0.000*	*2.782*
-0.072	*0.510*	*-0.141*
0.000	*0.001*	*0.163*

Results of Long-Run Estimations:

. xtreg LNGDP LOER LFDI LPRO, fe

Fixed-effects (within) regression Number of obs = 396

Group variable: id Number of groups = 11

R-sq: Obs per group:

Within = 0.6555 min = 36

Between = 0.3752 avg = 36.0

Overall = 0.4492 max = 36

F (3,382) = 242.32

corr(u_i, Xb) = 0.0262 Prob > F = 0.0000

LNGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LOER	.1978155	.0230929	8.57	0.000	.1524104	.2432206
LFDI	.2284146	.0217289	10.51	0.000	.1856913	.2711379
LPRO	.2847969	.0203137	14.02	0.000	.2448562	.3247376
_cons	8.054799	.2318232	34.75	0.000	7.59899	8.510609
sigma_u	.90258858					
sigma_e	.39013714					
rho	.84257812 (fraction of variance due to u_i)					

F test that all u_i=0: F (10, 382) = 158.26 Prob > F = 0.0000

. xtcd2 LNGDP

Pesaran (2015) test for weak cross-sectional dependence

H0: errors are weakly cross-sectional dependent.

CD = 44.364

P-value = 0.000

. xtreg LOER LNGDP LFDI LPRO, fe

Fixed-effects (within) regression Number of obs = 396

Group variable: id Number of groups = 11

R-sq: Obs per group:

Within = 0.4208 min = 36

Between = 0.4229 avg = 36.0

Overall = 0.4054 max = 36

F (3,382) = 92.51

corr(u_i, Xb) = -0.2984 Prob > F = 0.0000

LOER	Coef.	St.d. Err.	t	P>|t|	[95% Conf. Interval]	
LNGDP	.8145773	.0950933	8.57	0.000	.6276054	1.001549
LFDI	.2508733	.0483931	5.18	0.000	.1557232	.3460235
LPRO	-.2785248	.0486876	-5.72	0.000	-.3742541	-.1827955
_cons	-3.300496	.9445495	-3.49	0.001	-5.157663	-1.443329
sigma_u	.71939816					
sigma_e	.79168662					
rho	.45227045 (fraction of variance due to u_i)					

F test that all u_i=0: F (10, 382) = 25.88 Prob > F = 0.0000

. xtcd2 LOER

Pesaran (2015) test for weak cross-sectional dependence

H0: errors are weakly cross-sectional dependent.

CD = 44.350

P-value = 0.000

. xtreg LFDI LNGDP LOER LPRO, fe

Fixed-effects (within) regression   Number of obs = 396

Group variable: id   Number of groups = 11

R-sq: Obs per group:

Within = 0.4866   min = 36

Between = 0.0630   avg = 36.0

Overall = 0.1751   max = 36

F (3,382) = 120.71

corr(u_i, Xb) = -0.4761   Prob > F = 0.0000

LFDI	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNGDP	.9822889	.0934445	10.51	0.000	.798559	1.166019
LOER	.2619979	.050539	5.18	0.000	.1626285	.3613674
LPRO	-.1255681	.0514433	-2.44	0.015	-.2267155	-.0244207
_cons	-3.773916	.9613704	-3.93	0.000	-5.664156	-1.883676

sigma_u | 1.5068475

sigma_e | .80904932

rho | .77623002 (fraction of variance due to u_i)

F test that all u_i=0: F (10, 382) = 76.03   Prob > F = 0.0000

. xtcd2 LFDI

Pesaran (2015) test for weak cross-sectional dependence

H0: errors are weakly cross-sectional dependent.

CD = 44.162

P-value = 0.000

. xtreg LPRO LNGDP LOER LFDI, fe

Fixed-effects (within) regression *Number of obs = 396*

Group variable: id *Number of groups = 11*

R-sq: *Obs per group:*

Within = 0.3724 *min = 36*

Between = 0.2999 *avg = 36.0*

Overall = 0.3067 *max = 36*

F (3,382) =75.57

corr(u_i, Xb) = -0.4050 *Prob > F = 0.0000*

LPRO	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNGDP	1.192914	.085087	14.02	0.000	1.025616	1.360211
LOER	-.2833124	.0495245	-5.72	0.000	-.3806872	-.1859376
LFDI	-.1223032	.0501057	-2.44	0.015	-.2208206	-.0237857
_cons	-13.20716	.6927449	-19.06	0.000	-14.56923	-11.84509
sigma_u	1.1452016					
sigma_e	.79846187					
rho	.67289269 (fraction of variance due to u_i)					

F test that all u_i=0: F (10, 382) = 47.33 *Prob > F = 0.0000*

. xtcd2 LPRO

Pesaran (2015) test for weak cross-sectional dependence

H0: errors are weakly cross-sectional dependent.

CD = 41.157

P-value = 0.000

. xtmg LNGDP LOER LFDI LPRO

Pesaran & Smith (1995) Mean Group estimator

All coefficients present represent averages across groups (id)

Coefficient averages computed as unweighted means

Mean Group type estimation Number of obs = 396

Group variable: id Number of groups = 11

Obs per group:

min = 36

avg = 36.0

max = 36

Wald chi2(3) = 20.52

Prob > chi2 = 0.0001

LNGDP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LOER	.1412402	.0586045	2.41	0.016	.0263774	.2561029
LFDI	.2314301	.0567459	4.08	0.000	.1202103	.34265
LPRO	.2524257	.1478454	1.71	0.088	-.0373459	.5421973
_cons	8.535476	1.180266	7.23	0.000	6.222197	10.84876

Root Mean Squared Error (sigma): 0.1996

. xtcd2 LNGDP

Pesaran (2015) test for weak cross-sectional dependence

H0: errors are weakly cross-sectional dependent.

CD = 44.364

p-value = 0.000

```
.   xtmg LOER LNGDP LFDI LPRO
Pesaran & Smith (1995) Mean Group estimator
All coefficients present represent averages across groups (id)
Coefficient averages computed as unweighted means
Mean Group type estimation                    Number of obs     =       396
Group variable: id                            Number of groups =        11
                                          Obs per group:
                                           min =        36
                                           avg =       36.0
                                           max =        36
                                    Wald chi2(3)      =      9.31
                                    Prob > chi2       =    0.0255
---------------------------------------------------------------------------
       LOER |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+-------------------------------------------------------------
      LNGDP |   .5892182   .2918835     2.02   0.044     .0171371    1.161299
       LFDI |   .4674462   .2054731     2.27   0.023     .0647264    .8701661
       LPRO |  -.4608124   .3660986    -1.26   0.208    -1.178352    .2567277
      _cons |  -3.074658   4.923685    -0.62   0.532     -12.7249    6.575587
---------------------------------------------------------------------------
Root Mean Squared Error (sigma): 0.5399


. xtcd2 LOER
Pesaran (2015) test for weak cross-sectional dependence
H0: errors are weakly cross-sectional dependent.
       CD = 44.350
        P-value = 0.000
```

```
.   xtmg LFDI LNGDP LOER LPRO
Pesaran & Smith (1995) Mean Group estimator
All coefficients present represent averages across groups (id)
Coefficient averages computed as unweighted means
Mean Group type estimation                  Number of obs     =      396
Group variable: id                          Number of groups =        11
                                       Obs per group:
                                         min =        36
                                         avg =      36.0
                                         max =        36
                                   Wald chi2(3)      =     15.26
                                   Prob > chi2       =    0.0016
------------------------------------------------------------------------------
      LFDI |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     LNGDP |    1.495499   .4047196     3.70   0.000      .702263    2.288735
      LOER |    .0872335   .0886916     0.98   0.325    -.086599    .2610659
      LPRO |   -.3725306   .2250022    -1.66   0.098    -.8135269    .0684657
     _cons |   -9.026534   5.325028    -1.70   0.090     -19.4634    1.410328
------------------------------------------------------------------------------
Root Mean Squared Error (sigma): 0.6057
```

```
. xtcd2 LFDI
Pesaran (2015) test for weak cross-sectional dependence
H0: errors are weakly cross-sectional dependent.
      CD = 44.162
       P-value = 0.000
```

. xtmg LPRO LNGDP LOER LFDI

Pesaran & Smith (1995) Mean Group estimator

All coefficients present represent averages across groups (id)

Coefficient averages computed as unweighted means

Mean Group type estimation Number of obs = 396

Group variable: id Number of groups = 11

Obs per group:

min = 36

avg = 36.0

max = 36

Wald chi2(3) = 5.21

Prob > chi2 = 0.1569

LPRO	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LNGDP	.4454307	.2419186	1.84	0.066	-.028721	.9195824
LOER	-.2152539	.1706458	-1.26	0.207	-.5497135	.1192058
LFDI	-.3240853	.1662659	-1.95	0.051	-.6499604	.0017898
_cons	-2.698498	4.054628	-0.67	0.506	-10.64542	5.248428

Root Mean Squared Error (sigma): 0.3960

. xtcd2 LPRO

Pesaran (2015) test for weak cross-sectional dependence

H0: errors are weakly cross-sectional dependent.

CD = 41.157

P-value = 0.000

. xtdcce2 LNGDP LOER LFDI LPRO, p (LOER LFDI LPRO) cr (LNGDP LOER LFDI LPRO) cr_lags(3) pooledc

(Dynamic) Common Correlated Effects Estimator - Pooled

Panel Variable (i): id	***Number of obs = 363***
Time Variable (t): year	***Number of groups = 11***
	Obs per group (T) = 33
Degrees of freedom per country:	
Without cross-sectional averages = 30	***F (179, 184) = 1.46***
With cross-sectional averages = 14	***Prob > F = 0.01***
Number of	***R-squared = 0.59***
Cross sectional lags = 3	***Adj. R-squared = 0.18***
Variables in mean group regression = 3	***Root MSE = 0.12***
Variables partialled out = 176	
	CD Statistic = -3.18
	P-value = 0.0015

LNGDP	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Pooled Variables:						
LOER	-.005937	.074723	-0.08	0.937	-.1523916	.1405184
LFDI	-.01412	.057197	-0.25	0.805	-.1262238	.0979839
LPRO	.593086	.120659	4.92	0.000	.3565977	.8295735

Pooled Variables: LOER LFDI LPRO

Cross Sectional Averaged Variables: LNGDP LOER LFDI LPRO

Homogenous constant removed from model.

. xtdcce2 LOER LNGDP LFDI LPRO, p (LNGDP LFDI LPRO) cr (LNGDP LOER LFDI LPRO) cr_lags (3) pooledc

(Dynamic) Common Correlated Effects Estimator - Pooled

```
Panel Variable (i): id                              Number of obs = 363
Time Variable (t): year                             Number of groups = 11
                                                   Obs per group (T) = 33
Degrees of freedom per country:
 without cross-sectional averages = 30              F (179, 184) = 0.15
 With cross-sectional averages = 14                 Prob > F = 1.00
Number of                                           R-squared = 0.13
 Cross sectional lags = 3                           Adj. R-squared = -0.72
 Variables in mean group regression = 3             Root MSE = 0.29
 Variables partialled out = 176
                                                    CD Statistic= -1.87
                                                    P-value =    0.0619
------------------------------------------------------------------------------------
              LOER|     Coef.   Std. Err.     z    P>|z|    [95% Conf. Interval]
-----------------------+------------------------------------------------------------
Pooled Variables:      |
             LNGDP| -.034403    .310321    -0.11   0.912    -.6426213    .573816
              LFDI| -.045985    .089942    -0.51   0.609     -.222269   .1302982
              LPRO|  .486149     .41412     1.17   0.240    -.3255104   1.297808
------------------------------------------------------------------------------------
Pooled Variables:  LNGDP LFDI LPRO
Cross Sectional Averaged Variables: LNGDP LOER LFDI LPRO
Homogenous constant removed from model.
```

. xtdcce2 LFDI LNGDP LOER LPRO, p (LNGDP LOER LPRO) cr (LNGDP LOER LFDI LPRO) cr_lags (3) pooledc

(Dynamic) Common Correlated Effects Estimator - Pooled

Panel Variable (i): id *Number of obs = 363*

Time Variable (t): year *Number of groups = 11*

Obs per group (T) = 33

Degrees of freedom per country:

Without cross-sectional averages = 30 *F (179, 184) = 0.03*

With cross-sectional averages = 14 *Prob > F = 1.00*

Number of *R-squared = 0.03*

Cross sectional lags = 3 *Adj. R-squared = -0.92*

Variables in mean group regression = 3 *Root MSE = 0.28*

Variables partialled out= 176

CD Statistic = -3.06

P-value = 0.0022

LFDI	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Pooled Variables:						
LNGDP	-.075871	.236337	-0.32	0.748	-.5390832	.3873416
LOER	-.042639	.122406	-0.35	0.728	-.2825512	.1972726
LPRO	.260339	.192603	1.35	0.176	-.1171547	.6378336

Pooled Variables: LNGDP LOER LPRO

Cross Sectional Averaged Variables: LNGDP LOER LFDI LPRO

Homogenous constant removed from model.

. xtdcce2 LPRO LNGDP LOER LFDI, p (LNGDP LOER LFDI) cr (LNGDP LOER LFDI LPRO) cr_lags (3) pooledc

(Dynamic) Common Correlated Effects Estimator - Pooled

Panel Variable (i): id *Number of obs = 363*

Time Variable (t): year *Number of groups = 11*

Obs per group (T) = 33

Degrees of freedom per country:

Without cross-sectional averages= 30 *F (179, 184) = 1.67*

With cross-sectional averages = 14 *Prob > F = 0.00*

Number of *R-squared =0.62*

Cross sectional lags= 3 *Adj. R-squared = 0.25*

Variables in mean group regression = 3 *Root MSE = 0.15*

Variables partialled out= 176

CD Statistic= -3.81

P-value = 0.0001

LPRO	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Pooled Variables:						
LNGDP	.926553	.183087	5.06	0.000	.5677094	1.285397
LOER	.13106	.118267	1.11	0.268	-.1007387	.3628592
LFDI	.075692	.042182	1.79	0.073	-.0069827	.1583672

Pooled Variables: LNGDP LOER LFDI

Cross Sectional Averaged Variables: LNGDP LOER LFDI LPRO

Homogenous constant removed from model.

. xtdcce2 LNGDP LOER LFDI LPRO, cr (LNGDP LOER LFDI LPRO) cr_lags (3)

(Dynamic) Common Correlated Effects Estimator - Mean Group

Panel Variable (i): id *Number of obs = 363*

Time Variable (t): year *Number of groups = 11*

Obs per group (T) = 33

Degrees of freedom per country:

Without cross-sectional averages = 30 ***F (210, 153) = 3.39***

With cross-sectional averages = 13 ***Prob > F = 0.00***

Number of ***R-squared = 0.82***

Cross sectional lags = 3 ***Adj. R-squared=0.58***

Variables in mean group regression = 33 ***Root MSE =0.09***

Variables partialled out = 177

CD Statistic= 3.25

P-value= 0.0011

LNGDP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Mean Group Estimates:						
LOER	.052178	.037258	1.40	0.161	-.0208455	.1252016
LFDI	.035963	.038829	0.93	0.354	-.0401395	.1120664
LPRO	.642677	.090698	7.09	0.000	.4649123	.8204423

Mean Group Variables: LOER LFDI LPRO

Cross Sectional Averaged Variables: LNGDP LOER LFDI LPRO

Heterogenous constant partialled out.

. xtdcce2 LOER LNGDP LFDI LPRO, cr (LOER LNGDP LFDI LPRO) cr_lags (3)

(Dynamic) Common Correlated Effects Estimator - Mean Group

Panel Variable (i): id ***Number of obs = 363***

Time Variable (t): year ***Number of groups = 11***

Obs per group (T) = 33

Degrees of freedom per country:

Without cross-sectional averages = 30 ***F (210, 153) = 0.40***

With cross-sectional averages= 13 ***Prob > F = 1.00***

Number of ***R-squared = 0.35***

Cross sectional lags = 3 ***Adj. R-squared = -0.54***

Variables in mean group regression= 33 ***Root MSE = 0.24***

Variables partialled out= 177

CD Statistic = 0.15

P-value = 0.8812

LOER	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Mean Group Estimates:						
LNGDP	.016354	.450384	0.04	0.971	-.8663831	.8990905
LFDI	.012263	.086047	0.14	0.887	-.1563857	.1809115
LPRO	.234294	.312065	0.75	0.453	-.3773421	.845931

Mean Group Variables: LNGDP LFDI LPRO

Cross Sectional Averaged Variables: LOER LNGDP LFDI LPRO

Heterogenous constant partialled out.

. xtdcce2 LFDI LNGDP LOER LPRO, cr (LFDI LNGDP LOER LPRO) cr_lags (3)

(Dynamic) Common Correlated Effects Estimator - Mean Group

Panel Variable (i): id ***Number of obs = 363***

Time Variable (t): year ***Number of groups = 11***

Obs per group (T) = 33

Degrees of freedom per country:

Without cross-sectional averages = 30 *F (210, 153) =0.19*

With cross-sectional averages= 13 *Prob > F =1.00*

Number of *R-squared=0.21*

Cross sectional lags= 3 *Adj. R-squared= -0.89*

Variables in mean group regression = 33 *Root MSE= 0.27*

Variables partialled out= 177

CD Statistic = -2.62

P-value = 0.0088

LFDI	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Mean Group Estimates:						
LNGDP	-.345893	.599244	-0.58	0.564	-1.520389	.8286025
LOER	.079882	.127283	0.63	0.530	-.1695883	.3293533
LPRO	.67661	.646585	1.05	0.295	-.5906722	1.943893

Mean Group Variables: LNGDP LOER LPRO

Cross Sectional Averaged Variables: LFDI LNGDP LOER LPRO

Heterogenous constant partialled out.

. xtdcce2 LPRO LNGDP LOER LFDI, cr (LPRO LNGDP LOER LFDI) cr_lags (3)

(Dynamic) Common Correlated Effects Estimator - Mean Group

Panel Variable (i): id *Number of obs = 363*

Time Variable (t): year *Number of groups = 11*

Obs per group (T) = 33

Degrees of freedom per country:

Without cross-sectional averages= 30 *F (210, 153) = 2.67*

With cross-sectional averages= 13 *Prob > F = 0.00*
Number of *R-squared = 0.79*
Cross sectional lags = 3 *Adj. R-squared = 0.49*
Variables in mean group regression = 33 *Root MSE = 0.11*
Variables partialled out = 177

CD Statistic = -1.25
P-value = 0.2097

```
------------------------------------------------------------------------------------
        LPRO|      Coef.   Std. Err.      z    P>|z|       [95% Conf. Interval]
-----------------------+------------------------------------------------------------
Mean Group Estimates:  |
       LNGDP|  1.27707    .250629     5.10   0.000      .7858459   1.768295
        LOER| -.061822      .0789    -0.78   0.433      -.216462   .0928184
        LFDI|  .068941     .08078     0.85   0.393     -.0893858   .2272676
------------------------------------------------------------------------------------
```

Mean Group Variables: LNGDP LOER LFDI
Cross Sectional Averaged Variables: LPRO LNGDP LOER LFDI
Heterogenous constant partialled out.

Result of Dynamic panel causality:

```
. tsset id year
       panel variable:  id (strongly balanced)
        time variable:  year, 1980 to 2015
```

delta: 1 unit

. xtpmg d.LNGDP d.LOER d.LFDI d.LPRO, lr(l.LNGDP LOER LFDI LPRO) ec(ECT)

Iteration 0: log likelihood = 510.28265 (not concave)

Iteration 1: log likelihood = 518.42939

Iteration 2: log likelihood = 519.30472

Iteration 3: log likelihood = 519.30706

Iteration 4: log likelihood = 519.30706

Pooled Mean Group Regression

(Estimate results saved as pmg)

Panel Variable (i): id *Number of obs = 385*

Time Variable (t): year *Number of groups = 11*

Obs per group: min = 35

avg = 35.0

max = 35

Log Likelihood = 519.3071

D.LNGDP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ECT						
LOER	.5034784	.112476	4.48	0.000	.2830294	.7239274
LFDI	.3967797	.1164312	3.41	0.001	.1685786	.6249807

```
        LPRO |    .203246   .0585922     3.47   0.001     .0884075    .3180846
-------------+----------------------------------------------------------------
SR           |
         ECT |  -.0672574   .0250553    -2.68   0.007    -.1163649   -.0181499
             |
        LOER |
         D1. |  -.0152687   .0405631    -0.38   0.707    -.0947708    .0642334
             |
        LFDI |
         D1. |   .0886561   .0642086     1.38   0.167    -.0371904    .2145027
             |
        LPRO |
         D1. |    .349869   .1085662     3.22   0.001     .1370831    .5626549
             |
       _cons |   .2102944   .0770235     2.73   0.006     .0593312    .3612576
------------------------------------------------------------------------------
```

. xtpmg d.LOER d.LNGDP d.LFDI d.LPRO, lr(l.LOER LNGDP LFDI LPRO) ec(ect)

```
Iteration 0:   log likelihood = -82.052637
Iteration 1:   log likelihood = -81.822937  (not concave)
Iteration 2:   log likelihood = -75.653561
```

Iteration 3:   log likelihood = -75.331459

Iteration 4:   log likelihood = -75.157854

Iteration 5:   log likelihood = -75.151457

Iteration 6:   log likelihood = -75.151428

Iteration 7:   log likelihood = -75.151428

Pooled Mean Group Regression

(Estimate results saved as pmg)

Panel Variable (i): id   *Number of obs   =   385*

Time Variable (t): year   *Number of groups   =   11*

Obs per group: min =   35

avg =   35.0

max =   35

Log Likelihood   = -75.15143

D.LOER | Coef.   Std. Err.   z   P>|z| [95% Conf. Interval]

-------------+--

ect |

LNGDP | 1.120641   .2568659   4.36   0.000   .6171933   1.624089

```
       LFDI |   .4676178    .138893     3.37   0.001     .1953926     .739843
       LPRO |  -.1402186   .0608036    -2.31   0.021    -.2593915   -.0210458
-------------+----------------------------------------------------------------
SR           |
        ect |  -.1936479   .0526544    -3.68   0.000    -.2968486   -.0904472
             |
      LNGDP |
        D1. |   .7596821   2.287626     0.33   0.740    -3.723983    5.243347
             |
       LFDI |
        D1. |   .1111584    .147301     0.75   0.450    -.1775463    .3998631
             |
       LPRO |
        D1. |  -2.186448   2.225095    -0.98   0.326    -6.547554    2.174658
             |
      _cons |  -1.642851   .5236263    -3.14   0.002     -2.66914   -.6165621
------------------------------------------------------------------------------
```

```
. xtpmg d.LFDI d.LNGDP d.LOER d.LPRO, lr(l.LFDI LNGDP
LOER LPRO ) ec(Ect)
```

```
Iteration 0:   log likelihood =  118.91848  (not concave)
Iteration 1:   log likelihood =  121.29858  (not concave)
Iteration 2:   log likelihood =  122.32912  (not concave)
```

Iteration 3:   log likelihood = 123.30024

Iteration 4:   log likelihood = 124.28972

Iteration 5:   log likelihood = 125.20048

Iteration 6:   log likelihood = 125.20338

Iteration 7:   log likelihood = 125.20338

Pooled Mean Group Regression

(Estimate results saved as pmg)

Panel Variable (i): id   *Number of obs = 385*

Time Variable (t): year   *Number of groups = 11*

Obs per group: min = 35

avg = 35.0

max = 35

Log Likelihood = 125.2034

D.LFDI	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Ect						
LNGDP	.1583413	.1426634	1.11	0.267	-.1212737	.4379564
LOER	.3828115	.0618652	6.19	0.000	.261558	.504065
LPRO	-.0113858	.0413792	-0.28	0.783	-.0924875	.069716

```
-------------+----------------------------------------------------------------
SR           |
         Ect |  -.1411643   .0511749    -2.76   0.006    -.2414653   -.0408633
             |
       LNGDP |
         D1. |  -3.055405     3.4378    -0.89   0.374     -9.79337     3.68256
             |
        LOER |
         D1. |   .0650183   .0676821     0.96   0.337    -.0676362    .1976728
             |
        LPRO |
         D1. |   3.772404   3.732052     1.01   0.312    -3.542284    11.08709
             |
       _cons |   .7858438   .2292433     3.43   0.001     .3365352    1.235152
------------------------------------------------------------------------------
```

```
. xtpmg d.LFDI d.LNGDP d.LOER d.LPRO, lr(l.LFDI LNGDP LOER LPRO ) ec(Ect)

Iteration 0:   log likelihood =  118.91848  (not concave)
Iteration 1:   log likelihood =  121.29858  (not concave)
Iteration 2:   log likelihood =  122.32912  (not concave)
Iteration 3:   log likelihood =  123.30024
Iteration 4:   log likelihood =  124.28972
```

Iteration 5:   log likelihood = 125.20048

Iteration 6:   log likelihood = 125.20338

Iteration 7:   log likelihood = 125.20338

Pooled Mean Group Regression

(Estimate results saved as pmg)

Panel Variable (i): id	*Number of obs = 385*
Time Variable (t): year	*Number of groups = 11*
	Obs per group: min = 35
	avg = 35.0
	max = 35
	Log Likelihood = 125.2034

D.LFDI	*Coef.*	*Std. Err.*	*z*	*P>|z|*	*[95% Conf. Interval]*	
Ect						
LNGDP	*.1583413*	*.1426634*	*1.11*	*0.267*	*-.1212737*	*.4379564*
LOER	*.3828115*	*.0618652*	*6.19*	*0.000*	*.261558*	*.504065*
LPRO	*-.0113858*	*.0413792*	*-0.28*	*0.783*	*-.0924875*	*.069716*

```
SR          |
       Ect |  -.1411643   .0511749    -2.76   0.006    -.2414653   -.0408633
           |
     LNGDP |
       D1. |  -3.055405     3.4378    -0.89   0.374    -9.79337     3.68256
           |
      LOER |
       D1. |   .0650183   .0676821     0.96   0.337    -.0676362    .1976728
           |
      LPRO |
       D1. |   3.772404   3.732052     1.01   0.312    -3.542284    11.08709
           |
     _cons |   .7858438   .2292433     3.43   0.001     .3365352    1.235152
------------------------------------------------------------------------------
```

```
. xtpmg d.LPRO d.LNGDP d.LOER d.LFDI , lr(l.LPRO LNGDP LOER
LFDI ) ec(ECt)

Iteration 0:   log likelihood =  160.69098  (not concave)
Iteration 1:   log likelihood =  180.48896  (not concave)
Iteration 2:   log likelihood =  186.18262
Iteration 3:   log likelihood =  191.05793
Iteration 4:   log likelihood =  191.28487
Iteration 5:   log likelihood =  191.28505
```

Iteration 6: log likelihood = 191.28505

Pooled Mean Group Regression

(Estimate results saved as pmg)

Panel Variable (i): id	*Number of obs = 385*
Time Variable (t): year	*Number of groups = 11*
	Obs per group: min = 35
	avg = 35.0
	max = 35
	Log Likelihood = 191.285

D.LPRO	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ECt						
LNGDP	.8121355	.0661199	12.28	0.000	.682543	.9417281
LOER	-.3067895	.0256178	-11.98	0.000	-.3569995	-.2565795
LFDI	.314307	.0633235	4.96	0.000	.1901952	.4384188
SR						

```
      ECt |  -.1333696   .0881481    -1.51   0.130    -.3061368    .0393975
          |
    LNGDP |
      D1. |   1.122832   .2149061     5.22   0.000     .7016241     1.54404
          |
     LOER |
      D1. |   -.106289   .0865933    -1.23   0.220    -.2760087    .0634307
          |
     LFDI |
      D1. |  -.0102658   .1352807    -0.08   0.940     -.275411    .2548794
          |
    _cons |  -1.887409   1.242311    -1.52   0.129    -4.322294    .5474761
------------------------------------------------------------------------------
```

Dumitrescu & Hurlin (2012) Granger non-causality test:

xtgcause LNGDP LFDI, l(bic)

```
Dumitrescu & Hurlin (2012) Granger non-causality test results:
--------------------------------------------------------------
Optimal number of lags (BIC): 1 (lags tested: 1 to 10).
W-bar =         2.6992
Z-bar =         3.9850   (p-value = 0.0001)
```

Z-bar tilde =   3.4112 (p-value = 0.0006)

--

H0: LFDI does not Granger-cause LNGDP.

H1: LFDI does Granger-cause LNGDP for at least one panelvar (id).

xtgcause LFDI LNGDP, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar =   2.6808

Z-bar =   3.9419 (p-value = 0.0001)

Z-bar tilde =   3.3729 (p-value = 0.0007)

--

H0: LNGDP does not Granger-cause LFDI.

H1: LNGDP does Granger-cause LFDI for at least one panelvar (id).

xtgcause LNGDP LOER, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar =   3.1856

Z-bar =   5.1257 (p-value = 0.0000)

Z-bar tilde =   4.4276 (p-value = 0.0000)

--

H0: LOER does not Granger-cause LNGDP.

H1: LOER does Granger-cause LNGDP for at least one panelvar (id).

xtgcause LOER LNGDP, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 5.2620

Z-bar = 9.9952 (p-value = 0.0000)

Z-bar tilde = 8.7662 (p-value = 0.0000)

--

H0: LNGDP does not Granger-cause LOER.

H1: LNGDP does Granger-cause LOER for at least one panelvar (id).

xtgcause LFDI LOER, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 5.9554

Z-bar = 11.6214 (p-value = 0.0000)

Z-bar tilde = 10.2152 (p-value = 0.0000)

--

H0: LOER does not Granger-cause LFDI.

H1: LOER does Granger-cause LFDI for at least one panelvar (id).

xtgcause LOER LFDI, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 3.5204

Z-bar = 5.9108 (p-value = 0.0000)

Z-bar tilde = 5.1271 (p-value = 0.0000)

--

H0: LFDI does not Granger-cause LOER.

H1: LFDI does Granger-cause LOER for at least one panelvar (id).

xtgcause LPRO LOER, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 6.4827

Z-bar = 12.8581 (p-value = 0.0000)

Z-bar tilde = 11.3170 (p-value = 0.0000)

--

H0: LOER does not Granger-cause LPRO.

H1: LOER does Granger-cause LPRO for at least one panelvar (id).

xtgcause LOER LPRO, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 2.0337

Z-bar = 2.4242 (p-value = 0.0153)

Z-bar tilde = 2.0206 (p-value = 0.0433)

--

H0: LPRO does not Granger-cause LOER.

H1: LPRO does Granger-cause LOER for at least one panelvar (id).

.

xtgcause LPRO LFDI, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

--

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 3.4721

Z-bar = 5.7975 (p-value = 0.0000)

Z-bar tilde = 5.0262 (p-value = 0.0000)

--

H0: LFDI does not Granger-cause LPRO.

H1: LFDI does Granger-cause LPRO for at least one panelvar (id).

. xtgcause LFDI LPRO, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

Optimal number of lags (BIC): 1 (lags tested: 1 to 10).

W-bar = 1.7269

Z-bar = 1.7047 (p-value = 0.0882)

Z-bar tilde = 1.3796 (p-value = 0.1677)

H0: LPRO does not Granger-cause LFDI

چکیده

هدف اصلی از ارائه این پایان نامه، بررسی روابط کوتاه مدت و بلند مدت بین متغیرهای کلان شامل صادرات نفت(***Oil Export***)، سرمایه‌گذاری مستقیم خارجی(***Foreign Direct Investment***)، تولید ناخالص داخلی غیر نفتی(***Non-Oil GDP***) و بهره وری (***Productivity***)در کشورهای عضو اوپک با تاکید بر حضور شکست ساختاری و وابستگی مقطعی است. همچنین، از جمله اهداف فرعی این تحقیق نیز بررسی روابط کوتاه مدت و بلند مدت میان دوبه دو این متغیرها برای کشورهای عضو اوپک طی دوره ۲۰۱۵ -۱۹۸۰ با ا ستفاده از رویکرد داده های تلفیقی باتاکید بر حضور شکست ساختاری و وابستگی مقطعی می باشد. سپس، از برآوردگرهای بلندمدت : اثرات ثابت(***Fixed Effects***)، میانگین گروهی(***Mean Group***)، اثرات مشترک به هم وابسته ترکیبی(***Common Correlated Effects Pooled***) و میانگین گروهی از اثرات مشترک به هم وابسته ترکیبی(***Common Correlated Effects Mean Group***) برای برآورد روابط بلند مدت و از مدل تصحیح خطای برداری (***VECM***) به منظور برآورد رابطه پویای کوتاه مدت بین متغیرهای تحقیق استفاده می کند. به منظور یافتن رابطه علیت بین هر چهار متغیر وهر دو متغیر از متغیرهای تحقیق از آزمون علیت پنل پویا استفاده می شود. نتایج تحقیق نشان می‌دهد که متغیرهای تحقیق در سطح نامانا هستند و با یک بار تفاضل گیری مانا می‌شوند. نتایج حاصل از برآورد گرهای بلندمدت نشان میدهد که یک رابطه تعادلی بلندمدت بین متغیرهای تحقیق وجود دارد همچنین برای هر چهار تخمین زننده تاثیر تولید ناخالص داخلی در بخش غیر نفتی بر روی متغیرهای وابسته بزرگتر است نسبت به سایر متغیرهای مستقل . نتایج آزمون پنلی علیت گرنجری برای متغیرهای تحقیق در کوتاه مدت نشان می دهد که رابطه علیت یک طرفه از تولید ناخالص داخلی، صادرات نفت و بهره وری به سرمایه گذاری مستقیم خارجی وجود دارد همچنین یه رابطه علیت دوطرفه بین تولید ناخالص داخلی (بخش غیرنفتی) و بهره وری وجود دارد. برای علیت بلند مدت و کوتاه مدت معناداری ظرایب تصحیح خطا نشان می دهد که، تمام چهار متغیر به نسبت یک رابطه تعادلی در بلندمدت (به جز بهره وری به عنوان یک متغیر وابسته در کوتاه مدت) تعدیل شده است، بنابراین روابط علیت دوطرفه بین چهار متغییر در بلندمدت وجود دارد. همچنین، نتایج حاصل از آزمون پنلی علیت گرنجری برای دو به دومتغیرها در بلند مدت نشان میدهد که رابطه علیت دوطرفه بین دو به دو متغیرها برای کشورهای عضو اوپک وجود دارد. با توجه به وجود یک رابطه بلندمدت بین صادرات نفت و بخش تولید ناخالص داخلی غیر نفتی، ما می توانیم بگوییم که کشورهای عضو اوپک همچنان نیاز به پیگیری سیاست های مناسب اقتصادی برای استفاده از درآمد صادرات نفت خام دارند. این سیاست باید در مسیر هدایت درآمدهای مازاد برای سرمایه گذاری در بخش های غیر نفتی جهت کاهش شوک های منفی در بخش های نفت و قیمت های صادراتی اتخاذ گردد.

کلیدواژگان:تولید ناخالص داخلی بخش غیر نفتی، صادرات نفت، سرمایه گذاری مستقیم خارجی، بهره وری، آزمون ریشه واحد و آزمون هم انباشتگی ، شکست ساختاری، وابستگی مقطعی، مدل تصحیح خطا، علیت گرنجری

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