THE LINKAGE BETWEEN ECONOMIC COMPLEXITY, GOVERNANCE AND ECONOMIC GROWTH FOR AFRICA’S TOP PERFORMING COUNTRIES: A PARDL APPROACH

by

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DECLARATION

I hereby declare that "THE LINKAGE BETWEEN ECONOMIC COMPLEXITY, GOVERNANCE AND ECONOMIC GROWTH FOR AFRICA'S TOP PERFORMING COUNTRIES: A PARDL APPROACH" is my work and that all the sources that I have used or quoted have been indicated and acknowledged by using complete references and that this work has not been submitted before for any other degree at any other institution.

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Date : 2022

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ABSTRACT

Several economists have identified economic complexity and governance to be significant engines for growth and development. Compared to governance, economic complexity is a relatively new concept that has gained attention from various authors and is considered to have a greater impact on economic growth, particularly in the African context. In the last decade, Sub-Saharan countries have experienced negative economic growth rates which have worsened in terms of good governance and economic complexity. Accordingly, the objective of this study is to analyse the linkage between economic complexity, governance, and economic growth for Africa's top-performing countries by using panel data from 2002-2017.The results of the unit root tests show that the variables are integrated of order(0) and order(1), or a combination of both, which justified the use of the PARDL approach. Panel cointegration methods were employed to analyse the short and long run relationships of the variables of interest. These tests found that there is a long run relationship between GDP and the explanatory variables with the short run results depicting an error correction term of -0.59. The results show that economic complexity, government effectiveness, regulatory quality and political stability have a positive impact on economic growth whilst the control of corruption and voice and accountability have a negative impact on growth. The study further employed the impulse response function and variance decomposition tests to assess how shocks to the economic variables reverberate through an economic system. Furthermore, economic tests such as the Engle-Granger causality test were conducted to establish the causal relationship between GDP and other explanatory variables. Economic complexity, government effectiveness, regulatory quality and political stability are seen to be great contributors to economic growth; hence, policies aimed at increasing these variables should be made the primary objectives of these African countries.

KEYWORDS: Economic Complexity, Governance, Economic Growth, PARDL

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ACRONYMS

AIC	:	Akaike Information Criterion
ADF	:	Augmented Dickey-Fuller
COC	:	Control of corruption
ECT	:	Error Correction term
ECI	:	Economic complexity index
FPE	:	Final prediction error
FDI	:	Foreign direct investment
GDP	:	Gross domestic product
HQ	:	Hannan – Quinn
IMF	:	International Monetary Fund
IPS	:	Im, Pesaran and Shin
IRF	:	Impulse response function
GE	:	Government effectiveness
LLC	:	Levin, Lin and Chin
OLS	:	Ordinary Least Squares
PARDL	:	Panel Auto Redistributive Lag
PS	:	Political stability
SC	:	Schwarz Criterion
VECM	:	Vector error correction model
VAR	:	Vector autoregressive

V and A : Voice and accountability

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 Introduction and Background

Even though there is ample evidence to support the notion that economic growth strongly affects the quality of life of the people, to date growth remains devilishly difficult to predict (Luciano, Andréa & Zaccaria, 2019). The determinants of income and growth differences amongst countries are controversial issues in the field of Economics. In recent years, many studies have been written to establish factors contributing to economic growth, or to answer questions as to why certain countries are rich and continue to be richer whilst others continue to be poorer (Armeanu, Vintila & Gherghina, 2018; Scott, 2017; Jesus, Utsav & Arnelyn, 2010; Smith, 1776).

To deal with issues around growth, Hausmann and Hildago (2009) introduced the concept of economic complexity, which they referred to as the engine for growth or the main driver of economic prosperity. They indicated that economic complexity is highly correlated to the income per capita of countries and highly predictive of their future growth rates. They suggested that the process of growth involves changing what and how you produce. Similarly, Gala, Rocha and Magacho (2018) state that the production of diverse and complex goods leads to high productivity levels, a rise in technological possibilities and increasing returns, which are all essential for growth stimulation. In the same vein, Gala et al. (2018) emphasises the need to produce more complex goods from the mining and manufacturing sector as these types of goods are key contributors to growth compared to those produced from simple sectors such as mining.

The major issue around economic complexity is the diversification of economic activities. According to Hvidt (2013), the famous English saying “putting all of one’s eggs in one basket” emphasises the importance of diversification. The saying suggests that it is important not to concentrate all resources and efforts in one area as one can lose everything. Analogous to economies, the saying implies that the diversification of output structures tends to reduce the possible risks faced by a nation. Consequently, relying on single or fewer products may harm a country in instances where unexpected shocks come to that or those product(s), thus diversification generates numerous income sources.

According to Mustafa et al. (2017), Asian advanced economies, which are commonly referred to as the ‘Asian Miracle’ countries, including Japan, South Korea, and Taiwan, were successful in promoting industrial diversification thus, achieving exceptional or high growth rates over 30-40 years. This was associated with rapid human developments, bringing them to almost the same level as those of advanced industrialised countries. On the other hand, the Middle East and North African (MENA) countries compared to these countries are characterised by structural issues such as low productivity levels, chronic unemployment, low non-oil sector exports and weak integration (Hamid & Abed, 2003). The authors thus recommend the use of economic complexity as a pivotal policy strategy to deal with these issues.

Even though the diversification of output structures tends to reduce the possible risks faced by a nation, all these can only be realised under a tolerable administration of justice. This notion was well captured by Smith (1755), who said: “Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism but peace, easy taxes, and a tolerable administration of justice: all the rest being brought about by the natural course of things”. Although this emphasised the importance of governance as a key factor in growth, it did not take centre stage in development studies until recently. In the same vein, I-Ming and Noha (2016) specify that over the years, a vast number of developing MENA countries have been characterised by disappointing and slow economic growth rates. According to the authors, the importance of institutions of governance as key drivers of economic growth only became apparent in the early 1980s after papers on growth and development were popularised.

Similarly, Scott (2017) refers to government institutions as the ‘’rules of the game’ that give incentives to people and businesses. To place further emphasis on the importance of institutions, the author refers to the early 1953s wherein North Korea was a dictatorial and communist nation where free and open markets, as well as the rule of law, were repressed. South Korea, on the other hand, consisted of institutions that provided incentives for productivity and innovations. As a result, the country ranks amongst the richest nations, whilst North Korea ranks amongst the poorest. This suggests that the provision of strong property rights, Rule of Law by the government and free markets play an integral role in enabling the market to thrive, thus stimulating economic growth. There is no magic formula that can be used by countries to become developed economies, and consequently, achieve increased growth rates. Kadhim (2013) thus recommends that to achieve increased growth rates, countries need to put in place institutional environments in which property rights can be established and contracts enforced.

The Neo-classical theory has always disregarded the effects of governance on economic growth. It is only in the 1980s through the emergence of the Endogenous Growth theory that public governance became a pivotal component of economic growth(Yilmaz, 2016). According to Bichaka (2010), Many Sub-Saharan countries have been bogged down by serious problems of corruption, political instability, government ineffectiveness, lack of rule of law and political instabilities which are all indicators of bad governance. On the same vein, Yalta (2021) is of the view that in a world that has become more globalised and complex, Middle East and North African countries still rank below other countries in terms of economic complexity.

In the recent years, South Africa, Nigeria, Morrocco, Algeria, Ethiopia, Ghana, and Egypt have shown tremendous improvements in terms of economic complexity and public governance which is why this study is envisaged to focus on these 7 African countries. According to the International Monetary Fund (2021), the above-mentioned countries are Africa's top performing countries in terms of GDP with Nigeria ranking as the largest performing country with a GDP of R480.482 billion, followed by South Africa with a GDP of R415.315 billion, followed by Algeria, Morocco, Kenya, Ethiopia, and Ghana respectfully. Consequently, this study seeks to establish whether governance and economic complexity are directly or indirectly linked or have contributed to the overall growth rates of these countries.

1.2 Statement of the Problem

There seems to be serious challenges around the issues of economic complexity, governance, and economic growth in Africa. The World Bank (2016) reported that South Asia and Sub-Saharan Africa consisted of GDP per capita, which was slightly 34 times lower than that of North America. This illustrates that there is a highly uneven global distribution of income. Accordingly, this study is aimed at establishing the link between economic complexity, governance, and economic growth for a selected group of African countries which are assumed to be the best performing countries in the continent in terms the value of their GDP in 2021. These countries are South Africa, Nigeria, Morocco, Algeria, Egypt, Ethiopia, and Ghana(IMF, 2021). Hausmann (2011) argue that income differences amongst countries are not caused by differences in factors of production or factor accumulation but are caused mainly by the "know-how or capabilities" required to produce non-ubiquitous, rare, and complex goods. According to the Atlas of Economic Complexity (2017), South Africa is the 64th most complex economy in the world; Egypt is reported as number 68; Algeria 108; Morocco 90 and Nigeria 130. Even though according to Trading Economics (2020) and Wasaka (2018), these are the top ten wealthiest countries in Africa according to GDP. However, in contrast to other world economies, these countries are ranked lower in terms of economic complexity, which is a key contributor to growth and development.

This challenge is echoed by Bichaka and Christian (2013), who argued that African countries have been unable to achieve higher economic growth rates due to a lack of good governance. They lament that these countries are characterised by high scores of political instabilities, corruption, lack of rule of law and government ineffectiveness. It is for these reasons that the improvement of good governance in Africa has been prioritised in the New Partnership for Africa's Development (NPAD). A similar case has been put forward by Hamid (2016), who indicates that the quality of governance for most MENA countries ranks below average. He pointed out that in 2014, 14 out of 24 MENA countries ranked below the 50th percentile, eight of them were ranked below the 25th percentile and 17 consisted of a negative governance score. Kagundu (2006), on the other hand, denotes that widespread social, political, and economic problems faced by developing countries such as terrorism, economic security and human security, are a result of public institutions that are led by authoritarian leaders. These weak institutions are therefore at risk of being apprehended by vested interests, which may potentially deter the success of reforms established to promote economic and political competition.

1.3 Research aims and objectives

1.3.1 Aim of the study

The study is aimed at examining the linkage between economic complexity, governance, and economic growth for Africa's top-performing countries for the period 2002-2017.

1.3.2 Objectives of the study

To achieve our main aim, the objectives of the study are as follows:

- To analyse the link between economic growth and governance.
- To examine the link between economic growth and economic complexity.

1.4 Research questions

The questions presented below were answered by this study.

- What is the link between economic growth and governance?
- What is the link between economic growth and economic complexity?

1.5 Significance of the study

A plethora of studies has been written focusing on the linkage between governance and economic growth as well as the linkage between economic complexity and economic growth separately. However, to the best knowledge of this the researcher, only two studies were undertaken by Hausman et al. (2011) and Haartman (2016), which focused on economic complexity, governance, and growth. Hence, to contribute to this research gap and to provide new knowledge, this study is envisaged to incorporate all these variables to do a similar analysis in the African context. Upon completion, it is believed that the study will shed more insight on the dynamics of economic complexity and governance as well as their impacts on the growth of Africa's top-performing countries.

1.6 Definition of concepts

The following concepts play a pivotal role in the conceptual framework and modelling of this study. Hence, it is appropriate to provide some context to their meaning.

- Economic complexity

According to Hausmann et al. (2011), economic complexity refers to a country's composition of productive output and conveys structures necessary to combine and hold the knowledge. The author assumes that there is a link between economic complexity and the multiplicity of useful knowledge as well as capabilities embedded in an economy to produce sophisticated and diverse products. In addition, economic complexity individually examines countries and provides them with different paths to achieve higher growth and development rates.

- Governance

Kaufmann, Kraay and Mastruzzi (2010) describe the term "governance" as heterogeneous, multi-dimensional, complex, and broad. The authors define governance as a set of institutions and traditions used to practise the power of authority. The term consists of six dimensions or indicators, namely, rule of law, control of corruption, political stability, voice and accountability, violence or terrorism, regulatory quality, and government effectiveness. This study will only focus on four indicators that are defined below.

- Control of corruption

The control of corruption indicator conveys existing perceptions concerning public power being used to fulfil private interests (Kaufmann et al., 2010). The indicator makes use of activities, including irregular payments, anti-corruption activities transparency and accountability in the government sector to provide a measure for the conduct of public officials and politicians concerning corruption. According to the World Bank Group (2016), irregular payments by public agents and officials may take place through imports and exports, public utilities, tax collections and judicial decisions.

- Government effectiveness

According to Noh and I-Ming (2016), the government effectiveness indicator conveys how independent civil services are from pressures in the public sector. The indicator also measures the effectiveness of public policy formulation as well as services in the public sector.

- Regulatory Quality

Noha and I-Ming (2016) define regulatory quality as a governance indicator that measures the extent to which the government can promote private sector improvement and provide sound policies and regulations.

- Political stability

This is one of the governance indicators that provides a measurement of how likely the government can be destabilised by violent or unconstitutional acts of terrorism. In other words, it measures how likely the current authority can be overthrown (Noha & Ming, 2016).

- Voice and accountability

According to Noha and I-Ming (2016), voice and accountability is a governance indicator which is used to measure the extent to which citizens of a given country can take part in choosing their government and have freedom of expression, freedom of press and freedom of association. This indicator also provides a measurement of how accountable the government is.

- Economic Growth

Wells (2014) defines economic growth as a rise in the aggregate goods and services produced by an economy in a specific period and within its borders. In the same vein, Mohr and Fourie (2008) view economic growth as the total value of all final goods and services produced within the boundaries of a country for a given period and is calculated as a % increase in the real gross domestic product (GDP).

1.7 Ethical consideration

This study used secondary data that does not involve any human or animal interaction but shall, however, observe all the necessary guidelines of the ethical conversation as outlined in the University of Limpopo’s postgraduate manual. The study is my work and shall not consist of any intentional plagiarism. All sources that have been used or quoted in the study shall be indicated and duly acknowledged through complete references.

1.8 **Structure of the dissertation**

This dissertation is divided into numerous chapters that are named below:

Chapter 1: This chapter provides a detailed orientation of the study. The former includes the introduction and background of the study, the problem statement, definition of concepts, research aim, research objective, research questions, significance of the study and ethical considerations.

Chapter 2: This chapter outlines the overview of the trends in economic complexity, governance, and economic growth for Africa's top-performing countries from the period 2002-2017.

Chapter 3: This chapter provides the theoretical and empirical literature of the study. The former includes the Solow Neoclassical growth theory, the Endogenous growth theory and the New growth theory. In addition, the empirical literature focuses on providing evidence and findings of relevant previous studies which have employed variables like those of this study.

Chapter 4: This chapter consists of the methodology employed by the study. It includes numerous econometric techniques that will be used to test the significance of the model of the study.

Chapter 5: The chapter provides a detailed presentation and interpretation of all the findings of tests that have been carried out in the study.

Chapter 6: This is the last chapter of the study, which entails the summary, limitations as well as recommendations for further studies. In addition, the chapter outlines the limitations of the study.

The introduction and background, statement of the problem, research objectives and model significance of the study were outlined in this chapter. Detailed definitions of numerous concepts associated with the study were provided to outline distinctive viewpoints on the subject matter of the study. In addition, the structure of the study and ethical considerations were included in this chapter. The following chapter consists of numerous trends of economic complexity, governance, and economic growth for Africa's top-performing countries.

CHAPTER 2

OVERVIEW OF AFRICA'S TOP-PERFORMING COUNTRIES

2.1 Introduction

This chapter provides an analysis of the various trends of the variables employed in the model. The variables include governance indicators, namely, control of corruption, government effectiveness, regulatory quality, political stability as well as the voice and accountability of the people. Also included in the variables are the economic complexity index and economic growth, which are proxied by GDP per capita. The analysis covers trends of these variables for the entire period of the study.

2.1.1 Economic complexity

The economic complexity index for Africa's country group for the years 2002 and 2017 is illustrated in Table 2.1.

Table 2.1 African countries with the highest ECI rankings

2017				2002			
Country	Economic complexity index	ECI Rank in Africa	ECI Ranking in the world	Country	Economic Complexity Index	ECI Rank in Africa	ECI rank In the world
Tunisia	0.331	*1	46	Eswatini	0.4242	1	40
South Africa	-0.0339	2	61	South Africa	0.2966	2	47
Eswatini	-0.0558	3	63	Tunisia	0.0529	3	57
Egypt	-0.0677	4	65	Namibia	-0.1381	4	73
Mauritius	-0.2307	5	70	Egypt	-0.381	5	78
Botswana	-0.3837	6	79	Mauritius	-0.3886	6	79
Mali	-0.4478	7	86	Kenya	-0.599	7	90
Namibia	-0.4931	8	88	Liberia	-0.6801	8	94
Kenya	-0.5443	9	89	Morocco	-0.6974	9	95
Morocco	-0.5766	10	90	Libya	-0.6991	10	96

Uganda	-0.607	11	93	Mali	-0.7611	11	99
Liberia	-0.6915	12	95	Côte d'Ivoire	-0.8042	12	104
Ethiopia	-0.8482	13	100	Zambia	-0.8375	13	105
Algeria	-0.8612	14	102	Algeria	-0.9264	14	110
Ghana	-0.916	15	104	Madagascar	-1.1117	15	115

Source: The atlas of economic complexity, https://atlas.cid.harvard.edu/rankings

It can be deduced from Table 2.1 that economic complexity is relatively higher in South Africa, Tunisia, Eswatini and Egypt, which suggests that these countries had a more diversified product space during the period of the investigation. According to Yalta and Yalta (2021), Egypt ranked 61 and Tunisia 44th in the 2015 global ECI rankings, which suggests that they performed relatively well on the global stage compared to other countries in the MENA region. On the contrary, when compared to the rest of the world, these countries still lag far behind concerning ECI rankings. For instance, in 2002 South Africa, Tunisia, Eswatini and Egypt had ECI rankings of 47th, 57th, 40th and 78th, respectively out of 134 countries in the world that were evaluated. It is also evident that out of the 15 top highly ranked African countries in 2017, Algeria and Ghana ranked the lowest compared to the rest of the world with rankings of 14th and 15th, respectively. In their recent study, Yalta, and Yalta (2021) found that in 2015, Algeria ranked the lowest out of 108 countries with a 105th ECI ranking.

It is important to take into consideration that the sombre picture depicted in Table 2.1 has already attracted the attention of numerous policymakers in the African continent. Furthermore, countries like South Africa, Tunisia and Egypt are seen to have made improvements in their economic complexity ratings on the world stage from the period 2002-2017.

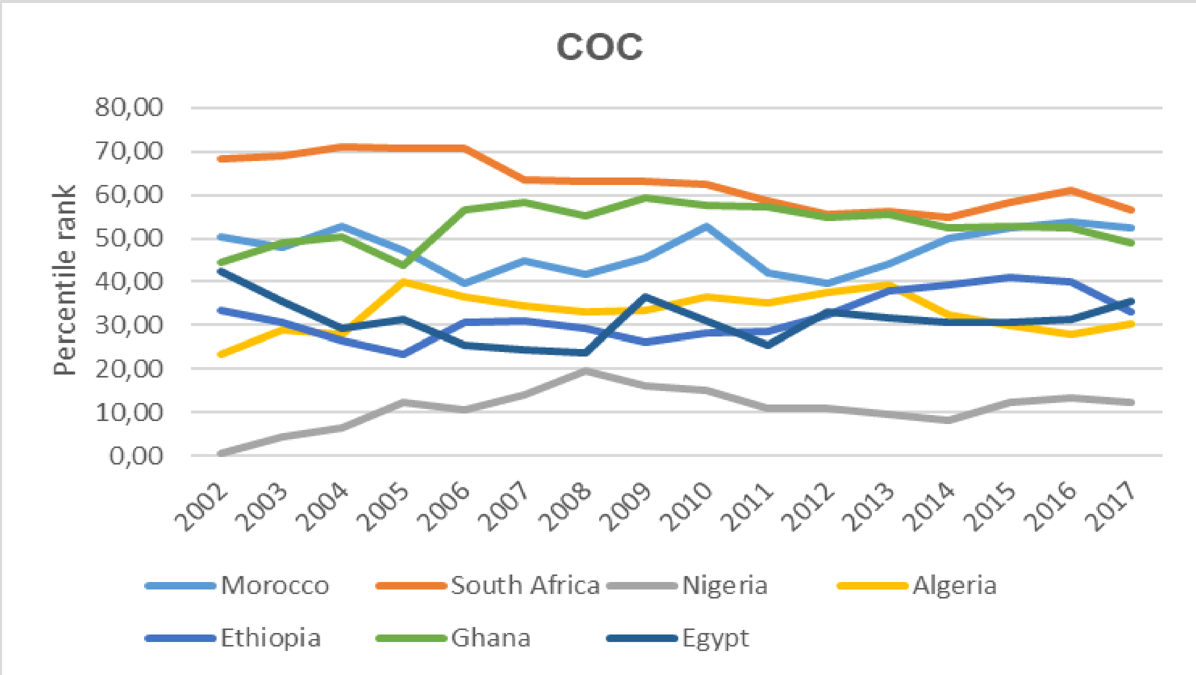
2.1.2 Trends in governance indicators

As indicated in section 1.6, governance is proxied by several indicators whose trend analyses are presented as follows:

2.1.2.1 Control of corruption

Figure 2.1 shows the control of corruption indicator. In 2002, the ranks of countries varied from 0 for Nigeria to 70 for South Africa.

Figure 2.1 Control of corruption



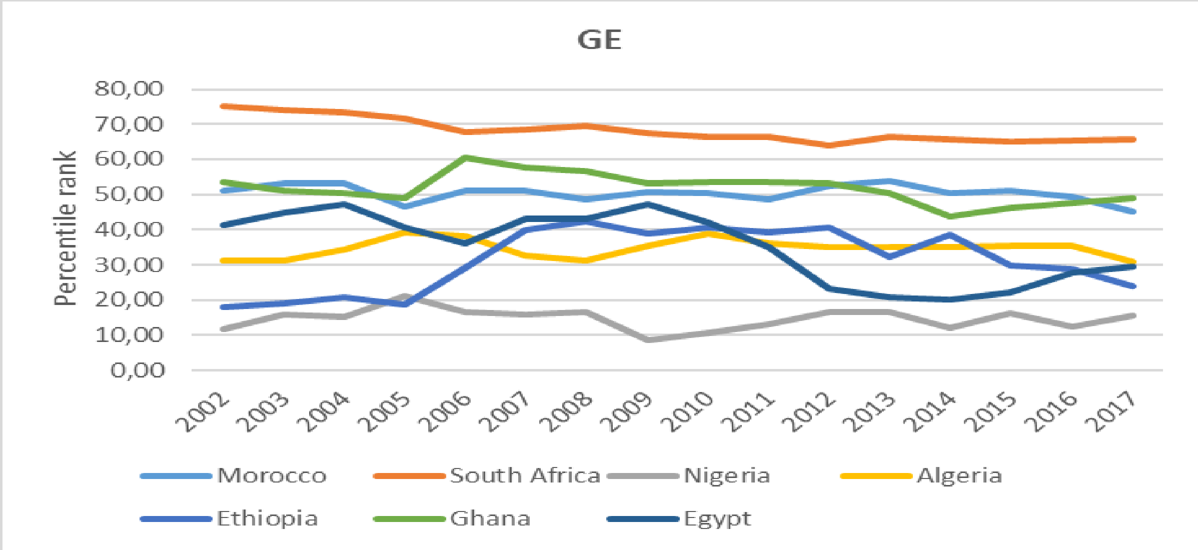
Source: Author's compilation with data from www.govindicators.org

The the illustrations in Figure 2.1 indicates that general and significant characteristic is that except for South Africa, Ghana, and Morocco, all the other countries ranked lower. The figure indicates that South Africa had a positive rank in 2002 but experienced some concurrent drops in subsequent years. Other countries such as Algeria, Ethiopia, Egypt, and Nigeria indicate fluctuation throughout the investigation. However, compared to the rest of the world, their ranking is below par because they have never managed to achieve a rating of more than 50%.

2.1.2.2 Government effectiveness

This indicator is intending to measure the effectiveness of public policy formulation as well as services in the public sector of the countries under investigation and the trends of these countries are presented in Figure 2.2 as follows,

Figure 2.2 Government Effectiveness



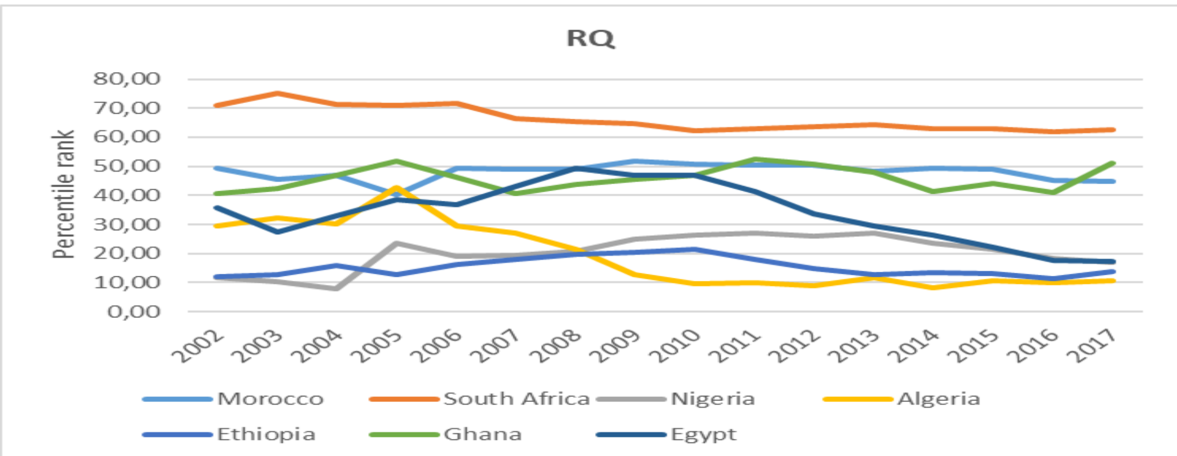
Source: Author's compilation with data from www.govindicators.org

The observation made from the trends in Figure 2.2 is that government effectiveness is trending patterns are similar to that of the control of corruption indicator. Except for Ghana, Morocco and South Africa, Ethiopia, Algeria, Egypt and Nigeria are ranked below the 50th percentile.

2.1.2.3 Regulatory quality

The regulatory quality is a governance indicator that is intended to quantify the scope to which the government can promote private sector improvement and provide sound policies and regulations.

Figure 2.3 Regulatory Quality



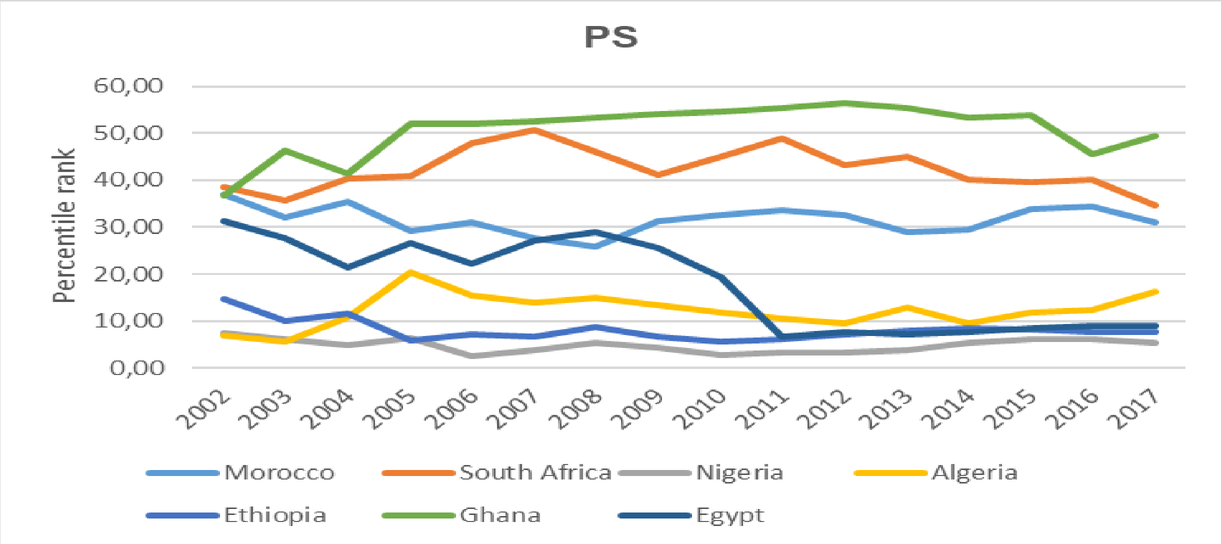
Source: Author's compilation with data from www.govindicators.org

As shown in Figure 2.3, slight improvements are seen for almost all the countries, most especially from 2003-2006. Although South Africa is seen to be performing better than the other countries with this indicator, the country experienced a continuous decline from 2002-2017 but managed to remain above the 50th percentile rank.

2.1.2.4 Political stability

This indicator is measuring of how likely the government can be destabilised by violent or unconstitutional acts of terrorism. As determined by Cervantes and Villaseñor (2015) countries with higher development levels tend to be more stable. Therefore, Figure 2.4 presents trends of political s tability and the absence of violence.

Figure 2.4 Political stability and absence of violence



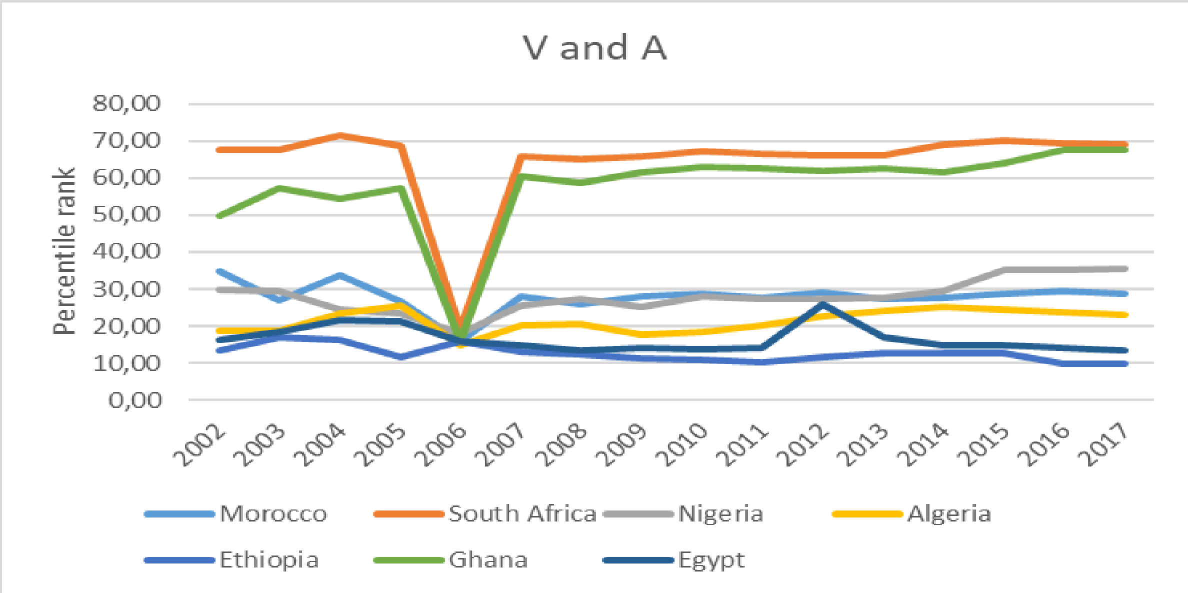
Source: Author's compilation with data from www.govindicators.org

The graphical illustration indicates that this indicator is one of the most poorly ranked indicators for Africa's top-performing countries. Except for Ghana, the countries are all ranked below the 50th percentile rank out of 230 counties, which were ranked from 2002-2017. Regardless of the improvements observed from 2004-2005, these countries continued to experience a decline in their ranking until 2017.

2.1.2.5 Voice and Accountability

This indicator is incorporated in the study to establish how accountable the governments are and how does that influence the economic performance growth for Africa's top performing countries.

Figure 2.5 Voice and accountability



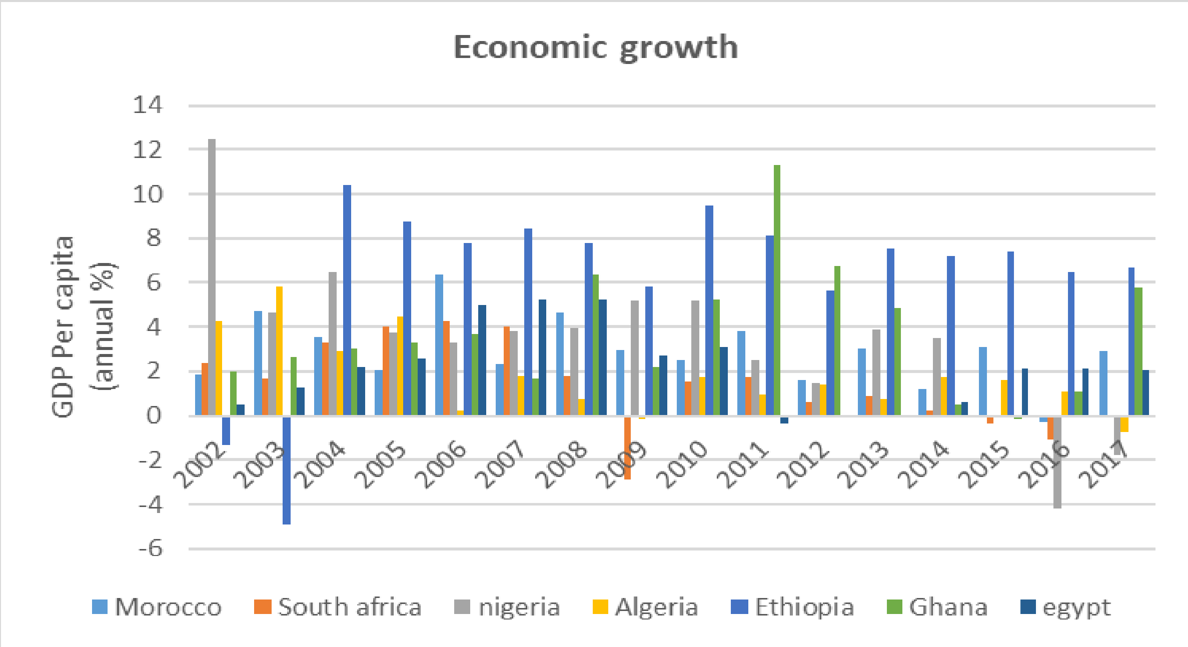
Source: Author's compilation with data from www.govindicators.org

As depicted in Figure 2.5, the voice and accountability indicator convey that for the period 2002-2006, Ghana and South Africa managed to rank above 50%. However, in 2006 the countries' percentile ranks declined tremendously to 20%. After 2006, an improvement was seen in these two countries as they managed to rank above 50%. On the other hand, Morocco, Nigeria, Algeria, Egypt, and Ethiopia were shown not to rank well with this indicator, and from 2002-2017, all these countries did not manage to rank above 50% out of 230 countries that were evaluated.

2.1.3 Trends in economic growth

Analogous to the rest of the world, the GDP growth rates of African countries decreased tremendously between 2007 and 2009 due to the global financial crises. However, compared to the other African countries, as illustrated in Figure 2.6, Ethiopia, Nigeria, Egypt, and Ghana have shown some resilience during this crisis. It is assumed that this resilience is partly due to improvements in institutional quality and governance in these countries.

Figure 2.6 Economic growth for Africa's top-performing countries



Source: Authors compilation with data from http://data.worldbank.org

Figure 2.6 provides an analysis of the growth of GDP per capita for Africa's top-performing countries for the period 2002-2017. As depicted in the graph, these countries managed to achieve satisfactory growth rates during the period of study. However, between 2002 and 2003, Egypt experienced negative growth ratings and improvements from 2004-2017. Similarly, South Africa had negative growth rates in 2009, 2015 and 2016 as well as Nigeria in 2016.

2.2 Chapter overview

This chapter provided an overview of trends in economic growth, economic complexity index, government effectiveness, control of corruption, regulatory quality, political stability as well as voice and accountability variables of Africa's top-performing countries selected for this study. From the trends, it was established that South Africa and Egypt have managed to achieve substantial ECI rankings compared to their African counterparts with South Africa ranking 2nd in 2002 and 2017, and Egypt ranking 4th in 2002 and 5th in 2017 for African countries rankings. The analysis of the governance indicators showed that South Africa, Ghana, and Morocco were positively ranked with more than 50% percentile ranking for the period 2002-2017, whilst Egypt, Nigeria, Ethiopia, and Algeria were negatively ranked below 50%. However, concerning political stability, the trends showed that only Ghana was ranked above the 50% percentile point from 2002-2017 while other countries continued to experience poor ratings for this period.

Regarding economic growth, the trend patterns show that all the countries performed substantially well for the period 2002-2017 except for South Africa. The analysis showed that South Africa experienced a downfall in its growth rates for the period 2009-2016. This is assumed to have been associated with the world's financial crisis of 2008.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

This chapter covers the theoretical and empirical background related to the linkage between economic complexity, governance, and economic growth for Africa's top-performing countries. The chapter starts with the theoretical literature, which highlights numerous theories on the effect of economic complexity and governance on economic growth. The second section of the chapter covers the empirical literature, which outlines evidence of findings derived from the empirical literature and ends with a summary of the chapter.

3.2 Theoretical Framework

This study assumes that the linkage between economic complexity, governance and economic growth is underpinned by several theories such as the Solow growth model, new growth theory and the endogenous growth model.

3.2.1 The Solow neoclassical growth model

The Solow (1956) neoclassical growth model is a model that falls within the neoclassical framework. The model illustrates the importance of three main factors of output growth. These factors include an increase in capital through investment and savings, an increase in the quality and quantity of labour through education and population as well as improvements in technology. According to the model, the accumulation of stock is likely to be affected by investments through savings, depreciation, and labour. This suggests that a rise in savings is likely to cause a higher rise in the level of investment capital, resulting in a further rise in the quantity of output. According to Solow (1956), economic growth in the short run is caused by a shift towards a new steady state formed by a change in the rate of depreciation, labour forces of growth as well as capital investments. In the long run, the Solow growth model illustrates that economic growth can be achieved through technological progress.

According to Romer (2001), the Solow growth model suggests that a rise in labour productivity can be interpreted as analogous to the technological improvements in the model. This is because the model does not provide any specifications concerning technological improvements. Moreover, the author states that these improvements can result in an increase in economic growth through capital accumulation. According to Romer (2001), improvements in quality instructions provide a conducive environment for investors. In terms of this view, physical and human capital developments such as abilities, knowledge, and skills, are acquired through a learning process, resulting in an increase in investment levels and output per worker. Besides, a rise in physical capital investments increases capital per worker, leading to a further increase in economic growth through capital accumulation (Romer, 2001). Furthermore, Romer (2001) states that improved institutions and governance policies foster the effective distribution of a country's resources used for production and investment means, resulting in increased economic growth rates.

3.2.2 New Growth Theory

Romer (1986) established the New Growth model to analyse economic growth. This sparked a wave of interest in growth amongst numerous economists. The new growth theory is defined by Romer (1986) as a theory that includes two significant viewpoints. The first viewpoint is that technological progress is assumed to be determined by activities in an economy rather than non-market forces. This implies that technology is internalised into a model of how markets operate and is assumed to be caused by factors outside a given economy. As a result, the New Growth theory is often referred to as the ''endogenous growth theory''.

The second viewpoint of the New Growth theory suggests that technology and knowledge are attributed to increasing returns, which are the main drivers of economic growth. Many neoclassical economists such as Solow (1956) have developed exogenous growth models and failed to explain factors that enhance improvements in technology over a given period. In other words, these exogenous growth models assumed that improvements in technology simply occurred by chance. The New growth theory challenges the exogeneity of technological progress by outlining that technological progress in each economy is caused by international openness, profit-seeking research (ideas) as well as human capital formation.

According to the new growth theory, knowledge is a significant contributor to economic growth (Romer, 2001; Mankiw & Ball, 2011). This implies that boundless growth can be achieved by an increase in new knowledge than capital or labour. In addition, Romer (2001) is of the view that following the New Growth theory results in property rights, which form part of favourable institutions, which enhance investments in research and development, resulting in increased economic growth rates.

3.2.3 Endogenous Growth theory

According to Romer (1986) and Lucas (1988), the Endogenous Growth theory contrasts the Neoclassical exogenous economic theory by arguing that a spur in growth rates requires investments in innovation, knowledge as well as human capital. The theory follows that a skilled labour force and efficient technology play an integral role in enhancing productivity. In addition, Meng and Ye (2009) contend that the Endogenous Growth theory emphasises on the spill-over effects of a knowledge-based economy along with positive externalities that may increase economic development.

3.2.4 Relationship between governance and economic growth

Over the past years, there has been significant discussions on whether governance can influence economic growth. This date back to the work of (Yilmaz, 2016) who conveyed that public governance is an important determinant of sustained economic growth. A plethora of studies have employed different forms of indicators as proxy variables for governance. This study follows the work of Kaufman and Kray (2010) who developed six governance indicators by aggregating data from numerous sources. These data sources include surveys from individuals and firms, non-government organisations, and commercial risk rating agencies. For the purposes of this study, only 5 of these indicators were used as proxies for governance, namely, governance effectiveness, control of corruption, political stability, voice and accountability and regulatory quality. The percentile rank of these governance indicators ranging from 0 (lowest) to 100 (highest) was used.

3.3 Empirical literature

This section is aimed at discussing and providing an overview of empirical literature surrounding the impact of economic complexity and governance on economic growth.

3.3.1 Economic complexity and growth

According to Barbaros (2019), economic systems have become rapidly complex. There are bottlenecks concerning modelling or measuring this level of “complexity”. According to the author, economic complexity requires a combination of sophistication and diversity. However, measuring the level of sophistication of exports is very difficult. Hidalgo and Hausmann (2007) and Lall, Weiss and Zhang (2006) are among a plethora of authors who came up with indexes to try and measure the level of sophistication in exports. Both authors made use of the levels of income by countries, which resulted in their papers being biased. In a quest to correct this bias, Hausmann et al. (2011) formulated a much stronger approach for measuring the level of sophistication in exports by illustrating that the production of sophisticated goods requires a combination of many capabilities, which most countries do not have, thus are unable to produce them. This suggests that these products are less ubiquitous.

Economic complexity is relatively new. Therefore, only a few papers have empirically analysed its impact on growth. Hausman and Hildago (2009) are the first authors who introduced the concept of economic complexity in their paper aimed at determining the building blocks of economic complexity. The authors interpreted trade data as a bipartite network that links countries to the number of goods and services they export. The results of their paper show that the economic complexity index (ECI) is highly correlated to the income per capita of countries. Deviations from this relationship predict their future growth. The authors illustrate that countries have a catch-up effect on the level of income resulting from the complexity of their productive structures. In addition, the authors find it very significant for development efforts to focus on the generation of conditions that can enable the emergence of complexity as this is essential in generating sustained prosperity and economic growth.

A study to establish the link between economic complexity and economic performance between groups of countries was undertaken by Barbaros (2019) for the period between 1981 and 2015. The author made use of the ECI which was developed by Hidalgo and Hausmann (2009). In addition, the author also made use of a panel vector autoregressive model to analyse the relationship between economic complexity and output volatility. The estimation results of this study show that economic complexity is a pivotal driver of economic growth and subsequently affects its speed of convergence positively. It is therefore of paramount importance for countries to come up with policies that prioritise the improvement of their economic complexity indexes as they contribute greatly to their economic performances and help to stabilise their economies.

Abdon and Felipe (2011) made use of a product space to examine the economic development of Sub-Saharan African countries and argue that most Sub-Saharan African countries consist of a product space with parts that are poorly connected and less sophisticated. Moreover, the study reveals that these countries have insufficient capabilities to shift them to the production of more sophisticated goods. It is therefore of paramount importance for these countries to encourage policies aimed at attaining incentives for investments necessary to produce sophisticated and complex goods as this is very essential for growth. Similarly, Ferrarini and Scaramozzino (2013) used density variables to determine the effects of economic complexity on growth. They conclude that on average, countries consisting of denser occupation spaces tend to enjoy relatively faster growths for the period 1990-2009.

Yasemin (2011) undertook a study on the determinants of economic complexity for the MENA region, mainly emphasising the role of the composition of human capital. As proposed by Arellano and Bover (1995), the author employed the GMM approach based on annual data for 12 MENA countries from the period 1970-2015. The results of the study showed that there is a positive relationship between human capital and economic growth. Hausmann et al. (2014) embarked on a study to analyse Uganda's economic structure. The findings of the study showed that the country experienced high economic growth rates. The authors concluded that the economic prosperity of Uganda was due to the country's understanding of the importance of sophistication and diversification. Similarly, O' Clery (2016) argues that Ireland was ranked as the

90th complex country in 2003. The author is of the view that due to its low economic complexity; Ireland underwent major crises after the global financial crisis.

Hausmann et al. (2011) studied the implications of economic complexity on growth by making use of institutional quality, human capital, and competitiveness. The study used the World Governance Indicators as determinants of institutional quality. The findings of this study conclude that whether combined or individually, ECI is a more accurate and better indicator of growth as compared to the six governance indicators. Moreover, the authors made use of schooling years derived from Barro and Lee (2001) as well as cognitive ability data from Hanushek and Woesmann (2008) as indicators of human capital. However, the study still concludes that economic complexity captures more growth information as compared to human capital. Lastly, the global competitive index was employed to compare the impacts of complexity vs competitiveness on economic growth. The study found that economic complexity contributes much better to growth compared to competitiveness (Hausman et al., 2011).

Haartman et al. (2016) analysed the relationship between income inequality, economic complexity, and institutions. A multivariate regression analysis was employed to illustrate that there is an indirect and insignificant relationship between income inequality and economic growth. Furthermore, the relationship between these variables can be used to control aggregate measures of human capital, income, and institutions. The authors conclude that countries that export more complex goods as measured by ECI tend to have smaller levels of income inequality as compared to those exporting simpler products. Also, the author's findings suggest that the productive structures of a country may limit its range of income inequality.

3.3.2 Relationship between governance and economic growth

Over the decades, factors contributing to the economic growth of countries have been the centre of many economic theories. According to Tharanga (2018), there is a direct link between the established sets of institutions and how the state exercises its power, which is fundamental for growth. Stable macro-economic conditions, contract enforcements that are not biased, lower information gaps amongst buyers and sellers as well as well-defined property rights are examples of such institutions (North, 1991;

Grief, 1994; Acemoglu & Robinson, 2012; Acemoglu & Robinson, 2010; North & Thomas, 1973; Rodrik & Subramanian, 2003). Furthermore, Tharanga (2018) states that the provision of well-accomplished governance plays a major role in the improvement of these quality institutions, thus increasing economic growth. The rise in economic growth due to improvement in these quality institutions can be explained through the Endogenous Growth theory and the Solow model.

As mentioned above, well-accomplished governance policies result in improved quality institutions, which are pivotal for economic growth. According to Tharanga (2018), these quality institutions result in a rise in the availability of technology, thus contributing to the Solow growth model. The author further states that dimensions of governance, including widespread corruption, a rise in political violence and the availability of technology, lead to immense physical and emotional hurt to citizens, thus decreasing their productivity levels. This suggests that better governance contributes greatly to the improvement of the productivity levels of citizens. It does this by decreasing or removing these physical and emotional constraints. In a similar perspective, numerous authors follow these favourable institutions and governance policies necessary to spur production and investment essential to achieving increased growth rates because of better governance (North, 1991; North & Thomas, 1973; Grief, 1994; Acemoglu & Robinson, 2012).

Quantifying governance serves as the biggest challenge faced by many empirical studies aimed at establishing the link between governance and economic growth. A variety of empirical studies have made use of governance indicators such as rule of law, regulatory quality, government effectiveness, voice, and accountability.

To study the impact of governance on economic growth, Kaufmann and Kraay (2002) made use of an aggregate of six indicators of governance from numerous perception indexes based on the various dimensions of governance. They used aggregate indicators such as political stability, government effectiveness, regulatory quality, rule of law, control of corruption as well as voice and accountability. Their results revealed that improved governance leads to an increase in economic growth but not the other way around. They also discovered that long term economic growth affects the quality of governance negatively.

Huynh and Jacho-Chavez (2009) analysed the link between governance and growth using a nonparametric method. The authors conclude that political stability, rule of law, voice and accountability are statistically and economically significant whilst control of corruption, government effectiveness and regulatory quality are insignificant. Their findings thus support those by Glaeser, La Porta, de Silva and Shleifer (2004), who found that poor countries consisting of good policies tend to grow rapidly and gradually out of poverty.

Mongale and Masipa (2019) undertook a study on the nexus between human capital development, regulatory quality, and economic growth in South Africa. The authors posit that there are limited studies that have made use of econometric techniques and incorporated governance variables to analyse the above-mentioned relationship. Employing the ARDL model, they found that aggregate fixed capital formation, aggregate consolidated expenditure on health and regulatory quality are positively related to growth. Similarly, Majone (1994) is of the view that the general processes of liberalisation and privatisation have resulted in many problems and challenges faced by developing countries, thus making the concept of "regulation' of paramount importance. Quality of regulation is essential in dealing with market failures and allows for competitive markets wherein the private sector can freely operate (World Bank, 2001).

Frontier Economics (2012) states that there is a complex link between economic growth and regulatory quality. From the author's perspective, regulatory quality impacts growth both positively and negatively, depending on the regulation used. In the same vein, regulatory quality contributes to growth by enhancing economic efficiency and eliminating certain market failures. On the contrary, regulatory quality impedes growth by creating unfavourable market distortions and substantial compliance costs.

Also, Laffont (2005) is of the view that the quality of regulations is motivated by public interests, and in poorer countries, they serve as an important tool for the attainment of infrastructure services that are equal and have sustainable growth rates. Barro (1997) undertook a cross-country empirical study on factors that determine growth. The author employed the rule of law and democracy. The Democracy index measures the ability of citizens to participate meaningfully in political processes. The rule of law index, on the other hand, measures the level of confidence that agents must abide by existing rules of the society, especially those relating to property rights, contract enforcement, courts, and police. The study finds that there is a causal relationship between economic growth and democracy (Barro, 1997). This implies that democracy tends to increase growth in situations where political freedom is very low and decreases growth in instances whereby a given optimal level of freedom is reached. Besides, the author finds that there is a direct and statistically significant relationship between economic growth and rule of law.

According to Haggard and Tiede (2011), the rule of law is a governance indicator that ensures personal security, unbiased contract enforcements, property rights and control of corruption. The government maintains the rule of law by ensuring that there is law and order, judicial independence, and control of corruption. There is a positive or direct relationship between rule of law and economic growth (Rogobon & Rodrik, 2004), which suggests that developing countries suffering from impaired rules of law are more likely to experience high rates of corruption, expropriation, and violence, vice-versa is true. Also, numerous authors such as Rogobon and Rodrik (2004) and Butkiewicz and Yanikkaya (2004) argue that the rule of law as a single and independent indicator cannot result in increased growth rates. Therefore, the authors suggest that coupling the rule of law with democracy is essential to achieving increased growth.

I-ming and Noha (2016) embarked on a study to establish the effects of governance on economic growth for the Middle East and North African countries. Employing the analysis of the principal components (PCA) method, the authors made use of 188 countries and created a composite governance index (CGI) to summarise the six governance indicators (rule of law, control of corruption, government effectiveness, regulatory quality, political stability, voice and accountability) as provided by the Worldwide Governance Indicators (WGI). The authors found that a rise in CGI results in a 2% increase in GDP per capita. Nonetheless, the authors also found that the GDP per capita of most oil-rich MENA countries such as Algeria, Egypt and Morocco do not account for improvements in governance. This suggests that most MENA countries have managed to obtain tenuous growth levels that are not dependent on sound governance.

On the contrary, Han et al. (2014) undertook a study on governance gaps and how they impact economic growth rates for MENA countries. The results of their study indicate that in comparison to MENA countries consisting of deficits in indicators such as government effectiveness, corruption and political stability, MENA countries with a surplus in these indicators tend to grow faster by at least 2.5% points yearly. The study suggests that governance is pivotal and contributes immensely to growth levels in the MENA region.

Hamid (2017) investigated the effects of the determinants of growth and economic complexity on economic growth for low-income, lower-middle-income and upper-middle-income economies. The study made use of pooled cross-country time series data for the period 2002-2014 and found that there is a positive and direct relationship between governance and the economic development of developing countries, regardless of their levels of income. Furthermore, they concluded that rule of law, political stability; voice and accountability are positively and significantly related to growth. The study further indicates that government effectiveness, regulatory quality, political stability, and control of corruption have major contributions to the development of Lower-Middle economies (Hamid, 2017).

According to Kaufman, Kraay and Mastruzzi (2010), government effectiveness consists of the quality of government services, competent policy formulation and the ability to implement desired policies. La Porta et al. (1999) is of the view that to achieve increased economic growth rates, government intervention should be minimum, there should be legitimacy in property rights and contract enforcement and bureaucracy must be competent as well. Kaufman, Kray and Mastruzzi (2010) also emphasised the significance of using regulatory quality as a complementary governance indicator to government effectiveness to achieve increased growth rates.

3.3 Chapter overview

This chapter reflected the theoretical and empirical literature employed in the study. The study was underpinned by the Solow Neoclassical growth theory, the Endogenous Growth theory and the New Growth theory. Detailed insight into empirical literature was also provided to include inference from relevant previous studies. The next chapter shall look at the various research methodologies, data process collection methods, model specification as well as estimation techniques employed in the study.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

This chapter presents the methodology that will be applied. The study consists of the methods that will be used for data collection, model specification as well as model estimation. The chapter will elaborate on all the steps necessary to achieve the objectives of the study.

4.2 Data

This study will make use of annual panel data for the period 2002-2017. The study consists of a panel of seven of Africa's top-performing countries, namely, Morocco, South Africa, Nigeria, Algeria, Ethiopia, Ghana, and Egypt. The data for constant real GDP per capita was sourced from the World Bank website. Data on governance indicators were accessed from the World Bank Governance Indicators database, and data on the Economic Complexity Index was collected from the Atlas of economic complexity database. The E-views 9 statistical package will be used to analyse the data.

The international Monetary Fund(2021) reported Nigeria, South Africa, Egypt, Algeria, Morocco, Kenya, Ethiopia, and Ghana as the top 7 best performing African countries in terms of GDP for the year 2021. According to Trading Economics (2021), Egypt is considered to have a safe investment destination due to its support from foreign parties. The country is strong in fossil fuels and agriculture which contribute immensely to its economic growth. On the same line, South Africa compared to other African economies has a more complex and diverse economy which is more industrialised and technologically advanced which has a positive impact on its growth rates. In addition, Algeria is the world's sixth largest exporter of natural gas which contributed immensely to its GDP in 2021. This study will focus on these selected above-mentioned countries to determine whether governance and economic complexity are key contributors to their increased growth rates.

According to Barbieri (2006), the economic theory for dealing with Panel data was mainly established to handle data sets that had a small number of time series observations but a larger number of groups or individuals. Panel data consists of a plethora of advantages compared to cross-sectional and time series data. According to Hsiao (2007), panel data consists of more sample variability and degrees of freedom and has more precise inferences and model parameters. In addition, panel data in comparison to single cross-section and time series data has a greater capacity to capture complex human behaviours and can control the impacts of omitted variables. In the same vein, the use of panel data allows us to uncover dynamic relationships and to generate accurate predictions for individual outputs by pooling the data instead of creating predictions of individual output by making use of the data of the individual in question.

According to Hsiao (2007), there are various disadvantages attributed to the use of Panel data in econometric analysis. According to the author, compared to time series data and cross-sectional data, panel data is associated with problems of non-response, and coverage and is costly. In addition, the author is of the view that panel data has unobserved heterogeneity amongst its variables in specific periods, which suggests that this form of data is heterogeneously biased. Consequently, should heterogeneity be ignored, it may lead to meaningless and inconsistent estimates of parameters. Baltagi (2005) states that panel data suffer from selectivity problems or bias. These problems include the inability of the data to randomly draw samples from its population. Other problems with Panel data include self-selectivity as well as non-response.

According to Baltagi(2005), panel data tends to convey selective bias, which suggests that its samples cannot be easily drawn randomly from the population. Non-response, attrition and self-selectivity are some examples of panel data selectivity problems. .

4.3 Model specification

To determine the link between economic complexity, governance and economic vgrowth, the specified linear model of the study is presented below as follows:

$$GDP_{it} = \beta_0 + \beta_1 ECI_{it} + \beta_2 COC_{it} + \beta_3 GE_{it} + \beta_4 RQ_{it} + \beta_5 PS_{it} + \beta_6 V\&A \quad + \varepsilon_{it} \qquad (4.1)$$

Where:

GDP_{it}	=	Gross domestic product
β_0 to β_6	=	Coefficients to be estimated
ECI_{it}	=	Economic complexity index
COC_{it}	=	Control of corruption
GE_{it}	=	Government effectiveness
RQ_{it}	=	Regulatory quality
PS_{it}	=	Political stability
$V\&A_{it}$	=	Voice and accountability
ε_{it}	=	Disturbance term
i and t	=	Indexes for country and time respectively

4.4 Estimation techniques

This chapter covers econometric techniques to be employed by the study to investigate the linkage between economic growth, economic complexity, and governance. The chapter begins with an explanation of panel unit root tests and proceeds to the cointegration tests, Panel autoregressive distributed lag model (PARDL), Engle-Granger causality tests, variance decomposition, and impulse response function (IRF). Lastly, diagnostic tests are employed.

4.4.1 Panel Unit root tests

Non-stationarity of data is one of the major problems associated with empirical analysis, which makes it pivotal to test for unit roots. Testing for stationarity is key as it enables us to establish possibilities of cointegration, reduces possibilities of spurious results and enables forecasting should stationarity be achieved (Junki, 2011).

Panel data consists of wider space and dimensions; hence they are popularly employed by numerous empirical researchers who have sets of panel data. Brooks (2008) denotes that Panel data compared to cross-sectional and time series data is a more efficient and effective econometric technique. Similarly, Martin (2009) is of the view that unit roots that are panel-based have greater power compared to individual time series roots. Similarly, the use of Panel data techniques is assumed to allow for greater flexibility for a specific model, which has not been estimated yet.

Maddala and Wu (1999) define panel unit root tests as tests that are used on panel data structures. Panel unit root tests are employed in a single series to increase the power of unit root tests. According to Karlsson et al. (2000), all panel unit root tests are based on the null hypothesis that each series in the panel consists of a unit root and the alternative hypothesis, which stipulates that at least one of the individual series in the panel is stationary.

To combat challenges associated with stationarity, the Levin, Lin, and Chin (LLC), Im, Pesaran and Shin (IPS) and Fisher-type tests (Fisher-ADF and Fisher-PP) tests are employed. These tests allow for the differentiation of variables in the study to achieve stationarity .The confirmation of stationarity and determination of the correct lag length is key as it allows for Panel cointegration tests to be conducted (Ahmed, 2015). The author further denotes that Panel unit root tests assist in overcoming spurious and misleading results. The author continues to illustrate that panel unit root tests are employed at first and if it occurs that the series is not stationary, the first and second differencing of the series is carried out until stationarity is achieved.

The level of integration which is used to establish whether the data is stationary or not is given as $Y_{t\sim}I(d)$, where *d* represents the order of integration (Lutkepohl, 1993). Alexiou et al. (2016) refer to the LLC, IPS and Fisher ADF and PP tests as multiple series of a unit root. This study employs the LLC, IPS and Fisher ADF and PP to test for stationarity and in addition, visual inspection or graphs are employed to establish whether the model has a unit root or not. The null and alternative hypotheses of all these tests are presented below:

$$H_0 = Y_{it} \sim I(1) \qquad (4.2)$$

$$H_1: Y_{it} \sim I_0 \qquad (4.3)$$

The possible outcomes are reject H_0 and do not reject H_0.

4.4.1.1 LLC panel unit root test

The Levin, Lin and Chu (2002) test is one of the most prominent tests widely used in research to establish the null hypothesis of the existence of panel unit root versus the alternative hypothesis of no panel unit root when cross-sectional units seem to be independent of each other. The LLC test generalises Quah's model and allows for individual deterministic effects as well as the serial correlation structure of the error term to be heterogeneous by assuming that the first first-order autoregressive parameters are homogeneous (Barbieri, 2006).

The LLC Panel unit root formula is presented as follows:

$$\Delta Y_{it} = \propto_i d_t + \delta Y_{it-1} + \mu_{it} \tag{4.4}$$

Where t=1…, T and i=1…, N represents the time series, and d_t the disturbance term. The AR process can be written as:

$$\emptyset_i(L) = \mu_{it} = \ell_{it} \tag{4.5}$$

Where $\emptyset_i(L) = 1 - \sum_{j=1}^{pi} \emptyset_{ij} L^j$ is a polynomial with the lag operator of L and ℓ_{it} which has a variance of $\emptyset_i^2$ is the mean zero error but is assumed to be independent across i and t (Westerland, 2009).

4.4.1.2 IPS unit root test result

Im, Pesaran and Shin (1997) showed an alternative test to unit root testing, which is abbreviated as IPS. The IPS test is assumed to be a more computationally simple and flexible approach to test for a unit root in panel data. Barbieri (2006) is of the view that the IPS test allows error variables across groups to be heterogeneous and further allows for residual serial correlation. The authors further argued that the IPS considers the mean of the ADF statistic computed for individual cross-section units in a panel when the disturbance term has different serial correlation patterns across its cross-sectional units.

The IPS model can be written as:

$$\Delta Y_{it} = \mu + \beta_i Y_{i,t-1} + \sum_{k=1}^{pi} \emptyset_{i,k} \, \Delta \, Y_{i,t-k} + \gamma_i^t + \varepsilon_{it} \tag{4.6}$$

Where $i = 1, \dots N$ and $t = 1, \dots T$

The relevant hypothesis of the IPS test is presented in equation 4.6 as the hypothesis of the common dynamics appears to be relaxed:

H_0 : $\beta_i = 0, \forall_I$ (4.7)

H_1 : $\exists_{i,st.}$ (4.8)

$\beta < 0$ (4.9)

According to Karlsson and Lothgren (2010), the IPS test has the highest test power compared to other panel unit root tests. However, the test tends to fail with small samples.

4.4.1.3 Panel Unit Root Fisher type tests (ADF and PP)

The IPS and LLC tests for stationarity were found to be weak in dealing with the issue of unit root; therefore, Maddala and Wu (1999) and Choi (2001) introduced the Fisher-type tests for running panel data unit root testing. The Fisher-type tests make use of Meta-analysis and are a non-parametric approach to unit root testing. These tests shall assist in handling unbalanced panels, which is crucial in testing for stationarity. As indicated, the study will also engage the use of visual inspection or unit root line graphs. The Fisher tests are assumed to be statistically significant when analysing contingency tables; and compared to the IPS tests, the tests do not need the panel data to be balanced (Maddala & Wu, 1999). On the contrary, the author states that the use of the Fisher test in panel data analysis can be disadvantageous in instances where the Monte Carlo simulation is employed to obtain the p-value.

4.4.2 Lag length criteria

According to Brooks (2008), the determination of lag length criteria which best fits the model is of paramount importance in econometric analysis. Lag length determination and verification is critical as it enables us to specify VAR models and proceed to cointegration. Ozcicek and Mcmillin (1999) also indicate that the consistency of the impulse response function and variance decomposition obtained from the estimated VAR is dependent on the use of the correct lag length criterion. The use of an optimum number of lags instead of overfitting is essential because using the correct lag length instead of a higher order lag length helps us to avoid having a specified model that has high mean square forecasting errors (Lutkepohl, 1993). In addition, underfitting of the lag length may also result in autocorrelated errors thus leading to the bias of the results obtained.

The lag length criteria for the model are established by employing various statistical criteria. These include the Akaike Information Criterion (AIC), Schwarz information criterion(SC), Final Prediction error and the Hannan-Quinn information criterion (Ozcicek & Mcmillin, 1999). Compared to the HQ and SC criteria, the FPE and AIC criteria are assumed to have better properties when selecting the correct order to use. However, Brooks (2008) is of the view that the SC and HQ criteria are efficient, and consistent and can select correct lag orders even with large samples.

4.4.3 Panel cointegration tests

Before computing panel cointegration tests, the length selection criteria shall firstly be employed as illustrated earlier to establish how many lags are to be employed by the study. Panel cointegration tests are conducted to establish the existence of a long run relationship between economic complexity, governance, and economic growth in the specified model. According to Pedroni (1995), the use of cointegration approaches in empirical literature has become increasingly popular and is used to establish long run relationships between variables.

The concept of integration provides an effective approach to modelling the short and long run dynamics of the specified model (Punis & Ho, 2005). Cointegration tests are primarily employed to identify whether there is evidence of spurious estimated results (Alexiou et al, 2016). The null hypothesis, which assumes that there is no cointegration between the variables is tested against the alternative hypothesis which assumes there is cointegration amongst the variables as hypothesised by Johansen and Juselus (1990). The Pedroni and Kao Panel cointegration tests have been carried out by the study and are based on a 2-step Engle-Granger (1987). These tests are assumed to be highly sensitive to the use of the correct lag length selected in the lag length selection criterion (VAR). According to Shiller and Pedroni (1985), the power of these tests is dependent on the duration of the data instead of the frequency of the data.

4.4.3.1 The Pedroni panel cointegration

According to Ncanywa et al. (2016), the Pedroni panel cointegration is made up of seven statistics that have distinct probability values. The rejection or acceptance of the null hypothesis of these statistics will depend on their p-values.

Pedroni proposed numerous tests for cointegration which made provision for trend coefficients and intercepts to be heterogeneous. The Pedroni panel cointegration test employs kernel estimations that are parametric and non-parametric (Dritsakis, 2012; Ahmad, 2015).

The regression is expressed as:

$$Y_{it} = \propto_i + \delta_i t + \beta_{1i,t} X_{1i,t} + \beta_{2i,t} X_{2i,t} + \cdots + \beta_{mi} X_{mi,t} + \mu_{i,t,} \qquad (4.10)$$

Where *T* represents the number of observations over time, *N* is the number of individual members in the panel, *M* is the number of regressors, $\beta_{1i,\ldots,}\beta_{Mi}$ represents the slope coefficients and α_i represents the member-specific intercept and can be different across each cross-section.

Pedroni (1999) has introduced seven residual-based tests. These tests allow individual units in a panel to be heterogeneous. According to Alexou et al. (2016), 3 of the residual tests are based between dimensions whilst 4 are based within-dimension. The seven residual tests are represented below:

$$Y_{it} = \alpha_i + \delta_i t + \beta_{1t} X_{1i,t} \beta_{2i} X_{2i,t} + \cdots + \beta_{mi} X_{mi,t} + \ell_{i,t} \qquad (4.11)$$

Where $X_{i,t}$ represents the regressors for n across sections, δ represents the parameters which can be set at zero, $t = 1, \ldots, m = 1, \ldots, M$ and $\ell, X\ and\ Y$ are assumed to be cointegrated of order 1 (Gutierrez, 2003).

The IPS tests consist of two alternative hypotheses, namely, homogeneous alternative $(\rho_i = \rho) < 1$ for all i and the alternative heterogeneous hypothesis, where $\rho < 1$ for all i. Seven residual-based tests are free from the imposition of exogenous requirements on the cointegrating regression and allow an individual unit of a panel to be heterogeneous (Gutierrez, 2003). Three of these residual tests are based between dimensions whilst the other four are based within a dimension.

The seven residual-based tests are presented as follows:

$$Y_{it} = \alpha_i + \beta_i X_{1,i,t} + \beta_2 X_{2,i,t} + \cdots + \beta_n X_{n,i,t} + \mu_{it} \quad (4.12)$$

Where the regressors for n across sections are represented by X_{it}

A regression formulated from equation 4.12 is given as:

$$\mu_{it} = \zeta_i \mu_{i,t-1} + Z_{i,t} \quad (4.13)$$

The null hypothesis which assumes that there is cointegration between the variables and the alternative hypothesis which assumes that there is cointegration using the within dimension framework for the seven statistics are given as:

$$H_0: \zeta_i = 1 \text{ for all } i \quad (4.14)$$

$$H_1: \zeta_i = \zeta < 1 \text{ for all } i \quad (4.15)$$

According to Alexiou et al. (2016), the between-dimension framework is less restrictive as it allows the individual units to be heterogeneous with the alternative hypothesis of $H_1: \zeta_i < 1$ for at least 1 i.

4.4.3.2 The Kao panel cointegration test

The Kao cointegration test is analogous to the Pedroni test but differs in the sense that Kao (1999) specifies the homogeneity of cross-section intercepts and coefficients of the regressors in the first stage.

$$Y_{it} = \propto_i + \beta x_{it} + \ell_{it} \quad (4.16)$$

$$Y_{it} = Y_{it-1} + \mu_{it} \quad (4.17)$$

$$X_{it} = X_{it-1} + \mu_{it} \quad (4.18)$$

Where β represents the slopes of the parameters, α the individual constants, ℓ_{it} is the stationarity of disturbance terms, *t*=1,…*T*, *i*=1,…and both Y_{it} and X_{it} are random walks and follow that ℓ_{it} should be non-stationary under the null hypothesis of no cointegration.

The Kao pooled auxiliary regression is presented as:

$$\ell_{it} = \rho \ell_{1,t-1} + \upsilon_{it} \quad (4.19)$$

The Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests were derived in 1999 by Kao as additions to cointegrations tests.

The DF type test is presented as

$$\hat{u}_{it} = \rho\hat{u}_{it-1} + \hat{u}_{it} \quad (4.20)$$

Where $\hat{u}_{it}$ is an estimated residual of equation 4.21

The ADF type test is presented as

$$\hat{u}_{it} = \rho\hat{u}_{it} + \sum_{j=1}^{p} \gamma\,,\Delta\hat{u}_{it} + \upsilon_{it} \quad (4.21)$$

Where $\hat{u}_{it}$ is an estimated residual of equation 4.21 and ρ represents the number of lags that are included in the specified ADF model.

The null and alternative hypotheses to test whether Y_{it} and X_{it} are cointegrated employing the DF and ADF test statistics are presented below:

$$H_0: \rho = 1 \quad (4.22)$$

$$H_A: \rho < 1 \quad (4.23)$$

According to Gutierrez (2000), there are four types of DF tests introduced by Kao, where two assume that regressors are exogenous and the other two assume that regressors can be endogenous. Kao (1999) and Gutierrez (2003) specify that the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests proposed by Kao consist of asymptotic distributions and are likely to converge to normal standard distribution N(0.1) $T \rightarrow \infty$ and $N \rightarrow \infty$.

4.4.4 Panel Autoregressive Distributed Lag (PARDL) model

In recent years, the Panel Autoregressive Distributed Lag (PARDL) have become very popular and is the most used method in determining cointegration between specified variables (Persaran, Shin & Smith, 2001). The PARDL models are defined as standard least-squares regressions, which consist of Lags of explanatory variables and response variables. According to Nkoro and Uko (2016), distributed lag models include unrestricted lags of regressors in the regression.

The PARDL model is prominently used in instances where the variables are cointegrated of a mixture of order 0 and 1 or they are cointegrated or either order 0 or 1. In this instance, Pesaran et al. (2004) emphasise that the PARDL model is likely to yield realistic, efficient, and appropriate results or estimates. The author continued to emphasise the fact that in the long run, PARDL models tend to produce consistent estimates of coefficients even in instances where regressors are integrated of order 0 or order 1. On the same note, Nkoro and Uko (2016) are of the view that in instances where there are multiple cointegrating vectors, the PARDL approach can easily identify these vectors. Furthermore, the PARDL can distinguish between explanatory and dependant variables most particularly within a single long run relationship where it is also assumed that all variables are endogenous.

Compared to other approaches, the PARDL model is assumed to be free of serial correlation. On the contrary, the model is assumed to consist of numerous disadvantages which include, among many, the fact that the model is likely to crash in instances where there is an integration of order 2 and tends to produce robust estimates of long run coefficients in instances where there is a small sample size and a singular long run relationship between the variables.

4.4.5 Engle and Granger causality test

Testing for cointegration is pivotal before proceeding to employ the Granger causality test. According to Brooks (2006), the Granger causality test does not necessarily ascertain that changes in one variable can result in physical changes in the other variables, thus making it very important to bear in mind the fact that the Granger causality test appears to be a misnomer. The Granger causality tests are conducted to test for causality between variables. Gujarati (2004) is of the view that due to the high sensitivity of these tests; they are commonly misused in economic research. At least one direction of causality between variables should be seen (Cetintas & Barisik, 2009). The authors indicate that panel data allows for larger observations, and as a result, enhances the higher power of these tests. There are numerous detriments attributed to the use of the two-step granger causality tests. For instance, these tests are used to make sure that residuals are integrated of either order 1 or order 0 before proceeding to step 2. Should the variables be integrated at order 1 or I(1), an estimation of a model which includes only the first difference should be conducted.

Step two of the Granger causality two-step method is derived from using step 1 residuals of the test as a single variable in the error correction model. For instance:

$$\Delta Y_t = \beta_1 \Delta x_t + \beta_2 (\hat{u}_{t-1}) \times y_t \quad (4.24)$$

Where $\hat{u}_{t-1} = y_{t-1} - \tau x_{t-1}$ (4.25)

Simultaneous biases and lack of power in unit root tests, as well as cointegration, are some of the problems associated with causality tests, especially in instances where there is bidirectional causality between X and Y (Brooks, 2008). Ahmad (2015) is of the view that causality tests are essential in establishing whether previous values of x_{it} (the independent variable) influence the prediction of the value of y_{it} (the dependent variable). Furthermore, these tests can be used to establish the unidirectional and bidirectional causality between the variables of interest.

4.4.6 Diagnostic testing

Diagnostic tests have been employed to ensure that true estimates are produced from the regression. These tests are further employed to validate inferences that were made earlier in building the model.

4.4.6.1 Normality test

Normality tests are essential in determining the normal distribution of data (Oztuna, Elhan & Tuccar, 2006). The Jarque-Bera test, which is also referred to as the goodness-of-fit, is the most used test for normality which is undertaken to test whether the kurtosis matches normal distribution and if there is skewness in the sample data. When residuals are normally distributed, the probability value should not be more than a 5% level of significance (Gujarati & Porter, 2009). In addition, the normal distribution of data requires the shape of the histogram to be bell-shaped, the expected skewness to be zero and the coefficient of the kurtosis to be 3. The kurtosis measures the fatness of the tails of the distribution.

According to Oztuna et al. (2006), there are potential problems associated with normality tests as they consist of limited power to reject the null hypothesis when dealing with smaller sample sizes. Consequently, smaller sample sizes are likely to pass the normality tests whilst the larger sample sizes tend to struggle as they are expected to consider departures from normality. Although the data may be normally distributed, there might be problems if residuals are serially corrected as determined by the test for serial correlation.

4.4.6.2 Serial correlation testing

According to Verbeek (2004), serial correlation occurs when the assumption that random error components or disturbances are independently and identically distributed is violated. Serial correlation is defined as the correlation amongst members of observations ordered in space or time. Wooldridge (2009) states that serial correlation has a greater impact on the efficiency of estimates and standard errors of the model. It is therefore important to check whether there is serial correlation and random effect amongst the variables because failure to do so may lead to misleading inferences when certain significant components have not been included (Baltagi, Song, Jung & Koh, 2003). According to Ljung and Box (1979), when partial autocorrelations and autocorrelations at lags are near zero and the probability values are insignificant, it implies that the variables are not serially correlated.

4.4.7 Impulse Response Function

According to Gujarati (2004) and Brooks (2008), the impulse response function is employed to establish how the dependent variables will respond to shocks in the disturbance term within the VAR system. This study employs the Impulse response function to determine how economic growth responds to shocks in economic complexity and governance. The IRF also measures how the variables respond to their shocks, and the extent to which the future and current values of the endogenous variables within the model are impacted by a change in one of the variables (Ahmad, 2015). In addition, the author contends that there are problems where shocks in individual variables are not represented appropriately as a result of shocks in variables that are contemporaneously correlated. This problem, however, may be fixed by employing the Cholesky decomposition. However, this test is assumed to be highly sensitive to the lag structure of variables. Asmah (2013) states that a stable system is represented by any shock that falls to zero, and an unstable system produces explosive time paths.

4.4.8 Variance decomposition

The variance decomposition test is employed to establish how changes in the dependent variables are caused by their shocks or by shocks from other variables in the model (Gujarati, 2004; Brooks, 2008). According to Brooks (2008), the variance decomposition test consists of a lot of advantages, including, amongst many, the ability of the test to give relevant information in terms of how significant each random innovation impacts the VAR variables. Granger (1988) states that a long run Granger causality amongst the independent and dependent variables exists when the error correction term is statistically significant. On the contrary, a long run non-causality relationship between the variables exists when the error correction is not significant. This implies that there is a weak exogenous relationship between the explanatory variables (Hall & Milne, 1994).

4.4.9 Stability testing

To test the stability of the model, the inverse Roots of AR characteristic polynomials, which is a visual inspection approach, are undertaken. The estimated VAR is assumed to be stable (stationary) when all its roots lie inside the unit and have a modulus of less than 1 (Lutkepohl, 1991). It is of paramount importance for the variables of the study to be stable as they may be used for policy formulation and decision-making.

4.5 Chapter overview

This chapter presented the research methodology of the study wherein data collection methods as well as the model specification were outlined. Included in the estimation techniques are the numerous tests employed in the study to test for model stability and significance. Panel unit root tests and cointegration tests were conducted to test for stationarity and long run relationship between the dependent and independent variables, respectively. The PARDL approach was also used to check for the short and long run relationship between the variables and to project the speed at which the model is likely to adjust back to equilibrium. In addition, the study employed the Engle-granger causality test to establish whether the variables are likely to forecast one another. Finally, diagnostic tests were employed to check how stable the model is, and the impulse response function and variance decomposition tests were used to determine how the dependent variables respond to external shocks from the model or error term.

The subsequent chapter is mainly focused on the empirical findings of the estimated model.

CHAPTER 5

DISCUSSION / PRESENTATION / INTERPRETATION OF FINDINGS

5.1 Introduction

The previous chapter outlined the various methodologies that will be used in the study. This chapter gives an exhibition of the application of these methodologies. The chapter also conveys results and discussions derived from the estimated model. All relevant tests i.e., unit root tests, cointegration tests, impulse response function and variance decomposition, granger causality tests, diagnostic tests and stability tests were conducted using Econometric Views (EViews) software to ensure that the model does not produce spurious results.

5.2 Empirical tests result

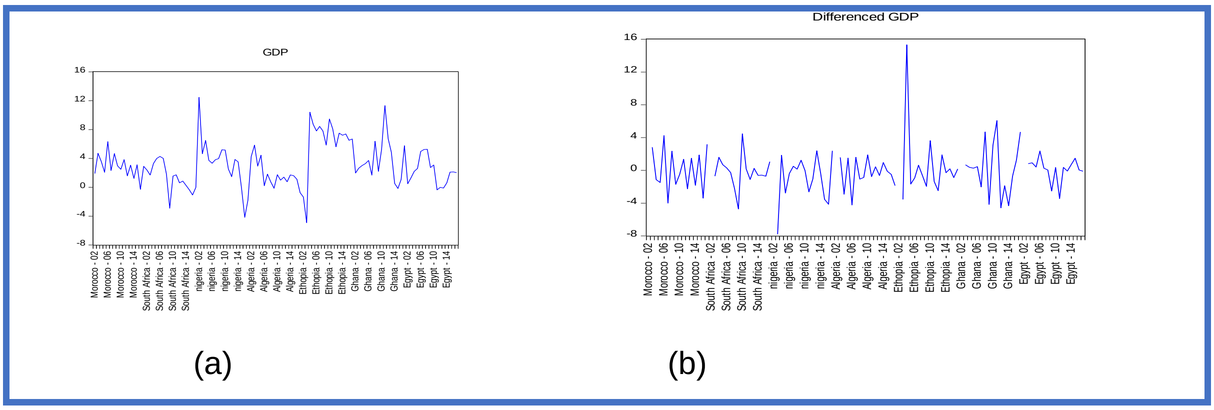
This section presents the results of the empirical tests of the study.

5.2.1 Panel unit root test results

Two forms of unit root analysis, that is, the informal and formal analyses were performed. The results of the informal testing are presented mainly graphically. This will be followed by the results of more robust and formal techniques to make a proper determination of the stationarity analysis.

5.2.1.1 Informal Panel unit root tests

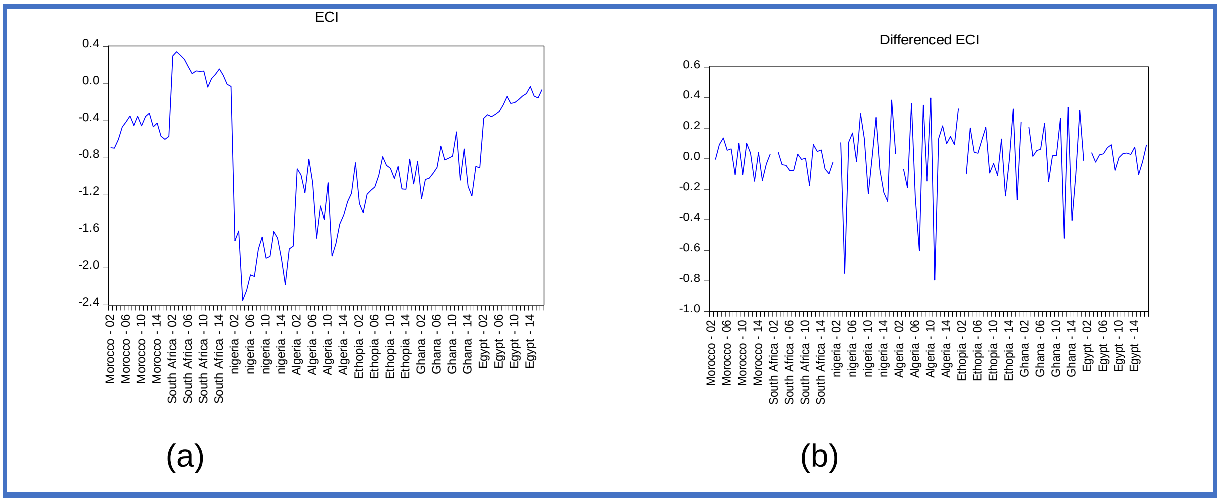
Figure 5.1 GDP at level and at first difference



Source: Author's computations

Figure 5.1(a) suggests that GDP is non-stationary at level as indicated by a downward sloping pattern. However, Figure 5.1(b) suggests that stationary might be found at first difference because the covariances appear to be time-invariant and the mean is hovering around zero on the y-axis.

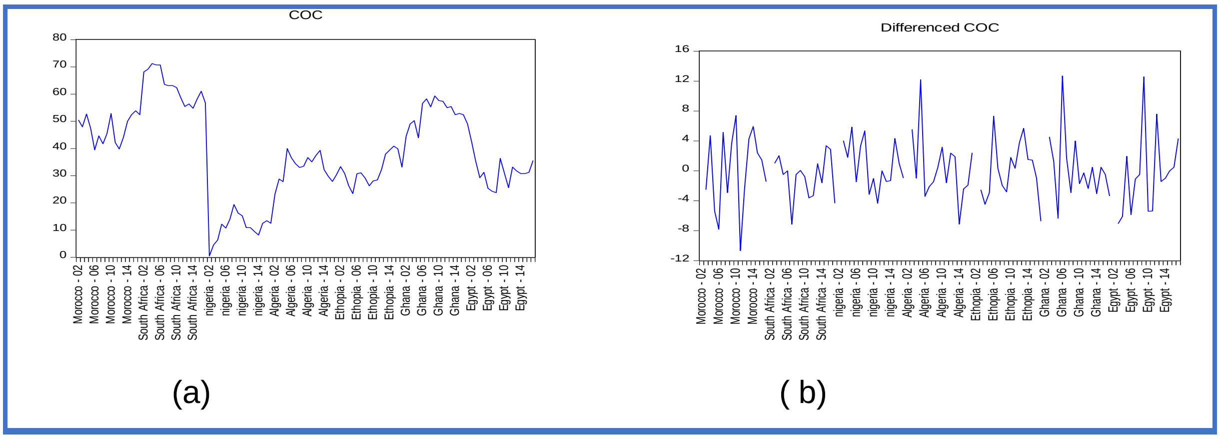
Figure 5.2 ECI at level and at first difference



Source: Author's computations

Figure 5.2 depicts a graphical analysis of unit root for output of ECI at level form as well as at first difference. Based on the illustration in Figure 5.2 (a), it appears that ECI is not stationary at level, and was differenced at least once to make it stationary, which is illustrated in Figure 5.2(b). Therefore, it appears that ECI is stationary at first difference.

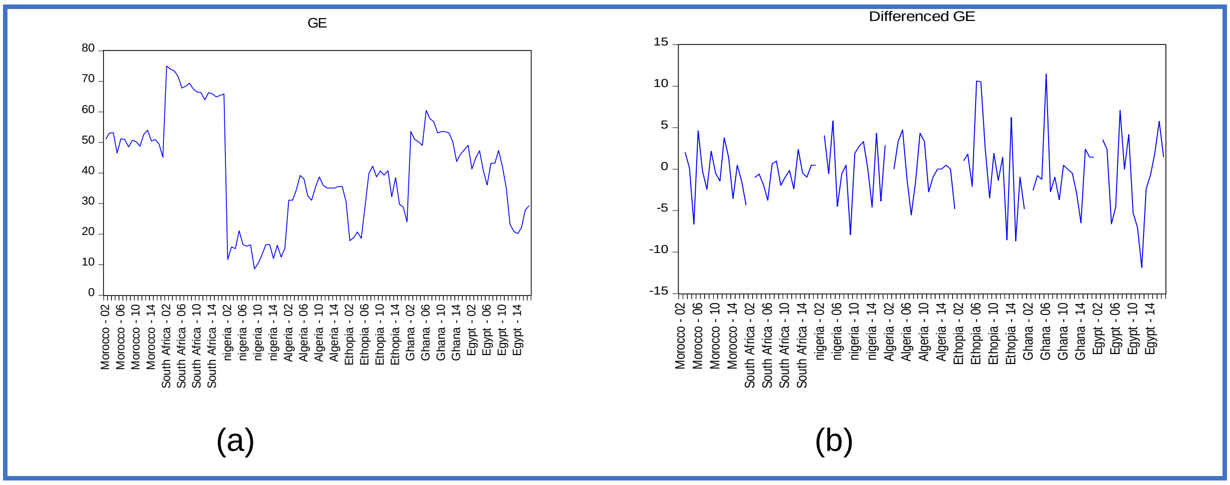
Figure 5.3 COC at level and at first difference



Source: Authors computations

According to the graphical representation in Figure 5.3, COC appears to be non-stationary at level (Figure 5.3 a) but stationary at first difference (Figure 5.3 b).

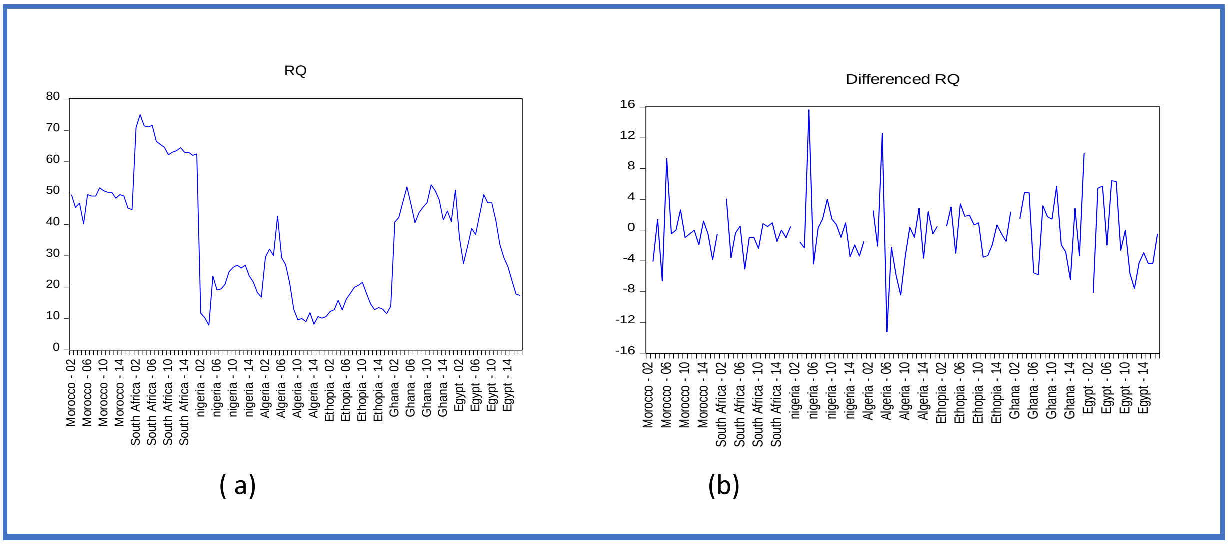
Figure 5.4 GE at level and at first difference



Source: Authors computations

Government effectiveness appears to be non-stationary at level as depicted in figure 5.4 (a). However, its mean appears to be strongly hovering around zero after differencing as seen in figure 5.4(b), which suggests that GE is stationary when differenced at least once.

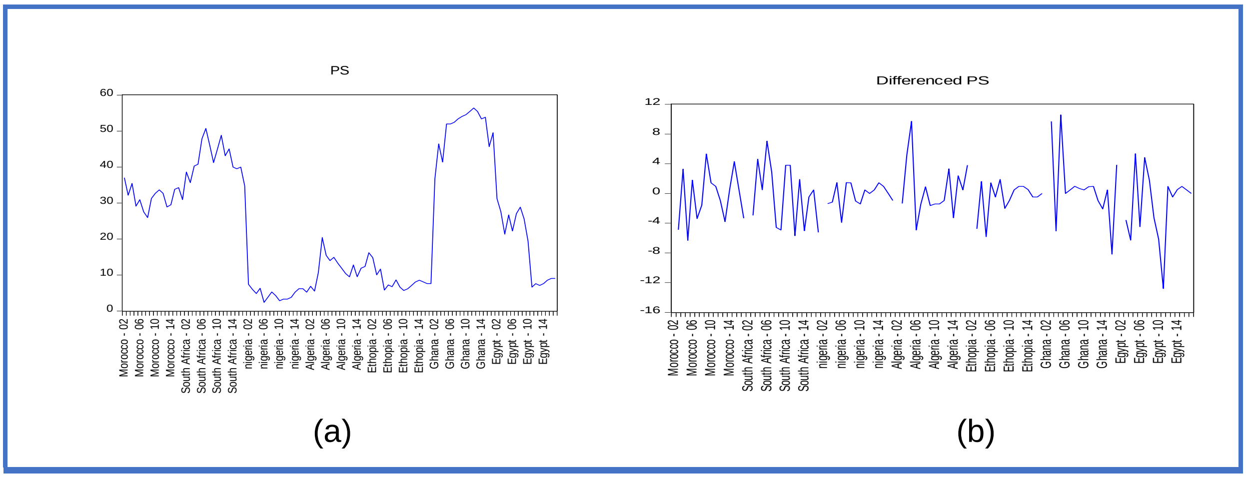
Figure 5.5 RQ at level and at first difference



Source: Author's computations

Figure 5.5 illustrates the trend in regulatory quality for the period 2002-2017. It portrays that RQ appears to be non-stationary at level as depicted in Figure 5.5(a). Figure 5.5(b), however, shows that the mean is strongly hovering around zero on the y-axis, suggesting that RQ might be stationary at first difference.

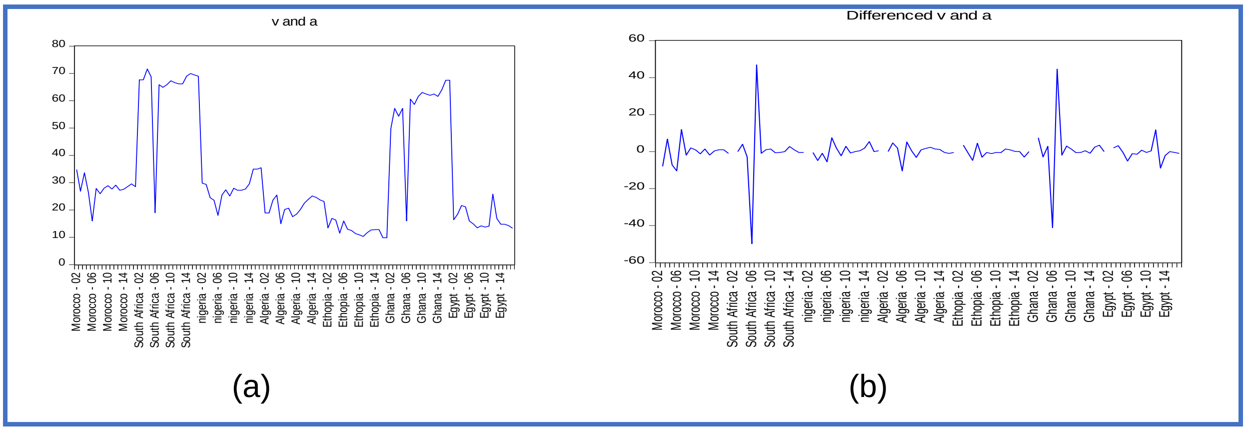
Figure 5.6 PS at level and at first difference



Source: Author's computations

Figure 5.6 shows the trend of political stability for the period 2002-2017. Plot (a) appears not to be trending, which suggests that PS is non-stationary at level, whereas plot (b), on the other hand, shows the mean oscillating horizontally around the mean of zero on the x-axis, suggesting stationarity at first difference.

Figure 5.7 V and A at level and at first difference



Source: Author's computations

Figure 5.7 presents a graphical representation of Voice and Accountability. From the visual inspection, V and A as depicted in the plot (b) consist of a mean which is strongly oscillating around the mean of zero along the x-axis as opposed to plot (a) where the mean is inconsistent. Therefore, it is assumed that V and A are non-stationary at level and stationary at first difference.

The results of the visual inspection are further confirmed through formal unit testing as presented under 5.2.1.2.

5.2.1.2 Formal unit root tests

The following unit root tests were employed to ascertain the orders of integration for all the variables of the study, IM-Shin Pesaran, (IPS), ADF-Fisher Chi-square, PP-Fisher Chi-Square, and Levin-Lin (LLC) tests. Table 5.1 presents a summary of the results obtained at the individual intercept, and trend as well as at none. In addition, the complete outputs are presented in the Appendix section.

Table 5.1 Summary of the formal unit root tests results

VARIABLES	TEST	MODEL SPECIFICATION	LEVEL	1^{ST} DIFFERENCE	ORDER OF INTEGRATION	CONCLUSION
GDP	IPS	Individual intercept	0.0000		I (0)	Stationary
		Individual intercept & trend	0.0000		I (0)	Stationary
	Fisher-ADF	Individual intercept	0.0006		I (0)	Stationary
		Individual intercept & trend	0.0013		I (0)	Stationary
		None	0.0155		I (0)	Stationary
	Fisher-PP	Individual intercept	0.0001		I (0)	Stationary
		Individual intercept&trend	0.0001		I (0)	Stationary
		None	0.0040		I (0)	Stationary
	LLC	Individual Intercept	0.0000		I(0)	Stationary
		Individual trend & intercept	0.0000		I(0)	Stationary
		None	0.0001		I (0)	Stationary

ECI	IPS	Individual intercept	0.0819	0.0000	I (1)	Stationary
		Individual Intercept & Trend	0.3537	0.0004	I (1)	Stationary
	Fisher-ADF	Individual intercept	0.1321	0.0000	I (1)	Stationary
		Individual Intercept & Trend	0.3141	0.0009	I (1)	Stationary
		None	0.0801	0.0000	I(1)	Stationary
	Fisher-PP	Individual intercept	0.0772	0.0000	I(1)	Stationary
		Individual intercept & trend	0.3729	0.0000	I (1)	Stationary
		None	0.0043		I (0)	Stationary
	LLC	Individual intercept	0.0035		I (0)	Stationary
		Individual intercept & trend	0.0003		I (0)	Stationary
		None	0.0088		I (0)	Stationary

COC	IPS	Individual intercept	0.0684	0.0001	I (1)	Stationary
		Individual Intercept & Trend	0.3931	0.0039	I (1)	Stationary
	Fisher-ADF	Individual intercept	0.1134	0.0004	I (1)	Stationary
		Individual Intercept & Trend	0.4569	0.0044	I (1)	Stationary
		None	0.8467	0.0000	I (1)	Stationary
	Fisher-PP	Individual intercept	0.0174		I (0)	Stationary
		Individual intercept &trend	0.0469		I (0)	Stationary
		None	0.8062	0.0000	I(1)	Stationary
	LLC	Individual intercept	0.0743	0.0000	I(1)	Stationary
		Individual intercept & trend	0.0287		I (0)	Stationary

		None	0.1577	0.0000	I (1)	Stationary
GE	IPS	Individual intercept	0.0057		I (0)	Stationary
		Individual intercept & trend	0.3297	0.0003	I (1)	Stationary
	Fisher-ADF	Individual intercept	0.0077		I (0)	Stationary
		Individual intercept& trend	0.1956	0.0006	I (1)	Stationary
		None	0.4899	0.0000	I (1)	Stationary
	Fisher-PP	Individual intercept	0.0334		I (0)	Stationary
		Individual intercept& trend	0.7631	0.0000	I(1)	Stationary
		None	0.2446	0.0000	I (1)	Stationary
	LLC	Individual intercept	0.0017		I (0)	Stationary
		Individual intercept & trend	0.0384		I (0)	Stationary
		None	0.0242		I (0)	Stationary

RQ	IPS	Individual intercept	0.2652	0.0171	I (1)	Stationary
		Individual intercept & trend	0.9407	0.0211	I (1)	Stationary
	Fisher-ADF	Individual intercept	0.3199	0.0373	I (1)	Stationary
		Individual intercept & trend	0.9451	0.0180	I (1)	Stationary
		None	0.2307	0.0000	I (1)	Stationary
	Fisher-PP	Individual intercept	0.4318	0.0000	I (1)	Stationary
		Individual intercept & trend	0.8854	0.0000	I (1)	Stationary

		None	0.4710	0.0000	I (1)	Stationary
	LLC	Individual intercept	0.1416	0.1213	I (1)	Stationary
		Individual intercept & trend	0.6347	0.0004	I (1)	Stationary
		None	0.0066		I (0)	Stationary

PS	IPS	Individual intercept	0.0326		I (0)	Stationary
		Individual intercept & trend	0.7050	0.0114	I(0)	Stationary
	Fisher-ADF	Individual intercept	0.0533		I (0)	Stationary
		Individual intercept & trend	0.6777	0.0127	I (1)	Stationary
		None	0.5742	0.0000	I (1)	Stationary
	Fisher-PP	Individual intercept	0.0006		I (0)	Stationary
		Individual intercept &trend	0.1552	0.0000	I (1)	Stationary
		None	0.2296	0.0000	I (1)	Stationary
	LLC	Individual intercept	0.0835	0.0762	I (1)	Stationary
		Individual intercept & trend	0.2162	0.0836	I(1)	Stationary
		None	0.2711	0.0000	I (1)	Stationary

V&A	IPS	Individual intercept	0.1180		I (0)	Stationary
		Individual intercept & trend	0.1032		I (0)	Stationary
	Fisher-ADF	Individual intercept	0.1774	0.0000	I (1)	Stationary
		Individual intercept & trend	0.1684	0.0001	I (1)	Stationary
		None	0.7995	0.0000	I (1)	Stationary
	Fisher-PP	Individual intercept	0.0006		I (0)	Stationary
		Individual	0.0000		I (0)	Stationary

		intercept & trend				
		None	0.8409	0.0000	I (1)	Stationary
	LLC	Individual intercept	0.0092		I (0)	Stationary
		Individual intercept & trend	0.0000		I (0)	Stationary
		None	0.2576	0.0000	I (1)	Stationary

Source: Author's computations

The results in Table 5.1 above show that the series of the model are integrated of I(0) and I(1).

In summary,

GDP : Stationarity at I(0) for all the tests

ECI : Stationarity at I(O) for LLC and stationarity at I(1) for IPS; Fisher-ADF and Fisher-PP

COC : Stationarity at I(O) for Fisher-ADF and stationarity at I(1) for IPS; LLC And Fisher-PP

GE : Stationary at I(0) for IPS and stationary at I(1) for LLC; Fisher-ADF And Fisher-PP

RQ : Stationarity at I(1) for all the tests

V and A : Stationary at I(0) for LLC, IPS, Fisher-PP and stationery at I(1) for For Fisher-ADF

According to Nkoro and Uko (2016), the PARDL cointegration technique is preferred in instances where the variables are integrated into a mixture of I(0) and I(1) or either I(0) or I(1). Consecutively, the results in Table 5.1 indicate a combination of order I(1) and I(0) thus, the study shall employ the PARDL model.

In addition, none of the variables is integrated in the order I(2), hence suggesting that the model can be feasibly employed within the PARDL model as the stationarity criteria are strongly satisfied.

5.2.2 Lag length criteria selection

It is pivotal to establish the lag length criteria of the model as they enable us to proceed to cointegration. Table 5.2 presents a summary of the results obtained from running the lag length criteria selection tests using the EViews statistical package. The information criteria employed include the Schwarz Information Criterion (SC), Final Prediction Error (FPE), Hannan Quinn information criterion (HQ), and Akaike Information Criterion (AIC) as well as the sequentially modified test statistic (LR). The information with the smallest value is indicated using asterisks and is usually the most preferred. Appendix C shows the results of the Var lag order selection.

Table 5.2: Lag length selection criteria results

	Logl	LR	FPE	AIC	SC	HQ
0	-1496.941	NA	1.08e+10	42.96973	43.19458	43.05905
1	-972.5995	928.8328	13772.64*	29.38856	31.18735*	30.10306*
2	-930.0061	66.93256*	17217.63	29.57160	32.94435	30.91130
3	-891.4473	52.88067	25819.75	29.86992	34.81661	31.83481
4	-847.0210	52.04217	36544.85	30.00060	36.52124	32.59068
5	-791.0123	54.40849	44124.09	29.80035	37.89493	33.01562
6	-720.7779	54.18079	46600.76	29.19365*	38.86218	33.03411

Source: Author's computations

As indicated in Table 5.2 above, the majority of the Asterix lie on lag 1, implying that based on the FPE, AIC and SC, the optimum lag length of this model is achieved at lag length 1. Conclusively, lag length 1 shall be employed in building the model.

5.2.3 Panel cointegration results

According to Guttierrez (2003), Kao (1999) and Pedroni (1999), the null hypothesis of the panel cointegration tests assumes that the variables are cointegrated, and the alternative hypothesis assumes that there is no cointegration amongst the variables. Therefore, this study employed both the Pedroni and Kao cointegration tests to establish the existence of cointegration between the variables in the model. Appendix D shows the results of these tests.

5.2.2.1 *Pedroni panel cointegration test results*

Table 5.3: Pedroni panel cointegration results

Panel Statistics	Probability	
Panel v-Statistic	0.6894	0.9319.
Panel rho-Statistic	0.9647	0.9390
Panel PP-Statistic	0.0000	0.0001
Panel ADF-Statistic	0.0000	0.0001
Group Statistics	Probability	
Group rho-Statistic	0.9961	
Group PP-Statistic	0.0000	
Group ADF-Statistic	0.0001	

Source: Author's computations

According to Dunis and Ho (2005), cointegration is pivotal as it provides an efficient methodology for modelling the short and long run dynamics of the system. Table 5.3 illustrates that the Pedroni test has been used to test for cointegration. The results of the test show that out of eleven statistics, there are six cointegrating equations at Panel-ADF, Panel-PP, Group PP and Group PP with p-values of less than 0.05. This suggests that the model rejects the null hypothesis of no cointegration at a 5% level of significance.

5.2.2.2 *The Kao panel cointegration results*

Table 5.4 presents the results obtained from the Kao test. Detailed results of the test are presented in Appendix D.

Table 5.4 The Kao cointegration results

Long Run	Coefficient	Probability
ECI	0.010737	0.9431
COC	-0.068110	0.0000
GE	0.054169	0.0016
RQ	0.124820	0.0000
PS	-0.143485	0.0000
V and A	-0.090583	0.0001
Short run (speed of adjustment) -0.590657		

Source: Author's computations

The Kao test results in Table 5.4 indicate a p-value of 0.0000, which is less than 0.05, meaning that we accept the alternative hypothesis that there is cointegration between the variables, and reject the null hypothesis of no cointegration at a 5% level of significance. This implies that there is a long run relationship between the variables.

5.2.4 Panel Autoregressive Distributed Lags (PARDL) model results

The PARDL approach was employed to establish the impacts of the model coefficients in the long and short run. This is essential in determining how the dependent variable is influenced by the independent variables. The short run shows the speed of adjustment, which is an indication of how long it will take the model to converge back to equilibrium after any given external shocks. The summaries of the results are presented in Tables 5.5 and 5.6, respectively, and the full results are available in Appendix E.

Table 5.5 PARDL long run results

Long Run	Coefficient	Probability
ECI	0.010737	0.9431
COC	-0.068110	0.0000
GE	0.054169	0.0016
RQ	0.124820	0.0000
PS	-0.143485	0.0000
V and A	-0.090583	0.0001
Short run (speed of adjustment) -0.590657		

Source: Author's computations

Table 5.5 displays the normalised coefficient, which represents long run elasticities of the model, which are used as coefficients in equation 5.1 to determine the impact of the regressors on the dependent variable.

$$GDP = +0.017ECI - 0.068COC + 0.054GE + 0.0125RQ - 0.143PS - 0.091V\&A \quad (5.1)$$

Equation 5.1 shows that ECI, COC, GE, RQ, PS and V&A all have a long run relationship with GDP. The coefficient of ECI is reported as 0.017, suggesting that there is a positive relationship between ECI and GDP. This implies that a 1% increase in the Economic complexity index will result in a 1.7% increase in economic growth (GDP), ceteris paribus. This is comparable to findings by Hildago and Hausman

(2009), who checked whether the method of reflection has an impact on economic growth. Employing the OLS methodology, the authors found that economic complexity is positively related to economic growth and development. Hausman (2017) also embarked on a study wherein he analysed the significance of economic complexity on growth. The results of his study revealed that countries that are exporting goods of higher productivity tend to yield increased growth rates. In 2011, Hausman (2011) further undertook an additional study on the impacts of complexity on growth. The results found that countries which have high levels of complexity in contrast to their income levels are most likely to experience increased growth rates. This implies that not only is economic complexity a major determinant of growth, but it is also a significant indicator of future growth rates.

On the contrary, there is a negative relationship between the Control of corruption (COC) and economic growth. This is represented by the coefficient of (-0.068), implying that for every 1% rise in the control of corruption, Economic growth shall decline by a 6.8% magnitude, in the long run, ceteris paribus. On the contrary, Albassan (2013) found that there was a moderate, significant and positive relationship between the control of corruption and growth, particularly during the world economic crisis. In addition, Bichaka et al. (2013) also found a positive relationship between the control of corruption and per capita income in Africa. In the same vein, the long run results of this study found that economic growth is positively influenced by government effectiveness, which is represented by a coefficient of 0.054, which suggests that should government effectiveness increase by 1%, economic growth will respond positively with an increase of 5.4%, ceteris paribus. Similarly, there is a positive relationship between regulatory quality and economic growth as the outcomes of the results indicate that a 1% increase in regulatory quality shall result in a 1.2% increase in regulatory quality, ceteris paribus.

For every 1 % increase in political stability, economic growth will increase by 14.3 % in the long run, ceteris paribus. This suggests a positive relationship between these variables. On the other hand, voice and accountability are negatively related to economic growth, which implies that for each 1% increase in voice and accountability, economic growth will decrease by 9.1% in the long run, ceteris paribus. On the contrary, Bichaka et al. (2013) conducted a study on African countries to determine the impacts of governance on economic growth. The results of their study show that when voice and accountability are employed as a single proxy for governance indicators, a 10 per cent increase in voice and accountability results in a 68 per cent rise in real income per capita, implying that a significant and positive relationship exists between the two variables. The results of the short run estimates are reported in Appendix E. Table 4.6, on the other hand, presents a summary of the results of the speed of adjustment. The error correction term (ECT) is a measure of the speed of adjustment and is the most important part of the short run analysis.

Table 5.6 PARDL short run results

Short Run	Coefficient	Probability
ECI	0.646207	0.7510
COC	-0.038166	0.6981
GE	0.006360	0.9226
RQ	0.171734	0.0158
PS	0.097045	0.4603
V and A	-0.156982	0.3876
Short run (speed of adjustment) -0.590657		

Source: Author's computations

According to Gujarati and Porter (2009), the speed of adjustment should always be negative, which means that a positive speed suggests that the model consists of instabilities or specification challenges, and will, therefore, fail to converge in the long run. The error correction term for this model is reported in Table 5.6 as -0.590657, which has an expected negative sign and supports the expected apriori. This is quite satisfactory as the speed of adjustment is 59%, indicating that this model will converge back to equilibrium at a faster pace. A satisfactory ECT such as this one validates the stability of the model and cointegration between the variables. In addition, it implies that there is a long run causality between the dependent and independent variables, which suggests that it takes approximately 59% for GDP to converge back to equilibrium, which is not a relatively slow speed.

5.2.5 Engle-Granger causality test results

The existence of a cointegration relationship between GDP and its determinants (economic complexity, control of corruption, government effectiveness, regulatory quality, political stability as well as voice and accountability) was established as indicated in Tables 5.5 and 5.6. Henceforth, the study proceeds to employ the Granger causality test to determine the existence of a causal relationship between these variables. Table 5.7 reports a summary of the test results with the full results presented in Appendix F.

Table 5.7 Granger Causality results

NULL HYPOTHESIS	PROBABILITY
ECI does not Granger Cause GDP GDP does not Granger Cause ECI	0.4899 0.2349
COC does not Granger Cause GDP GDP does not Granger Cause COC	0.9519 0.3590
GE does not Granger Cause GDP GDP does not Granger Cause GE	0.7163 0.7575
RQ does not Granger Cause GDP GDP does not Granger Cause RQ	0.1968 0.6422
PS does not Granger Cause GDP GDP does not Granger Cause PS	0.4785 0.8629
V and A do not Granger Cause GDP GDP does not Granger Cause V and A	0.3610 0.6500
COC does not Granger Cause ECI ECI does not Granger Cause COC	0.4954 0.2162
GE does not Granger Cause ECI ECI does not Granger Cause GE	0.1369 0.6397
RQ does not Granger Cause ECI ECI does not Granger Cause RQ	0.4116 0.4005
PS does not Granger Cause ECI ECI does not Granger Cause PS	0.8035 0.7018
V and A do not Granger Cause ECI ECI does not Granger Cause V and A	0.9753 0.8341
GE does not Granger Cause COC COC does not Granger Cause GE	0.0009 0.4728
RQ does not Granger Cause COC COC does not Granger Cause RQ	0.0713 0.7497
PS does not Granger Cause COC COC does not Granger Cause PS	0.1634 0.2179
V and A do not Granger Cause COC COC does not Granger Cause V and A	0.1710 0.0287

Source: Author's computations

According to the results depicted in Table 5.7, there is no directional relationship between GDP and the economic complexity index, suggesting that the two variables do not influence each other, thus the null hypothesis of no causality cannot be rejected. Similarly, the control of corruption does not Granger cause economic growth, implying that the null hypothesis of Granger causality cannot be rejected.

Regulatory quality does not Granger cause economic growth or vice-versa as their p-value is greater than a 5% level of significance. This suggests that the study cannot reject the null hypothesis of no causality. Similarly, political stability and economic growth do not Granger cause each other as they consist of a p-value which is not statistically significant. Therefore, the study fails to reject the null hypothesis of no causality. Furthermore, it is assumed that in the period 2002-2017, a change in voice and accountability did not alter a change in economic growth, suggesting that the two variables do not influence each other. Therefore, the study fails to reject the null hypothesis of no causality. All the given dependent variables of this model do not granger cause the dependent variable.

Sorensen (2005) specifies that the validity of the VAR Granger causality is determined by the existence of Granger causality in at least one direction. On that note, this model finds that government effectiveness does granger cause the control of corruption as its p-value is reported as 0.0009, which is significant at 1%, which implies that the null hypothesis is rejected at a 1% level of significance as it is unidirectional. Similarly, the results reveal that the control of corruption does granger cause voice and accountability at a 1% level of significance given a p-value of 0.0287%.

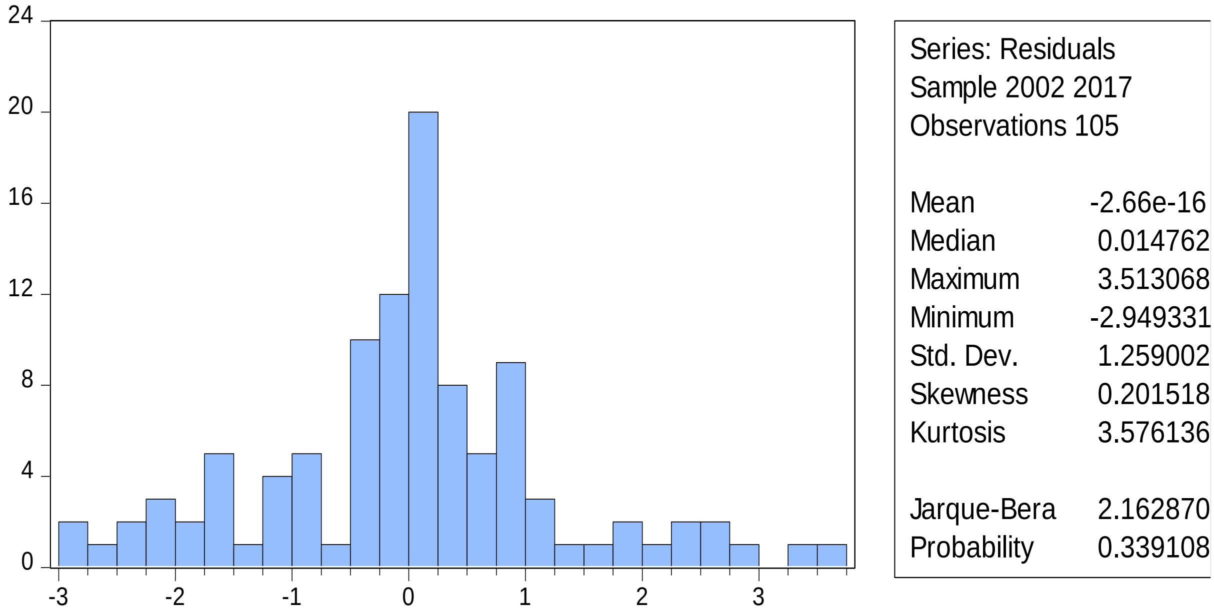
5.2.6 Diagnostic test results

Diagnostic tests have been carried out to check whether the model is of good fit and has been specified correctly. Probability values are used to determine whether to reject or accept the null hypothesis. The general rule of diagnostic tests assumes that the null hypothesis should be accepted provided that the p-values of the variables are above a 5% level of significance, and vice versa is true. A summary of these tests is presented in Figures 5.8 and 5.9 as well as Tables 5.8 and 5.9.

5.2.6.1 Normality test results

Gujarati and Porter (2009) emphasise the importance of running diagnostic tests to validate inferences mentioned earlier in building this model. The Jarque-Bera test of normality is employed to determine if the error term follows a normal distribution and that the results of the PARDL determined are not spurious.

Figure 5.8: The Jarque-Bera normality results



Source: Author's computations

Figure 5.8 reports a probability value of 0.339108, which is greater than a 5% level of significance; hence the study fails to reject the null hypothesis that suggests that residuals are normally distributed. This is further justified by a kurtosis of 3.6, which is greater than 3%.

5.2.6.2 Serial correlation LM test results

The Lagrange Multiplier (LM) was employed to determine the existence of a serial correlation between the variables of the model. The test was also used to establish if the model suffers from serial correlation or autocorrelation. The lack of serial correlation implies that the model is significant. Table 5.9 shows a summary of the LM test, and the complete output of the results is in Appendix G.

Table 5.8: Autocorrelation LM test results

LAGS	LM-STAT	PROBABILITY
1	58.87470	0.1577
2	44.07085	0.6728
3	47.19783	0.5465
4	42.15879	0.7447
5	45.46052	0.6174

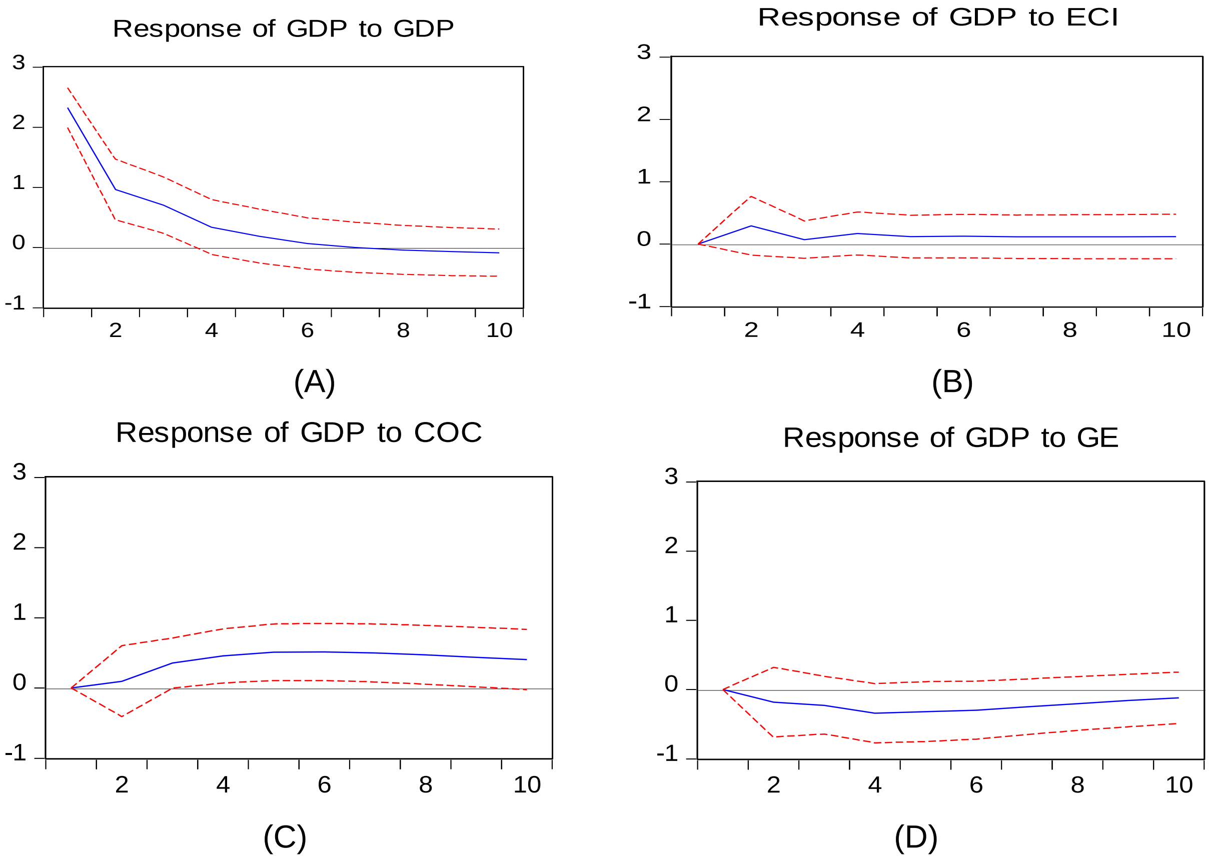
Source: Author's computations

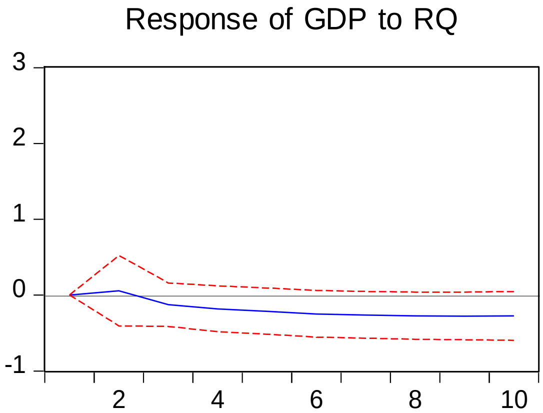
The probability values for all lags in Table 5.8 are all greater than a 5% level of significance, and as a result, the study cannot reject the null hypothesis of no serial correlation, which suggests that the model is statistically significant.

5.2.7 Impulse Response Function (IRF) test results

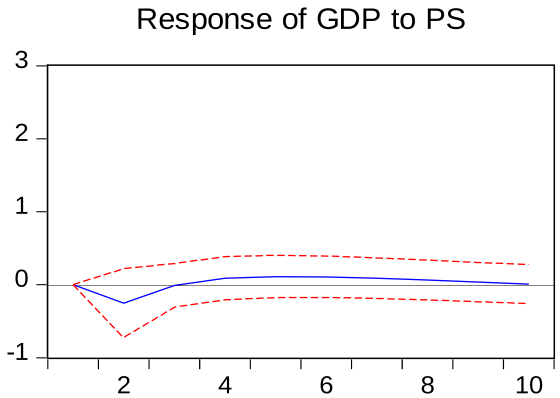
Figure 5.9 below presents the impulse response function results of GDP to response to Cholesky, one SD innovations ± 2 SE for 2002-2017.

Figure 5.9: Response of GDP to Cholesky, one SD innovations

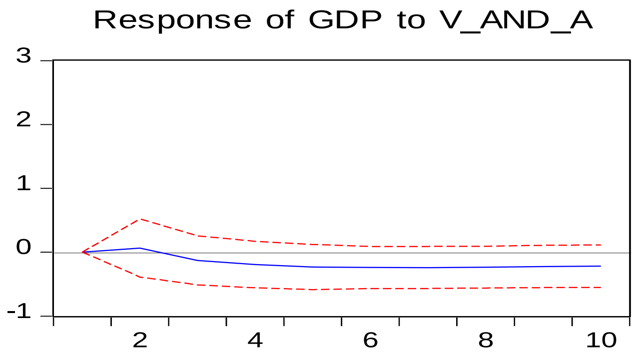




(E)



(F)



(G)

Source: Author's computations

GDP on the IRF graphs depicted above is represented by a blue line. According to plot (a), GDP responds negatively to its shock. Such a conclusion is based on the illustration in the plot (a), which shows that from year 1 the variable starts responding positively at zero until year 6, where it becomes negative and reaches its lowest level between year 6 to year 10. On the other hand, plots d, e, f and g depict the response of GDP to shocks from government effectiveness, regulatory quality, political stability and voice and accountability, respectively. The results show that GDP responds negatively to any shock from these variables because its line is lying below the zero line throughout the investigation. On the contrary, GDP tends to respond positively to any shocks in economic complexity and control of corruption as depicted in the plot (b) and plot(c), respectively. This is because GDP is observed to be responding positively and significantly to ECI and COC as its line lies above the zero line.

5.2.8 Variance decomposition results

The variance decomposition was employed to indicate how the variance or forecast of a given variable is impacted by a shock that occurred to one variable. Table 4.10 depicts the summary of these test results.

Table 5.9: Variance decomposition results

VARIANCE DECOMPOSITION OF GDP								
PERIOD	S.E	GDP	ECI	COC	GE	RQ	PS	V and A
1	2.326193	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.558128	96.94154	1.320530	0.141672	0.510648	0.049643	0.970739	0.065225
3	2.693939	94.26851	1.262881	1.869515	1.165762	0.265640	0.876522	0.291170
4	2.794095	89.11367	1.547303	4.418977	2.582692	0.669356	0.914232	0.753774
5	2.886224	83.93809	1.620239	7.260534	3.649067	1.172034	1.002944	1.357089
6	2.972112	79.20854	1.708808	9.830226	4.445056	1.799403	1.076979	1.930983
7	3.048373	75.29507	1.773850	12.02721	4.889177	2.447260	1.109230	2.458201
8	3.114985	72.12632	1.839727	13.80404	5.102422	3.105440	1.104254	2.917801
9	3.172845	69.56492	1.910222	15.21623	5.165948	3.746424	1.077000	3.319261
10	3.223308	67.47389	1.989159	16.31734	5.144745	4.358882	1.044157	3.671827

Source: Author's computations

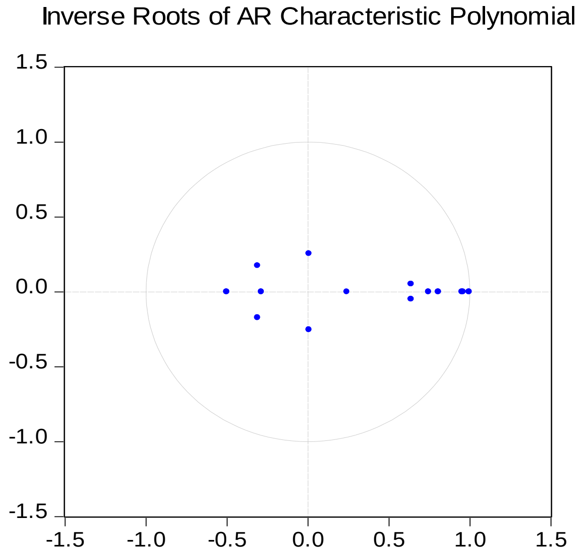
The results presented in Table 5.9 indicate that in the short run or period 3, innovation towards GDP accounts for a 94.27% variation of the influence in GDP or its shock. This implies that GDP is strongly endogenous and significant. Similarly, the short run shocks on ECI may result in 1.3% fluctuations in GDP, while control of corruption, government effectiveness, regulatory quality, political stability, as well as voice and accountability may result in 1.26, 1.87, 1.66, 0.27,0.88 and 0.29% influences on GDP, respectively. This suggests that these variables exhibit a weak influence on GDP in a short period.

Furthermore, Table 5.9 reveals that in the long run, which is illustrated by period 10, GDP is shown to be a strong predictor of its variable as any shock to GDP results in about 67% change variation of fluctuations in GDP (own shock). Analogous to the short run, the economic complexity index, control of corruption, governance, regulatory quality, political stability as well as voice and accountability all seem to be strongly exogenous, implying that they do not have much influence on GDP in all periods.

Conclusively, GDP exhibits a strong influence on itself or is greatly shocked by its innovations in the short and long run because from periods 1-10, its percentages are more than percentages from other variables.

5.2.9 Stability test results

Figure 5.10 AR roots graph



Source: Author's computations

To confirm the stability of the model, the Inverse Roots of the Polynomial depicted in Figure 5.10 was employed. The results show that all roots consist of a modulus which is less than one and all lie within the unit circle. This implies that the model is stable and has no unit root.

5.3 Chapter overview

This chapter provided an empirical analysis of the linkage between economic complexity, governance, and economic growth for Africa's top-performing countries. The chapter included the model estimations as well as interpretations. The study began by testing for stationarity by employing both the formal and informal panel unit roots, which showed that variables are integrated at orders 0 and 1. The lag length selection criteria advocated for the use of lag one in running the model.

Furthermore, the Pedroni and Kao cointegration tests were employed to test whether there is a long run relationship among the variables under study. The results of the two tests confirmed that there is cointegration between the variables of interest. The results of the PARDL model revealed that economic growth is positively influenced by economic complexity, government effectiveness, regulatory quality, and political stability. The control of corruption and voice and accountability governance indicators was found to be negatively related to economic growth.

The normality and significance of the model were verified by employing diagnostic tests such as the Jarque-Bera and the LM test. The results of these tests show that the model is significant and normally distributed.

The next chapter deals with the conclusion and recommendations of the study.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Summary and interpretation of findings

This chapter provides an overview of the research findings, the conclusion as well as recommendations. Also included in this chapter are the limitations of the study and possible areas for future research. This study gave an account of the linkage of economic complexity, governance, and economic growth for Africa's top-performing countries from 2002-2017.

Numerous theories were employed to provide meaningful insight into the behaviours of economic complexity, governance, and economic growth, particularly in the countries of interest. These theories included the Solow Neoclassical growth theory, the Endogenous Growth theory, and the New Growth theory. The explanatory variables of the study were economic complexity, control of corruption, government effectiveness, regulatory quality, political stability and voice and accountability, whilst the dependent variable was economic growth proxied by GDP per capita (annual %). The panel unit root tests, namely, the IPS, Fisher-ADF, Fisher-PP and LLC were conducted to test for stationarity of the variables, which were found to be stationary at I(0) and I(1), which justified the use of the PARDL approach for the analysis. The results revealed the presence of cointegration, which implied that in the long run, the variables of the study tend to move together.

The results of the study indicated that economic growth is positively related to economic complexity, government effectiveness, regulatory quality, and political stability. Furthermore, the results showed that the control of corruption and voice and accountability governance indicators are both negatively related to economic growth. This implies that an increase in these variables will lead to a decrease in economic growth, ceteris paribus.

Governance and economic complexity have greater impacts on the financial system of any given economy as this study showed how both phenomena are linked to economic growth.

It is concluded that economic complexity and sound governance are of paramount importance in the ever-growing competitive world market. Due to this revelation, corporations and the government should always strive to develop policies and make decisions aimed at strengthening the power of economic complexity and sound governance.

6.2 Recommendations of the study

The results of the study indicated the presence of a long run relationship between the variables under investigation. The control of corruption and voice and accountability indicators have shown to have negative impacts on economic growth rates, making it essential for government policymakers to urgently come up with policies geared towards promoting the voice and accountability of the people and tightening the control of corruption. In addition, the study recommends increased levels of decentralisation as this will result in a decline in the levels of corruption by bringing the government closer to the people and ensuring that government officials can be held accountable when the need arises.

To help alleviate poverty, institutional capacity must be strengthened and well reformed. It is also recommended by the study that African countries adopt policies that enhance private ownership as well as proper legal protection for existing and potential investors like what has been seen working well for South Korea.

On the other hand, economic complexity was found to be also a major determinant of growth; hence to help boost ECI, the study recommends that private partnerships take part in financing large infrastructural projects that produce complex goods such as industrial zones. Furthermore, African oil-exporting countries like Nigeria, Algeria, Ghana, and Egypt may also consider implementing policies aimed at improving the management of their natural resources. In addition, these policies may include how better and more efficiently revenues derived from these natural resources can be managed.

6.3 Limitations of the study

The limitations of this study include high collinearity concerning the governance indicators. In addition, data constraints were also a huge limitation wherein there was a lack of adequate data between 2002-2017, which failed to employ certain tests that are essential to the study.

6.4 Areas for future research

There is limited literature related to the current study, most especially in the African context. More studies need to be conducted on this phenomenon by either employing the same variables as that of this study or by incorporating different variables to further analyse the linkage between economic complexity, governance, and economic growth of the world countries. Most importantly, this study incorporated multiple governance indicators on an individual capacity instead of compositing them into a single governance index. Therefore, an invitation is extended to future researchers to criticise or prove the accuracy of this model.

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APPENDICES

Appendix A: DATA USED IN THE STUDY

COUNTRY	YEAR	GDP	ECI	COC	GE	RQ	PS	V&A
Morocco	2002	1,893661	-0.6974	50,51	51,02	49,49	37,04	34,83
Morocco	2003	4,71076	-0.703	47,98	53,06	45,41	32,16	26,87
Morocco	2004	3,56844	-0.6104	52,68	53,20	46,80	35,44	33,65
Morocco	2005	2,084365	-0.4742	47,32	46,57	40,20	29,13	26,44
Morocco	2006	6,321998	-0.4194	39,51	51,22	49,51	30,92	16,00
Morocco	2007	2,324166	-0.3548	44,66	50,97	49,03	27,54	27,88
Morocco	2008	4,667119	-0.4585	41,75	48,54	49,03	25,96	25,96
Morocco	2009	2,964337	-0.3575	45,45	50,72	51,67	31,28	27,96
Morocco	2010	2,485684	-0.4621	52,86	50,24	50,72	32,70	28,91
Morocco	2011	3,835245	-0.3618	42,18	48,82	50,24	33,65	27,70
Morocco	2012	1,580555	-0.3253	39,81	52,61	50,24	32,70	29,11
Morocco	2013	3,060308	-0.4729	44,08	54,03	48,34	28,91	27,23
Morocco	2014	1,229529	-0.4319	50,00	50,48	49,52	29,52	27,59
Morocco	2015	3,103111	-0.574	52,40	50,96	49,04	33,81	28,57
Morocco	2016	-0,28666	-0.6081	53,85	49,52	45,19	34,29	29,56
Morocco	2017	2,896264	-0.5766	52,40	45,19	44,71	30,95	28,57
South Africa	2002	2,397938	0.2966	68,18	75,00	70,92	38,62	67,66
South Africa	2003	1,696812	0.3405	69,19	73,98	75,00	35,68	67,66
South Africa	2004	3,289048	0.3014	71,22	73,40	71,43	40,29	71,63
South Africa	2005	3,98203	0.2581	70,73	71,57	71,08	40,78	68,75
South Africa	2006	4,27776	0.1793	70,73	67,80	71,57	47,83	19,00
South Africa	2007	4,008496	0.1029	63,59	68,45	66,50	50,72	65,87
South Africa	2008	1,8235	0.1335	63,11	69,42	65,53	46,15	64,90
South Africa	2009	-2,89873	0.1285	63,16	67,46	64,59	41,23	65,88
South Africa	2010	1,551071	0.1321	62,38	66,51	62,20	45,02	67,30
South Africa	2011	1,721528	-0.0428	58,77	66,35	63,03	48,82	66,67
South Africa	2012	0,609713	0.0495	55,45	63,98	63,51	43,13	66,20
South Africa	2013	0,854081	0.0967	56,40	66,35	64,45	45,02	66,20
South Africa	2014	0,246658	0.1544	54,81	65,87	62,98	40,00	68,97
South Africa	2015	-0,34498	0.0871	58,17	64,90	62,98	39,52	69,95
South Africa	2016	-1,0679	-0.0113	61,06	65,38	62,02	40,00	69,46
South Africa	2017	-0,01234	-0.0339	56,73	65,87	62,50	34,76	68,97
Nigeria	2002	12,45747	-1.7065	0,51	11,73	11,73	7,41	29,85
Nigeria	2003	4,657786	-1.6002	4,55	15,82	10,20	6,03	29,35
Nigeria	2004	6,489604	-2.3516	6,34	15,27	7,88	4,85	24,52
Nigeria	2005	3,721624	-2.2429	12,20	21,08	23,53	6,31	23,56
Nigeria	2006	3,326218	-2.0742	10,73	16,59	19,12	2,42	18,00
Nigeria	2007	3,822072	-2.092	14,08	16,02	19,42	3,86	25,48
Nigeria	2008	3,97251	-1.7968	19,42	16,50	20,87	5,29	27,40
Nigeria	2009	5,197954	-1.6652	16,27	8,61	24,88	4,27	25,12
Nigeria	2010	5,158545	-1.895	15,24	10,53	26,32	2,84	27,96
Nigeria	2011	2,525322	-1.8758	10,90	13,27	27,01	3,32	27,23
Nigeria	2012	1,472851	-1.6056	10,90	16,59	26,07	3,32	27,23

Nigeria	2013	3,853723	-1.6781	9,48	16,59	27,01	3,79	27,70
Nigeria	2014	3,513977	-1.9002	8,17	12,02	23,56	5,24	29,56
Nigeria	2015	-0,02928	-2.1798	12,50	16,35	21,63	6,19	34,98
Nigeria	2016	-4,16839	-1.7944	13,46	12,50	18,27	6,19	34,98
Nigeria	2017	-1,78882	-1.7646	12,50	15,38	16,83	5,24	35,47
Algeria	2002	4,262072	-0.9264	23,23	31,12	29,59	6,88	18,91
Algeria	2003	5,840905	-0.994	28,79	31,12	32,14	5,53	18,91
Algeria	2004	2,934542	-1.1848	27,80	34,48	30,05	10,68	23,56
Algeria	2005	4,438258	-0.8213	40,00	39,22	42,65	20,39	25,48
Algeria	2006	0,214792	-1.0785	36,59	38,05	29,41	15,46	15,00
Algeria	2007	1,808253	-1.6796	34,47	32,52	27,18	14,01	20,19
Algeria	2008	0,738195	-1.3281	33,01	31,07	21,36	14,90	20,67
Algeria	2009	-0,13468	-1.4756	33,49	35,41	12,92	13,27	17,54
Algeria	2010	1,746791	-1.0764	36,67	38,76	9,57	11,85	18,48
Algeria	2011	0,98021	-1.8721	35,07	36,02	9,95	10,43	20,19
Algeria	2012	1,401748	-1.7405	37,44	35,07	9,00	9,48	22,54
Algeria	2013	0,761699	-1.5256	39,34	35,07	11,85	12,80	23,94
Algeria	2014	1,710455	-1.4274	32,21	35,10	8,17	9,52	25,12
Algeria	2015	1,600494	-1.2822	29,81	35,58	10,58	11,90	24,63
Algeria	2016	1,10457	-1.1902	27,88	35,58	10,10	12,38	23,65
Algeria	2017	-0,75046	-0.8612	30,29	30,77	10,58	16,19	23,15
Ethiopia	2002	-1,35474	-1.3006	33,33	17,86	12,24	14,81	13,43
Ethiopia	2003	-4,9113	-1.4022	30,81	18,88	12,76	10,05	16,92
Ethiopia	2004	10,40753	-1.2012	26,34	20,69	15,76	11,65	16,35
Ethiopia	2005	8,73309	-1.1586	23,41	18,63	12,75	5,83	11,54
Ethiopia	2006	7,808742	-1.1226	30,73	29,27	16,18	7,25	16,00
Ethiopia	2007	8,437275	-1.0003	31,07	39,81	17,96	6,76	12,98
Ethiopia	2008	7,793017	-0.795	29,13	42,23	19,90	8,65	12,50
Ethiopia	2009	5,843986	-0.8887	26,32	38,76	20,57	6,64	11,37
Ethiopia	2010	9,460612	-0.9203	28,10	40,67	21,53	5,69	10,90
Ethiopia	2011	8,094846	-1.0306	28,44	39,34	18,01	6,16	10,33
Ethiopia	2012	5,616571	-0.9013	32,23	40,76	14,69	7,11	11,74
Ethiopia	2013	7,499868	-1.1448	37,91	32,23	12,80	8,06	12,68
Ethiopia	2014	7,213184	-1.1476	39,42	38,46	13,46	8,57	12,81
Ethiopia	2015	7,391469	-0.8208	40,87	29,81	12,98	8,10	12,81
Ethiopia	2016	6,509712	-1.0904	39,90	28,85	11,54	7,62	9,85
Ethiopia	2017	6,68456	-0.8482	33,17	24,04	13,94	7,62	9,85
Ghana	2002	1,973759	-1.2508	44,44	53,57	40,74	36,73	49,75
Ghana	2003	2,645163	-1.0431	48,99	51,02	42,21	46,43	57,21
Ghana	2004	3,008591	-1.0275	50,24	50,25	47,09	41,38	54,33
Ghana	2005	3,267292	-0.9738	43,90	49,02	51,94	51,96	57,21
Ghana	2006	3,716463	-0.9119	56,59	60,49	46,38	51,96	16,00
Ghana	2007	1,689118	-0.6796	58,25	57,77	40,58	52,43	60,58
Ghana	2008	6,371073	-0.8314	55,34	56,80	43,75	53,40	58,65
Ghana	2009	2,211067	-0.812	59,33	53,11	45,50	54,07	61,61
Ghana	2010	5,249331	-0.7899	57,62	53,59	46,92	54,55	63,03
Ghana	2011	11,31541	-0.5275	57,35	53,55	52,61	55,45	62,44
Ghana	2012	6,733556	-1.0496	54,98	53,08	50,71	56,40	61,97
Ghana	2013	4,847518	-0.7114	55,45	50,24	47,87	55,45	62,44
Ghana	2014	0,525774	-1.116	52,40	43,75	41,43	53,37	61,58
Ghana	2015	-0,17005	-1.2189	52,88	46,15	44,29	53,85	64,04
Ghana	2016	1,07696	-0.9011	52,40	47,60	40,95	45,67	67,49

Ghana	2017	5,754349	-0.916	49,04	49,04	50,95	49,52	67,49
Egypt	2002	0,481793	-0.381	42,42	41,33	35,71	31,22	16,42
Egypt	2003	1,293196	-0.3409	35,35	44,90	27,55	27,64	18,41
Egypt	2004	2,203154	-0.3632	29,27	47,29	33,00	21,36	21,63
Egypt	2005	2,602211	-0.3376	31,22	40,69	38,73	26,70	21,15
Egypt	2006	4,967393	-0.3055	25,37	36,10	36,76	22,22	16,00
Egypt	2007	5,228311	-0.2334	24,27	43,20	43,20	27,05	14,90
Egypt	2008	5,267155	-0.1419	23,79	43,20	49,51	28,85	13,46
Egypt	2009	2,740087	-0.2179	36,36	47,37	46,89	25,59	14,22
Egypt	2010	3,080842	-0.2101	30,95	42,11	46,89	19,43	13,74
Egypt	2011	-0,36393	-0.1766	25,59	35,07	41,23	6,64	14,08
Egypt	2012	-0,01296	-0.1394	33,18	23,22	33,65	7,58	25,82
Egypt	2013	-0,10597	-0.1115	31,75	20,85	29,38	7,11	16,90
Egypt	2014	0,616851	-0.0356	30,77	20,19	26,44	7,62	14,78
Egypt	2015	2,093736	-0.1394	30,77	22,12	22,12	8,57	14,78
Egypt	2016	2,132015	-0.1594	31,25	27,88	17,79	9,05	14,29
Egypt	2017	2,02558	-0.0677	35,58	29,33	17,31	9,05	13,30

Appendix B: PANEL UNIT ROOT TEST

Appendix B1: GDP unit root tests

LEVEL

Panel unit root test: Summary
Series: GDP
Date: 10/11/21 Time: 22:58
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.43515	0.0000	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.68879	0.0000	7	98
ADF - Fisher Chi-square	37.6463	0.0006	7	98
PP - Fisher Chi-square	43.3650	0.0001	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: GDP
Date: 10/11/21 Time: 22:59
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.3318	0.0000	7	98
Breitung t-stat	-0.54852	0.2917	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.79570	0.0000	7	98
ADF - Fisher Chi-square	35.4288	0.0013	7	98
PP - Fisher Chi-square	44.1193	0.0001	7	105

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

None

Panel unit root test: Summary
Series: GDP
Date: 10/11/21 Time: 22:59
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.64135	0.0001	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	27.7230	0.0155	7	98
PP - Fisher Chi-square	32.0047	0.0040	7	105

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

1ST DIFFERENCE

Individual intercept

Panel unit root test: Summary
Series: D(GDP)
Date: 10/11/21 Time: 23:00
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.24331	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.65882	0.0000	7	91
ADF - Fisher Chi-square	64.6020	0.0000	7	91
PP - Fisher Chi-square	110.421	0.0000	7	98

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

Individual Trend and Intercept

Panel unit root test: Summary
Series: D(GDP)
Date: 10/11/21 Time: 23:01
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.54727	0.0002	7	91
Breitung t-stat	-1.71726	0.0430	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.18304	0.0000	7	91
ADF - Fisher Chi-square	43.8139	0.0001	7	91
PP - Fisher Chi-square	91.5801	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(GDP)
Date: 10/11/21 Time: 23:01
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.8300	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	89.5495	0.0000	7	91
PP - Fisher Chi-square	131.262	0.0000	7	98

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

Appendix B2: ECI unit root tests

LEVEL

Individual intercept

Panel unit root test: Summary
Series: ECI
Date: 10/11/21 Time: 23:02
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.69417	0.0035	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.39236	0.0819	7	98
ADF - Fisher Chi-square	19.9386	0.1321	7	98
PP - Fisher Chi-square	22.0673	0.0772	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: ECI
Date: 10/11/21 Time: 23:03
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.43755	0.0003	7	98
Breitung t-stat	0.59637	0.7245	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.37535	0.3537	7	98
ADF - Fisher Chi-square	15.9878	0.3141	7	98
PP - Fisher Chi-square	15.0773	0.3729	7	105

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

None

Panel unit root test: Summary
Series: ECI
Date: 10/11/21 Time: 23:03
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.37218	0.0088	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	21.9275	0.0801	7	98
PP - Fisher Chi-square	31.7805	0.0043	7	105

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

Differenced ECI

Individual intercept

Panel unit root test: Summary
Series: D(ECI)
Date: 10/11/21 Time: 23:04
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.26756	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.47362	0.0000	7	91
ADF - Fisher Chi-square	46.0828	0.0000	7	91
PP - Fisher Chi-square	96.2766	0.0000	7	98

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

Individual trend and intercept

Panel unit root test: Summary
Series: D(ECI)
Date: 10/11/21 Time: 23:04
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.15608	0.0000	7	91
Breitung t-stat	-2.98945	0.0014	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.38519	0.0004	7	91
ADF - Fisher Chi-square	36.3297	0.0009	7	91
PP - Fisher Chi-square	103.835	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(ECI)
Date: 10/11/21 Time: 23:05
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.73204	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	76.7583	0.0000	7	91
PP - Fisher Chi-square	126.169	0.0000	7	98

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

Appendix B3: COC unit root tests

LEVEL

Individual intercept

Panel unit root test: Summary
Series: COC
Date: 10/11/21 Time: 23:06
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.44477	0.0743	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.48744	0.0684	7	98
ADF - Fisher Chi-square	20.5619	0.1134	7	98
PP - Fisher Chi-square	27.3372	0.0174	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: COC
Date: 10/11/21 Time: 23:06
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.89952	0.0287	7	98
Breitung t-stat	-0.28058	0.3895	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.27122	0.3931	7	98
ADF - Fisher Chi-square	13.9040	0.4569	7	98
PP - Fisher Chi-square	23.9132	0.0469	7	105

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

None

Panel unit root test: Summary
Series: COC
Date: 10/11/21 Time: 23:07
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.00384	0.1577	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	8.75023	0.8467	7	98
PP - Fisher Chi-square	9.37723	0.8062	7	105

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

1ST DIFFERENCE

Individual intercept

Panel unit root test: Summary
Series: D(COC)
Date: 10/11/21 Time: 23:07
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.75226	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.68462	0.0001	7	91
ADF - Fisher Chi-square	38.8676	0.0004	7	91
PP - Fisher Chi-square	67.0212	0.0000	7	98

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

Individual intercept and trend

Panel unit root test: Summary
Series: D(COC)
Date: 10/11/21 Time: 23:08
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.91427	0.0000	7	91
Breitung t-stat	-1.33052	0.0917	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.65868	0.0039	7	91
ADF - Fisher Chi-square	31.6797	0.0044	7	91
PP - Fisher Chi-square	81.0658	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(COC)
Date: 10/11/21 Time: 23:08
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.03768	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	72.6169	0.0000	7	91
PP - Fisher Chi-square	107.307	0.0000	7	98

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

Appendix B4: GE unit root tests

LEVEL

Individual intercept

Panel unit root test: Summary
Series: GE
Date: 10/11/21 Time: 23:09
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.93611	0.0017	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.53270	0.0057	7	98
ADF - Fisher Chi-square	29.9854	0.0077	7	98
PP - Fisher Chi-square	25.1215	0.0334	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: GE
Date: 10/11/21 Time: 23:10
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.77009	0.0384	7	98
Breitung t-stat	0.36485	0.6424	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.44080	0.3297	7	98
ADF - Fisher Chi-square	18.2508	0.1956	7	98
PP - Fisher Chi-square	9.98677	0.7631	7	105

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

None

Panel unit root test: Summary
Series: GE
Date: 10/11/21 Time: 23:11
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.97359	0.0242	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	13.4693	0.4899	7	98
PP - Fisher Chi-square	17.2202	0.2446	7	105

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

1st DIFFERENCE

Individual intercept

Panel unit root test: Summary
Series: D(GE)
Date: 10/11/21 Time: 23:12
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.23046	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.20238	0.0000	7	91
ADF - Fisher Chi-square	44.0966	0.0001	7	91
PP - Fisher Chi-square	63.1344	0.0000	7	98

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

Individual intercept and trend

Panel unit root test: Summary
Series: D(GE)
Date: 10/11/21 Time: 23:12
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.11195	0.0000	7	91
Breitung t-stat	-3.29073	0.0005	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.41675	0.0003	7	91
ADF - Fisher Chi-square	37.6352	0.0006	7	91
PP - Fisher Chi-square	67.7385	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(GE)
Date: 10/11/21 Time: 23:13
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.47306	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	75.4814	0.0000	7	91
PP - Fisher Chi-square	98.2468	0.0000	7	98

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

Appendix B5: RQ unit root tests

LEVEL

Individual intercept

Panel unit root test: Summary
Series: RQ
Date: 10/11/21 Time: 23:14
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.07331	0.1416	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.62741	0.2652	7	98
ADF - Fisher Chi-square	15.8943	0.3199	7	98
PP - Fisher Chi-square	14.2423	0.4318	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: RQ
Date: 10/11/21 Time: 23:15
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.34441	0.6347	7	98
Breitung t-stat	0.24473	0.5967	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.56066	0.9407	7	98
ADF - Fisher Chi-square	6.71539	0.9451	7	98
PP - Fisher Chi-square	8.07399	0.8854	7	105

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

None

Panel unit root test: Summary
Series: RQ
Date: 10/11/21 Time: 23:15
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.47949	0.0066	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	17.4966	0.2307	7	98
PP - Fisher Chi-square	13.7165	0.4710	7	105

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

1ST DIFFERENCE

Individual intercept

Panel unit root test: Summary
Series: D(RQ)
Date: 10/11/21 Time: 23:16
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.16830	0.1213	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.11868	0.0171	7	91
ADF - Fisher Chi-square	24.7285	0.0373	7	91
PP - Fisher Chi-square	72.4538	0.0000	7	98

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

Individual intercept and trend

Panel unit root test: Summary
Series: D(RQ)
Date: 10/11/21 Time: 23:17
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.38667	0.0004	7	91
Breitung t-stat	-2.49282	0.0063	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.03138	0.0211	7	91
ADF - Fisher Chi-square	27.2290	0.0180	7	91
PP - Fisher Chi-square	80.5353	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(RQ)
Date: 10/11/21 Time: 23:17
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.87067	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	51.0340	0.0000	7	91
PP - Fisher Chi-square	107.066	0.0000	7	98

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

Appendix B6: PS unit root tests

LEVEL

Individual intercept

Panel unit root test: Summary
Series: PS
Date: 10/11/21 Time: 23:18
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.38217	0.0835	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.84439	0.0326	7	98
ADF - Fisher Chi-square	23.4493	0.0533	7	98
PP - Fisher Chi-square	37.3636	0.0006	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: PS
Date: 10/11/21 Time: 23:19
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.78514	0.2162	7	98
Breitung t-stat	2.03350	0.9790	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.53890	0.7050	7	98
ADF - Fisher Chi-square	11.1063	0.6777	7	98
PP - Fisher Chi-square	19.2609	0.1552	7	105

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

None

Panel unit root test: Summary
Series: PS
Date: 10/11/21 Time: 23:19
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.60957	0.2711	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	12.4008	0.5742	7	98
PP - Fisher Chi-square	17.5191	0.2296	7	105

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

1ST DIFFERENCE

Individual intercept

Panel unit root test: Summary
Series: D(PS)
Date: 10/11/21 Time: 23:20
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.43105	0.0762	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.47875	0.0066	7	91
ADF - Fisher Chi-square	28.3916	0.0126	7	91
PP - Fisher Chi-square	85.9665	0.0000	7	98

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

Individual intercept and trend

Panel unit root test: Summary
Series: D(PS)
Date: 10/11/21 Time: 23:20
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.38157	0.0836	7	91
Breitung t-stat	-3.08818	0.0010	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.27613	0.0114	7	91
ADF - Fisher Chi-square	28.3696	0.0127	7	91
PP - Fisher Chi-square	104.122	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(PS)
Date: 10/11/21 Time: 23:21
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.94412	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	59.9920	0.0000	7	91
PP - Fisher Chi-square	127.290	0.0000	7	98

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

Appendix B7: V&A unit root tests

LEVEL

Individual intercept

Panel unit root test: Summary
Series: V_AND_A
Date: 10/11/21 Time: 23:22
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.35770	0.0092	7	98
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.18497	0.1180	7	98
ADF - Fisher Chi-square	18.6826	0.1774	7	98
PP - Fisher Chi-square	37.4466	0.0006	7	105

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

Individual intercept and trend

Panel unit root test: Summary
Series: V_AND_A
Date: 10/11/21 Time: 23:22
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.22298	0.0000	7	98
Breitung t-stat	-1.78514	0.0371	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.26343	0.1032	7	98
ADF - Fisher Chi-square	18.9095	0.1684	7	98
PP - Fisher Chi-square	47.0841	0.0000	7	105

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

None

Panel unit root test: Summary
Series: V_AND_A
Date: 10/11/21 Time: 23:23
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.65089	0.2576	7	98
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	9.47482	0.7995	7	98
PP - Fisher Chi-square	8.84409	0.8409	7	105

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

1ST DIFFERENCE

Individual intercept

Panel unit root test: Summary
Series: D(V_AND_A)
Date: 10/11/21 Time: 23:23
Sample: 2002 2017
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.28407	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.92932	0.0000	7	91
ADF - Fisher Chi-square	59.6191	0.0000	7	91
PP - Fisher Chi-square	151.143	0.0000	7	98

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

Individual intercept and trend

Panel unit root test: Summary
Series: D(V_AND_A)
Date: 10/11/21 Time: 23:24
Sample: 2002 2017
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.00076	0.0000	7	91
Breitung t-stat	-6.63923	0.0000	7	84
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.06221	0.0000	7	91
ADF - Fisher Chi-square	42.1046	0.0001	7	91
PP - Fisher Chi-square	116.049	0.0000	7	98

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

None

Panel unit root test: Summary
Series: D(V_AND_A)
Date: 10/11/21 Time: 23:24
Sample: 2002 2017
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.3895	0.0000	7	91
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	97.1012	0.0000	7	91
PP - Fisher Chi-square	141.781	0.0000	7	98

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

Appendix C: LAG LENGTH CRITERIA

VAR Lag Order Selection Criteria
Endogenous variables: GDP ECI COC GE RQ PS V_AND_A
Exogenous variables: C
Date: 10/11/21 Time: 23:35
Sample: 2002 2017
Included observations: 70

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1496.941	NA	1.08e+10	42.96973	43.19458	43.05905
1	-972.5995	928.8328	13772.64*	29.38856	31.18735*	30.10306*
2	-930.0061	66.93256*	17217.63	29.57160	32.94435	30.91130
3	-891.4473	52.88067	25819.75	29.86992	34.81661	31.83481
4	-847.0210	52.04217	36544.85	30.00060	36.52124	32.59068
5	-791.0123	54.40849	44124.09	29.80035	37.89493	33.01562
6	-720.7779	54.18079	46600.76	29.19365*	38.86218	33.03411

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix D: PANEL COINTEGRATION RESULTS

Appendix D1: The Pedroni cointegration test

Individual intercept

Pedroni Residual Cointegration Test
Series: GDP ECI COC GE RQ PS V_AND_A
Date: 10/12/21 Time: 00:08
Sample: 2002 2017
Included observations: 112
Cross-sections included: 7
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Automatic lag length selection based on SIC with a max lag of 1
Newey-West automatic bandwidth selection and Bartlett kernel

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

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.494177	0.6894	-1.490258	0.9319
Panel rho-Statistic	1.808506	0.9647	1.546480	0.9390
Panel PP-Statistic	-4.588780	0.0000	-3.783839	0.0001
Panel ADF-Statistic	-3.966671	0.0000	-3.651130	0.0001

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

	Statistic	Prob.
Group rho-Statistic	2.659192	0.9961
Group PP-Statistic	-4.078674	0.0000
Group ADF-Statistic	-3.646139	0.0001

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
Morocco	-0.072	0.922350	1.110061	2.00	15
South Africa	-0.213	1.261299	1.129066	2.00	15
nigeria	-0.233	3.835653	3.835653	0.00	15
Algeria	-0.328	0.271767	0.279832	1.00	15
Ethopia	-0.208	8.759824	4.049633	4.00	15
Ghana	-0.183	1.993387	1.993387	0.00	15
Egypt	-0.091	0.729294	0.421846	4.00	15

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
Morocco	-0.072	0.922350	0	1	15
South Africa	-0.213	1.261299	0	1	15
nigeria	-0.233	3.835653	0	1	15
Algeria	-0.328	0.271767	0	1	15
Ethopia	-0.208	8.759824	0	1	15
Ghana	-0.183	1.993387	0	1	15
Egypt	-0.091	0.729294	0	1	15

Individual intercept and individual trend

Pedroni Residual Cointegration Test
Series: GDP ECI COC GE RQ PS V_AND_A
Date: 10/12/21 Time: 00:10
Sample: 2002 2017
Included observations: 112
Cross-sections included: 7
Null Hypothesis: No cointegration
Trend assumption: Deterministic intercept and trend
Automatic lag length selection based on SIC with a max lag of 1
Newey-West automatic bandwidth selection and Bartlett kernel

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

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.808566	0.7906	-2.060957	0.9803
Panel rho-Statistic	2.628973	0.9957	2.285235	0.9889
Panel PP-Statistic	-4.133787	0.0000	-4.466727	0.0000
Panel ADF-Statistic	-3.318301	0.0005	-3.662426	0.0001

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

	Statistic	Prob.
Group rho-Statistic	3.142179	0.9992
Group PP-Statistic	-10.66154	0.0000
Group ADF-Statistic	-4.986813	0.0000

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
Morocco	-0.468	0.529666	0.529666	0.00	15
South Africa	-0.351	1.035433	0.633927	3.00	15
nigeria	-0.293	1.970013	0.720892	5.00	15
Algeria	-0.368	0.262241	0.262241	0.00	15
Ethopia	-0.182	8.398221	6.021060	3.00	15
Ghana	-0.143	1.986698	1.986698	0.00	15
Egypt	-0.600	0.189226	0.031937	14.00	15

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
Morocco	-0.468	0.529666	0	1	15
South Africa	-0.351	1.035433	0	1	15
nigeria	-0.293	1.970013	0	1	15
Algeria	-0.368	0.262241	0	1	15
Ethopia	-0.182	8.398221	0	1	15
Ghana	-0.143	1.986698	0	1	15
Egypt	-1.311	0.154548	1	1	14

No intercept or trend

Pedroni Residual Cointegration Test
Series: GDP ECI COC GE RQ PS V_AND_A
Date: 10/12/21 Time: 00:10
Sample: 2002 2017
Included observations: 112
Cross-sections included: 7
Null Hypothesis: No cointegration
Trend assumption: No deterministic intercept or trend
Automatic lag length selection based on SIC with a max lag of 1
Newey-West automatic bandwidth selection and Bartlett kernel

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

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.765325	0.7780	-1.643119	0.9498
Panel rho-Statistic	2.455529	0.9930	2.001208	0.9773
Panel PP-Statistic	-1.148551	0.1254	-1.116052	0.1322
Panel ADF-Statistic	-1.053965	0.1459	-1.141576	0.1268

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

	Statistic	Prob.
Group rho-Statistic	3.108477	0.9991
Group PP-Statistic	-2.440927	0.0073
Group ADF-Statistic	-1.636369	0.0509

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
Morocco	-0.016	0.981109	1.203665	2.00	15
South Africa	0.006	1.931352	0.834566	8.00	15
nigeria	0.471	5.028701	5.445256	1.00	15
Algeria	-0.498	0.273399	0.182710	3.00	15
Ethopia	-0.069	9.849879	3.016195	5.00	15
Ghana	1E-04	2.636862	2.597700	1.00	15
Egypt	0.362	1.242503	1.242503	0.00	15

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
Morocco	-0.016	0.981109	0	1	15
South Africa	0.006	1.931352	0	1	15
nigeria	0.471	5.028701	0	1	15
Algeria	-0.498	0.273399	0	1	15
Ethopia	-0.069	9.849879	0	1	15
Ghana	1E-04	2.636862	0	1	15
Egypt	0.362	1.242503	0	1	15

Appendix D2: Kao Cointegration test

Individual intercept

Dependent Variable: D(GDP)
Method: ARDL
Date: 10/12/21 Time: 00:14
Sample: 2003 2017
Included observations: 105
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): ECI COC GE RQ PS V_AND_A
Fixed regressors: C
Number of models evalulated: 1
Selected Model: ARDL(1, 1, 1, 1, 1, 1, 1)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
		Long Run Equation		
ECI	0.010737	0.149587	0.071775	0.9431
COC	-0.068110	0.011045	-6.166556	0.0000
GE	0.054169	0.016243	3.334897	0.0016
RQ	0.124820	0.002628	47.49514	0.0000
PS	-0.143485	0.022523	-6.370582	0.0000
V_AND_A	-0.090583	0.020466	-4.426030	0.0001
		Short Run Equation		
COINTEQ01	-0.590657	0.156219	-3.780957	0.0004
D(ECI)	0.646207	2.025096	0.319099	0.7510
D(COC)	-0.038166	0.097817	-0.390177	0.6981
D(GE)	0.006360	0.065127	0.097660	0.9226
D(RQ)	0.171734	0.068762	2.497489	0.0158
D(PS)	0.097045	0.130427	0.744057	0.4603
D(V_AND_A)	-0.156982	0.180097	-0.871653	0.3876
C	3.317345	0.934779	3.548801	0.0009

Mean dependent var	-0.069551	S.D. dependent var	2.738744
S.E. of regression	1.815759	Akaike info criterion	3.341954
Sum squared resid	164.8490	Schwarz criterion	4.846837
Log likelihood	-125.1494	Hannan-Quinn criter.	3.952533

*Note: p-values and any subsequent tests do not account for model selection.

Appendix F: GRANGER-CAUSALITY TEST RESULTS

Pairwise Granger Causality Tests
Date: 10/12/21 Time: 00:19
Sample: 2002 2017
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
ECI does not Granger Cause GDP	98	0.71908	0.4899
GDP does not Granger Cause ECI		1.47132	0.2349
COC does not Granger Cause GDP	98	0.04929	0.9519
GDP does not Granger Cause COC		1.03586	0.3590
GE does not Granger Cause GDP	98	0.33488	0.7163
GDP does not Granger Cause GE		0.27861	0.7575
RQ does not Granger Cause GDP	98	1.65446	0.1968
GDP does not Granger Cause RQ		0.44501	0.6422
PS does not Granger Cause GDP	98	0.74291	0.4785
GDP does not Granger Cause PS		0.14771	0.8629
V_AND_A does not Granger Cause GDP	98	1.03022	0.3610
GDP does not Granger Cause V_AND_A		0.43281	0.6500
COC does not Granger Cause ECI	98	0.70781	0.4954
ECI does not Granger Cause COC		1.55689	0.2162
GE does not Granger Cause ECI	98	2.03173	0.1369
ECI does not Granger Cause GE		0.44896	0.6397
RQ does not Granger Cause ECI	98	0.89614	0.4116
ECI does not Granger Cause RQ		0.92412	0.4005
PS does not Granger Cause ECI	98	0.21930	0.8035
ECI does not Granger Cause PS		0.35545	0.7018
V_AND_A does not Granger Cause ECI	98	0.02497	0.9753
ECI does not Granger Cause V_AND_A		0.18172	0.8341
GE does not Granger Cause COC	98	4.01155	0.0213
COC does not Granger Cause GE		2.59248	0.0802
RQ does not Granger Cause COC	98	1.11487	0.3323
COC does not Granger Cause RQ		2.12539	0.1251
PS does not Granger Cause COC	98	1.08693	0.3415
COC does not Granger Cause PS		1.17831	0.3123
V_AND_A does not Granger Cause COC	98	0.31298	0.7320
COC does not Granger Cause V_AND_A		0.98951	0.3756
RQ does not Granger Cause GE	98	0.34728	0.7075
GE does not Granger Cause RQ		0.69449	0.5019
PS does not Granger Cause GE	98	2.10954	0.1271
GE does not Granger Cause PS		0.58350	0.5600
V_AND_A does not Granger Cause GE	98	0.88387	0.4166
GE does not Granger Cause V_AND_A		0.92008	0.4021
PS does not Granger Cause RQ	98	4.25937	0.0170
RQ does not Granger Cause PS		0.14497	0.8652
V_AND_A does not Granger Cause RQ	98	2.31390	0.1045
RQ does not Granger Cause V_AND_A		2.35262	0.1008
V_AND_A does not Granger Cause PS	98	2.70940	0.0718
PS does not Granger Cause V_AND_A		3.91448	0.0233

Appendix G: DIAGNOSTIC TEST RESULTS

Appendix G2: AUTO CORRELATION LM TEST RESULTS

VAR Residual Serial Correlation LM T...
Null Hypothesis: no serial correlation a...
Date: 10/12/21 Time: 00:23
Sample: 2002 2017
Included observations: 98

Lags	LM-Stat	Prob
1	58.87470	0.1577
2	44.07085	0.6728
3	47.19783	0.5465
4	42.15879	0.7447
5	45.46052	0.6174
6	41.54975	0.7661

Probs from chi-square with 49 df.

APPENDIX H : VARIENCE DECOMPOSITION

Variance Decomposition of GDP:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	2.326193	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.558128	96.94154	1.320530	0.141672	0.510648	0.049643	0.970739	0.065225
3	2.693939	94.26851	1.262881	1.869515	1.165762	0.265640	0.876522	0.291170
4	2.794095	89.11367	1.547303	4.418977	2.582692	0.669356	0.914232	0.753774
5	2.886224	83.93809	1.620239	7.260534	3.649067	1.172034	1.002944	1.357089
6	2.972112	79.20854	1.708808	9.830226	4.445056	1.799403	1.076979	1.930983
7	3.048373	75.29507	1.773850	12.02721	4.889177	2.447260	1.109230	2.458201
8	3.114985	72.12632	1.839727	13.80404	5.102422	3.105440	1.104254	2.917801
9	3.172845	69.56492	1.910222	15.21623	5.165948	3.746424	1.077000	3.319261
10	3.223308	67.47389	1.989159	16.31734	5.144745	4.358882	1.044157	3.671827

Variance Decomposition of ECI:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	0.195429	0.481044	99.51896	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.234567	0.360770	92.69085	0.000944	4.310365	2.432266	0.000189	0.204619
3	0.268074	0.592556	92.41309	0.121942	3.952296	2.190384	0.032112	0.697623
4	0.295592	1.049453	91.09874	0.543206	3.774493	2.392336	0.064298	1.077476
5	0.318058	1.522758	89.92320	0.942526	3.660650	2.438456	0.071307	1.441107
6	0.337670	1.910038	88.88988	1.287540	3.642325	2.503720	0.069706	1.696794
7	0.354495	2.179288	88.00102	1.542051	3.747549	2.573215	0.063591	1.893288
8	0.369287	2.357383	87.26200	1.716440	3.931415	2.645498	0.059264	2.028002
9	0.382381	2.465783	86.62393	1.831100	4.177352	2.721062	0.059260	2.121514
10	0.394094	2.527007	86.06891	1.902224	4.458263	2.797521	0.063688	2.182387

Variance Decomposition of COC:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	4.125124	0.602897	0.769889	98.62721	0.000000	0.000000	0.000000	0.000000
2	5.293404	0.384880	0.682200	96.22731	1.400047	0.184008	0.966213	0.155344
3	6.024103	0.719276	0.594128	93.76432	3.085132	0.325831	1.200751	0.310566
4	6.585840	1.467687	0.552303	89.95692	5.664289	0.310815	1.254439	0.793543
5	7.049388	2.225045	0.583057	86.38052	7.985974	0.330084	1.266248	1.229076
6	7.450722	2.830403	0.666329	83.28152	9.898168	0.330993	1.313344	1.679240
7	7.800164	3.277109	0.765731	80.79534	11.38754	0.333613	1.375717	2.064952
8	8.108686	3.582140	0.883122	78.81639	12.51004	0.333073	1.461034	2.414202
9	8.383485	3.787318	1.001878	77.23914	13.36473	0.330788	1.558766	2.717385
10	8.630355	3.922357	1.119858	75.95870	14.01896	0.326361	1.666381	2.987385

Variance Decomposition of GE:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	4.009718	2.714777	0.162013	6.323162	90.80005	0.000000	0.000000	0.000000
2	5.591932	4.128881	0.083581	3.923997	89.78499	7.17E-06	2.052941	0.025600
3	6.449593	5.289839	0.384740	4.031714	87.76856	2.01E-05	2.357003	0.168124
4	7.044207	5.831820	0.608272	5.028334	85.45054	0.000865	2.459748	0.620420
5	7.484564	6.044189	0.869542	6.599164	82.87355	0.005049	2.552365	1.056141
6	7.844677	6.090620	1.137340	8.430551	80.13938	0.006935	2.675408	1.519770
7	8.151546	6.064643	1.378729	10.32296	77.48927	0.008804	2.792052	1.943545
8	8.422717	6.002256	1.601079	12.15093	74.98375	0.009235	2.910623	2.342130
9	8.666462	5.930555	1.794333	13.84813	72.69071	0.008924	3.024769	2.702575
10	8.888218	5.860514	1.962676	15.38241	70.61619	0.008517	3.136799	3.032890

Variance Decomposition of RQ:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	4.052109	19.21715	2.790777	0.056978	4.769569	73.16552	0.000000	0.000000
2	5.501116	22.78239	1.516046	3.338616	6.837006	63.30817	0.697694	1.520077
3	6.497825	23.66268	1.681938	4.562754	7.953473	59.08567	0.562545	2.490942
4	7.321432	23.86414	1.581249	5.305824	9.034155	56.44255	0.475517	3.296565
5	7.956908	23.80972	1.610046	5.683200	9.523271	54.74753	0.590002	4.036229
6	8.480334	23.57081	1.620034	5.734689	9.770159	53.61185	0.906266	4.786197
7	8.916321	23.27555	1.605785	5.607845	9.861303	52.73325	1.387249	5.529015
8	9.294228	22.94791	1.568477	5.376265	9.858005	51.96470	2.001445	6.283202
9	9.631194	22.61939	1.509769	5.100018	9.804390	51.21815	2.705675	7.042604
10	9.940252	22.29909	1.438641	4.816683	9.721351	50.44604	3.468444	7.809755

Variance Decomposition of PS:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	3.580047	5.922090	0.257413	10.01863	1.737474	11.52975	70.53464	0.000000
2	4.519284	7.532149	0.267258	10.67296	1.475310	10.89368	69.10487	0.053784
3	5.263375	8.459713	0.199049	12.30352	1.286304	10.51753	66.33254	0.901340
4	5.843733	9.171604	0.269584	14.39975	1.383309	9.788096	63.31682	1.670841
5	6.374271	9.571572	0.333927	16.21051	1.497190	9.077090	60.43758	2.872130
6	6.852645	9.904558	0.462056	17.88498	1.680801	8.412816	57.60731	4.047483
7	7.301339	10.14206	0.607328	19.30303	1.886905	7.817822	54.94426	5.298589
8	7.723405	10.34310	0.780744	20.51597	2.120373	7.286982	52.46205	6.490784
9	8.125480	10.51154	0.966258	21.51969	2.365201	6.818846	50.18102	7.637455
10	8.509638	10.66399	1.163158	22.34835	2.616747	6.405635	48.09557	8.706546

Variance Decomposition of V_AND_A:

Period	S.E.	GDP	ECI	COC	GE	RQ	PS	V_AND_A
1	8.511461	1.250334	0.012464	0.352141	0.114150	0.104722	1.62E-05	98.16617
2	9.445285	2.484106	1.024170	0.944187	0.331063	1.470482	0.652041	93.09395
3	10.50078	2.627208	1.261673	0.885499	0.369166	1.344296	1.269630	92.24253
4	11.02594	2.441256	2.424356	0.888258	0.528547	1.290778	1.304287	91.12252
5	11.59144	2.210639	3.166952	0.820696	0.672654	1.619355	1.672269	89.83744
6	12.06262	2.171397	4.236131	0.762144	0.914224	1.997461	1.960124	87.95852
7	12.54265	2.310365	5.124384	0.704922	1.136644	2.529708	2.388978	85.80500
8	13.00677	2.651386	6.041506	0.655679	1.362610	3.068324	2.827096	83.39340
9	13.47232	3.118527	6.859459	0.611235	1.549996	3.608027	3.330683	80.92207
10	13.93226	3.675711	7.632808	0.571868	1.704495	4.100683	3.860591	78.45384

Cholesky Ordering: GDP ECI COC GE RQ PS V_AND_A