The Slippery Slope of Oil

Estimating the future GDP of Nigeria with uni- and multivariate approaches

by

Clara Karlsson Schedvin
cl2483ka-s@student.lu.se

Nigeria is, by population, the largest country in Africa and their economic growth will be a key part in the world reaching the goals of eradicating poverty. This paper investigates the economic growth performance of Nigeria and the relationship between oil and the GDP performance by using growth accounting, ARIMA, VAR and VEC models. Through the ARIMA and VAR models, the GDP is forecasted until 2050. The statistical models prove to us that oil plays an important role in the economic performance through a one-way direct effect on GDP and through a two-way effect on the capital stock. With the global need to decrease their dependency on oil, this offers up some potentially large problems for Nigeria, which is why the forecasts are important. The forecasted values of the models are rather different where the ARIMA results offer a forecast with an average growth similar to that of the last 30 years. The VAR model instead generate a forecast with an average growth rate of less than one percent. This low forecast is disturbing since it would lead to a significant drop in living standards and increase in people living in poverty. Considering the results and the previous research it seems likely that Nigeria is suffering from the Dutch disease and they need to diversify their economy to be able to generate a sustainable growth in relation to their extremely stable population growth.

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1   Introduction

As of 2000 the world set the goal to improve the living situation for the most vulnerable people in the world. Since the adoption of first the Millennium Development Goals (MDG) and then the following Sustainable Development Goals (SDG), there have been areas which have been progressing strongly and some areas which are struggling to achieve similar results (MDG, 2021a, 2021b; SDG, 2021). The difficulty of improving their situation lies with creating economic growth which can both keep up and hopefully outpace the population growth, which is high in the areas which is also in most need of economic growth. Where large parts of Asia have managed to improve their average living situation and economic standing, large parts of Africa are struggling to achieve the same results (Austin, 2016; Thorbecke and Ouyang, 2016). This is disheartening as Africa is expected to experience a large population growth within the coming decades, which might potentially cause the continent to fall even further behind if economic growth cannot keep up (Gerland et al. 2014; Tartiyus, Dauda and Peter, 2015). This population growth could of course also offer a large potential for growth in the increased supply of workers, however there are many factors of an economy which must be fulfilled for this to be successful (Akeju and Olanipekun, 2014; Gerland et al. 2014).

The growth of Africa at large has been struggling to follow the expected path of modern economic growth and development. The GDP growth has varied over the many countries though generally it has been disappointing and most of the countries struggle to achieve the expected structural transformation. The factors as for why the economic growth has been underperforming when Africa is a continent of many natural riches, have been of massive interest for many researchers. One theory which has earned a lot of focus is the role of the institutions and their quality, especially in relation to the remnants of the colonising era. With poor institutional quality, modern economic growth becomes difficult to achieve and tends to lead economic development being hindered in areas beyond GDP growth; such as human capital and investments into areas benefiting the population at large. Indications of this becomes evident when considering how poorly managed the natural resources often are. The revenues are often left unchecked with the owners, and income inequality increases. Other areas which have been identified as important for the African growth performance is the geography of the continent, and how much the countries differ between each other as well as differ from the European countries, who were trying to apply their agricultural technology with mostly unsuccessful results. Beyond these factors, African countries are also facing a global market with more regulations than ever before and the giant of China cornering a larger and larger share of the global manufacturing sector, which has been a successful engine for growth in previously developing countries.

In the case of Nigeria, it currently has the world's seventh largest population, with a yearly growth rate of between two and a half and three percent for several decades and a total population of over 200 million people (The World Bank, 2021a, 2021b). At the latest measurements by the World Bank (2021c) around 40 percent of the Nigerian population live

below the international poverty line, having declined from 56 percent nearly a decade before. However, Nigeria's population is projected to continue to grow to at least twice its size by 2050 and possibly four times its current size by 2100 (Gerland et al. 2014). With such a high level of poverty, the number of people experiencing poverty is very high and the economic growth needed for a continued decrease in poverty levels with such a high population growth will need to be substantial, which is where the problem lies.

Several factors have been identified in previous research as being of larger important to the Nigerian growth performance and are included in this research. The agricultural sector is still occupying a large share of the labour force, especially among the poorest. However, the productivity of the sector does not seem to be keeping up with the labour required, which is a problem for the structural transformation and in the strive to lower the share and absolute numbers of extremely poor. Nigeria is also a prime example of how the access to a valued natural resource does not automatically fix the economic situation. The oil resources were found in the 60's and they were able to reap large incomes with the price boom in the 70's and they have been ever since whenever the oil prices are beneficial. However, this has not led to as large improvements in the living standards. For example, at the start of the 90's Nigeria and Indonesia were at similar levels of income and living standards yet since then Indonesian living standards have surpassed Nigerian ones by almost tenfold. This inability to successfully harness the power of the oil resources for sustainable growth is likely related to the poor investment climate and market structure of Nigeria. This also affects the efficiency and attractiveness of foreign investments, which has been found to be a good source for growth when used correctly. Lastly Nigeria is facing a large challenge in improving the quality and levels of schooling, as it is currently low and unevenly distributed.

Considering these factors and the importance oil has played in the Nigerian growth, this paper focused on the interaction between those two factors and what this means for the future of Nigerian growth. Natural resources have been found to unstable sources for economic growth as their prices are volatile and cause fluctuations in the economic performance of a country. Add on to this the global need to move away from oil as a resource for energy and the Nigerian future growth looks rather unstable.

To evaluate the past economic growth and forecast the potential future a combination of statistical approaches are used in this paper. Growth accounting is used to find the average growth of GDP, population and capital over the decades from the 1950's and onwards. To crease forecasting models, both a univariate and a multivariate approach is used by using an Autoregressive Integrated Moving Average (ARIMA) model and a Vector Autoregressive (VAR) model. The Vector Error Correlation (VEC) model is used to find the short- and long-run relationship between the oil revenue and capital stock, which is useful in the analysis of the results.

The growth of Nigeria has been fluctuating rather dramatically over the years with the lowest average growth of under one percent and the highest average growth coming in just shy of eight percent. The forecasts result in rather different outcomes, where the ARIMA model forecasts the GDP growth to continue at a similar level to the average growth of the last 30 years. However, the VAR model, which forecasts based on the interaction of GDP and the oil revenue, generates an average growth rate below one percent which would lead to a problematic situation

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for the Nigerian population. This result is potentially due to a lack of observations of the oil revenues, however it does offer a potential outcome should the world manage to move away from oil faster than expected. With the VAR model it is identified that oil revenues have an impact on GDP, and the VEC model finds that oil revenues and capital stock affect each other both in the short- and long-term, through more so does oil affect the capital stock. Considering the population growth forecast by previous papers and the results of the models, Nigeria might be struggling to keep their population out of poverty, especially since the population in 2050 could quite easily reach 600 million people based on previous behaviour.

The results indicate that Nigeria needs to diversify the economy to make it more stable and less vulnerable when the world looks for alternate energy sources to oil. It is also important that the governance and regime changes as it needs to invest into a more varied capital stock rather than the focus on the extractive industries that they do right now. This is especially important to succeed in keeping the number of people living in poverty low and eventually reach zero. If not, Nigeria is set to become a poverty trap. This is an area where it would be most interesting to continue conducting research on Nigeria.

1.1 Research Problem

Considering the future population of Nigeria and the need for a stable continuous growth to support all these future people, the potential future economic growth of Nigeria is of import. It is by far the largest country in Africa, when measuring by population and a not insignificant part of the success of the SDG's will be tied in with their future economic performance. So far, their growth has fluctuated and seem to be quite connected to the oil prices and their capabilities of exporting it. Therefore, this research focuses on the economic performance so far and potential future growth of Nigeria, especially in relation to the performance of oil. However, future growth is often also connected to past growth which will be partially focused on in the analysis. This leads to one research question, with s number of sub-questions as to answer the main one:

What future growth might Nigeria experience based on their economic experience so far?

1. *What has the economic growth looked like in the past?*
2. *How might oil affect the future Nigerian economic growth performance?*
3. *Based on previous growth, what are potential future scenarios for Nigerian economic growth?*

1.1.1 Aim and Scope

The aim of this paper is to evaluate the economic growth performance of Nigeria and anchor it in previous research. Based on this, projections into what the potential future growth of Nigeria might look like will be made with a focus on the economic impact of oil. This paper focuses on

analysing and forecasting the economic growth based on a limited number of variables. Forecasting anything is difficult and the economic performance is linked to many variables of the economy, however due to time constraints a more limited approach is used in this paper. The outcomes of the forecast are analysed from the perspective that the world needs to move away from oil as a power source, as well as the future population of Nigeria. The paper is based on economic data from large renowned data providers and stretches as far back as the 1950's. The older data however will not be as heavily contemplated as economic data is always a bit problematic and especially so the further back in time data is harvested. The data used is checked against other similar sources to ensure that they show similar results.

1.2　Outline of the Thesis

This first chapter has offered an insight into the situation in Africa and more specifically Nigeria and why it is of interest to analyse the case. The second chapter supplies a deeper dive into the African growth experience and as well as what has been previously found to affect the growth in Nigeria. Chapter three goes into to the data used, where it is collected from and what potential weaknesses might exist within it. Chapter four goes into the methodology of the research and finds the forecasting models. Chapter five presents the forecasting results and contains the discussion on those results. Chapter six offers the conclusions of this paper and its results as well as potential future research potential.

2   Theory and Background

The economic growth of the African continent has been a subject of a lot of research over the years and the theories as for what has been driving or hindering the economic growth are numerous. This chapter starts by looking into the research which has focused on African at large and what has affected its growth over the years. This research goes into the effects of the colonizing years and nations, the geographical and natural endowments as well as foreign investment, extraction and aid and the political stability of nations. The second half of this chapter goes into the economic and population growth of Nigeria and the research which has identified drivers and hindrances to these factors. A large share of this research is focused on the role of agriculture and its financing, but the human capital levels, foreign investment and monetary policies of the nation is also identified as important for successful economic growth.

2.1   African Growth

Although it is problematic to clump all of Africa together in research, there are similarities which recur in many of the nations on the continent. The theories of Modern Economic Growth suggests that the African countries should be experiencing rapid economic growth in the form of GDP growth at the same time as the population growth increased (Kuznets, 1966; 1973). This growth should be driven by an increase in productivity of the labour force and their use of capital. At the start of the process, agriculture is generally the driver of the economic engine, occupying a large share of the labour force. The productivity increase would then free up the population to shift into other sectors such as manufacturing and services, which are more stable and a stronger source for growth, which speeds along the process of structural transformation further (Kuznets, 1973). However, many developing countries are struggling to achieve this, and in Africa especially so, since it hinges on stable institutional and political frameworks (Kuznets, 1966; 1973). The reason behind the generally unsuccessful economic growth of Africa has been research by many and the theories are several. A number of the theories more focused on by researchers are further discussed in this section.

2.1.1   Institutions

The rather recent colonization of many of the nations are expected to have had detrimental effects to their economic growth performance to this day. One of the most referred bodies of research on this subject is the works by Acemoglu, Johnson and Robinson (2002) and their "Reversal of Fortune" theory and their paper on why Africa in specific is poor (Acemoglu and Robinson, 2010). The reversal theory is based on the importance of the quality of institutions in a country and what type was brought into the nation based on the colonizing forces

(Acemoglu, Johnson and Robinson, 2002). The quality and type of institution was based on the geography of the location and whether this was conductive to Europeans settling and building a society or instead choosing to extract resources. Their research points towards the areas which were prosperous half a century ago having been drained for wealth, and that wealth having been moved into the European countries and settler colonies (Acemoglu, Johnson and Robinson, 2002). Moving more specifically onto the case of Africa and their institutional quality, Acemoglu and Robinson (2010) focus on why Africa has become the poorest area in the world. They assume that the root of this problem lies with the quality of political and economic institutions and they find that this has been the case for longer than they first thought. Except for a few cases, Africa, and more specifically Sub-Saharan Africa, has always been lagging behind the world in levels of technology and economic growth (Acemoglu and Robinson, 2010). Generally, the reasons for these institutions working so poorly lies with their late emergence and the fact that they were very patrimonial and absolutist which have been unsuitable for creating an environment for sustained economic growth (Acemoglu and Robinson, 2010). Researchers also argue that the effects of colonialism meant that the institutions which already were at work in the countries were manipulated to not benefit most of the people and the imported institutions which are often suggested as a solution lack legitimacy (Engelbert, 2000; Nugent, 2010). This is backed by Bowden, Chiripanhura and Mosley (2008) who find that areas where strong chiefs and indigenous people resided, the small-holders were able to become much more productive. On the other hand, the areas where Europeans were clearly stronger than the local forces, the institutions turned extractive and economic outcome was worse (Bowden, Chiripanhura and Mosley, 2008).

These ideas have not gone by without some academic resistance. Austin (2008a) in particular, is suspicious of the idea of the "reversal theory". Austin (2008a) does admit that this is a useful addition to economic history research, but he argues that it is too simplistic and ignores factors which might be important to economic growth. Furthermore, it is unlikely that the type of institutions Acemoglu and Robinson (2010) think will work for a stronger economic growth will work for the over fifty nations in Africa, it is rare that one size fit all, especially in the case of politics and economics (Austin, 2008a). One interesting facet of this is the difference between which country colonized the African nation, as they had different outlooks on how to run their colonies and what the outcome of them was to be (Austin, 2010; Cogneau and Moradi, 2014). This is further echoed by Green (2018) who argues that the colonizers boosted the economic growth in southern Africa. However, this was all focused on establishing and strengthening the exports and not on building domestic, functioning markets. Green (2018) finds that the colonization and its institutional effect was mostly beneficial for the short-term economic growth, but a hindrance to the long-term growth. This lack of long-term economic growth is identified by Arrighi (2002) as well, who calls it perverse growth.

2.1.2   Natural Resources and Geography

In many of the classical ideas of economics, Africa would be considered gifted with large reserves of gold, minerals and diamonds as well as large expanses of land, oil resources and in many countries a large population. However, these factors do not seem to have helped the

continent in many cases but rather caused unstable growth and increased income and wealth inequality.

Austin (2008b) for example points out that though African countries have large populations, the vastness of their land makes them land abundant which would suggest a potential for success in agricultural businesses. However, just because there is a lot of land does not mean it is all suitable for agriculture. Compared to other areas on the globe, the African soil is mostly only nutritious in the top layer, making the use of ploughs and many other agricultural techniques useless (Austin, 2008b). The struggles are also that this top layer easily washes away when surrounding trees and such is cleared to make the earth useful for agriculture. The lack of technological progress already existing and the fact that importing techniques from foreign countries does not work in combination with the difficulty to attract direct foreign investment has made it difficult for Africa to expand their agricultural sector (Austin, 2008b). Beyond these factors, the rainfall in Africa is also much more extreme in its seasonality than in for example Europe (Austin, 2010). There have also been examples of agriculture being a successful driver for economic growth, however over all the low productivity of the agricultural sector slows down the structural transformation and thus economic growth (Thorbecke and Ouyang, 2016).

Another area of abundance in Africa is the access to precious metals and minerals which should offer a possibility for rather easily accessible economic growth. However, that has not been the case and it appears to be so due to several reasons. One of the major issues of primary commodities, such as metals, is the volatility of the prices and the difficulty in predicting their future prices (Deaton, 1999). With the example of copper, Deaton (1999) visualizes the historical difficulties in forecasting, all examples having been terribly of mark. It seems rather that the trends are slightly negative for many of the African commodities. With this volatility, it becomes difficult for governments to make long-term investments or boost consumption (Deaton, 1999). Add to this the risk of the countries falling into the "Dutch Disease" and the negative connotations which come with that and the natural resources have the potential to become a dangerous trap rather than a growth potential (Deaton, 1999).

2.1.3   External Factors

The 80's is known in development economics as "the lost decade", where development halted in most places and even degraded. During this decade the global market and attitude towards the developing world changed. The World Bank, which had until then been an important source for investments, started putting demands on their loans and aid to try to encourage institutional development in a certain direction (Arrighi, 2002). During this time period the World Bank largely adapted the view of the global political winds, which was liberalism and minimalist state intervention. As this happened it became more difficult for the developing countries to meet the requirements to become eligible for loans and to attract direct investments from countries as well as the World Bank became less involved in the countries, lowering their reliability (Arrighi, 2002; Engelbert, 2000). During the 90's the World Bank moved from the attitude of minimalist state intervention towards instead promoting what they called good governance and bureaucracies (Arrighi, 2002). This is where, as mentioned earlier as well, the idea of imported institutions come into place and have been problematic in their lack of validity and thereby also lack capability for governance (Engelbert, 2000).

Beyond these institutional factors, African countries are today facing a global market which looks very different from what it did a few decades ago. When many of the East Asian countries managed to achieve a strong and sustained economic growth, the influence from international organisations such as the World Trade Organization (WTO) and International Labour Organization (ILO) was lower than it is today (Baek, 2005; Wade, 2003). The global market also looks different today since China occupies such a massive part of the global manufacturing market, both lower and higher skilled types (Subramanian and Kessler, 2013). For this reason, the classic idea of structural transformation seems to be more difficult to achieve for the African nations as there might not be enough room in the manufacturing sector to sustain and drive their economies (Austin, 2016; Thorbecke and Ouyang, 2016).

2.2   Nigerian Growth

The growth of a country is obviously dependent on many different things, depending on their natural composition, political system, trade and history. Based on the research for this paper, this section goes further into the factors which have been especially identified as important for Nigeria's growth performance. Nyoni and Bonga (2018) have identified the population growth, agriculture, natural resources, financial and monetary policies, foreign aid investments and lastly human capital development as being especially important for the economic growth performance of Nigeria. When delving deeper into the economic growth of Nigeria, it becomes evident that several the factors identified in the previous sector are also an issue for them as they struggle with their structural transformation, efficiently using their natural resources and investments as well as increasing their human capital.

2.2.1   Population

A growing population offers both potential and problems to the economy of a country, as it creates a larger potential working force, however it also puts more strain on many social institutions and potentially increases the risk of poverty when economic growth does not keep up (Tartiyus, Dauda and Peter, 2015). The Nigerian population growth has been steadily high for a number of decades, shifting between 2,5 and 3 percent average growth since the 50's, included in Table 5.1 for specific numbers. This has led to Nigeria becoming the most populous country in Africa by far with a population of over 200 million people today (The World Bank, 2021a). The basic ideas of modern economic growth would argue that with increased population comes increased productivity, however it seems that Nigeria has not really been able to achieve this (Tartiyus, Dauda and Peter, 2015). With the high GDP growth and the high population growth, the GDP per capita growth has been much lower, averaging just over 1,5 percent over the last thirty years, also visible in table 5.1. This falls in line with some of the theory as well, that it can be difficult for GDP growth to keep up with a fast population increase, especially for the less developed countries (Tartiyus, Dauda and Peter, 2015).

Considering the historical population growth of Nigeria, it is expected that their future population growth will continue in a similar manner for quite some time. Currently the Total

Fertility Rate (TFR) high and the signs points towards the decrease of fertility being slow, which leads to a projected population by 2050 of about 500 million people and potentially reaching a billion people by 2100 before potentially reaching a plateau (Gerland et al. 2014). To experience a shift in their demographic, Nigeria needs a shift in attitudes towards marriage, when one should start having children and how many children are considered the optimal size of a family (Becker, Cinnirella and Woessmann, 2010; Friedlander, Okun and Segal, 1999; Lee, 2003). The reason for why this shift happens is the focus of many theories. Some theorize that it is due to child mortality dropping and the security which children offered their parents in the future was not as vulnerable and therefore people chose to have fewer children (Lee, 2003). Others theorize that it has a lot to do with what is socially acceptable in the area, one must be both ready, willing and able (RWA) to lower the fertility rates (Lesthaeghe and Vanderhoeft, 2001). The power of the society around you is found to be very powerful in these theories and religion often plays a large part in the general attitude towards family size.

Even though the projections of Nigeria's future population come with upper and lower estimates which become wider the further into the future the projection, the lowest numbers for 2050 predict at least a doubling of the current population. These rapid expansions pose many potential challenges for Nigeria when it comes to investments in public services, infrastructure, the population health, poverty and unemployment (Akeju and Olanipekun, 2014; Gerland et al. 2014). Nigeria has been struggling with high numbers of unemployment due to matching struggles and slow interventions by the federal government which has especially affected the rural areas harder than the urban (Akeju and Olanipekun, 2014). With over 50 percent of their population being under 20 years old and an increased interest in higher education, this unemployment trend is likely to continue as the lack of appropriate jobs seems to continue due to lacking qualities in starting new companies (AfDB, 2021; Akeju and Olanipekun, 2014). Combining this with the high rates of urbanisation and Nigeria finds themselves at risk of urban decay which might further slowdown the economic growth (Adedeji and Arayela, 2018). They go so far as to state that an urban renewal approach is the only way to save the future economic growth of Nigeria (Adedeji and Arayela, 2018). This will likely prove to be difficult to achieve as these investments depend on strong political willpower, which is often not the structure in an oil-nation, which is further mentioned in section 2.2.3 (Adedeji and Arayela, 2018).

2.2.2   Agriculture

As with many countries in their developing stage, agriculture has been an important part of the economic activity of Nigeria, especially before the discovery of oil. Compared to many other countries in Africa, Nigeria's nature is rather beneficial to agricultural practises with a varied nature and vegetation, a quite steady supply of water and good arable farmland which is not always the case for African nations (Sertoglu, Urugal and Bekun, 2017). Its important historical position has led to agriculture being judged as an important factor in Nigeria's fight against poverty in the Millennium Development Goals (Sertoglu, Urugal and Bekun, 2017). Some examples of the importance of agriculture, in the rural areas especially, in Nigeria are strong positive correlations between food production and increases in school enrolment and a similar negative effect with the child mortality rate (Odetola and Etumnu, 2013; Oyakhilomen and Zihab, 2014). Poverty levels in Nigeria have been struggling to decrease despite strong

economic growth performance so far, which is attributed to the focus on oil rather than agriculture and to combat this problem, more targeted efforts and a move away from oil is needed (Oyakhilomen and Zihab, 2014).

The importance of agriculture as a share of the economic growth performance (in real GDP) in Nigeria has greatly shifted over time, with numbers starting well over 60 percent in the 1950's. This share of GDP steadily declined and was accelerated once Nigeria found oil reserves, as the sector then became much less prioritized by policymakers (Sertoglu, Urugal and Bekun, 2017). Its share reached a bottom low by the 70's and start of the 80's, and has since fluctuated, peaking by the start of the new millennia and today hovering at about 20 percent in the most recent years (The World Bank, 2021e). Even though the agricultural sector is still important to the domestic growth performance, its self-sufficiency has suffered since the oil discovery and has become quite dependent on imports (Otaha, 2012). Several authors find that agriculture is a valuable source of economic growth for Nigeria, as it has been historically and they estimate that it will be, going forward as well (Sertoglu, Urugal and Bekun, 2017; Odetola and Etumnu, 2013).

One important feature, as identified by Odetola and Etumnu (2013), of the agricultural sector of Nigeria has been the resilience of it, as this sector has bounced back to previous levels quicker than other sectors in the face of external shocks. The importance of the sector is also backed by Obansa and Maduekwe (2013) who find a dual causality between the agricultural sector and the economic growth performance, meaning that they both affect each other's performance. This is hardly surprising considering the size of the agricultural sector and the amount of people employed within the agricultural sector (The World Bank, 2021f). There does also seem to be a lot of room left for productivity increases in agriculture in Nigeria, as the share of people employed in agriculture lies at above 10 percentage points above its share of value added to GDP.

2.2.3   Natural Resources

As mentioned in the previous section of this paper, natural resources can be both a blessing and a curse, as has been obvious in many cases in Africa. In the case of Nigeria, the discovery of oil changed the focus of investments, with a massive shift towards the oil industry. Today, oil in different forms, such as crude and refined petroleum, makes up 85 percent of Nigeria's total exports (OEC, 2021). As mentioned above, once oil was found in Nigeria, other sectors were less prioritized, which can be noted in the complexity of their economy as their economy has grown less complex over the years (OEC, 2021). Otaha (2012) finds that Nigeria has fallen into the trap of the "Dutch Disease" where the other sectors of the economy have noticeably suffered due to the attention to the oil industry, such as the agricultural sector having become dependent on imports at a much larger share than before the oil discovery. These results are backed by Ogunleye (2008) who finds a negative relationship between oil revenue and the agriculture and manufacturing sectors.

This fairly large dependence on one industry has offered great moments of growth but also a great instability of the economy. Aliyu (2009) finds that the Nigerian economic growth has at moments greatly benefitted from oil price shocks, mostly in a direct way but also through the

exchange rates. However, these moments are unpredictable and cannot be dependent upon to continuously sustain an economy, especially as there also exists a risk of sudden price collapses. To secure a more stable economic growth in the future as well as ensuring that it is more inclusive Nigeria needs a diversification of their economy (Aliyu, 2009; Ogunleye, 2008; Otaha, 2012).

The oil dependency has also led to a problematic political structure as is often the case in many oil-nations (Ogunleye, 2008; Otaha, 2012; Oyefusi, 2007). The political power tends to be unchecked and distributed at the whim of the ruler in an uneven fashion. The ownership of the oil companies and their revenues also tends to be hoarded by a few already rich individuals due to this lacking political quality and governance (Deaton, 1999; Ogunleye, 2008; Otaha, 2012; Oyefusi, 2007). Otaha (2012) especially sees many problems with Nigeria's oil dependency and lack of political quality as those who have previously managed to handle sudden oil riches and still moving focusing on other sectors of the economy have had much more effective applications of the Rule of Law before the discoveries. An example of such a case can be made when comparing the cases of Nigeria and Indonesia, who were at similar levels of income three decades ago but have since handled their oil incomes completely differently (Otaha, 2012). The outcomes of their differing approaches have been astounding where Indonesia's income levels are today more than 10 times larger than Nigeria's with clear differences in quality of life as well (Otaha, 2012). Oyefusi (2007) finds that the inherent inequality and problematic structure of the oil industry also leads to civil conflicts with rent seeking, looting behaviour and violence.

One other issue not mentioned by these papers, is the issue of depending on oil in a world which needs to move away from consuming and extracting oil. For the sake of the planet, there exists a need to move away as much as possible from using oil both for heat and for fuel. This will therefore produce a problematic future for Nigeria, as a massive industry of theirs might become obsolete (Austin, 2016). Overall, the oil industry in Nigeria seemingly has the power to drive the economic growth. However, the lacking political structures, governance quality and threat of a waning global demand of oil is likely to stand in the way of oil driving a sustainable long-run development for Nigeria.

2.2.4 Financial and Monetary Policies

Financial and monetary policies, and the influence that politics has over these, are naturally of import for the economic growth of a country. In the case of Nigeria, most of the power lies with the central bank and their customary function of controlling the amount of money flowing through the nation (Fasanya, Onakoya and Agboluaje 2013). Certain financial intermediation has been found to be successful in Nigeria so far and others have been identified as more important for the future of Nigerian economic growth (Fasanya, Onakoya and Agboluaje 2013; Shittu, 2012; Onyeiwu, 2012). The most efficient actions have been the central banks interventions into the monetary flow, which has been found to have a direct effect on productivity levels in Nigeria (Shittu, 2012).

However, it seems like there exists a need to expand the ways to exercise monetary policies in Nigeria as of right now it seems to not work as efficiently as they possibly could (Chimobi, 2010; Fasanya, Onakoya and Agboluaje 2013; Onyeiwu, 2012). Inflation rates do not respond

as expected to the actions of the central bank, which is likely due to the poor structure of the market and this leading to the effects dissipating before reaching the people (Chimobi, 2010; Onyeiwu, 2012). It is important to change this at it has been found to have a noticeable effect on economic growth. To solve these issues, the financial markets operations need to improve, with regulatory capacity and their depth and breadth to create a more favourable effect to garner economic growth (Onyeiwu, 2012). Furthermore, remittances into different sectors of the economy have been found to be effective in boosting the economic growth of Nigeria (Oluwatayo, 2017). Similarly, to the previous examples several interventions are needed to increase these types of investments, such as reducing taxes and strengthening the financial sector (Oluwatayo, 2017).

2.2.5   Foreign Investment

Foreign direct investments (FDI) are one of the types of remittances, mentioned earlier, which can potentially have a large effect on the economic growth performance of Nigeria. This could be especially beneficial as the Nigerian economy tends to fluctuate with the oil price and demand and some researchers find that FDI has a potential for economic growth which is multiple times larger than the oil industry (Adeleke, Olowe and Oluwafolakemi, 2014; Ayanwale, 2007). The effects are however not only positive as there exists a fear that it might replace exports and productivity, and thusly the employment. Inekwe's (2013) research into how FDI effects different sectors of the economic growth finds differing results depending on the sector and economic measurement. Services and manufacturing react differently, where the employment in manufacturing benefits from FDI the service sector employment instead suffers, whereas the relationship is the opposite when it comes to economic growth impact (Inekwe, 2012). The negative effects which occur in the manufacturing sector reflect the poor environment for business which has been pointed put in several other sections in this paper so far (Ayanwale, 2007). The Nigerian economic growth at large does seem to benefit from foreign investments and could be an efficient way to stabilize the economy (Adeleke, Olowe and Oluwafolakemi, 2014).

The factors of the economy which have been identified as important to attract FDI by Ayanwale (2007) are the size of the market, infrastructure level and the stability of the economy. However, human capital and economic openness was not identified as something which attracted investments (Ayanwale, 2007). To try to increase the attraction of foreign investments it has been found that Nigeria can and should take a number of actions. As mentioned in earlier sections, the financial and monetary markets are not optimal in Nigeria and these need to be improved to decrease the risks of investments (Oluwatayo, 2017; Onyeiwu, 2012). Furthermore, reducing the barriers to trade, such as tariffs on imports and exports, might also aid in investment attraction (Adeleke, Olowe and Oluwafolakemi, 2014). However, this too is dependent on the will and effectiveness of the governing power, which has been mentioned is lacking in Nigeria.

2.2.6 Human Capital

Human capital has been part of the answer to the question of the residual when it comes to the productivity increases in economic growth. The lesser the quality of the human capital the worse the application of new technology, thus hindering the productivity and the economic growth of the country. In the case of Nigeria, there seems to exist a strong relationship between the quality and quantity of human capital and economic growth performance (Adelakun, 2011). However, the Nigerian levels of human capital are not as high as one would want, such as the high illiteracy rates and unsatisfying enrolment levels for all levels of school (Adelakun, 2011). Furthermore, the schooling quality seems to be lacking and focused on less beneficial types of education (Adawo, 2011). With the high levels of poverty in Nigeria it will be difficult to improve the human capital levels, especially in the rural areas considering that currently half of the population is still living rurally (Macrotrends, 2021a). To combat this, increased investments into schooling must be made both to better the quality and the access to it (Adawo, 2011; Adelakun, 2011).

2.3 Previous Research

Forecasting the growth of anything is difficult, not just when it comes to economic growth and performance. Some examples of problems with forecasting can be found in the attempts to estimate future prices of copper (Deaton, 1999) or when trying to estimate the maximum average lifespan of a population (Oeppen and Vaupel, 2002). However, when it is comes to economic forecasting, the variables which one can take into consideration are many, as proven by the previous sections of this chapter which touches upon a few of the important ones in the case of Nigeria. Previous research and attempts into forecasting economic growth performances have utilized different models with a large spread of outcomes. Ianchovichina and Kacker (2005) utilize several different models to estimate the average growth for the years 2004 -2015 for a number of countries from each continent. The estimates are rather far of, at least for Nigeria, and only when looking at the 90 percent confidence intervals are the correct average growth rates included (Ianchovichina and Kacker, 2005). With their different models the projects growth rates are 0.45, 0,35 and 0,2 percent, with confidence intervals varying between -12 and 12 percent at most. They also find that the most important aspect to benefit future growth in Sub-Saharan Africa is for the countries to lower the government burden (Ianchovichina and Kacker, 2005). Abonazel and Abd-Elftah (2019) use the Autoregressive integrated Moving Average Model (ARIMA) model to estimate the future growth of Egypt from 2017 to 2026. Using the Box-Jenkins approach to find the ARIMA set up which follows the GDP growth most closely and their forecasting so far is staying quite close to reality (Abonazel and Abd-Elftah, 2019). The Seasonal ARIMA model has been found to be the most effective one when estimating inflation by both Omane-Adjepong, Oduro and Oduro (2013) and Ekpenyong and Udoudo (2016) when evaluating both Nigeria's and Ghana's inflation.

3 Data

This section presents and dives into where data has been collected and what it is based upon and a comparison to offer some extra credibility to the estimates used. Furthermore, the strengths and weaknesses of the data used in this research are discussed.

3.1 Source Material

All data in this research is secondary data and most of it is collected from the latest table of economic data presented by Penn World Tables (PWT). At the time of writing, that is the Penn World Table 10.0, and this section will go into which variables were collected and a table will be added in Appendix A with further detail (Feenstra, Inklaar and Timmer, 2015; PWT, 2021a). For the growth accounting used to analyse the previous growth performance of Nigeria, the real GDP is used as it is motivated by the creators to be used for this type of research (Feenstra, Inklaar and Timmer, 2015; PWT, 2021a). The Penn world Table also supplied the population numbers and capital stock. There have been a few updates to this latest dataset compared to earlier versions of the Penn World Table. The calculation of the capital share was changed in the version before this version of the PWT to make it more accurate, and now reflects the productive capital share (PWT, 2021b). All these variables are available from 1950.

To validate the data accessed, some of the numbers have been compared to other sources for international data. The GDP of Nigeria in the Penn World Tables, is compared to the data from "Our World in Data" as well as the development indicators from the World Bank, who both publish a large volume of economic data (OWID, 2021b; The World Bank, 2021d). The national accounts data is similar in both cases which strengthens the validity of the data used in this research.

The data regarding the value of oil production was a little tricky to get a hand on. However, the Extractive Industries Transparency Initiative (EITI) supplies data for the value of the Nigerian extractive industries and these measurements will be used. These numbers include both oil and gas extractions which does not offer a true measurement of the oil (EITI, 2021). It was investigated if it was possible to split out the oil numbers from the total, however the accounting changed a bit between the years and so it was decided to use the total value of the extractive industries. This is not deemed to be too large of an issue as oil is clearly the largest part of the total when investigating the reports each year, especially as the other industries are gas and mining which are related to oil extraction (EITI, 2021). For the global prices of the crude oil, the imported crude oil prices from the US have been used as they are easily accessible and report their data in dollars, which is used in the reports from the EITI as well (EIA, 2021).

The data used in this paper is a time series, which requires several tests to ensure that it is useful for statistical testing. GDP generally grows over time, and so is the case for Nigeria as well which is visible in figure 3.1. This might cause problems, however that will be delt with in the methodology section. Furthermore, a timeseries should be made up of at least 50 variables to be able to form good models. That is not a problem with most of the variables used, only the oil revenue of Nigeria potentially offers a problem in this case.

Table 3.1 Summary Statistics

Variable	No. obs.	Mean	Min	Max	Std. Dev.
GDP (bill $)	70	355	789	1'006	269
Population (mill)	70	93,3	32	201	48,6
Capital Stock	69	1605484	146870	4590716	1351866
Oil Revenue (bill $)	20	34,2	8,13	68,6	18,2
Int. Oil Price ($)	52	56	19	120	29,6

Source: Constructed by author, EIA (2021), EITI (2021) and PWT (2021a)

3.1.1 Critique

As is often the case with all economic data, the further back one goes the more unreliable it becomes. In many cases the national accounting for countries today are also of questionable quality, which should be kept in mind. Due to this, the data from as far back as 1950 will not weigh heavily in the estimates for the future potential growth performance of Nigeria. It is also important to remember that there always exists a certain level of problem with economic data, however the data used for this paper has been sourced from trusted resources and compared to ensure it is as good as possible.

The low number of variables for the oil revenue might cause problems when trying to forecast something based on this variable. This will be important to keep in mind for the analysis later in the paper. Also, worth noting is the employment numbers referenced earlier in this document (The World Bank, 2021f). They are from the World Bank, which can be seen as a reliable source, however the numbers are estimates modelled by the International Labour Organisation (ILO) and often there exists an informal sector as well as the formal one, which means that the amount of people working with agriculture might be larger than the recorded numbers presented. This variable is not used in any statistical model, however it is important to keep in mind when discussing the role of the most vulnerable.
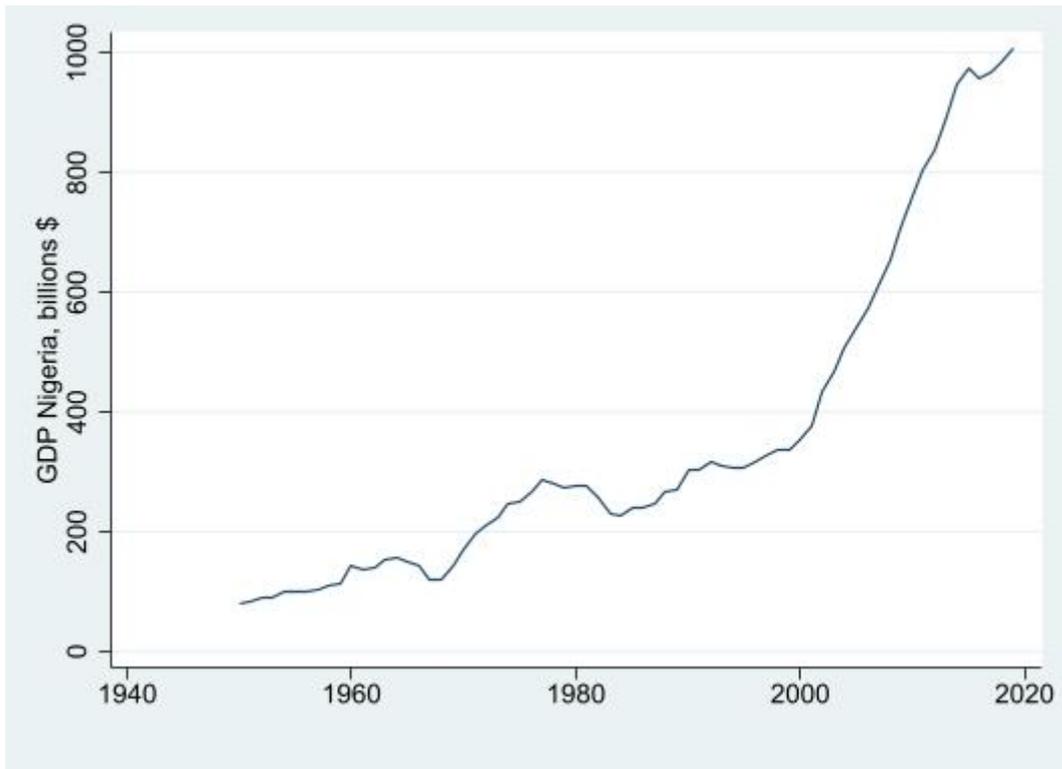
Figure 3.1 GDP of Nigeria

4 Methods

The methodology chosen for this research is in part based on basic growth accounting to illustrate the average growth of Nigeria over the years. The largest part of this research however hangs on the forecasting methodology, which will estimate how Nigeria's economic growth might develop in the future, based on how the GDP has changed over the years.

4.1 The Approach

The previous sections suggest that many different factors affect the economic growth in Nigeria. However, the scope of this research does not facilitate a more in depth look into how those factors might individually affect the future growth performance of Nigeria and instead the growth forecasting will be based on the previous growth performances of the country. All the factors will however be brought into the discussion again when the results of the models are further discussed. Two approaches will be tested, where one is based on just applying the average growth rate on GDP for each year, as well as a more dynamic approach of the time series data using both a univariate and multivariate approach to forecasting.

4.1.1 Growth Accounting

To calculate the historical growth of Nigeria, a standard approach of growth accounting is used. The growth of each year is easily calculated with a simple division equation and this data will be of use in the forecasting model.

$$Growth_1 = \left(\frac{X_1 - X_0}{X_0}\right) * 100 \qquad \text{[Eq. 1]}$$

The yearly growth is however not of much use or interest when looking for trends and looking at how the economy has developed over time. Therefore, we instead focus on the average growth of each decade through which we can analyse longer trends and effects visible in the country. These numbers are calculated with the following equation, most of which will be by decade but also an average of the last three decades will also be calculated with the same equation.

$$Average\ Yearly\ Growth_{t0-t1} = \left(\left(\frac{X_{t1}}{X_{t0}}\right)^{\left(\frac{1}{Year_{t1} - Year_{t0}}\right)} - 1\right) * 100 \quad \text{[Eq. 2]}$$

The growth accounting averages are presented in Table 4.1, something which would normally be presented in the next section of the paper. However, the results here are useful when motivating the choices made in the following forecasting models and therefore the results are included here. They are included and further analysed in section 5 of the paper.

Table 4.1 Average Growth Rates of Nigeria

	Average Growth Rates of Nigeria (%)							
Decades	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10	2010-19	*1990-2019*
GDP	6,0	1,9	5,0	0,8	1,6	7,9	3,1	*4,2*
Pop.	2,7	3,0	2,7	2,6	2,5	2,6	2,7	*2,6*
GDP/Pop	3,2	-1,0	2,2	-1,7	-0,9	5,2	0,9	*1,6*
Capital	-	8,5	11,7	-8,8	-1,4	19,2	-3,9	*4,4*

Calculations by author, Source: PWT (2021a)

4.1.2   Forecasting

This research is based on time series data and for that to be useable in a forecasting model the data there is a number of factors which needs to be fulfilled to be useful. Those three factors are (1) the data must lack seasonality, (2) the mean needs to be zero and (3) the standard deviation needs to be zero. The growth data of a country naturally increases over time and so the data must be investigated for this and should the conditions be violated, the model or the data must be adaptable or altered to be useful. As expected, it becomes obvious when graphing the GDP data that it is not stationary, though there is no seasonality, neither the mean nor standard deviation is constant, visible in Figure 4.1. Due to this the models must use some form of differential of the data, which will be tested when finding the appropriate version of the statistical models.

Autoregressive Integrated Moving Average (ARIMA)

Firstly, this research will focus solely on the historical development of the GDP of Nigeria through a univariate approach to forecasting. The non-stationarity already found in the data is further established through the Autocorrelation (AC) and Partial Autocorrelation (PAC) tests (available in Appendix B). For this reason, the ARIMA (*p; d; q*) model is chosen. The ARIMA model is made up of an Autoregressive (AR) part which is the regression of the variable of lagged previous values. The Moving Average (MA) part which is made up of the linear combination of the error terms of the repeated values and the Integration represents the level of differential made to ensure that the data becomes stationary. The (*p; d; q*) defines the parameters of autoregression, integration and moving average. Finding the model which matches the best with the past economic growth, will generate an equation for forecasting the potential future growth of Nigeria.

Most often GDP data can be made stationary through a first or second difference which is further confirmed through the statistical tests (Bowerman, O'Connell and Koehler, 2005). These tests are included in Appendix B and upon a graphical inspection of the first and second differences, there is not a lot of variance between the two. Due to this, models using both the *d* parameter of 1 and 2 will be tested. By investigating the AC and PAC it is possible to find a place to start estimating the *p* and *q* of the model as they indicate which lags might be statistically significant. The AC graphs for both levels of difference indicate that the MA estimate should be 1, giving us an ARIMA(*p, d*, 1) as a starting point. The PAC graphs, however, offer different potential starting points for the first and second differential models, which need to be tested to find the most appropriate one. The first difference PAC indicates an AR order of 1 or 7. For the second difference the PAC graph indicate an AR order of either 1, 2, 4 or 6. Through the Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) estimates as well as the Log-Likelihood (LL) in combination with the significance of the estimates, we find the best model. AIC and BIC number should be as low as possible, and the higher the LL the better as long as the estimates in the model make sense.

Table 4.2 ARIMA Models - Goodness of Fit Test

Model	Test for Goodness of Fit		
	AIC	BIC	Log-likelihood
ARIMA(1,1,1)	-193,1	-184,1	100,5
ARIMA(7,1,1)	-190,9	-168,5	105,4
ARIMA(1,2,1)	-185,9	-177,0	96,96
ARIMA(2,2,1)	-183,9	-172,8	96,96
ARIMA(4,2,1)	-182,5	-169,2	97,25
ARIMA(6,2,1)	-178,6	-160,8	97,29

Source: Constructed by author, EIA (2021) and PWT (2021a)

All though these tests indicate that the ARIMA(*6,2,1*) model is the best fit, the estimates generated by the model are not useable as they are not below 1 and none of them are significant. These problems remain for all the second difference models. Instead, the ARIMA(*7,1,1*) offers the best fit as a model for the forecast and will be used in estimating of the potential future GDP of Nigeria.

Vector Autoregressive (VAR) & Vector Error Correlation (VEC) Model

Moving forward from the univariate, this section goes into a multivariate approach to forecasting. Considering the role of oil in the Nigerian economic growth performance, indicated by the theory and previous research featured in earlier sections, this paper will focus on forecasting GDP based on that relationship. To investigate the relationship between two
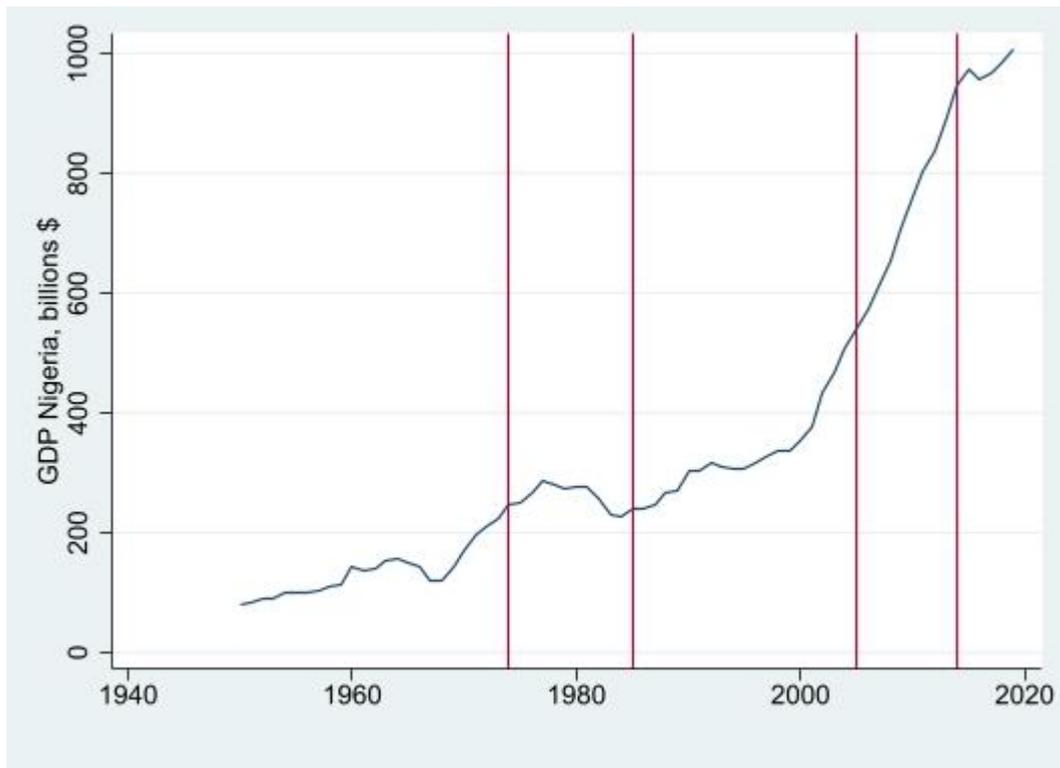
Figure 4.1 GDP of Nigeria w. Oil Price Indicators

variables and its impact on growth in the past and future, the Vector Autoregressive model (VAR) is chosen. The VAR model considers how the performance of two variables affect each other today and how their past performances effect each other today. This model does not require as much motivation for which variables are used as multivariable models do, rather a suspicion that the two variables impact each other in some way is enough. The suspected relationship between the two variables becomes evident when comparing the periods of strong economic growth performance in Nigeria and price booms in crude oil (EIA, 2021; Macrotrends, 2021b). This is illustrated in figure 4.1, where the periods of price booms are marked with red vertical lines. These prices booms are defined as the times the price surpassed the average price of the whole time period of available price data (1968 – 2019) which is 56 dollars. These spikes also match up with the peaks in the value of the extractive industries in Nigeria, where oil extraction is the largest section, but it includes gas and mining as well. The price booms and economic growth surges also coincide with the growth of the capital stock, and this relationship to the GDP will therefore be tested as well to add depth to the analysis.

VAR models are characterized by their order, which denotes how many lags of the variable is included in the model, e.g., a fourth order VAR includes four lags of the variable. The number of lags can be any number and gives us the equation of the VAR to the *p*-th order.

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_t \qquad \text{[Eq. 3]}$$

When setting up the model with two variables which interact with each other, lagged variables of the second variable is included in the model for the first variable, and equally so for the equation for the second variable. A first order VAR equation would be expressed like this when written in a matrix form:

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$$\begin{bmatrix} y_{1,t} \\ y_{2,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \beta_{1,1} & \beta_{1,2} \\ \beta_{2,1} & \beta_{2,2} \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \end{bmatrix} + \begin{vmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{vmatrix} \qquad \text{[Eq. 4]}$$

To find the right order of the VAR model, a number of steps are carried out similarly to the ARIMA model previously. Firstly, the correct number of lags must be identified, which will be followed by a stationarity check of the data. We already know that the GDP data is not stationary and can be made so by using the natural logarithm and a first difference, however the secondary variable will also need to be checked for stationarity. A test for co-integration of the variables will also be carried out to find if any non-stationary variables share an equilibrium state. Depending on the results, either a VAR model or a Vector Error Correlation (VEC) model is used to account for the co-integration. After finding the correct model, the forecasting and the control tests can be performed to check the validity of the results. To find the correct number of lags, Stata runs several tests with the two variables which generates several results. The best lag number is identified through finding the lag with the most significant estimates among the tests, going by the majority rule. These tests are presented in Appendix C and the appropriate lags are summarized in Table 4.3.

Table 4.3 Appropriate Lags for Variable Interactions

	Variables		No. of Lags
(1)	Nigerian GDP	International Oil Price	2
(2)	Nigerian GDP	Nigerian Oil Revenue	1
(3)	Nigerian GDP	Nigerian Capital Stock	2
(4)	International Oil Price	Nigerian Capital Stock	2
(5)	Nigerian Oil Revenue	Nigerian Capital Stock	4

Source: Constructed by author, EIA (2021) and PWT (2021a)

This paper focuses on the relationship between the GDP and other variables, however the interaction between the oil variables and the capital stock is tested to add depth to the analysis.

After finding these lags, tests for cointegration must be performed, as the data in its natural form is not stationary, at least in the case of the GDP. This is done through what is called the Johansen cointegration test. This test's null hypothesis assumes that there is no cointegration and the alternative hypothesis assumes that there is cointegration. This test offers us the *trace-* and *max values* which are tested against the *critical value*. Should the critical value be less than the test values then the null hypothesis can be rejected and cointegration exists, which will alter the model, or the data used.

Four out of the five models do not have a problem with co-integration and an unrestricted VAR model can therefore be applied with these variables. Moving forward these interactions are tested as VAR models to find which ones produce a significant model that can be used for forecasting the potential future GDP of Nigeria. When estimating a VAR model, it offers two

outcomes, one for each of the variables and the one of interest to the model is the one where GDP is the dependent variable. Out of the four VAR models, oil revenue is the only variable which has a significant effect on the GDP in Nigeria.

Table 4.4 Co-integration Test

Interacting Variables	Trend Values Max Values	Critical Values Critical Values	Co-integration
(1) Nigerian GDP Int. Oil Price	7,4258 | 1,4057 6,0201 | 1,4057	15,41 | 3,76 14,07 | 3,76	No
(2) Nigerian GDP Oil Revenue	17,4097 | 1,9173 15,4924 | 1,9173	15,41 | 3,76 14,07 | 3,76	No
(3) Nigerian GDP Capital Stock	20,3145 | 2,1884 18,1261 | 2,1884	15,41 | 3,76 14,07 | 3,76	No
(4) Int. Oil Prices Capital Stock	21,8093 | 7,1635 14,6459 | 7,1635	15,41 | 3,76 14,07 | 3,76	No
(5) Oil Revenue Capital Stock	31,7881 | 4,4755 27,3126 | 4,4755	15,41 | 3,76 14,07 | 3,76	Yes

Source: Constructed by author, EIA (2021) and PWT (2021a)

For the fifth model, some form of modification is needed since the data is non-stationary and this will be tested with a VEC model. The VEC model uses the first difference of the data to counteract the issues, similarly to the ARIMA model. The first difference is indicated with the D1 notation in the variables.

Table 4.5 VEC Model Estimation Long-Run Effect

Models	Coefficient	P-value	R-squared
D1 Oil Revenue	-	0,0084	0,7199
D1 Capital Stock	-	0,0000	0,9118
Variables			
D1 Oil Revenue			
Co-integrating Eq.	-1,730715	0,012	-
D1 Capital Stock			
Co-integrating Eq.	-0,0000315	0,001	-

Source: Constructed by author, EIA (2021), EITI (2021) and PWT (2021a)

With the VEC model it is possible to estimate the short- and long-term effect between the two variables in question and in which direction they affect each other. The *P-values* of the two models (0,0084 and 0,0000) are highly significant and the *R-square* numbers also indicate that

these models are significant and that these estimates affect each other. The coefficient of the cointegrating equation estimates need to be negative and have significant *P-values*, which they do, thus further indicating that there is a long-term causality between these variables. The estimates of the model indicate the short-term causality between the variables. The full VEC model estimate can be found in Appendix D, as the statistical output is very long. The results indicate that the Oil Revenues are only slightly affected in the short term by the capital stock at the first lag as only that individual estimate is significant. However, the capital stock in Nigeria is very much affected by the oil revenue in the short term, all the way to three lags. To further test the variables for autocorrelation a Lagrange test is performed, where the null hypotheses is that there is no autocorrelation at lag order *x*.

Table 4.6 Lagrange Test VEC Model

Lags	Chi2	Deg. Of Freedom	Prob > Chi2
1	4,5078	4	0,34162
2	1,2848	4	0,86395

Source: Constructed by author, EIA (2021) and PWT (2021a)

Since the *P-values* are not significant, the null hypotheses cannot be discarded which means that there is no problem with autocorrelation between the variables at any level of lag. Furthermore, these variables are also checked for their normality distribution through a Jarque-Bera test. This test has a null hypothesis that there is no problem with the normality distribution of the variables. With none of the probability values of the test being significant the null hypothesis cannot be rejected, which means that there is no problem with the normality distribution of the variables.

Table 4.7 Jarque-Bera Test VEC Model

Equation	Chi2	Deg. Of Freedom	Prob > Chi2
D1 Oil Revenue	0,060	2	0,97027
D1 Capital Stock	0,496	2	0,78027
ALL	0,557	4	0,96776

Source: Constructed by author, EIA (2021) and PWT (2021a)

These variables are not of interest to forecast in the upcoming section as they do not forecast the GDP of Nigeria. However, they are of interest to discuss in the analysis to further the possible futures for the Nigerian economy.

5   Empirical Analysis

This chapter contains the results of the basic growth accounting and the ARIMA and VAR models as well as the discussion and reflection on those results in relation to what is expected considering the previous research. The VEC model could not produce any forecasting, however the implications of the causality are included in the discussion. This section will also be the main basis for the following conclusion section.

5.1   Results

This section is made up of the empirical results from the models previously presented as well as some graphical representation of some of the forecasting. Their impact and meaning is shortly commented on in this section, however these thoughts are further elaborated upon in the second section of this chapter.

5.1.1   Growth Accounting

Following are the average growth rates of each decade since 1950 for Nigeria, based on the basic growth accounting equation, presented earlier (Eq. 2). Included in the last column is also the average annual growth rate based on the last three decades to offer a longer perspective.

Table 5.1 Average Growth Rates of Nigeria

	Average Growth Rates of Nigeria (%)							
Decades	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10	2010-19	*1990-2019*
GDP	6,0	1,9	5,0	**0,8**	1,6	**7,9**	3,1	*4,2*
Pop.	2,7	3,0	2,7	2,6	2,5	2,6	2,7	*2,6*
GDP/Pop	3,2	-1,0	2,2	-1,7	-0,9	5,2	0,9	*1,6*
Capital	-	8,5	11,7	**-8,8**	-1,4	**19,2**	-3,9	*4,4*

Calculations by author, Source: PWT (2021a)

The average growth rates which are presented over the decades makes the instability of the Nigerian growth evident, where the most successful decades have an average growth rate of almost eight percent whereas two decades earlier the economy barely grew at all with a growth

rate below one percent. The average population growth rate has been incredibly stable over the years, hovering between two and a half at a minimum and three percent at the most with the last three decades averaging out at just over two and a half percent. Making use of these simple measurements a simple forecast is made with the highest, lowest and last thirty years average economic growth rates to present a potential best- and worst-case scenario for Nigerian future growth. The potential outcomes vary drastically where the unrealistically high average growth rate of almost eight percent would lead to a tenfold increase of the GDP levels by 2050, which would be amazing though extremely unlikely. With the average population estimate by Gerland et al. (2014) Nigeria's population in 2050 will be around 400 million people and should the average growth rate of about four percent be sustained during that period, the GDP per capita would increase by about 80 percent, included in table 5.5. This increase would result in a substantial increase in life quality at least by monetary standards.
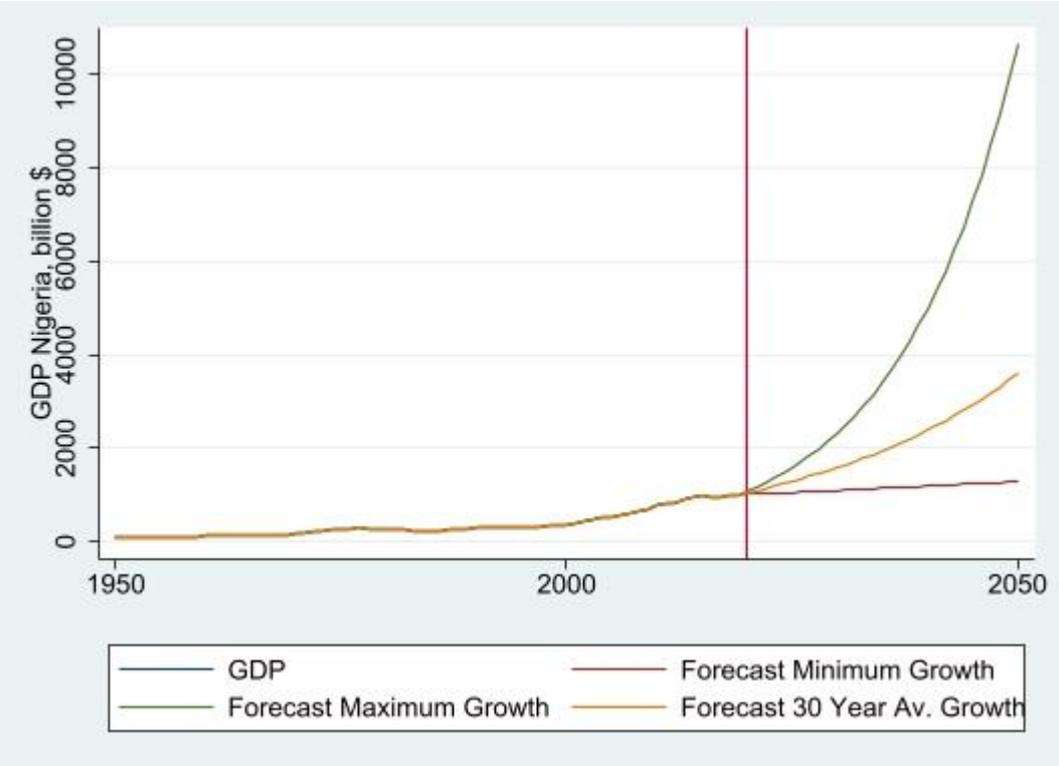

Figure 5.1 GDP Forecast with Growth Accounting

5.1.2 Forecasting

This section presents the results of the forecasting models presented in the methodology section of this paper.

Autoregressive Integrated Moving Average (ARIMA)

The model of ARIMA identified previously is presented beneath in Table 5.3, and is shortly commented on in this first section, though more thoroughly discussed in part 5.2.

Table 5.2 ARIMA(7,1,1) Model Estimates

Variable	Estimate	Standard Error	z-statistic	P-value
Constant	0,0372949	0,0098705	3,78	0,000
AR(1)	-0,0426053	0,3006331	-0,14	0,887
AR(2)	0,1796371	0,1158904	1,55	0,121
AR(3)	-0,054755	0,1350358	-0,41	0,685
AR(4)	-0,1014609	0,1590974	-0,64	0,524
AR(5)	-0,0496744	0,149347	-0,33	0,739
AR(6)	0,1202211	0,1289991	0,91	0,351
AR(7)	-0,2935576	0,1410462	-2,08	0,037
MA(1)	0,4933033	0,3004874	1,64	0,101

Source: Constructed by author, EIA (2021), EITI (2021) and PWT (2021a)

Using this model, the GDP values are estimated since the start of the dataset to evaluate the accuracy of it, but more importantly the GDP is predicted until the year 2050. The previous estimates are less accurate further back in time, though they are generally rather close to the true data and a certain error margin is to be expected in this sort of model, visible in Figure 5.2. At first glance, the estimates from the model mirror the outcome of the average growth rate outcome from the growth accounting rather well when looking at the graphical outcomes. However, there is a difference of 350 billion dollars between the two estimates, which translates to a noticeable difference in potential GDP per capita level, summarized in table 5.X.

The forecasted values from 2020 and onward function on a fixed effect, dynamic model which gives the curve a rather smooth appearance. Though it is not as smooth as when simply using the average growth rates from the earlier graph and there is a noticeable difference in the ultimate outcome of the GDP level.
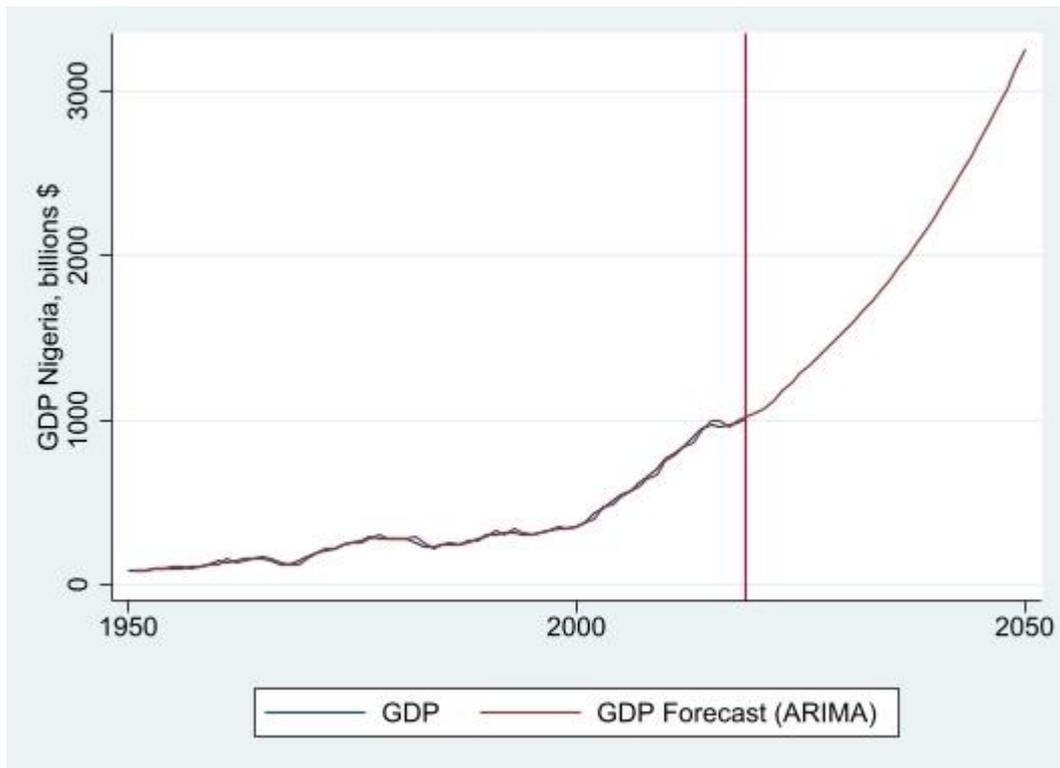
Figure 5.2 GDP Forecast with ARIMA(7,1,1)

Vector Autoregressive (VAR)

When evaluating the interaction between the variables in question in the methodology section it became obvious that the Nigerian GDP performance is affected by the oil revenue and that oil revenue and the capital stock affects each other. The VAR model and its estimates are expressed in table 5.3, which shows a high *R-squared* when GDP is the dependent variable, and a much less one for when the Oil Revenue is dependent (0,9956 and 0,4467). With the use of a Granger Causality test, it is also possible to check how these variables affect each other; does GDP and oil revenue effect each other similarly or is there only one which affects the other? The causality test, visible in table 5.4, shows that oil revenue does affect the GDP as the *P-values* are low. However, the GDP does not affect the oil revenue which is expected based on the VAR results and on common sense. Oil revenues depends much more on the prices set and the deals made by OPEC, of which Nigeria has been a member since the 70's (OPEC, 2021) rather than the economic performance of the country. Considering the effects found in the VEC model it is instead much more likely that the oil revenue is indirectly affected by the GDP through the changes in the capital stock. The VEC model is however not further addressed in this section as there are too few observations available between the two variables to perform a forecast.

Table 5.3 VAR(1) Model Estimates

Model	Coefficient	P-value	R-square
GDP		0,0000	0,9956
Oil Revenue		0,0005	0,4467
Dep. Variable			
Indep. Variables			
GDP			
GDP lag1	0,9523822	0,000	
Oil Rev lag1	6,82e-07	0,001	
Constant	42513,82	0,000	
Oil Revenue			
GDP lag1	64,12652	0,997	
Oil Revenue lag1	0,6291653	0,001	
Constant	1,40e+10	0,147	

Source: Constructed by author, EIA (2021), EITI (2021) and PWT (2021a)

Table 5.4 Granger Causality Test

Equation	Excluded	Prob > Chi2
GDP	Oil Revenue	0,001
	ALL	0,001
Oil Revenue	GDP	0,997
	ALL	0,997

Source: Constructed by author, EIA (2021), EITI (2021) and PWT (2021a)

Using the VAR model with a dynamic approach for forecasting the years from 2019, the GDP of Nigeria is forecast until the year 2050. The results using this model are much more modest than the expectations based on the ARIMA model or the one growth accounting estimates, visible in figure 5.3. These outcomes yield some potentially very problematic outcomes for the Nigerian population which will be addressed in the discussion.
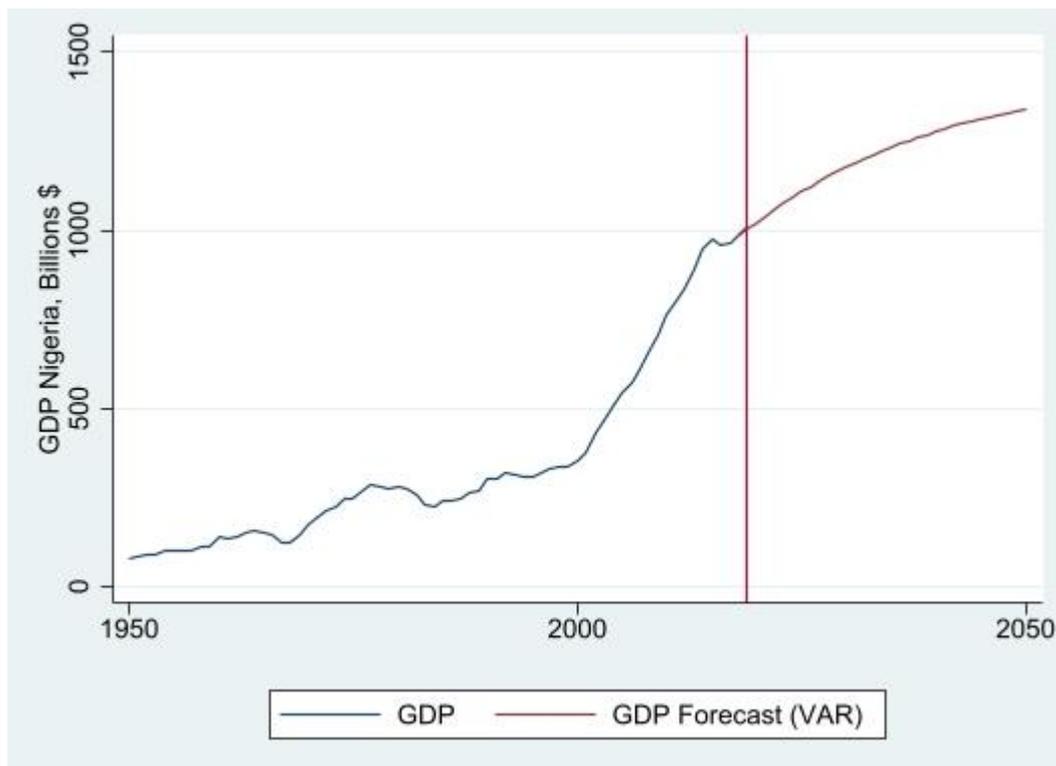
Figure 5.3 GDP Forecast with VAR(1)

The forecasted outcomes differ by quite a lot which would translate into quite different potential lifestyles for the Nigerian population in the future. These outcomes, summarized in table 5.5, are further analysed in the following section.

Table 5.5 Forecasting Summary Table

Variable	2050 Forecast	2050 GDP per Cap ($)	*Av. Growth Rate (%)*
GDP Min Growth	1'288'180'110'000	~ 3'220	*0,8*
GDP Max Growth	10'625'879'310'000	~ 26'500	*7,9*
GDP 30 Year Av. Growth	3'602'461'778'000	~ 9'000	*4,2*
ARIMA(7,1,1)	3'247'608'000'000	~ 8'100	*3,9*
VAR(1)	1'338'276'600'000	~ 3'350	*0,9*
2019 Values	1'006'236'600'00	~ 5'000	

Source: Constructed by author, EIA (2021), EITI (2021) and PWT (2021a)

5.2　Discussion

This section will analyse the empirical results based on the research question and thus the sub-questions posed in the introduction to the paper.

The Nigerian growth process has been a bit volatile over the years as is indicated by the average growth over the decades in table 5.1. Where the population growth has been extremely stable, the GDP growth has fluctuated between just over one percent average growth to just under eight percent. There are strong indicators pointing towards the GDP performance having a heavy reliance on the oil industry as two of their strongest decades of growth have coincided with the two identified spikes in global oil prices, as seen in figure 4.1. Especially the first decade of this millennia was successful for Nigeria, as it was for many other countries in Africa, sparking the research into the African growth miracle. This is also backed by the research into those who have previously looked at the case of Nigeria. Both in the direct way of oil resources generating revenue and in how it has affected other sectors of the economy to fall behind due to de-prioritization, thus leaving the economy in a more vulnerable position when the oil prices have not been able to generate enough to keep the economy stable. This idea finds support in the changes in the capital stock, visible in the growth accounting in table 5.1. The growth of the capital stock is impressive in the decades of oil price booms and often contracting during the decades when the oil prices are not beneficial. Considering how oil nations are generally lacking in control mechanisms to spread the wealth and investments these results are hardly surprising, and instead point toward the lack of quality governance in Nigeria. The spike in economic growth also seems to be rather out of the ordinary for Nigeria as the periods before have a more stable incline, compared to the results of the first decade of the 21st century. This indicates that perhaps this high level of growth is not a sustainable performance for Nigeria and considering how the now developed countries of the world have performed historically it does not seem likely that they should manage to continue this for several decades to come. The population on the other hand, has grown at an extremely steady rate since the 50's and is unlikely to slow down in a significant way for a number of decades. The combination of the volatile GDP growth and stable population increase has led to the GDP per capita levels increasing and contracting rather violently over the years, in time with the capital stock and oil price booming and shrinking.

The dependency on oil previously suspected is further confirmed through the statistical models generated. The VAR and VEC models can both be used to find causal relationships between GDP, capital stock and oil revenue. The VAR model, which is proven statistically sound, offers a Granger causality test which can indicate if the variables have a causal effect on each other. This test, viewed in table 5.4, shows that GDP is indeed affected by the oil revenues. This emphasises the importance of the oil in the forecasting models used. Oil revenues are however not affected by the GDP growth, which makes sense as they are much more dictated by the international price and the volumes sold, which are dictated by OPEC. The VEC model tests the interaction between the oil revenue and capital stock in Nigeria and can find whether or not they affect each other in the short- and/or long-run. The models estimated indicate that between these two variables there exists a long-term effect as well as a short-term effect. The oil revenues have a stronger short-term effect on the capital stock than the opposite, which is not surprising.

Considering the previously mentioned tendency of oil industries being prioritized in oil nations, increases in oil revenues would then affect the capital stock in favour of the extracting sector.

Out of the three different variable combinations which could represent the relationship between GDP and the impact of oil, only the relationship between GDP and the oil revenues provides a useful model for forecasting. The result of the forecasting stretches until 2050 and are quite negative. The forecast level of GDP is merely an increase of about 30 percent, which translates to an average growth rate of less than one percent and a GDP per capita of about 3300 dollars, which is less than half of todays value. Such a dramatic drop in the per capita GDP would be extremely troublesome for the population as it has already been stated that the governance and institutional quality in of questionable quality in Nigeria. They would be left with less money and less public amenities.

Considering that the world needs to move away from oil as a source for energy, the forecast in figure 5.3 might be an accurate representation of how the GDP might progress in the future. However, the oil revenue is also lacking in number of observations available, which might affect the outcome of the forecast. Considering the low average growth rate of the forecasted period, less than 0,9 percent, it seems unlikely that the growth would fall so low over the period as the average growth of the last 30 years has been over four percent. It is also unlikely that the world will become less dependent on oil at this speed, which would mean that the oil revenues would remain higher than this forecast indicates.

Based on the previous GDP growth, the outcomes of the ARIMA model does seem more likely to be close to the future GDP growth than the VAR model outcome. The ARIMA model manages to estimate the previous growth closely to the actual GDP values and the forecast values generate an average growth just shy of four percent which is a more likely average growth rate, even though that too is a rather high rate. Considering the papers which have previously used the ARIMA model to make forecasts seem to have been quite close to the actual outcomes, it seems plausible that this model offers the most likely GDP outcome, at least for a few coming years. This of course assumes no large external shocks, and it must be mentioned that the pandemic is not included in this data as the 2020 national accounts are not yet available. Such things can throw the forecast of course rather violently. Utilising the most extreme values of average growth rates, provides two extreme outcomes. A minimum growth would lead to a similar situation as the one forecast by the VAR model and the maximum growth would lead to a fortunate situation for the Nigerian population by 2050.

However, with these potential future GDP outcomes, the future population must also be addressed. The expected value of the Gerland et al. (2014) is around 400 million which is a 100 percent increase of the values today. Small differences in the choices for each person might however lead to large outcomes in population by 2050 which could result in a population of almost 600 million by that point instead. A population development of such calibre would result in a dramatic drop in the GDP per capita level.

The results of the ARIMA, VAR and VEC models combined indicate that oil revenues have a large role in the GDP composition in Nigeria and price booms are beneficial for the short-term economic gain. However, there exists a discrepancy between the incomes and the rest of the economy benefiting in the long-run, as the capital stock contracts after oil price booms and the

economy slows down. As indicated in the previous research, other areas of the economy are not benefiting at the same pace as the extraction capital stock, causing an unstable foundation for long-term economic growth. Depending on how Nigeria manages to handle their future oil revenues, they could possibly be heading towards a population moving further into poverty as the economy stalls and the population continues to grow. With a regime which focuses on maximizing the revenues of the extracting industries it is difficult to improve the situation for those who are not directly benefiting from these revenues. Considering the previous research, it would for example be of import to instead invest into the agricultural sector, since it is so important to a large share of the population, especially the poor.

To summarize, oil is found to have been an important part of the growth process in Nigeria and the is likely to continue to be so in the future. The forecasted GDP levels by 2050 vary greatly depending on the model and depending on the population growth the situation of Nigeria could become very dire by 2050. It seems likely that they need to diversify their economy as both these results and previous research points towards Nigeria suffering from the Dutch disease. To avoid rising numbers of people living in poverty, they need to instead invest into agriculture and other areas where the poor make their living.

6 Conclusion

To conclude this paper, the aim was to evaluate the historical economic growth of Nigeria with a focus on how oil affected their growth process and based on this forecast the potential future growth of GDP. This is to be analysed from the perspective that the world must find alternative energy sources to oil, thus decreasing the demand for it and with the potential future population in mind. Through growth accounting it becomes obvious that the Nigerian GDP growth has been volatile while the population growth has been incredibly stable, which has led to a shifting GDP per capita over the years. With the average growth accounting results as well as through the statistical ARIMA and VAR models, forecasts of GDP until 2050 were made. The results vary greatly, where the ARIMA model is judged to offer the most likely future outcome as the average growth rate there was just under four percent. Considering the stability of the population growth, this estimated growth would lead to a GDP per capita level about 60 percent higher than it is today. This would offer a noticeable increase in living standards. However, without a shift in governance this increase will likely not be spread evenly among the population, especially is oil is the economic driver.

Considering the relationships identified between GDP, oil revenue and capital stock it becomes evident that Nigeria needs to work to become less dependent on this resource to ensure a sustainable growth. Other sectors of the economy need to stabilize and generate growth despite the performance of the extractive industries. With the research into some other areas of the economy in mind, the quality and validity of the governance and institutions would need to change for this to manageable. The causality found between the oil revenues and capital stock, and the growth and contraction of the capital stock, indicate that Nigeria might be suffering from the Dutch disease, which has also been found in research. This is another problematic aspect that need to be counteracted to achieve a higher future growth. For a country to depend on a resource which must decrease in demand for the survival of the planet is not a sustainable plan.

6.1 Future Research

Continued research into the future growth of Nigeria is of importance. It is a country with a large population which is forecasted to continue to grow steadily. To be able to keep the number of people living in poverty low, and eventually reach zero, a sustainable growth will be of utmost importance. For example, it would be important to investigate how to ensure sustainable investments into the capital and how to benefit the poor in Nigeria.

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Appendix A

List of variables used and their sources:

Variable	Description	Source
GDP	International 2011 Dollars	PWT (2021a)
Population	Total Population	PWT (2021a)
Capital Stock	Value of total Capital Stock	PWT (2021a)
International Oil Price	Price per Barrel, Dollars ($), based on import prices for the US	EIA (2021)
Oil Revenue	Extractive industries	EITI (2021)

Appendix B

ARIMA Autocorrelations and Partial Autocorrelation, Table and Graphs

```
LAG    AC      PAC      Q      Prob>Q
--------------------------------------------------
1     0.9459   1.0360   65.359  0.0000
2     0.8891  -0.5860   123.94  0.0000
3     0.8299  -0.0281   175.76  0.0000
4     0.7675  -0.0137   220.74  0.0000
5     0.6987  -0.1539   258.59  0.0000
6     0.6290   0.0574   289.75  0.0000
7     0.5629   0.1035   315.1   0.0000
8     0.5013   0.2158   335.53  0.0000
9     0.4415  -0.0740   351.63  0.0000
10    0.3848   0.2457   364.07  0.0000
11    0.3345  -0.1374   373.63  0.0000
12    0.2882  -0.0945   380.84  0.0000
13    0.2453   0.1252   386.16  0.0000
14    0.2064   0.2403   390     0.0000
15    0.1705   0.0312   392.66  0.0000
16    0.1370   0.0613   394.41  0.0000
17    0.1069  -0.0932   395.5   0.0000
18    0.0781  -0.1495   396.09  0.0000
19    0.0558   0.4197   396.4   0.0000
20    0.0367   0.1836   396.54  0.0000
21    0.0210   0.1148   396.58  0.0000
22    0.0062   0.0584   396.59  0.0000
23   -0.0073   0.1894   396.59  0.0000
24   -0.0193   0.0872   396.63  0.0000
25   -0.0285   0.1844   396.72  0.0000
26   -0.0382  -0.0431   396.89  0.0000
27   -0.0480   0.2421   397.16  0.0000
28   -0.0580   0.4469   397.56  0.0000
29   -0.0673   0.2372   398.12  0.0000
30   -0.0774   0.5931   398.88  0.0000
31   -0.0837   0.2700   399.78  0.0000
32   -0.0899   1.1380   400.85  0.0000
33   -0.0958   0.6852   402.1   0.0000
```

Bartlett's formula for MA(q) 95% confidence bands

95% Confidence bands [se = 1/sqrt(n)]

42
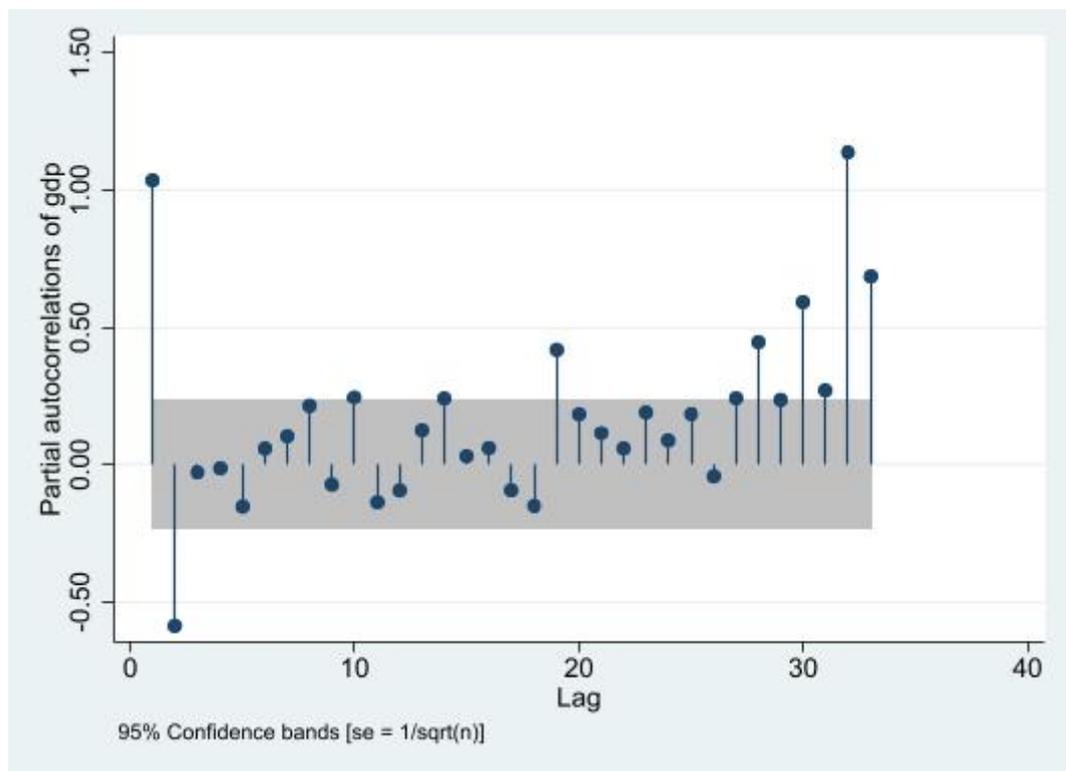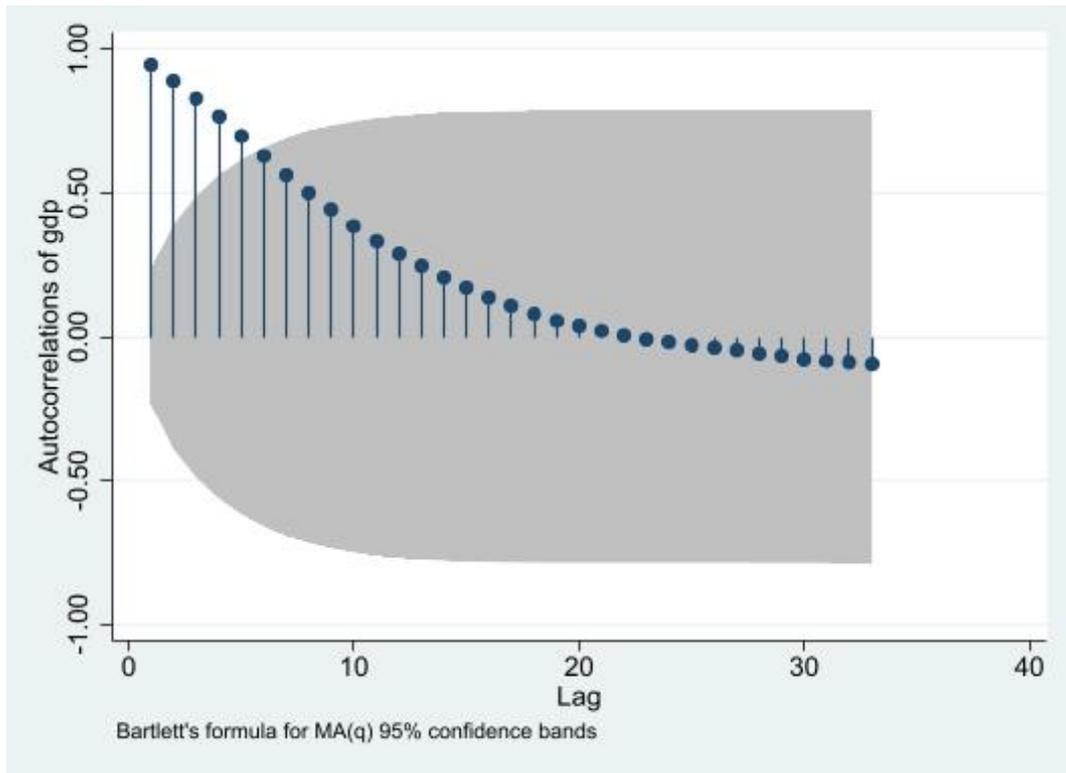
Appendix C

Tests for finding the appropriate number of lags for different variables.

Lag-test for GDP and Oil Prices

```
Selection-order criteria
Sample:  1972 - 2019                    Number of obs    =      48
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-891.704				5.1e+13	37.2377	37.2671	37.3156
1	-738.082	307.24	4	0.000	1.0e+11	31.0034	31.0918	31.2373
2	-726.327	23.509*	4	0.000	7.2e+10*	30.6803*	30.8276*	31.0701*
3	-725.181	2.2924	4	0.682	8.2e+10	30.7992	31.0055	31.345
4	-720.535	9.2931	4	0.054	8.0e+10	30.7723	31.0375	31.474

```
Endogenous:  gdp usoilp
 Exogenous:  _cons
```

Lag-test for GDP and Oil Revenue

```
Selection-order criteria
Sample:  2003 - 2018                    Number of obs    =      16
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-614.639				1.0e+31	77.0799	77.0849	77.1765
1	-568.09	93.1*	4	0.000	5.1e+28*	71.7612*	71.776*	72.0509*
2	-567.34	1.4999	4	0.827	7.9e+28	72.1674	72.1922	72.6503
3	-564.726	5.2267	4	0.265	1.0e+29	72.3408	72.3754	73.0168
4	-563.52	2.4131	4	0.660	1.7e+29	72.69	72.7345	73.5591

```
Endogenous:  gdp oilrev
 Exogenous:  _cons
```

Lag-test for GDP and Capital Stock

```
Selection-order criteria
Sample:  1954 - 2019                    Number of obs    =      66
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1913.93				5.6e+22	58.0585	58.0847	58.1248
1	-1650.28	527.29	4	0.000	2.2e+19	50.1904	50.2691	50.3895
2	-1592.64	115.3	4	0.000	4.2e+18*	48.5647*	48.6958*	48.8965*
3	-1591.1	3.0762	4	0.545	4.6e+18	48.6393	48.8229	49.1038
4	-1584.82	12.563*	4	0.014	4.3e+18	48.5702	48.8062	49.1674

```
Endogenous:  gdp capstock
 Exogenous:  _cons
```

Lag-test for Oil Prices and Capital Stock

```
Selection-order criteria
Sample:  1972 - 2019                    Number of obs      =        48

┌─────┬──────────────────────────────────────────────────────────────────────────┐
│ lag │    LL       LR      df    p      FPE       AIC       HQIC       SBIC       │
├─────┼──────────────────────────────────────────────────────────────────────────┤
│  0  │ -950.469                        5.9e+14   39.6862   39.7157    39.7642     │
│  1  │ -867.474   165.99   4  0.000    2.2e+13   36.3947   36.4831    36.6286     │
│  2  │ -835.639   63.67    4  0.000    6.9e+12*  35.235*   35.3823*   35.6248*    │
│  3  │ -833.164   4.9503   4  0.292    7.4e+12   35.2985   35.5047    35.8443     │
│  4  │ -827.922   10.484*  4  0.033    7.0e+12   35.2468   35.5119    35.9485     │
└─────┴──────────────────────────────────────────────────────────────────────────┘

Endogenous:  usoilp capstock
 Exogenous:  _cons
```

Lag-test for Oil Revenue and Capital Stock

```
Selection-order criteria
Sample:  2003 - 2018                    Number of obs      =        16

┌─────┬──────────────────────────────────────────────────────────────────────────┐
│ lag │    LL       LR      df    p      FPE       AIC       HQIC       SBIC       │
├─────┼──────────────────────────────────────────────────────────────────────────┤
│  0  │ -631.402                        8.3e+31   79.1752   79.1802    79.2718     │
│  1  │ -615.297   32.209   4  0.000    1.9e+31   77.6622   77.677     77.9519     │
│  2  │ -606.299   17.997   4  0.001    1.0e+31   77.0373   77.0621    77.5202     │
│  3  │ -605.243   2.1123   4  0.715    1.6e+31   77.4053   77.4399    78.0813     │
│  4  │ -591.928   26.63*   4  0.000    6.0e+30*  76.241*   76.2855*   77.1101*    │
└─────┴──────────────────────────────────────────────────────────────────────────┘

Endogenous:  oilrev capstock
 Exogenous:  _cons
```

Appendix D

Full VECM output

```
Vector error-correction model

Sample:  2003 - 2018                        Number of obs   =        16
                                            AIC             =  76.39568
Log likelihood = -594.1654                  HQIC            =  76.43771
Det(Sigma_ml)  =  6.17e+29                  SBIC            =  77.21655

Equation          Parms      RMSE     R-sq      chi2     P>chi2

D_oilrev              8     1.2e+10   0.7199   20.56146   0.0084
D_capstock            8      154890   0.9118   82.68914   0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
D_oilrev						
_ce1						
L1.	-1.730715	.6876224	-2.52	0.012	-3.07843	-.3830001
oilrev						
LD.	.7810292	.6538697	1.19	0.232	-.5005319	2.06259
L2D.	.6209443	.5512863	1.13	0.260	-.4595569	1.701446
L3D.	.4360715	.4010828	1.09	0.277	-.3500365	1.222179
capstock						
LD.	-6926.478	16295.35	-0.43	0.671	-38864.79	25011.83
L2D.	-22113.87	22136.23	-1.00	0.318	-65500.07	21272.34
L3D.	20164.25	20112.34	1.00	0.316	-19255.21	59583.71
_cons	-1.847317	4.03e+09	-0.00	1.000	-7.91e+09	7.91e+09
D_capstock						
_ce1						
L1.	-.0000315	9.09e-06	-3.46	0.001	-.0000493	-.0000137
oilrev						
LD.	.0000222	8.64e-06	2.57	0.010	5.29e-06	.0000392
L2D.	.0000228	7.29e-06	3.13	0.002	8.55e-06	.0000371
L3D.	.0000202	5.30e-06	3.80	0.000	9.77e-06	.0000306
capstock						
LD.	.7927861	.2153989	3.68	0.000	.3706121	1.21496
L2D.	-.5768503	.292606	-1.97	0.049	-1.150347	-.0033531
L3D.	-.3667328	.2658534	-1.38	0.168	-.8877959	.1543303
_cons	101572.8	53320.14	1.90	0.057	-2932.712	206078.4