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Natural Resources and Development

The Oil Industry‘s Effects on Nigeria‘s Level of Macroeconomic Stability

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Supervisor: Daði Már Kristófersson

Faculty of Economics

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HÁSKÓLI ÍSLANDS

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Preface

This paper is a 12 ECTS unit thesis for a BSc undergraduate degree at the University of Iceland's Faculty of Economics. The supervisor for this thesis was Daði Már Kristófersson, associate professor at the University of Iceland, and I would like to thank him for useful insights with regard to how I could approach my topic.

I would also like to thank my mother, Ingunn Björnsdóttir, for reading through the paper, providing useful suggestions and encouraging me in the final stages of writing it.

Abstract

Instability in the revenues of natural resources that play a large role in a country's economy is bound to have various effects. Oil plays a large role in Nigeria's economy with its share in total exports having been over 90 percent in the past decades and its share in federally collected revenue being close to 80 percent.

The aim of this thesis is to explain how the oil industry, with its volatile commodity prices, affects macroeconomic stability in Nigeria. The primary focus is on oil price changes along with three specific macroeconomic variables; export value as a ratio of GDP, inflation and GDP growth.

The analysis of the aforementioned variables is primarily based on economic literature on the subject. A vector error correction model is also set up for the three variables and oil price with graphs of the corresponding impulse responses to shocks in oil prices.

The role of macroeconomic and institutional policies in either exacerbating or potentially mitigating the effects of oil shocks is also explored.

The conclusions reached are that volatile oil prices affect not only macroeconomic stability but also political stability and government decisions. Additionally, it is concluded that a better coordination of fiscal and monetary policies is needed to avoid exacerbating the ripples of oil shocks instead of mitigating them.

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1 Introduction

Oil abundant developing countries are usually confronted with problems such as macroeconomic volatility, the Dutch disease, political instability, conflict, weak governance and rent-seeking. Poor growth, poverty and underdevelopment are often the distinctive features of such oil abundant economies.

What I hope to achieve in writing this paper is to shed light on and present evidence on to what extent factors associated with significant oil reserves affect the level of macroeconomic stability. Macroeconomic stability is quite a broad term and can be evaluated in many ways. In this essay I will focus on how fluctuations in three specific macroeconomic indicators could be traced back to having sizeable oil reserves, how these indicators relate to macroeconomic stability and summarize some of the findings of others pertaining to the topic of macroeconomic stability. The macroeconomic indicators of choice are inflation, gross domestic product (GDP) growth and export value as a ratio of GDP. Inflation and GDP growth are chosen because they are two of the most basic measures of macroeconomic performance and provide clear signs for determining an economy's stability. Export revenue as a ratio of GDP is chosen because it is a more direct link to the outside world than the other two indicators, oil is a commodity traded in the world market and the country being analyzed relies heavily on oil for its exports.

To begin with, I will explain how and why macroeconomic stability is important to the growth and development of an economy. Section 2 covers that in addition to briefly addressing different methods for evaluating macroeconomic stability.

Section 3 will give a summary of important historical developments in the Nigerian oil sector and the world oil industry relevant to my analysis. I will also briefly address the petroleum industry's role in the world economy.

Using vector auto regression (VAR) techniques I will analyze the effects significant world oil price shocks have had on the Nigerian economy in section 4. I will present some of the major results of others who have used vector autoregression to analyze oil's effects on the Nigerian economy in tandem with my own and compare them.

Section 5 explores and explains the underlying economic phenomena of the Nigerian oil industry's effects on the economy.

Additionally, I will briefly address the effects of the oil industry on the political and institutional layout of the country of choice in section 6 and how institutional and economic policies could potentially be improved. The approach adopted in the policy section is one that considers how oil windfalls influence and, to some extent, debase economic and institutional policies and if and how this can be countered. The country I have chosen as a case study is Nigeria because it is frequently mentioned as having made a lot of progress growth-wise in recent years, forecasts suggest it will be one of the world's fastest growing economies in the next decades and the majority of its exports consist of petroleum products. Moreover, I thought it would be interesting to see how much data I could actually find about a country so far away from- and so very different from my own home country. I wanted to see if I could reach a plausible and whole conclusion or if I would run in to too many obstacles to do so.

Much of my analysis will be more qualitative than quantitative as quantitative data for Nigeria are somewhat limited or ill-accessible. Therefore, the bulk of this paper will be a compilation of the various conclusions of academic research that has ventured into the topic of the effects of oil on the Nigerian economy. The focus is more on identifying the historical and theoretical channels, whether they be disputed ones or relatively undisputed ones, through which the oil industry affects the stability of key macroeconomic indicators rather than determining magnitudes of the oil industry's effects.

This also means that when there is mention of many countering forces affecting the economy, through the oil sector at the same time, I will not necessarily be able to determine which ones outweigh others. However, I will attempt to assign each effect that is mentioned a direction, whether it be one towards more stability of the economy or one towards lesser stability of the economy.

In the context of how natural resources such as oil and gas affect economies there has been some debate, particularly in relation to theories about the existence of a resource curse. Before the 80s the conventional wisdom was that resource abundance would help developing countries move from the stage of underdevelopment to that of

industrial „take-off“, as obtained in such countries as the USA and Britain. This wisdom came under dispute in the late 80s when more and more scholars claimed that resource abundance was not a blessing, but rather a curse. Those who think there is a resource curse believe that resource abundance has detrimental effects on the development of an economy. According to some studies the per capita incomes of resource poor countries increased at rates two or three times faster than those of resource abundant countries in the last decades of the 20th century (Akinlo, 2012).

The various channels through which natural resource abundance, and oil abundance in particular, supposedly affects economies have been identified to some extent in economic literature. The channels most prominent in the literature include, but are not limited to:

1. **How huge oil revenues enable governments to spend and invest massively without recourse to taxation.**

2. **The provision of intermediate inputs to the rest of the economy.**

3. **The pronounced accumulation of foreign exchange via the large-scale exporting of oil enabling countries to amass hefty foreign reserves.**

4. **The oil sector‘s demand for various goods and services provided by local sources. Oil sector related services generally spring up once oil production commences because of the sector‘s demand for them.**

5. **The inflow of Foreign Direct Investment, hereafter FDI, and portfolio investment. In fact, the bulk of FDI into the majority of oil exporting economies is concentrated in the oil sector.**

6. **The Dutch disease. An appreciation of the real exchange rate due to exporting of the abundant resource results in an appreciation of the real exchange rate, lowering the ability of other sectors’ exports to compete in the world markt.**

7. **Volatility of oil revenues due to sharp and significant fluctuations in oil prices over relatively short periods of time.**

8. **How windfall oil revenues tend to promote rent-seeking activities that involve voracity, corruption and civil conflict.**

I will address each of these channels in this paper, how they affect macroeconomic stability and how they are connected to the macroeconomic indicators that I mentioned as my main points of focus.

2 The Importance of Macroeconomic Stability

In an IMF factsheet it is insisted that "macroeconomic stability is essential for high and sustainable rates of growth" (Ames, Brown, Devarajan, & Izquierdo, 2001) and growth is most important in poverty reduction, as long as its distributional patterns and sectoral composition favor the poor. However, macroeconomic stability is concluded to be only a necessary condition for sustained growth and not a sufficient one (Ames, Brown, Devarajan, & Izquierdo, 2001). The strength of the empirical relationship between macroeconomic stability and growth remains uncertain. Sirimaneethan & Temple (2009) hypothesize that once a certain threshold level of stability is obtained, the marginal benefits of greater stability could be minimal.

In the absence of macroeconomic stability, domestic and foreign investors will hesitate to invest and instead divert resources elsewhere. There exists no generally acknowledged threshold-value method for distinguishing between stability and instability of macroeconomic variables, although some researchers, Sirimaneethan & Temple for example, have come up with methods to sort countries in order of low level of macroeconomic stability to high level of macroeconomic stability. It may be relatively easy to identify a country in a state of macroeconomic instability or stability. The following are symptoms of macroeconomic instability:

- double-digit inflation rates
- stagnant or declining GDP
- large current account deficits financed by short-term loans
- high and increasing levels of public debt

and these are symptoms of macroeconomic stability:

- low single-digit inflation
- rising per capita GDP
- fiscal balances and current account balances in tune with low and declining debt levels (Ames, Brown, Devarajan, & Izquierdo, 2001).

Looking at data downloaded off the World Bank's website (2012), represented graphically in figure 1, the average annual real per capita GDP growth for the years 1961-2011 was 1,6% with a standard deviation of 6,9% showing that growth in Nigeria has been unstable. Also, it is clear from looking at the figure that per capita GDP has not always been rising in Nigeria. As an example, the growth rate was persistently negative from 1980 to 1984, a clear sympton of macroeconomic instability.

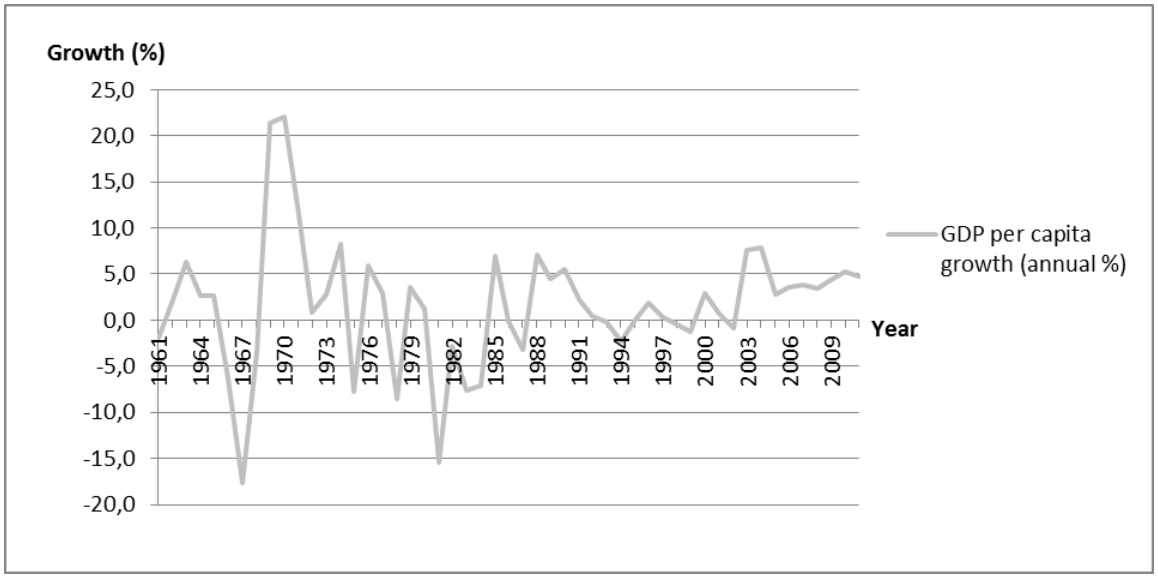


Figure 1. Annual real per capita GDP growth in Nigeria, 1961-2011.[1]

It should be noted that Nigerian data for the years 1966-1973 are somewhat unreliable due to the Biafra war's impact on data collection. Because of the war, many time series do not include the three Eastern Region states for the years 1967-1970 and there is no way of estimating the trend in that area during these years with any accuracy (Bevan, Collier, & Gunning, 1999). I will therefore focus more on the period 1974-2011 where the average annual growth rate was 1,1% with a standard deviation of 5,2% in my vector autoregression analysis.

In Citigroup's forecasts for the future, Nigeria is expected to be one of the fastest growing economies in the world in the next four decades with a projected average annual real per capita GDP growth of 6,9%. (Buiter & Rahbari, 2011)

The inflation rates in Nigeria have been very erratic and in the double-digits most of the time during the period 1961-2011 as figure 2 illustrates.

[1] The figure is my own compilation based on data from the World Bank's DataBank (2012).

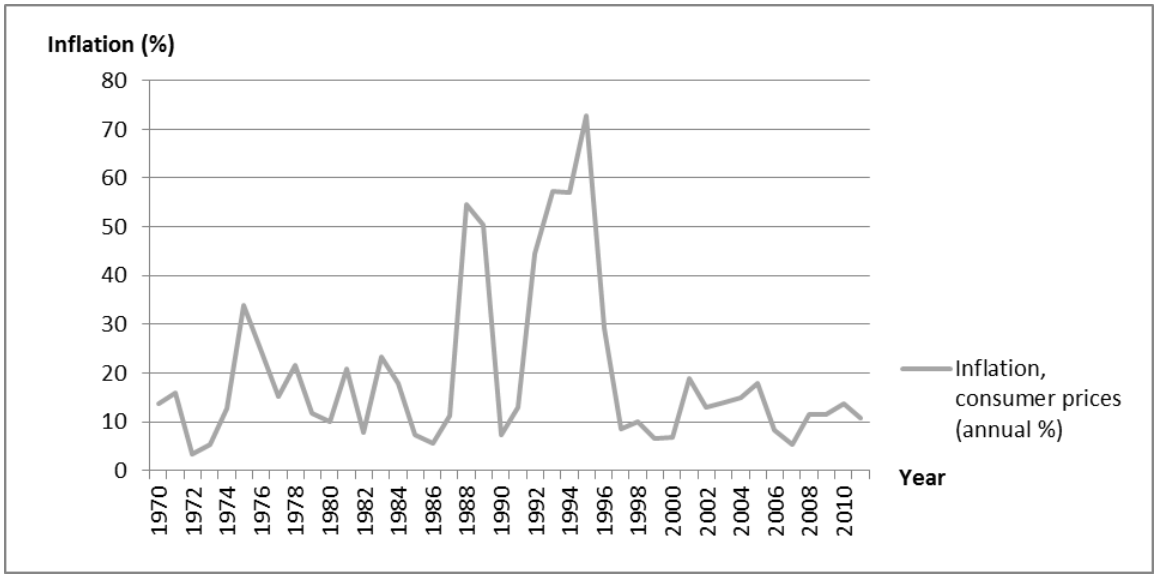


Figure 2. Annual CPI-based inflation rates in Nigeria, 1961-2011. [2]

Sirimaneethan and Temple (2009) are among those who have designed a measure of macroeconomic stability, theirs is a composite index and their aim is to sharpen the link between statistical modeling and informal commentary on policy and growth. They use a panel-data sample consisting only of developing countries and also look at the distribution of growth rates across countries from 1970-1999.

The outlier-robust principal components of their index include mathematical transformations of the mean black market premium, variation of the dollar real exchange rate measure, inflation, mean overvaluation index and budget surplus as a share of GDP. They order the countries according to index value and then split the sample at the 33rd and 66th percentiles into three categories; stability, intermediate stability and instability. Nigeria fell into the category of intermediate stability in their analysis.

If some of Sirimaneethan and Temple's main results were to be taken at face value, a 1 standard deviation improvement in stability of a country's economy as measured by their composite index could improve GDP per capita by 23% over the course of 30 years.

Also, according to their estimates, fundamentals such as good institutions in a country are not strongly associated with growth unless it also has a somewhat high level of macroeconomic stability. They conclude their article by saying that recent research

[2] The figure is my own compilation based on data from the World Bank's DataBank (2012).

suggesting irrelevancy of macroeconomic stability might be premature (Sirimaneethan & Temple, 2009).

Section 6 considers what can be done to facilitate greater stability.

3 Nigeria and the world: a historical overview of significant oil industry developments

Recent estimates suggest that Nigeria currently has about 2,13% of global oil production and 3,1% of global proven reserves. It is among the top ten oil producers globally (Akinlo, 2012) and the Nigerian National Petroleum Corporation is the 8th largest oil and gas firm in the world by proven reserves. (Ross, 2012)

Its oil is mostly sweet crude oil (Nwokeji, 2007) which is more valuable than sour crude. Some studies use a country-specific discount factor to approximate the true price of oil from a particular country (Arezki & Brückner, 2009), taking into consideration cross-country geological differences and the composition of oil. I will not do that here for lack of data to construct such a discount factor and instead use a weighted average time series for oil price.

Figure 3 shows the development of the average annual world spot price of crude oil in nominal dollars ($) per barrel from 1961-2011. The price is a weighted average of Brent, Dubai and West Texas Intermediate spot oil prices, equally weighed. In what follows, I will go over the most significant peaks and troughs the figure displays.

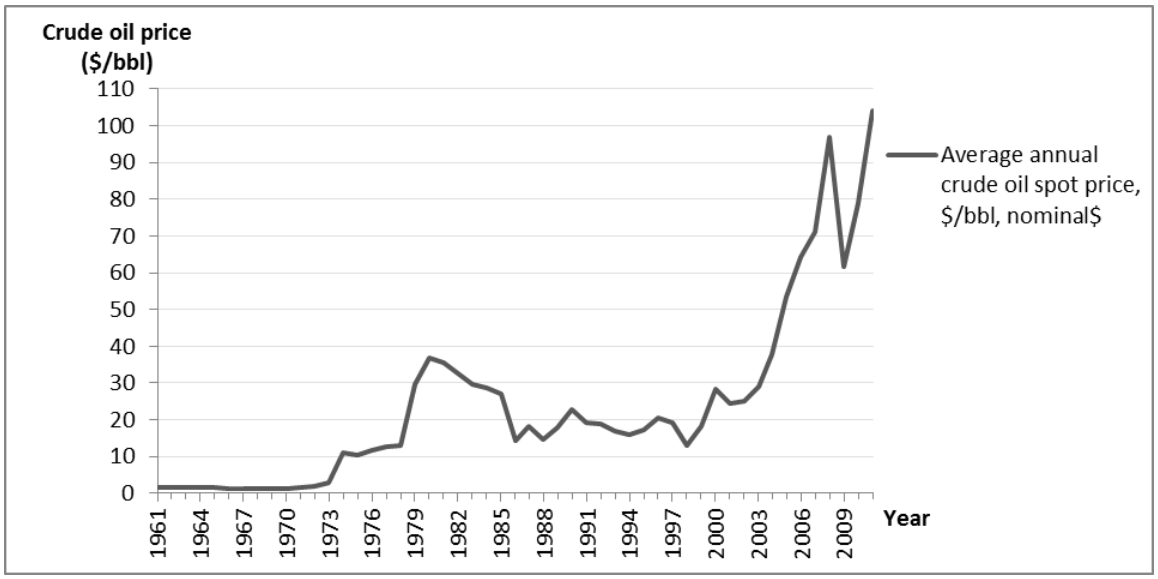


Figure 3. Average annual world crude oil price, 1961-2011.[3]

A wave of nationalizations hit the world's oil industry in the 1960s and the 1970s. This resulted in a transformation of the scale, source and volatility of petroleum revenues due to a break in the vertical integration of the oil industry as the world's major oil companies at the time no longer controlled the extraction, refining, export, shipping and marketing of almost all the world's petroleum. The vertical integration of the previous version of the world oil industry had enabled the major oil companies, known as the "Seven Sisters", to keep prices steady and capture most of the profits for themselves (Ross, 2012).

The power of these companies had been intolerable for governments of oil-rich states, since it deprived them of control over their nation's assets and most of the profits of oil extraction were being captured by the companies. More importantly, when considering the effects of the nationalizations on the world market, the oil companies were forcing governments to extract more oil, or less oil, than the they believed would serve the state's interests (Ross, 2012). However, Ross insists that nationalization of oil companies around the world has made the problems facing oil states a lot worse and that certainly has been the case for Nigeria according to Nwokeji's (2007) dissection of the Nigerian national oil company.

At the same time as the nationalizations in the oil industry were taking place, the major oil exporters of the developing world started colluding through the Organization of the Petroleum Exporting Countries, established in 1960 (Ross, 2012; OPEC, 2013).

Also, the Bretton Woods system of fixed exchange rates, a contributor to the the stability of oil prices, fell apart in 1971 (Ross, 2012). Currencies had previously been fixed in relation to the US dollar and in relation to gold, with the price of an ounce of gold having been fixed at 35$. After the Bretton Woods system collapsed, the value of the US dollar depriciated dramaticalliy against gold and all Western currencies except the pound sterling. By mid-1973 the dollar had fallen by an average of 25 percent relative to other major Western currencies. Since it was customary for oil contracts to be stipulated in dollars this meant that oil revenues per unit from these other Western

[3] The figure is my own compilation based on data from the World Bank's DataBank (2012).

countries fell to OPEC and oil's price in terms of gold diminished, giving OPEC an incentive to raise prices (Hammes & Wills, 2005).

Shortly after these transitions, in 1973, the world price of a barrel of crude increased significantly. The price shock is frequently attributed the Yom Kippur war and the oil embargo certain OPEC member states proclaimed in response to U.S. support of Israel in the war (Center for Culture, History and Environment, 2011) but the collapse of the Bretton Woods system certainly had its effects too.

Another oil price shock materialized in 1979 as a result of supply disruptions caused by the Iranian revolution (Blanchard & Galí, 2007) and the Iran-Iraq war. During this time, consumers reacted by setting up better insulation in their homes and new homes were built with better insulation. Industrial processes were also subject to improvements in energy efficiency along with new automobiles.

Oil price steadily declined in the next few years of the 1980s as many of the reactions to the oil price increases in the years prior were permanent and inherently demand reducing reactions such as increased home insulation, increased energy efficiency in industrial processes and etc (Williams, 2011).

In 1990 oil price spiked in response to Iraq's invasion into Kuwait and the ensuing Gulf war. The invasion led to an immediate disruption of oil supply from key producers (Hamilton, 2009).

Oil price spikes from early 1999 to the end of the year 2000 can be traced back to greater cooperation among OPEC members and their restrictions on crude oil production, growing oil demand in Asia following the recovery from economic crisis and shrinking non-OPEC oil production (Umar & Kilishi, 2010).

Oil prices plummeted after the september 11th terror attacks in 2001 but recovered quickly and in 2004 they increased significantly once more. Prices kept rising up until the 2008 banking crises. The price increases were attributed to a steady depreciation of the US dollar against other major currencies, political tension in the Middle East, high demand for crude oil by China and the uncertain future of Russian oil producer Yukos.

The global economic meltdown caused by the banking crisis of 2008 led to a steep decline in the price of crude oil. At the start of the year oil price had been 100 dollars

per barrel, mid-2008 it moved up to 140 $/bbl and by the end of the year it had crashed to a point below 40 $/bbl.

However, it did not take a long time for prices to pick up again and as figure 3 shows they were at their highest in 2011 when looking at the entire time period, 1961-2011. OPEC had cut production in January 2009, causing an increase in price. Further upward pressure was put on oil price as a consequence of the loss of Libyan exports due to the Libyan civil war in February 2011. Although Libyan production was restored mid-October that year, concern for additional interruptions from civil unrest in other oil-producing countries in North Africa and the Middle East kept the pressure on oil prices (Williams, 2011).

As is evident from the figure and the following summary of the reasons behind the peaks and troughs, many different forces determine the world price of oil, making it very unpredictable and volatile. The three most prominent forces in influencing the price are supply, demand and OPEC with its production quotas and regulations.

Given such volatile prices and a country that relies so heavily on oil, for export earnings and government revenue, it is interesting to see if and how this volatility is transferred into the country‘s economy. Section 4 explores that.

3.1.1 A summary of the Nigerian oil sector‘s history

The first commercial discovery of oil in Nigeria took place in 1956 at Oloibiri in the Niger Delta, which then led to the opening up of the country‘s oil industry in 1961 when several petroleum companies rushed to join Shell Petroleum Development Company in oil exploration efforts onshore and offshore. (Nigerian National Petroleum Corporation, 2010) The exporting of oil began in 1958 and it soon became clear that oil would become an important source of both foreign exchange and government revenue (Bevan, Collier, & Gunning, 1999).

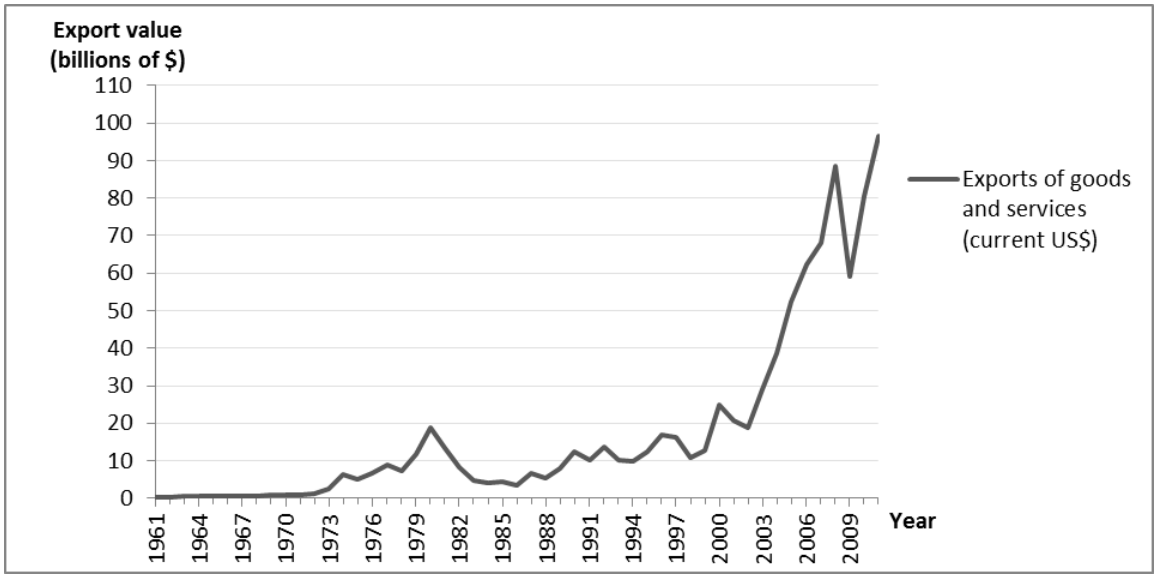


Figure 4. Nominal value of Nigerian exports in billions of dollars, 1961-2011.[4]

In the years 1960-1966, right after Nigeria had become independent, macroeconomic discipline suffered due to favorable initial conditions in the form of huge foreign exchange reserves and the oil bonanza (Bevan, Collier, & Gunning, 1999).

Figure 4 shows how the nominal value of exports of goods and services has changed over time in Nigeria. Looking at the figure and comparing it to figure 3 on page 16, there seems to be a strong correlation between Nigerian export value and world oil prices. That makes sense given Nigeria's extreme dependence on oil in its exports.

Revenue allocation between the various regions of Nigeria had long been the source of contention and with the discovery of oil in what became the Midwestern state, the stakes were raised resulting in shifts in the different regions' preferred method of allocation (Bevan, Collier, & Gunning, 1999).

Nigeria joined OPEC in 1971 (OPEC, 2013). One of the requirements OPEC had for its member states was that they would nationalize their respective oil industries. Following the conclusion of the Biafra War in the late 1960s, the Nigerian oil industry was nationalized in a few stages between the years 1969 and 1977 and the country became a major oil producer. Production of oil in terms of quantity grew by 380 percent and at the same time the real price of oil nearly quadrupled. Nationalization started with the government's introduction of the Petroleum Act, in 1969, that reserved to the

[4] The figure is my own compilation based on data from the World Bank's DataBank (2012).

government the discretionary option of part ownership in all new concessions (Nwokeji, 2007; Ross, 2012).

The Nigerian National Oil Corporation (NNOC) was established as Nigeria's first national oil company.

Nigeria failed to take full advantage of the 1973 crude oil price hike due to preferential crude oil discounts to select buyers instigated by highly-placed NNOC personnel. This meant that crude oil was being sold out of the country at prices below the world market price to the benefit of certain international oil companies and traders. A panel set up to probe the company was unable to prove that the NNOC personnel personally profited from selling the crude oil at discount prices because it lacked "resources and materials" (Nwokeji, 2007).

NNOC was dissolved in 1977 due to suspicions of corruption. The Nigerian National Petroleum Corporation (NNPC) was established in its place with the hope that national oil company corruption would end. That did not happen. Corruption - with the underreporting of crude oil output, inflation of contracts, importation of substandard fuels and diversion of crude oil and project funds - has been a persistent problem within the NNPC (Nwokeji, 2007).

From 1978-1979 legislation developments led to the amendment of the Nigerian constitution to include a section which declared all oil, natural gas and other natural resources found within Nigeria to be legal property of the government (Okonta & Douglas, 2001).

Bevan, Collier and Gunning (1999) attribute a large oil trade windfall to the years 1974-1981 whose estimated (undiscounted) value was almost double what GDP had been in the year just before the boom.

Declining world oil prices between 1980 and 1990 possibly had a more drastic impact on the Nigerian economy than on any other oil reliant economy due to Nigeria's extreme reliance on oil rents, low investment on capital projects and generally poor record of reinvestment, monumental corruption, low income per capita and the flawed political structure that thrived on the marginalization of oil-producing minority regions. All this along with a relatively heterogenous, large and rapidly growing population meant the political and economic stability of Nigeria was relatively poor compared to

that of other oil-producing countries such as Kuwait, Libya or Saudi Arabia (Nwokeji, 2007). According to Nwokeji (p. 67, 2007), “These countries’ smaller populations, much higher per capita incomes, and relatively homogenous populations, primed them better to resist the shocks of sharply declined oil revenues.”

Oil theft is said to have been on the rise in Nigeria in since the 1980s and in 2003 it was reported that profits from oil theft were in excess of those of the formal market. NNPC officials have frequently been the prime suspects in oil theft cases, unsurprisingly given the corruption stigma of the corporation.

Another example of the corruption is the disappearance of a 12b $ Gulf war oil windfall through special accounts reportedly created by the military ruler of Nigeria at the time.

However, willingness to confront corruption has been discernible through the years, with government regimes of 1983-1985 and 1993 showing significant interest in fighting corruption. The regimes that replaced these two regimes showed no interest in fighting oil industry corruption and instead thrived on it (Nwokeji, 2007).

Table 1. Oil production, exports and revenue, 1961 – 2009.

Year	Production (millions of barrels)	Oil Revenue (₦m)	Oil Revenue/Total Federal Revenue (%)	Oil/GDP (%)	Oil Export (₦m)	Oil Export/Total Export (%)
1961	16,8	n/a	n/a	0,9	23,1	6,7
1965	150,3	n/a	n/a	3,4	136,2	25,4
1970	395,7	166,4	26,3	9,3	509,6	57,5
1975	660,1	4.271,5	77,5	19,4	4.563,1	92,6
1980	760,1	12.353,2	81,1	28,5	13.632,1	96,1
1985	507,5	10.923,7	72,6	16,8	11.223,7	95,8
1990	660,6	71.887,1	73,3	37,5	106.623,5	97,0
1995	712,3	324.547,6	70,6	39,7	927.565,3	97,6
2000	797,9	1.591.675,8	83,5	47,7	1.920.900,4	98,7
2005	919,3	4.762.400,0	85,8	38,9	7.140.578,9	98,5
2009	759,2	3.191.938,0	78,7	37,4	8.543.261,2	96,7

Table 1 shows the 1961-2009 development of oil output in millions of barrels, oil revenue in millions of Nairas, oil revenue as a percentage of total federally collected revenue, the percentage contribution of the oil sector to GDP and the percentage of oil exports in total exports. The data in the table was obtained from Anthony E. Akinlo‘s 2012 journal article on the importance of oil to Nigeria‘s economic growth.

Gas has a greater share in Nigeria’s hydrocarbon reserves but wasn’t considered profitable to exploit for a long time. A part of the deterrents to greater gas exploitation are safety concerns due to frequent attacks on pipelines (Nwokeji, 2007).

Nigerian refineries have consistently underperformed partly due to a lack of skilled labor and that has resulted in the importation of the majority of refined petroleum products for consumption in the local market, i.e. Nigeria exports crude oil abroad where it gets refined and then a part of it is imported back (Nwokeji, 2007).

3.1.2 A summary of the petroleum industry‘s role in the world economy

Petroleum products make up for 14,2 % of the world‘s commodity trade, making the petroleum industry the largest in the world. Global demand for petroleum products is projected to grow in the next decades even though a large body of evidence suggests that with the burning of fossil fuels comes the significant negative externality of a destabilized climate on Earth (Ross, 2012). Oil accounts for approximately 40% of the world‘s energy supply (Klare & Volman, 2006).

In the next few decades, a majority of the world's new oil supplies will come from developing countries at the same time as a large increase in demand is predicted, particularly by Chinese and Indian consumers. In other words, new oil revenue windfalls are beginning to hit some of the poorest countries in the world and something needs to be done or else these windfalls will hurt, rather than help, people living on the petroleum frontier (Ross, 2012).

However, Michael Ross asserts in his book on the oil curse that „while economic growth in the oil states has been unusually volatile, in the long run it has been neither faster nor slower than in the rest of the world." (Ross, p. 13, 2012). The real problem according to Ross is not that growth has been slow when it ought to have been "normal". The real problem is that growth ought to have been faster than normal while it has been normal, given the huge inflow of revenues to the government. Ross attributes the disappointingly slow growth to

- the failure of oil states to generate more jobs for women, which would have lowered fertility rates and population growth and thus boosted per capita income growth and
- the inability of oil state governments to cope with the extraordinary challenges created by revenue volatility.

The petroleum business generally operates in economic enclaves within oil producing countries worldwide, geographically isolated and self-contained having few direct effects on the rest of the economy. However, this is not always the case as Nigeria proves to some extent, wherein pipelines were estimated to stretch across 7000 kilometres in a 2006 study (Ross, 2012).

The owners of fossil fuel reserves are the public in most cases, they elect a government to make executive decisions on the management of the reserves and the use of fees obtained from the reserves (Bevan, Collier, & Gunning, 1999). Since Nigeria is a democracy then, by definition, this is the case there. A principal-agent problem may arise because of this since the owners of the resource are not directly involved in its management or in the investment of its rents.

4 A VAR analysis of the Nigerian economy

In a 2007 paper Olivier Blanchard and Jordí Galí investigate how and why the macroeconomic effects of oil price shocks have varied at different points in history. Their focus is on oil importers. I will endeavour to use a method similar to the one they used to analyse a single oil exporter. For an oil importer the effects of an oil price shock will depend on the nature of the demand for oil whereas for an oil exporter the effects will depend on the nature of the supply of oil. Since oil is a depletable resource there is only so much one can supply at any given time without risking excessive speed of depletion. Any depletion speed that is faster than the profit-maximizing one is excessive. Demand, on the other hand, is not constricted by such limits.

Two recent journal articles I found use vector autoregression techniques to investigate the oil industry's effects on the Nigerian economy much like I do. One of the articles estimates the effects oil price fluctuations have on certain macroeconomic variables, much like I do, and the other estimates the effects oil revenue fluctuations have on macroeconomic performance with special attention paid to a variable for institutional quality. The one focusing on oil price is by Umar and Kilishi (2010) and the one focusing on oil revenues and institutional quality is by Ushie, Adeniyi and Akongwale (2012). Both articles consider the interplay of oil revenues or oil prices and monetary- and fiscal policies.

The conclusion reached by Umar and Kilishi (2010) is that oil prices have a statistically significant impact on three out of four variables used in that particular study, namely the real GDP, money supply and unemployment. The impact on the fourth variable, consumer price index, is concluded not to be significant. Thus, the Nigerian economy is shown to be vulnerable to external shocks resulting from the volatility of world oil prices. This vulnerability and the volatile macroeconomic performance connoted mean macroeconomic management can prove difficult. Umar and Kilishi pertain that diversification of the economy is neccesary to minimize the negative impact of external shocks.

An increase in oil prices is concluded to cause an increase in Nigerian GDP and an oil price decline is concluded to result in a fall in GDP.

However, Umar and Kilishi do note that some Nigerian studies such as Philip and Akintoye (2006) and Olusegun (2008) did not find any significant impact of oil price shocks on some of the same variables as they did. Variables mentioned in that context are money supply and output. That does not neccesarily mean there is no significant impact.

Ushie, Adeniyi and Akongwale‘s (2012) results support the general view that inflation, lower output growth and real exchange rate appreciation in Nigeria can be traced back to fluctuations in oil revenues. The institutional variable they use, the Fraser Institute‘s Economic Freedom of the World (EFW) index, is also found to be significant. Their data is annual time series data covering the years 1970-2008.

They set up a few vector autoregressions; grouping them into output, inflation and exchange rate VARs. From impulse response analysis of an output VAR that uses money supply growth as its monetary policy variable, fiscal deficit as a ratio of GDP as its fiscal policy variable and the EFW index as its institutional quality variable they find that output counterintuitively declines on impact given a one standard deviation positvie shock to oil revenue. Their oil revenue variable is oil revenue‘s share in GDP. They hypothesize that this happens because of the fiscal policy stance taken when oil revenues increased. According to their impulse respons function estimates, fiscal deficit as a ratio of GDP jumped on impact. They suggest poor growth performance can, in light of that, be traced back to volatile and lopsided spending, on unproductive ventures in particular, as budgeting and development planning for key sectors that should ordinarily induce output growth is insufficient (Ushie, Adeniyi, & Akongwale, 2012). An example of the Nigerian government‘s spending on unproductive ventures in the past fifty years is the subsidizing of imported beef and other food items during oil windfall episodes between 1971 and 1980 (Nwokeji, 2007).

While it is relatively easy for government to increase expenditures during oil booms, cutting down on expenditures when oil revenus dwindle can plausibly prove difficult due to the influence of heightened public expectations about future revenue streams (Ushie, Adeniyi, & Akongwale, 2012).

Impulse responses from an output VAR where money supply growth has been replaced by interest rate show a different result for the response of GDP growth to a one standard deviation shock in oil revenue as a ratio of GDP. Output is concluded to increase on impact up to the second year. Ushie, Adeniyi and Akongwale (2012) attribute this evidence of better growth performance to the stimulation of aggregate demand through higher oil revenues. At the same time as fiscal deficits increase moderately, growth sarts to wane during the thrid and fourth years of the ten year impulse response period in their model.

They go on to suggest that in the absence of the appropriate institutional environment there is a greater likelihood of procyclicality of macroeconomic policies and such procyclicality helps in fostering perverse economic outcomes.

For my analyzis I downloaded data for the average monthly spot price of crude oil off the World Bank‘s databank website. I then used that data to construct a time series of the average annual spot price of crude oil in order to set up a VAR model with Nigerian macroeconomic variables, most of which were not obtainable in monthly or quarterly terms. This means that if and when the effects of a significant oil price shock take less than a year to appear in inflation-, growth-, and export statistics my analysis is flawed. It is flawed in the sense that it will understate the true effects of an oil price shock on the aforementioned variables when the effects take less than a year to dissipate. Also, oil prices usually fluctuate a lot within a year.

Conventional accounts of the 1970s‘ two significant episodes of low growth, high inflation and high unemployment in most industrialized economies blame them on large increases in oil price. The first large oil price increase was triggered by the Yom Kippur war in 1973 and the second large price increase by the 1979 Iranian Revolution.

The effects of similar oil price shocks in the 2000s were much less pronounced in the industrialized economies Blanchard and Galí investigated. They discuss several hypotheses as to why the effects of oil price shocks were less pronounced in the 2000s than in the 1970s.

One plausible hypothesis is that the effects of the oil price increases coincided in time with large economic shocks of a different nature. Such shocks might have either amplified the macroeconomic effects of an oil price increase in the 1970s or countered

the effects in the 2000s. Examples of such shocks could be large rises in the prices of other commodities in the 1970s or the high productivity growth and world demand in the 2000s.

To evaluate such a hypothesis the components of macroeconomic fluctuations associated with exogenous oil price changes must be isolated. That can be done with a vector autoregression model, either a large multivariate VAR or a bivariate VAR of stationary variables. Blanchard and Galí used a structural multivariate VAR that allowed for a break in the sample and a rolling bivariate VAR in their analysis.

A change in real wage rigidities, monetary policy or the share of oil in production and consumption are also factors that could potentially cause a change in the magnitude of the effects of oil price shocks on macroeconomic variables. In fact, Blanchard and Galí conclude their paper by asserting that according to some quite compelling econometric evidence that is the case for the countries they analyzed.

The macroeconomic variables I chose for my study, along with oil price, are an inflation variable, a GDP growth variable and an export revenue variable. I found time series data for each of these variables in the World Bank‘s internet databank. The time range for which I obtained data for the vector autoregression was 1974-2011. The next step was to make sure all the variables chosen were stationary in an attempt to avoid spurious regressions.

To do so an augmented Dickey-Fuller (ADF) test was performed on various inflation-, growth-, export value- and oil price variables in the econometric computer programme gretl. The null hypothesis of an augmented Dickey-Fuller test states that the series in question is nonstationary. Therefore, if the null hypothesis is rejected the alternative hypothesis is assumed to be true, i.e. the series is assumed to be stationary. The null hypothesis is rejected if the τ-statistic is less than or equal to the critical value and it is not rejected if the τ-statistic is greater than the critical value.

I started out with time series for the average annual change in the real world price of crude oil, annual real GDP growth per capita, annual CPI inflation and exports‘ share in GDP. The time series for these four variables are available in appendix 1, where Ch_rOilP denotes the change in the world price of crude oil, rGDPgrowth denotes the

GDP growth per capita, Inflation denotes annual CPI inflation and Expsh_GDP denotes exports' share in GDP.

The crude oil price series I chose was the one shown in Figure 3 deflated by the Nigerian GDP deflator to get an estimate of real oil price. Data for the deflator was obtained via the World Bank's DataBank. I then calculated the year to year percentage changes in the real oil price time series.

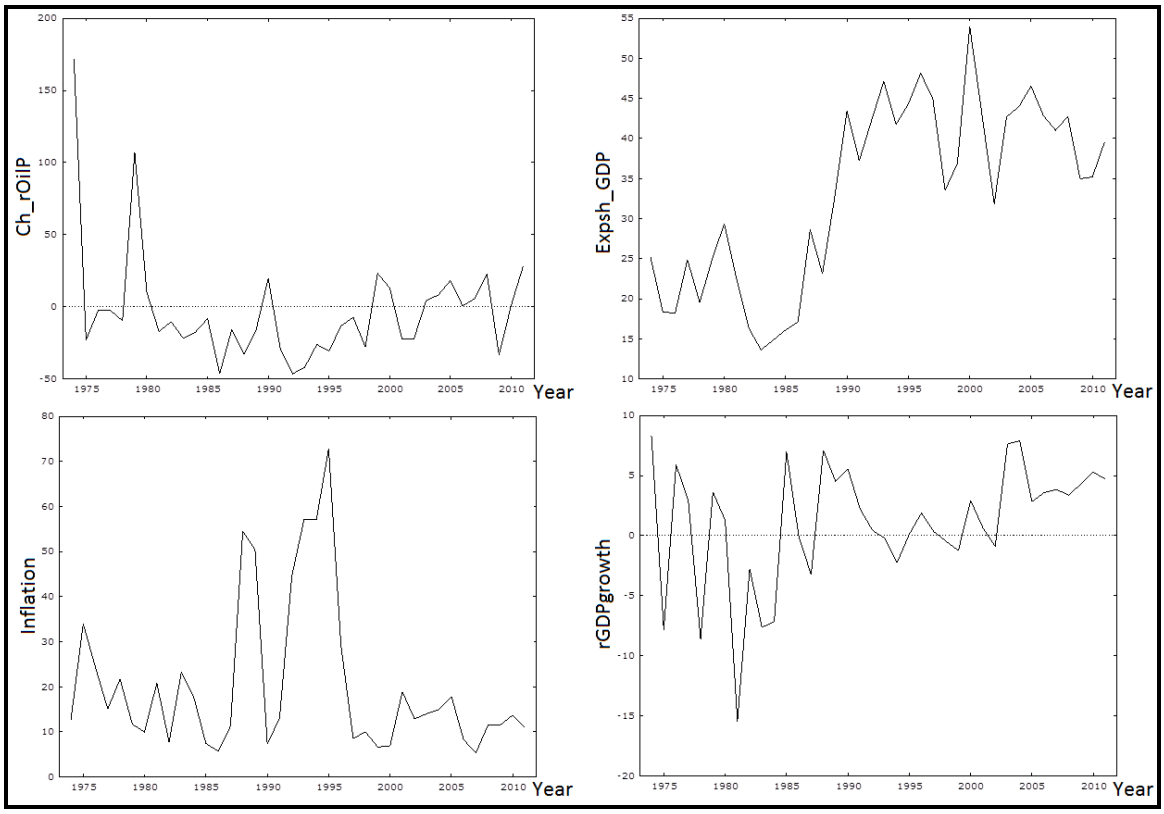


Figure 5. Graphs for macroeconomic variables to be subjected to an Augmented Dickey-Fuller test.[5]

Figure 5 shows the graph representation of the four time series chosen. From looking at the graphs, I determined which type of augmented Dickey-Fuller test would be most appropriate for each time series; ADF test with no constant and no trend, ADF test with a constant or an ADF test with a constant and a trend. It is not always obvious which ADF test type is most appropriate to use from looking at graphs. For example, rGDPgrowth looks like it might be stationary around a constant and a trend whereas intuitively one would expect it to be stationary around a constant with no trend considering that countries' growth rates very often are. The higher the number of

[5] The figure is my own compilation based on data from the World Bank's DataBank (2012).

observations are the clearer it is which type of test best suits the data. The number of observations is quite low in these time series. Where it is unsure what type of test best suits the data more than one type of test can be used. I have done that for the rGDPgrowth series. The results of the ADF tests are summarized in table 2.

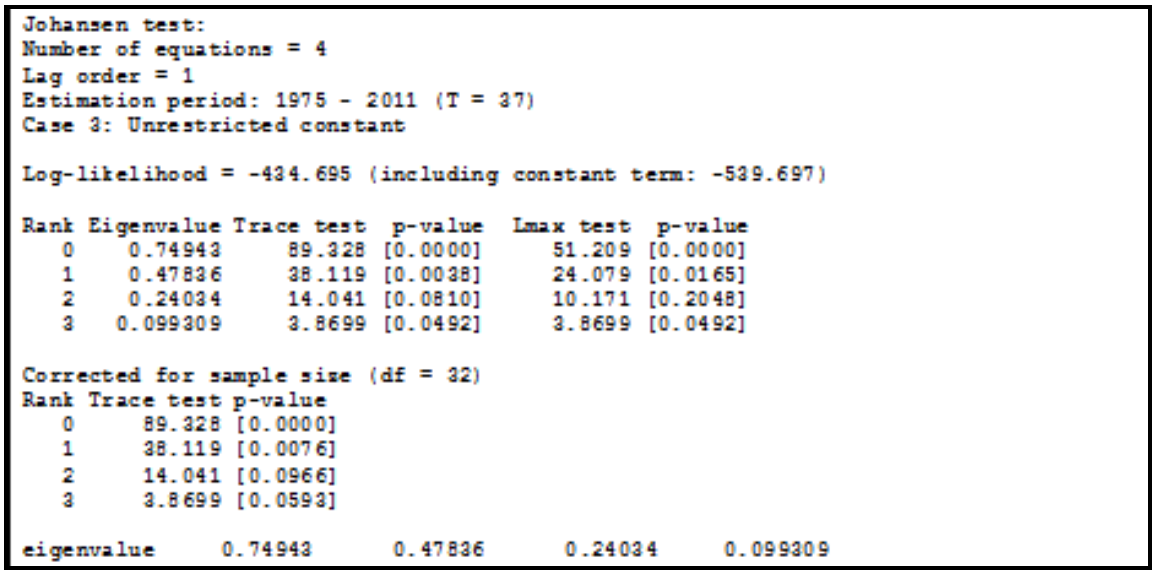
Null hypothesis: no stationarity * and (**) mean the null hypothesis is rejected at the 5% and (1%) significance levels, respectively.		**Augmented Dickey-Fuller tests with 5 lags**			
		with no constant and no trend	with constant	with constant and trend	**Conclusion**
Significance level:			*Critical values*		
1%		**-2,56**	**-3,43**	**-3,96**	
5%		**-1,94**	**-2,86**	**-3,41**	
Variable:			*τ-statisitics*		
Ch_rOilP	Level	-1,37			I(1)
	1st diff.	-7,62**			
Expsh_GDP	Level			-2,07	I(1)
	1st diff.			-7,37**	
Inflation	Level		-3,49**		I(0)
	1st diff.				
rGDPgrowth	Level	-2,18*	-2,31	-3,53*	I(1)
	1st diff.	-3,57**	-4,28**	-4,11**	

Table 2. Summary of the results of an augmented Dickey-Fuller test.[6]

As the table shows, the result of the ADF tests was that Ch_rOilP, Expsh_GDP and rGDPgrowth were concluded to be I(1) at the 1% significance level and Inflation was concluded to be I(0). I(0) and I(1) stand for stationarity and first-difference stationarity, respectively. Three of the variables are thus non-stationary at levels but stationary at first differences given a 1% significance level.

Due to the presence of non-stationary variables in the chosen set a test of cointegration needs to be performed in order to determine whether there exists long-run co-movement among the variables. The results of a Johansen test for cointegration are in figure 6. According to the results, after they have been corrected for sample size, there are two cointegrating relationships among the variables given a 5% significance level. The p-values for the test, shown in square brackets, are lower than 0,05 for the first two ranks, hence the conclusion of two cointegrating equations.

[6] The critical values in the table are from Griffiths, Hill & Lim (2008) and the rest of the table's data was compiled and conformed by me in gretl and Excel based on data from the World Bank's DataBank (2012).



```
Johansen test:
Number of equations = 4
Lag order = 1
Estimation period: 1975 - 2011 (T = 37)
Case 3: Unrestricted constant

Log-likelihood = -434.695 (including constant term: -539.697)

Rank Eigenvalue Trace test  p-value  Lmax test  p-value
   0    0.74943     89.328 [0.0000]     51.209 [0.0000]
   1    0.47836     38.119 [0.0038]     24.079 [0.0165]
   2    0.24034     14.041 [0.0810]     10.171 [0.2048]
   3   0.099309     3.8699 [0.0492]     3.8699 [0.0492]

Corrected for sample size (df = 32)
Rank Trace test p-value
   0     89.328 [0.0000]
   1     38.119 [0.0076]
   2     14.041 [0.0966]
   3     3.8699 [0.0593]

eigenvalue      0.74943      0.47836      0.24034      0.099309
```

Figure 6. A gretl-computed Johansen test of cointegration.

For establishing whether there is short-term causality between variables, Granger causality tests come in handy. The results from such tests for Ch_rOilP, Expsh_GDP, Inflation and rGDPgrowth are summarized in table 2 under the heading „F-tests of zero restrictions“. The same results along with the unrestricted VAR estimation results gretl computed with them can be found in appendix 2. The null hypothesis of a Granger-causality test is that no lags of variable j are significant in the equation for variable i. In other words, past values of variable j are not statistically significant predictors of future values of i. The null hypothesis is rejected for all the Granger-causality tests between variables, with p-values greater than 0,05 in all cases.

F-tests of zero restrictions:
Variable: Ch_rOilP All lags of Expsh_GDP F(1, 32) = 0.058997 [0.8096] All lags of Inflation F(1, 32) = 0.10354 [0.7497] All lags of rGDPgrowth F(1, 32) = 0.57852 [0.4525]
Variable: Expsh_GDP All lags of Ch_rOilP F(1, 32) = 2.0742 [0.1595] All lags of Inflation F(1, 32) = 1.6474 [0.2085] All lags of rGDPgrowth F(1, 32) = 3.1359 [0.0861]
Variable: Inflation All lags of Ch_rOilP F(1, 32) = 0.0031771 [0.9554] All lags of Expsh_GDP F(1, 32) = 0.043981 [0.8352] All lags of rGDPgrowth F(1, 32) = 0.020127 [0.8881]
Variable: rGDPgrowth All lags of Ch_rOilP F(1, 32) = 1.225 [0.2766] All lags of Expsh_GDP F(1, 32) = 0.73613 [0.3973] All lags of Inflation F(1, 32) = 0.0077173 [0.9305]

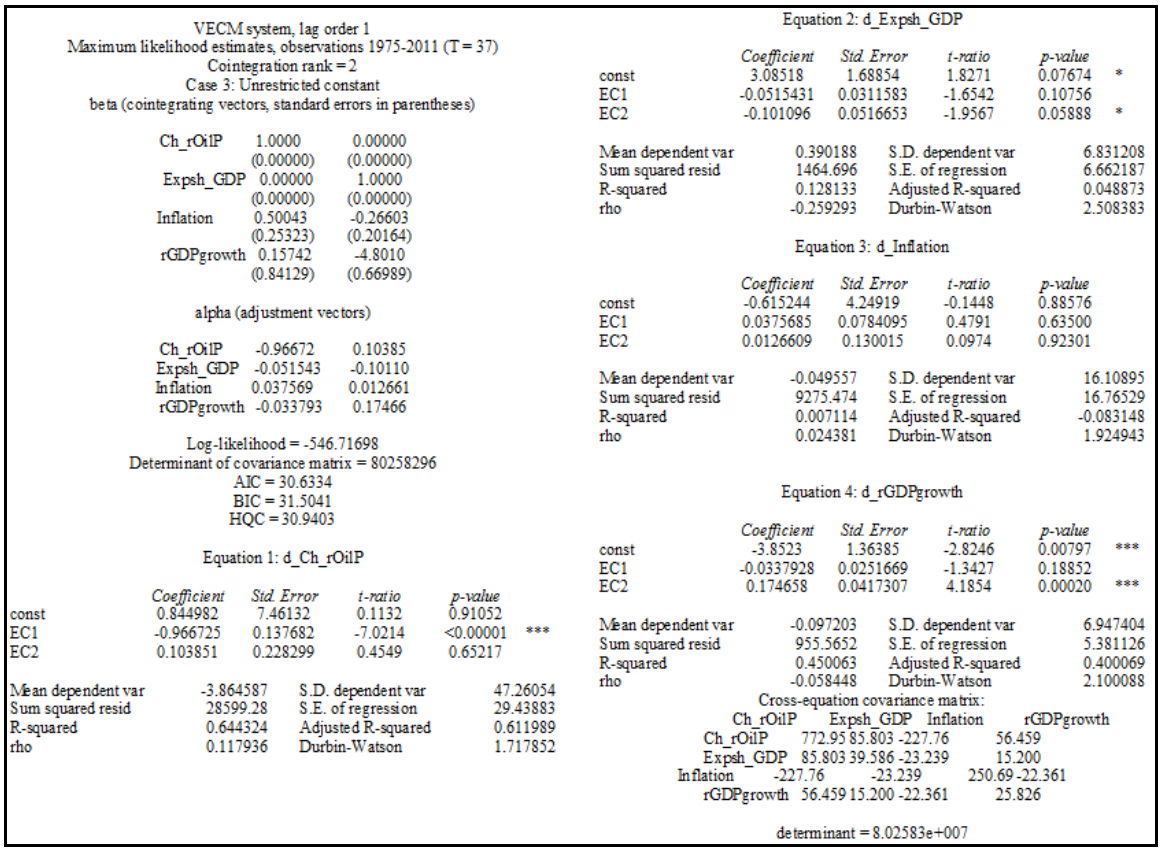
Table 3. Granger causality tests of macroeconomic variables.

A convenient property of a vector autoregression is that it obviates a decision as to what contemporaneus variables are exogenous since all variables can be treated as endogenous (Umar & Kilishi, 2010).

All variables in the model I estimated are assumed to be endogenous although the oil price variable is considered least

endogenous. That is because Nigeria‘s oil industry has only a small share in the world‘s oil industry and therefore isn‘t likely to have a great impact on world oil prices even if, for example, major supply disruptions were to vastly reduce oil supply from the country. However, there probably would be a slight world oil price increase if that were to happen and therfore oil price is assumed to be endogenous.

Because of the existence of cointegration among the variables the most appropriate model to use is a special case of a vector autoregression known as a vector error correction model. The error correction coefficient results of such a model, computed in gretl with the cointegration rank set to 2 and a lag order of 1 because the data is annual, can be seen in figure 7.



VECM system, lag order 1
Maximum likelihood estimates, observations 1975-2011 (T = 37)
Cointegration rank = 2
Case 3: Unrestricted constant
beta (cointegrating vectors, standard errors in parentheses)

Ch_rOilP	1.0000	0.00000
	(0.00000)	(0.00000)
Expsh_GDP	0.00000	1.0000
	(0.00000)	(0.00000)
Inflation	0.50043	-0.26603
	(0.25323)	(0.20164)
rGDPgrowth	0.15742	-4.8010
	(0.84129)	(0.66989)

alpha (adjustment vectors)

Ch_rOilP	-0.96672	0.10385
Expsh_GDP	-0.051543	-0.10110
Inflation	0.037569	0.012661
rGDPgrowth	-0.033793	0.17466

Log-likelihood = -546.71698
Determinant of covariance matrix = 80258296
AIC = 30.6334
BIC = 31.5041
HQC = 30.9403

Equation 1: d_Ch_rOilP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.844982	7.46132	0.1132	0.91052	
EC1	-0.966725	0.137682	-7.0214	<0.00001	***
EC2	0.103851	0.228299	0.4549	0.65217	

Mean dependent var	-3.864587	S.D. dependent var	47.26054
Sum squared resid	28599.28	S.E. of regression	29.43883
R-squared	0.644324	Adjusted R-squared	0.611989
rho	0.117936	Durbin-Watson	1.717852

Equation 2: d_Expsh_GDP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	3.08518	1.68854	1.8271	0.07674	*
EC1	-0.0515431	0.0311583	-1.6542	0.10756	
EC2	-0.101096	0.0516653	-1.9567	0.05888	*

Mean dependent var	0.390188	S.D. dependent var	6.831208
Sum squared resid	1464.696	S.E. of regression	6.662187
R-squared	0.128133	Adjusted R-squared	0.048873
rho	-0.259293	Durbin-Watson	2.508383

Equation 3: d_Inflation

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	-0.615244	4.24919	-0.1448	0.88576
EC1	0.0375685	0.0784095	0.4791	0.63500
EC2	0.0126609	0.130015	0.0974	0.92301

Mean dependent var	-0.049557	S.D. dependent var	16.10895
Sum squared resid	9275.474	S.E. of regression	16.76529
R-squared	0.007114	Adjusted R-squared	-0.083148
rho	0.024381	Durbin-Watson	1.924943

Equation 4: d_rGDPgrowth

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-3.8523	1.36385	-2.8246	0.00797	***
EC1	-0.0337928	0.0251669	-1.3427	0.18852	
EC2	0.174658	0.0417307	4.1854	0.00020	***

Mean dependent var	-0.097203	S.D. dependent var	6.947404
Sum squared resid	955.5652	S.E. of regression	5.381126
R-squared	0.450063	Adjusted R-squared	0.400069
rho	-0.058448	Durbin-Watson	2.100088

Cross-equation covariance matrix:

	Ch_rOilP	Expsh_GDP	Inflation	rGDPgrowth
Ch_rOilP	772.95	85.803	-227.76	56.459
Expsh_GDP	85.803	39.586	-23.239	15.200
Inflation	-227.76	-23.239	250.69	-22.361
rGDPgrowth	56.459	15.200	-22.361	25.826

determinant = 8.02583e+007

Figure 7. A vector error correction model with one lag and two cointegrating equations.

The impulse response functions to a one standard deviation shock in percentage change of real oil prices are in figures 8-10.

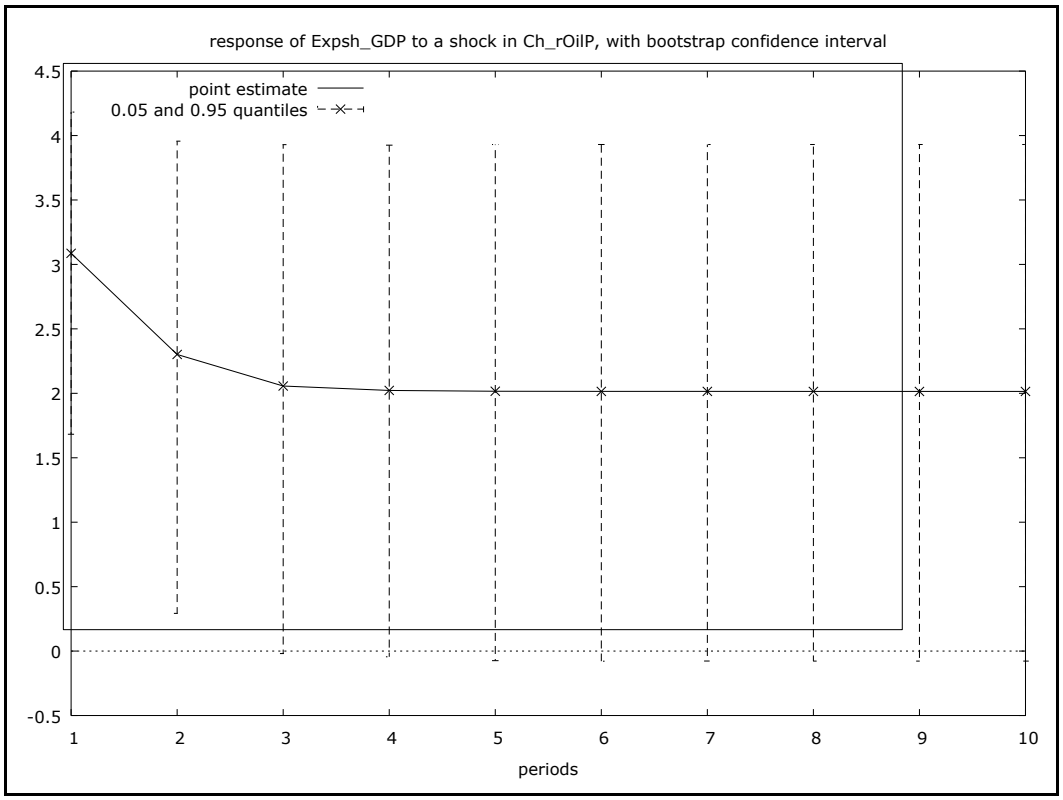


Figure 8. Impulse response of Nigerian annual exports as a ratio of GDP to a one standard deviation positive shock in the annual percentage change of real oil price.

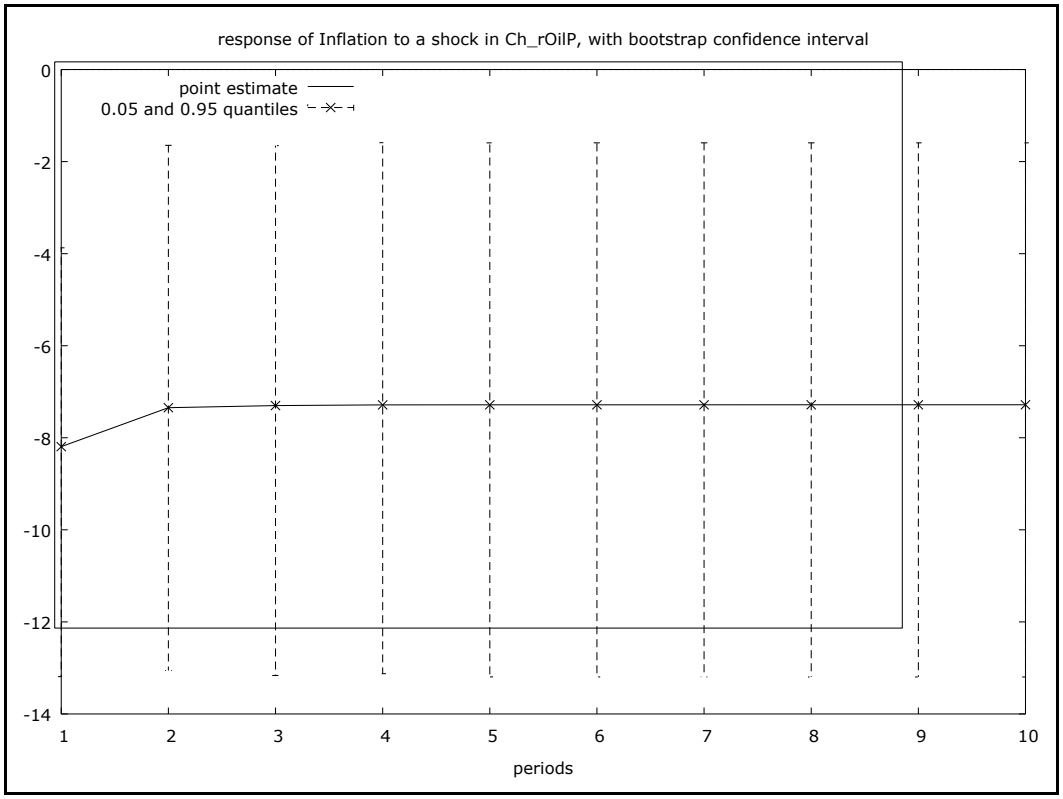


Figure 9. Impulse response of Nigerian annual CPI inflation to a one standard deviation positive shock in the annual percentage change of real oil price.

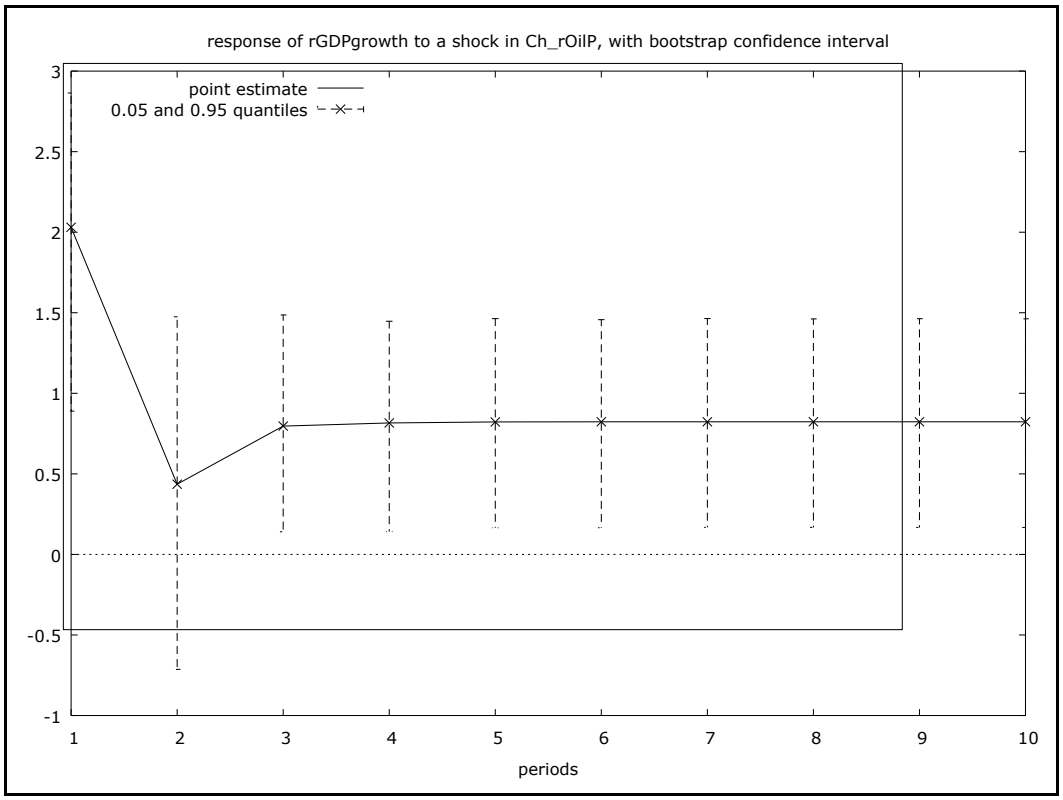


Figure 10. Impulse response of Nigerian annual real GDP per capita growth to a one standard deviation positive shock in the annual percentage change of real oil price.

Expsh_GDP jumps on impact given a positive shock in crude oil prices and remains relatively high until the third year where it reaches a steady state.

5 Theoretical aspects

5.1 The Dutch disease

Dutch disease is the term used to describe the negative consequences of windfall increases in a country‘s income. It is usually associated with the sudden surge of income coming from the discovery of a natural resource but has also been used when analyzing the effects of any large increase in foreign currency, including foreign direct investment, foreign aid or a substantial increase in the prices of a natural resource. It is considered as having two main effects, namely:

- An appreciation of the real exchange rate and thus a decrease in the price competitiveness of the affected country‘s manufactured and agricultural goods. The booming sector will thus attract capital and labor resources from the agriculture and manufacturing sectors. This is referred to as a resource movement effect.
- An increase in imports since the higher real exchange rate makes it cheaper to import manufactured and agricultural goods rather than producing them domestically. This is referred to as a spending effect.

These two factors can contribute to manufacturing jobs being moved to lower-cost countries in the long run. (Investopedia)

The Dutch Disease caused a reduction in value of Nigerian agricultural production from the 1970s to the mid-1980s and devastated industries relying on the export of cocoa, palm oil and rubber. The agricultural industry is a relatively labor intesive industry whereas the oil industry is more capital intensive (Ross, 2012). The resource movement effect would therfore most likely result in a loss of jobs at the same time as competition in the world market hardened causing agricultural workers to go out of business.

5.2 Comprehensive wealth accounting and Hartwick‘s rule

All countries have four types of wealth; physical capital, human capital, social capital and natural capital. Fossil fuel reserves fall under the category of natural capital, which is a type of capital that has a non-renewable element to it. All of the other types of capital and some types of natural capital are renewable and can be sustained if properly

taken care of. Fossil fuels, as non-renewable resources, cannot be regenerated once exploited so when a country extracts and sells its oil it reduces its total stock of natural capital. Therefore, in order for the depledability element of oil extraction not to result in a drop in the country's income, such a reduction in the natural capital must be met with investing the rents from extraction in other forms of capital. The rents could, for example, be invested in roads, buildings or education; those are examples of physical capital, physical capital and human capital, respectively (Bevan, Collier, & Gunning, 1999).

Hartwick's rule defines the amount of investment required in renewable types of capital to exactly offset declining stocks of exhaustible resources such as oil. This rule is followed if the level of consumption in an economy is sustained into the future (Hartwick, 1977).

Nigeria has a genuine savings rate of minus 30 percent. The genuine savings rate of a country can, among other things, serve as gauge for whether future generations are being impoverished through excessive current consumption of an exhaustible resource (van der Ploeg, 2010). In Frederick van der Ploeg's 2010 article on genuine savings and rent-seeking the definition of genuine savings is as follows:

> Genuine savings is defined as public and private saving at home and abroad, net of depreciation, plus current spending of education to capture changes in intangible human capital minus depletion of natural exhaustible and renewable resources minus damage of stock pollutants (CO2 and particulate matter). (van der Ploeg, p. 29, 2010)

Future generations are clearly being impoverished in Nigeria with a genuine savings rate so negative (van der Ploeg, 2010).

Macroeconomic stability in the non-resource sector of a resource abundant economy is of particular importance if growth is to be sustained once the resource is depleted.

5.3 Rent-seeking in the oil industry

Natural resources such as oil generate rents and those lead to predatory rent-seeking activities. Rent-seeking, as opposed to value adding profit-seeking, is detrimental to growth. That is because by definition, rent-seeking is the act of using scarce resources

to take posession of or benefit from wealth created by others. Examples of rent-seeking behaviour include the appropriation of state assets by oligarchs and the relatives of politicians and rake-offs on government contracts (The Financial Times Ltd., 2013), both of which there are examples of in Nigeria (Nwokeji, 2007).

The Nigerian oil industry has generated a huge amount of rents. From 1970 to 1999 the total sum of rents generated was as great as 231 billion dollars in constant 1999 dollars. Interestingly, these rents have not resulted in increased income or reduced poverty as one might think they ought to (Ross, Nigeria's Oil Sector and the Poor, 2003).

6 Institutions and politics

6.1 Institutional Policies

Following an impulse response function analysis Ushie, Adeniyi and Akongwale (2012) find a plausible indication of the impact and sustainability of institutions being important in dampening the negative consequences of the Dutch disease in Nigeria during oil windfall episodes. Therefore it is not just the establishment of institutions that is important but also, and even more so, the impact and sustainability of these institutions.

Sound institutions are, for example, found to have a way of mitigating the adverse effects of oil revenue shocks' direct pass-through to domestic prices.

6.2 Countercyclical Fiscal and Monetary Policies

Due to the Nigerian economy's increasing dependence on oil exports, the share of oil revenue in total federally collected revenue increased prodigiously from 1970 to 2005 as table 1 clearly shows; the respective shares being 26,3% and 85,8%. A major implication of this increase lies in the fact that increases in government expenditures correlate positively with increases in government revenues in Nigeria and thus, if the economy boomed with a surge in export incomes from oil then government revenues increased and an increase in government expenditures followed. Alternatively, if the economy slumped with relatively low export incomes from oil, then government revenues dropped and a decrease in government expenditures followed. This means that the Nigerian government was running a procyclical fiscal policy and by doing so, exacerbating the ripples of oil shocks on the economy (Akinlo, 2012). To be clear, referring back to the subject matter of this paper, deterioration in macroeconomic stability is what is implied when the exacerbation of ripples of oil shocks on the economy is mentioned.

The reasons behind government's tendency to squander federal revenue during positive oil shocks are twofold. Firstly, the positive shocks can cause an unhealthy expansion of the size of government. Here, an unhealthy expansion refers to one where

the rate of growth in the size of government is so great that there is no way the level of government efficiency can be sustained and rent seeking and corruption increase. Secondly, positive shocks often lead to a reduction in public investment quality. While increased quantity of investment is good, a reduction in the quality of these investments is not. Just as a too rapid an expansion in the size of a country's government can result in a loss of efficiency, too rapid an expansion in the quantity of investment can result in a loss of quality as there is a limited number of investments that are prudent and yield a significant return at any given moment. A revenue boom can lead to a relaxation of government's standards in choosing investments because of pressures from rent-seeking. The government may also relax aforementioned standards due to a desire to "speed up" economic growth without taking into account the detrimental effects of the reduced quality of investment (Ross, 2003).

Significant negative oil revenue shocks lead to unexpected interruptions in government programs. Some government programs require years of sustained funding and management and with large negative oil shocks, they become susceptible to disruptions that can be fatal to them (Ross, 2003).

For oil revenue volatility's harmful effects on GDP growth to be mitigated a more pragmatic approach to formulation and implementation of fiscal and monetary policies is required. Oil revenue volatility's negative effect on growth has historically been exacerbated by accommodating procyclical fiscal and monetary policies. Monetary policy exacerbates the ripples of oil shocks via rising real interest rates and fiscal policy does the same through excessive government spending during booms and limited government spending during slumps. A better coordination of fiscal and monetary policy and a focus on delinking the economy from oil revenue volatility are therefore needed. Certain steps have been taken in the right direction with regard to that, such as an oil price-based fiscal rule and the adoption of the so-called Medium Term Expenditure Framework (Ushie, Adeniyi, & Akongwale, 2012).

7 Discussion

The vector autoregression approach was a somewhat ambitious approach, when taking the training in use of such models into account. The setting up of the model is therefore not flawless, and explanations and interpretation somewhat short, of for example the impulse response functions. Variables in multivariate VARs can also be sensitive to their ordering when put into the model. Perhaps a better approach would have been to run a bivariate VAR of oil price against each of the other variables.

In my attempted VAR analysis the appropriate normality tests of the residuals and tests for autocorrelation, such as the Portmanteau test, are noticeably missing so there is no statistically significant "guarantee" of the VAR estimators being the best linear unbiased ones. That does not necessarily mean the estimators are not the best linear unbiased ones, it only means I cannot say for sure that they are. I decided to go through with the VAR estimation anyway to practice carrying out and interpreting other aspects of vector autoregressions as far as that went.

I did not find any granger causality between variables, neither in the multivariate VAR presented nor in pairwise tests I conducted outside the pages of this paper in gretl, but Umar & Kilishi (2010) found several granger causalities in their data. They did for example find evidence of CPI granger causing crude oil price at a 5 percent significance level but I did not find any causality between Inflation and crude oil price changes in my model.

Also, the article by Umar and Kilishi (2010), that I refer much to, may leave something to be desired as regards reliability, based on the fact that the title is not descriptive and the language usage leaves room for improvement. The title mentions a variance autoregression. The correct term for what the article is about is vector autoregression. However, the model specification and much of the analysis in it seemed legitimate and so did the name of the journal the article was published in, *International Journal of Business and Management*.

Blanchard and Galí (2007) have an interesting approach in their vector autoregression analysis of oil importers in that they allow for a structural break in their

sample to see if the effects of oil on macroeconomic variables have changed over time. Properly set up vector autoregressions of Nigerian macroeconomic variables allowing for a structural breaks could be an interesting addition to the results presented in this paper to see if and how the effects of the oil industry have changed over time.

8 Conclusion

The conclusion reached is that volatile oil prices affect not only macroeconomic stability but also political stability and government decisions. Additionally, it is concluded that a better coordination of fiscal and monetary policies is needed to avoid exacerbating the ripples of oil shocks instead of mitigating them.

As mentioned in the discussion, the basis for the results could have been more solid than it actually was, so a more thorough analysis is needed. Furthermore, scarcity of research in the field in general causes the literature to give an incomplete picture of the macroeconomic effects of the oil industry in Nigeria.

On the positive side, this conclusion leaves much room for further studies, but those studies rely on more data collection of good quality within the country, a condition that hardly exists today.

Appendix 1

Year	Ch_rOilP (%)	rGDPgrowth (%)	Inflation (%)	Expsh_GDP (%)
1974	171,571	8,278	12,674	25,179
1975	-23,031	-7,814	33,964	18,339
1976	-2,514	5,910	24,300	18,216
1977	-2,415	2,865	15,088	24,872
1978	-9,758	-8,597	21,709	19,553
1979	107,051	3,626	11,710	24,816
1980	9,991	1,283	9,972	29,375
1981	-17,181	-15,435	20,813	22,530
1982	-10,337	-2,765	7,698	16,343
1983	-21,782	-7,628	23,212	13,612
1984	-17,663	-7,157	17,821	14,851
1985	-8,198	6,973	7,435	16,098
1986	-46,407	-0,081	5,717	17,095
1987	-15,745	-3,235	11,290	28,610
1988	-33,175	7,094	54,511	23,122
1989	-16,050	4,493	50,467	32,694
1990	19,684	5,514	7,364	43,431
1991	-29,548	2,205	13,007	37,217
1992	-46,525	0,448	44,589	42,239
1993	-41,991	-0,223	57,165	47,121
1994	-26,172	-2,249	57,032	41,756
1995	-30,651	0,113	72,836	44,288
1996	-13,195	1,889	29,268	48,145
1997	-7,377	0,339	8,530	44,952
1998	-27,848	-0,465	9,996	33,525
1999	23,189	-1,244	6,618	36,898
2000	13,059	2,925	6,933	53,977
2001	-22,101	0,646	18,874	42,994
2002	-22,141	-0,897	12,877	31,867
2003	4,258	7,619	14,032	42,703
2004	8,153	7,898	14,998	43,951
2005	18,149	2,819	17,863	46,537
2006	0,713	3,595	8,240	42,868
2007	5,545	3,833	5,382	41,020
2008	22,887	3,371	11,578	42,755
2009	-33,388	4,313	11,538	34,987
2010	0,952	5,294	13,720	35,204
2011	28,582	4,681	10,841	39,616

I made the table based on data from the World Bank‘s DataBank (2012). The Ch_rOilP is computed by dividing the DataBank‘s time series for average annual oil price by the DataBank‘s time series for the Nigerian GDP deflator.

Appendix 2

A VAR system computed in econometric computer program gretl:

VAR system, lag order 1
OLS estimates, observations 1975-2011 (T = 37)
Log-likelihood = -539.69658
Determinant of covariance matrix = 54914044
AIC = 30.2539
BIC = 31.1246
HQC = 30.5609
Portmanteau test: LB(9) = 168.198, df = 128 [0.0099]

Equation 1: Ch_rOilP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
Const	-0.403512	15.9581	-0.0253	0.97998
Ch_rOilP_1	0.0672767	0.137088	0.4908	0.62695
Expsh_GDP_1	-0.111846	0.460473	-0.2429	0.80964
Inflation_1	-0.095998	0.298334	-0.3218	0.74971
rGDPgrowth_1	-0.818709	1.07639	-0.7606	0.45246

Mean dependent var	-7.107516	S.D. dependent var	27.76346
Sum squared resid	26735.10	S.E. of regression	28.90453
R-squared	0.036543	Adjusted R-squared	-0.083889
F(4, 32)	0.303435	P-value(F)	0.873495
Rho	0.203966	Durbin-Watson	1.538813

F-tests of zero restrictions:
All lags of Expsh_GDP F(1, 32) = 0.058997 [0.8096]
All lags of Inflation F(1, 32) = 0.10354 [0.7497]
All lags of rGDPgrowth F(1, 32) = 0.57852 [0.4525]

Equation 2: Expsh_GDP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	6.94081	3.47862	1.9953	0.05459	*
Ch_rOilP_1	-0.043038	0.029883	-1.4402	0.15952	
Expsh_GDP_1	0.733073	0.100376	7.3033	<0.00001	***
Inflation_1	0.0834697	0.0650321	1.2835	0.20853	
rGDPgrowth_1	0.415505	0.234636	1.7708	0.08611	*

Mean dependent var	33.46424	S.D. dependent var	11.48856
Sum squared resid	1270.379	S.E. of regression	6.300741
R-squared	0.732638	Adjusted R-squared	0.699218
F(4, 32)	21.92199	P-value(F)	8.67e-09
rho	-0.161658	Durbin-Watson	2.296382

F-tests of zero restrictions:
All lags of Ch_rOilP F(1, 32) = 2.0742 [0.1595]
All lags of Inflation F(1, 32) = 1.6474 [0.2085]
All lags of rGDPgrowth F(1, 32) = 3.1359 [0.0861]

Equation 3: Inflation

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	7.12899	8.34775	0.8540	0.39945	
Ch_rOilP_1	0.00404205	0.0717112	0.0564	0.95540	
Expsh_GDP_1	0.0505156	0.240875	0.2097	0.83522	
Inflation_1	0.572172	0.15606	3.6664	0.00089	***
rGDPgrowth_1	0.079881	0.563065	0.1419	0.88807	

Mean dependent var	20.78347	S.D. dependent var	17.37730
Sum squared resid	7315.755	S.E. of regression	15.12010
R-squared	0.327036	Adjusted R-squared	0.242915
F(4, 32)	3.887705	P-value(F)	0.011029
rho	0.180183	Durbin-Watson	1.596813

F-tests of zero restrictions:

All lags of Ch_rOilP F(1, 32) = 0.0031771 [0.9554]
All lags of Expsh_GDP F(1, 32) = 0.043981 [0.8352]
All lags of rGDPgrowth F(1, 32) = 0.020127 [0.8881]

Equation 4: rGDPgrowth

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	-1.77706	2.86508	-0.6202	0.53949
Ch_rOilP_1	-0.0272408	0.0246124	-1.1068	0.27664
Expsh_GDP_1	0.0709313	0.0826722	0.8580	0.39728
Inflation_1	0.00470533	0.0535622	0.0878	0.93054
rGDPgrowth_1	0.112821	0.193253	0.5838	0.56345

Mean dependent var	0.863700	S.D. dependent var	5.115034
Sum squared resid	861.7739	S.E. of regression	5.189454
R-squared	0.085058	Adjusted R-squared	-0.029310
F(4, 32)	0.743721	P-value(F)	0.569352
rho	0.007566	Durbin-Watson	1.952323

F-tests of zero restrictions:

All lags of Ch_rOilP F(1, 32) = 1.225 [0.2766]
All lags of Expsh_GDP F(1, 32) = 0.73613 [0.3973]
All lags of Inflation F(1, 32) = 0.0077173 [0.9305]

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