The International Linkages of Nigeria as an Oil-Dependent Economy: A Macroeconometric Analysis

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Abstract

Nigeria is an oil-driven economy with a high level of global integration. This thesis considers how oil- related fluctuations impact the economy by exploring three important aspects of the nexus between oil dependency and global integration.

First, by modelling global integration through cross-country trade linkages, the thesis examines the impact of external (oil-related) shocks on Nigeria, and compares this with the impact of domestically generated shocks. The findings show that although oil price shocks cause real exchange rate appreciation and a consequent reduction of real GDP, these effects are not statistically significant. This implies that Dutch disease, particularly the spending effect of the disease, is not statistically significant in Nigeria. This is reasonable, as the country adopts the flexible exchange rate policy, which absorbs shocks and prevents "false" appreciation of real exchange rate. However, domestic shocks, specifically shocks to real GDP and inflation, have statistically significant impact in the country.

Second, the international linkages between Nigeria and its main trade partners (i.e. US and Euro Area) are examined in terms of oil-related growth comovements, in order to test the decoupling hypothesis. This involves investigating whether or not the business cycles of the emerging and developing economy (Nigeria) has decoupled from those of the advanced economies (ADs). The rationale underlying the focus on oil-related comovements is that Nigeria is a major oil exporter and therefore oil price is likely to have a strong role to play in the transmission of international business cycles onto the country. The results show a statistically significant degree of growth comovements between the three economies under consideration, indicating that the decoupling hypothesis does not hold for Nigeria.

Finally, the international linkages between Nigeria and the global economy are examined with respect to the effectiveness of Nigeria's stabilization fund and oil-price-based fiscal rule. The results show that the two fiscal instruments are effective at cushioning the impact of oil shocks on the economy, in terms of both fiscal and broader macroeconomic effects. These findings suggest the increased resilience of Nigeria to global shocks originating from the ADs (as dominant importers of Nigeria's exports). Complementing the findings with those on the decoupling hypothesis indicates that resilience does not require decoupling for Nigeria, which

is consistent with the broad literature on the decoupling of the emerging market and developing economies (EMDEs) from the ADs.

These results have policy implications for Nigeria. First, the country should maintain the adoption of the flexible exchange rate policy, because it has been effective as a shock absorber against Dutch disease. Second, broader macroeconomic policies are required to limit the adverse effects of internal shocks. Third, resilience does not appear to require decoupling for Nigeria, so long as effective arrangements are made to limit the effects of the shocks originating from the ADs. Fourth, Nigeria should maintain its stabilization fund and oil-price-based fiscal rule, possibly complementing them with more countercyclical policies, in order to build stronger resilience to external shocks.

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Chapter 1: General Introduction

1.1. Motivation for the Study

Nigeria is an emerging market and developing economy (EMDE) with a high degree of global integration. Several factors have contributed to the high global integration of the country since its independence in 1960.

Firstly, Nigeria's increased exports of oil since the oil boom of the early 1970s has increased the country's interactions with other oil exporters and with oil importers, particularly with developed countries (Odularu, 2008; Akinlo, 2012). The second contributing factor is trade liberalization policy as part of the Structural Adjustment Programme (SAP) of 1986 (NCEMA, 2004; Anyanwu, 1992).

Thirdly, the Nigerian Investment Promotion Commission (NIPC) Act of 1995 was followed by increased Foreign Direct Investment (FDI) (Zakari et al., 2012; Nigerian Investment Promotion Commission, 2015). Fourthly, the Bank re-capitalization policy introduced in 2004 strengthened the financial sector, leading to increased international confidence and international financial transactions (Bello, 2005; James and Pat, 2011; Bakare, 2011).

Finally, the return of the country from political instability to democratic governance in 1999 increased the confidence of the international community in the nation and led to a rise in the country's political and social integration into the world economy.

Furthermore, the oil boom of the 1970s made the country to become an oil-dependent economy, as the oil windfalls led to the neglect of the non-oil sector. Based on the relatively high global integration and the oil-dependent nature of the country, the question arises: *what are the transmission mechanisms of the oil shocks experienced by the nation and what can be done to limit the effects of the shocks?* The motivation for this thesis is to answer this question, examining both the observed and unobserved transmission channels of the shocks, together with the policy instruments to buffer their negative effects.

1.2. Objectives and Contributions of the Study

The specific objectives of this thesis are to:

(i) Compare the effects of externally generated (i.e. oil-related) shocks with domestically generated shocks on Nigeria. To the best of our knowledge, studies on external shocks focusing on Nigeria do not capture internal shocks from a global perspective. Generally, the literature on the EMDEs seems to focus more on external shocks, leading to a research gap. The main contribution of the thesis in this context is the evidence that the spending effect of Dutch disease is not statistically significant in Nigeria.

(ii) Investigate whether or not Nigeria has decoupled from its industrialised trade partners by examining the business-cycle comovements between Nigeria and its main industrialized trade partners based on an oil-related unobserved factor. This involves testing the decoupling hypothesis for Nigeria. Based on the significant role of oil, the oil channel is a key channel through which international business cycles are transmitted, especially into the economy of a major oil exporter. Regarding this objective, the thesis contributes to the literature on the decoupling hypothesis which has little Nigeria-specific studies.

(iii) Investigate the effectiveness of Nigeria's stabilization fund and oil-price-based fiscal rule, which are major fiscal policy instruments designed to buffer against the negative impact of oil shocks. There are many empirical studies that have examined the effectiveness of stabilization funds and fiscal rules in resource-rich countries as a group, including Nigeria. But the Nigeria-specific studies in this line of study are done from a qualitative standpoint, where no econometric techniques are employed (e.g. Okonjo-Iweala and Osafo-Kwaako, 2007; Okonjo-Iweala, 2008). Therefore, in this thesis we use econometric techniques to analyse the effectiveness of the two fiscal instruments in the country, contributing to filling the gap created by the little empirical work.

1.3. Organization of the Thesis

To achieve the above objectives the thesis is divided into six other chapters in addition to this general introductory chapter as discussed below.

Chapter 2: The Nigerian Economy

This chapter gives a general overview of the Nigerian economy. The purpose of the chapter is to give the reader broad background knowledge of the country. The chapter shows that the country is a small and highly open economy that is well integrated economically, politically and socially with the rest of the world. The government operates a mix of discretionary and rule-based macroeconomic policies with oil playing a strategic role in economic performance.

Chapter 3: Literature Review

International transmission of shocks occupies a central place in the empirical chapters of the thesis. Therefore, chapter 3 reviews theories on international shocks. The theories are classified mainly into crisis and non-crisis models, with trade and financial linkages playing a central role in the latter class. This thesis primarily deals with the latter group of models, with oil-related models such as Dutch Disease models constituting a sub-division of the group. The theories are further classified into theories relating to fiscal and monetary shocks. This further classification is particularly relevant, in that it helps in relating the shocks analysed in the thesis to the mechanisms of cross-border spillovers.

Chapter 4: The Relative Effects of External and Domestic Shocks on the Nigerian Economy: Evidence from the GVAR Model

This chapter explores the relative impacts of external (oil-related) and domestic shocks within the framework of a global model that captures the high level of openness and the global integration of the Nigerian economy. The chapter focuses on oil-related issues, especially the Dutch disease channel of the resource curse. The GVAR model employed in the chapter consists of strategically selected countries of the world, with Nigeria added to the countries of the original model of Dees et al. (2007). The model used in the chapter aims to represent the global economy and its interlinkages, particularly with regard to trade.

Chapter 5: Growth Comovements between Nigeria and Its Industrialized Trade Partners: Does the Decoupling Hypothesis Hold for Nigeria?

This chapter builds on the results of chapter 4, by exploring further the business-cycle linkages between Nigeria and its two main (industrial) trade partners, namely the US and the Euro Area. Such linkages have been investigated with observed factors or variables in the preceding chapter. Therefore, we undertake further analysis of the linkages in this chapter using a model that is capable of revealing unobserved factor(s) that drive the real GDPs of the three economies, with a focus on the oil channel of international transmission of business cycles.

We focus on the oil channel of international transmission of business cycles for two primary reasons: (i) Nigeria is an oil-dependent country. (ii) Oil is a highly globalised product that has a major role in the international transmission of business cycles.

Chapter 6: How Effective are the Nigerian Stabilization Fund and Oil-Price-Based Fiscal Rule as Buffers of Global Oil-Price Volatility?

This chapter concludes the empirical analysis of the thesis by investigating the effectiveness of the stabilization fund, which is designed to work together with an oil-price-based fiscal rule to buffer the effect of the volatility of oil price on Nigeria.

We investigate the effectiveness of the fiscal policy instruments with respect to fiscal impact and the reduction of macroeconomic (i.e. growth) volatility in the country. In Nigeria the instruments are designed to buffer the volatility of the oil price by de-linking public expenditure from oil revenue. Therefore, the effectiveness of the instruments can be measured by investigating the extent to which they limit the volatility. Besides, the effectiveness of the instruments can also be measured in terms of the behaviours of broad macroeconomic variables such as real GDP growth, since the de-linking will affect such variables.

Chapter 7: Conclusion

The chapter summarizes the results of the empirical studies of chapters 4 to 6 and links the results with the findings of other studies. The chapter concludes that externally generated oil

price shocks do not lead to the resource curse in Nigeria through the Dutch disease channel. However, internally generated shocks to real GDP and inflation have statistically significant impacts in the economy. This suggests the following things: (i) Other causative factors of the resource curse, namely institutional weakness and resource price volatility, seem to be the main causes of Nigeria's resource curse. (ii) Domestic fluctuations may also have a role to play in Nigeria's resource curse.

We observe a statistically significant degree of growth comovements between Nigeria and its two main (industrial) trade partners caused by an oil-related unobserved factor. This shows that Nigeria has not decoupled from the trade partners as a consequence of the former's dependency on exporting oil. Furthermore, the study on the effectiveness of the fiscal instruments employed by Nigeria to buffer oil price volatility shows that the instruments have been successful.

The findings of the three empirical chapters of the thesis suggest that Nigeria should maintain the adoption of the flexible exchange rate policy which it began to adopt since 1986, because it is effective in protecting the economy against Dutch disease; limit domestic shocks; and maintain the present stabilization fund and oil-price-based fiscal rule, possibly complementing them with more countercyclical policies. The chapter also discusses the limitations of the thesis and gives recommendations and suggestions for further research.

Chapter 2: The Nigerian Economy

2.1. Introduction

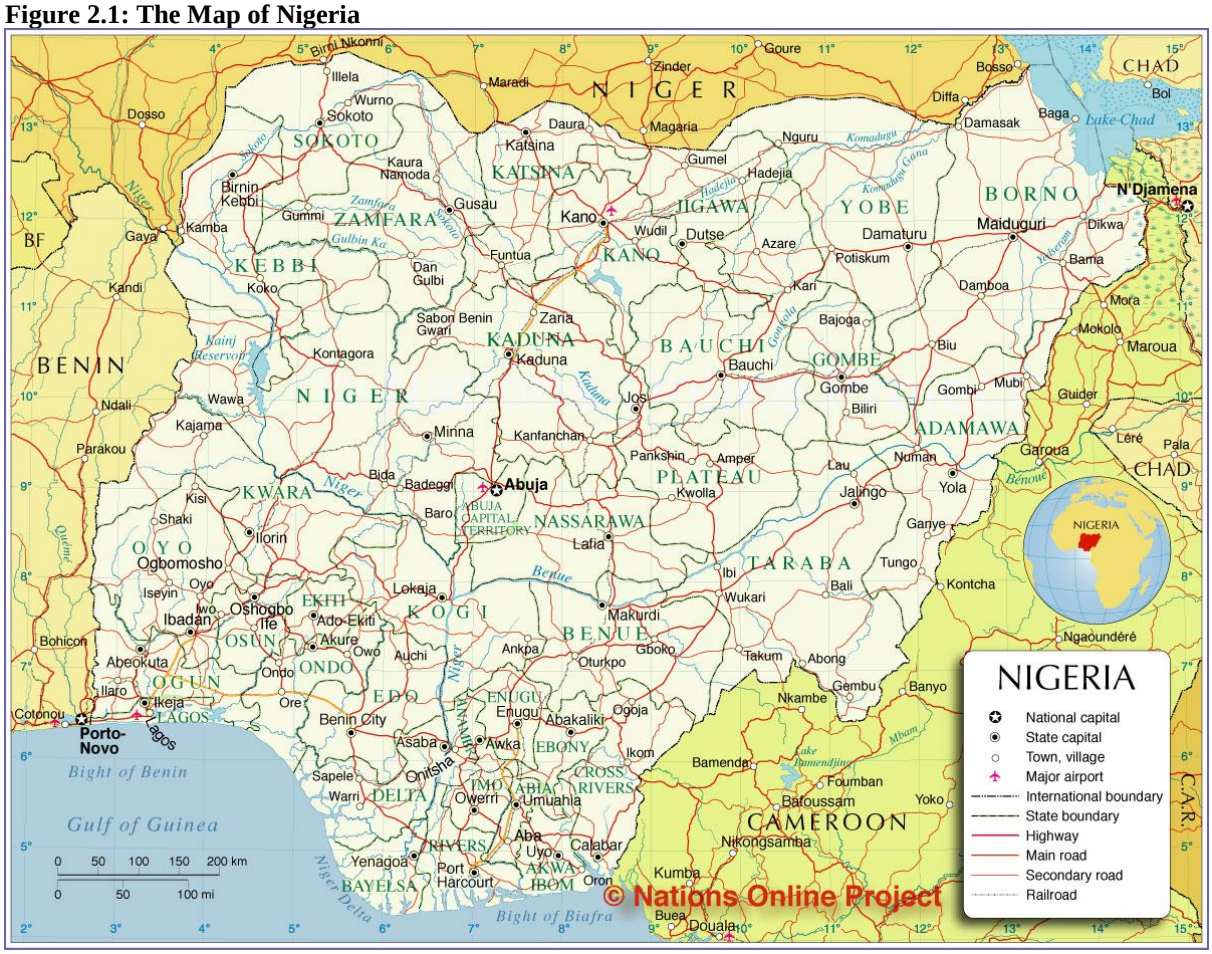
Nigeria has features distinguishing it from other countries. To this end, the objective of this chapter is to discuss the features of the economy. The chapter begins with an overview of the country's key geographical and political features. Thereafter, there is a detailed discussion of the country's economic features, before concluding remarks are made.

2.2. The Geographical and Political Features of the Economy

Nigeria is a West African country covering a total land area of around 356,667square miles (about 924, 000 square kilometres). It is the most populous country in Africa, with a population of about 173.6 million (2013 estimate). Nigeria's bordering countries are the Republic of Benin in the west; Cameroon and Chad in the east; and Niger in the north. Although English is its official language, many local languages like Hausa, Yoruba, Igbo, and Ijaw are spoken in Nigeria. The country adopts the federalist system of government, with a president, state governors, and local government chairmen. Presently it has 36 states, 774 local government areas, and a federal capital territory. For ease of resource sharing, the 36 states are divided into six geopolitical zones, namely North-West zone, North-East zone, North-Central (Middle Belt) zone, South-West zone, South- East zone, and South-South zone.

As a West African country, the nation is part of the area called Sub-Saharan Africa, which lies south of the Saharan Desert and excludes North Africa, which is classified as part of the Arab world. As shown in Figure 2.2 Sub-Saharan Africa consists of Central Africa, Southern Africa, East Africa, and West Africa. The location of Nigeria in West Africa means the country has a tropical climate, so that the temperature of the region is relatively constant with an annual mean value of at least 18^0C (64^0F). Nigeria became independent from British colonial rule in 1960 and has had a mixture of 8 military and 5 civilian national leaders between the time of its independence and 1999. Since 1999 it has consistently had democratically elected civilian national leaders. Figure 2.1 presents the map of the country showing its states, federal capital territory, and neighbouring countries.

Figure 2.1: The Map of Nigeria

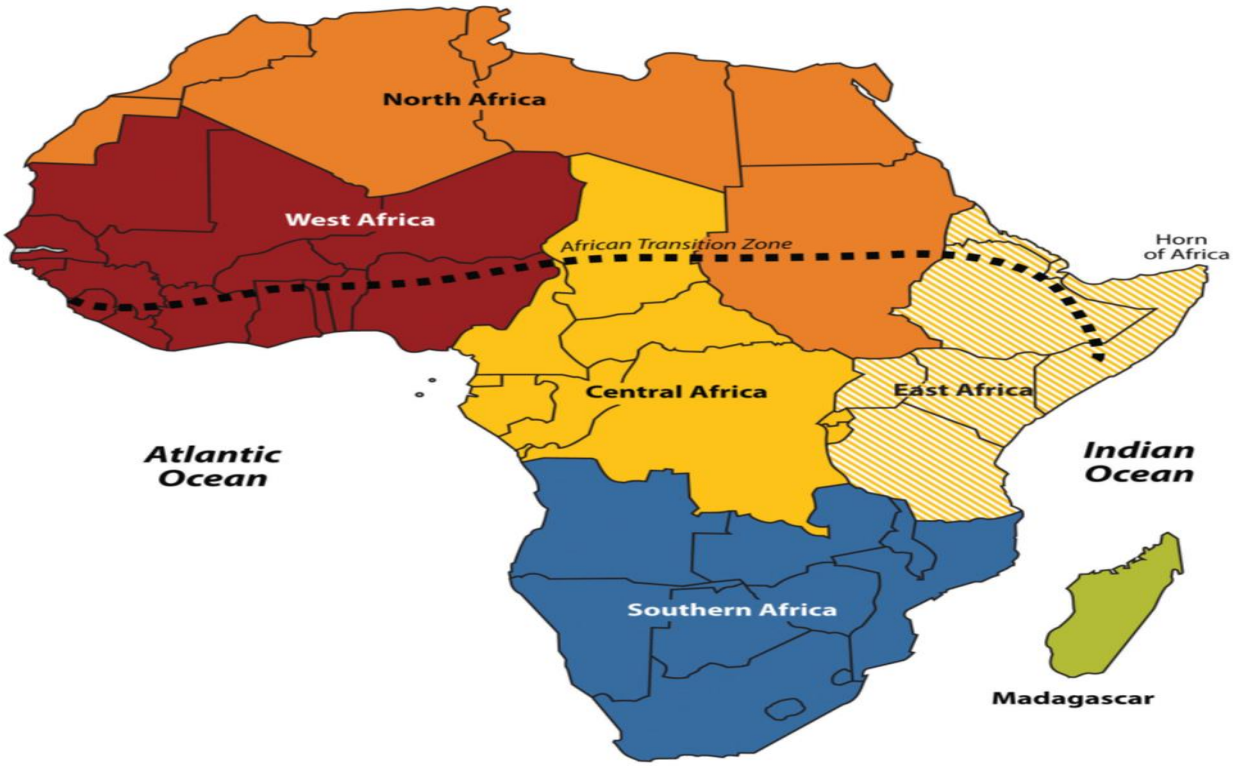


Source: Nations online (www.nationsonline.org).

2.3. Economic Development

Nigeria may be summarily described as an oil-driven emerging and developing economy. The World Bank classifies it as a lower middle income economy (World Bank, 2014). The IMF classifies it as an emerging and developing economy in the World Economic Outlook (WEO) reports (IMF World Economic Outlook, 2014). Furthermore, the economy is classed as a low human development economy based on the Human Development Index (HDI) and Inequality-Adjusted Human Development Index (IHDI) of the United Nations (United Nations Human Development Programme (UNDP), 2014).

Figure 2.2: The Regions of Africa



Source: Regional Geography of the World: Globalization, People, and Places (http://2012books.lardbucket.org/).

As explained by the United Nations, HDI is a composite index that measures human development with respect to the following three dimensions of development: long and healthy life, access to knowledge, and a decent standard of living. Computing the HDI requires building individual indices for the three dimensions of human development. On the other hand, the IHDI is computed by accounting for inequality in the population.

2.4. The Role of Oil in the Economy

Nigeria is abundantly endowed with oil. Consequently, it is one of the major net oil exporters of the world (see US Energy Information Administration, 2015; www.eia.gov). The nation started to produce oil in 1958, but only became heavily dependent on the resource as consequence of the oil boom of the 1970s. This starting point for the heavy oil dependence is observable in the contributions of the oil and the non-oil sectors to the total export and government expenditure in the economy, as shown in Figures 2.3 and 2.4. Commenting on the degree of Nigeria's dependence on oil, Mark Tomlinson, a former World Bank Country Director for the nation, described the country as "…the most dependent on oil of all countries in the world…" (OPEC Bulletin, 2002). He backed this assertion with the empirical evidence

of oil's contribution of about 96% of the country's total foreign exchange earnings. Ross (2003) also notes that oil has accounted for over 90% of the annual export income of the economy since the oil price shock of 1974. According to Ross, this trend made the country the most oil dependent economy in the world in 2000, with an oil export income of 99.6%, as shown in Table 2.1. The trend has not changed as shown in the works of Odularu (2008) and Akinlo (2012). As shown in Table 2.2, oil has dominant contributions to total revenues and exports in Nigeria between 1970 and 2009, particularly after the oil boom of the middle of 1970s.

The oil-dependent nature of the country led to the neglect and consequent weak development of the non-oil sector, particularly agriculture which had been central to the economy before the oil boom of the 1970s (Oyejide, 1986; Azih, 2008; Nigerian National Petroleum Corporation, 2014). This is why consistent growth of the non-oil sector has become essential for export diversification and the sustainability of the overall growth of the economy. Hesse (2008) observes that export diversification enhances the per capita growth of developing economies, in contrast to most developed economies that perform better with export specialization. For example, the findings of Sannassee et al. (2014) in their study of diversification in Mauritius show that export diversification has positive effects on both short-run and long-run growth, with a stronger impact in the long-run.

Oil dependence also enhances income inequality in Nigeria. This inequality is a major factor causing the low human development mentioned earlier. Bakare (2012) states that "there is a disturbing income inequality in Nigeria," based on the results of the author's analysis on the subject. The poorest who accounts for half of the population receives only 10% of the national income of the country, according to Adegoke (2013). Furthermore, Aigbokhan (2008) analyses the link between growth, inequality, and poverty in Nigeria and observes that when growth increases, inequality increases, but poverty decreases. This suggests that the growth pulls up the income of the poorest less quickly than the income of the richer rises.

Oil promotes inequality in the country mainly due to weak institution. For example, weak institution enhances the mismanagement of oil windfalls by the authorities. In a study of 17 oil exporters Hooshmand et al. (2012) observe that oil rents have a negative impact on financial development through the channel of weak institutions in some oil exporting countries.

Mallaye et al. (2015) in a study of 40 countries including Nigeria, show that corruption is a major channel through which oil rent promotes inequality. The authors report a positive relationship between oil rent and inequality, because corruption increases when oil revenues increase. This phenomenon, as the authors note, agrees with the resource curse theory relating to the countries in question.

The results of the oil-institution-inequality nexus are consistent with the findings of the Nigeria-specific studies on the subject (see Herbst and Olukoshi, 1994; Ndikumana and Boyce, 2012). Weak institutions have been strongly associated with the resource curse challenge facing the country (Sala-i-Martin Xavier and Subramanian Arvind, 2003). The manifestation of the curse is observable through the behaviour of variables like oil supply, oil revenue, the real exchange rate, the economic freedom index, oil-related violence, and the growth of the economy (see Wit Martin and Crookes Doug, 2013; Ologunla et al., 2014; Opeyemi, 2012; Mähler, 2010). For example, Ologunla et al. (2014) show that the economic freedom index, which indicates strong institutions, is negatively related to resource dependency of a country. In this study the economic freedom index varies between 0 and 10, with a higher value indicating higher economic freedom; while oil export is the proxy for resource dependence. Mahler (2010) notes the contribution of oil-related violence to resource curse in the country, which is consistent with the findings of Rosser (2006).

Rosser (2006) notes that civil unrest is one of the ways through which the resource curse manifests in resource-rich economies. There are two key types of violence in Nigeria. Firstly, there are frequent protests in the Niger Delta where the oil resource is mainly located, as the local population are aggrieved by the low level of development despite the amount of oil extracted and also aggrieved by the environmental damage associated with extraction. The Niger Delta region includes the following littoral and oil-producing states in the south of the country: Akwa Ibom, Cross River, Edo, Rivers, Bayelsa, Delta, and Ondo. Secondly, there are many clashes between the ethnic groups within the oil producing region due to competition for oil wealth. There are over forty ethnic groups in the region.

Table 2.1: Twenty Most Oil Dependent Countries in 2000 (Fuel Exports as a Percentage of Total Exports)

1	Nigeria	99.6
2	Algeria	97.2
3	Saudi Arabia	92.1
4	Iran, Islamic Rep.	88.5
5	Venezuela, RB	86.1
6	Azerbaijan	85.1
7	Oman	82.5
8	Turkmenistan	81.0
9	Syrian Arab Republic	76.3
10	Bahrain	71.0
11	Trinidad and Tobago	65.3
12	Norway	63.9
13	Kazakhstan	53.9
14	Russian Federation	51.3
15	Ecuador	49.4
16	Colombia	41.4
17	Papua New Guinea	28.8
18	Indonesia	25.4
19	Australia	21.9
20	Lithuania	20.9

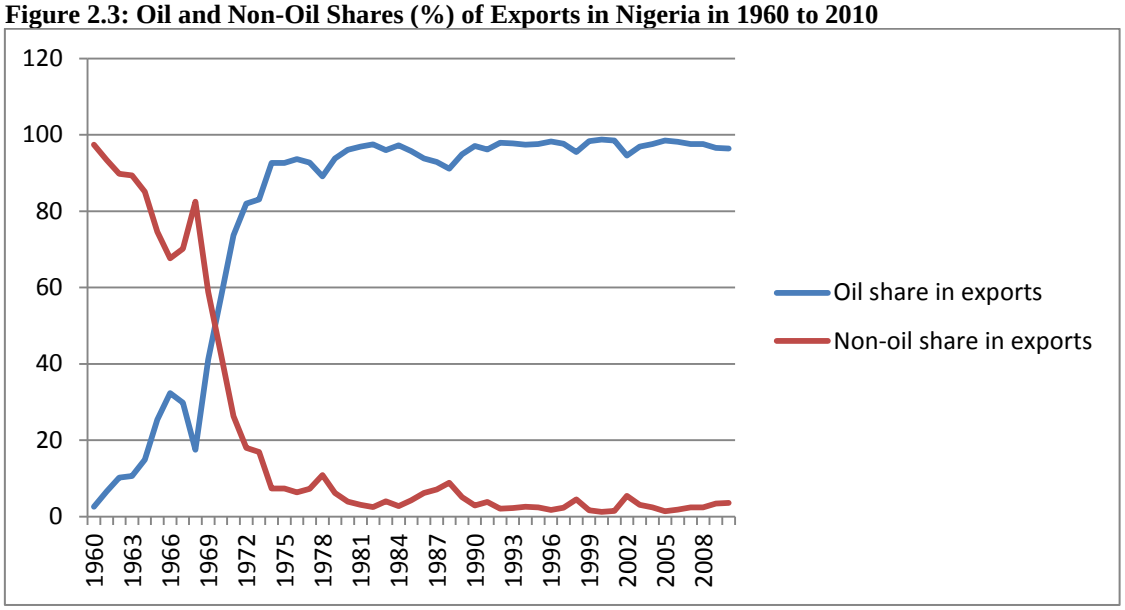
Source: Ross (2003)

Table 2.2: The Contributions of Oil to the Nigerian Economy (1970-2009)

Year	Oil Revenue/Total Revenue (%)	Oil/ GDP (%)	Oil Export/Total Export (%)
1970	26.3	9.27	57.54
1975	77.5	19.37	92.64
1980	81.1	28.48	96.09
1985	72.6	16.75	95.76
1990	73.3	37.46	97.03
1995	70.6	39.65	97.57
2000	83.5	47.72	98.72
2005	85.8	38.87	98.53
2009	78.7	37.44	96.73

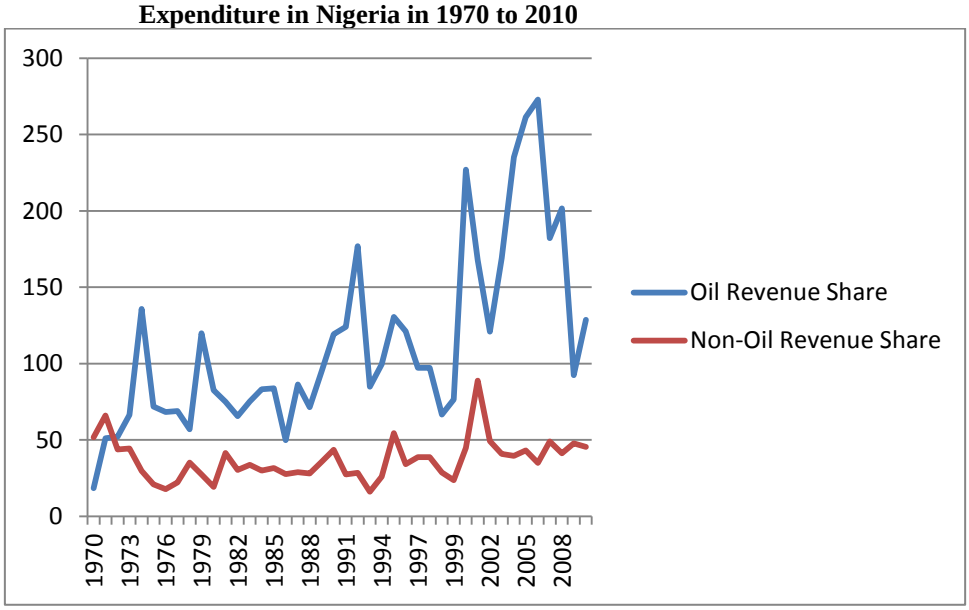
Source: Akinlo, 2012.

Figure 2.3: Oil and Non-Oil Shares (%) of Exports in Nigeria in 1960 to 2010



Data Source: Nigerian Central Bank Statistical Bulletin, 2010 Edition.

Figure 2.4: Oil Revenue and Non-Oil Revenue Shares (%) of Total Government Expenditure in Nigeria in 1970 to 2010



Data Source: Nigerian Central Bank Statistical Bulletin, 2010 Edition.

2.4.1. How Nigeria Operates in the Global Oil Market

Nigeria does not operate as an independent producer in the global oil market. It operates as a member of the Organization of the Petroleum Exporting Countries (OPEC).[1] The objective of

[1] OPEC is an international Organization created in 1960 by five founding members, namely Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela. Other countries joined the organization later: Qatar (1961), Indonesia (1962), Libya (1962), the United Arab Emirates (1967), Algeria (1969), Nigeria (1971), Ecuador (1973), Gabon (1975) and Angola (2007). Gabon terminated its membership in January 1995 and rejoined the Organization in

the organization is: "to co-ordinate and unify petroleum policies among Member Countries, in order to secure fair and stable prices for petroleum producers; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on capital to those investing in the industry" (OPEC website, 2015; www.opec.org). The objective shows that the organization has the aim of having a balanced role that captures the welfare of producers, consumers, and investors in the world oil market. Unlike the non-OPEC suppliers that supply based on individual and unconstrained decisions, the supply of OPEC suppliers in the oil market is regulated through the quota policy of the organization that was introduced in 1982, while the forces of demand and supply play a major role regarding the prices at which both categories of suppliers sell in the market.

Although the organization is classed as a cartel by many not all agree. Although the organization is largely influential in the oil market based on its relative oil reserves and costs of production as shown in Figures 2.5 and 2.6, it does not appear to have a predetermined motive to regulate supply and manipulate prices in order to maximize profit, as a classic cartel would . However, to oil importers and other exporters its responses to market conditions may make its operation look like that of a cartel. For examples, the studies of Rolf et al. (2014) and Griffin (1985) suggests that the organization operates like a cartel. But the work of Gurcan (1996) shows that the organization as a whole seems not to operate to regulate production in order to influence price, which is consistent with the finding of Dahl and Yucel (1991) regarding the non-cartel behaviour of the group of oil exporters.

Although OPEC is influential in the world oil market, it still has to compete in the market with Non-OPEC suppliers. Examples of Non-OPEC suppliers are Russia, Mexico, Norway, and Canada. However, unlike OPEC producers, the non-OPEC suppliers have higher levels of supply in the market on average and tend to operate more like price-takers responding to prices by producing close to full capacity (US Energy Information Administration, 2015; www.eia.gov). The non-OPEC behaviour regarding price may be one of the reasons OPEC is viewed by some as a price setter and a cartel.

July 2016; Ecuador suspended its membership from December 1992 to October 2007; while Indonesia suspended its membership from January 2009, reactivated membership in January 2016 and suspended membership again in November, 2016. Therefore, the organization presently has 13 members, including Nigeria.

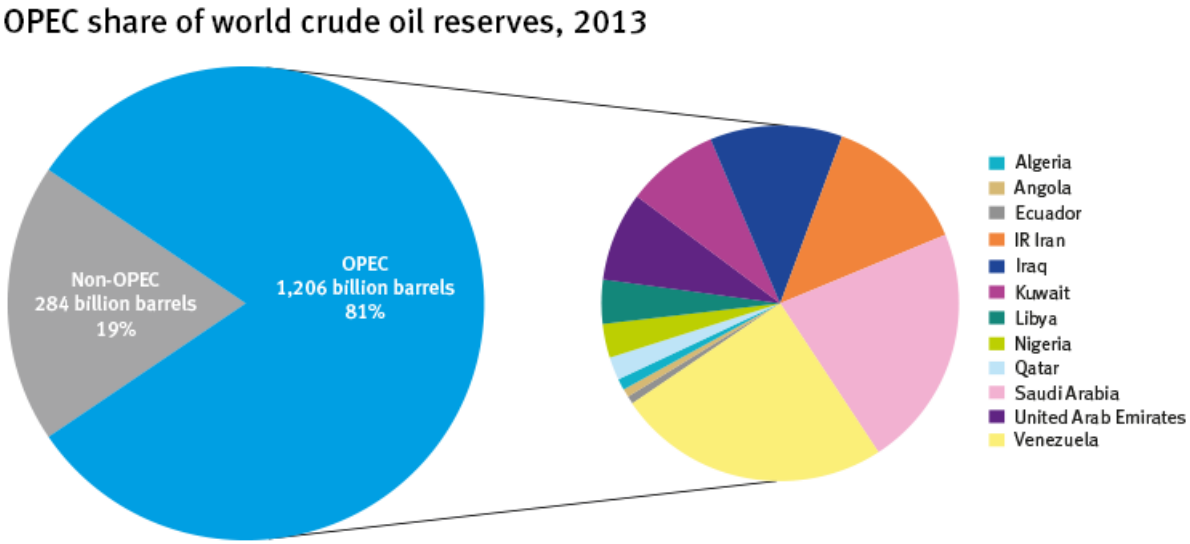
The non-OPEC behaviour regarding price may also be one of the factors responsible for their higher level of supply in the market (see Figure 2.7). As the US Energy Information Administration (2015) notes, the non-OPEC suppliers tend to produce when it is profitable to do so, because the production activities are mostly controlled by private international or investor-owned companies. In contrast, the OPEC supplies are mostly controlled by national oil companies (NOCs) that usually have other objectives such as employment creation and infrastructure development, in addition to the profitability goal. Some of the other factors that may be responsible for the higher level of non-OPEC supply are: (i) Higher prices during the oil crisis of the 1970s which encouraged new investment in non-OPEC production. (ii) Increasing demand for oil in the world which leads to rising non-OPEC supply which is usually profit-driven as indicated earlier. (iii) Technological advancement in the world leading to new oil exploration and production technologies in the non-OPEC countries. (iv) New discoveries of oil in non-OPEC countries.

The Nigerian National Petroleum Corporation (NNPC) is the government-owned oil corporation serving as the enterprise through which the government regulates and participates in the oil industry. The Corporation was established in 1977 as a merger of the Nigerian National Oil Corporation (NNOC) and the Ministry of Petroleum Resources (MPR), in order to strengthen the representation of the Nigerian government in the petroleum industry. The NNOC was earlier established in 1971 for the purpose of nationalizing the petroleum sector and gaining control over the industry from the international oil companies (IOC) that had been dominant due to technological and financial advantages. The goal of becoming an OPEC member also motivated nationalization as OPEC requires that the governments of its members have large participation in their oil sectors (Nwokeji, 2007). As the author shows, the MPR was on the other hand created in 1975 to strengthen the operation of NNOC, leading to the transfer of the NNOC into the MPR. However, the NNOC and MPR were merged in 1977 to form the NNPC, because it was believed that the merger would enhance the achievement of the nationalization objective of the oil sector (Nwokeji, 2007; Thurber et al., 2010; Madichie, 2012).

The NNPC has subsidiaries relating to the key aspects of oil industry activities such as exploration, production, refining, distribution, and investment. It is through one of its subsidiaries called National Petroleum Investment Management Services (NAPIMS) that the Corporation controls the operations of the IOCs through Joint Ventures (JVs) and Production

Share Contracts (PSCs) between it on behalf of the Federal Government and the IOCs. The mission of NAPIMS is: "to enhance the benefits accruing to the Federation from its investments in the upstream petroleum industry through effective cost control and supervision of JV and PSC operations, as well as opening up new frontiers " (NNPC Website, 2015, www.nnpcgroup.com).[2]

Figure 2.5: OPEC and Non-OPEC Oil Reserves



OPEC proven crude oil reserves, at end of 2013 ***(billion barrels, OPEC share)***

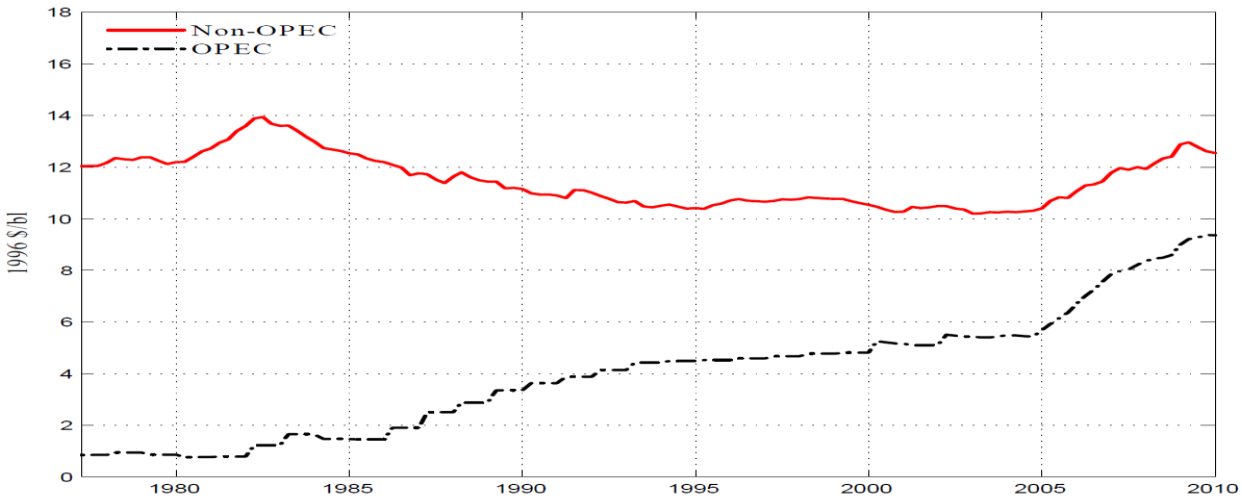
Venezuela	298.4	24.7%	Iraq	144.2	12.0%	Libya	48.4	4.0%	Algeria	12.2	1.0%
Saudi Arabia	265.8	22.0%	Kuwait	101.5	8.4%	Nigeria	37.1	3.1%	Angola	9.0	0.7%
IR Iran	157.8	13.1%	UAE	97.8	8.1%	Qatar	25.2	2.1%	Ecuador	8.8	0.7%

Source: OPEC Annual Statistical Bulletin 2014.

Source: OPEC Website, www.opec.org.

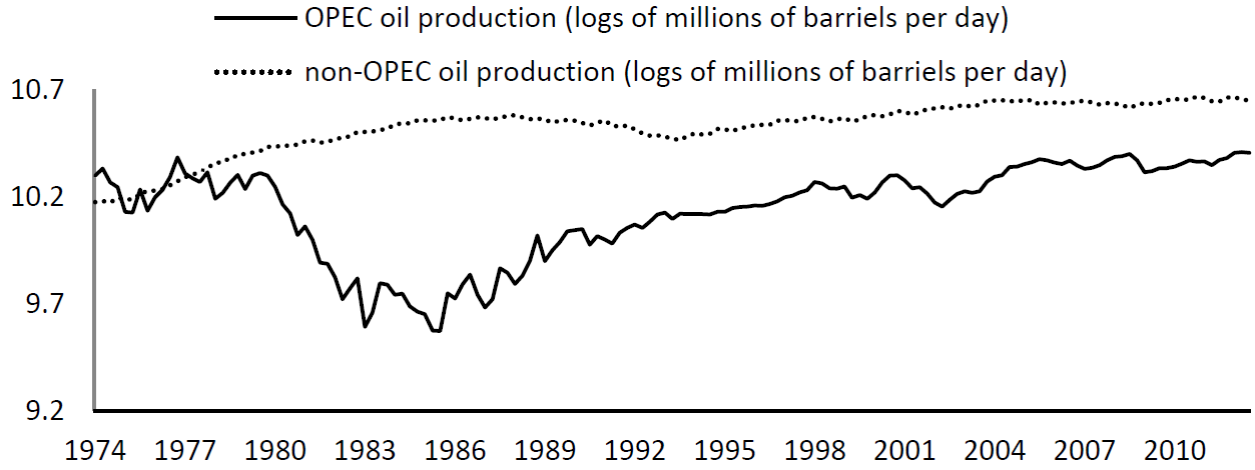
[2] The IOCs operating in the country are: Chevron, Exxon-Mobil, Royal Dutch Shell, Texaco, Agip, Elf, and Total. It is through the JVs and PSCs between NNPC and the IOCs that the crude oil exports of Nigeria is produced.

Figure 2.6: The Real Cost of Production in OPEC and non-OPEC Countries



Source: Rolf et al. (2014)

Figure 2.7: OPEC and Non-OPEC Oil Production Levels: 1974Q1-2012Q4



Source: Ratti, R.A. and Vespignani, J.L. (2014).

2.5. Key Macroeconomic Policies of Nigeria

The following sub-sections describe the key macroeconomic policies of Nigeria, namely fiscal and monetary polices.

2.5.1. Fiscal Policy in the Economy

The Nigeria Federal Ministry of Finance (FMF) is the main authority in charge of the fiscal policy. The Ministry is headed by the Minister of Finance who is also called the Coordinating Minister of the Economy. Deriving its power from the Finance Ordinance, the Ministry was

created in 1958 for the purpose of controlling and managing the public finance of the country (FMF, 2015). According to the author, some of the specific functions of the Ministry are:

(i) Preparation of annual budgetary estimates for revenue and expenditure of the national budget. The proposed budget presented by the Ministry must be approved by the legislative arm of the government, then signed into law by the President of the nation, before it can be implemented (Ekeocha, 2012).

(ii) Designing policies relating to fiscal and monetary issues. This function implies that although the Ministry is basically in charge of fiscal policies, its policies are coordinated with monetary policy.

(iii) Monitoring government revenue from oil and non-oil resources. The Ministry basically does this through its fiscal policies and budgetary functions. For example, the Ministry has adopted an oil-price-based fiscal rule, as indicated earlier in the General Introduction. This rule is employed by the Ministry in designing the annual budgets, as discussed in detail in chapter six.

(iv) Working alongside international organizations such as the World Bank and the International Monetary Fund (IMF) on behalf of the country. For example, the Minister of Finance of the country attends meetings organized by international organizations.

(v) Management of revenue allocations across the tiers of government. The Ministry oversees the allocations of revenue to the federal, state, and local governments of the country through the principles of fiscal federalism, which is discussed in detail in the following section.

2.5.1.1. Fiscal Federalism in the Economy

As indicated earlier, the system of government operating in Nigeria is federalism, which involves power sharing between the federal government, the 36 state governments, and the 774 local governments. Fiscal federalism is the method of intergovernmental fiscal relations within the country in which there is constitutional provision for the fiscal powers and responsibilities of each level of government in relation to expenditures and revenues.

Table 2.3 presents expenditure assignment for the three tiers of government of the country, while Table 2.4 presents tax jurisdiction and revenue for the three levels of government. As revealed in Table 2.3, the central government is in charge of nationally strategic functions like provision of defence, while the local governments are in charge of grass root or local functions such as the management of land use. The residual power of the state governments indicated in the table refers to functions that are not assigned to the federal government or the local governments. The exclusive power is for the central government to conduct nationally strategic functions, while the concurrent power is for the central and state governments to carry out their shared functions (Akindele et al., 2002).

Regarding revenue, as shown in Table 2.4, there are revenues that the tiers of government are empowered by the constitution to generate themselves through taxation and there are also taxation-based revenues distributed to them from a common purse. In the table, "law" points to the tier of government that is the source of the power backing the collection of tax, "collection" means the level of government that legally has the responsibility to collect tax, while retention/right to collect points to the tier of government or the account that has the legal right to be the owner or custodian of collected revenue.

The revenues disbursed across the different tiers of government are usually based on a revenue allocation formula (RAF), which consists of two sub-formulae through which funds are distributed from a national account called the Federation Account, namely the horizontal and vertical allocation formulae (Lukpata, 2013; Salami, 2011). The vertical allocation formula indicates the percentages of revenue allocated to the three tiers of government from the Federation Account, while the horizontal formula shows the percentages of revenue allocated to the states and local governments only, based on the initial allocation of the vertical allocation formula.

The RAF was initially based on the recommendations of ad hoc commissions/committees and the approval of the president of the country. Then in 1989 a permanent commission called the Revenue Mobilization, Allocation, and Fiscal Commission (RMAFC) was established to recommend the RAF and deal with other related fiscal matters.

Table 2.3: Assignment of Expenditure Responsibilities to the Tiers of Government in Nigeria

Federal Only
Defence
Foreign affairs
International trade including export marking
Currency, banking, borrowing, exchange control
Use of water resources
Shipping, federal trunk roads
Elections
Aviation, railways, postal service
Police and other security services
Regulation of labour, interstate commerce, telecommunications immigration
Mines and minerals, nuclear energy, citizenship and naturalization rights
Social Security, insurance, national statistical system (Census births, death, etc.)
Guidelines and basis for minimum education
Business registration
Price control
Federal-State Shared
Health, Social welfare
Education (post primary/technology)
Culture
Antiquities
Monuments, archives
Statistics, stamp duties
Commerce, industry
Electricity (generation, transmission, distribution)
Research surveys
States Only
Residual power, i.e. subject neither assigned to federal nor local government level
Local Governments Only
Economic planning and development
Health services
Land use
Control and regulation of advertisements, pets, small businesses
Markets, public conveniences
Social welfare, sewage and refuse disposal, registration of births, death, Marriages
Primary, adult and vocational education
Development of agriculture and natural resources

Source: Jimoh, 2003.

Table 2.4: Nigeria's Tax Jurisdiction and Right to Revenue

Tax	**Legal Jurisdiction**		**Retention/Right to Revenue**
	Law	**Collection**	
Import duties	Federal	Federal	Federation Account
Excise duties	Federal	Federal	Federation Account
Export duties	Federal	Federal	Federation Account
Mining rents and royalty	Federal	Federal	Federation Account
Petroleum profits tax	Federal	Federal	Federation Account
Capital gains tax	Federal	State	State
Personal income tax (apart from the ones listed below)	Federal	State	State
Personal income tax: armed and police forces, external affairs officers, residents of the Federal Capital Territory	Federal	Federal	Federal
Value added tax (sales tax before 1994)	Federal	Federal/State	Federal/State
Company tax	Federal	Federal	Federation Account
Stamp duties	Federal	State	State
Gift tax	Federal	State	State
Property tax and ratings	State	State/Local	State/Local
Licenses and fees	Local	Local	Local
Motor park dues	Local	Local	Local
Motor vehicle	State	Local	Local
Capital transfer tax	Federal	State	State
Pools betting and other betting taxes	State	State	State
Entertainment tax	State	State	State
Land registration and survey fees	State	State	State
Market and trading license and fees	State	Local	Local

Source: Salami, 2011; Jimoh, 2003.

In carrying out its functions, the RMAFC is empowered by law to function as an autonomous entity that is not subject to the authority of any other organization. However, it works with relevant government agencies including the FMF as the main authority in charge of fiscal policy in the country (RMAFC, 2015).

The Federation Account is kept by the Central Bank of the country and disbursement from the account to the three tiers of government is by a committee called the Federation Accounts Allocation Committee (FAAC). Key members of the committee include the Minister of States for Finance (chair), the Accountant General of the country, RMAFC, and the commissioners of finance of the 36 states of the nation (RMAFC, 2015; Lukpata, 2013; Salami, 2011).

2.5.1.2. Fiscal Deficit in the Economy

The behaviour of the fiscal deficit in Nigeria is largely influenced by oil and the developing nature of the economy,. The following three features are observable in Figure 2.8: (i) The relatively high budget-surplus to GDP ratio around the middle of the 1970s, which is associated with the oil boom of the time. (ii) The dominance of fiscal deficits over the 1970-2010 period. (iii) Fiscal deficit of less than 5% of the GDP between 2000-2010, suggesting more fiscal discipline in the sub-period than over the previous period. This may be due to the effects of the stabilization fund and the oil-price-based fiscal rule established in the sub-period. It may also be due to the country's strive to meet the covergence criteria of the proposed West Africa Monetary Zone (WAMZ), which was initially designed to start in the early 2000s.[3]

Furthermore, the comovements in the graphs of Figure 2.9, particularly some of the outliers of the graphs, give the perception of procyclicality of fiscal policy in Nigeria, which is a characteristic of fiscal policy that is common in developing countries (Talvi and Végh, 2005). These authors and others (e.g. Lane, 2003; Lane and Tornell, 1998) argue that political economy externalities associated with the diffusion of political power among different

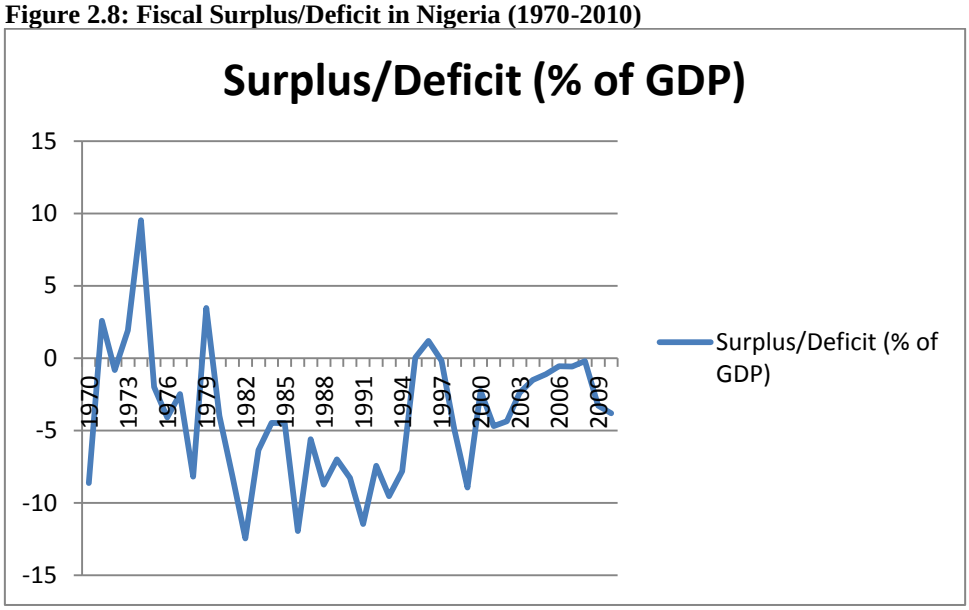
[3]Achieving a fiscal deficit of no more than 4% of the GDP by all the proposing members of the monetary union is one of the convergence criteria of the union. The monetary union was to start in 2003 with the following proposing members: Nigeria, Ghana, Guinea, Sierra Leone, and Gambia. But the starting date has been postponed five times, because the proposing members have not all met the convergence criteria for starting it. The five postponements are: from 2003 to 2005, from 2005 to 2010, from 2010 to 2014, from 2014 to 2015, and from 2015 to 2020.

authorities may be the key factor causing the procyclicality of fiscal policy. The fiscal federalism adopted by the country which distributes power between the three tiers of government and multiple organizations and agencies within the different levels of government can lead to the proliferation of authorities that may be "competing" for their shares of the national resources. The quest to have the best share of the "national cake" by multiple authorities may put pressure on the national resources and cause government expenditure to increase during the booms and decrease during the recessions.

For example, based on possible implicit rent-seeking motives, the 36 state governments and some individuals in political positions in Nigeria sued the Federal government over the illegality of the Excess Crude Account (ECA) established by the government for the purpose of saving surplus oil revenue during oil booms and dissaving during oil revenue shortfalls (see for examples, This Day Live Newspaper, 2014; channels TV, 2012). The central argument underlying the alleged illegality is that section 162(1) of the Nigerian constitution indicates that all revenues earned by the federal government, with the exception of certain proceeds from the personal income tax that only the federal government has the right to collect, should be kept only in the Federation Account and not in any other account. The exempted personal income tax proceeds include proceeds from the armed forces of the country, the Ministry of external affairs, the police force, and the residents of the Federal Capital Territory, as shown in Table 2.4 above. The developments affected the continuity of the building process of the ECA and led to its replacement by a sovereign wealth fund (see Sovereign wealth Fund Institute, 2015; http://www.swfinstitute.org).

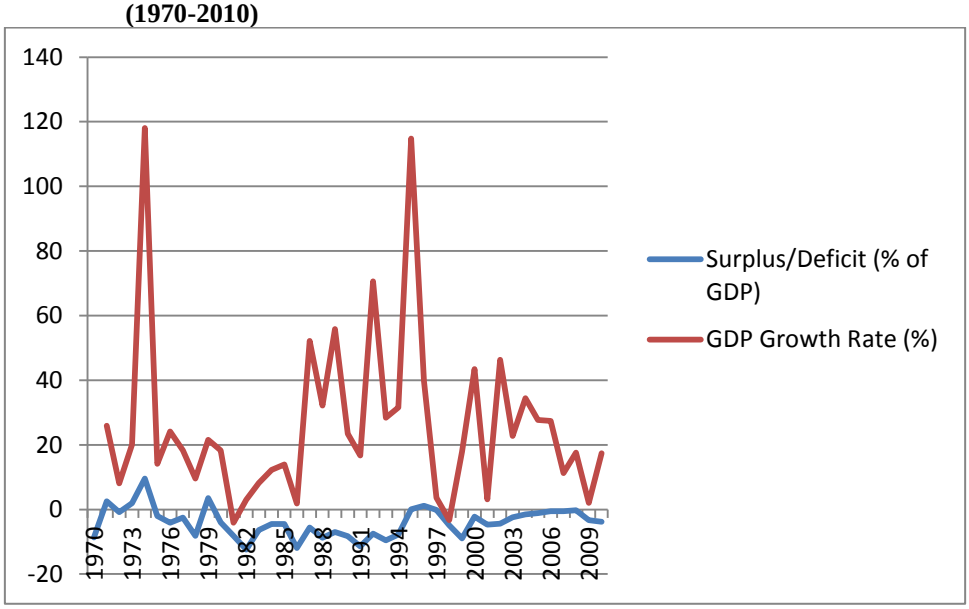
Therefore, the Nigerian Sovereign Investment Authority Act of 2011 was enacted, upon which the establishment of the Nigerian Sovereign Investment Authority (NSIA) is based. The 2011 Act authorizes the NSIA to function as an independent entity to manage Nigeria's Sovereign Wealth Fund, which has three sub-funds jointly owned by the three arms of the government of the country, namely the Future Generations Fund, the Nigeria Infrastructure Fund, and the Stabilization Fund (see Nigerian Sovereign Investment Authority, 2015; http://nsia.com.ng). As the author shows, in line with the names of the three sub-funds, they capture three main purposes: (i) saving for future generations; (ii) infrastructure development; and (iii) protection of the macroeconomy against external shocks associated with the dependence of the country on the export of hydrocarbons, particularly crude oil.

Figure 2.8: Fiscal Surplus/Deficit in Nigeria (1970-2010)



Data Source: Central Bank of Nigeria Statistical Bulletin, 2010 Edition.

Figure 2.9:Nominal GDP Growth Rate and Fiscal Surplus/Deficit in Nigeria (1970-2010)



Data Source: Central Bank of Nigeria Statistical Bulletin, 2010 Edition.

2.5.2. Monetary Policy in the Economy

The Central Bank of Nigeria (CBN), headed by a Governor, is the main authority in charge of monetary policy in Nigeria, with legal authority over other banks. The Bank came into being in 1959, deriving its power from the Central Bank Act of 1958, which has different amended versions (CBN, 2015). The earlier Act of the Bank was replaced by the CBN Act of 2007. The operations of the Bank have been based on the framework created by the Acts. The

operations reflect the relationships of the Bank with the government, other banks in the country, and the economy as a whole. Discussions of the key features of the operations are done as follows.

2.5.2.1. Central Bank Independence

According to CBN (2015), the CBN Act of 2007 gives the Bank *full independence* compared to the *limited autonomy* of the previous Act. However, the full independence is practically in terms of the Bank's power to use monetary instruments. That is, the independence may be termed *instrument independence*, as distict from *goal independence* (Ojo, 2013). Crowe and Meade (2008) distinguish between the two types of independece, based on the works of Debelle and Fischer (1995) and Fischer (1995). Instrument independence implies that a central bank is legally free to use monetary policy instruments to achieve the goals set by a higher authority, which is usually the government.On the other hand, goal independence gives the bank the power to set monetary policy objectives.

Based on the nature of the independence of the CBN, it is subject to the Nigerian federal government in some way, which may give room for political interference in the operations of the Bank. Such interference may cause weak coordination between fiscal and monetary authorities in the economy.

2.5.2.2. Implicit Inflation Targeting

The main objectives that the CBN pursues as stated in the CBN Act of 2007 (Federal Republic of Nigeria Official Gazatte, 2007) are:

(a) Monetary and price stability.

(b) Provision of legal tender currency.

(c) Management of external reserves to protect the international value of the currency.

(d) Fostering a sound financial system in the country.

(e) Serving as the banker of the Federal Government, and providing economic and financial advice to the government.

A key feature of the 2007 Act distiguishing it from the 1958 Act and its amendments is that it has price stability explicitly stated as one of the objectives of the Bank (Ojo, 2013). Achieving low inflation gradually became the focus of the CBN since the introduction of the 2007 Act, with the interest rate being the main policy instrument (Ojo, 2013; Nnanna, 2011; Chibundu, 2009), which is consistent with the policy implications of the New Consesus Macroeconomics (NCM) (Arestis, 2009).

Unlike advanced countries like New Zealand, Canada, and United Kingdom; and emerging markets like Brazil, Chile, and South Africa that have formerly adopted the Inflation Targeting (IT) policy, Nigeria only adopts the partial dimension of the policy. Economies like the US, the Euro Area, Japan, and Switzerland also adopt some of the features of the IT, and like Nigeria the economies are not classified as IT economies in the literature (Roger, 2010).

A key element of the IT framework is that the central bank of an economy directly and explicitly announces a particular numerical value of the inflation target as the primary and only goal of monetary policy, with inflation being the only monetary variable for which a target is announced (IMF, 2006; Ojo, 2013; Roger, 2010). Besides, it is also necessary in formal inflation targeting that inflation forecasts are obtained and published to serve as guides regarding possible inflation pressures.

The CBN targets "single digit" inflation, using market-based instruments, particularly the interest rate, to achieve the "inflation target," while pursuing the achievement of other monetary policy objectives, reflecting the indirect and implicit form of the policy. That is, the country's inflation target is "single digit inflation" and price stability is not explicitly given the priority in the five objectives of the CBN stated above.

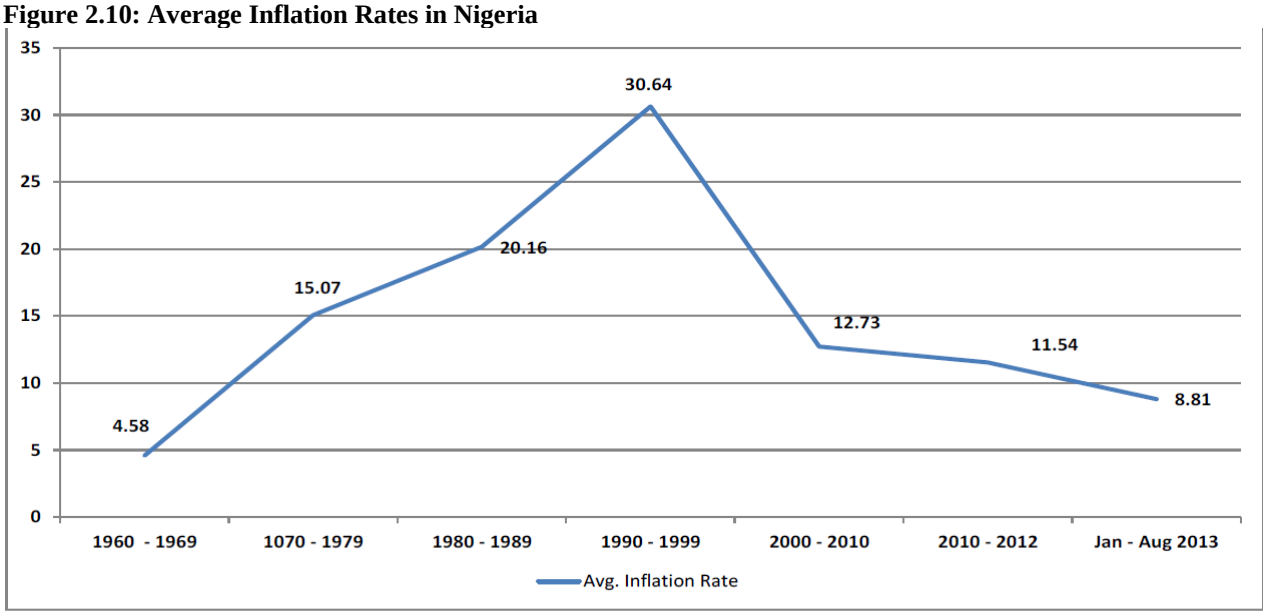
2.5.2.3. Interest Rate as the Main Policy Instrument

As indicated earlier, the interest rate is the main monetary instrument of the CBN in achieving the objectives. The dynamics through which the instrument works is that a central interest rate serves as the anchor for the other rates, so that variations in the anchor rate initiates desired

policy changes in the other rates and the system as a whole. The interest rates currently used in monetary policy by the CBN include: interbank discount rate, Treasury Bill rate, saving deposit rate, fixed deposit rate, lending rate, and Monetary Policy Rate (MPR), with the MPR serving as the anchor rate.

The MPR was introduced in 2006 to replace the Minimum Rediscount Rate (MRR) which was the initial anchor rate. The MRR was replaced because it was not effective in anchoring other rates and impacting on the broad macroeconomy (Ononugbo, 2012). There has been improvement in the performance of monetary policy since the introduction of the MPR, particularly in terms of inflation rate (Mordi and Adebiyi, 2014), which is a main objective of the policy. Figure 2.10 below displays the average inflation rates in Nigeria before and after the introduction of the MPR.

Figure 2.10: Average Inflation Rates in Nigeria



Source: Mordi and Adebiyi, 2014.

The success of the MPR may be associated with the market-based or indirect monetary policy approach under which the interest rate works. The approach has been the method of monetary policy adopted by the CBN since 1993. The market-based method of monetary policy is generally regarded to be the most effective approach. For example, direct monetary instruments like administrative control of interest rates may lead to inefficient resource allocation in the economy.

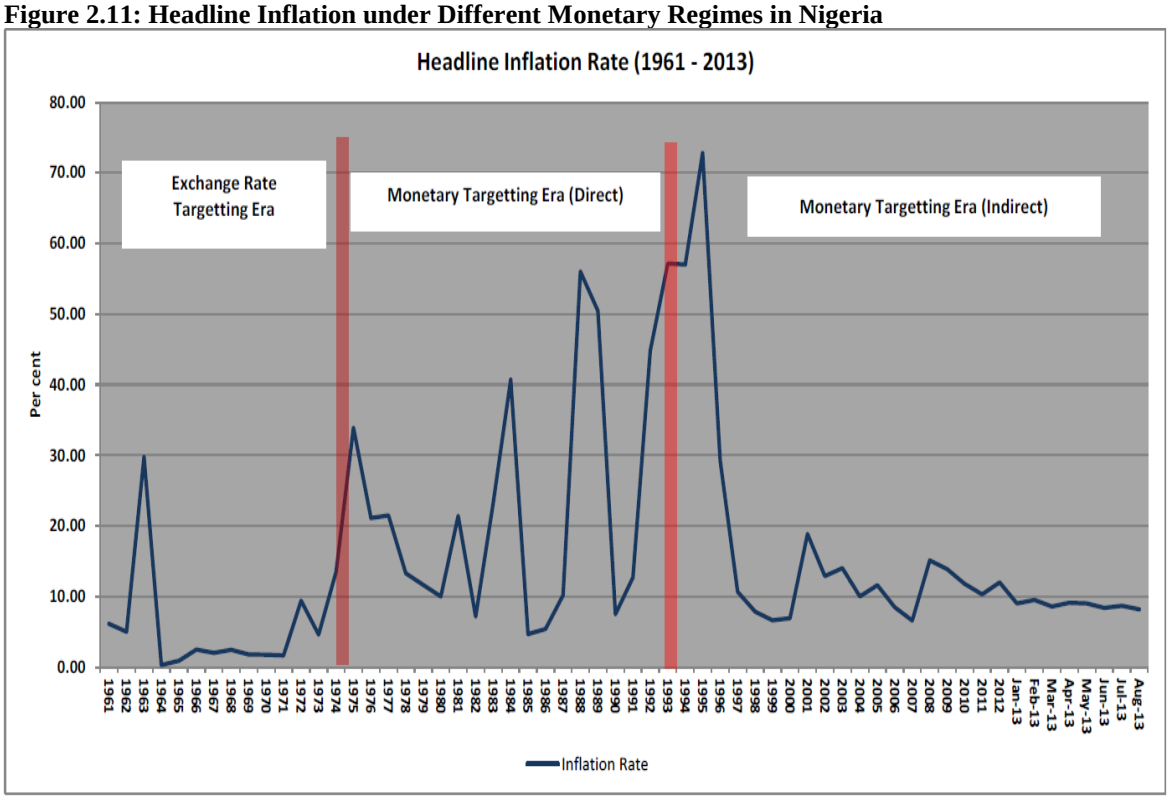
2.5.2.4. Monetary Policy Frameworks

Generally, monetary policy approaches in Nigeria may be broadly divided into two phases, namely the exchange rate targeting phase (1959-1973) and the monetary targeting phase (1974-date), with the latter having direct (1974-1992) and market-based monetary targeting (1993-date) sub-phases (see for examples, Chibundu, 2009; Nnanna, 2001; Mordi and Adebiyi, 2014). The exchange rate targeting and direct monetary targeting frameworks involved administrative determination of monetary variables.

Exchange rate targeting started with fixing the exchange rate between the Nigerian currency and the British currency, while the direct monetary targeting involved the CBN setting the interets rate, identifying priority sectors of the economy, and directing banks on the allocation of credit to the sectors accordingly. Monetary aggregates were controlled through these processes. However, under the indirect monetary targeting, tools like the Open Market Operation (OMO) are employed to achieve the targets of monetary aggregates, which are determined in line with the the general macoeconomic policies of the country.

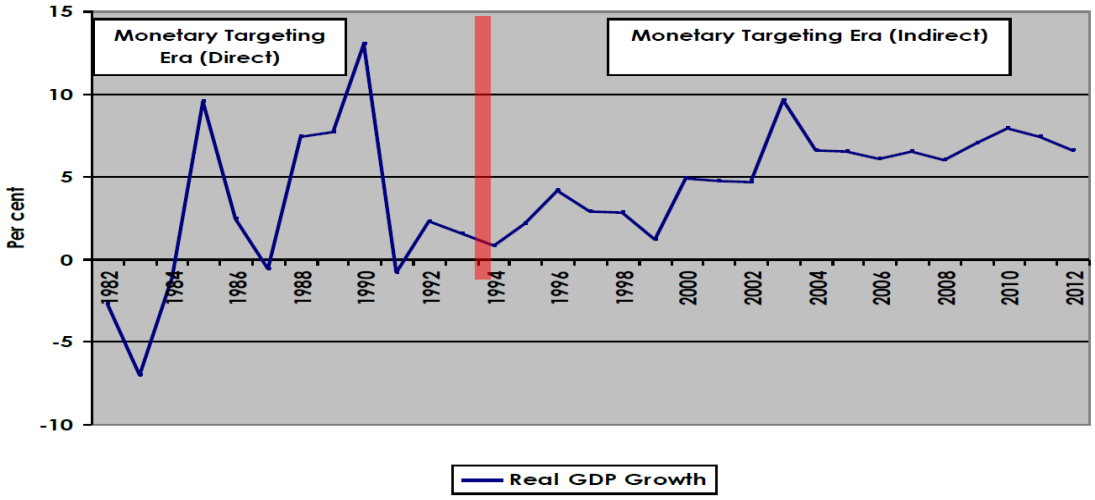
Again, in terms of low inflation as a key monetary policy objective, monetary policy under the indirect monetary targeting regime has perfomed well on average, with headline inflation falling from over 70% in 1996 to below 10% in August 2013, as shown in Figure 2.11 below (Mordi and Adebiyi, 2014). According to these authors, real growth under the regime rose from about 0.8% in 1994 to about 6.6% in 2012, as shown in Figure 2.12 below.

Figure 2.11: Headline Inflation under Different Monetary Regimes in Nigeria



Source: Mordi and Adebiyi, 2014.

Figure 2.12: Real GDP Growth under Different Monetary Regimes in Nigeria



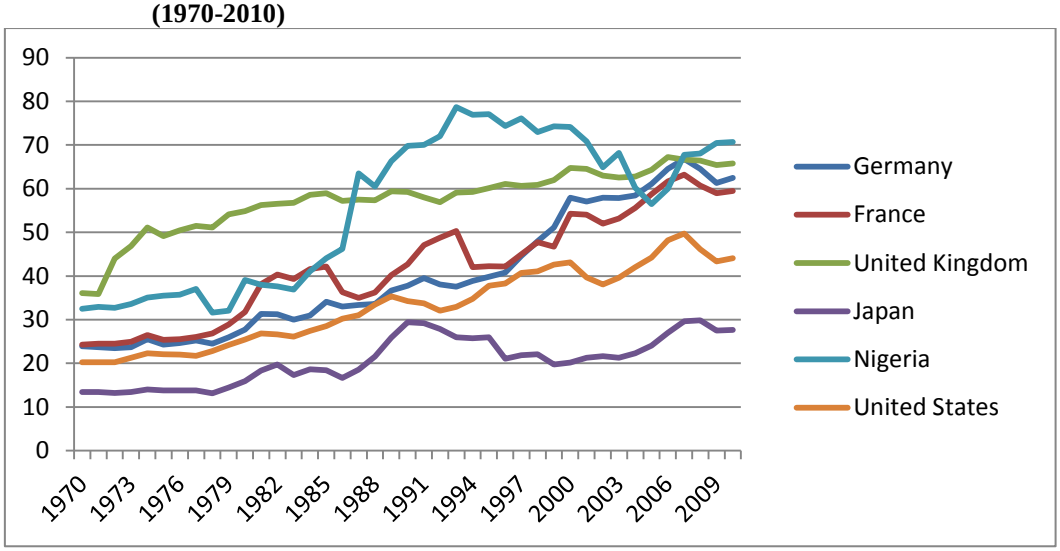
Source: Mordi and Adebiyi, 2014.

2.6. The Degree of Openness and Global Integration of the Economy

Nigeria's degree of openness and global integration is relatively high. Obadan (2008) notes that the level of the country's trade openness is high, even compared to that of some industrial

economies. Figure 2.13 below shows the degrees of openness in Nigeria and selected developed countries, with respect to trade and other forms of cross-country flows.[4]

Figure 2.13: The Degrees of Openness in Nigeria and Selected Developed Countries (1970-2010)



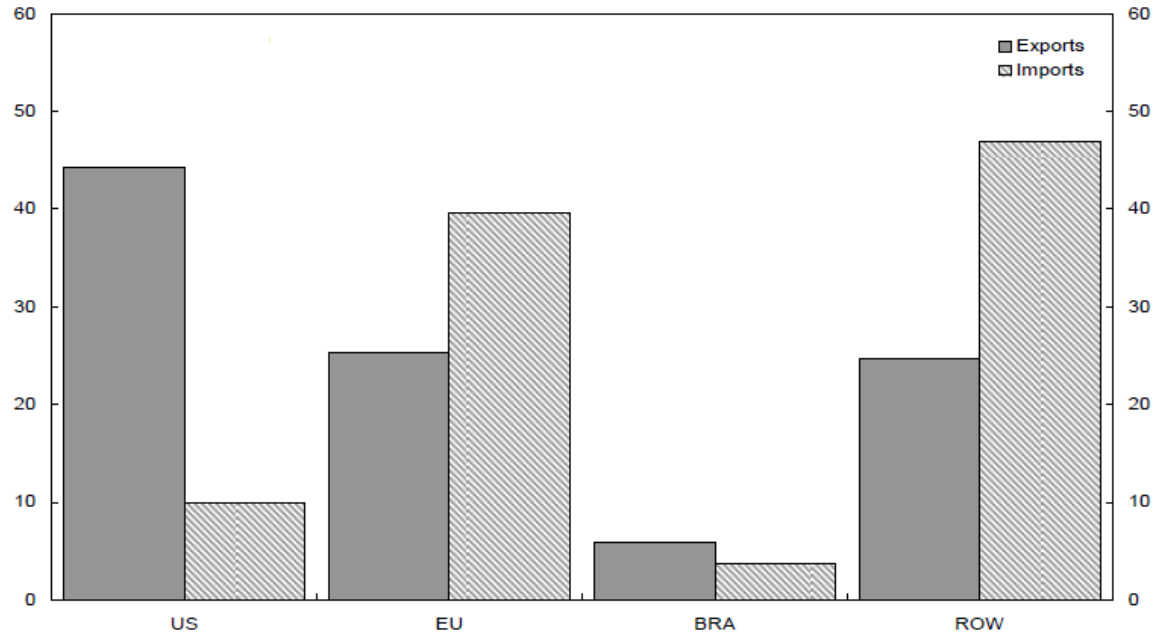
Source of Data: KOF Swiss Economic Institute (www.kof.ethz.ch).

Regarding globalization, Nigeria is ranked 81st in 2012 and 67th in 2013 in the world globalization ranking, based on the evaluation of 208 and 207 economies respectively (KOF Swiss Economic Institute, 2013, *www.kof.ethz.ch*). The globalization ranking is done annually based on an index that is computed by using economic, social, and political factors that affect the global integration of the economies evaluated.

Trade plays a key role in Nigeria's openness and globalization, because it is the dominant source of macroeconomic fluctuations in country as a trade-oriented economy. The US is the most important trade partner of the country as shown in Figures 2.14 and 2.15 below. Figure 2.14 indicates that the US accounts for about 45% of Nigeria's exports, while the European Union (EU) accounts for about 25% of the exports. According to Figure 2.15, Spain is the dominant market of Nigeria's exports within the EU, as it accounts for over 30% of the exports to the Union.

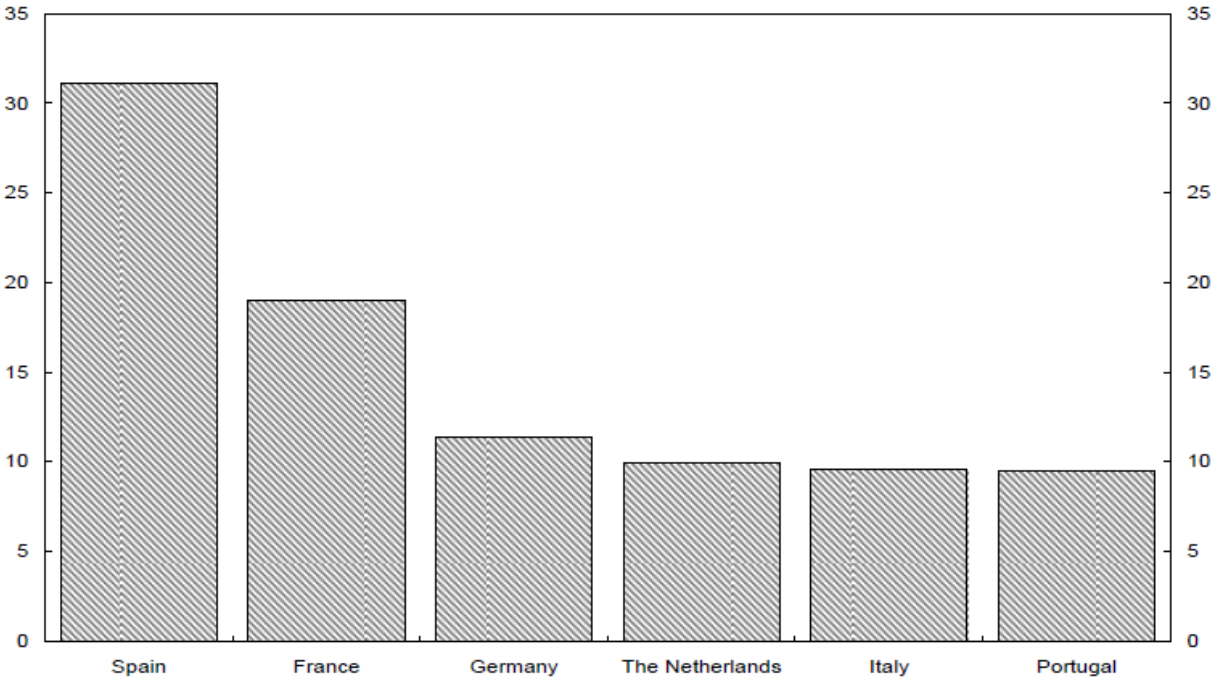
[4] The degree of openness is defined as the aggregated percentage share of the flows in the GDPs of the considered countries. The flows consist of trade (% of GDP); foreign direct investment (FDI) and stocks (% of GDP); portfolio investment (% of GDP); and income payments to foreign nationals (% of GDP).

Figure 2.14: Nigeria's Direction of Trade in Goods and Services (% of Total) in 1990 to 2007



Source: Obiora (2009).

Figure 2.15: Nigeria's Main Exports Markets within the European Union (1990-2007)



Source: Obiora (2009).

2.7. Conclusion

Since independence Nigeria has experienced various policy and institutional frameworks, as shown in the nature of its monetary and fiscal policies, which are a mix of discretionary and rule-based policies. The degree of the latter form of polices may increase in the economy when the proposed West Africa Monetary Zone is eventually formed.

The chapter finds that oil has a central role in the fiscal policy of the country. This is revealed by the structural changes in vital fiscal varibles like government revenue, government expenditure, and fiscal deficit, particularly in the middle of the 1970s. Regarding monetary policy, there is the evidence of improved performance of the policy within the market-led framework involving indirect instruments, relative to the controlled policy framework that existed earlier. However, the relatively high level of the openness, the global integration, and the oil dependency of the economy has strategic roles to play in the fluctuations and the behaviours of the economy. This subject is examined further in the subsequent chapters of the thesis.

Chapter 3: Overview of the Theoretical Literature on the Transmission of Shocks

3.1. Introduction

Over the years, international shocks such as unexpected or unpredicted variations in economic and financial variables have affected countries, regions, and the global economy with varied signs (negative or positive), magnitude, speed of transmission, and persistence. Consequently shocks have received considerable attention in the literature. The literature has various theoretical models explaining the transmission of shocks.

The purpose of this chapter is to present an overview of the theoretical literature on the transmission of international shocks, in order to provide the theoretical foundation of the empirical chapters of the thesis, which deal with different dimensions of the transmission of shocks. The first empirical chapter (chapter 4) deals with the transmission of oil and domestic shocks within a global framework (GVAR), linking the focus economy (Nigeria) with the rest of the world. The second empirical chapter (chapter 5) deals with common growth fluctuations between Nigeria, US and Euro Area, which are transmitted from the latter economies, particularly the US. The third and last empirical chapter (chapter 6) examines the effectiveness of Nigeria's fiscal policy instruments in protecting the country against oil shocks transmitted from the global economy.

The present chapter begins with the review of the theories of transmission of shocks under the two broad categories shown in the theoretical literature, namely crisis-based and non-crisis based theories. Generally, shocks are transmitted during tranquil and crisis periods. However, the theoretical literature also shows that macroeconomic (i.e. fiscal and monetary) shocks are transmitted via certain channels. Therefore, the chapter also examines the theories relating to the channels of the transmission of monetary and fiscal shocks.

3.2. Theoretical Models of Shocks

The theories relating to internationally transmitted shocks may be categorized into two: (i) crisis-based theories; and (ii) non-crisis-based theories. While the underlying factor of the

crisis-based theories is the existence of some "disaster" causing the transmission of fluctuations from an individual economy (or a group of economies) into other economies, the non-crisis-based theories are rooted in the normal interdependence between economies due to trade and financial linkages. We present detailed discussions on the two categories of theories as follows:

3.2.1. Crisis-Based Theories

Contagion is the key concept underlying the crisis-based theories. The concept has been defined variously in the literature. For example, Dornbusch et al. (2000) define contagion as an increase in cross-market comovement during a crisis episode. On the other hand, Edwards (2000) defines the concept as a condition in which the actual level of the transmission of international shocks is above the level expected by market agents. As argued by Edwards, this "residual-related" definition is consistent with the concept of contagion in the epidemiological literature, where the actual level of the manifestation of a disease above the expected level is regarded as contagion.

The central point of the argument of Edwards (2000) is that the residual-based definition means that pure contagion occurs when there are internationally transmitted shocks that are not *global shocks* or *shocks from related economies*. As the author explains, the global or common shocks, like the global recession of 2007-2009, are the ones that affect the world economy as a whole; while the shocks from related economies are based on interdependence or similarity of features between the origins and destinations of the shocks, such as the case of the shocks originating from trade partners or the shocks between emerging markets. This implies that pure contagion occurs when international shocks excluding global shocks and shocks from related economics are transmitted during crisis. Pure contagion is therefore measured by the correlation existing between economies during crisis that is not explained by fundamentals.

This notion of contagion is consistent with that of Masson (1998), who also distinguishes between contagion and the other two forms of shocks indicated by Edward (2000). Based on these two studies, we therefore have three main forms of international shocks, which may be measured through fundamentals and non-fundamentals accordingly: (i) Global or common

shocks which can be measured through fundamentals.[5] (ii) Shocks from related or interdependent economies, which can also be measured through fundamentals.[6] As shown by Dornbusch et al. (2000), these two forms of shocks would only cause contagion (i.e. fundamentals-based contagion) when they are associated with a crisis, as the shocks may take place both in crisis and tranquil times. (iii) Pure contagion, which is based on the behaviour of economic or market agents, reflecting that they are explained by non-fundamentals and not fundamentals. In line with the foregoing explanations, the crisis-based theories in the literature are discussed under two broad classes as follows:

3.2.1.1. Agent-Based Contagion

As noted above, this form of contagion, which is the cross-country transmission of a crisis without any observed variations in macroeconomic fundamentals, is called pure contagion. Some of the key theories relating to this form of contagion are discussed below.

3.2.1.1.1. Multiple Equilibria Theory

Basically, multiple equilibria is an abnormal market condition in which there is more than one equilibria, because the supply curve cuts the demand curve more than once. This implies there is more than one market clearing price. In a multiple equilibria framework, contagion occurs when a crisis in one economy shifts another economy from a good to a bad equilibrium regardless of the state of the macroeconomic fundamentals. The shift is due to changes in the expectations of economic agents on the second economy.

The crisis in the first economy causes a change in the investors' beliefs in the second economy, causing the agents to sell their assets in the latter economy, despite the fact that there are no observed changes in its macroeconomic fundamentals. Examples of studies involving multiple equilibria are Masson (1998), and Jeanne (1997). These theories are useful in explaining phenomena like speculative attacks on economies with sound macroeconomic fundamentals.

[5]Masson (1998) shows that common shocks can also take place when the policy actions of advanced economies have common effects on emerging markets. This makes the nature of the shocks global, since the economies of the world may be broadly divided into industrial and emerging groups. The author gives the term "monsoonal effects" to this type of shocks.

[6] Masson (1998) terms this type of shocks as "spillovers."

3.2.1.1.2. Endogenous Liquidity Theory

Endogenous liquidity models argue that contagion is a consequence of international liquidity constraints initiated by a crisis in one country. For example, a crisis in one country may lead to a decrease in the liquidity of investors in the crisis country and forces them to sell their assets in the neighbouring countries to meet regulatory requirements to stay in the crisis hit market. Examples of theoretical studies of endogenous liquidity are Valdes (1998) and Calvo (1999).

As this explanation shows, endogenous liquidity is different from exogenous liquidity. The former refers to the liquidity inherent in the assets of the investors, which may be called inside liquidity. On the other hand, exogenous liquidity is associated with the liability structure of the investors, such as their ability to borrow, which may be called outside liquidity.

3.2.1.1.3. Herding

Generally, herding describes the mutual behaviour of the individuals in a group without any pre-planned direction. Examples of studies on the theory of herding are the works of Calvo and Mendoza (2000) and Cipriani and Guarino (2010).

Herding is associated with informational cascade, which occurs when certain agents follow the behaviour of other agents, because the former agents believe that the latter ones have better information. Therefore, herding models are basically social learning models involving agents obtaining information and learning from the behaviour of others, with the actions of agents revealing their private information and initiating public beliefs and common choices (Gale, 1996; Chamley, 2004). However, if agents move contrary to the behaviour of the other agents, contrarianism occurs instead of herding.

3.2.1.2. Fundamentals-Based Contagion

Fundamentals-based contagion is related to the transmission of world or local shocks between countries due to real and/or financial linkages. A key feature of this form of contagion is the negative effects of the crisis underlying the transmission of shocks between countries. This is because in tranquil times shocks associated with normal real and financial interdependence

between countries may have positive effects, but in crisis periods such effects may be negative.

Some of the examples of theories relating to fundamentals-based contagion are in Pristker (2000) and Chang and Majnoni (2000). For instance, Chang and Majnoni (2000) present a model involving a country rolling over foreign debt, with the possibility of both fundamentals and self-fulling expectations of market agents causing contagion. In the model, there is an opportunity cost to the government of the domestic economy of obtaining foreign funds by selling new debt, which is associated to the returns of the alternative investments of foreign investors.

Therefore, a crisis in foreign economies such as a monetary policy shock in industrial economies can increase the opportunity cost of foreign funds and cause the domestic economy to experience contagion, which is equivalent to what Masson (1998) terms "monsoonal effects." Besides, a shock in an economy similar in nature to the domestic economy (e.g. a shock between two emerging markets) can also increase the opportunity cost and cause contagion in the home economy, which is what Masson terms "spillovers." Two key fundamentals driving contagion in the model are the size of government debt and the maturity period of the debt.

3.2.2. Non-Crisis-Based Theories

The empirical chapters of this thesis relate to the non-crisis-based theories rather than the crisis-based ones. The core of the non-crisis-based theories is that cross-country shocks occur because of the trade and financial linkages between the countries of the world. This implies that whether there is tranquillity or crisis the linkages would transmit shocks between countries.

Kose and Riezman (2001) present a model of a small open economy that captures the major characteristics of an African economy in order to analyse the relative effects of trade shocks in Africa. These characteristics include: (i) Heavy dependence on trade, particularly primary commodities as exports and intermediate inputs and capital goods as imports, which creates potential vulnerability to terms of trade shocks. (ii) Heavy indebtedness and the necessity of debt service, leading to susceptibility to fluctuations in the world interest rate. The authors'

model is dynamic, stochastic, and multi-sectoral, where trade shocks are modelled as fluctuations in the prices of exports and imports, while financial shocks are variations in the global real interest rate.

Mendoza (1995) constructed a small three-sector open economy model using an intertemporal general equilibrium approach to explore the role terms-of-trade shocks in the fluctuations of business cycles. The transmission mechanisms of the terms-of-trade shocks in the model are through international capital mobility, the cost of imported inputs, and the overall purchasing power of exports. As shown by the author, the constructed model is suitable to test certain regular empirical features of business cycles, one of which is the size, persistence, and procyclicality of terms-of-trade shocks.

Gerlach and Smets (1995) employ a two-country model involving trade flows to show how speculative attacks on the currency of one country can lead to trade deficits and speculative attacks on the currency of the second country, causing the collapse of the exchange parities of the economies to be interrelated. A central assumption of the model is that the economies operate fixed exchange rate regimes, since the floating exchange rates should not be susceptible to speculative attacks.

Karayalcin (1996) built a two-country model to explore the effects of a supply shock emanating from one of the countries and the transmission of the shock through the stock markets channel, assuming adjustment costs affect the investment decisions of the firms. As indicated by the author, a central feature of the model is that it deviates from the assumption in the related literature that capital can be moved costlessly between countries. Summarily, the model involves the transmission of a "real" shock through a financial channel.

Shimokawa and Kyle (2003) developed a portfolio selection model to explore the transmission of shocks through the financial linkages created by international bank lending. The authors note that a unique feature of the model is the nature of its banks' profit function. The profit function has international and home parts. The nature of the model makes it possible to derive a simultaneous equations system through which the model is solved. The model captures the correlation between the domestic conditions of banks' home economies and their lending behaviour. The findings demonstrate the possibility of transmission of

shocks from a lender country to debtor countries and the transmission of shocks between debtor countries through a creditor.

3.2.2.1. Oil-Related Theories

Based on the focus given to oil in this thesis, we choose to discuss oil-related theories that are associated with the non-crisis theories below. The oil-related theories were built to explain the transmission mechanisms and effects of oil price fluctuations on the economy. Therefore, the relationship between the non-crisis and the oil-related theories is that the former show the connection between cross-country shocks and international interdependence, while the latter reveal the transmission channels and impacts of oil price shocks on the economy based on the interdependence.

The oils shocks can have permanent effects on the economy through rent seeking, the Dutch disease, and the like, as discussed below:

3.2.2.1.1. Rent-Seeking Models

Rent-seeking models show how individual economic agents seek to acquire more wealth from the economy's resources at the expense of the welfare of other agents. The work of Tornell and Lane (1999) seems to be outstanding in the rent-seeking literature. The authors' model consists of a two-sector economy where powerful groups exist and interact, with the interaction modelled as an infinite-horizon dynamic game. The existence of weak legal and political institutions of the economy enables the powerful groups to seek a greater share of the resources of the economy following a windfall (e.g. a windfall following a rise in resource price), leading to a redistributive struggle between the groups that eventually leads to resources been used on non-taxable and unproductive activities that may hinder growth.

According to the authors, there is therefore a voracity effect in the above process, leading to an inefficient rise in redistribution which would not exist if the political and legal framework of the economy restricted the powerful groups and enhanced diffusion of power. One major implication of the behaviour of the rent-seeking powerful groups is that they may use their power to obtain economic policies that may hinder growth. For example, they may influence the optimal fiscal policy of the society, which may eventually cause rising inflation and a

growth slowdown. Other studies of the rent-seeking theory are Wick and Bulte (2006); and Torvik (2002).

3.2.2.1.2. Dutch-Disease Models

These models explain the negative impact of a resource boom on an economy through a mechanism involving the booming sector causing more expensive non-resource exports, the reallocation of resources from the non-resource sector (i.e. manufacturing sector) to the non-tradable sector, and the eventual decline of the non-resource sector, as a consequence of exchange rate appreciating in real terms.

Wijnbergen (1984) developed a model showing how oil can cause a decrease in aggregate income through the channel of learning by doing. When oil revenue increases in a country, the population seeks to use part of the increase for the consumption of non-traded goods, transferring resources from the traded sector to the non-traded sector. This consequently decreases learning by doing and production in the traded sector, leading to weaker aggregate income in the economy. More recent works on the Dutch disease theory are Sachs and Warner (1995); Matsen and Torvik (2005); and Torvik (2001).

3.2.2.1.3. Models Explaining Oil-Shock-Macroeconomy Relationship with Focus on Oil Importers

The theoretical literature also clearly shows the negative impact of positive oil price shocks on the economy of oil importers. The mechanism through which the increases in oil price shocks affect oil importers include the terms of trade at the macroeconomic level and the purchasing power of economic agents at the microeconomic level. The price increases are wealth transfers from oil importers to exporters, leading to effects similar to that of a tax on the consumption of economic agents, which eventually weakens their purchasing power.

DePratto et al. (2009) built a New Keynesian general equilibrium open economy model to explore the effects of oil price increases on an oil importing economy. In the model oil price variations are transmitted through different channels, which allow the fluctuations to have short-term and long-term effects on output both via the demand-side and supply-side of the economy, with the latter and former captured through the IS curve and the Phillips curve

respectively. This makes it possible to compare short-term and long-term effects of oil shocks, as well as demand-side and supply-side effects. Other theoretical works on the impact of oil shocks on the economy of an importer are Rotemberg and Woodford (1996); and Fin (2000).

3.3. Theories Relating to the Transmission of Fiscal and Monetary Shocks

The theoretical literature shows that there are certain mechanisms through which fiscal and monetary shocks in individual economies are transmitted into other economies. Designing optimum policies requires that policymakers have accurate knowledge of these channels, considering the increasing interlinkages and interdependencies between the countries of the world. Globalization has changed the magnitude and structures of cross-country interactions and comovements (Frankel, 2000; Kose and Prasad, 2010), hence external developments have become key factors to consider in designing national policies. The main transmission channels of fiscal and monetary shocks shown in the theoretical literature are discussed below.

3.3.1. Channels of Transmission of Fiscal Policy Shocks

Fiscal shocks in individual economies lead to fiscal spillovers from source countries to recipient countries. The shocks occur due to changes in variables such as government expenditure, government revenue, and government budget balance. The spillovers emanating from the shocks are of various forms (Weyerstrass et al., 2006; Belke and Osowski, 2016):

i. External vs Internal Spillovers: External spillovers originate from the interlinkages between the recipients of spillovers and foreign countries. Internal spillovers occur between countries having economic integration or between the sectors of individual countries. For example, internal spillovers can occur between the members of the Euro Area or between the oil sector and the other sectors of an oil exporter such as Nigeria.

ii. Direct vs Indirect Spillovers: Direct spillovers are the ones working via trade linkages. Increases or decreases in domestic demand originating from fiscal shocks are transmitted directly through the exports and imports of concerned economies. This implies that the exports and imports of trade partners will also be impacted. On the other hand, indirect

spillovers work via non-fiscal (i.e. monetary) variables such as interest rates and exchange rates.

iii. Positive or Negative Spillovers: Positive spillovers are the ones that enhance the macroeconomic welfare of origin and recipient countries, while negative spillovers are the ones with negative impact. For example, the recession of 2007-2009 which originated from the US had negative fiscal effects on the US and other countries, hence the spillovers associated with the recession were negative ones.

iv. Policy-Induced vs Shock-Induced Spillovers: Policy-induced spillovers point to the cross-border impact of fiscal policies adopted in individual countries, while shock-induced spillovers are caused by large and usually unexpected changes in the values of fiscal variables in source countries. In the context of this thesis, external and internal spillovers are particularly relevant, in that both external and internal shocks are captured in the empirical chapters.

According to Alcidi et al. (2016), three main channels through which fiscal policy shocks are transmitted internationally are demand channel, competitiveness channel, and financial markets channel. The relative roles of the channels in individual countries depend on the structures of the countries, as shown in the discussions below.

i. Demand Channel: Fiscal shocks in individual countries affect domestic demand and demand for imported goods, due to their impact on output. Export demand will change in the economies of trade partners because of the change in the demand for imports. This leads to the transmission of fiscal shocks from source countries into their trade partners. The output channel is also called the trade channel because of the role of trade in its operation. Kose and Raymond (2001) show through their model of a typical African economy such as Nigeria that the trade channel is the most important channel in Africa, with respect to contributions to variations in aggregate output. This is largely due to the large dependence of African countries on trade. Generally, empirical evidence shows that trade is the dominant channel of international transmission of business cycles (Baxter and Kouparitsas, 2005; Dees et al., 2007).

ii. The Competitiveness Channel: Fiscal shocks lead to changes in inflation in source countries and their trade partners. This causes changes in relative prices and hence the terms of trade, leading to spillover effects through the competitiveness channel, which is also called the terms of trade channel. The findings of Mendoza (1995) give important insight on the competitiveness channel for developing countries such as Nigeria. The author shows through a theoretical model of a small open economy that terms of trade shocks account for about 50% of GDP variations in developing economies.

iii. Financial Markets Channel: This channel consists of various financial mechanisms of cross-country spillovers, such as the interest rate and exchange rate mechanisms. Fiscal shocks in one country can cause changes in the interest rates and exchange rates of other countries, leading to interest rates and exchange rates spillovers. In the context of this thesis, the traditional small open-economy literature (i.e. Fleming, 1962; Mundell, 1963; Dornbusch, 1976) shows that small economies such as Nigeria are small relative to the global economy, therefore the economies are exogenously impacted by variations in global variables and variables of large economies such as the US. This has relevance for the financial markets channel, in that variations in, say the US interest rate, will have spillover effects in Nigeria, while variations in the Nigeria's interest rate will not have significant spillover effects on the US. The financial markets channel can also be associated with agent sentiments. Fiscal shocks can be triggered in the economy by financial news such as the announcement of government spending forecasts (Callegari et al., 2016). Such news can cause agent sentiments and cross-country spillovers through financial contagion effects. The channel of stock markets is also a potential financial channel of international spillovers (Karayalcin, 1996), hence fiscal spillovers may also occur through the stock markets of developing countries, particularly frontier markets such as Nigeria. Some African economies, including Nigeria, are classified as frontier markets in international stock markets rankings. The stock markets of frontier markets play a large role in their economic activity, as the markets are experiencing increasing development and attracting investors (Nellor, 2008). Therefore, the markets constitute a significant potential channel of spillovers.

3.3.2. Channels of Transmission of Monetary Policy Shocks

Monetary policy shocks are transmitted via mechanisms relating to financial market prices and quantities (Taylor, 1995). Examples of the prices are short-term interest rates, long-term

interest rates, exchange rates, etc. On the other hand, examples of the quantities are bank credits, money supply, government bonds, etc. The theories of the transmission channels of monetary policy associated with the financial market prices and quantities may be classified into the following main categories (Boivin et al., 2010; Endut et al., 2015):

i. The "Money" View: Theories under the money view relates primarily to the interest rate and exchange rate channels, hence this category can also be tagged the financial market prices view. Since the theories under the category deal with the effects of shocks on prices, they explain the spending behaviours of firms and households associated with variations in the prices. The interest rate plays a key role in the spillover effects of the theories. For example, a contractionary monetary policy in a country will affect agent behaviour about investment by increasing long-term interest rates and the cost of capital, which will eventually increase investment and interest rates in other countries. The exchange rate also affects the transmission of monetary policy shocks via international trade, based a mechanism involving net exports. Under a flexible exchange rate policy, exports decrease and imports increase when there is exchange rate appreciation in the economy. A contractionary monetary policy shock in a country will make real interest rate to increase, which will lead to the inflow of capital into the nation, in line with the degree of financial openness of the economy. Domestic currency will appreciate due to the increase in capital inflow. Exports will increase and imports will decrease due to the appreciation of exchange rate, leading to a decrease in net exports.

ii. Credit View: There are two main transmission channels under this view, namely the balance sheet and bank-lending channels. The channels operate based on the spending behaviours of agents during shocks. These behaviours relate to market imperfections: the balance sheet channel works through adverse selection and moral hazard, while the bank-lending channel operates based on asymmetry information in the private markets where banks supply loans.

a. Bank-Lending Channel: There are no perfect substitutes for retail bank deposits in the private markets where banks supply loans. Therefore, a shock, say an expansionary monetary policy shock, will increase bank deposits and the quantity of bank loans in the economy where the private markets operate, leading to an increase in investment by domestic firms, particularly small firms, that rely on loans as the main source of finance because they cannot

get funds from other sources (e.g. stock markets). The shock will also attract firms from other economies to invest in the domestic economy, which may lead to reduction of investment in the foreign economies, implying positive investment effects in the domestic economy and negative effects in foreign economies. Shimokawa and Kyle (2003) show that monetary policy shocks transmitted through the bank-lending channel can be of two forms: spillover effects from creditor banks in advanced economies to debtors (developing countries); and common creditor effects involving spillovers between debtor countries due to common creditors. For example, a shock in a debtor country may reduce the profitability of a creditor, leading to reduction of credit and investment in other debtor countries. In the Nigerian context, the bank recapitalization policy introduced in 2005 to strengthen the banking sector has increased the effectiveness of banks (Bakare, 2011). This has consequently promoted the operation of the country's bank-lending channel by increasing lending (Enoch, 2013).

b. Balance Sheets Channel: As indicate earlier, this channel is associated with asymmetry information problems in privates markets, such as moral hazard and adverse selection. The central point about the channel is that the status of balance sheets is a mechanism of the response of the economy, via private markets, to monetary policy shocks. The net worth of agents correlates with agents' collateral, as a reduction in the former causes a reduction in the latter, leading to a rise in adverse selection and moral hazard problems in the markets. The problems will make lenders to reduce loans, which will eventually cause reduction of spending and aggregate demand in the economy. The balance sheets channel plays a significant role in the transmission of monetary policy shocks into the Nigerian macroeconomic economy (Olowofeso et al. 2014). The study of these authors is particularly relevant, in that it explores the transmission of monetary policy shocks through the balance sheets channel from a macroeconomic perspective, by examining the transmission of shocks via output and prices into the macroeconomy.

3.4. Conclusion

This chapter reviews the theoretical literature on internationally transmitted shocks, with the aim of providing the theoretical foundation for the empirical analysis of the thesis. The review captures the main theories of transmission of shocks in the theoretical literature: theories of transmission of crisis-based and non-crisis-based shocks; and theories of transmission of fiscal and monetary shocks. The review shows that there is little Africa-specific work (e.g.

Kose and Raymond, 2011) on the transmission of shocks. This makes the analyses of the empirical chapters of this thesis relevant, as they contribute to filling the identified gap by providing empirical evidence on some aspects of the transmission mechanisms of the theoretical literature on Nigeria's internationally transmitted shocks. However, there are some important findings got from the review of the present chapter.

The chapter shows that recent crises such as those of Mexico (1994), Europe (1992-1993), and Asia (1997-1998) are widely captured in the crisis-based theories. The reason for this may be that the crises have significant effects on neighbouring economies and the world as a whole, compared to previous crises. This implies that the wide attention given to the crises is associated with the key underlying feature of the non-crisis-based theories: cross-country interdependence. This interdependence implies globalization or the intertwining of the economies of the world, which has been increasing over the years, with the increase enhancing cross-country transmission and impact of crisis. Furthermore, the non-crisis-based theories relating to oil reveal that oil price variations will always impact exporters such as Nigeria based on their interlinkages with other economies and individual internal weaknesses, whether there is crisis or not. However, based on the interlinkages, there is also the possibility that oil price fluctuations lead to a regional or global crisis. This implies that crisis affects interdependence, and interdependence affects crisis!

Regarding the transmission of fiscal and monetary shocks, the chapter shows that African countries such as Nigeria which depend largely on trade and are indebted to developed countries will likely experience significant spillover effects of fiscal and monetary shocks via the exchange rate and interest rate channels. However, that many of these countries have adopted shock-absorbing polices to protect themselves from external developments because of previous experiences such as the debt crisis of the early 1980s necessitates empirical studies on the impact of shocks on the economies, as done for Nigeria in the empirical chapters of this thesis.

Chapter 4: The Relative Effects of Internal and External Shocks on the Growth of Nigeria: Evidence from the Global VAR Model

4.1. Introduction

"When the U.S. sneezes, emerging markets catch a cold."

(General Economic and Financial Adage)

"… emerging markets are more vulnerable to external shocks than large and developed economies."

(Bartosz Maćkowiak, 2007)

"… it … seems plausible that there may be noticeable differences between the response of a highly open economy… and a relatively closed economy … to certain domestic shocks."

(Erceg Christopher, Gust Christopher, and López-Salido David, 2010)

As shown in chapter 2, Nigeria is an oil-driven emerging and developing economy with a high degree of openness and global integration. Since these features may make the effects of internally and externally driven fluctuations on the country distinctive, it is necessary to examine the effects of fluctuations on the country's growth. Furthermore, in recent times the effects of shocks on the emerging and developing economies seem to be receiving increasing attention in the literature, probably because of the increasing trade and financial interlinkages between the economies and the rest of the world caused by globalization.[7]

Therefore, in line with the channels of transmission of shocks reviewed in chapter 3, the objective of this chapter is to examine the effects of some selected external (oil-related) and internal shocks on the growth of Nigeria, using the Global VAR (GVAR) model introduced by Dees et al (2007). The role of openness and globalization in the transmission of the external and internal shocks is the key factor underlying the analysis of the chapter. The vulnerability of the emerging and developing economies to external shocks, particularly the

[7] For examples, see Chui et al, 2004; Desroches, 2004; Tchakarov and Elekdag, 2006; Calvo, 2007; Utlaut and Boye ,2010; Didier, et al., 2011;Adler et al., 2012.

ones that originate from the US, is widely known. However, similar susceptibility to internally generated fluctuations is possible in an emerging market with a high level of openness and global integration such as Nigeria, because domestic shocks may cause changes in openness-related domestic variables such as the elasticity of substitution between domestic and imported goods.

The chapter contributes to the literature in two main ways: (i) It contributes to filling the gap on the little Africa-related work (Kose and Raymond, 2011) on internationally transmitted shocks, which is a finding of the literature review of chapter 3. (ii) It provides the first empirical evidence obtained through a global model such as the GVAR, to the best of our knowledge, on the role of openness and globalization in the transmission of both domestic and oil shocks for an oil-exporting country (Nigeria). Existing literature on oil-exporting countries focuses either on oil shocks only (e.g. Cashin et al., 2012; Mendoza and Vera, 2010), or depends on models that do not capture cross-country openness and globalization like the GVAR, where domestic shocks are touched on (e.g. Mehrara and Mohaghegh, 2011; Omojolaibi, 2013).

Among the channels of transmission of international shocks touched on in the literature review of chapter 3, the exchange rate channel is particularly relevant in the present chapter, in that the transmission of the effects of oil shocks via the channel is examined to determine whether or not the spending effect of Dutch disease, which involves real exchange rate appreciation and consequent fall in growth (i.e. negative correlation between real exchange rate and growth), exists in Nigeria. During oil price increases, the spending effect of Dutch disease may manifest in an oil dependent economy via the link between the tradable and non-tradable sectors of the economy and real exchange rate. As shown in Brahmbhatt et al. (2010), in the theoretical model of Dutch disease, the prices of the tradable sector, which consists of oil and non-oil tradables in Nigeria's case, are determined in the world market, while the prices of the non-tradable sector are determined in the domestic economy, which makes the real exchange rate to appreciate during oil price increases, since the real exchange rate is calculated as the price of non-tradables relative to the price of tradables.

The results of the present chapter show that the spending effect of Dutch disease is not statistically significant in Nigeria, as the appreciation of real exchange rate and consequent fall in growth are not statistically significant. The main reason for this is that the country

adopts the flexible exchange rate policy, which prevents "false" appreciation or overvaluation of real exchange rate during oil price increases, because the policy is an effective shock absorber. The country also adopts a fiscal policy involving a stabilization fund working together with an oil-price-based fiscal rule to absorb oil price shocks and smooth oil revenue, which is shown to be effective in chapter 6 of the thesis. However, the results show that domestic shocks to real output and inflation have statistically significant impact on growth in the economy. Domestic shock to real exchange rate does not have statistically significant impact on growth, confirming the role of exchange rate as a shock absorber.

The rest of the chapter is organized as follows: Section 4.2 presents the review of the empirical literature on shocks. Section 4.3 discusses the GVAR methodology. Section 4.4 presents and discusses the empirical results of the analysis. Concluding remarks are given in section 4.5.

4.2. Empirical Review

The empirical review touches on studies on crisis-based and non-crisis-based shocks and discusses the mechanisms through which shocks are transmitted. In discussing the empirical studies on the non-crisis-based theories we undertake our discussion under two divisions, namely non-oil related and oil-related studies. The rationale behind this division is that oil shocks play a central role in the analysis of this chapter, which relates to the non-crisis-based theories. Generally, the empirical chapters of this thesis primarily relate to normal international interdependence and not cross-country crisis. The review shows that all the channels of international transmission of shocks discussed in chapter 3 are relevant. But trade channel is the most important channel for African economies such as Nigeria, due to dependency on trade.

4.2.1. Crisis-Based Studies

The empirical studies on cross-country transmission of crisis relate to the existence of contagion measured through fundamentals and investors' behaviour. The studies employ methodologies designed to measure cross-market comovements due to a crisis.

Baur (2012) explores contagion from a global perspective by examining the contagion effects of the global financial crisis of 2007-2009, both within and across 25 developed and emerging stock markets. The author studies contagion across financial sectors and between financial and real sectors by examining financial and real sector stocks. The results show that there was cross-country contagion of the financial sector; domestic contagion between the financial and real sectors; and cross-country contagion from the financial sector to the real sector. The authors indicate that none of the countries considered was unaffected by the crisis, which confirms the global nature of the crisis. The countries are ones playing key roles in the global economy, such as US, France, Germany, Italy, Spain (i.e. Euro Area countries), Japan, Brazil, Russian, India, China (i.e. BRIC), South Africa, etc. However, the US plays a dominant role in international spillovers. This makes some studies (e.g. Guesmi et al., 2013) to focus on the role of the US in cross-border transmission of crisis.

Mondria and Quintana-Domeque (2013) examine an interesting mechanism of cross-border contagion called agents' attention relocation. The authors show that the mechanism can make crisis to be transmitted between countries and regions without correlated fundamentals. Agents' attention relocation is a process that relates to human psychology. The human brain has information processing limitations, hence there is information-related trade-off between giving attention to one market at the expense of another market. This makes attention to be an information-related resource. Suppose agents invest in two markets and volatility becomes high in one market due to crisis. Agents will give attention to the market with high volatility, which will lead to reduced expected returns in the second market because agents consider it to be riskier, since less information resource is processed on it because less attention is given to it. The reduction of expected returns will make agents to sell their assets, leading to low asset value and crisis in the second market, although its fundamentals are uncorrelated with those of the first market. The authors provide evidence supporting that the attention relocation mechanism was a channel of transmission of the Asian crisis of 1997 to Latin America.

Although internationally transmitted crises have increased because of increasing globalization, policies and institutions can limit their effects. The effects of any form of crisis will be minimal in recipient economies having sound policies and institutions. For example, Angkinand et al. (2010) show that although financial liberalization policy is a causative factor of banking crisis, good institutions in form of sound capital regulation and supervision reduce the probability of the policy causing crisis. One way through which financial liberalization

causes crisis is that it increases cross-border exposures, which affects cross-border stability of banks' balance sheets by making shocks reducing liabilities in certain countries to reduce assets in other countries (Degryse et al., 2010).

Calvo and Reinhart (1996) show that the comovements of equity and Brady bond returns between Latin American emerging markets increased after the 1994 Mexican crisis, consistent with the existence of contagion which is not associated with domestic fundamentals. The authors' claim is mainly based on evidence from correlations and principal components. While the authors employ the correlations to investigate the degree of cross-country comovements of the equity and the Brandy bond returns before and after the crisis, they use the principal components to identify the unobserved factor driving the equity returns during the crisis, which is found to have significantly strong power in driving the returns.

Focusing mainly on agent-based contagion, Baig and Goldfajn (1998) analyse financial-market comovements between Malaysia, Indonesia, Korea, Philippines, and Thailand, in order to investigate whether the crisis that originated in Thailand in July 1997 due to the collapse of the Thai baht's peg was transmitted to the other four countries. Using correlations, VAR, and linear regressions, the authors observe the evidence of contagion between the countries, mainly due to the herd behaviour of investors. However, the analysis also reveals that fundamentals play a role in the cross-country transmission of the crisis, albeit with relatively lower power. The authors therefore note that distinguishing between these two causes of contagion is required in dealing with financial contagion.

Differentiating between the causes of contagion and their relative roles in the crisis is necessary in applying effective policies to deal with the challenge. For example, regarding the Asian crisis, many authors argue that agent behaviour was the primary factor that caused the crisis its regional transmission. But in an empirical review, Corsetti et al. (1998) show that the crisis was primarily caused by weaknesses in macroeconomic fundamentals. The authors explain that structural and policy weaknesses in the countries of the region constituted the main origin of the crisis, although market and agent reactions made the crisis stronger than the fundamental weaknesses would have accounted for.

For example, the authors note that there was high degree of openness in most Asian countries in the period preceding the crisis and many East Asian countries experienced negative terms

of trade shocks in 1996 with the decrease in the price of some of their key exports. Besides, the authors also show that majority of the currencies that crashed in 1997 had experienced real appreciation prior to the crisis that led to loss of competiveness and current account difficulties. The real appreciation was due to the US dollar appreciating in the months preceding the crisis at a time when most of the crisis countries pegged their exchange rates to a basket of currencies in which the US dollar had a very strong effective weight.

A common limitation of empirical studies on contagion seems to be that non-economic factors causing cross-country crises are not properly captured. For example, political factors may contribute significantly to the European 1992-1993 Exchange Rate Mechanism crisis (see Drazen, 1999), but this may not be sufficiently captured in the analysis of the crisis if non-economic factors are not give due attention. Basically, such political factors may be classed as fundamental causes of the European crisis, as distinct from agent-related causes.

4.2.2. Non-Crisis-Based Studies

Empirical studies on non-crisis-based transmission of shocks are based on the central factor underlying such transmission: cross-country interdependence relating to trade and financial flows. Gurara and Ncube (2013) examines the spillover effects of growth shocks from the Euro Zone and BRICs on the growth of African countries, using a GVAR model that links modelled countries together through trade flows, because most African countries are trade-dependent economies. The model has wide coverage of African economies, in that it has 46 African countries including Nigeria and 30 developed and emerging market countries. The considered African countries are not examined individually but on group basis. The countries are divided into the following three classes based on the characteristic of each country: factor-driven African economies which are further divided as oil and non-oil exporters; investment-driven African economies; and fragile and post-conflict African economies.

The factor-driven economies are the ones which depend largely on basic factors of production such as labour and natural resources (part of land). Nigeria is classified as an oil-exporting factor-driven African economy in the analysis. The investment-driven economies are the ones with the capacity and desire to invest largely in technology. On the other hand, the fragile and post-conflict economies are the ones that have been affected by recent crisis, and generally have weak policies and institutions, when compared to other countries.

The three groups of African countries have varying responses to growth shocks from the Euro Zone and BRICs, as the results of the analysis show that growth slowdowns in the two non-African economies have varying significant effects that vary due to groups-specific characteristics of the African countries. The study also examines the impact of quantitative easing (QE) of the US, Euro, UK, and Japan (G4) and finds that the unconventional monetary policy has moderate inflation and exchange rate effects in Africa.

The work of De Waal (2014) focuses on international spillovers in South Africa and relates to the increasing importance of China in the world economy. The author argues that the trend of South Africa's trade has changed in recent years, mainly due to China's emergence in the global economy. Therefore, China has overtaken the US as the dominant trade partner of South Africa. The author therefore employs a GVAR model built with cross-country trade flows for 33 countries to investigate the impact of GDP shocks from the US and China on South Africa's GDP and finds that over time the impact of China's shocks has become higher than that of US shocks. The finding has relevance for policymaking in South Africa and other Africa countries. Africa's policymakers need to consider the increasing role of China in designing policies. For example, China has invested largely in Africa in key areas such as the natural resources sector over the last decade (Yanzhuo, 2014).

Kose and Riezman (2001) observe from empirical estimations of their dynamic, stochastic, equilibrium model designed to represent a typical African economy that trade shocks account for over 44% of the variations in aggregate output in the modelled economy, whereas world interest rate shocks only have minor influence on the economy, despite many of the African economies being significantly indebted.

These findings are consistent with the results of Mendoza (1995), who observes that terms of trade shocks account for around half of GDP fluctuations in developing countries. African economies in particular seem to follow an export-led growth process leading to a strong role of the prices of exports and imports (largely the inputs used in producing the exports) in the fluctuations of growth in these countries. This implies that trade has a strong role in the dynamics of the business cycles of African economies not only in terms of output fluctuations, but also with respect to variations of vital variables like investment and labour supply (Kose and Riezman, 2001).

Hoffmaister et al. (1998) investigate the factors causing macroeconomic fluctuations in Sub-Saharan Africa, by comparing the sources of fluctuations in CFA franc and non-CFA franc countries.[8] The findings show that external shocks, particularly terms of trade shocks seems to have greater role in output and exchange rate variations in the CFA franc countries, compared to their non-CFA franc counterparts.

As the authors note, the findings are more likely to be associated with the fixed exchange rate policy of the CFA franc countries, involving a fixed peg to the French franc in the sample period of the analysis (1971-1993), distinguishing these countries from the non-CFA franc economies which adopted adjustable pegs and more flexible exchange rate arrangements during the period. The CFA franc countries would probably have had a different experience regarding external shocks, if they had adopted the flexible exchange rate policy. According to Edwards and Yeyati (2003), the flexible exchange rate policy is an effective buffer of external shocks both in emerging and developed economies, allowing the countries adopting the policy to grow faster.[9]

Bussière et al. (2009) employ the GVAR model consisting of 21 emerging and advanced economies to explore global trade flows, modelling imports and exports with other key variables, in order to capture the dynamics of the flows. The findings indicate the central role of the US in global trade flows. The US output shock significantly affects the exports of foreign countries, while the real appreciation of the US dollar also increases the exports of foreign countries, but the role of the appreciation is not as strong as that of the output in stimulating the exports.

The work of Shimokawa and Kyle (2003) on international lending of commercial banks has vital empirical findings on the subject. Using data over 1989-1999 for the banks of France,

[8] The CFA franc group consists of 14 Sub-Saharan African countries, each belonging to one of two monetary unions using the CFA franc, namely West African Economic and Monetary Union (WAEMU) and Central African Economic and Monetary Community (CAEMC). Benin, Burkina Faso, Côte D'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo belong to WAEMU; while CAEMC consists of Cameroon, Central African Republic, Chad, Republic of Congo, Equatorial Guinea, and Gabon. The CFA is the acronym for Communauté Financière Africaine (African Financial Community) within WAEMU and Coopération Financière en Afrique Centrale (Financial Cooperation in Central Africa) within CAEMC.

[9] Examples of other studies indicating the role of the exchange rate policy as an effective external shock buffer are Edwards (2006) and Sek (2010).

Germany, Japan, the Netherlands, the UK, and the US, which are the largest six international creditor countries, the authors observe, for example, that there is common creditor effect in the transmission of shocks relating to international bank lending. That is, a negative shock in a region consisting of borrowing countries may be transmitted across the region through a creditor that has concentration of loans in the area.

Using a GVAR model capturing 33 countries, with data on financial and macroeconomic variables, Eickmeier and Ng (2011) explore the effects of credit supply shocks emanating from the US, the euro area, and Japan on other economies. The results reveal vital facts on international credit supply shocks, but the main finding is that among the three origins of the shocks, the negative shocks from the US have the strongest effects on the GDPs of foreign countries, confirming the strategic role of the US among the key financial centres of the global economy.

4.2.2.1. Oil-Related Studies

Regarding the importers of oil like the US, Roubini and Setser (2004) explain that oil price increases usually have negative impact on growth in the economy, with the degree of impact depending on magnitude of shock, persistence of shock, the intensity of oil dependency of the economy, and fiscal and monetary policy responses to the shock. In this line, the authors note the strong role of oil in recessions, noting that oil price increases have initiated or/and contributed to previous US and global recessions. As indicated under the discussion of theories, the terms of trade is a major channel through which oil price shocks affect oil importers. Backus and Crucini (2000) show that there is a strong relationship between changes in oil price and terms of trade in major advanced economies, many of which are oil importers.

Treviño (2011) empirically investigated whether Dutch disease (DD) is present in the oil-exporting countries of the CFA franc zone, by comparing the oil exporters and importers of the zone, using macroeconomic data. The author observes that the DD is present in the oil exporting countries, based on what the traditional DD theory predicts regarding real exchange rate appreciation and labour relocation when there is a resource boom. The theory shows that when there is a boom, persistent exchange rate appreciation and the shift of labour from the primary (agriculture) sector to the resource sector, indicate that the DD is present.

These findings agree with the results of Ismail (2010), who also find the evidence of the DD in oil exporting countries with microeconomic data. Ismail employed microeconomic data on the manufacturing sectors of selected countries including oil exporting countries to test for the presence of the DD in the selected oil exporters. The author argues that the primary advantage of the micro dataset over its macro counterpart is that the former better captures the heterogeneity of the considered sectors, leading to more robust estimates of possible divergent growth trends of the sectors. A central point to note about the considered empirical studies is that finding the evidence of the DD with macro and micro data suggests that the challenge is indeed present, at least in some resource-rich countries.

Using a general equilibrium model, Angelopoulos and Economides (2008) empirically analyses the nexus between fiscal policy, rent-seeking, economic growth, and uncertainty about maintaining a political office in 25 OECD countries, and find that rent-seeking working via the pathway of fiscal policy has a negative impact on growth. The uncertainty about holding a political office makes the incumbent office holders to develop myopic attitudes towards policies, leading to a large government share of the economy. This may be the case, at least partially, in Nigeria, where Sala-i-Martin and Subramanian (2003) argue that weak institution and resource waste have largely contributed to resource curse. Weak institution usually promotes rent-seeking activities and wasteful spending in an economy.

4.3. The GVAR Methodology

The GVAR model was introduced by Pesaran et al. (2004) and extended by Dees et al. (2007). We adopt the model of Dees et al. (2007) in this chapter. The GVAR model is a global model consisting of individual country-specific VARX models, which are first solved separately and thereafter combined systematically to form the global VAR model which is finally solved as an overall system. The VARX models have country-specific domestic variables and weakly exogenous corresponding foreign variables. The foreign variables are built from the domestic variables by using the international trade flows between the countries in question. Financial or other kinds of flows may also be used, depending on the modelling objectives. But as Dees et al. (2007) show, using trade flows is the best way of capturing international linkages, as trade is the dominant means of international transmission of business cycles. The GVAR model may also include global variables such as oil prices. The

model of Dees et al. (2007) includes the oil price as a global variable and treats it as endogenous in the dominant country (i.e. US) and weakly exogenous in the other countries, because of the strategic role of the US in the global economy regarding the transmission of international shocks.[10]

The GVAR strategy for solving a global model overcomes the curse of dimensionality associated with using the standard VAR approach to model cross-country inter-relationships. There will be a proliferation of unknown coefficients that will make estimation infeasible if the standard VAR is employed for cross-country inter-linkages. The GVAR strategy helps to overcome this limitation by treating foreign and global variables as weakly exogenous based on the rationale that each of the countries, with the exception of the dominant economy (i.e. US), is small with reference to the global economy. Chudik and Smith (2013) provide support for the US as the dominant economy in the GVAR model by showing that the country is the main source of global interdependence. The foregoing makes weak exogeneity to be a major assumption of the GVAR model and weak exogeneity test to be a part of the estimation procedure of the model.

The weak exogeneity assumption is based on the assertion of the small open-economy macroeconomics literature that most economies, with the plausible exception of the US, are small relative to the world economy and that global variables are exogenous for small economies (see Fleming, 1962; Mundell, 1963; Dornbusch, 1976). The weak exogeneity assumption implies that foreign variables are long-run forcing for domestic variables in the country-specific VARX models of the GVAR model. That is, foreign variables affect domestic variables in the long-run, while the latter do not affect the former in the long run. But lagged short-run feedbacks between foreign and domestic variables are possible in the country-specific VARX models.

Since there exists contemporaneous dependence of the country-specific domestic variables on the foreign variables, the country-specific VARX models are solved simultaneously for the domestic variables, by combining the individual models to form an overall global VAR system. In the overall global VAR system all variables (i.e. domestic and foreign variables of

[10] This is a major distinguishing feature between the GVAR models of Dees et al. (2007) and Pesaran et al. (2004), as the oil price is treated as weakly exogenous for all countries in the latter model.

the individual VARX models) are endogenous, implying that the overall system is not a VARX model.

The described features of the GVAR model mean that the model makes interlinkages between modelled economies to be possible through the following channels:
(i) The dependence of country-specific domestic variables on corresponding foreign variables.
(ii) The dependence of country-specific domestic variables on common global variables.
(iii) The contemporaneous interdependence between country-specific shocks.

4.3.1. The Country-Specific VARX* Models

To construct the GVAR model, suppose there are N+1 countries in the global economy, indexed by $i = 0, 1, 2, \dots, N$, where N is the reference economy (i.e. US). The country-specific VAR model is a VARX* (*p, q*) model, where *p, q* are the lag orders of the domestic and foreign variables respectively. A VARX* (*p, q*) model is a VAR model with a weakly exogenous (X) foreign (*) variable. Suppose *p, q* are equal to two, the VARX (2, 2) model for ith country with constant and trend is:

$$\boldsymbol{X}_{it} = \boldsymbol{a}_{i0} + \boldsymbol{a}_{i1}t + \boldsymbol{\Pi}_{i1}\boldsymbol{X}_{i,t-1} + \boldsymbol{\Pi}_{i2}\boldsymbol{X}_{i,t-2} + \boldsymbol{\Upsilon}_{i0}X^{*}_{it} + \boldsymbol{\Upsilon}_{i1}\boldsymbol{X}^{*}_{\boldsymbol{i},t-1} + \boldsymbol{\Upsilon}_{i2}\boldsymbol{X}^{*}_{i,t-2} + \varepsilon_{it}\ , \tag{4.1}$$

where

t = 1, 2 …., T

i = 0, 1, 2 …, N

$\boldsymbol{X}_{it} = k \times 1$ vector of domestic variables

$\boldsymbol{X}^{*}_{it} = k^{*}_{i} \times 1$ vector of foreign variables

$\boldsymbol{\Pi}_{i1} = k_i \times k_i$ matrix of lagged coefficients associated with domestic variables

$\boldsymbol{\Pi}_{i2} = k_i \times k_i$ matrix of lagged coefficients associated with domestic variables

$\boldsymbol{\Upsilon}_{i0} = k_i \times k^{*}_{i}$ matrix of coefficients associated with foreign variables

$\boldsymbol{\Upsilon}_{i1} = k_i \times k^{*}_{i}$ matrix of lagged coefficients associated with foreign variables

$\boldsymbol{\Upsilon}_{21} = k_i \times k^{*}_{i}$ matrix of lagged coefficients associated with foreign Variables

$\varepsilon_{it} = k_i \times 1$ vector of idiosyncratic country-specific shocks with no serial correlation

The error-correction form of equation 4.1 is given by

$$\Delta \boldsymbol{X_{it}} = \boldsymbol{c_{i0}} + \boldsymbol{\alpha_i \beta_i'}\left[\boldsymbol{z_{i,t-1}} - \boldsymbol{\gamma_i}(t-1)\right] + \boldsymbol{\Lambda_{i0}} \Delta \boldsymbol{X_{it}^*} + \boldsymbol{\Gamma_i} \Delta \boldsymbol{z_{i,t-1}} + \boldsymbol{u_{it}} \,, \tag{4.2}$$

where

$\boldsymbol{z_{it}} = (\boldsymbol{X_{it}'}, \boldsymbol{X_{it}^{*\prime}})'$

$\boldsymbol{\alpha_i} = k_i \times r_i$ matrix of rank r_i, which is the matrix containing the speed of adjustment coefficients

$\boldsymbol{\beta_i} = (k_i + k_i^*) \times r_i$ matrix of rank r_i, which is the matrix containing the cointegrating vectors.

Using $\boldsymbol{\beta_i} = (\boldsymbol{\beta_{ix}'}, \boldsymbol{\beta_{ix*}'})'$, the r_i error-correction terms of equation 4.2 can be re-written as

$$\boldsymbol{\beta_i'}(\boldsymbol{z_{it}} - \boldsymbol{\gamma_i t}) = \boldsymbol{\beta_{ix}'} \boldsymbol{X_{it}} + \boldsymbol{\beta_{ix*}'} \boldsymbol{X_{it}^*} - (\boldsymbol{\beta_i'} \boldsymbol{\gamma_i}) t \,, \tag{4.3}$$

which implies that cointegration is possible in $\boldsymbol{X_{it}}$, between $\boldsymbol{X_{it}}$ and $\boldsymbol{X_{it}^*}$, and across $\boldsymbol{X_{it}}$ and $\boldsymbol{X_{jt}}$ when $i \neq j$.

The VECM* models, which captures the short-run and long-run relations, are estimated separately for each country using reduced rank regression, with $\boldsymbol{X_{it}^*}$ taken as long-run forcing or weakly exogenous to the parameters of equation (4.2). For each country-specific model, r_i (the number of cointegrating equations), $\boldsymbol{\alpha_i}$ (the matrix containing the speed of adjustment coefficients) and β_i (the matrix containing the cointegrating vectors) are determined.

The domestic variables included in the country-specific models are real output (y_{it}), inflation rate ($Dp_{it} = p_{it} - p_{i,t-1}$), real equity price ($eq_{it}$), real exchange rate ($ep_{it} - p_{it}$), short-term interest rate (r_{it}), long-term interest rate (lr_{it}), and oil price ($poil_t$) which is treated only as domestic in the US model and exogenous in all other country-specific models following Dees et al. (2007). Specifically, the variables are calculated as follows:

$$y_{it} = \ln\left({GDP_{it}}/{CPI_{it}}\right), \qquad p_{it} = \ln(CPI_{it})$$

$$eq_{it} = \ln\left({EQ_{it}}/{CPI_{it}}\right), \qquad ep_{it} = \ln(E_{it}) \,, \tag{4.4}$$

$$r_{it} = 0.25 * \ln\left(1 + {R_{it}^S}/{100}\right), \qquad lr_{it} = 0.25 * \ln\left(1 + {R_{it}^L}/{100}\right)$$

$$poil_t = ln(poil_t)$$

where

GDP_{it} = nominal gross domestic product of country i at time t, in domestic currency,

CPI_{it} = consumer price index in country i at time t,

EQ_{it} = nominal equity price index in country i at time t,

E_{it} = nominal exchange rate of country i at time t in terms of US dollars,

R_{it}^{S} = short-run nominal rate of interest per annum in percentage, in country i at time t,

R_{it}^{L} = long-run nominal rate of interest per annum in percentage, in country i at time t and

$poil_t$ = price of oil (in US Dollar)

By the formulas used to calculate the short-term and long-term interest rates, the rates are adjusted from annual rates to quarterly rates. According to Dees et al. (2007), the oil price is treated as the domestic (endogenous) variable of the US model only because of the dominant role of the country in the transmission of international shocks, such as the evolution of macroeconomic shocks in the global economy. The country-specific foreign variables denoted by $\boldsymbol{X_{it}^{*}}$ are built from the domestic variables, using country-specific fixed trade weights as shown below:

$$\boldsymbol{X}_{it}^{*} = (y_{it}^{*}, p_{it}^{*}, eq_{it}^{*}, ep_{it}^{*}, r_{it}^{*}, lr_{it}^{*})',$$

$$y_{it}^{*} = \sum_{j=0}^{N} w_{ij}^{y} y_{jt}, \qquad p_{it}^{*} = \sum_{j=0}^{N} w_{ij}^{p} p_{jt},$$

$$eq_{it}^{*} = \sum_{j=0}^{N} w_{ij}^{eq} eq_{jt}, \qquad ep_{it}^{*} = \sum_{j=1}^{N} w_{ij}^{ep} ep_{jt}, \qquad (4.5)$$

$$r_{it}^{*} = \sum_{j=0}^{N} w_{ij}^{r} r_{jt}, \qquad lr_{it}^{*} = \sum_{j=0}^{N} w_{ij}^{lr} lr_{jt}.$$

where w_{ij}^{y}, w_{ij}^{p}, w_{ij}^{eq}, w_{ij}^{ep}, w_{ij}^{r}, w_{ij}^{lr} are trade weights built from the share of country j in the total trade of country i. The fixed trade weights are constructed based on trade flows data spanning 2006-2009. The period 2006-2008 is selected in order to capture recent trade trends within the sample period (1979Q2-2009Q4) of our analysis, as the data for the macroeconomic variables cover 1979Q2-2009Q4. Further details on data are given in section 4.3.3 below. The trade weights could also be time-varying weights, but following Dees et al. (2007), we use fixed weights in our analysis.

4.3.2. The Overall Global Model

After the country-specific models above are estimated, the overall GVAR model is built by treating all the country-specific domestic and foreign variables as endogenous. The overall GVAR model is solved in terms of the endogenous variables collected in a $k_i \times 1$ global variable vector ($k = \sum_{i=0}^{N} k_i$). To derive the solution to the overall global system, use $\boldsymbol{z_{it}} = (\boldsymbol{X'_{it}}, \boldsymbol{X^{*\prime}_{it}})'$ to re-write the VARX*(2, 2) models from equation (4.1) for each economy as

$$\boldsymbol{A_{i0} z_{it}} = \boldsymbol{a_{i0}} + \boldsymbol{a_{i1}} t + \boldsymbol{A_{i1} z_{i,t-1}} + \boldsymbol{A_{i2} z_{i,t-2}} + \boldsymbol{u_{it}} \quad (4.6)$$

where $\boldsymbol{A_{i0}} = (\boldsymbol{I_{ki}} - \boldsymbol{\Lambda_{i0}})$, $\boldsymbol{A_{i1}} = (\boldsymbol{\Phi_{i1}}, \boldsymbol{\Lambda_{1i}})$, $\boldsymbol{A_{i2}} = (\boldsymbol{\Phi_{i2}}, \boldsymbol{\Lambda_{i2}})$.

We can now derive the identity $\boldsymbol{z_{it}} = \boldsymbol{W_i X_t}$ (4.7)

where

$\boldsymbol{X_t} = (\boldsymbol{X'}_{0t}, \boldsymbol{X'}_{1t}, \ldots, \boldsymbol{X'}_{Nt})$ is a $k \times 1$ vector of endogenous variables, and

$\boldsymbol{W_i} = (k_i + k_i^*) \times k$ link matrix obtained through the country-specific trade weights w_{ij}.

Note that k_i and k_i^* are the number of domestic and foreign variables respectively.

Using the above identity, we can re-write equation (4.6) as

$$\boldsymbol{A_{i0} W_i X_t} = \boldsymbol{a_{i0}} + \boldsymbol{a_{i1}} t + \boldsymbol{A_{i1} W_i X_{t-1}} + \boldsymbol{A_{i2} W_i X_{t-2}} + \boldsymbol{u_{it}} \quad (4.8)$$

The individual country models are thereafter stacked to obtain

$$\boldsymbol{G_0 X_t} = \boldsymbol{a_0} + \boldsymbol{a_1} t + \boldsymbol{G_1 X_{t-1}} + \boldsymbol{G_2 X_{t-2}} + \boldsymbol{u_t} \quad (4.9)$$

where $\boldsymbol{G_0} = \begin{pmatrix} \boldsymbol{A_{00} W_0} \\ \boldsymbol{A_{10} W_1} \\ \vdots \\ \boldsymbol{A_{N0} W_N} \end{pmatrix}$, $\boldsymbol{G_1} = \begin{pmatrix} \boldsymbol{A_{01} W_0} \\ \boldsymbol{A_{11} W_1} \\ \vdots \\ \boldsymbol{A_{N1} W_N} \end{pmatrix}$, $\boldsymbol{G_2} = \begin{pmatrix} \boldsymbol{A_{02} W_0} \\ \boldsymbol{A_{12} W_1} \\ \vdots \\ \boldsymbol{A_{N2} W_N} \end{pmatrix}$

$$\boldsymbol{a_0} = \begin{pmatrix} \boldsymbol{a_{00}} \\ \boldsymbol{a_{10}} \\ \vdots \\ \boldsymbol{a_{N0}} \end{pmatrix}, \quad \boldsymbol{a_1} = \begin{pmatrix} \boldsymbol{a_{01}} \\ \boldsymbol{a_{11}} \\ \vdots \\ \boldsymbol{a_{N1}} \end{pmatrix}, \quad \boldsymbol{u_t} = \begin{pmatrix} \boldsymbol{u_{0t}} \\ \boldsymbol{u_{1t}} \\ \vdots \\ \boldsymbol{u_{Nt}} \end{pmatrix}$$

Equation (4.9) is now pre-multiplied by G_0^{-1}, since $\boldsymbol{G_0}$ is a non-singular matrix that is already known. The resulting GVAR(2) model is

$$\boldsymbol{X_t} = \boldsymbol{b_0} + \boldsymbol{b_1} t + \boldsymbol{F_1 X_{t-1}} + \boldsymbol{F_2 X_{t-2}} + \boldsymbol{\varepsilon_t} \quad (4.10)$$

where

$$\boldsymbol{b_0} = \boldsymbol{G_0^{-1} a_0}, \boldsymbol{b_1} = \boldsymbol{G_0^{-1} a_1}, \boldsymbol{F_1} = \boldsymbol{G_0^{-1} G_1}, \boldsymbol{F_2} = \boldsymbol{G_0^{-1} G_2},$$

$$\boldsymbol{\varepsilon_t} = \boldsymbol{G_0^{-1} u_t}$$

The GVAR model in equation (4.10) is solved recursively and may be used for forecasting, impulse response analysis, etc. We use the GVAR solution for impulse response analysis in this chapter. Note that if regional variables are desired in a GVAR model, the domestic variables for the region which will be included in the region-specific VARX* model are constructed from the variables of the countries forming the region as explained below:

Suppose a regional variable, say real GDP y_{it}, is required, it is built from country- specific variables y_{iht}, by using a weighted average as follows:

$$y_{it}=\sum_{h=1}^{N_i} w_{ih}^{0}\, y_{iht}\,, \tag{4.11}$$

where y_{it} is the output of country h in region i and w_{ih}^{0} are the PPP-GDP weights (or some other desired type of weights) for a year or the average of more than one year.

4.3.3. Variables and Data

The data of the domestic variables for the countries in the original GVAR model of Dees et al. (2007) are from the "2009 Vintage" GVAR database of the GVAR toolbox 1.1 (Smith and Galesi, 2011). The data cover 1979Q2-2009Q4. The data were the only GVAR data available when our analysis was done. The trade flow data in the "2009 Vintage" cover 1980-2009.[11] Detailed information about the data, including data sources, can be found in Technical Appendix B of the GVAR Toolbox 1.1 User Guide, authored by Smith and Galesi (2011). Nigerian data matching the "2009 Vintage" were added to the GVAR dataset. We use the data span 1979Q2-2009Q4 in our analysis because the GVAR data (i.e. GVAR Toolbox 1.1 data) available when the analysis was done cover this period. Table 4.1 presents the summary on the data used in the chapter.

[11] The trade flows data are in annual form, because the GVAR software (GVAR Toolbox 1.1) used for the GVAR estimation only supports annual trade flows.

Table 4.1: Data and Variables

Variable	Description	Information on Nigerian Data
Trade Flows	Trade between the countries of the global model.	Nigerian data were obtained from the IMF Direction of Trade Statistics, 2014 Edition.
y_{it}	Real GDP Volume	Nigerian data obtained in annual form from the May 2014 Edition of the International Financial Statistics (IFS) and converted to quarterly form through interpolation and extrapolation.
Dp_{it}	Domestic inflation calculated by using seasonally adjusted CPI.	Nigerian CPI data were obtained in quarterly form from the April 2012 edition of the IFS and seasonally adjusted.
eq_{it}	Real equity prices	Nigerian data were not included due to data limitations.
ep_{it}	Domestic real exchange rate in term of US Dollar	Nigerian data obtained in monthly form from the 2010 edition of the Central Bank of Nigeria (CBN) Statistical Bulletin and converted into quarterly form using the average of the values for each quarter.
r_{it}	Short-term interest rates	Nigerian data obtained in quarterly form from the April, 2012 edition of the IFS.
lr_{it}	Long-term interest rate	Nigerian data were not included due to non-availability of data.
$poil_{it}$	Oil price	
Purchasing Power Parity GDP	This is used for the construction of Purchasing Power Parity GDP weights employed for the aggregation of countries into regions.	

The domestic variables included for each of the countries of original GVAR model of Dees et al (2007) are the ones in Table 4.1, except in cases where certain variables are not available due to data availability. As shown in Table 4.1, four variables are included for Nigeria. For all countries the corresponding foreign variables for the included domestic variables are constructed using the trade weights, as mentioned above. In our analysis we calculate trade weights based on trade flow data spanning 2006-2008. The period 2006-2008 is chosen to capture relatively current trade trends within the overall sample period of 1979Q2-2009Q4 of

the GVAR analysis. This approach follows the approach of Dees et al. (2007) who built trade weights from trade flows of years indicating current trade trends.

Due to the fact that the US is the dominant country of the GVAR model, its country-specific VARX* model has a different specification in terms of domestic and foreign variables. In the US model real GDP, inflation, real equity prices, short-term interest rate, long-term interest rate, and the oil price are endogenous. The oil price is treated as endogenous as explained earlier. The weakly exogenous foreign variables for the US are foreign real GDP ($y^*_{US,t}$), foreign inflation ($Dp^*_{US,t}$), and foreign real exchange rate ($ep^*_{US,t}$). The foreign equity prices, foreign short-term interest rate and foreign long-term interest rate are not included in the US VARX* model, because they are not to have a long-run impact (i.e. not long-run forcing) on their domestic counterparts, due to the dominant role of the US financial variables in the world economy (Dees et al., 2007). Table 4.2 below summarizes the domestic and foreign variables included in the country-specific models of the GVAR model, while Table 4.3 presents the countries of the model.

Table 4.2: Variables Included in Country-Specific VARX* Models of GVAR Model

	All Countries Except US		US	
Variables	Domestic	Foreign	Domestic	Foreign
Real GDP	y_{it}	y^*_{it}	$y_{US,t}$	$y^*_{US,t}$
Inflation	Dp_{it}	Dp^*_{it}	$Dp_{US,t}$	$Dp^*_{US,t}$
Real exchange rate	ep_{it}-p_{it}	–	–	$ep^*_{US,t} - p^*_{US,t}$
Real equity price	eq_{it}	eq^*_{it}	$eq_{US,t}$	–
Short-term interest rate	r_{it}	r^*_{it}	$r_{US,t}$	–
Long-term interest rate	lr_{it}	lr^*_{it}	$lr_{US,t}$	–
Oil Price	–	$poil_{it}$	$poil_{it}$	–

Table 4.3: The Countries and Regions of the GVAR Model of the Study

USA	**Euro Area**	**Latin America**
China	Germany	Brazil
Japan	France	Mexico
UK	Italy	Argentina
Other Developed Economies	Spain	Chile
Canada	Netherlands	Peru
Australia	Belgium	
New Zealand	Austria	
	Finland	
Rest of Asia	**Rest of Western Europe**	**Rest of the World**
Korea	Sweden	India
Indonesia	Switzerland	South Africa
Thailand	Norway	Turkey
Philippines		Saudi Arabia
Malaysia		Nigeria
Singapore		

Based on modelling objectives, desired regions may be modelled using the groupings in this table accordingly. Following Dees et al (2007), only the Euro Area is modelled in our GVAR model, with the data for the monetary union aggregated by cross-section weighted averages of the domestic variables of the concerned countries, using the Purchasing Power Parity GDP weights, based on Purchasing Power Parity GDP data spanning 2006-2009.

4.4. Empirical Results

The empirical results of our analysis touch on the trade weights matrix calculated from the direction of trade statistics; unit root tests of the stationarity of the data; weak exogeneity tests of the suitability of the trade-weighted foreign variables and the oil price as exogenous regressors of the country-specific VECMs; cointegration tests through which the country-specific VECMs are solved; and the impulse response functions through which the effects of the simulated shocks are explored. The results are presented below:

4.4.1. Trade Weights Matrix

Table 4.4 shows the trade weight matrix for Nigeria and the two economies (i.e. US and Euro Area) identified in the overall trade weight matrix as the economies with dominant trade in

Nigeria's trade. The U.S. and Euro Area account for about 38% and 25% respectively as shown in Table 4.4, reflecting the central role of the two industrial economies regarding the transmission of external shocks to Nigeria.[12] Therefore, we focus on these two economies among Nigeria's foreign economies in the presentation of the results. Table A.1 in the appendix of this chapter contains the full trade weight matrix for all the economies of the GVAR model, as produced originally by the GVAR software.

Table 4.4: Trade Weights Matrix

Country/Region	USA	Euro Area	Nigeria
USA	0	0.15	0.01
Euro Area	0.17	0	0.01
Nigeria	0.38	0.25	0

Note that in the GVAR model economies are captured by their macroeconomic variables (i.e. real GDP, inflation, real exchange rate, etc), while trade weights reflect trade flows between individual economies. This implies that the trade weights capture and link all the macroeconomic variables of the considered economies together.

4.4.2. Unit Root Tests

The stationarity properties of all the variables (i.e. domestic, foreign and global variables) of the GVAR model are examined in level, and after first and second differencing, using the ADF and the weighted symmetric estimation of the ADF type regressions (WF) introduced by Park and Fuller (1995). The WF technique has higher power than the ADF technique (Dees et al. 2007). The results of the tests show that the first differences of the oil price and all the endogenous variables included in the USA, Euro Area, and Nigerian models are stationary at the 5% level of significance, as shown in Tables 4.5-4.6 below. Similar results are obtained for the foreign variables of these economies. This suggests that the variables of the three economies are I (1). The full results of the unit root tests for all endogenous and foreign

[12]Note that in the original output of the GVAR software, the trade weights sum up to 1 by column not row (see the GVAR Handbook of Smith, L.V. and A. Galesi, 2011). As noted by the authors, the original GVAR table needs to be transposed to make the weights to sum up to 1 by row. So, table 2 is a transposed form of the trade weights produced by the GVAR software on the US, Euro Area, and Nigeria.

variables of the GVAR model are presented in Tables A.2 and A.3 of the appendix of the chapter respectively.

Table 4.5: Unit Root Tests for the Domestic Variables

Domestic Variables	Statistic	Critical Value	EURO	NIGERIA	USA
y (with trend)	ADF	-3.45	-0.83	-3.54	-2.28
y (with trend)	WS	-3.24	-1.18	-2.49	-2.45
y (no trend)	ADF	-2.89	-1.28	0.35	-0.83
y (no trend)	WS	-2.55	0.87	0.26	1.23
Dy	ADF	-2.89	-3.71	-2.86	-5.00
Dy	WS	-2.55	-3.90	-2.97	-4.74
DDy	ADF	-2.89	-7.75	-8.16	-7.89
DDy	WS	-2.55	-7.76	-8.41	-7.66
Dp (with trend)	ADF	-3.45	-2.88	-4.39	-4.27
Dp (with trend)	WS	-3.24	-2.01	-4.48	-1.34
Dp (no trend)	ADF	-2.89	-3.15	-4.32	-4.40
Dp (no trend)	WS	-2.55	-0.68	-4.46	0.04
DDp	ADF	-2.89	-6.57	-7.61	-8.46
DDp	WS	-2.55	-6.66	-7.78	-8.64
DDDp	ADF	-2.89	-9.01	-10.94	-9.70
DDDp	WS	-2.55	-8.89	-9.99	-9.43
eq (with trend)	ADF	-3.45	-2.21		-1.46
eq (with trend)	WS	-3.24	-2.46		-1.75
eq (no trend)	ADF	-2.89	-1.61		-1.28
eq (no trend)	WS	-2.55	-0.93		-0.61
Deq	ADF	-2.89	-6.62		-6.12
Deq	WS	-2.55	-6.76		-6.24
DDeq	ADF	-2.89	-9.76		-7.84
DDeq	WS	-2.55	-9.96		-8.02
ep (with trend)	ADF	-3.45	-2.13	-2.06	
ep (with trend)	WS	-3.24	-2.36	-2.32	
ep (no trend)	ADF	-2.89	-0.55	-2.10	
ep (no trend)	WS	-2.55	-0.16	-2.32	
Dep	ADF	-2.89	-6.80	-6.51	
Dep	WS	-2.55	-6.83	-6.66	
DDep	ADF	-2.89	-9.88	-8.51	
DDep	WS	-2.55	-10.03	-8.75	
r (with trend)	ADF	-3.45	-3.15	-1.96	-3.64
r (with trend)	WS	-3.24	-3.04	-1.86	-3.76
r (no trend)	ADF	-2.89	-1.08	-2.37	-2.25
r (no trend)	WS	-2.55	-1.18	-1.81	-1.65
Dr	ADF	-2.89	-4.84	-6.98	-3.58

Table 4.5 (Continuation): Unit Root Tests for the Domestic Variables

Domestic Variables	Statistic	Critical Value	EURO	NIGERIA	USA
Dr	WS	-2.55	-3.91	-7.20	-3.70
DDr	ADF	-2.89	-8.55	-8.61	-6.02
DDr	WS	-2.55	-8.38	-8.86	-7.24
lr (with trend)	ADF	-3.45	-3.13		-3.92
lr (with trend)	WS	-3.24	-3.05		-3.98
lr (no trend)	ADF	-2.89	-1.05		-1.62
lr (no trend)	WS	-2.55	-1.02		-1.51
Dlr	ADF	-2.89	-5.36		-5.89
Dlr	WS	-2.55	-5.14		-5.83
DDlr	ADF	-2.89	-8.22		-7.04
DDlr	WS	-2.55	-8.40		-7.73

Note: ADF stands for Augmented Dickey-Fuller, while WS for weighted symmetric ADF; y for real output; Dp for inflation; eq for real equity price; ep for real exchange rate; r for nominal short-term interest rate; lr for nominal long-term interest rate. Test is based on the 5% significance level.

Table 4.6: Unit Root Tests for the Global Variable

Global Variables	Test	Critical Value	Statistic
poil (with trend)	ADF	-3.45	-1.46
poil (with trend)	WS	-3.24	-1.28
poil (no trend)	ADF	-2.89	-0.69
poil (no trend)	WS	-2.55	-1.00
Dpoil	ADF	-2.89	-6.38
Dpoil	WS	-2.55	-6.49
DDpoil	ADF	-2.89	-8.70
Dpoil	WS	-2.55	-8.86

Note: ADF stands for Augmented Dickey-Fuller, WS for weighted symmetric ADF, and poil for global oil price. Test is based on the 5% significance level.

4.4.3. Weak Exogeneity Tests

Weak exogeneity testing is central to GVAR modelling. For example, if the weak exogeneity assumptions are rejected for all the foreign variables of the GVAR model, then the model cannot be solved. The exogeneity of foreign variables in the country-specific VECMs indicates that the variables are long-run forcing in relation to their domestic counterparts. The weak exogeneity test is based on the approach of Johansen (1992) and Harbo et al. (1998) and it involves testing the joint significance (i.e. F test) of the estimated error correction terms of

the country VECX* models of equation (4.2) for the foreign variables and the oil price in auxiliary equations to equation (4.2).

The implication of the test is that in these auxiliary equations the error correction terms of equation (4.2) estimated for the domestic variables $\boldsymbol{X}_{it}$ are not supposed to be jointly statistically significant, because the weak exogeneity assumption implies that there is no long-run feedback from $\boldsymbol{X}_{it}$ to the foreign variables $\boldsymbol{X}_{it}^{*}$, while there is long-run feedback from $\boldsymbol{X}_{it}^{*}$ to $\boldsymbol{X}_{it}$.

The weak exogeneity assumptions are accepted for all the foreign variables of the country-specific models of the Euro Area, the US, and Nigeria, except US foreign inflation. The results of the exogeneity tests for Nigeria, the U.S, and the Euro Area are presented in Table 4.7 below. The full results of the weak exogeneity tests for all the economies of the model are presented in Table A.4 in the appendix of the chapter.

Table 4.7: Test for Weak Exogeneity at the 5% Significance Level, Using the F Statistic

Country	F test	Critical Value	ys	Dps	eqs	eps	rs	lrs	poil
EURO	F(2,98)	3.09	1.52	1.76	0.37		2.30	1.33	0.53
NIGERIA	F(1,103)	3.93	1.07	0.03	0.22		0.89	0.10	0.57
USA	F(2,102)	3.09	0.77	3.44		1.54			

Notes: "poil" stands for global oil price; while the letter "s" points to "star", added to differentiate the earlier indicated symbols of the domestic variables from their foreign counterparts.

4.4.4. Cointegration Tests

Once the variables to be included in the individual country models VARX* (p_i, q_i) are determined, the Akaike Information Criteria (AIC) is used to determine the lag orders for the corresponding cointegration VARX models. The Johansen trace statistic is used to determine the number of cointegrating vectors. Table 4.8 below shows the cointegration results of the 3 focus economies. The full cointegration results for all the economies of the analysis are presented in Table A.5 of the appendix.

Table 4.8: VARX* Order and Cointegrating Relationships of the Country-Specific Models

	p	q	Cointegrating Relations
Euro	2	1	2
Nigeria	2	1	1
USA	2	1	2

4.4.5. Generalized Impulse Response Functions

Our impulse response functions relate to simulated external (oil-related) and domestic shocks as shown below:

4.4.5.1 External Shocks

The main external shocks simulated are: (i) positive shock to global oil price treated as endogenous in the US model; (ii) positive shock to US real output; (iii) positive shock to Euro Area real output. The latter two shocks are oil-related because increases in the real GDP of the US and the Euro Area as large oil importers are expected to cause the oil price to increase. On the other hand, the oil price is treated as endogenous in the US model for the first shock because of the dominant role of the country in the transmission of global shocks to other countries, as mentioned earlier. All the impulse responses to the shocks are over a 40-quarter horizon. In the analysis we examine the impulse responses of the real GDPs of all the concerned economies, together with the impulse responses of oil price and the real exchange rate of Nigeria, in order to examine the spending effect of Dutch disease in Nigeria. Figures 4.1-4.4 below present the impulse responses.

Figure 4.1 shows that a positive shock to the oil price, treated as endogenous in the US model, tends to increase growth in the US and the Euro Area, but these effects are not statistically significant. Increase in domestic demand for energy in an oil importer such as the US may tend to increase growth if the energy is used for production. The plausible reason for the statistical insignificance of the effects is that the simulated oil shock is endogenously driven from the US, whereas oil shocks that impacted the US significantly, such as the shock of

1979, were exogenous to the US.[13] The simulated oil shock leads to a statistically significant increase in global oil price by 10 to 20% over the simulated time horizon, which would bring oil windfall into Nigeria as an exporter of oil. Due to the shock, Nigeria's GDP falls by less than 1% over the time horizon, while the real exchange rate of the country appreciates, but below 10% over the time horizon. But these effects are not statistically significant. This implies that the Dutch disease effect of oil windfall is not statistically significant in Nigeria. Appreciation of real exchange rate and consequent growth slowdown (i.e. negative correlation between real exchange rate and growth) during oil windfall is a sign of the spending effect of Dutch disease (Treviño, 2011).[14] The finding on the non-existence of Dutch disease in Nigeria is consistent with other works on Dutch disease in the country (e.g. Budina et al., 2007; Sala-i-Martin and Subramanian, 2003).

The spending effect of Dutch disease occurs when increased income caused by a resource boom leads to higher aggregate demand, and this consequently leads to increased relative prices of domestic goods and services (Treviño, 2011, Brahmbhatt et al., 2010). The wages in the booming resource sector increase and eventually lead to increased wages in the whole economy. The increased wages lead to higher demand for domestically produced goods and services and higher prices. The exchange rate mechanism plays a key role in this process, in that it is measured as the price of non-tradables relative to the price of tradables which consist of oil and non-oil tradables (Brahmbhatt et al., 2010). As shown by these authors in their explanation of the real exchange rate mechanism of the spending effect of Dutch disease, in the theory of Dutch disease the prices of the tradables are determined in the world market, while the prices of non-tradables are determined domestically, which makes oil booms to cause the appreciation of real exchange rate, measured as the price of non-tradables relative to the price of tradables.

The increased domestic aggregate spending arising from the oil boom leads to higher demand and prices of non-tradables relative to the prices of the non-oil tradables (i.e. agriculture and manufacturing), which are determined in the international market. This tends to make real exchange rate to appreciate. However, such appreciation is "false" appreciation, in that true

[13] Dees et al. (2007), whose approach of treating the oil price as endogenous in the US we follow, also finds that the effects of oil price shocks on the US and Euro Area based on the approach are statistically insignificant.
[14] The Dutch disease has another effect called the resource-movement effect, which involves the relocation of capital and labour from the rest of the economy into the resource sector during the boom of the resource sector.

appreciation is caused by increased exports relative to imports, triggered by increased production activity and output in the real sector (Tule and Osude, 2014).

That the spending effect of Dutch disease is not statistically significant in Nigeria implies that "false" appreciation of real exchange rate is not statistically significant in the country, which makes sense in that the country adopts the flexible exchange rate policy, generally known to be an effective shock absorber (Edwards and Yeyati, 2003; Edwards, 2006; Sek, 2010). Nigeria began to adopt the flexible exchange rate policy in 1986. Before this time, oil price increases usually caused "false" appreciation of real exchange rate (Obadan, 2006). This necessitated the introduction of the flexible exchange rate regime, which has been effective in protecting the country against international developments. Soludo (2009), for example, shows that the policy was effective in limiting the impact of the 2007-2009 financial crisis on the country. Besides, Nigeria adopts a stabilization fund and an oil-price-based fiscal rule, designed to work together to absorb oil price shocks and smooth oil revenue, which are effective fiscal instruments, as shown in the analysis of chapter 6 of this thesis. Basically, the stabilization fund and fiscal rule will not be effective under the pegged exchange rate regime, in that the process of domestic adjustment to oil shocks will be hindered by the rigidity of the pegged system.

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The effect of treating the oil price as endogenous in the US model is compared to treating the variable as endogenous in the model of a large oil exporter, namely Saudi Arabia (Figure 4.2).[15] In this case, in contrast to what happens when treating the oil price as endogenous to the US, there is a statistically significant negative growth effect in the US from the 4^{th} quarter to around the 28^{th} quarter, as the oil price shock is exogenous to the economy as noted earlier. The spending effect of Dutch disease is still statistically insignificant in Nigeria when oil price is treated as endogenous in the Saudi-Arabia model. Over the time horizon, the shock leads to a statistically significant rise in oil price by an average of 10% for about 8 quarters. Nigeria's GDP falls with a maximum value of 1% and the real exchange rate of the country appreciates with a maximum value of 10%, but these effects are not statistically significant. Treating the oil price as endogenous in the Saudi-Arabian and US models separately makes it possible to simulate supply-driven and demand-driven oil shocks respectively.

[15] Note the treating the oil price as endogenous in the Saudi Arabia model involves solving the GVAR based on this specification before the oil shock is simulated.

As shown in Figure 4.3, a positive shock to the US real GDP has positive growth effects in both the US and the Euro Area. Over the time horizon, the oil price has an increasing trend with a maximum value lower than 10%, but the trend is not statistically significant. Nigeria's GDP falls with a value below 0.5%, while the real exchange rate of the country appreciates by an average of 1%, but the effects are also not statistically significant, implying that the non-existence of the spending effect of Dutch disease is maintained.

The Euro Area experiences a positive growth effect of the positive shock to its real GDP, as shown in Figure 4.4. Furthermore, increase in the real GDP of the Euro Area does not lead to a statistically significant increase in the oil price. Nigeria's real GDP tends to have positive values over most of the time horizon when its real exchange rate has a depreciating trend, compared to when it tends to appreciate, but these effects are still not statistically significant.

Figure 4.1: Generalized Impulse Responses of a Positive Unit (1 S.E.) Shock to Global Oil Price in the US Model (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds): Demand- Driven Oil Shock

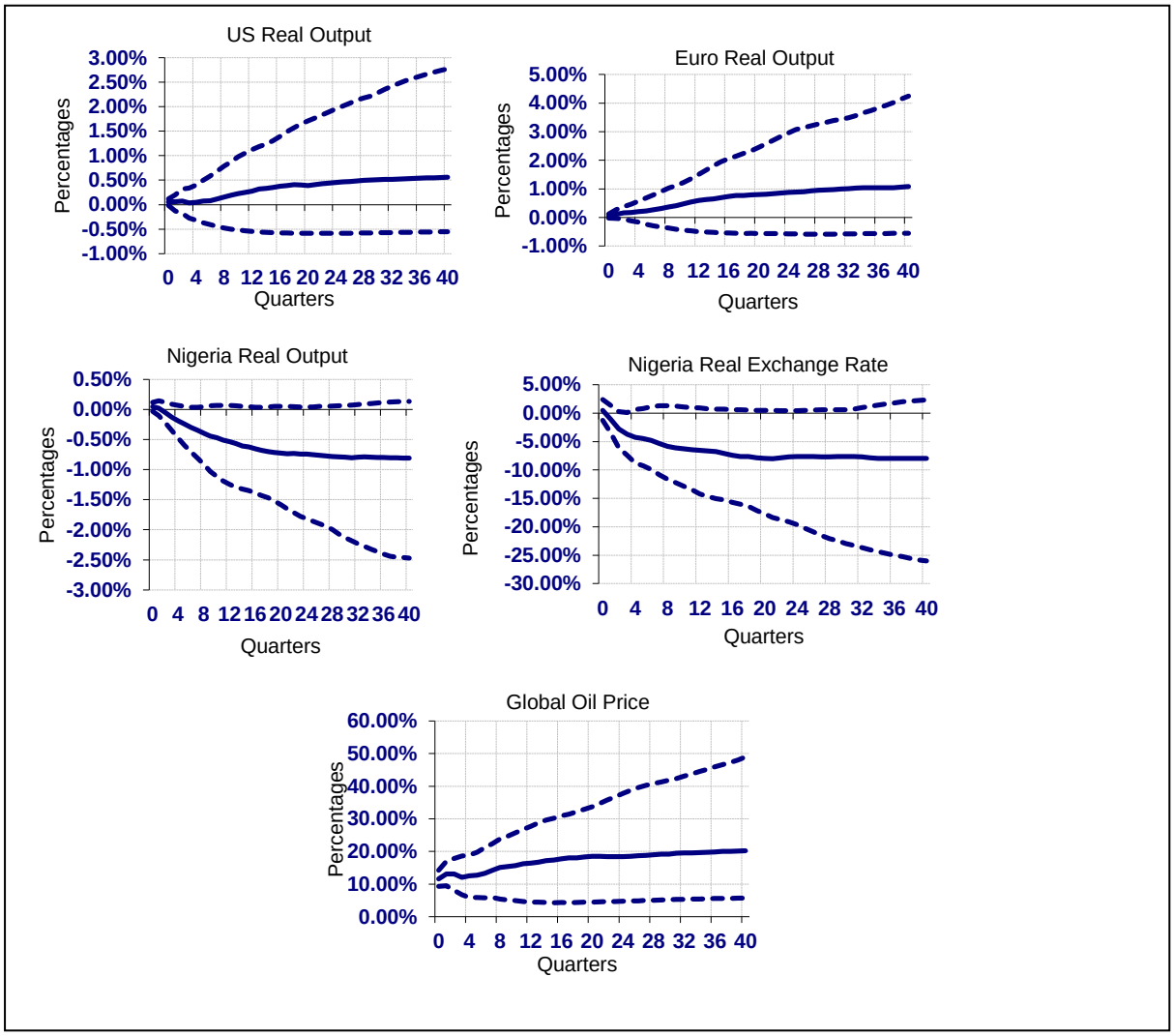


Figure 4.2: Generalized Impulse Responses of a Positive Unit (1 S.E.) Shock to Global Oil Price in the Saudi-Arabian Model (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds): Supply -Driven Shock

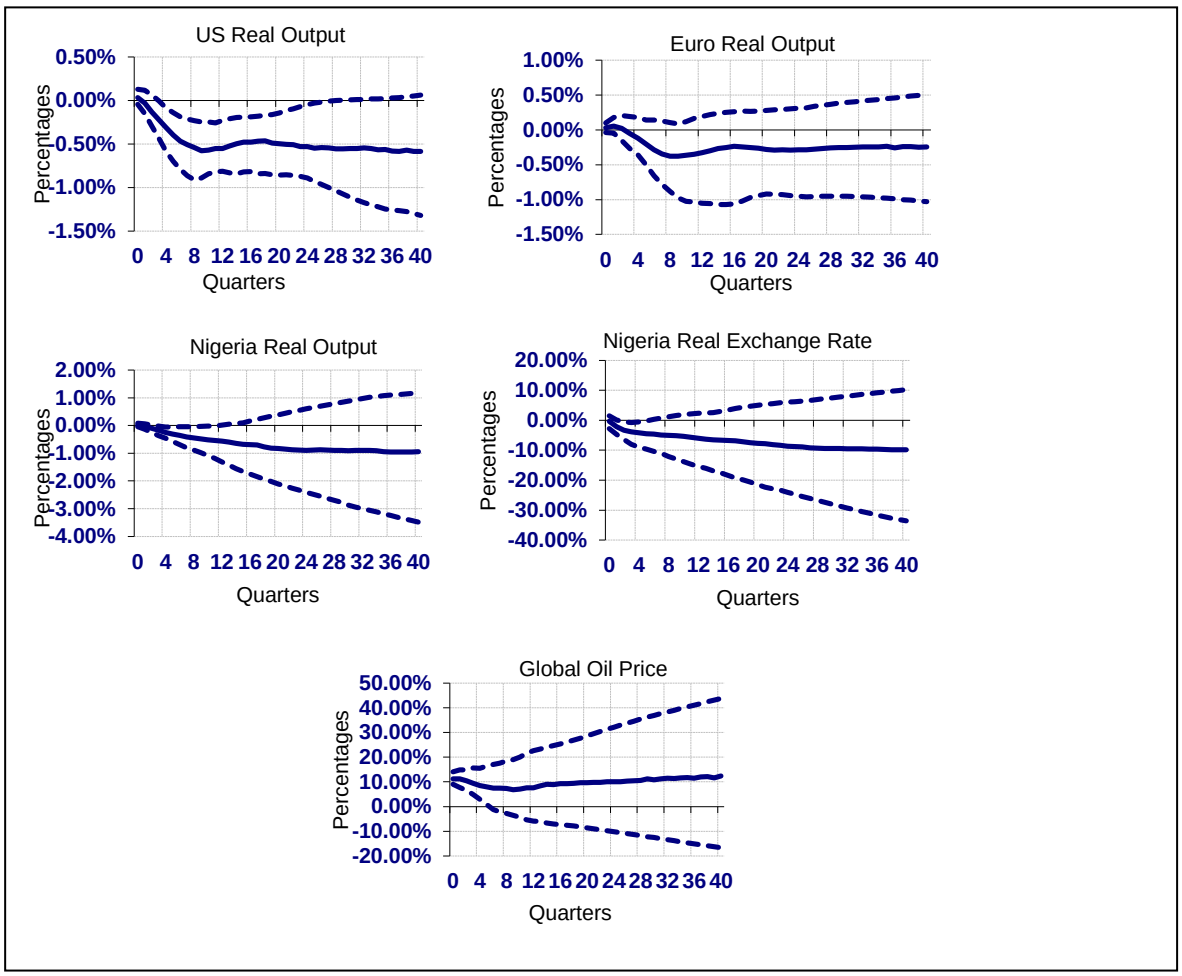


Figure 4.3: Generalized Impulse Responses of a Positive Unit (1 S.E.) Shock to US Real Output (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds)

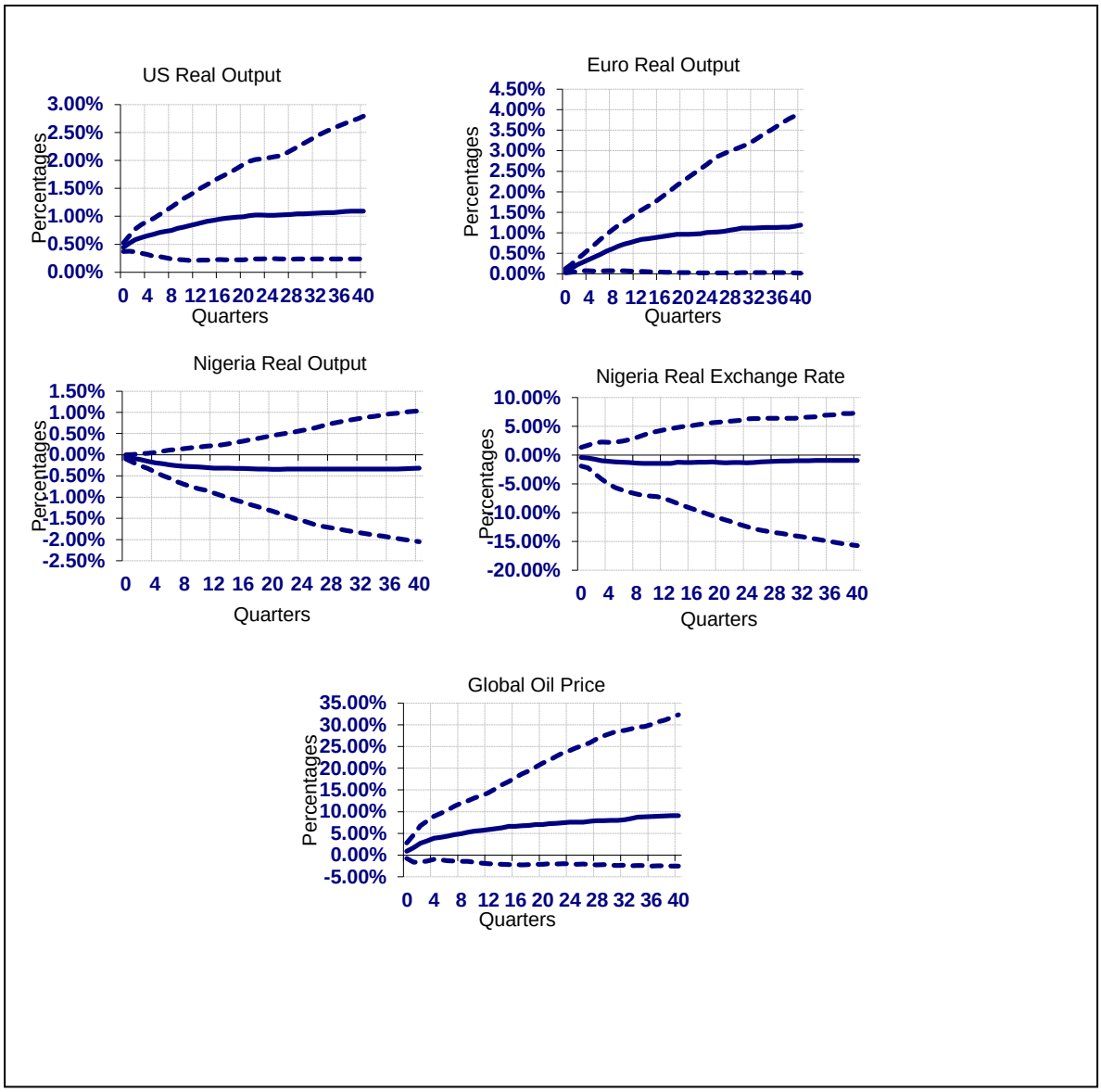
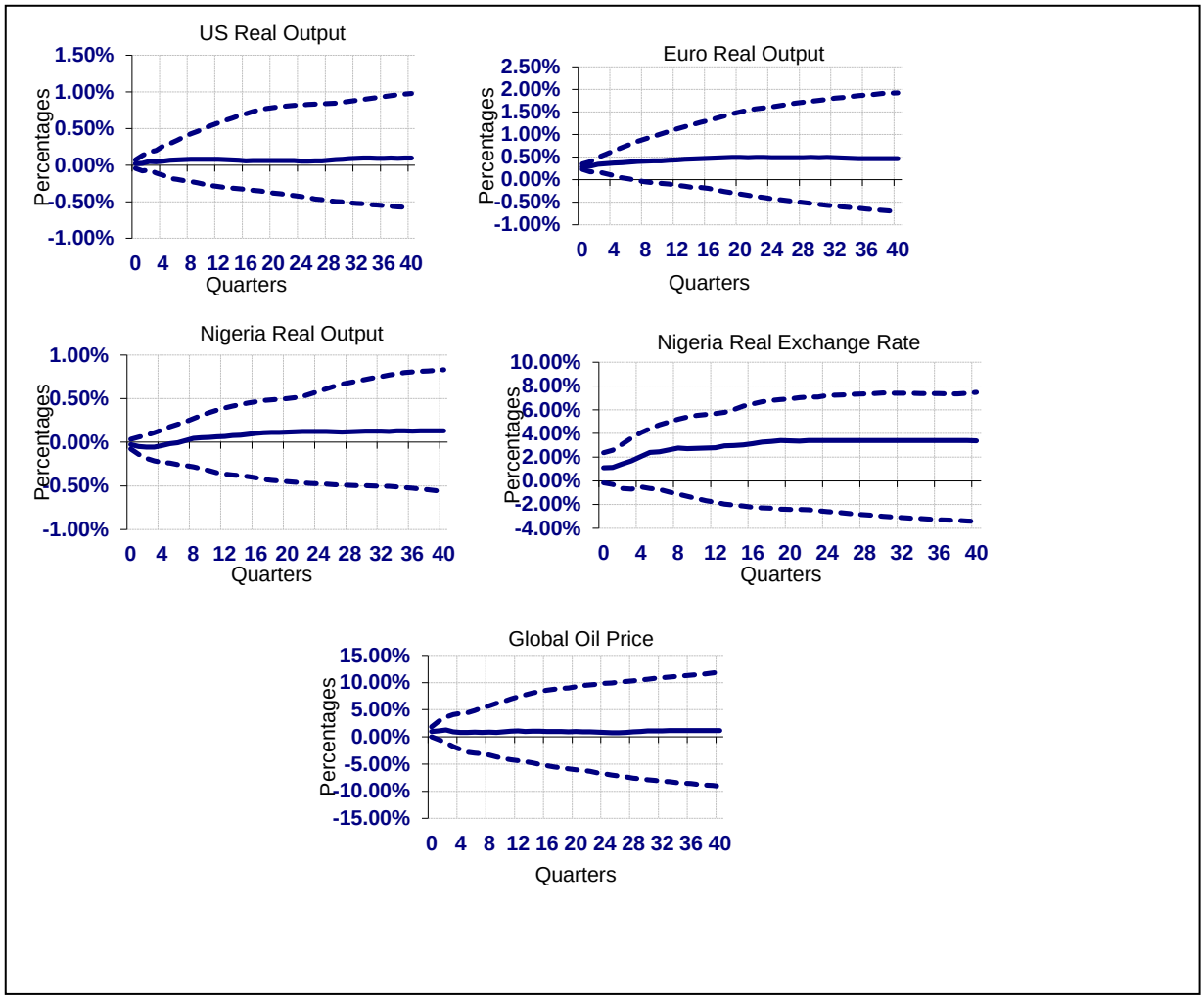


Figure 4.4: Generalized Impulse Responses of a Positive Unit (1 S.E.) Shock to Euro Area Real Output (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds)



4.4.5.2 Domestic Shocks

As shown in Figures 4.5-4.7, domestic shocks are simulated as shocks to real GDP, inflation and the real exchange rate. The results are in line with *a priori* expectations in terms of the signs of the GIRFs. There is a statistically significant negative response of the real GDP to its own negative shock. The positive shock to inflation also has a statistically significant negative impact on real GDP. The response of GDP to the negative shock to real exchange rate is negative for most of the simulation horizon, which is to be expected for an open economy, but these effects are not statistically significant. This further indicates that flexible exchange rate absorbs shocks. The shock to real exchange rate would have led to statistically significant growth slowdown if not absorbed.

Figure 4.5: Generalized Impulse Response of a Negative Unit (1 S.E.) Shock to Nigeria's Real Output (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds)

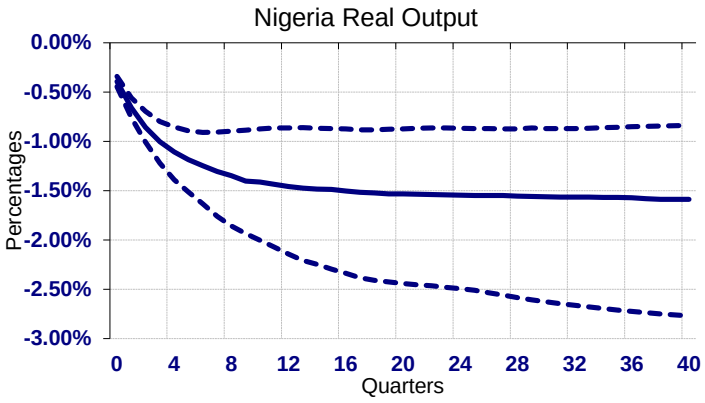


Figure 4.6: Generalized Impulse Response of a Positive Unit (1 S.E.) Shock to Nigeria's Inflation (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds)

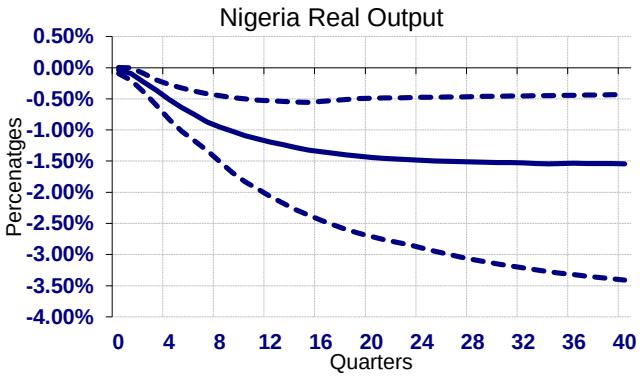
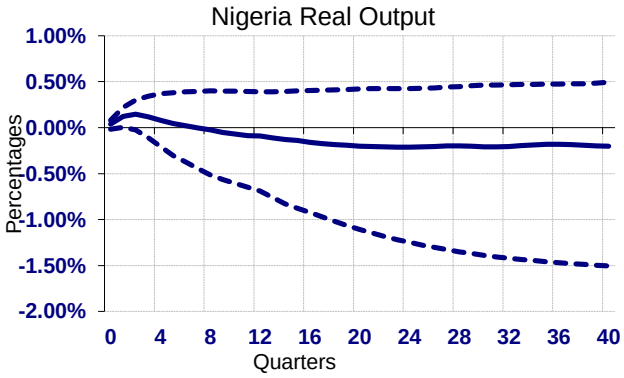


Figure 4.7: Generalized Impulse Response of a Negative Unit (1 S.E.) Shock to Nigeria's Real Exchange Rate (Bootstrap Mean Estimates with 90% Bootstrap Error Bounds)



4.5. Concluding Remarks

This chapter examines the relative effects of internal and external shocks on the Nigerian economy from the perspective of openness and global integration, using the GVAR model introduced by Dee et al (2007). The main simulated external shocks originate from the US

and the Euro Area, which are the two dominant trade partners of Nigeria. The external shocks show that the spending effect of Dutch disease is not statistically significant in Nigeria. There are three causative factors of the resource cause shown in the theoretical literature, namely Dutch disease, resource price volatility, and institutional weakness (Sala-i-Martin and Subramanian, 2003). Since Dutch disease is not statistically significant in Nigeria, the other two factors are mainly responsible for resource curse in the country. Policymaking in the economy should therefore focus on the two factors.

Furthermore, since the effects of internal shocks to real GDP and inflation are statistically significant, policymaking needs to focus on limiting internal shocks. The effectiveness of the flexible exchange rate policy is shown in the results of the external and internal shocks examined, implying that the policy should be maintained in the country. Unlike countries with pegged exchange rates which tend to experience macroeconomic fluctuations due to vulnerability to shocks, economies with flexible exchange rates tend to be resilient to shocks.

Chapter 5: Growth Comovements between Nigeria and Its Industrialized Trade Partners: Does the Decoupling Hypothesis Hold for Nigeria?

5.1. Introduction

The decoupling hypothesis relates to business-cycle spillovers from advanced economies (ADs) to emerging market and developing economies (EMDEs) such as Nigeria. The spillovers can occur via one or more of the channels of international transmission of shocks examined in the literature review of chapter 3, depending on the kinds of shocks from source economies. For example, there were business-cycle spillovers from the ADs to the EMDEs largely via the financial channels during the global financial crisis of 2007-2009. Specifically, the present chapter provides empirical evidence relating to reduction of spillovers occurring via the mechanisms of cross-border spillovers discussed in chapter 3, as the decoupling hypothesis tests whether or not there is decrease of spillovers. Such empirical evidence is particularly relevant for Nigeria, because to the best of our knowledge there is only one decoupling work (i.e. Obiora, 2009) that focuses on the country, as discussed further in this introductory part of the present chapter.

The decoupling hypothesis came into being because of the stronger growth performance in recent years of the EMDEs relative to the ADs (IMF, 2012). This new development led to observers speculating that the business cycles of the EMDEs have been decoupling from those of the ADs. Traditionally the rate of growth of the EMDEs largely depended on the rate of growth of the ADs. Therefore, the decoupling hypothesis involves testing whether the business cycles of the EMDEs are no longer as closely linked to the business cycles of the ADs as previously. The hypothesis has been tested in the literature for individual EMDEs, selected regions, and for the whole group of EMDEs.

The literature shows that there are a number of factors that may enhance the decoupling of the EMDEs from the ADs. For example, consumption in the EMDEs has risen to the level where it may replace decreases in exports when consumption in the US falls (Obiora, 2009). Intra-group trade and financial linkages have also increased within the EMDEs, leading to possible decreases of spillovers from the US and other industrial economies (Kose, 2008; Kose et al., 2008).

The objective of this chapter is to empirically investigate whether or not the decoupling hypothesis holds for Nigeria with regard to its two main trade partners identified in chapter four, namely the Euro Area and the US. Since Nigeria is a major oil exporting country, the oil price is likely to have a significant role to play in the transmission of international business cycles into the economy. Therefore, the analysis of this chapter primarily involves the dynamic factor model (DFM) with oil-related exogenous covariates. The DFM has strong power to reveal hidden or unobserved joint movements in data.

To the best of our knowledge, no study has analysed the decoupling hypothesis for Nigeria by exploring the oil channel through a DFM that includes oil-related variables, which creates a gap in the literature. For example, Kose et al. (2008) analyse the decoupling hypothesis in a DFM involving 106 countries that includes Nigeria, based on three dependent variables, namely GDP, investment, and consumption, without using any oil-related exogenous variables. Besides, Obiora (2009), which is the only decoupling work focusing specifically on Nigeria to the best of our knowledge, investigates whether the hypothesis holds for the country by using a Vector Autoregressive model to analyse the relative importance of spillovers to the nation through the trade, financial, and commodity price channels, but this does not involve any unobserved factor.

The major limitation in Obiora (2009) is that it does not capture unobserved movements in the spillovers between Nigeria and its industrial trade partners. This thesis addresses this limitation in the analysis of the present chapter with the use of the DFM, as the technique captures hidden movements in data. In discussing the power of the DFM, Kose et al. (2008) note that "the DFM is in fact a decomposition of the entire joint spectral density matrix of the data."

Overall, the results of the chapter show a statistically significant degree of growth comovements between the three economies under consideration, reflecting that the decoupling hypothesis does not hold for Nigeria. The present chapter makes important contributions to the literature in the following ways: (i) The findings of the chapter contribute to empirical works relating to the theories of international transmission of shocks, as the observed comovements are fluctuations originating from Nigeria's industrial trade partners and transmitted to Nigeria via the mechanisms of cross-border spillovers. (ii) The findings also contribute to the decoupling hypothesis literature which has little Nigeria-related studies.

The remaining parts of the chapter are organized as follows: Stylized empirical discussions on the decoupling hypothesis are done in section 5.2. Section 5.3 discusses the variables and data used in the study. The methodology and econometric frameworks are expounded in section 5.4. The empirical results are presented in section 5.5 and discussed further in section 5.6. Concluding remarks are given in section 5.7.

5.2. The Decoupling Hypothesis: Stylized Empirical Discussions

The decoupling of the EMDEs from the ADs has two forms, namely real decoupling and financial decoupling. Real decoupling concerns the desynchronization of the business cycles of the countries of the two economic groups, which can be measured through "real" variables such as GDP and trade flows, while financial decoupling requires insignificant financial spillovers or the absence of financial contagion between the economies of the two groups, which can be measured through financial variables such as stock prices and interest rates (Cutrini and Galeazzi, 2012). This chapter addresses real decoupling.

Kose and Prasad (2010) provide excellent discussions of global growth trends involving the EMDEs and ADs. As shown by these authors, the contributions of the ADs to global growth followed a decreasing trend over the Bretton Woods (1960-1972), pre-globalization (1973-1985), and globalization (1986-2009) periods, in contrast to the shares of the AMDEs which had an increasing trend over these periods, as indicated in Table 5.1. This table also shows that these trends continued in the most recent years (2008-2009) of the sample.

Table 5.1: Distribution of Global GDP (Measured in Percentages)

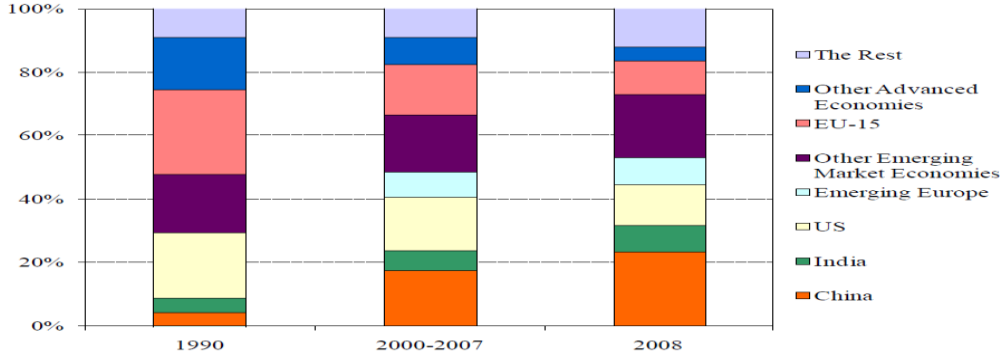
Group	1960-1972	1973-1985	1986-2009	2008-2009
Advanced Economies	80.30	73.21	65.71	56.98
Emerging Market Economies	16.60	22.86	30.69	39.06
Other Developing Economies	3.09	3.93	3.60	3.95
US	32.64	27.08	25.88	23.58
Japan	7.77	9.40	9.06	7.03
G-7	70.19	61.19	55.29	47.46
EU-15	34.41	31.10	25.74	21.77
Major Emerging Market Economies	6.30	9.04	15.09	22.57

Notes: The values are the shares of GDP in total world GDP calculated by using PPP exchange rates. EU-15 consists of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and UK, while the major emerging markets include Brazil, China and India.

Source: Kose and Prasad (2010).

Three emerging markets, namely Brazil, China, and India made significant contributions to the improved growth performance of the EMDEs, with China having the strongest share among the three outstanding countries, as indicated in Figure 5.1 below.[16] Kose and Prasad (2010) also note the dominant contributions of the US to the trade and financial linkages of the EMDEs.

Figure 5.1: Contributions to World Growth (Measured in Percentages)



Notes: The values are measured in PPP exchange rates. Countries considered separately are not included in the economic groups to which they belong.

Source: Kose and Prasad (2010).

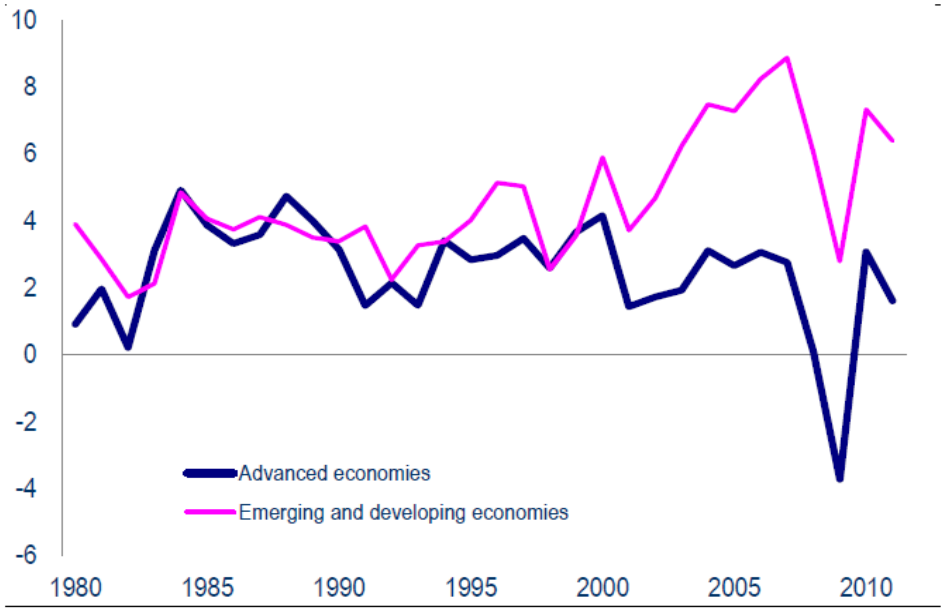
[16] The three economies are part of the group of large developing countries tagged the BRICs in the literature, which has been observed to have outstanding growth. In fact, it has been predicted that the growth of BRICs would overtake the growth of the G6 (US, Japan, UK, Germany, France, and Italy) by 2050 (see Bell, 2011; Wilson and Purushothaman, 2003).

Apart from the definition of decoupling involving business-cycles desynchronization or disconnection, the concept of decoupling may also be defined in terms of the relative shares of country-specific, regional, and global factors in the economic performance of EMDEs (Kose et al., 2008); and the degree of resilience of the EMDEs to shocks from the ADs (Pesce, 2014). Increases in the relative contributions of country-specific and regional factors in the economic performance of a country/region at the expense of the share of global factors, and a rise in the degree of resilience may point to decoupling. In this chapter, we measure decoupling based on the definition involving desynchronization, by examining the correlation or comovement of the considered variables.

Studies of real decoupling may be categorized into two main classes. The first class of studies are conducted from the perspective of the aggregate growth performance of the EMDEs, looking for evidence of divergence from the growth of ADs (see for examples, Economic and Financial Affairs, 2011; Dervis, 2012). The main finding of the studies in this class shows that the increasing aggregate growth performance of the EMDEs over the ADs in recent years is a consequence of the divergence of the long-run aggregate growth trends of the two groups and not due to the short-run cyclical components of growth. This evidence of business-cycle comovement between the two groups contradicts the decoupling hypothesis.

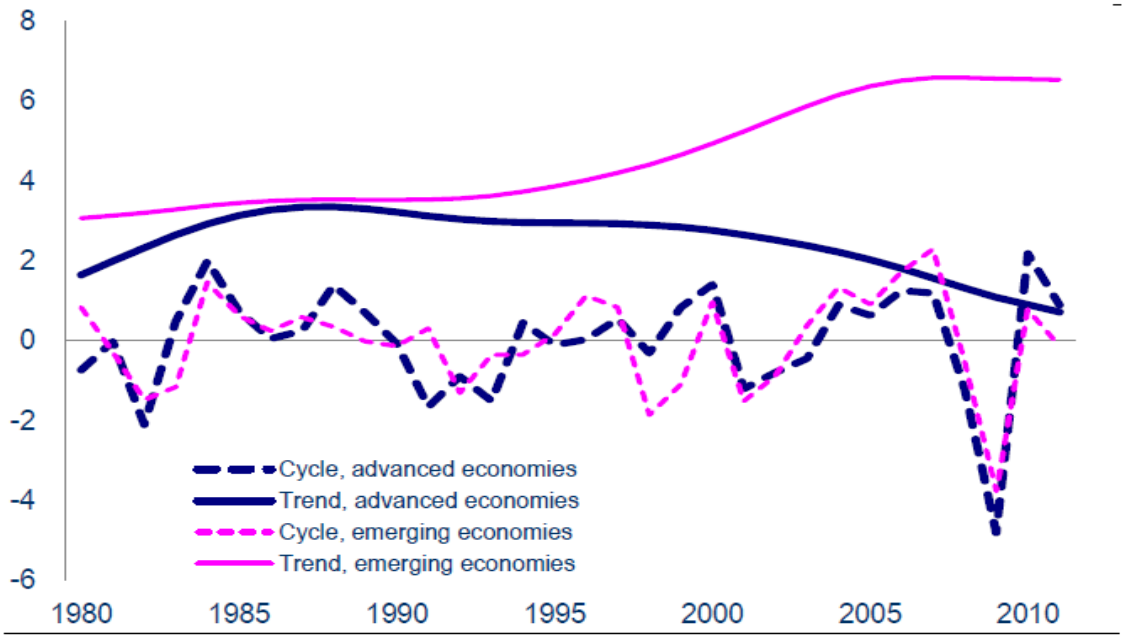
Dervis (2012) agrees with this argument writing that: "Growth in emerging market and developing economies is less dependent on advanced economies over the long run, but in the short run they dance together." Figure 5.2 shows the overall growth performances of the two economic groups without decomposition into cycles and trends, while Figure 5.3 displays the convergence and divergence of the cycles and the trends respectively.

Figure 5.2: Real GDP Growth in Emerging Market and Developing and Advanced Economics (Annual % Changes; 1980-2011)



Source: Economic and Financial Affairs, 2011.

Figure 5.3: Cycles and Trends of Annual GDP Growth Rates in Emerging and Advanced Economies (1980-2011)



Notes: Trends are in % annual growth rates and cycles in % of trend.

Source: Economic and Financial Affairs, 2011.

The studies of the second class focus on investigating whether individual EMDEs or EMDE regions have been decoupling from the ADs, particularly the US. Unlike the studies of the

first class which employ aggregate variables, the studies of the second class use variables relating to individual countries and regions. Besides, unlike the studies of the first class, the studies of the second class have mixed findings. Some of the findings show that no decoupling has taken place (for examples, Willett et al., 2011; Wälti, 2009; Lam and Yetman (2013); Wyrobek and Stańczyk (2013); Jayaram et al. (2009); Obiora (2009)). Other findings provide evidence of the desynchronization of the business cycles of certain emerging and developing countries and regions from the business cycles of the advanced economies (for examples, Park and Shin, 2009; He and Liao, 2011; Kose et al., 2008).

The differences in the findings of the two classes of studies suggest that the increasing growth performance of the EMDEs in recent years may be a concomitant of varying contributions of the individual economies to the aggregate . While some, such as China, Brazil and India, may be growing significantly , others may be experiencing lower growth rates. This implies that there may be varying shares of country-specific, regional, and global factors in the economic performances of these countries. Besides, they may have varying level of resilience to shocks from the ADs. This necessitates case-by-case empirical studies in dealing with the decoupling hypothesis.

Besides, case-by-case empirical studies are required because economic theory has contrasting arguments regarding the subject of decoupling. Theories relating to international comovements suggest that trade linkages, which vary across individual EMDEs, enhance cross-country spillovers and output comovements. But theories based around the principle of comparative advantage also show that if increased trade linkages lead to higher specialization in the production of the EMDEs, then the level of international output comovement between the EMDEs and their industrial trade partners may fall.

At this juncture, we address the question: ‘What factors can make real decoupling likely, particularly in resource-rich economies like Nigeria?’ Dealing with this question is necessary, because as Cutrini and Galeazzi (2012) note, while there is agreement on the possibility of financial decoupling in the literature, some authors seem to believe that the idea of real decoupling is a fallacy. For example, panic may motivate investors to move their assets from traditional markets to new ones, leading to significant changes in traditional cross-country financial comovement and decoupling. But this process may not lead to real decoupling, since

real decoupling involves macroeconomic fundamentals which may not desynchronize quickly.

The empirical literature suggests four factors that may enhance the growth of an EMDE and make its business cycles less dependent on that of its industrial trade partners. Firstly, intra-regional trade may enhance the decoupling of a resource-rich economy. The economy's increasing intra-regional linkages may diversify international trade away from industrial trade partners like the US and reduce international business-cycle linkages. For example, the analysis of Ilahi and Shendy (2008) on the intra-regional growth linkages between the oil-producing countries of the Gulf Cooperation Council (GCC) and eight countries in the Middle East suggest that the linkages strengthen the growth of the region and increases the potential for decoupling from the industrial countries.

Reducing the degree of reliance on the resource sector by developing the non-resource sector is a second factor through which the decoupling potential may be strengthened, since this diversifies the economy and enhance growth. Diversification usually enhances growth in developing economies (Hesse, 2008; Sannassee et al., 2014).

Thirdly, the nature of growth also contributes to the ability to decouple. The possibility of an EMDE decoupling from the ADs will increase, if the former does not rely solely on the export-driven growth strategy, as shown in Cutrini and Galeazzi (2012). The authors argue that the increased integration of the EMDEs into the global economy over the past two decades was largely due to the fact that they have been following an export-led growth strategy, which does not enhance decoupling because it hinders the growth rate of internal demand.

Fourthly, improved institutional quality in the resource-rich economies will also enhance their ability to decouple, as shown in the work of Sala-i-Martin and Subramanian (2003) on Nigeria. Good institution will help to limit the resource-growth paradox. Logically, this must be done first before any significant decoupling process can exist.

At this point we present the review of the methods adopted in analysing decoupling in the literature. Cutrini and Galeazzi (2012) presents a review of the econometric techniques employed in the empirical literature to analyse decoupling, together with the countries, data

frequencies, periods, and findings associated with the techniques. The findings are mixed as indicated earlier: some show the evidence of decoupling, while some do not. As shown in Table 5.2 below, examples of econometrics techniques mentioned by Cutrini and Galeazzi (2012) in their review are dynamic factor model, synchronicity measure, dynamic correlations, and panel VAR, all of which have the ability to measure comovement.

Table 5.2: A Summary of Empirical Studies on Real Decoupling

	Methods	Period (frequency)	Countries	Is the decoupling hypothesis verified?
Kose *et al.* (2008)	Dynamic factor model based on GDP growth rates	1960-2005 (annual)	106 countries classified as advanced, emerging and other developing	Yes. Mild support to decoupling.
Wälti (2009)	Synchronicity measure developed by Mink *et al.* (2007)	1980-2007 (annual)	8 Asian countries, 9 Latin American countries and 13 Eastern European countries	No. Decoupling is a myth
Willett *et al.* (2011)	Correlations of GDP growth and deviation from GDP growth trend	1960-2008 (annual)	BRICs	No, even China and India were not able to insulate from the Global Recession
Fidrmuc and Korhonen (2010)	Dynamic correlations of GDP growth rates (Croux *et al.*, 2001)	1992-2008 (quarterly)	Emerging Asia vs. OECD countries (focus on China and India)	Yes. However the co-movements have generally increased as a result of the global financial crisis
Kim *et al.* (2011)	Panel VAR (correlation of GDP growth rates)	1990-2008 (quarterly)	Emerging Asian economies vs. G6 (Canada, France, Germany, Italy, United Kingdom, and United States)	No. Bidirectional interdependences
Park and Shin (2009)	Cyclical measures of output for the three blocs based on growth rate of real output of each group	1990-2006 (quarterly)	3 economic blocs: the U.S., the EU and Emerging Asia	Yes. Decoupling of emerging Asia before the global financial crisis
He and Liao (2011)	Multi-level structural factor model based on GDP growth rates	1981-2008 (quarterly)	9 Asian countries: Honk Kong, China, Indonesia, South Korea, Malaysia, Philippine, Singapore, Taiwan, Thailand	Yes. Asian decoupling can be explained in terms of common productivity shocks

Source: Cutrini and Galeazzi (2012).

The comovement of a group of economic series points to the existence of a common feature of the series caused by common components like cycles and trends. The common feature implies it is possible to reduce a large number of series to a more parsimonious and most likely a more informative form, which can be modelled through cointegration techniques for non-stationary series and models such as dynamic factor models for stationary series (Vahid and Engle, 1993; Centoni and Cubadda, 2011). The cointegration of variables having stochastic trends means that they have some common stochastic trends affecting their long-run fluctuations, with the trend capturing all the random shocks having permanent effects on

the variables. On the other hand, a dynamic factor model produces an unobserved factor representing an unobserved common characteristic in a group of stationary series.

A vital implication of the papers of Table 5.2 is that there are mixed findings on the decoupling of individual EMDEs and EMDE regions as indicated earlier, which may be due to country-specific and region-specific characteristics and the periods covered in studies. Again, this makes country-by-country approach to studying decoupling necessary. The need for this approach is even shown by the mixed findings of more recent studies. For example, Pesce (2014) employs a time-varying panel VAR with factorization of coefficients to explore the average responses of the EMDEs to shocks from the ADs, using an annual dataset (1978-2010) consisting of 21 ADs and 57 EMDEs and observe that although the resilience of the EMDEs has increased over time, they are still vulnerable to the shocks emanating from the ADs, suggesting that the EMDEs have not decoupled from the ADs. On the other hand, the findings of Claassen et al. (2013) suggest the decoupling of the EMDEs from the ADs, based on dynamic factor analysis involving quarterly data (1973Q3-2011Q2) for a sample of 32 EMDE and AD economies. The aim of the analysis is to determine the extent to which common components cause comovements in vital variables (e.g. real GDP, exchange rate, imports, exports) for the economies considered.

5.3. Variables and Data

The variables used in the study are the GDP of Nigeria, the US and the Euro Area, and the global oil price. The GDP and global oil price data employed are the same as used in Chapter 4 of the thesis. The oil price cycles and trend are generated from the oil price through the Hodrick-Prescott (HP) filter. Table 5.3 below presents the summary of the information on the data used in the study.

Table 5.3: The Data of the Study

Variable	Source of Data	Form of Data
Euro Area real GDP	GVAR database	Quarterly (1979Q2-2009Q4)
USA real GDP	GVAR database	Quarterly (1979Q2-2009Q4)
Nigeria's real GDP	GVAR database (added to the database as discussed in chapter four)	Quarterly (1979Q2-2009Q4)
Oil Price	GVAR database	Quarterly (1979Q2-2009Q4)
Oil price trend	HP Filter applied to oil price of GVAR database	Quarterly (1979Q2-2009Q4)

5.4. Methodology and Econometric Framework

Unit root tests are undertaken to examine the stationarity of the considered variables. Cointegration techniques are employed to analyse the long-run relationship between the three GDPs and the oil price. This is to serve as the initial analysis of comovement. Thereafter, the DFM, our main technique, is estimated for further comovement analysis, after which the covariate model is employed for the robustness check of the DFM. The cointegration analysis is particularly relevant because existence or non-existence of cointegration is a relevant factor of comovement. Hidden or unobserved joint movements which the DFM is modelled to capture may not exist, if considered variables do not move together over the long-run.

5.4.1. Unit Root Tests

Basically, we employ the same unit root methods used in the GVAR model discussed in chapter four, which are the Augmented Dickey-Fuller (ADF) and weighted symmetric (WS) approaches. As stated in chapter four, the WS technique is more powerful than the ADF technique (Dees et al. 2007). Examining the stationarity of considered variables via unit root tests helps in determining the appropriate techniques of cointegration to be employed.

The Johansen cointegration technique is appropriate for I (1) variables and when there is the likelihood of more than one cointegrating relationships. Cointegration techniques such as the Bounds testing technique proposed by Pesaran et al. (1999) are not appropriate when there is the likelihood of more than one cointegrating relationships.

5.4.2. Cointegration Tests

The Johansen (1991, 1995) technique is employed to test for the existence of cointegration between the oil price and the three GDPs under consideration. The Johansen cointegration technique is based on maximum likelihood estimation, with two different likelihood ratio tests, namely the trace and the maximum eigenvalue tests. The technique involves the estimation of a VECM of the form $\Delta y_t = \propto \beta' y_{t-1} + \sum_{t-1}^{p-1} \Lambda_i \Delta y_{t-1} + u_t$, where y_t is the (K×1) vector of US real GDP (usagdp), Euro Area real GDP (eurogdp), Nigeria's real GDP (niggdp), and oil price (oil), which are I(1) variables; $\propto and\ \beta$ are (K × r) parameter matrices of rank r < K; Λ_i are the matrices of parameters; and u_t is the vector of serially uncorrelated errors.

As indicated earlier, a major advantage of the Johansen approach is that in a dataset containing two or more series it can estimate more than one cointegrating relationship. This helps in giving theory-consistent interpretations of the cointegration results, since cointegration relationships usually have theoretical meanings. With respect to ability to estimate more than one cointegrating relationship, the Johansen approach has higher power over other cointegration methods such as the Engle-Granger procedure (Engle and Granger, 1987), the Phillip-Ouliaris approach (Phillip and Ouliaris, 1990), and the technique of Pesaran et al. (1999).

5.4.3. Dynamic Factor Model

Cointegration is expected to give us an initial perception of the existence of comovement before we employ the DFM, which is our main technique. Generally, as Kose et al. (2008) explain, the DFM is able to produce results that common alternative techniques of analysing comovement like static correlation may not produce. The authors explain the features that make the DFMs advantageous over the alternatives in this respect. Firstly, the dynamic nature

of the DFMs enables them to capture such dynamic properties of a dataset as autocorrelations and cross-autocorrelations.

Secondly, the DFM has the ability to detect the common component of a set of variables and the responses of the variables to the component. This means, the DFM can, for example, identify the varying responses of the GDPs of Nigeria, the Euro Area, and the US to the unobserved factor and assign the appropriate sign to the factor loading of each GDP series.

Finally, the DFM makes it possible to specify or identify multiple unobserved factors driving considered variables, so that comovements across all the variables and the subsets of the variables can be explored, implying that the relative roles of the factors can also be examined. This feature is particularly useful for analysis involving multiple factors.

The DFM therefore can capture the features causing the comovements of variables within a dataset. According to Kose et al. (2008), "the DFM is in fact a decomposition of the entire joint spectral density matrix of the data." The DFM was proposed by Geweke (1977) with the central principle that a few latent or unobserved factors drive the comovements of a vector of observed time-series variables. The model can also be used to explore comovements driven by a single unobserved factor.

We model our DFM based on the conjecture that a latent oil-related factor drives the comovement between the real GDPs of Nigeria, the Euro Area, and the US. The factor has oil-related exogenous covariates, which are the trend and the cycles of the oil price obtained through the Hodrick-Prescott (HP) filter. The covariates are employed with the belief that they will help to capture the business-cycle linkages between Nigeria and the two industrial trade partners, since the former is a major oil exporter, while the industrial countries are major oil importers.

Therefore, in our DFM the three considered real GDPs denoted by *niggdp*, *eurogdp*, and *usagdp* for Nigeria, the Euro Area, and the US respectively, are linear functions of the unobserved factor, which in turn is a function of the oil price trend and the oil price cycle denoted by *oiltrend* and *oilcycle* respectively and a second-order autoregressive process, as shown in the equations below:

$$y_{it} = \mathrm{A}f_t + u_{it} \quad (5.1)$$

$$f_t = \mathrm{B}z_t + \Pi_1 f_{t-1} + \Pi_2 f_{t-2} + v_t \quad (5.2)$$

where y_{it} = is a $k \times 1$ vector of niggdp, eurogdp, and usagdp

A = $k \times n_f$ matrix of parameters which are the factor loadings

$f_t = n_f \times 1$ vector of unobserved factors, which is a column vector because we have only one factor

$u_{it} = k \times 1$ vector of disturbances

B = $n_f \times n_z$ matrix of parameters

$z_t = n_z \times 1$ vector of oiltrend and oilcycle

$\Pi_i = n_f \times n_f$ matrix of autocorrelated parameters for $i \in \{1, 2, 3\}$

$v_t = n_f \times 1$ vector of disturbances

Equation 5.1 can be written more explicitly for the three GDPs under consideration as follows:

$$Dln(eurogdp)_t = \mathrm{A}_1 f_t + u_{1t} \quad (5.3)$$

$$Dln(niggdp)_t = \mathrm{A}_2 f_t + u_{2t} \quad (5.4)$$

$$Dln(usagdp)_t = \mathrm{A}_3 f_t + u_{3t} \quad (5.5)$$

where eurogdp, niggdp, and usagdp stand for the real GDPs of the Euro Area, Nigeria, and the US respectively.

the oil price cycles and oil price trend used in our DFM are obtained from the oil price through the Hodrick-Prescott (HP) filter procedure, which is explained in the next section.

5.4.3.1. The Hodrick-Prescott Filter

The HP filter, which was introduced by Hodrick and Prescott (1997), is a technique that is used for decomposing a series into its long-term trend and short-term cyclical components, in order to remove the short-term component and obtain a smooth long-term component. The filtering procedure of the HP filter is an optimization process that produces the smooth series from the original series by minimising the variance of the latter around the former. Suppose a series y_t consists of a trend component z_t and a cyclical component c_t, so that $y_t = z_t + c_t$. Based on a penalty parameter λ that constrains the second difference of z_t, the smooth trend component is obtained by minimizing:

$$\sum_{t=1}^{T}(y_t - z_t)^2 + \lambda \sum_{t=2}^{T-1}\left((z_{t+1} - z_t) - (z_t - z_{t-1})\right)^2 \quad (5.6)$$

Since $y_t = z_t + c_t$, equation 5.6 is also the same as:

$$\sum_{t=1}^{T}(c_t)^2 + \lambda \sum_{t=2}^{T-1}\left((z_{t+1} - z_t) - (z_t - z_{t-1})\right)^2 \quad (5.7)$$

The smoothness of the trend component depends on the value of the parameter λ, reflecting that the trend becomes smoother as $\lambda \to \infty$. Hodrick and Prescott (1997) recommend varying values of λ for different periodicity of the data used in the filtering process as follows:

$$\lambda = \begin{pmatrix} 100 & \text{for annual data} \\ 1{,}600 & \text{for quaterly data} \\ 14{,}400 & \text{for monthly data} \end{pmatrix} \quad (5.8)$$

In this line, we set λ to be equal to 1,600 in our study, since we employ quarterly data for the analysis.

5.4.4. Covariate Model: Robustness Check of the Dynamic Factor Model

We undertake a robustness check of the DFM with the unobserved factor in a covariate model where the Nigerian GDP is regressed in turn against the unobserved factor, the lagged terms

of the GDPs of the US and the Euro Area, and the lagged terms of the Nigerian GDP. As indicated by Stock and Watson (2010), the predicted factor of a DFM can be employed for postestimation regressions of various purposes.

The covariate model consists of three equations. In the first equation, the Nigerian GDP is regressed against the predicted unobserved factor, which acts as a standardized variable across the three GDPs, since it captures their comovements. In the other two equations, the lagged forms of the GDPs are included accordingly as covariates, since the GDPs have individual localized independence and can change the results of the first equation. The hypotheses relating to the three equations of the covariate model are therefore as follows:

Hypotheses for first equation of covariate model:

H_0: Unobserved factor does not have impact on regressand (Nigerian real GDP) similar to the impact of DFM

H_1: Unobserved factor have impact on regressand (Nigerian real GDP) similar to impact of DFM

Hypotheses for second equation of covariate model:

H_0: The presence of US and Euro Area covariates does not change the results of the first equation

H_1: The presence of US and Euro Area covariates changes the results of the first equation

Hypotheses for third equation of covariate model:

H_0: The presence of Nigerian covariate does not change the results of the second equation

H_1: The presence of Nigerian covariate changes the results of the second equation

The hypotheses of the three equations are designed to test whether or not the unobserved factor obtained from the DFM truly serves as the standardized variable capturing

comovements across the three GDPs under consideration. The real GDP of the focus economy (Nigeria) is therefore regressed against the unobserved factor in the first equation, while covariate effects of included covariates are examined in the second and third equations of the covariate model. The existence of covariate effects points to the robustness of the DFM.

The first equation of the covariate model is:

$$Dln(niggdp)_t = \gamma_0 + \gamma_1 f_t + u_t \quad (5.9)$$

where $niggdp_t$ = Nigeria's real GDP

f_t = unobserved factor

u_t = error term

The second equation of the model extends the first equation by including twelve lags each of the real GDPs of the Euro Area and the US as covariates, making the model to have lagged covariates:

$$Dln(niggdp)_t = \pi_0 + \pi_1 f_t + \pi_2 Dln(eurogdp)_{t-1} \ldots \pi_{13} Dln(eurogdp)_{t-12} + \pi_{14} Dln(usagdp)_{t-1} \ldots \pi_{25} Dln(usagdp)_{t-12} + v_t \quad (5.10)$$

where $eurogdp_t$ = the real GDP of the Euro Area

$usagdp_t$ = the real GDP of USA

v_t = error term

The third equation of the model extends the second equation by also including twelve lags of the Nigerian GDP as covariates, making the model to have an autoregressive feature. The covariates are expected to change the impact of the unobserved factor of equation 5.9, as mentioned earlier. The third equation is as follows:

$$Dln(niggdp)_t = \pi_0 + \pi_1 f_t + \pi_2 Dln(eurogdp)_{t-1} \dots \pi_{13} Dln(eurogdp)_{t-12} + \pi_{14} Dln(usagdp)_{t-1} \dots \pi_{25} Dln(usagdp)_{t-12} + \pi_{26} Dln(niggdp)_{t-1} \dots + \pi_{37} Dln(niggdp)_{t-12} + z_t \quad (5.11)$$

where z_t = error term

The chosen number of lags (i.e. twelve) of the covariates is based on empirical discretion. The number of lags should be sufficient to capture the dynamics of the business cycles of the economies.

5.4.5. The Relationship between Oil Price and Unobserved Factor: Evidence from Statistics

Together with the above robust check, statistics showing the nature of the relationship between the oil price and the estimated unobserved factor are also estimated. This is to done to confirm the relationship between the two variables shown in the results of the DFM, as this will further reveal the level of the success of the estimated DFM.

The statistics estimated capture vital statistical characteristics like volatility, correlation, and covariance, making it possible to examine the role of oil in the international business cycles transmission relating to the three economies in question.

5.5. Empirical Results

We present and discuss below the empirical results of the analysis, capturing unit root tests; cointegration tests including their lag-length selection criteria; the DFM; the covariate model; and the statistics showing the relationship between the oil price and the unobserved factor.

5.5.1. Unit Root Tests

As shown in the Tables 5.4 both the ADF and WS approaches indicate that the three GDPs and the oil price are stationary after first differencing, reflecting that the variables are all *I* (1). As indicated earlier, the WS technique has stronger relative performance power over the ADF

method, suggesting that the *I* (1) status of the variables is proven to be valid by the similar results of the methods of varying strength of performance.

Table 5.4: Unit Root Tests for Real Output and Global Oil Price at the 5% Significance Level

Specification	Test	Critical Value	Euro Output	Nigeria Output	US Output	Oil Price
With trend	ADF	-3.45	-0.83	-1.36	-2.28	-1.46
With trend	WS	-3.24	-1.18	-1.71	-2.45	-1.28
No trend	ADF	-2.89	-1.28	-1.34	-0.83	-0.69
No trend	WS	-2.55	0.87	0.40	1.23	-1.00
First Difference	ADF	-2.89	-3.71	-4.19	-5.00	-6.38
First Difference	WS	-2.55	-3.90	-4.22	-4.74	-6.49

Notes: As in chapter four, ADF stands for Augmented Dickey-Fuller, and WS for weighted symmetric ADF. Based on the prompting for options by the GVAR software regarding the unit root tests, we choose the Akaike Information Criteria (AIC) for the lag order selection and 4 as the maximum lag order, since our data are in quarterly form.

5.5.2. Cointegration Tests

Table 5.5 presents the VAR lag selection criteria statistics for the cointegration tests. We employ the Akaike's Information Criterion (AIC), the Hannan and Quinn Information Criterion (HQIC), and the Schwarz's Bayesian Information Criterion (SBIC) in selecting the optimum VAR lag for the cointegration, using the levels forms of the considered variables, which are the oil price and the three GDPs under consideration. As shown in Table 5.5, the optimum number of lags chosen by the three information criteria is 2. Based on the finding on the optimal lag, we proceed to undertake the cointegration test, using one lag of each of the differenced variables. The cointegration results for the trace and maximum eigenvalue statistics are presented in Tables 5.6 and 5.7.

Table 5.5: VAR Lag Selection Criteria of Cointegration Test

Lag	AIC	HQIC	SBIC
0	-6.70	-6.67	-6.61
1	-22.54	-22.35	-22.07
2	-23.54*	-23.20*	-22.70*
3	-23.54	-23.04	-22.32
4	-23.35	-22.70	-21.76

Notes: AIC represents Akaike's Information Criterion; HQIC stands for Hannan and Quinn Information Criterion; SBIC represents Schwarz's Bayesian Information Criterion; while * points to optimal lag.

Table 5.6: Trace Test of Johansen Cointegration

Trace Test						
Number of Lags = 1						
With Constant				With Trend		
H_0	Trace Statistic	5% Critical Value	1% Critical Value	Trace Statistic	5% Critical Value	1% Critical Value
$r \leq 0$	81.52	47.21	54.46	89.51	54.64	61.21
$r \leq 1$	34.90***	29.68	35.65	36.94***	34.55	40.49
$r \leq 2$	11.46**	15.41	20.04	15.25**	18.17	23.46
$r \leq 3$	2.26	3.76	6.65	3.94	3.74	6.40

Notes: r represents the maximum rank of cointegration, while *** and ** denote the rejection of the null hypothesis at 1% and 5% levels respectively.

Table 5.7: Maximum Eigenvalue Test of Johansen Cointegration

Maximum Eigenvalue Test						
Number of Lags = 1						
With Constant				With Trend		
H_0	Maximum Eigenvalue Statistic	5% Critical Value	1% Critical Value	Maximum Eigenvalue Statistic	5% Critical Value	1% Critical Value
r = 0	46.62	27.07	32.24	52.57	30.33	35.68
r = 1	23.44***	20.97	25.52	21.69*****	23.78	28.83
r = 2	9.20**	14.07	18.63	11.31	16.87	21.47
r = 3	2.26	3.76	6.65	3.94	3.74	6.40

Note: r represents the maximum rank of cointegration, while *** and ** denote the rejection of the null hypothesis at 1% and 5% levels respectively.

As shown in the foregoing discussions, the cointegration tests are undertaken for the oil price and the three GDPs under consideration over 1979Q2-2009Q4. Table 5.6 indicates that the trace test (both with constant and trend) produces $r \leq 1$ at the 1% level of significance and $r \leq 2$ at the 5% level of significance, implying that with constant and trend we have at least 1 cointegrating equation and at least 2 cointegrating equations at the 1% and 5% levels respectively.

According to 5.7, the Eigenvalue test (with constant) produces r = 1 at the 1% level of significance and r = 2 at the 5% level of significance. On the other hand, the Eigenvalue test (with trend) produces r = 1 at both the 1% and 5% levels of significance. This means that for the Eigenvalue test with constant, there is exactly one cointegrating equation at the 1% level of significance and exactly 2 cointegrating equations at the 5% level of significance; while with trend there is exactly 1 cointegrating equation at the 1% and 5% levels of significance. These findings suggest the existence of long-run relationships between the three GDPs and the oil price. This gives the initial evidence of some form of comovements between the four variables, making it plausible to employ the DFM, whose results are presented next, for further analysis.

5.5.3. Dynamic Factor Model

As noted earlier, the DFM is the main econometric technique of this chapter. The results of the model capture the coefficients of the oil-related exogenous variables; the coefficients of the lagged terms of the unobserved factor; and the factor loadings relating to each of the considered dependent variables. Table 5.8 below presents the results.

As shown in this table, the unobserved factor denoted by f has statistically significant negative and positive autoregressive parameter impacts on it. The oil price trend and oil price cycles also have statistically significant positive and negative effects respectively on the unobserved factor. The unobserved factor represents the comovement of the GDP series of the three economies considered.

Table 5.8: Dynamic Factor Model of the Real GDPs of Nigeria, the Euro Area, and the US

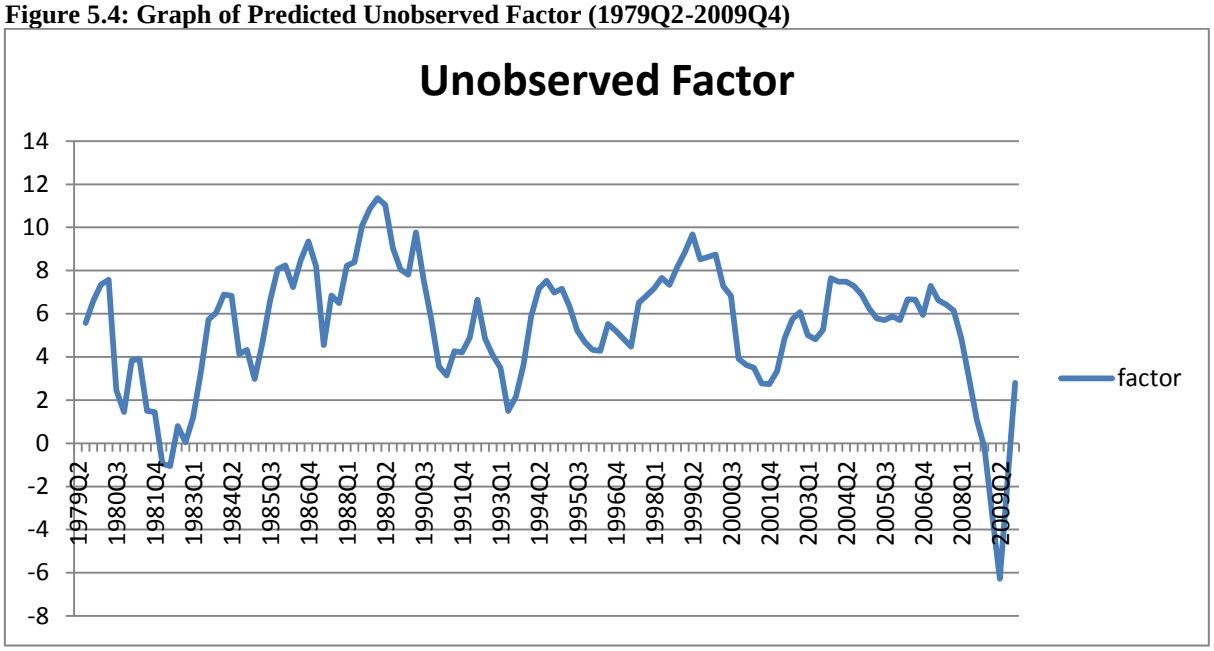
			Wald chi2 (7) = 5567.83 Prob > chi2 = 0.00	
	Coef.	Std. Err.	Z	P>|z|
f f				
L1	1.50***	0.20	7.38	0.00
L2	-0.58***	0.19	-3.11	0.002
oilcycle	-1.84**	0.84	-2.2	0.03
oiltrend	0.13**	0.06	2.35	0.02
Dln(niggdp) f	0.001**	0.001	2.35	0.02
Dln(usagdp) f	0.001**	0.001	2.11	0.04
Dln(eurogdp) f	0.001**	0.0004	2.14	0.03

Notes: ***, **, and * denote statistical significance at 1%, 5%, and 10% levels of significance respectively.

As noted before, comovement statistically means a "common move" in a set of series captured through a more parsimonious and likely more informative series or structure (Vahid and Engle, 1993; Centoni and Cubadda, 2011). For the three GDPs under consideration, the common component causing comovement may relate to shocks affecting the three series, as displayed by the graph of the common unobserved factor, which captures the global recessions of the early 1980s and the late 2000s, as shown in Figure 5.4 below.[17]

[17]Adding the GDPs of more countries in the analysis may enable the graph to reveal more recessions within the data span of the study, apart from those of early 1980s and late 2000s. The recession of the early 1980s was experienced by both advanced and developing countries, with the latter group of countries experiencing a debt crisis; while the recession of the late 2000s involved a financial crisis originating from the US and transmitted to Europe and the rest of the world in turn, with advanced and developing economies significantly affected.

Figure 5.4: Graph of Predicted Unobserved Factor (1979Q2-2009Q4)



Source: Author

Therefore, the high negative impact (-1.84) of the oil cycles on the factor is largely due to the fact that oil price spikes are usually associated with global growth slowdowns and sometimes recessions, with the oil importing industrial economies, particularly the US, playing a leading role in the cross-country transmissions of the growth difficulties (see Kose et al, 2003; Roubini and Setser, 2004; Hamilton, 2009; Tapia, 2013). The studies show that oil price increases have a role to play in each of the post-73 global recessions, but not all such shocks caused a recession.

Specifically, the recessions of the early 1980s and the late 2000s that are shown as part of the comovement between the three countries under consideration were not solely consequences of oil price shocks, but oil price increases played significant roles in them. The recession of the early 1980s was largely caused by a restrictive monetary policy in the US, which led to a recession in the country and an eventual global recession, but the oil price spike that was associated with the Iranian revolution of 1979 had a role to play in the downturn. On the other hand, the US housing bubble was a primary causative factor of the recession of the late 2000s, but as Hamilton (2009) indicates, the oil price increases of 2007-2008 played a role in the downturn.

Furthermore, as shown by the factor loading, the correlation between the unobserved factor and each of the GDPs of Nigeria, the US, and the Euro Area is statistically significant, with a

value of 0.001, reflecting that the impact of the factor on each the three GDPs is about 0.1%. The three GDPs therefore move together based on about the same impact of the common factor on them. Finally, the Wald test results in the table are for all the parameters of the table. The null hypothesis for the test is that all the parameters are zero, and as the results show, the null is rejected. This means that the considered coefficients are jointly statistically significant.

5.5.4. Covariate Model

The covariate model is employed to check the robustness of the DFM, as mentioned before. The covariate model involves the three equations of the model indicated earlier as shown below in Table 5.9. The first equation of the covariate model involves regressing the Nigerian GDP against the unobserved factor, which is a regressor acting as a standardised variable across the three GDPs under consideration, as distinct from the GDPs themselves, which have individual localized independence, as noted earlier. Localized independence is one of the key features of covariates, justifying the use of the lagged terms of the three GDPs as covariates.

As shown in Panel A of Table 5.9, the unobserved factor has a statistically significant positive impact of about 0.10% on the Nigerian GDP, which is consistent with the positive correlation between the factor and the GDP in the DFM results of Table 5.8. However, as shown in Panel B of Table 5.9, the positive impact of the factor on the Nigerian GDP increases to about 0.20% when the lagged terms of the GDPs of the US and the Euro Area are added as exogenous covariates.

Panel B also shows that the added covariates have varying individual effects on the Nigerian GDP. Over a three-year period (i.e. twelve quarters), the lagged terms of the US GDP have three negative and one positive statistically significant impacts and a negative net-impact (i.e. positive-negative impacts) on the Nigerian GDP. On the other hand, the lagged terms of the GDP of the Euro Area have two statistically significant positive impacts and hence a positive overall impact over the same time horizon.

These effects are consistent with the impacts of the oil shocks triggered by the growth of the US and the Euro Area, which are simulated in chapter four. In the simulation, the growth of the US leads to a statistically significant increase of the oil price and a fall in the growth rate

of Nigeria. On the other hand, the growth of the Euro Area causes a rise in the oil price, but the increase is not statistically significant and the growth rate of Nigeria does not fall.

Table 5.9: Covariate Model

		Panel A: Equation 5.9 of Covariate Model (without lagged covariates)	Panel B: Equation 5.10 of Covariate Model (with lagged covariates)	Panel C: Equation 5.11 of Covariate Model (with lagged covariates and autoregressive feature)
Dependent Variable: Dln(niggdp)		Coefficient	Coefficient	Coefficient
factor		.001***	.002***	.0003
Dln(usagdp)	L1.		-.41**	-.15
	L2.		-.31**	-.06
	L3.		-.01	.17*
	L4.		.077	.06
	L5.		.22*	.13
	L6.		.15	.02
	L7.		.15	.15*
	L8.		.10	-.004
	L9.		-.01	-.07
	L10.		-.06	.01
	L11.		.05	.15*
	L12.		-.18*	-.11
Dln(eurogdp)	L1.		-.20	.05
	L2.		.04	.03
	L3.		.01	-.13
	L4.		-.18	-.17
	L5.		-.06	.05
	L6.		-.07	.07
	L7.		.35**	.23**
	L8.		.26	-.06
	L9.		.26*	.09
	L10.		.19	.03
	L11.		.25	.22**
	L12.		.14	-.10
Dln(niggdp)	L1.			.81***
	L2.			-.08
	L3.			.04
	L4.			-.48***
	L5.			.46***
	L6.			-.05
	L7.			.03
	L8.			-.37***
	L9.			.33**
	L10.			.04
	L11.			-.07
	L12.			.10
Constant		.001	-.01***	-.004*
F		13.30***	5.01***	11.32***
R-squared		0.10	0.60	0.85

Notes: ***, **, and * denote statistical significance at 1%, 5%, and 10% levels of significance respectively.

Panel C shows that the impact of the unobserved factor on the Nigerian GDP becomes statistically insignificant, when the lagged terms of Nigerian GDP are added as additional covariates. This further confirms the comovements between the three GDPs under consideration, due to the factor. Because the factor is the cause of the comovement, the factor's impact on the Nigerian GDP should become insignificant when the lags of the three GDPs are present as regressors. These findings show the robustness of the factor and the DFM.

Furthermore, the inclusion of the lagged terms of the Nigerian GDP as covariates changes the impact of the US GDP, which now only has positive statistically significant impacts on the former GDP, with three of such impacts existing within the three-year horizon. However, the positive impacts of the GDP of the Euro Area are maintained, after the inclusion of the Nigerian covariates. The impacts of the lagged terms of the Nigerian GDP over the three-year horizon are both positive and negative, with three positive and negative impacts respectively and a positive net impact. The overall impacts of the Nigerian covariates are also higher than the impacts of the US and Euro Area covariates, with the statistically significant impacts of the former covariates being about five times greater than those of the latter ones. This is consistent with the results showing the greater role of domestic shocks over external (oil-related) shocks in Nigeria in chapter four.

Finally, as indicated before, the unobserved factor has a high inverse relationship with oil price cycles, which is the component of the price with frequent variations (i.e. volatility). The means that the earlier indicated nature of the factor is inversely associated with oil price volatility, implying that the statistical insignificance of the factor in Panel C alludes to low impact of oil price volatility. Since oil price volatility is one of the causes of the resource curse (Sala-i-Martin and Subramanian, 2003), that the US GDP has only statistically significant positive impact on the Nigerian GDP in Panel C may point to the fact that low oil price volatility limits the resource curse in Nigeria.

5.5.5. The Relationship between Oil Price and the Unobserved Factor: Summary Statistics

In addition to the robustness check of the DFM undertaken through the covariate model, in this section we provide descriptive statistics (i.e. mean, median, correlation, etc) in Table 5.10

relating to the relationship between oil price and the unobserved factor. The statistics shown in the table, particularly the correlation and covariance, are consistent with the inverse relationship between the oil cycles and the unobserved factor in the DFM results.

As indicated in Table 5.10, the correlation and covariance between the oil price and the unobserved factor are -0.39 and -0.60 respectively. These values clearly show that the variables tend to move in opposite directions, which is mainly due to the slowdowns and recessions caused by oil price spikes, as mentioned earlier. As shown in the table, the fluctuation or volatility of the price of oil, by say a standard deviation of 0.53 will cause a larger degree of fluctuation in the unobserved factor by a standard deviation of 2.91. This suggests that an oil price spike of about 50% in magnitude may lead to growth downturns that are larger than the size of the oil shock in the concerned economies, due to the unobserved factor, which is consistent with the negative covariance and correlation values.

Conceptually, covariance measures the degree to which two variables change together, which is statistically measured by the product of the two variables, after they are deviated from their means. But the value of covariance may be difficult to interpret, if the units in which the considered variables are measured are different. This limitation is overcome in the formula of correlation, which is covariance divided by the standard deviations of the considered variables, because the numerator and the denominator of the formula are in the same units.

Table 5.10: Statistics on the Relationship between Oil Price and Global Unobserved Factor

	ln(Oil)	Unobserved Factor
Mean	3.30	5.41
Std. Dev.	0.53	2.91
Min	2.41	-6.28
Max	4.81	11.35
Correlation		
ln(Oil)	1	-0.39
Covariance		
ln(Oil)	0.28	-0.60
Unobserved Factor	-0.60	8.45

5.6. Discussion of Findings

The results of this chapter contain findings relating to both Nigeria's decoupling and resource curse, the latter being a key subject of the findings of chapter four. Therefore, in this section we discuss the findings of the present chapter under two sub-headings below, relating the findings to the empirical literature.

5.6.1. The Decoupling of Nigeria from Its Industrial Trade Partners

The results of tables 5.4-5.10 show that the decoupling hypothesis does not hold for Nigeria, regardless of the form of analyses (cointegration, dynamic comovement or individual country impacts). This is perhaps not surprising given the role of oil price in the business-cycle linkages between the country and its considered industrial trade partners.

That the decoupling hypothesis does not hold for Nigeria is consistent with the findings of other studies of the literature regarding the decoupling of the EMDEs from their industrial counterparts. Such studies focus on individual EMDEs (e.g. Jayaram et al., 2009; Wyrobek and Stańczyk, 2013); regions consisting of selected EMDEs (e.g. Cutrini and Galeazzi, 2012; Lam and Yetman, 2013); and the aggregate of all EMDEs (e.g. Economic and Financial Affairs, 2011; Dervis, 2012).

However, to the best of our knowledge, the only study that tests the decoupling hypothesis specifically for Nigeria is Obiora (2009). The work of this author is similar to the work of this chapter, in particular with respect to the countries covered, the channels of international linkages considered, the role of oil in the linkages, and the overall findings. The author identifies the US as the largest trade partner of Nigeria, and the European Union as the second largest partner, based on Direction of Trade data, with the European Union consisting five (i.e. Spain, France, Germany, the Netherlands, and Italy) of the eight countries forming the Euro Area in our study.

Regarding the channels of international linkages, Obiora (2009) examines the relative roles of trade channel, financial channel, and the channel of commodity prices in the transmission of international spillovers from trade partners to Nigeria. Oil has a strong role in the spillovers, because it accounts for a large share of the trade channel. Besides, oil price is part of the

prices constituting the commodity prices channel. Concerning the overall findings, the author finds that the decoupling hypothesis does not hold for Nigeria, based on the dominance of the trade and the commodity prices channels relative to the financial channel, with the US playing a leading role in the transmission of the spillovers. Generally, the trade and financial linkages between the EMDEs and their industrial counterparts constitute a major factor that may not make the former economies to decouple from the latter ones.

5.6.2. Oil Price Volatility and the Resource Curse: The Nigerian Case

Key economic attributes of oil include non-renewability, high globalization, and price volatility. The first attribute means that oil is a resource given by nature and that it cannot be synthesized. The second attribute points to the dominant role as a source of energy. The third attribute, which relates to the discussion of this section, points to the time-varying standard deviations of oil price, which creates time-varying uncertainty. This means that oil price volatility is different from oil shock. Oil price volatility may be defined as the frequent deviations in oil prices, while oil price shocks point to large deviations in the prices (Ebrahim et al, 2014).

As indicated before the results of our covariate model show that when oil price volatility is weak, there are no negative statistically significant impacts from US GDP on Nigerian GDP over a three-year horizon, in contrast to when the volatility is not weak. This is because oil price volatility hinders growth by creating uncertainty. In fact, oil price volatility and oil price uncertainty can be used as synonymous terms (Jo, 2012). This means that the actual levels or values of oil price are different from the volatility or uncertainty associated with frequent variations of the price.

A major channel through which oil price volatility hinders growth is the decision making process of economic agents, namely firms, households, and governments. The agents usually delay the decisions relating to investment, consumption, production, and the like, when there is uncertainty about the price of oil, which eventually hinders the overall growth of the economy (Ebrahim et al, 2014). Other studies showing the negative impact of oil price volatility on growth are Elder and Serletis, 2010; Jo, 2012; Ferderer, 1996; and Guo and Kliesen, 2005. Finally, an obvious implication of the finding on volatility is that the US is a stronger source of oil price volatility than the Euro Area.

5.7. Conclusion

This chapter analyses the comovement of the real GDPs of Nigeria and its two main trade partners, in order to examine whether any degree of decoupling exists between Nigeria and the two industrial economies. Since Nigeria is a major oil exporter and oil is a strong source of international transmission of business cycles, we choose to analyse the decoupling by focusing on the oil channel.

We employ data on the real GDPs of the considered economies and the oil price from the GVAR database used in chapter four. Using the HP filter, we obtain the oil trend and cycles from the oil price. The main model used for the study is the DFM, in which we model an oil-related unobserved factor driving the three GDPs under consideration. The results show that the unobserved factor drives the three GDPs in the same direction, with positive factor loading of about 0.001 for each GDP.

We also test the robustness of our DFM. This mainly involves a covariate model in which the Nigerian GDP is regressed against the unobserved factor and covariates. The robust check shows that the unobserved factor is robust in the covariate model. Based on these findings, the decoupling hypothesis cannot be accepted for Nigeria. Finally, it is worth noting that since there are other channels (e.g. financial channel) of international linkages between Nigeria and its two main industrial trade partners, apart from the oil channel, further research capturing the other channels is needed to explore their roles in the linkages.

Chapter 6: How Effective are the Nigeria's Stabilization Fund and Oil-Price-Based Fiscal Rule as Buffers of Global Oil Price Volatility?

6.1. Introduction

The present chapter focuses on the analysis of resilience to spillovers via the channels examined in the literature review of chapter 3, by examining the effectiveness of Nigeria's stabilization fund and oil-price-based fiscal rule. The emerging market and developing economies (EMDEs) have shown more resilience to spillovers from advanced economies (ADs) in recent years, largely due to better policies (IMF, 2012). Many of the EMDEs have adopted better policies to protect themselves against developments originating from the ADs, due to lessons learnt from crises of the past, such as the debt crisis of the early 80s. Particularly, developing oil-exporting countries such as Nigeria have designed fiscal policies to reduce their susceptibility to oil shocks.

Nigeria's susceptibility to the volatility of the international oil market originated with the oil boom of the 1970s (Baunsgaard, 2003; Odularu, 2007; Akinlo, 2012). This presented the country with the challenge of macroeconomic volatility triggered largely by oil price volatility. World Bank (2003) compares the standard deviations of key economic indicators of several countries and found that the Nigerian economy was among the most volatile in the world between 1961 and 2000.

Though the volatility of oil price is external to the Nigerian economy, an internal factor exacerbating the macroeconomic volatility of Nigeria is the tie between public expenditure and oil revenue, as shown in Figures 6.1 and 6.2. The vulnerability of the nation to oil price volatility therefore necessitated decoupling government expenditure from oil revenue. To achieve the decoupling objective and limit macroeconomic volatility, a stabilization fund and an oil-price-based fiscal rule were introduced in the country in 2004.

The objective of this chapter is to investigate the effectiveness of the stabilization fund and the oil-price-based fiscal rule in achieving the mentioned objective. There is little Nigeria-specific empirical work exploring the effectiveness of the stabilization fund and fiscal rule. Nigeria-specific studies in this strand of the literature are largely done from a qualitative

perspective, without the use of econometric tools (e.g. Okonjo-Iweala and Osafo-Kwaako, 2007; Okonjo-Iweala, 2008). This chapter therefore contributes to filling this gap.

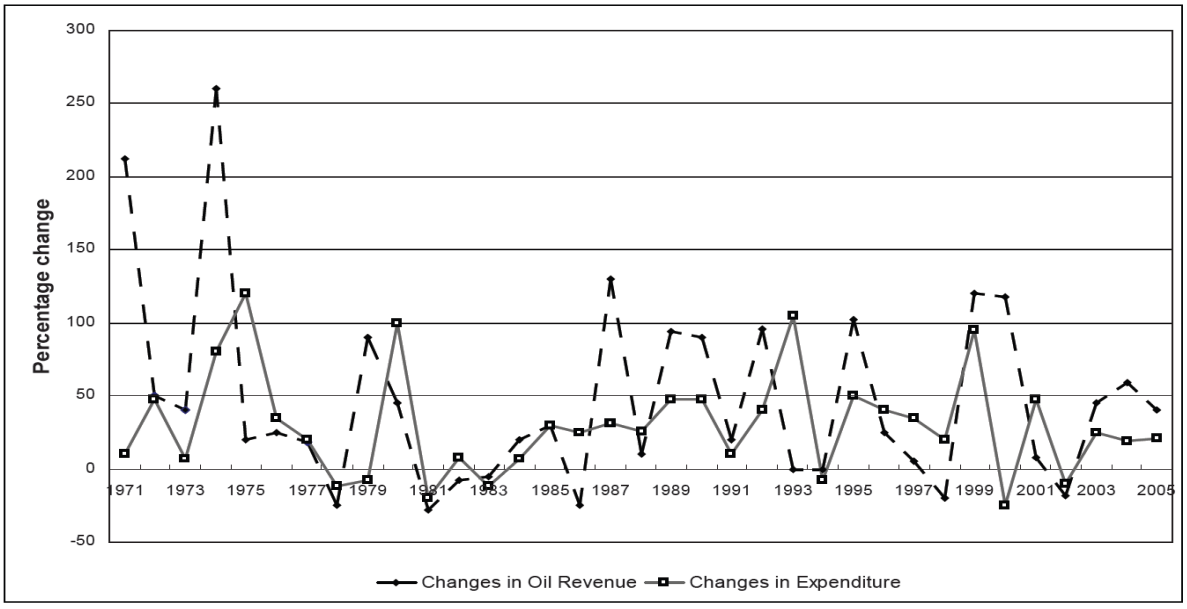
The analysis of the chapter has two main sections, which deal with the broad macroeconomic and fiscal policy impacts of the stabilization fund and fiscal rule. The first section deals with the broad macroeconomic impact, by employing the GARCH-in-Mean (GARCH-M) model to examine whether or not the two fiscal policy instruments reduce the volatility of growth. The second section deals with the fiscal policy impact of the two fiscal policy instruments, by examining the behaviours of government expenditure and oil revenue before and after the year (2004) the instruments were introduced in the country.

The results of the chapter show that the stabilization fund and fiscal rule are effective in Nigeria, which is consistent with the findings of other studies on the general impact of the instruments in resource-rich economies employing them (e.g. Sugawara, 2014; and Asik, 2013). Specifically, the findings of the present chapter is consistent with the observations of Nigeria-related studies (e.g. Nellor, 2008; Okonjo-Iweala and Osafo-Kwaako, 2007; and Okonjo-Iweala, 2008) regarding the effectiveness of the fiscal instruments in controlling the boom-bust pattern associated with the volatility of oil price in the country.

The effectiveness of the Nigeria's stabilization fund and fiscal rule points to the resilience of the economy to global shocks, which are usually caused by the industrial countries. The resilience of the EMDEs to shocks originating from the ADs in recent years is one of the reasons for the speculation on the decoupling of the former from the latter. However, the findings of chapter 5 and the present chapter show that *resilience may not mean decoupling* for the EMDEs, based on the Nigerian case study. This finding is consistent with the findings of other studies regarding the EMDEs (e.g. IMF, 2012; Economic and Financial Affairs, 2011).

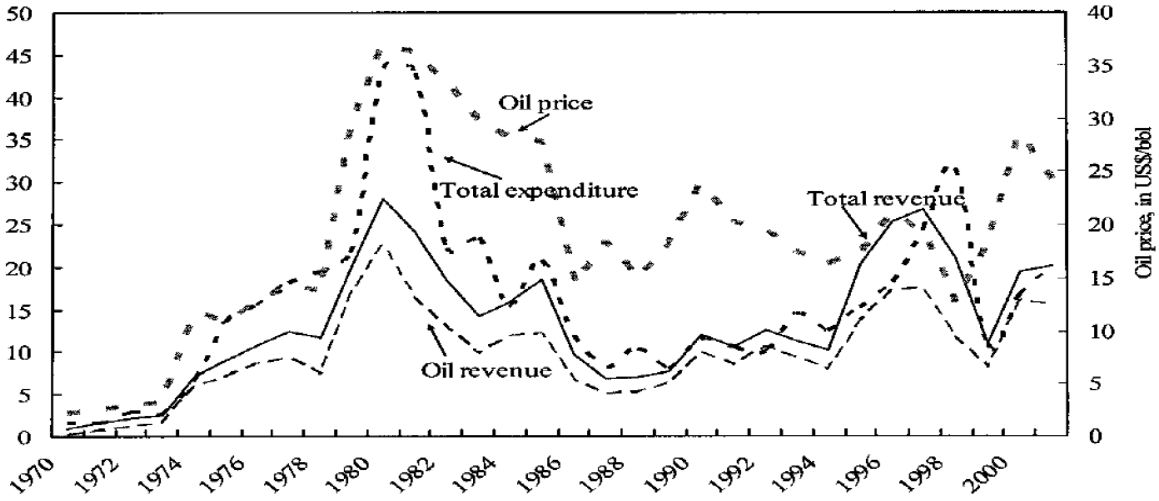
The rest of the chapter is organized as follows: A general overview of stabilization funds and fiscal rules are presented in section 6.2. The data used in the chapter are discussed in section 6.3. The econometric framework employed in the chapter is discussed in section 6.4. Section 6.5 presents the empirical results. Discussions of findings are done in section 6.6, while concluding remarks are given in section 6.7.

Figure 6.1: Fluctuations in Nigeria's Oil Revenue and Government Expenditure (1971-2005)



Source: Okonjo-Iweala and Osafo-Kwaako, 2007.

Figure 6.2: Oil Price, Oil Revenue, Total Revenue, and Total Expenditure in Nigeria (1970 to 2000)



Source: Baunsgaard, 2003.

These figures clearly indicate the features of oil revenue and government expenditure in Nigeria. Key ones among the features include the link between oil revenue and government expenditure, because changes in the latter follows changes in the former closely; large changes in oil revenue of the mid-70s and late-70s due to oil price shocks; and the significant separation of expenditure from revenue beginning from the year (2004) the Nigerian stabilization fund and fiscal rule were introduced, which gives the initial perception about the effectiveness of the fiscal instruments and makes further analysis plausible.

6.2. Stabilization Funds and Fiscal Rules in Oil-Rich Economies: A General Overview

Stabilization funds and fiscal rules are vital fiscal instruments that are widely used as buffers of shocks in resource-rich economies. In the context of resource-rich economies, stabilization funds are resource-based funds established for resource revenue smoothening, in order to prevent the uncertainty and risk associated with the fluctuation of the prices of the resources from affecting the budget (e.g. see Bagattini, 2011). For example, Scherer (2009) explains the role of stabilization funds in protecting oil exporting countries from the macroeconomic risk caused by oil price volatility.

To guard against the adverse impact of oil price volatility on fiscal policy in oil-rich economies, Shabsign and Ilahi (2007) note two factors that necessitate smoothing fiscal policy variables such as government expenditure and resource revenue through stabilization funds, in order to domestically protect the economy against the uncertainty of the international oil market.

Firstly, international capital inflows are usually procyclical so when the oil price falls oil exporters experience difficulty in securing external borrowing. Secondly, net the benefits of increasing public spending on large investment projects during booms is reduced by the cost of leaving the projects uncompleted during oil price falls. Uncompleted projects often lead to challenges such as unpaid wages and the accumulation of government debt, and a bias towards short term projects which may hinder long term growth.

Bagattini (2011) provides an excellent discussion of the characteristics of stabilization funds, which mentions the following aspects of the funds: the objective or purpose for establishment; the rules for managing the inflow and outflow of resources; the relationship to the government budget; the structures, institutions, and transparency; the use of resources and discretion; and the size of assets, as shown in Table 6.1.

The purpose of establishment relates to the underlying aim of a stabilization fund, which is usually to stabilize the economy by protecting from fluctuating resource prices; savings for intergenerational equity; limiting government spending; diversifying the economy by investing in non-resource sectors; or a combination of these aims, which may not make the fund's primary objective explicit. Achieving the objectives of a stabilization fund requires that

the fund is complemented with other policies and the broader institutional setting of the economy, as the fund is not a substitute for the latter (Rodrik, 2005). For example, the fund is not a substitute for the rule of law or employment regulations.

The rules for inflow and outflow of resources refer to the pre-determined legislated rule through which resources go in and out of a stabilization fund. The rules may stipulate thresholds determined for resource prices or revenues through which funds go in and out. Resources are saved in the fund when the market price is above the threshold level, while resources are withdrawn when the price is below the threshold level. Furthermore, the rules may also specify targets for government expenditure, savings level, etc. Therefore, the rules are intended to determine the amount of resources in a stabilization fund through the thresholds and targets.

With regard to the relationship to the budget, a stabilization fund may be employed as a tool of extra budgetary financing or a stabilization fund may be integrated into the budget, so that the fund serves as a "within budget" instead of an extra budgetary instrument.

The structures, institutions, and transparency of a stabilization fund refer to the organizational setting, the procedure of management, and the openness of management of the stabilization fund respectively. Central to these characteristics is the authority (e.g. Ministry of Finance, Central Bank, panel of experts etc) operating the fund.

The use of resources includes investing, earmarking, and employing the resources for the aims discussed under "purpose of establishment." On the other hand, discretion points to the extent to which discretion is used relative to rules by the authority managing the fund. Basically, the existence of rules limits the extent to which discretion is used and vice-versa.

Table 6.1: Characteristics of Stabilization Funds

Purpose	i. Stabilisation ii. Savings iii. Curtail spending iv. Economic diversification v. Ambiguous
In/outflow rules: reference	i. Commodity price threshold ii. Revenue level threshold iii. All resource revenues iv. Fixed amount v. Discretionary vi. Other (budget surplus, privatisation proceeds, etc.)
In/outflow rules: target	i. Fund size/savings level ii. Government expenditure level iii. None
Relationship to budget	i. Within budget framework (virtual/financing fund) ii. Extra-budgetary
Institutions: operational	i. Ministry of Finance/Treasury ii. Central bank iii. Committee of experts iv. Independent agency v. Civil society
Institutions: accountability	i. Horizontal accountability ii. Vertical accountability iii. Both iv. None
Institutions: transparency	i. Full reporting/auditing ii. Partial reporting/auditing iii. No reporting/auditing
Use of resources: asset management	i. Per cent of assets invested in international portfolio ii. Risk level of portfolio
Use of resources: earmarking	i. Earmarking of all resources ii. Earmarking of part of the resources iii. No earmarking of resources
Use of resources: purpose	i. Stabilisation/budget financing ii. Debt reduction iii. Social expenditure iv. Transfer to local government(s) v. National emergencies vi. Dividends/income
Discretion by head of state	i. Total ii. Some iii. None
Size	i. Total assets ii. Asset ratios (to GDP, exports, government revenue)

Source: Bagattini (2011).

Finally, the size of asset is the quantity of financial resources owned by a stabilization fund, which can be measured by the value of total equity of the fund or asset ratios to GDP, exports or government revenue. For example, in resource-dependent countries such as Nigeria, asset ratios to exports and government revenue tend to be relatively high, because the economies are resource-driven and not diversified. Basically, the size of asset of a stabilization fund depends on certain factors, namely the age of the fund, the level of investors' confidence in

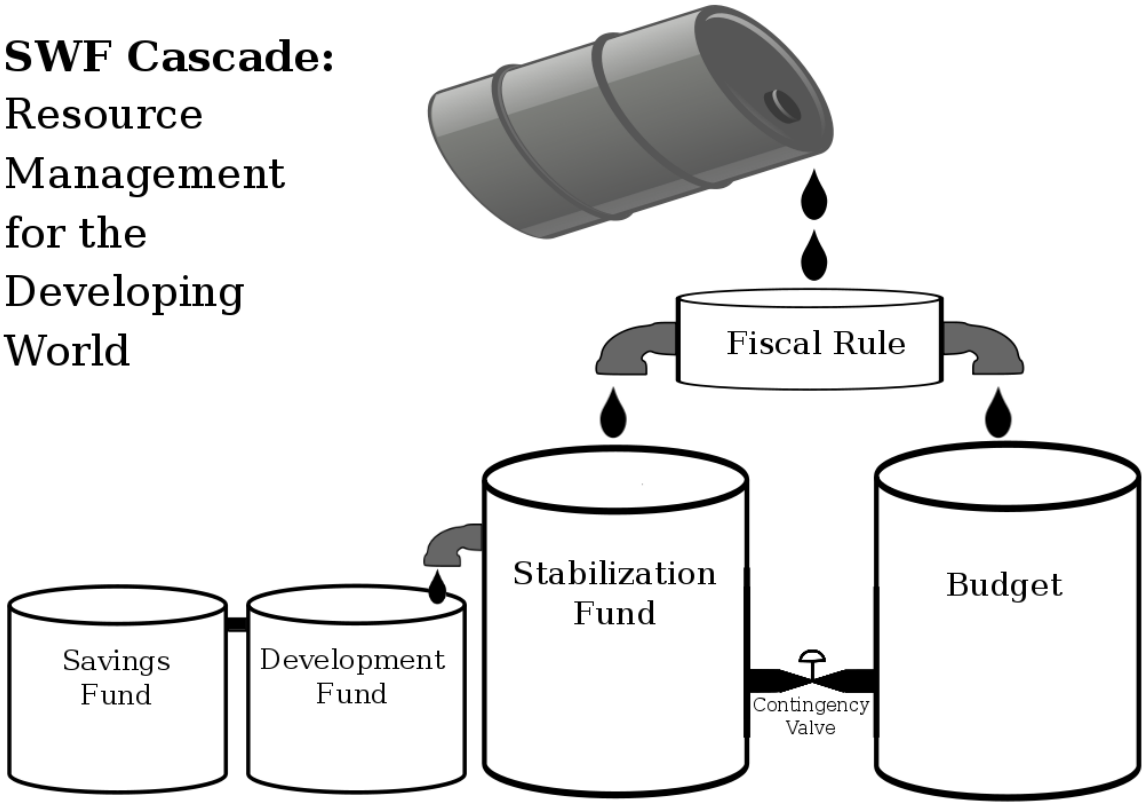
the fund, and the degree of public pressure to spend from the resources of the fund, particularly during windfalls. Older stabilization funds tend to have higher asset size, particularly if the stabilization funds are well managed. Higher investors' confidence tends to make investors to increase their investments in stabilization funds. Finally, if there is no public pressure to spend from the resources of stabilization funds, the savings of the funds tend to be higher, which will lead to higher size of asset.

Regarding the success of stabilization funds, many studies find that they are effective fiscal instruments in resource-rich economies (e.g. Fasano, 2000; Bagattini, 2011; Sugawara, 2014; Shabsigh and Ilahi, 2007; Davis et al., 2001). However, a potential factor that may hinder the effectiveness is weak level of institutions, according to Ossowski et al. (2008), who note the role of broader institutions (e.g. accountability, sound public administration, and transparency) in the success of policy in oil-rich economies. As earlier mentioned, stabilization funds are not supposed to be substitutes for broader institutions (Rodrik, 2005).

Fiscal rules usually play a role in the effectiveness of stabilization funds. Dixon and Monk (2011) propose the role of fiscal rules in a Sovereign Wealth Fund (SWF) for developing (African) resource-rich economies "cascade". The cascade has three forms of funds, namely stabilization fund, development fund, and saving fund, with stabilization fund taking priority over the other two forms of funds, and the fiscal rule serving as the tool for channelling resources into the stabilization fund and the budget, and with the connection between the stabilization fund and the budget creating a valve for dealing with the contingency of resource price volatility, as shown in Figure 6.3.

According to the authors, the rationale for prioritizing the stabilization fund over the other two funds is the dominance of the volatility challenge of resource prices over development and intergenerational saving challenges within the framework of developing economies. The authors argue that it is only when the volatility challenge is successfully overcome that developmental projects and intergenerational saving of the development and saving funds should be pursued in turn, with the resources for the two funds generated through stabilization fund.

Figure 6.3: Proposed Framework of Sovereign Wealth Funds (SWFs) in Developing (African) Countries



Source: Dixon and Monk (2011).

As shown in this figure, fiscal rules have a significant role to play in the proposed SWF framework of Dixon and Monk (2011). Generally, fiscal rules are permanent restraints on the fiscal policy imposed through long-run constraints on budgetary aggregates (IMF, 2009; Budina et al., 2012). The budgetary aggregates that the rules constrain determine their types. In this line, the authors mention four basic types of fiscal rules: debt rules, budget balance rules, expenditure rules, and revenue rules.

Debt rule restrains public debt by setting a limit on it, usually as a ratio to GDP; a balance budget rule aims to achieve a particular level of targeted fiscal policy variables such as debt-to-GDP ratio, which may be achieved by restraining both public revenue and expenditure; an expenditure rule sets a limit on government spending; while a revenue rule sets a limit on revenue. Each of the rules has advantages and disadvantages as shown in Table 6.2.

Table 6.2: The Features of the Different Types of Fiscal Rules

Type of rule	Pros	Cons
Debt rule	• Direct link to debt sustainability • Easy to communicate and monitor	• No clear operational guidance in the short run as policy impact on debt ratio is not immediate and limited • No economic stabilization feature (can be pro-cyclical) • Rule could be met via temporary measures (e.g., below-the-line transactions) • Debt could be affected by developments outside the control of the government
Budget balance rule	• Clear operational guidance • Close link to debt sustainability • Easy to communicate and monitor	• No economic stabilization feature (can be pro-cyclical) • Headline balance could be affected by developments outside the control of the government (e.g., a major economic downturn)
Structural budget balance rule	• Relatively clear operational guidance • Close link to debt sustainability • Economic stabilization function (i.e., accounts for economic shocks) • Allows to account for other one-off and temporary factors	• Correction for cycle is complicated, especially for countries undergoing structural changes • Need to pre-define one-off and temporary factors to avoid their discretionary use • Complexity makes it more difficult to communicate and monitor
Expenditure rule	• Clear operational guidance • Allows for economic stabilization • Steers the size of government • Relatively easy to communicate and monitor	• Not directly linked to debt sustainability since no constraint on revenue side • Could lead to unwanted changes in the distribution of spending if, to meet the ceiling, shift to spending categories occurs that are not covered by the rule
Revenue rule	• Steers the size of government • Can improve revenue policy and administration • Can prevent pro-cyclical spending (rules constraining use of windfall revenue)	• Not directly linked to debt sustainability since no constraint on expenditure side (except rules constraining use of windfall revenue) • No economic stabilization feature (can be pro-cyclical)

Source: Budina et al. (2012).

Like stabilization funds, fiscal rules have also been found to be effective instruments in various economies at national and supranational levels (e.g. European Commission, 2006; Kopits, 2000; Debrun et al., 2008). But good institutions are also required to get the maximum results from fiscal rules. Everything seems to centre on good levels of institutional quality in the developmental process of an economy. Even geography as the determinant of the existence of natural resources and international trade as the channel through which the resources are exchanged for money will only have optimal impact on growth in an economy if there are good institutions (Rodrik et al., 2002).

Regarding Nigeria, the oil-price-based fiscal rule, which was designed to work together with the stabilization rule of the country, has operated under varying levels of institutions since it was introduced. It operated only as an administrative rule from 2004 till 2007. But it became a "law" when it was integrated into the law of the nation in 2007 when the Fiscal Responsibility Act (FRA) was enacted.

The FRA is an Act that was put in place to promote the efficiency of fiscal policy procedure and implementation in the country (Nigerian National Assembly, 2007). For example, apart from the oil-price-based fiscal rule, the FRA requires the preparation of the Medium-Term Expenditure Framework (MTEF), which is a multi-year budgeting approach that involves the allocation of public resources on a rolling basis over a medium-term period consisting of three financial years (Nigerian Federal Ministry of Finance, 2010).

The fiscal rule operates by restraining government expenditure through oil revenue smoothing, which involves setting a volatility-absorbing reference oil price through which the revenue will be channelled into the budget, so that in the process the expenditure is de-linked from the revenue and the domestic volatility associated with oil price is constrained. The stabilization fund of the country, which was first called Excess Crude Account (ECA), serves as the account for saving the excess of budgeted oil revenues when the international oil price is higher than the reference price, so that withdrawals could be made from the account when the world price is below the benchmark price. The ECA was replaced by Nigeria's Sovereign Wealth Fund (NSWF) in 2012, following debate on the constitutional foundation of the former (see Nigeria Sovereign Wealth Institute, *www.nsia.com.ng*, 2015), as explained in chapter two.

The debate on the illegality of the ECA and its consequent replacement may also be interpreted to imply the shift of the operation of the stabilization fund from a weak to a good institutional framework. The stabilization fund was not initially established in line with section 162(1) of the Nigerian constitution, which stipulates that all revenues earned by the federal government, with the exception of certain proceeds from personal income tax that only the federal government has the right to collect, should be kept in an account called the Federation Account and not in any other account.

Besides, the ECA was not established as a legal entity in the eyes of the law and it operated only as an administrative arrangement (see Azaino, 2012). These weaknesses were overcome when the NSWF was established based on the Nigerian Sovereign Investment Authority Act of 2011, which authorizes the Nigerian Sovereign Investment Authority (NSIA) to function as an independent entity to manage the NSWF.

6.3. Data

We use the following data: (i) Nigerian data spanning 1979Q2-2009Q4 on real GDP, inflation, real exchange rate, and short-term interest rate, sourced from the GVAR dataset employed in chapter four. (ii) Constructed quarterly stabilization fund and fiscal rule dummy for Nigeria, which equals 1 in a year when the fiscal instruments are present in the country and 0 otherwise. To capture the role of the stabilization fund in reducing the transmission from oil price to real GDP, we interact the dummy with the oil price. (iii) Annual time series data (1970-2010) on nominal government expenditure, nominal oil revenue, and GDP price deflator, obtained from the 2010 edition of the Central Bank of Nigeria (CBN) Statistical Bulletin. The price deflator is used to deflate the government expenditure and the oil revenue series to obtain their real values.[18] (iv) Constructed annual stabilization fund and fiscal rule dummy, used in the analysis relating to government expenditure and oil revenue. Table 6.3 presents the summary of the information on the data used in the study.

Table 6.3: The Data of the Study

Variable	Source of Data	Form of Data/Remark
Nigeria's real GDP	GVAR database	Quarterly (1979Q2-2009Q4)
Nigeria's inflation	GVAR database	Quarterly (1979Q2-2009Q4)
Nigeria's real exchange rate	GVAR database	Quarterly (1979Q2-2009Q4)
Nigeria's short-term interest rate	GVAR database	Quarterly (1979Q2-2009Q4)
Oil price	GVAR database	Quarterly (1979Q2-2009Q4)
Quarterly Nigeria's stabilization fund and fiscal rule dummy	Constructed dummy interacted with the first differences of the log of oil price.	Quarterly (1979Q2-2009Q4)/dummy variable takes a value of 1 from 2004.
Annual Nigeria's stabilization fund and fiscal rule dummy	Constructed dummy	Annual (1970-2010)/dummy variable takes a value of 1 from 2004.
Nigeria's nominal oil revenue	CBN Statistical Bulletin, 2010	Annual (1970-2010)
Nigeria's nominal government expenditure	CBN Statistical Bulletin, 2010	Annual (1970-2010)
Nigeria's GDP price deflator	CBN Statistical Bulletin, 2010	Annual (1970-2010)

Notes: The stabilization and fiscal rule dummy is constructed based on their year of introduction in Sugawara (2012); and IMF (2009) and IMF (2015) respectively.

[18] We employ the price deflator instead of the CPI for the deflation, because the former reflects the prices of all the goods and services produced in the economy which makes it relatively suitable for the deflation.

6.4. Econometric Framework

The econometrics techniques used in the chapter are discussed as follows:

6.4.1. GARCH-in-Mean Model

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH)-in-mean (GARCH-M) process is employed to examine the impact of stabilization fund and fiscal rule on the volatility of real GDP in Nigeria. Basically, the GARCH-M model is a better model than the standard GARCH model, in that the mean equation of the latter does not have the GARCH term (i.e. measure of volatility) as the mean equation of the former does. Before the introduction of the stabilization fund and fiscal rule in Nigeria, the variability of government spending caused by the variability of oil revenue was impacting on real GDP. The GARCH-M specification picks up this and also makes it possible to test it the two fiscal instruments reduce the variability. Specifically, a GARCH-M (1, 1) model is employed for the analysis.

Modelling the Nigerian real GDP as I (1) in line with the unit root test results of chapters 4 and 5 of the thesis, the mean equation of the GARCH-M (1, 1) model is of the form:

$$Dln(rgdp)_t/I_{t-1} = \alpha + \beta_1 Dln(rgdp)_{t-1} + \beta_2 Dln(rgdp)_{t-2} + \beta_3 Dln(rgdp)_{t-3} + \beta_4 Dln(rgdp)_{t-4} + \propto ln(GARCH)_t + u_t \quad (6.1)$$

which indicates that the Nigerian real GDP, rgdp is a function of its 4 lagged terms, the log of the conditional variance (i.e. GARCH), and u_t, conditional on the information available up to time t-1.

The conditional variance equation of the GARCH-M (1, 1) model is of the form:

$$\sigma_t^2 = \pi_0 + \pi_1 u_{t-1}^2 + \pi_2 \sigma_{t-1}^2 + \omega(DU)_t \quad (6.2)$$

where σ_t^2 = conditional variance at time t

u_{t-1}^2 = lagged squared error term at time t-1, which is the ARCH term

σ_{t-1}^2 = conditional variance term at time t-1, which is the GARCH term

$(DU)_t$= stabilization fund and fiscal rule dummy

Furthermore, in dealing with GARCH-M (1, 1), it is necessary to try different parameterization forms of the model, in order to keep to the basic assumptions of ARCH modelling which are:

(i) Non-negativity assumption, which states that the parameters π_0, π_1, π_2 in equation 6.2 are not negative numbers.
(i) $0 \leq \pi_0, \ldots \pi_2 \leq 1$, which means that the parameters can be zero or greater than zero, but cannot be greater than one.

6.4.2. Techniques for Exploring the Behaviours of Government Expenditure and Oil Revenue

In this section we focus on the behaviours of Nigeria's government expenditure and oil revenue before and after stabilization fund and the fiscal rule were introduced in the country in 2004, using data spanning 1970-2010 as mentioned earlier.[19] Using 1970-2003 and 2004-2010 as sub-periods, the analysis is based on the following econometric techniques:
(a) Standard deviation, correlation, and covariance, which measure the volatility and the comovement of the two variables respectively.
(b) Autoregressive Conditional Heteroscedasticity (GARCH) model, which measures volatility clustering.
(c) Dummy-based structural break test to investigate whether or not there is a structural break from the year the stabilization fund and the fiscal rule were introduced.

The formulas and equations of the econometric techniques of the analysis are:

[19] Data on the government expenditure and the oil revenue are only available in annual forms, because the variables are key annual budgetary variables. Furthermore, the 1970 to 2010 period is employed for the analysis to capture the key global oil shocks that have taken place in the global economy, particularly the oil shocks of the early 1970s when the country began to depend on oil.

6.4.2.1. Standard Deviation

The formula of the standard deviation is:

$$SD = \sqrt{\sum(X - \bar{X})^2/n - 1} \quad (6.3)$$

where SD = standard deviation

X = each value of considered variable, which is Real Government Expenditure (RGE) or Real Oil Revenue (ROR) in this case

$\overline{X}$ = mean of considered variable

n = number of values in considered series

6.4.2.2. Correlation and Covariance

The formula of covariance is:

$$\mathrm{COV}(\mathrm{ROR}, \mathrm{RGE}) = \sum[(ROR_t - \overline{ROR})(RGE_t - \overline{RGE})/n - 1] \quad (6.4)$$

where $\mathrm{COV}(\mathrm{ROR}, \mathrm{RGE})$ = covariance between ROR and RGE

ROR= real oil revenue

RGE = real government expenditure

n = number of observations

$\overline{\mathrm{ROR}}$ = mean of ROR

$\overline{\mathrm{RGE}}$ = mean of RGE

On the other hand, the formula for the correlation, which is related to covariance, is:

$$r_{(ROR)(RGE)} = COV(ROR, RGE)/S_{(ROR)}S_{(RGE)} \quad (6.5)$$

where $r_{(ROR)(RGE)}$ = coefficient of the correlation between ROR and RGE

$\mathrm{COV(ROR, RGE)}$ = covariance between ROR and RGE

$S_{(ROR)}$ = standard deviation of ROR

$S_{(RGE)}$ = standard deviation of RGE

6.4.2.3. Generalized Autoregressive Conditional Heteroscedasticity Model

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model employed is a GARCH (1, 1) model with a conditional mean equation of the form:

$$Dln(RGE)_t/I_{t-1} = \alpha + \beta Dln(ROR)_t + u_t \quad (6.6)$$

which indicates that $Dln(RGE)_t$ is a function of $Dln(ROR)_t$ and u_t, conditional on the information available up to time t-1.

The conditional variance equation of the GARCH (1, 1) model is of the form:

$$\sigma_t^2 = \pi_0 + \pi_1 u_{t-1}^2 + \pi_2 \sigma_{t-1}^2 + DU * Dln(ROR)_t \quad (6.7)$$

where σ_t^2 = conditional variance at time t

u_{t-1}^2 = lagged squared error term at time t-1, which is the ARCH term

σ_{t-1}^2 = lagged conditional variance term at time t-1, which is the GARCH term

DU = stabilization fund and fiscal rule dummy

Note that different parameterization forms of the GARCH model need to be tried, in order to keep to the earlier mentioned assumptions of the ARCH process.

6.4.2.4. Dummy-Based Structural Change Test

In the equation of the structural change test we regress RGE on ROR and on a dummy that equals 1 from the year the Nigerian stabilization fund and fiscal rule were introduced (i.e. 2004), with the dummy interacted with ROR:

$$\text{Dln}(RGE)_t = \gamma_0 + \gamma_1 DU + \gamma_2 \text{Dln}(ROR)_t + \gamma_3 (DU_t * \text{Dln}(ROR)_t) + u_t \quad (6.8)$$

where DU_t = stabilization fund and fiscal rule dummy

$DU_t * Dln(ROR)_t$ = dummy in multiplicative interaction with ROR

u_t = error term

6.5. Empirical Results

We present the results of the analysis as follows:

6.5.1. GARCH-M Model of Growth Volatility

Table 6.4 presents the descriptive statistics of the first difference of the log of real GDP of Nigeria, which is the main variable of focus in the GARCH-M analysis. Table 6.5 presents the results of the GARCH-M analysis. In arriving at the results of the GARCH-M (1, 1) model, we try different parameterization forms of the ARCH and GARCH terms, and the contemporaneous and lagged terms of the DU term (i.e. the stabilization fund and fiscal rule dummy), keeping to the earlier mentioned assumptions of the ARCH model. In the parameterization process, the GARCH term of the model becomes zero, while the ARCH term remains in the model.

Furthermore, in the parameterization process, the contemporaneous term of DU has statistically significant negative impact on the volatility of the first difference of the log of real GDP of Nigeria, implying that the presence of stabilization fund and fiscal rule causes volatility break of growth in the country. This finding points to the effectiveness of the two fiscal instruments in limiting macroeconomic volatility in the Nigerian economy.

Table 6.4: Summary Statistics of Nigeria's Real GDP

	Dln(rgdp)
Mean	0.007
Median	0.008
Maximum	0.024
Minimum	-0.023
Std. Dev.	0.010

Notes: rgdp denotes the real GDP of Nigeria.

Table 6.5: GARCH-M Model of Nigeria's Real GDP

Dependent Variable: Dln(rgdp)	Coef.	Prob.
Mean Equation		
ln(GARCH)	-0.0004	0.406
Cons.	-0.001	0.822
Dln(rgdp) (-1)	0.770***	0.002
Dln(rgdp) (-2)	-0.017	0.951
Dln(rgdp) (-3)	-0.050	0.707
Dln(rgdp) (-4)	-0.166	0.102
Variance Equation		
Cons.	1.60E-05***	0.000
RESID(-1)^2	0.914**	0.049
DU	-5.74E-05***	0.0004
DU(-1)	-2.27E-05	0.220
Durbin-Watson stat	1.617	

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels of significance respectively; ln(rgdp) is modelled as I (1), based on the unit root tests results of chapters 4 and 5 of the thesis.

6.5.2. Delinking Government Expenditure from Oil Revenue

The results under this section focus on the behaviours of real government expenditure and real oil revenue in Nigeria before and after the introduction of stabilization fund and fiscal rule in Nigeria. The results touch on stationarity tests, correlation, covariance, standard deviation, structural break, and the GARCH process, as presented in Tables 6.6-6.8. Generally, the results show that the stabilization fund and fiscal rule are effective in separating government expenditure from oil revenue in Nigeria, which is consistent with GARCH-M results. We begin the presentation of the results under this section with unit root results.

6.5.2.1. Unit Root Tests

We employ the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) techniques for the unit root tests. The results show that Nigeria's Real Government Expenditure (RGE) and Real Oil Revenue (ROR) are both I (1) as shown in Table 6.10.

Table 6.6: Unit Root Tests

ADF With Trend				PP With Trend		
Variable	ADF Test Statistics	1% Critical Value	5% Critical Value	PP Statistics	1% Critical Value	5% Critical Value
ln(RGE)	-2.806	-4.251	-3.544	-2.275	-4.242	-3.540
ln(ROR)	-2.860	-4.251	-3.544	-3.332	-4.242	-3.540
Dln(RGE)	-5.310	-4.260	-3.548	-5.731	-4.251	-3.544
Dln(ROR)	-4.587	-4.260	-3.548	-6.668	-4.251	-3.544

Note: RGE = Real Government Expenditure; and ROR = Real Oil Revenue.

The results imply that we should employ the first differences of RGE and ROR in the regressions of structural change and GARCH.

6.5.2.2. Structural Change Test

The dummy-based structural change test shows that there is a structural change in Nigeria from the year (i.e. 2004) the country's stabilization fund and the fiscal rule were introduced.

As shown in Table 6.7, the structural change occurs mainly in the differential slope coefficient and not the differential intercept, with the slope having a statistically significant coefficient of -0.57, indicating a negative relationship between oil revenue and government expenditure and suggesting the de-linking of the two variables. These findings point to the effectiveness of Nigeria's stabilization fund and fiscal rule.

Table 6.7: Dummy-Based Structural Change Test on the Regression of Nigeria's Real Government Expenditure and Real Oil Revenue

Dependent Variable: Dln(RGE)				
	Coef.	Std. Err.	t	P>|t|
Dln(ROR)	0.56	0.17	3.19***	0.003
DU	0.05	0.07	0.63	0.53
DU*Dln(ROR)	-0.59	0.19	-3.12***	0.004
Cons.	0.02	0.06	0.41	0.69
F-statistic 3.52 Prob(F-statistic) 0.03				

Notes: DU is the dummy representing Nigeria's stabilization fund and fiscal rule; while *** denotes statistical significance at 1% level of significance. The standard errors are in robust forms.

6.5.2.3. Standard Deviation, Correlation, and Covariance

Under this section we focus on the standard deviations of RGE and ROR, and the correlation and covariance between the two variables, before and after the introduction of stabilization fund and fiscal rule in 2004, in order to capture the impact of the fiscal policy instruments on the volatility and the comovements between the two variables respectively.

As shown in Table 6.8, the introduction of the stabilization fund and fiscal rule seems to limit the volatility and enhance the decoupling of the two variables. The volatility of the two variables reduces after the introduction of the fiscal instruments. The correlation and covariance between them also become negative in the post-fiscal instruments period, suggesting the decoupling. Further evidence of the reduction of volatility in the Nigerian macroeconomy caused by the fiscal instruments is shown in Table 6.9, where the standard deviations of selected macroeconomic variables of the country are presented.

Table 6.8: Standard Deviation, Correlation, and Covariance of RGE and ROR

Before Stabilization Fund and Fiscal Rule (1970 -2003)			Stabilization Fund and Fiscal Rule Period (2004-2010)		
	Dln(RGE)	Dln(ROR)	Dln(RGE)	Dln(ROR)	Remark
Standard Deviation	0.46	0.50	0.12	0.38	Reduction of volatility after the introduction of stabilization fund and fiscal rule.
Correlation between Dln(RGE) and Dln(ROR)	0.60		-0.10		Decoupling after the introduction of stabilization fund and fiscal rule.
Covariance between Dln(RGE) and Dln(ROR)	0.13		-0.004		Decoupling after the introduction of stabilization fund and fiscal rule.

Table 6.9: Standard Deviations of Nigeria's Real GDP, Inflation, Real Exchange Rate and Short-term Interest Rate

Variable	1979Q2-2003Q4	2004Q1-2009Q4	Remarks
Real GDP	1.43	0.12	Reduced volatility after the introduction of stabilization fund and fiscal rule
Inflation	0.05	0.02	Reduced volatility after the introduction of stabilization fund and fiscal rule
Real exchange rate	0.57	0.18	Reduced volatility after the introduction of stabilization fund and fiscal rule
Short-term interest rate	0.011	0.007	Reduced volatility after the introduction of stabilization fund and fiscal rule

Notes: The four variables are from the GVAR dataset used in chapter 4 and are all in logged forms.

6.5.2.4. GARCH Model

The GARCH (1, 1) model basically involves regressing DlnRGE on DlnROR in the mean equation, with the dummy representing the stabilization fund and fiscal rule interacted with ROR and included in the conditional variance equation. The results suggest that the introduction of the two fiscal instruments causes a volatility break in the conditional variance

equation, as shown by a highly statistically significant negative coefficient of -0.29 in Table 6.10. The ROR has a strong positive statistically significant impact on the RGE in the mean equation as expected, while the GARCH term in the variance equation shows a statistically significant GARCH effect.

Table 6.10: GARCH Model of RGE and ROR

	Coefficient	P-value
Mean Equation		
Cons.	0.003	0.95
Dln(ROR)	0.49***	0.00
Variance Equation		
RESID(-1)^2	0.06	0.34
GARCH(-1)	0.94***	0.00
DU*Dln(ROR)	-0.29***	0.00
R-squared	0.30	

Notes: *** denotes statistical significance at 1% level of significance, while DU represents the dummy variable for the Nigerian stabilization fund and fiscal rule.

6.6. Discussion of Findings

Stabilization funds across the countries of the world are funded through different means. Some funds are funded from the proceeds of commodities, while some are funded from non-commodity sources. Among the stabilization funds that are commodity-funded, some are oil-funded, while some are not oil funded. The stabilization fund of Nigeria is primarily funded by oil, with a fiscal rule working together with the fund (Sovereign Wealth Fund Institute, 2015; Budina et al., 2012; IMF, 2009). The results of all the econometric techniques used in the analysis show that the fiscal instruments are effective. This is consistent with the findings of the literature on Nigeria-related studies (e.g. Bagattini, 2011; Sugawara, 2014; Okonjo-Iweala and Osafo-Kwaako, 2007; Okonjo-Iweala, 2008) and even studies not involving Nigeria (e.g. Fasano, 2000; Shabsigh and Ilahi, 2007).

Fasano (2010) reviews natural resource funds in five countries (Norway, Chile, Venezuela, Kuwait, and Oman) and one U.S. state (State of Alaska) and finds that the funds are effective in separating budget expenditure from revenue. However, Fasano also reports varying overall outcomes, due to varying objectives of funds, institutional frameworks, challenges associated with keeping to operational rules, and quality of broader fiscal policy. All the resource funds

reviewed are oil-based, except Chile's fund which is copper-based. The findings are therefore consistent with the impact of Nigeria's oil-based fund observed in this chapter.

Bagattini (2011) undertakes country-specific empirical analysis for each of 10 countries (i.e. Nigeria, Kazakhstan, Trinidad and Tobago, Algeria, Ecuador, Russia, Peru, Azerbaijan, Iran, and Chad), using a computed indicator of fiscal success[20] as the outcome, over the period of 1992-2007, with further analysis involving panel data. The values of this "success" variable before and after the introduction of stabilization fund are estimated and compared for each fund separately.

The results of the country-specific analysis show improved fiscal success in 9 of the considered countries following the adoption of stabilization funds. Only Chad has a (small) decrease in fiscal success after the establishment of stabilization fund. The results of the panel data analysis confirm the country-specific findings, by showing that stabilization funds have negative and positive effects on public debt and non-resource balance respectively, implying that the funds limit dependency on resource revenues to finance public expenditure. The impact of fiscal policy on the non-resource fiscal balance is important for the sustainability of fiscal position in resource-producing countries, as overall balance is largely influenced by the unpredictable and uncontrollable nature of the oil balance, making the non-oil balance to be a vital indicator of the effectiveness of fiscal policy (Barnett and Ossowski, 2002).[21]

The findings of Bagattini (2011) are also consistent with the results of this chapter. Specifically, the effectiveness of Nigeria's fund is shown in Bagattini's Nigeria-specific results and confirmed in his panel results. The pre-fund and post-fund values of the "success" variable for Nigeria's fund are 2.5 and 3.3 respectively showing a significant improvement in the level of fiscal success. This suggests a significant impact of the Nigerian fund on the country's fiscal management.

[20] The variable is computed on an additive six-point scale (i.e. values rage from 0 to 6), with 1 given for the presence of each of six fiscal conditions for each fiscal year. The conditions, which are based on the six variables mentioned earlier, are: (i) non-negative fiscal balance; (ii) improvement in the share of fiscal balance in GDP; (iii) non-negative non-resource fiscal balance; (iv) improvement in the share of non-resource fiscal balance in GDP; (iv) increase in the share of non-resource revenues in GDP; and (vi) reduction in the ratio of public debt to GDP.

[21] These authors focus on oil-producing countries in their study, but their discussion is applicable to resource-rich countries in general.

Furthermore, Sugawara (2014) investigates the impact of stabilization funds on the volatility of public expenditure in 68 resource-rich countries including Nigeria, over the period of 1988-2012. The author employs the panel data approach and finds that stabilization funds limit the volatility of government expenditure and enhance the smoothing of expenditure, which is consistent with the findings of this chapter. Sugawara (2014) also captures the role of fiscal rules, by interacting fiscal rules with stabilization funds in his model.

The impact of Nigeria's fiscal rule (i.e. oil-price-based fiscal rule) on fiscal management is specifically reviewed in Okonjo-Iweala and Osafo-Kwaako (2007) and Okonjo-Iweala (2008). The two studies demonstrate the effectiveness of the fiscal rule in delinking government expenditure from oil revenue and limiting macroeconomic volatility. For example, Okonjo-Iweala and Osafo-Kwaako (2007) show that after the Nigerian fiscal rule was introduced in 2004 budgeting was based on rule-based reference prices of $25 per barrel in 2004 and $30 per barrel in 2005, although there were higher market prices of $38.3 and $54.2 respectively, which led to the separation of government spending from oil revenues and the improvement of fiscal balance from deficit of 3.5% of GDP in 2003 to surpluses of about 10% of GDP and 11% of GDP in 2004 and 2005 respectively.

The findings of Shabsign and Ilahi (2007) on stabilization funds are also consistent with the results of this chapter. The authors employ panel data analysis to examine the impact of oil funds on macroeconomic stability in 8 oil exporters (i.e. Bahrain, Kuwait, Mexico, Norway, Oman, Sudan, Trinidad and Tobago, and Venezuela) and copper-based fund in 1 copper exporter (i.e. Chile). The main finding is that the funds are negatively related to the indicators of macroeconomic volatility considered, namely inflation, the volatility of broad money, and the volatility of prices.

A common feature in the works of Shabsign and Ilahi (2007) and this chapter is the consideration of macroeconomic effects of stabilization funds. Shabsign and Ilahi (2007) explore the macroeconomic impact of the funds and not the fiscal impact, while both the macroeconomic and fiscal impacts are covered in this chapter. As Shabsign and Ilahi (2007) argue, studies on stabilization funds (including the ones we have discussed earlier under this section) largely focus on the fiscal impact of the funds, yet the whole macroeconomy is affected by the funds.

The literature clearly shows that oil price volatility hinders growth (e.g. Ebrahim et al., 2014; Bleaney and Greenaway, 2001; Okonjo-Iweala and Osafo-Kwaako, 2007). The uncertainty associated with volatility affects the outcome of the decisions of economic agents and eventually hinders growth (Ebrahim et al., 2014). For example, volatile revenue hinders growth by affecting the productivity of government spending (Okonjo-Iweala and Osafo-Kwaako, 2007).[22]

Finally, the findings of the present chapter have a link with the findings of chapter 5, as the rejection of the decoupling hypothesis and the evidence of the effectiveness of fiscal instruments for Nigeria indicate that the resilience of the country to oil shocks does not imply the decoupling of the nation from the ADs. Regarding the decoupling debate, the literature generally shows that the resilience of the EMDEs to global events originating from the ADs does not imply decoupling between the two economic groups (IMF, 2012; Economic and Financial Affairs, 2011; Pesce, 2014).

IMF (2012) reviews the factors causing the resilience of the EMDEs, complementing it with a multivariate analysis involving parametric duration technique which allows for the modelling of durations of expansion (i.e. increasing economic performance) and recovery (i.e. good performance after downturns). The author finds that better policies account for about 60% of the resilience.

Economic and Financial Affairs (2011) reviews the vulnerability of the EMDEs to events in the ADs, considering *inter alia*, aggregate growth, growth trends, growth cycles, and the channels of cross-country transmissions. The author shows that although the EMDEs have stronger resilience to the shocks from the ADs in recent times due to improved macroeconomic policies and stronger financial institutions, there is no evidence of the desynchronization of the business cycles of the two groups, as there are still strong trade and financial linkages between them. In the analysis complementing the review, the author shows through causality tests that the stock markets of the US and Euro Area are the dominant forces causing changes in the stock markets of the EMDEs.

[22] Other studies showing the negative impact of oil price volatility on growth are Elder and Serletis, 2010; Jo, 2012; Ferderer, 1996; and Guo and Kliesen, 2005.

Pesce (2014) examines the subject of resilience empirically by using a time-varying panel VAR with factorization of coefficients to examine the average responses of the EMDEs to shocks from the ADs, based on a dataset consisting of 21 ADs and 57 EMDEs. The author observes that although the resilience of the EMDEs has increased over time, they are still vulnerable to the shocks originating from the ADs, suggesting that the resilience does not imply decoupling.

6.7. Conclusion

There is little quantitative work on the effectiveness of Nigeria's stabilization fund and fiscal rule, hence this chapter contributes to filling this gap in the literature. The chapter examines the impact of the Nigerian stabilization fund and fiscal rule, with respect to their effectiveness in limiting the global oil shocks transmitted into the country. The analysis of the chapter touches on both the fiscal and broad macroeconomic impacts of the two fiscal instruments.

The main finding of the chapter is that the stabilization fund and the fiscal rule have significantly contributed to the reduction of volatility in Nigeria. The chapter aligns with the strands of literature focusing on both the fiscal and broad macroeconomic impacts of stabilization funds and fiscal rules. In line with the findings of chapter 5, the present chapter also shows that the resilience of an EMDE to global shocks initiated by ADs does imply the decoupling of the former from the latter.

However, the present chapter does not explore the role of factors like politics or education in the impact of stabilization funds and fiscal rules. For example, the decision to introduce stabilization fund and fiscal rule may be driven by the level of education of nationals making them to seek "explanation" from government about how resource money is spent. It would be useful to cover this aspect in future research, as this may provide further insight on stabilization fund and fiscal rule.

Chapter 7: General Conclusions

7.1. Introduction

Nigeria is an oil dependent country with a high level of integration into the global economy. What role does the nexus between the country's oil dependency and global integration have in its economic performance?[23] The purpose of this thesis is to answer this question by examining the international linkages of the country in three areas where there are identified research gaps, which form the objectives of the study:

Chapter 4 considers the effects of oil shocks compared to domestic shocks within a global framework. Studies on oil shocks relating to the country largely focus on the role of global integration in the transmission of the oil shocks, leading to limited empirical work dealing with the role of global integration in the transmission of domestic shocks.

Chapter 5 considers whether or not Nigeria has decoupled from its main advanced trade partners, paying attention to oil-related growth comovements between Nigeria and its trade partners. There are no Nigeria-specific studies in the literature on the decoupling hypothesis employing an unobserved factor technique, which has stronger ability compared to other techniques to reveal the common and parsimonious movements in a set of series.

Chapter 6 considers whether or not Nigeria's policy framework of a stabilization fund and an oil-price-based fiscal rule is effective in protecting the economy from the adverse consequences of oil shocks. Nigeria-specific studies on this subject are largely done from a qualitative perspective involving no econometric techniques. Besides, group-specific studies on the subject involving Nigeria focus largely on the fiscal impact of the instruments rather than both fiscal and the broader macroeconomic impacts. This thesis therefore employs econometric techniques to test the effectiveness of the fiscal instruments, focusing on both the fiscal and macroeconomic impacts of the instruments.

[23] The global integration of a country may be defined as the level of the country's globalization with respect to financial and trade openness, political connection with other countries, social connection with other countries, etc.

In the present chapter, section 7.2 summarizes the findings of the empirical chapters; section 7.3 presents policy recommendations; while section 7.4 discusses the prospects for future research.

7.2. Main Findings

7.2.1. Insignificant Dutch-Disease Effect and Significant Role of Internal Shocks in Nigeria

This analysis is designed to explore the relative role of oil-related shocks and domestic fluctuations on growth within a framework in which the global integration of the Nigerian economy is modelled using the GVAR framework. The results show that on average domestic shocks, particularly shocks to real GDP and inflation, have stronger impact on growth than do oil shocks. Regarding the oil shocks, we observe statistically insignificant spending effect of Dutch disease involving the appreciation of real exchange rate.

The stronger role of domestic shocks over oil shocks suggests that internal macroeconomic factors, rather than oil, have a significant role in the fluctuations of the economy. In particular, domestically generated variations in real GDP and inflation, which are key macroeconomic variables, are important sources of fluctuations of the Nigerian economy.

7.2.2. Growth Comovements between Nigeria and Its Main Industrial Trade Partners and the Rejection of the Decoupling Hypothesis for Nigeria

The purpose of the analysis on this subject is to investigate whether or not Nigeria's business cycles have decoupled from the business cycles of the US and Euro Area (i.e. testing the decoupling hypothesis for Nigeria). The decoupling hypothesis can be tested for an EMDE by exploring international comovements, resilience to shocks from the ADs, or the relative role of country-specific factors in economic performance compared to global factors.

We test the hypothesis primarily through growth comovements between Nigeria and its two trade partners (i.e. US and Euro Area). However, Nigeria's resilience to external shocks is captured in chapter six through the examination of the effectiveness of the country's fiscal policy instruments in dealing with global oil shocks.

The results relating to comovements of growth show a statistically significant degree of comovements between Nigeria and its two main industrial trade partners, implying that the decoupling hypothesis cannot be accepted for Nigeria.

7.2.3. The Effectiveness of Nigeria's stabilization Fund and Fiscal Rule

The analysis on this subject focuses on examining the effectiveness of the two fiscal instruments in dealing with global oil shocks, which has implications for the level of resilience of the country to shocks originating from the ADs. The ADs, particularly the US, play a strong role in the transmission of oil shocks.

The findings show that the fiscal instruments are effective, implying the resilience of Nigeria to shocks from the ADs. But this resilience does not imply decoupling, bearing in mind the findings on decoupling in chapter 5.

7.3. Policy Recommendations

The findings of the thesis have important policy implications for Nigeria, with respect to Dutch disease; limiting the effects of the fluctuations in the business cycles of the industrial trade partners; and building stronger resilience to external shocks.

First, the findings relating to oil shocks and domestic shocks show that Nigeria should maintain the adoption of the flexible exchange rate policy it began to adopt since 1986, as it is effective in preventing "false" appreciation of the exchange rate during oil price increases. The country moved from pegged exchange rate policy in the 1970s to the flexible exchange rate policies since 1986, following the introduction of the Structural Adjustment Programme (SAP). The pegged exchange rate made upward movements in oil price to reflect significantly in exchange rate values in form of overvaluation, which had negative effects on the economy. Furthermore, there is the need to design policies tailored towards dealing with domestically generated shocks, particularly fluctuations in the real sector and price level.

Second, a major policy implication of the findings on decoupling is that Nigeria needs to diversify its trade away from the US and the Euro Area, in order to limit the impact of the fluctuations of their business cycles, as these industrial countries account for about 63% of the

country's trade based on the trade matrix computed in chapter four. The country can do this by increasing its trade with the EMDEs, domestically producing the products it imports from the industrial economies, which are mainly capital goods and intermediate inputs. This implies the diversification of Nigeria's production.

Finally, the stabilization fund and fiscal rule of the country have constituted an effective source of resilience to global oil shocks. Therefore, these fiscal policy instruments need to be maintained and complemented them with more countercyclical macroeconomic policies in the country. Introducing oil-price-oriented countercyclical monetary policy instruments and coordinating them with the fiscal policy instruments may be a good option. As Shabsign and Ilahi (2007) argue, monetary policy variables constitute one of the channels through which oil price volatility is transmitted into the economy. This necessitates dealing with the monetary policy channel of the transmission of volatility.

7.4. Prospects for Future Research

This thesis has certain limitations which provide prospects for future study. First, the chapter on oil shocks focuses on the spending effect of Dutch disease, but due to data limitation is unable to analyse the resource relocation effect, which involves the relocation of labour from the traditional sector (i.e. agriculture) into the oil sector during oil booms. The GVAR dataset employed for the analysis of the chapter does not contain sectoral data (i.e. data on agricultural, manufacturing, and labour sectors). During oil booms, statistically significant downward and upward trends in employment rates of the traditional (agricultural) and oil sectors respectively, point to the existence of the resource relocation effect of Dutch disease. It would be useful to include sectoral data in future GVAR research on the impact of oil shocks in Nigeria.

Second, the chapter on the decoupling hypothesis focuses mainly on real decoupling. But based on the role of the financial channel in cross-country interdependencies, it would be useful to examine financial decoupling in future research. This involves investigating the existence of cross-country financial contagion between Nigeria and other countries; the relative roles of country-specific and global financial factors in the financial sector of Nigeria, etc. In particular, agent behaviour plays a key role in cross-border transmission of financial

crisis, hence examining financial decoupling from the perspective of contagion would be useful.

Finally, the chapter on the stabilization fund and the fiscal rule does not capture the role of factors like politics and education in the impact of stabilization funds. For example, political tension on how resource money is spent by government may contribute largely to the introduction of stabilization fund and fiscal rule. Therefore, it would be useful to explore such a factor in future research. It would also be useful to include the role of institutions in future research on the two fiscal instruments, in that institution-related challenges, such as the voracity effect, may hinder the effectiveness of the instruments. The voracity effect points to the negative externalities of channelling public funds into private pockets through the mechanism of "false" public projects during resource booms.

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Appendix

Table A.1: Full Trade Weight of GVAR Model

country	Argentina	Australia	Brazil	Canada	China	Chile	Euro	India	Indonesia	Japan	Korea	Malaysia	Mexico	Nigeria	Norway	New Zealand	Peru	Philippines	South Africa	Saudi Arabia	Singapore	Sweden	Switzerland	Thailand	Turkey	UK	USA
Argentina	0.000	0.001	0.109	0.001	0.007	0.059	0.007	0.005	0.003	0.001	0.002	0.003	0.006	0.003	0.001	0.001	0.030	0.004	0.015	0.002	0.001	0.001	0.001	0.004	0.004	0.002	0.004
Australia	0.005	0.000	0.007	0.004	0.031	0.006	0.014	0.042	0.037	0.048	0.033	0.032	0.003	0.0004	0.002	0.244	0.004	0.015	0.025	0.011	0.035	0.010	0.006	0.043	0.006	0.011	0.011
Brazil	0.314	0.007	0.000	0.006	0.023	0.087	0.025	0.014	0.009	0.010	0.013	0.007	0.016	0.077	0.007	0.003	0.072	0.006	0.019	0.016	0.005	0.008	0.009	0.010	0.009	0.008	0.021
Canada	0.008	0.012	0.019	0.000	0.021	0.023	0.018	0.015	0.010	0.020	0.014	0.008	0.032	0.009	0.035	0.017	0.058	0.008	0.011	0.010	0.006	0.009	0.012	0.009	0.009	0.021	0.216
China	0.125	0.170	0.121	0.061	0.000	0.148	0.125	0.157	0.112	0.227	0.270	0.131	0.056	0.059	0.035	0.112	0.141	0.153	0.110	0.110	0.133	0.040	0.029	0.134	0.086	0.059	0.151
Chile	0.061	0.002	0.034	0.003	0.010	0.000	0.008	0.009	0.002	0.009	0.012	0.001	0.008	0.003	0.001	0.002	0.068	0.002	0.001	0.001	0.001	0.003	0.001	0.002	0.003	0.002	0.007
Euro	0.174	0.119	0.229	0.060	0.176	0.198	0.000	0.212	0.092	0.114	0.106	0.100	0.077	0.251	0.449	0.116	0.157	0.110	0.308	0.175	0.097	0.542	0.667	0.100	0.508	0.530	0.153
India	0.015	0.036	0.015	0.005	0.027	0.024	0.023	0.000	0.038	0.010	0.020	0.027	0.004	0.091	0.004	0.010	0.008	0.007	0.026	0.020	0.036	0.009	0.009	0.020	0.015	0.016	0.015
Indonesia	0.007	0.027	0.007	0.003	0.017	0.004	0.008	0.029	0.000	0.036	0.027	0.041	0.002	0.005	0.001	0.027	0.002	0.021	0.007	0.018	0.101	0.004	0.002	0.039	0.009	0.003	0.008
Japan	0.019	0.168	0.046	0.031	0.162	0.093	0.050	0.042	0.180	0.000	0.151	0.123	0.033	0.020	0.017	0.106	0.063	0.169	0.099	0.175	0.084	0.021	0.031	0.206	0.024	0.027	0.080
Korea	0.014	0.063	0.028	0.011	0.112	0.053	0.026	0.043	0.068	0.079	0.000	0.049	0.028	0.027	0.011	0.037	0.035	0.054	0.026	0.096	0.054	0.010	0.007	0.038	0.026	0.012	0.032
Malaysia	0.010	0.035	0.010	0.005	0.032	0.003	0.012	0.032	0.063	0.032	0.025	0.000	0.010	0.002	0.002	0.032	0.003	0.053	0.012	0.011	0.162	0.004	0.003	0.074	0.008	0.007	0.018
Mexico	0.034	0.006	0.028	0.028	0.010	0.040	0.016	0.009	0.003	0.012	0.015	0.005	0.000	0.003	0.001	0.009	0.029	0.002	0.004	0.003	0.004	0.004	0.004	0.005	0.003	0.004	0.133
Nigeria	0.003	0.0001	0.029	0.001	0.003	0.003	0.010	0.032	0.002	0.002	0.004	0.001	0.001	0.000	0.001	0.003	0.006	9.2E-05	0.020	0.0002	0.001	0.002	0.002	0.002	0.004	0.004	0.014
Norway	0.001	0.002	0.005	0.011	0.003	0.002	0.036	0.003	0.001	0.003	0.004	0.001	0.001	0.002	0.000	0.002	0.003	0.001	0.003	0.001	0.003	0.118	0.004	0.002	0.005	0.045	0.004
New Zealand	0.001	0.048	0.001	0.001	0.003	0.001	0.002	0.002	0.005	0.005	0.003	0.005	0.001	0.002	0.0003	0.000	0.001	0.005	0.002	0.003	0.005	0.001	0.001	0.005	0.001	0.002	0.002
Peru	0.012	0.001	0.011	0.003	0.004	0.030	0.003	0.001	0.0004	0.002	0.003	0.0002	0.002	0.002	0.001	0.001	0.000	0.0003	0.001	8.2E-05	9.9E-05	0.001	0.0004	0.001	0.001	0.001	0.004
Philippines	0.005	0.006	0.003	0.002	0.020	0.003	0.004	0.003	0.011	0.017	0.012	0.019	0.003	0.0001	0.001	0.012	0.001	0.000	0.001	0.014	0.026	0.001	0.001	0.022	0.001	0.002	0.007
South Africa	0.014	0.012	0.010	0.002	0.009	0.002	0.016	0.013	0.004	0.012	0.006	0.005	0.001	0.004	0.002	0.006	0.002	0.002	0.000	0.018	0.003	0.007	0.006	0.008	0.016	0.016	0.006
Saudi Arabia	0.005	0.010	0.017	0.003	0.020	0.001	0.019	0.020	0.025	0.045	0.048	0.010	0.001	0.001	0.001	0.015	0.001	0.040	0.040	0.000	0.026	0.005	0.005	0.030	0.026	0.007	0.020
Singapore	0.002	0.054	0.011	0.003	0.032	0.002	0.015	0.065	0.167	0.029	0.038	0.185	0.005	0.004	0.007	0.039	0.001	0.104	0.011	0.043	0.000	0.004	0.008	0.068	0.005	0.014	0.017
Sweden	0.004	0.009	0.009	0.004	0.006	0.009	0.058	0.009	0.005	0.004	0.004	0.004	0.002	0.005	0.111	0.006	0.007	0.002	0.014	0.006	0.003	0.000	0.010	0.004	0.016	0.025	0.007
Switzerland	0.010	0.009	0.013	0.005	0.006	0.004	0.085	0.011	0.004	0.008	0.004	0.007	0.003	0.006	0.009	0.006	0.036	0.003	0.019	0.007	0.007	0.012	0.000	0.016	0.041	0.020	0.013
Thailand	0.010	0.040	0.010	0.004	0.023	0.007	0.010	0.019	0.042	0.043	0.015	0.060	0.004	0.006	0.003	0.025	0.006	0.045	0.017	0.026	0.048	0.004	0.010	0.000	0.008	0.006	0.012
Turkey	0.006	0.003	0.005	0.002	0.008	0.010	0.039	0.009	0.009	0.003	0.007	0.004	0.001	0.007	0.005	0.002	0.003	0.002	0.013	0.016	0.002	0.011	0.015	0.005	0.000	0.016	0.005
UK	0.014	0.050	0.023	0.029	0.027	0.012	0.198	0.051	0.012	0.022	0.018	0.018	0.007	0.033	0.231	0.040	0.011	0.011	0.081	0.022	0.026	0.091	0.051	0.022	0.082	0.000	0.041
USA	0.127	0.113	0.200	0.713	0.210	0.176	0.173	0.154	0.094	0.207	0.145	0.154	0.695	0.379	0.063	0.127	0.253	0.179	0.114	0.196	0.133	0.074	0.104	0.129	0.083	0.141	0.000

Note: The trade weights are based on 2006-2008 trade flows.

Table A.2: Unit Root Results for the Endogenous Variables of the GVAR Model

Domestic Variables	Statistic	Critical Value	Argentina	Australia	Brazil	Canada	China	Chile	Euro	India	Indonesia	Japan	Korea	Malaysia	Mexico	Nigeria	Norway	New Zealand	Peru	Philippines	South Africa	Saudi Arabia	Singapore	Sweden	Switzerland	Thailand	Turkey	UK	USA
y (with trend)	ADF	-3.45	-2.51	-3.24	-2.24	-2.58	-1.76	-2.70	-0.83	-0.98	-1.97	-1.00	-0.70	-1.92	-3.13	-3.54	-1.46	-1.66	-1.19	-2.39	-1.25	-1.89	-1.44	-2.61	-2.45	-1.10	-2.48	-3.17	-2.28
y (with trend)	WS	-3.24	-2.20	-3.06	-2.39	-2.70	-2.04	-2.40	-1.18	-1.22	-1.80	-0.80	-1.10	-2.21	-3.34	-2.49	-1.80	-1.76	-1.46	-2.18	-1.54	-0.56	-1.49	-2.44	-2.67	-1.36	-2.73	-2.80	-2.45
y (no trend)	ADF	-2.89	0.05	-0.09	1.05	-0.58	1.08	-0.17	-1.28	1.95	-0.96	-2.28	-2.35	-0.89	-0.51	0.35	-1.13	0.05	0.47	0.61	1.03	1.31	-1.62	-0.24	-0.06	-1.53	-0.68	-1.28	-0.83
y (no trend)	WS	-2.55	-0.18	1.83	1.70	0.97	0.72	1.05	0.87	1.33	2.51	0.83	0.84	1.72	0.95	0.26	2.51	1.41	0.59	0.46	1.26	0.58	1.68	0.65	1.50	1.29	1.47	-0.87	1.23
Dy	ADF	-2.89	-5.02	-6.50	-6.55	-4.74	-3.35	-6.16	-3.71	-7.78	-6.94	-3.85	-5.37	-5.32	-4.10	-2.86	-6.82	-6.42	-7.47	-3.40	-5.07	-3.06	-6.03	-4.39	-5.84	-2.86	-7.71	-4.14	-5.00
Dy	WS	-2.55	-5.15	-6.47	-6.21	-4.92	-3.54	-6.16	-3.90	-7.92	-7.01	-3.94	-5.24	-5.45	-4.09	-2.97	-6.39	-6.53	-7.63	-3.56	-5.05	-2.95	-6.11	-4.51	-5.19	-3.09	-7.75	-2.97	-4.74
DDy	ADF	-2.89	-7.23	-8.88	-8.67	-7.14	-11.11	-9.56	-7.75	-10.25	-7.94	-7.01	-8.32	-7.74	-9.51	-8.16	-11.25	-9.08	-9.00	-9.68	-8.08	-17.31	-8.29	-7.84	-8.15	-9.17	-8.98	-12.69	-7.89
DDy	WS	-2.55	-7.36	-9.10	-7.81	-7.31	-11.19	-9.68	-7.76	-10.44	-8.17	-7.19	-7.51	-7.94	-9.75	-8.41	-10.83	-9.33	-9.10	-9.94	-7.87	-17.63	-8.57	-8.03	-8.17	-9.40	-9.14	-12.69	-7.66
Dp (with trend)	ADF	-3.45	-3.60	-3.61	-2.69	-3.46	-2.99	-5.30	-2.88	-5.52	-5.77	-4.18	-4.47	-5.32	-3.90	-4.39	-4.79	-4.06	-3.26	-5.04	-4.14	-4.40	-4.13	-3.85	-4.52	-4.60	-2.39	-5.20	-4.27
Dp (with trend)	WS	-3.24	-3.70	-3.67	-2.71	-3.48	-3.04	-5.06	-2.01	-5.69	-5.84	-3.16	-2.86	-5.45	-3.80	-4.48	-4.75	-3.81	-3.35	-5.17	-4.27	-4.47	-3.78	-3.69	-4.67	-3.07	-2.25	-2.65	-1.34
Dp (no trend)	ADF	-2.89	-2.37	-2.90	-2.18	-2.15	-2.85	-3.16	-3.15	-5.33	-5.79	-3.54	-4.69	-5.08	-2.55	-4.32	-2.05	-3.34	-2.93	-4.47	-2.69	-3.12	-4.10	-3.09	-3.62	-4.72	-2.29	-5.03	-4.40
Dp (no trend)	WS	-2.55	-2.61	-2.42	-2.45	-1.21	-3.02	-1.87	-0.68	-5.39	-5.85	-1.53	-2.18	-5.11	-2.81	-4.46	-2.03	-2.40	-3.13	-4.40	-2.80	-3.34	-3.43	-2.06	-3.52	-2.50	-1.57	-1.41	0.04
DDp	ADF	-2.89	-12.16	-9.59	-6.09	-7.57	-6.63	-7.05	-6.57	-8.73	-8.57	-7.60	-7.34	-8.75	-5.55	-7.61	-8.36	-7.35	-7.76	-6.71	-8.11	-8.72	-9.84	-6.76	-10.55	-9.59	-8.03	-7.77	-8.46
DDp	WS	-2.55	-12.36	-9.80	-6.30	-7.61	-6.85	-7.05	-6.66	-9.00	-8.68	-7.57	-6.82	-8.91	-5.76	-7.78	-7.86	-7.49	-7.99	-6.86	-8.31	-8.79	-9.86	-6.84	-10.67	-7.78	-7.84	-8.25	-8.64
DDDp	ADF	-2.89	-14.62	-9.90	-8.62	-10.03	-8.53	-10.80	-9.01	-9.43	-8.49	-10.86	-8.20	-11.43	-14.61	-10.94	-9.66	-9.11	-9.87	-8.51	-9.91	-9.47	-9.84	-8.90	-9.04	-10.50	-10.49	-11.62	-9.70
DDDp	WS	-2.55	-14.91	-10.05	-8.86	-10.03	-8.78	-11.03	-8.89	-9.48	-8.68	-11.03	-8.46	-11.79	-14.88	-9.99	-9.71	-9.35	-10.13	-8.72	-9.11	-9.61	-9.44	-8.42	-9.42	-8.71	-10.41	-10.39	-9.43
eq (with trend)	ADF	-3.45	-3.69	-4.47		-3.11		-2.06	-2.21	-3.51		-2.18	-2.51	-2.84			-4.14	-2.75		-1.57	-4.45		-4.26	-2.89	-2.13	-1.58		-1.54	-1.46
eq (with tren	WS	-3.24	-3.26	-4.52		-2.86		-2.30	-2.45	-3.67		-1.85	-2.74	-3.02			-4.05	-2.38		-1.75	-4.59		-3.83	-2.92	-2.11	-1.79		-1.77	-1.75

d)																													
eq (no trend)	ADF	-2.89	-2.65	-1.35		-0.74		-0.81	-1.61	-1.53		-2.53	-1.65	-2.15			-1.16	-3.03		-1.25	-0.97		-3.06	-1.73	-0.96	-1.28		-1.91	-1.28
eq (no trend)	WS	-2.55	-2.77	-0.74		-0.76		-0.33	-0.93	-0.87		-1.67	-1.64	-1.90			-0.97	-1.69		-1.46	-0.29		-1.80	-0.38	-0.65	-1.57		-0.75	-0.61
Deq	ADF	-2.89	-7.05	-6.00		-6.00		-5.44	-6.62	-7.04		-4.88	-5.64	-6.06			-7.78	-5.95		-4.40	-8.39		-6.24	-6.73	-6.43	-5.15		-7.34	-6.12
Deq	WS	-2.55	-6.76	-5.69		-6.21		-5.08	-6.76	-7.22		-5.06	-5.71	-6.15			-7.83	-6.16		-4.51	-8.42		-6.39	-6.86	-6.57	-5.02		-7.13	-6.24
DDeq	ADF	-2.89	-8.20	-8.11		-8.30		-7.97	-9.76	-8.94		-8.47	-13.06	-9.72			-14.06	-12.97		-12.90	-7.77		-10.00	-12.41	-12.09	-10.12		-7.55	-7.84
DDeq	WS	-2.55	-8.09	-8.34		-8.53		-7.43	-9.96	-9.16		-8.71	-13.13	-9.90			-14.26	-13.18		-13.07	-7.44		-10.17	-12.60	-12.27	-10.34		-7.40	-8.02
ep (with trend)	ADF	-3.45	-2.02	-2.41	-1.91	-2.04	-1.79	-2.08	-2.13	-0.91	-2.32	-2.08	-2.62	-2.28	-3.51	-2.06	-2.47	-2.64	-1.74	-1.96	-2.92	-1.52	-1.62	-2.28	-2.26	-2.59	-2.17	-3.06	
ep (with trend)	WS	-3.24	-2.26	-2.62	-2.17	-1.78	-1.25	-2.33	-2.36	-1.22	-2.59	-2.05	-2.82	-2.20	-3.70	-2.32	-2.66	-2.85	-1.80	-2.13	-3.12	-1.97	-1.44	-2.53	-2.49	-2.47	-1.35	-3.29	
ep (no trend)	ADF	-2.89	-1.85	-0.49	-0.99	-1.03	-1.57	-1.20	-0.55	-0.31	-2.41	-1.84	-1.65	-1.74	-1.39	-2.10	-0.87	-1.04	-1.53	-0.99	-2.14	-0.80	-0.97	-1.38	-0.67	-1.71	0.09	-0.84	
ep (no trend)	WS	-2.55	-2.09	0.29	-1.00	1.14	-1.23	-1.18	-0.16	-0.26	-2.64	-0.30	-0.94	-0.87	-0.80	-2.32	0.04	-0.39	0.38	-0.24	-2.00	-1.13	1.49	-1.11	-0.15	-0.70	-0.37	-0.10	
Dep	ADF	-2.89	-7.15	-7.73	-7.09	-7.30	-6.96	-6.85	-6.80	-5.73	-7.93	-5.12	-5.40	-7.14	-7.00	-6.51	-7.13	-6.39	-8.49	-5.97	-4.72	-3.02	-6.43	-6.93	-7.37	-5.77	-5.85	-6.10	
Dep	WS	-2.55	-7.24	-7.88	-7.25	-7.46	-7.08	-6.91	-6.83	-5.65	-8.10	-5.24	-5.60	-7.25	-7.12	-6.66	-7.24	-6.55	-8.61	-6.00	-4.79	-2.86	-6.37	-6.99	-7.48	-5.55	-5.97	-5.59	
DDep	ADF	-2.89	-9.07	-8.94	-8.25	-7.51	-10.57	-10.55	-9.88	-11.94	-10.95	-7.57	-8.49	-8.66	-10.17	-8.51	-8.08	-7.69	-8.43	-7.26	-15.30	-10.81	-8.00	-7.78	-9.91	-8.76	-9.73	-7.83	
DDep	WS	-2.55	-9.33	-9.18	-8.35	-7.70	-10.80	-10.73	-10.03	-12.13	-11.18	-7.47	-8.73	-8.91	-10.39	-8.75	-8.37	-7.92	-8.68	-7.47	-15.51	-11.04	-8.30	-8.14	-10.06	-8.99	-9.97	-8.86	
r (with trend)	ADF	-3.45	-2.65	-3.73	-2.95	-3.89	-1.78	-5.04	-3.15	-2.96	-3.92	-2.96	-2.65	-2.43	-2.98	-1.96	-3.75	-3.11	-3.29	-3.57	-3.63		-2.91	-4.49	-2.42	-3.56	-2.21	-3.17	-3.64
r (with trend)	WS	-3.24	-2.71	-3.29	-2.79	-4.08	-1.63	-5.00	-3.04	-3.03	-4.10	-3.20	-2.59	-2.12	-2.03	-1.86	-2.91	-3.12	-3.39	-3.37	-2.89		-3.11	-2.28	-2.20	-3.69	-1.48	-3.35	-3.76
r (no trend)	ADF	-2.89	-2.01	-1.66	-2.48	-1.40	-1.04	-2.12	-1.08	-2.51	-3.86	-2.08	-2.03	-1.88	-1.53	-2.36	-1.27	-1.75	-2.96	-2.28	-3.21		-2.01	-0.90	-1.91	-2.06	-2.18	-1.36	-2.25
r (no trend)	WS	-2.55	-2.27	-1.95	-2.65	-1.17	-1.43	-1.04	-1.18	-2.70	-4.05	-1.80	-0.88	-1.99	-1.78	-1.81	-1.57	-1.95	-3.18	-2.51	-2.84		-1.48	-1.29	-2.08	-2.11	-1.49	-1.18	-1.65
Dr	ADF	-2.89	-15.64	-7.32	-8.97	-5.71	-5.97	-6.56	-4.84	-6.50	-6.18	-9.13	-8.01	-6.73	-6.09	-6.98	-8.35	-7.95	-4.24	-7.78	-5.84		-4.91	-8.22	-5.06	-6.04	-8.91	-7.03	-3.58
Dr	WS	-2.55	-15.88	-7.47	-9.18	-5.86	-6.13	-6.76	-3.91	-6.66	-6.42	-4.94	-7.80	-6.87	-6.25	-7.20	-8.36	-8.15	-4.45	-7.94	-5.93		-4.57	-7.95	-4.93	-6.29	-9.08	-6.63	-3.70

DDr	ADF	-2.89	-12.60	-10.80	-11.07	-9.54	-7.66	-8.32	-8.55	-8.35	-11.85	-6.07	-8.94	-8.35	-10.63	-8.61	-8.41	-9.20	-8.69	-9.48	-7.93		-8.63	-10.36	-8.15	-7.51	-8.82	-9.06	-6.02
DDr	WS	-2.55	-12.92	-11.01	-11.36	-9.28	-7.90	-8.51	-8.37	-8.59	-12.04	-5.33	-9.40	-8.58	-10.91	-8.86	-8.53	-9.45	-8.94	-9.74	-8.14		-8.16	-10.61	-8.42	-7.85	-9.07	-8.83	-7.24
lr (with trend)	ADF	-3.45		-3.51		-3.99			-3.13			-2.26	-3.51				-2.98	-1.90			-2.97			-4.56	-3.49			-2.81	-3.92
lr (with trend)	WS	-3.24		-2.08		-3.54			-3.05			-2.50	-2.46				-1.43	-2.02			-0.69			-3.51	-2.58			-3.03	-3.98
lr (no trend)	ADF	-2.89		-0.76		-1.21			-1.05			-1.90	-3.06				-0.83	-0.95			-1.66			-0.32	-1.36			-1.45	-1.61
lr (no trend)	WS	-2.55		-1.22		-1.28			-1.02			-0.85	-0.34				-1.28	-0.96			-1.50			-0.70	-1.70			-0.43	-1.51
Dlr	ADF	-2.89		-5.72		-5.78			-5.36			-5.78	-7.28				-7.12	-7.37			-8.21			-6.79	-6.37			-8.60	-5.89
Dlr	WS	-2.55		-5.64		-5.69			-5.14			-5.44	-6.73				-7.08	-7.58			-8.38			-6.92	-5.91			-7.98	-5.83
DDlr	ADF	-2.89		-8.86		-8.43			-8.22			-7.85	-9.33				-7.55	-8.83			-8.12			-7.68	-7.53			-8.28	-7.04
DDlr	WS	-2.55		-9.10		-8.58			-8.40			-7.99	-9.20				-7.73	-9.09			-8.30			-8.04	-7.72			-8.60	-7.73

Note: The unit root tests are based on the 5% Level of Significance.

Table A.3: Unit Root Results for the Foreign Variables of the GVAR Model

Foreign Variables	Statistic	Critical Value	Argentina	Australia	Brazil	Canada	China	Chile	Euro	India	Indonesia	Japan	Korea	Malaysia	Mexico	Nigeria	Norway	New Zealand	Peru	Philippines	South Africa	Saudi Arabia	Singapore	Sweden	Switzerland	Thailand	Turkey	UK	USA
ys (with trend)	ADF	-3.45	-3.42	-1.82	-4.25	-2.29	-0.54	-3.56	-4.02	-2.40	-1.00	-3.01	-3.13	-1.14	-2.22	-2.90	-2.62	-2.12	-3.85	-1.02	-2.79	-0.96	-2.01	-2.02	-1.44	-1.96	-2.75	-1.90	-4.47
ys (with trend)	WS	-3.24	-3.05	-2.13	-3.42	-2.36	-1.13	-3.42	-3.66	-2.53	-1.38	-3.05	-3.29	-1.50	-2.34	-2.95	-2.40	-2.43	-3.62	-1.44	-2.65	-1.40	-2.27	-2.18	-1.70	-2.20	-2.54	-2.11	-4.41
ys (no trend)	ADF	-2.89	0.92	-1.11	0.23	-0.71	-1.64	0.04	-0.26	-0.59	-1.50	-0.23	-0.07	-1.41	-0.74	-0.49	-0.98	-0.93	-0.14	-1.34	-0.54	-1.54	-0.71	-0.84	-1.11	-1.04	-0.73	-0.91	-0.25
ys (no trend)	WS	-2.55	1.65	1.07	1.33	1.36	0.97	1.56	1.35	1.11	1.14	1.14	0.54	1.14	1.30	1.34	0.90	1.13	1.48	1.20	1.22	1.03	1.57	0.98	1.05	1.22	1.15	1.34	1.28
Dys	ADF	-2.89	-5.74	-4.29	-4.67	-4.93	-5.28	-4.68	-4.96	-4.54	-5.64	-4.62	-4.13	-5.71	-4.88	-4.75	-4.53	-4.58	-4.55	-4.43	-4.30	-4.40	-5.65	-3.17	-4.20	-5.72	-4.22	-4.50	-5.06
Dys	WS	-2.55	-5.80	-4.37	-4.77	-4.73	-5.45	-4.82	-4.84	-4.61	-5.83	-4.68	-4.32	-5.89	-4.66	-4.77	-4.27	-4.70	-4.69	-4.58	-4.34	-4.41	-5.83	-3.30	-4.28	-5.87	-4.26	-4.64	-5.25
DDy	ADF	-2.89	-8.14	-9.48	-7.31	-7.39	-7.65	-8.02	-7.74	-7.98	-8.36	-7.76	-10.11	-8.45	-7.14	-7.36	-7.19	-7.82	-8.96	-7.90	-7.90	-7.78	-8.70	-9.02	-8.03	-9.02	-7.99	-8.29	-7.89
DDy	WS	-2.55	-7.62	-9.59	-7.40	-7.45	-7.82	-8.03	-7.91	-8.14	-8.54	-7.92	-10.02	-8.65	-7.34	-7.32	-7.24	-8.01	-8.53	-8.08	-8.05	-7.95	-8.82	-8.92	-8.15	-9.06	-8.12	-8.33	-8.04
Dps (with trend)	ADF	-3.45	-2.64	-2.86	-3.39	-3.38	-3.02	-2.74	-2.57	-2.93	-2.70	-2.55	-2.98	-3.19	-3.37	-2.28	-3.02	-3.37	-2.85	-2.90	-2.74	-2.70	-4.56	-3.43	-3.04	-3.49	-2.67	-3.43	-2.59
Dps (with trend)	WS	-3.24	-2.68	-2.73	-3.54	-2.55	-3.20	-2.74	-2.81	-3.14	-2.66	-2.71	-3.16	-2.94	-3.24	-2.49	-2.55	-3.03	-2.93	-2.73	-2.95	-2.59	-4.42	-3.12	-2.60	-3.61	-2.74	-3.21	-2.33
Dps (no trend)	ADF	-2.89	-2.08	-2.33	-2.47	-2.67	-2.36	-1.98	-2.03	-2.29	-2.33	-2.03	-1.70	-2.59	-2.51	-1.78	-2.72	-2.39	-2.07	-2.49	-2.00	-2.31	-3.70	-2.36	-2.52	-2.13	-2.16	-2.29	-1.15
Dps (no trend)	WS	-2.55	-2.36	-1.17	-2.66	-0.45	-1.70	-2.24	-1.85	-2.03	-1.36	-1.51	-1.75	-1.38	-1.38	-1.97	-0.78	-0.88	-2.28	-1.39	-1.95	-1.18	-3.01	-0.72	-0.60	-1.47	-1.18	-0.72	-1.44
DDps	ADF	-2.89	-6.01	-7.59	-11.90	-8.16	-6.99	-7.41	-7.12	-6.31	-7.35	-7.31	-6.93	-7.56	-10.51	-8.71	-6.73	-7.62	-8.63	-7.48	-6.35	-7.23	-7.78	-6.91	-6.97	-6.97	-6.59	-6.92	-5.83
DDps	WS	-2.55	-6.23	-7.73	-12.08	-8.31	-7.05	-7.57	-7.05	-6.36	-7.46	-7.49	-7.11	-7.24	-10.67	-8.89	-6.97	-7.54	-8.80	-7.60	-6.42	-7.38	-7.84	-6.61	-7.08	-7.16	-6.75	-7.00	-5.95
DDDp	ADF	-2.89	-8.55	-9.33	-10.18	-9.89	-8.85	-7.75	-9.37	-8.15	-9.48	-9.71	-9.19	-9.44	-9.35	-9.04	-8.61	-9.30	-8.70	-9.54	-8.04	-9.35	-9.60	-8.90	-9.09	-9.31	-8.90	-8.87	-10.51
DDDp	WS	-2.55	-8.77	-9.55	-10.45	-9.60	-8.70	-7.92	-8.90	-8.36	-9.36	-9.60	-9.37	-9.74	-9.21	-9.08	-8.10	-9.39	-8.86	-9.58	-8.00	-9.00	-9.78	-8.54	-8.61	-9.59	-8.94	-8.67	-10.77
eqs (with trend)	ADF	-3.45	-1.92	-2.39	-3.42	-1.59	-2.31	-3.00	-2.15	-2.45	-2.77	-2.33	-2.26	-2.56	-1.74	-2.15	-2.09	-2.67	-2.24	-2.51	-2.25	-2.24	-2.44	-2.27	-2.14	-2.55	-2.18	-2.31	-3.05
eqs	WS	-3.24	-2.19	-2.54	-3.64	-1.88	-2.54	-3.26	-2.41	-2.67	-2.87	-2.55	-2.42	-2.73	-2.01	-2.41	-2.33	-2.88	-2.47	-2.66	-2.48	-2.45	-2.66	-2.52	-2.39	-2.66	-2.43	-2.55	-3.25

(with trend)																													
eqs (no trend)	ADF	-2.89	-1.36	-1.86	-1.26	-1.35	-1.59	-1.55	-1.45	-1.53	-1.94	-1.26	-1.79	-1.79	-1.31	-1.40	-1.63	-1.57	-1.25	-1.85	-1.61	-1.69	-1.52	-1.48	-1.58	-1.90	-1.53	-1.49	-1.39
eqs (no trend)	WS	-2.55	-0.38	-0.91	-0.63	-0.59	-0.82	-0.77	-0.51	-0.67	-1.02	-0.65	-0.75	-0.90	-0.59	-0.56	-0.67	-0.70	-0.51	-0.93	-0.77	-0.87	-0.83	-0.77	-0.81	-0.92	-0.74	-0.73	-0.78
Deqs	ADF	-2.89	-6.60	-6.96	-5.77	-6.30	-6.83	-7.11	-6.86	-6.99	-7.06	-6.94	-6.94	-7.12	-6.37	-6.69	-6.77	-6.89	-6.57	-7.04	-6.90	-6.84	-7.12	-6.82	-6.72	-6.92	-6.76	-6.77	-7.03
Deqs	WS	-2.55	-6.76	-7.09	-5.95	-6.42	-6.96	-7.26	-6.97	-7.13	-7.20	-7.07	-7.09	-7.25	-6.50	-6.81	-6.86	-7.05	-6.73	-7.19	-7.03	-6.97	-7.27	-6.97	-6.85	-7.07	-6.89	-6.92	-7.19
DDeq	ADF	-2.89	-9.72	-11.97	-13.39	-7.78	-11.94	-12.90	-9.42	-9.44	-11.84	-12.08	-9.51	-9.36	-7.79	-9.43	-9.73	-7.77	-11.83	-9.30	-12.35	-9.30	-12.14	-9.70	-9.73	-9.27	-9.65	-9.56	-7.76
DDeq	WS	-2.55	-9.93	-12.16	-13.55	-7.97	-12.12	-13.06	-9.63	-9.65	-12.03	-12.27	-9.72	-9.56	-7.99	-9.64	-9.95	-7.99	-12.02	-9.51	-12.55	-9.51	-12.33	-9.90	-9.94	-9.47	-9.86	-9.77	-7.98
eps (with trend)	ADF	-3.45	-1.67	-2.21	-2.11	-2.18	-1.89	-1.83	-2.44	-1.95	-1.95	-1.90	-2.00	-1.98	-1.91	-1.95	-2.31	-2.15	-1.88	-2.03	-2.12	-2.00	-2.22	-2.20	-2.12	-2.04	-2.17	-2.08	-2.01
eps (with trend)	WS	-3.24	-1.92	-2.45	-2.31	-2.37	-2.12	-2.07	-2.63	-2.18	-2.18	-2.07	-2.15	-2.23	-2.17	-2.19	-2.54	-2.40	-2.10	-2.29	-2.34	-2.26	-2.47	-2.44	-2.35	-2.30	-2.39	-2.31	-2.28
eps (no trend)	ADF	-2.89	-0.18	-0.33	-0.53	-0.11	-0.64	-0.20	-0.30	-0.06	-0.39	-0.02	0.14	-0.28	-0.13	-0.11	-0.64	-0.27	-0.08	-0.30	-0.22	-0.38	-0.57	-0.48	-0.45	-0.34	-0.37	-0.36	-0.14
eps (no trend)	WS	-2.55	-0.04	0.35	-0.29	0.41	0.50	0.22	0.17	0.27	0.73	-0.03	0.29	0.61	0.41	0.27	-0.05	0.43	0.24	0.48	0.28	0.38	-0.20	0.06	0.02	0.49	0.06	0.07	0.86
Deps	ADF	-2.89	-6.38	-7.07	-7.34	-7.35	-6.84	-6.55	-7.41	-7.26	-7.08	-6.67	-7.22	-6.82	-6.76	-6.50	-7.02	-7.04	-6.68	-7.17	-7.34	-7.08	-6.59	-6.99	-6.90	-7.23	-7.03	-6.91	-7.45
Deps	WS	-2.55	-6.48	-7.17	-7.31	-7.36	-6.94	-6.58	-7.39	-7.25	-7.19	-6.65	-7.32	-6.88	-6.82	-6.51	-7.01	-7.14	-6.71	-7.28	-7.37	-7.18	-6.67	-7.01	-6.92	-7.36	-7.03	-6.93	-7.50
DDep	ADF	-2.89	-9.40	-7.72	-8.82	-10.84	-7.39	-8.59	-7.73	-7.67	-7.78	-8.48	-7.78	-7.67	-7.34	-7.99	-9.67	-7.50	-8.25	-7.86	-7.53	-7.47	-8.49	-9.87	-9.95	-7.73	-10.00	-9.92	-10.51
DDep	WS	-2.55	-9.66	-8.14	-9.07	-11.05	-7.69	-8.84	-8.19	-8.06	-8.16	-8.73	-8.19	-8.05	-7.70	-8.23	-9.80	-7.90	-8.50	-8.25	-7.96	-7.79	-8.73	-10.04	-10.10	-8.10	-10.15	-10.08	-10.73
rs (with trend)	ADF	-3.45	-2.90	-2.57	-2.60	-3.36	-2.67	-2.98	-2.58	-2.70	-2.74	-2.56	-2.54	-3.30	-3.18	-2.89	-3.14	-3.36	-2.72	-3.09	-2.87	-2.64	-3.03	-3.30	-3.29	-2.69	-2.66	-3.31	-2.88
rs (with trend)	WS	-3.24	-2.72	-2.24	-2.53	-3.31	-2.14	-2.70	-1.86	-2.18	-2.42	-2.16	-1.67	-3.11	-3.15	-2.64	-2.23	-2.83	-2.41	-2.96	-2.44	-1.99	-2.48	-2.12	-2.18	-2.19	-2.22	-1.98	-1.09
rs (no trend)	ADF	-2.89	-2.33	-0.73	-1.55	-1.09	-0.94	-1.98	-1.03	-0.90	-0.96	-0.77	-0.65	-1.18	-1.32	-1.96	-0.58	-1.02	-1.64	-1.22	-1.25	-0.72	-0.94	-0.28	-0.34	-0.87	-0.76	-0.45	-0.46

rs (no trend)	WS	-2.55	-2.52	-0.98	-1.83	-1.12	-1.30	-2.25	-1.38	-1.26	-1.23	-1.10	-1.09	-1.34	-1.45	-2.22	-0.85	-1.30	-1.93	-1.36	-1.58	-1.10	-1.26	-0.71	-0.76	-1.21	-1.07	-0.86	-0.96
Drs	ADF	-2.89	-8.86	-6.04	-14.83	-4.79	-10.33	-6.26	-10.46	-6.51	-5.92	-6.38	-9.94	-5.46	-6.51	-10.63	-6.49	-5.02	-10.86	-5.25	-6.23	-10.37	-7.35	-8.95	-9.12	-6.24	-6.08	-6.51	-11.58
Drs	WS	-2.55	-9.07	-5.62	-15.05	-4.84	-10.46	-6.44	-10.61	-6.51	-5.59	-6.32	-10.05	-5.03	-6.42	-10.81	-5.95	-4.58	-11.04	-4.63	-6.31	-10.49	-7.41	-8.87	-9.07	-6.08	-5.86	-6.22	-11.73
DDr	ADF	-2.89	-11.03	-8.66	-12.21	-10.05	-10.52	-9.89	-10.43	-9.92	-9.50	-9.29	-10.07	-8.67	-10.20	-11.04	-9.42	-8.04	-10.39	-8.57	-9.80	-10.58	-10.47	-9.70	-10.22	-9.69	-9.52	-9.98	-10.50
DDr	WS	-2.55	-11.32	-8.77	-12.52	-9.75	-10.78	-10.15	-10.69	-10.13	-9.67	-9.45	-10.30	-8.68	-10.27	-11.32	-9.46	-8.11	-10.66	-8.56	-10.04	-10.82	-10.69	-9.81	-10.36	-9.89	-9.67	-10.12	-10.75
lrs (with trend)	ADF	-3.45	-2.92	-2.43	-2.78	-3.90	-2.47	-2.46	-3.88	-2.63	-2.42	-2.85	-3.15	-2.47	-3.93	-3.02	-2.76	-2.71	-2.93	-2.47	-2.45	-2.51	-2.44	-2.77	-2.64	-2.44	-2.61	-2.82	-3.23
lrs (with trend)	WS	-3.24	-2.78	-2.73	-2.76	-3.97	-2.75	-2.65	-3.88	-2.64	-2.72	-3.00	-3.20	-2.71	-4.04	-3.04	-2.66	-2.29	-2.98	-2.74	-2.53	-2.79	-2.69	-2.40	-2.53	-2.68	-2.53	-2.48	-3.32
lrs (no trend)	ADF	-2.89	-1.01	-1.47	-1.09	-1.30	-1.55	-1.33	-0.95	-1.06	-1.64	-1.22	-1.15	-1.39	-1.34	-1.17	-0.92	-0.87	-1.21	-1.54	-1.12	-1.54	-1.37	-0.89	-1.01	-1.38	-0.99	-0.90	-1.18
lrs (no trend)	WS	-2.55	-0.84	-0.43	-0.80	-1.13	-0.54	-0.67	-0.62	-0.68	-0.58	-0.58	-0.88	-0.63	-1.10	-0.89	-0.70	-0.80	-0.85	-0.66	-0.72	-0.58	-0.56	-0.85	-0.89	-0.71	-0.80	-0.89	-0.85
Dlrs	ADF	-2.89	-5.70	-6.06	-5.77	-5.85	-6.04	-5.93	-5.91	-6.02	-5.80	-6.30	-5.45	-5.94	-5.87	-5.61	-5.75	-5.98	-5.67	-5.77	-5.79	-5.91	-6.14	-5.73	-5.56	-5.66	-5.75	-5.66	-5.39
Dlrs	WS	-2.55	-5.64	-5.79	-5.69	-5.75	-5.73	-5.76	-5.81	-5.86	-5.34	-6.17	-5.29	-5.68	-5.75	-5.61	-5.61	-5.69	-5.59	-5.50	-5.58	-5.62	-5.88	-5.55	-5.40	-5.33	-5.56	-5.56	-5.12
DDlr	ADF	-2.89	-7.56	-7.94	-7.60	-7.17	-7.78	-7.63	-7.61	-7.66	-7.84	-7.81	-7.88	-7.63	-7.21	-7.47	-7.71	-7.68	-7.68	-7.59	-7.68	-7.69	-7.70	-7.57	-7.42	-7.72	-7.50	-7.46	-8.57
DDlr	WS	-2.55	-7.98	-8.29	-8.01	-7.84	-8.00	-7.92	-8.21	-8.03	-8.01	-8.12	-8.34	-7.92	-7.82	-8.01	-8.23	-7.96	-8.04	-7.85	-8.08	-7.95	-7.98	-8.00	-7.75	-8.02	-7.86	-7.81	-8.60

Note: The unit root tests are based on the 5% Level of Significance.

Table A.4: Test for Weak Exogeneity

Country	F test	Fcrit_0.05	ys	Dps	eqs	eps	rs	lrs	poil
ARGENTINA	F(2,100)	3.09	1.38	1.77	0.44		5.89	0.42	0.51
AUSTRALIA	F(4,102)	2.46	1.12	1.08	0.87		0.68	0.94	0.14
BRAZIL	F(1,103)	3.93	0.08	0.00	2.91		0.93	0.33	0.10
CANADA	F(4,102)	2.46	2.13	2.07	1.03		1.28	0.47	0.25
CHINA	F(2,106)	3.08	0.94	0.51	0.42		0.65	1.30	0.55
CHILE	F(2,100)	3.09	0.20	2.45	2.24		1.15	0.51	0.63
EURO	F(2,98)	3.09	1.52	1.76	0.37		2.30	1.32	0.53
INDIA	F(1,101)	3.94	0.21	4.69	0.10		4.98	0.04	0.28
INDONESIA	F(3,101)	2.69	1.51	1.24	0.84		0.39	0.63	0.63
JAPAN	F(2,98)	3.09	1.13	0.19	0.22		1.88	3.70	1.71
KOREA	F(4,96)	2.47	1.15	0.14	3.18		0.58	0.88	2.16
MALAYSIA	F(1,106)	3.93	2.13	0.17	0.13		1.13	0.24	1.58
MEXICO	F(2,106)	3.08	1.49	1.98	1.77		0.70	1.38	2.59
NIGERIA	F(1,103)	3.93	1.07	0.03	0.22		0.89	0.10	0.57
NORWAY	F(3,97)	2.70	1.72	2.43	1.39		0.43	2.11	0.57
NEW ZEALAND	F(3,97)	2.70	1.81	0.76	1.12		1.35	0.55	0.77
PERU	F(3,101)	2.69	0.91	1.30	0.31		0.87	0.97	0.59
PHILIPPINES	F(2,100)	3.09	0.97	2.16	1.22		0.70	1.42	3.13
SOUTH AFRICA	F(2,98)	3.09	0.24	0.77	0.42		1.18	2.25	4.20
SAUDI ARABIA	F(2,104)	3.08	1.08	3.59	5.08		0.47	0.93	0.46
SINGAPORE	F(2,100)	3.09	1.53	0.02	0.57		1.22	0.36	0.66
SWEDEN	F(2,98)	3.09	0.00	0.49	0.02		0.03	0.23	0.17
SWITZERLAND	F(3,97)	2.70	2.36	1.93	1.17		0.27	0.41	0.26
THAILAND	F(2,100)	3.09	0.31	1.91	0.23		0.86	0.77	0.11
TURKEY	F(1,103)	3.93	0.15	3.24	0.00		0.18	0.07	0.09
UNITED KINGDOM	F(2,104)	3.08	2.67	1.48	0.24		1.34	0.25	1.41
USA	F(2,102)	3.09	0.77	3.44		1.54			

Notes: The test is based on the 5% Significance Level and the F Statistic.

Table A.5: VARX* Order and Cointegrating Relationships of the Country-Specific Models

	p	q	Cointegrating Relations
ARGENTINA	2	1	2
AUSTRALIA	1	1	4
BRAZIL	2	1	1
CANADA	1	1	4
CHINA	1	1	2
CHILE	2	1	2
EURO	2	1	2
INDIA	2	1	1
INDONESIA	2	1	3
JAPAN	2	1	2
KOREA	2	1	4
MALAYSIA	1	1	1
MEXICO	1	1	2
NIGERIA	2	1	1
NORWAY	2	1	3
NEW ZEALAND	2	1	3
PERU	2	1	3
PHILIPPINES	2	1	2
SOUTH AFRICA	2	1	2
SAUDI ARABIA	2	1	2
SINGAPORE	2	1	2
SWEDEN	2	1	2
SWITZERLAND	2	1	3
THAILAND	2	1	2
TURKEY	2	1	1
UNITED KINGDOM	1	1	2
USA	2	1	2

Note: p and q are the lag orders of the domestic and foreign variables of the country specific VARX models of the GVAR model respectively.