

**THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND UNEMPLOYMENT IN
SOUTH AFRICA.**

by

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DISSERTATION

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DECLARATION

I, **MASHAMAITE PRECIOUS MAPHEYAHA** declare that this dissertation **THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND UNEMPLOYMENT IN SOUTH AFRICA**, is my original work. I have not used any other than permitted reference sources or materials nor engaged in any plagiarism. All references and other sources used have been appropriately acknowledged in the work. The work has not been submitted for the purpose of academic examination, either in its original or similar form anywhere else.

Student:

Signature

Date

DEDICATION

Every challenging work needs self-efforts as well as guidance of elders especially those who were close to our hearts. My sincere gratitude goes to my sweet and loving parents, whose affection, prayers, love and encouragement made me where I am today. Your love and support are much appreciated, may the Heavenly Father bless you always and forever.

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ABSTRACT

The concepts of economic growth and unemployment are at the beginning of the most important variables in the sense that all economies are choosing and implementing economic policies. The study examined the relationship between economic growth and unemployment in South Africa during 2005 to 2016 using the quarterly time series data. Cointegration test, Vector Error Correction Model (VECM) and granger causality test were employed in the analysis. The variables utilized in the investigation include the gross domestic product (LGDP), unemployment rate (UN), labour productivity (LP) and government budget deficit (GD). Stationarity test was conducted and the results indicated that all the variables were found stationary at first difference. Johansen Cointegration test confirmed that the long run relationship exist among variables under the study. More so, the VECM results showed that unemployment (UN) has a negative and insignificant impact on the gross domestic product (LGDP). Finally, the study also tested the granger causality between the variables to determine the short run relationship. Based on the findings above, the study therefore recommends that the government needs to cut taxes for businesses and individuals to increase investment spending to stimulate economic growth. Moreover, government should as a matter of urgency create more employment opportunities to absorb the teeming population of the unemployed labour force in the country through modernization of the agricultural sector, bring in modern equipment in the facilities of agriculture to make the sector more attractive to all citizens despite one's qualifications and professions, as that alone would go a long way in reducing unemployment level in the country.

Key words: Economic growth, Unemployment, VECM, South Africa.

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CHAPTER 1: ORIENTATION OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND

Reducing unemployment and achieving a high rate of economic growth are the most important priorities of developed and developing country economies. In terms of the success of a country's economy, economic growth and employment are two extremely important macroeconomic variables and are indispensable elements of the economic policies of many countries (Soylu, 2017). Economic growth, an indicator of welfare of a country, is measured by GNP or its per capita value. In most macroeconomic books, the concept of economic growth is defined as the increase in the amount of goods and services produced in a country during the time of progress. If we consider that there are many countries with different economic sizes all over the world, we can see that some of these countries are very rich, some are very poor, and a great majority is among these two extremes. Some of these countries are growing very fast, but some countries are either too slow or not growing at all. For this reason, researching the reasons for these differences in growth between countries and examining the concept of economic growth has become the focus of attention (Friedman, 2006).

Another macroeconomic variable that is as important as economic growth and which is of particular concern to countries is unemployment. Unemployment represents the level of employment in which people have the desire and ability to work and want to pay but who cannot find jobs. Unemployment arises from the economic structure of a country, and it arises from different reasons depending on whether it is a developed or underdeveloped country. The reason for unemployment in underdeveloped countries is capital inadequacy, while in developed countries technological progress is the reason (Yilmaz, 2005).

In South Africa, economy is growing at a slow pace as compared to other countries and this has been the case since the last quarter to December 2015. According to Lehohla (2015) GDP grew by only 1.3 per cent, seasonally adjusted and annualized. In the last quarter of 2014 GDP grew by 4.1 percent and the Stats SA announced that unadjusted real GDP expanded by 2.1 per cent over the first quarter of 2014 (StatsSA, 2009-2015). Moreover, the quarterly growth was lower than expected, hit by falling production in agriculture and manufacturing. In the previous years, the South African economy suffered

from the lengthy strikes on the platinum belt, experienced electricity problems (load shedding) and all these cite a host of policies hostile toward investors, which are likely part of the problem causing low business confidence. The key issue became that load shedding was taking its toll. Nene (2015) acknowledged that these power outages translate to a loss in production and jobs. Nene (2015) also responded to the GDP figures arguing that it is clear that the South African economy has lost momentum over the past years. This is partly due to strikes in the mining and manufacturing sectors coupled with regular electricity shortages with constant threats of further blackouts.

Theoretically, economic growth is viewed as the most important instrument for reducing unemployment and poverty. Economic growth helps to improve living standard of people. Kreishan (2011) states that an increase in the growth rate of GDP of an economy is expected to increase employment levels thus reducing unemployment. This is a widely accepted view in economic theory. Hence, the theoretical proposition relating output and unemployment is known as Okun's law. Okun's law demonstrates one of the well known empirical relationships between output and unemployment in macroeconomics theory and has been found to hold for several countries especially developed countries (Lee, 2000). Osinubi (2005) discovered that economic growth is necessary for reducing unemployment and poverty. However, it is not sufficient since economic growth alone cannot overcome all the crucial factors that contribute to poverty and unemployment. Therefore, there is a need to adopt more policies that help to construct investment programs which enable job creation, thus, stimulating economic growth and eradicating poverty.

According to Statistic South Africa, the unemployment rate in South Africa fell to 26.5 percent in the last three months of 2016 from a high 27.1 percent in the previous period (StatsSA, 2016). Employment rose while unemployment fell and more people have continued to join the labour force, bringing the participation rate up to a new high since 2002. Unemployment rate in South Africa averaged 25.37 percent during the period 2000-2016. Nevertheless, many people are also added to the list of those unemployed and discouraged job seekers.

The issue of unemployment in South Africa is well pronounced as evidenced by many people who dropped out of school, graduates who cannot find jobs and those who engage in jobs in which their potential are not fully utilized (Banda, et al., 2016). Isobel (2006) emphasizes that the persistent nature of unemployment in South Africa is reflected by the

fact that many unemployed people have never worked before. The youth occupies a large fraction of the unemployed population in the country.

The increase in unemployment has been more pronounced on average in European countries compared to the US, although the GDP growth rate has been following a similar pattern in both regions. Implicitly, this suggests that the relationship between these variables is not the same among economies (Haruyama & Leith, 2000). This empirical evidence is highlighted in certain empirical and econometric studies. Caballero (1993) found a weak positive relationship between growth and unemployment in US and UK from 1966 to 1989. Bean & Pissarides (1993) performed a cross-country analysis for OECD countries and did not find any link between growth and unemployment, except for a negative relationship during 1975 to 1985. Herwartz & Niebuhr (2011) developed an econometric model to study the relationship between growth and unemployment, taking Okun's law as a starting point. In their study, they found that the relationship between these variables changes across countries and crucially depends on labour market framework.

The current economic growth has seriously challenged a bedrock assumption in economics. It is a widely accepted view that the growth rate of GDP directly affects employment. If the GDP rises, then employment rises and unemployment falls. Many studies confirm the existence of a trade-off between economic growth and change rate of unemployment prevailing in the economy. The theoretical analysis of unemployment may lose its importance if it does not take into account the causal relationship in real world and economic policy does not aim at reducing unemployment rate and increasing growth rate.

1.2 STATEMENT OF THE PROBLEM

Unemployment is a global problem that almost every country is faced with. Even rich countries are compelled to invest significant resources in creating jobs and developing the economy with the aim of reducing unemployment (Peterson, 2010). South Africa has a high unemployment rate that directly causes poverty in the country. Statistics shows that at the last quarters from 2014 to 2016 the rate of unemployment has increased from 24.3% in 2014 to 24.5% in 2015 and it went extremely high to the rate of 26.5% in the last quarter of 2016. South Africa is also faced with slow growth economy as compared to other countries and this has been the case since the recession in 2009 (Stats SA, 2015). A slow

growth rate causes higher unemployment even though it is not always the case. During 2010 to 2013, the UK experienced a slow rate of economic growth, but unexpectedly unemployment fell. Nevertheless, if there is a poor growth, we expect a rise in unemployment (Stephan, 2012). This is because if there is less demand for goods, businesses produce less and so will need less workers. In recession, other business will go bankrupt making many people redundant and firms will be reluctant to hire workers when there is uncertainty and poor growth. (StatsSA, 2009-2015).

On the other hand, instances of a rise in unemployment may be experienced even if there is economic growth. Such growth originates from enhancement in technology and labour productivity. It means that firms can produce more goods and services from the same number of workers. Economic growth of 0.6% per year means that supply of such goods and services would be increasing faster than demand. Therefore, firms may have to lay off workers because there is insufficient demand (Okun, 1965).

1.3 RESEARCH AIM AND OBJECTIVES

1.3.1 Aim of the study

The study aims to investigate the relationship between economic growth and unemployment in South Africa during the period 2005-2016.

1.3.2 Objectives of the study

The objectives of the study includes the following:

- To determine the impact of economic growth on unemployment in South Africa.
- To examine the direction of causality between economic growth and unemployment in South Africa.
- To assess the response of shocks from the variables in the study.
- To make policy recommendations to boost economic growth and reduce unemployment levels in South Africa.

1.4 RESEARCH QUESTIONS

Based on the preceding two successive sub-sections, the research questions include:

- What is the relationship between unemployment and economic growth in South Africa?
- Does unemployment granger cause economic growth in South Africa?
- Does unemployment respond positively to shock from economic growth in South Africa?

1.5 SIGNIFICANCE OF THE STUDY

Full employment is one of the macroeconomic goals of any country. Unemployment is seen as a policy failure and there is cooperation on the part of government in defeating the impact of unemployment in an economy (StatsSA, 2009-2015). South Africa is in the crisis of slow growth rate and unemployment rate in the country is a day-to-day problem. The purpose of this study is to investigate the relationship between economic growth and unemployment in South Africa. This study will add to the existing literature on the current scenario of unemployment rate in South Africa and its correlation to the GDP. The study of economic growth and unemployment will be of immense benefit to researchers (Davies, 2014). The study will also be important in aiding the government, policy makers, economic planners, researchers and academia generally. The findings of the study will benefit policy makers in formulating and implementing appropriate policy measures to reduce unemployment and boost economic growth in South Africa.

CHAPTER 2: AN OVERVIEW OF ECONOMIC GROWTH AND UNEMPLOYMENT IN SOUTH AFRICA.

2.1 INTRODUCTION

This chapter looks at issues about economic growth, labour market, labour productivity and unemployment in South Africa.

2.2 DEFINITION OF CONCEPTS

2.2.1 Economic growth

In this study, gross domestic product (GDP) will be used as a proxy for economic growth. According to Krugman (2000) Gross Domestic Products refers to value of all finished goods and services produced within the borders of the country in a specific period. Economic growth or GDP can be measured in both real and nominal terms. Real GDP refers to the value of economic output produced in a given period, adjusted according to the changes in the general price level. Nominal GDP is the aggregate market value of the economic output produced in a year within the boundaries of the countries (Swan, 1956).

2.2.2 Unemployment

Unemployment occurs when a person who is actively searching for employment is unable to find work (Bean & Pissarides, 1993). This implies that unemployment rate measures the percentage of employable people in a country's workforce who are over the age of 16 and who have either lost their jobs or have been unsuccessful to secure jobs in the last month and are still actively seeking work (Moosa, 2008).

2.3 ECONOMIC GROWTH IN SOUTH AFRICA.

The South African economy is one of the largest in Africa accounting for 24% of the continent's GDP (Stephan, 2012). Since 1996, at the end of over twelve years of international sanctions, South Africa's GDP has almost tripled to \$400 billion. The country is rich in natural resources and is a leading producer of platinum, gold,

chromium and iron. From 2002 to 2008, South Africa grew at an average of 4.5 per cent year-on-year (StatsSA, 2009). However, in recent years, successive governments have failed to address successfully the country's structural problems such as the widening gap between the rich and the poor, low skilled labour force, high unemployment rate, deteriorating infrastructure, high corruption and crime rate. As a result, since the recession in 2009, South Africa's growth has been sluggish and below the African average (StatsSA, 2012).

According to the StatsSA (2017) the country's economy unexpectedly contracted an annualized 0.7 per cent in the first three months of 2017, following 0.3 per cent drop in the previous period and compared to market expectations of a 0.9 per cent expansion. The growth rate of the South African economy is lagging many of the developing countries in Sub-Saharan countries that have stable governments in place. To the north, Nigeria and Egypt are the 2nd and 3rd largest economies in Africa respectively, both of which are politically unstable. All of the Sub-Saharan countries are substantially smaller than South Africa and are growing off a much lower base. South Africa is the largest member of the Southern African Development Community (SADC) and plays a leading economic role among the 15 member nations (SADC, 2012).

The World Bank rates the South African economy as an upper-middle income economy, one of only four African countries, the others being, Mauritius, Botswana and Gabon (World Bank, 2012). However, the official unemployment rate is still 25% high and quarter of the population live on \$1.25 per day. Nevertheless, since the end of apartheid in 1994, the black middle class has grown substantially and the gross domestic product has increased from US\$136 billion to US\$408 billion. Per capita GDP has not increased proportionately, thus increasing the wealth gap between the rich and the poor to unacceptable levels. This has led to an increase in labour unrest which is hampering new investment and increasing the unemployment rate.

The largest industries, as measured by their nominal value added in the second quarter of 2012, were as follows (StatsSA, 2012):

- Finance, real estate and business services – 21.0 per cent;

- General government services – 16.7 per cent;
- Wholesale, retail and motor trade; catering and accommodation – 15.8 per cent;
and
- Manufacturing – 11.7 per cent.

The financial sector of the economy is exceptionally well managed, both at the government level and in the private banking sector. The SA banking sector is ranked in the top ten internationally by the WEF Competitiveness Report (2015) in terms of capital ratios. The general soundness and the largest banks in Africa are South African. Fiscal management is also ranked highly with the national debt standing at 40% and the budget deficit at 4.5% of GDP respectively in 2013. The top three provinces in SA in terms of economic value are Gauteng 33.7%, KwaZulu-Natal 15.8% and the Western Cape 14.1% of GDP with the rest of the country contributing 36.4%. Gauteng, the smallest province in terms of land mass, is the industrial heartland of the country (in fact, of the entire continent). KwaZulu-Natal and the Western Cape are industrialized but agriculture and tourism play a major role as well (StatsSA, 2010).

South Africa has one of the fastest growing tourism sectors in the world and Cape Town is ranked as the No. 1 travel destination in the world by TripAdvisor (StatsSA, 2013). Although mining has played a major role in shaping South Africa's political and economic history, the sector only contributes about 20% of the country's GDP. South Africa has the largest gold reserves in the world but lags behind China and Australia in terms of annual production. The country is a major exporter of iron ore and coal. In fact, Richards Bay Coal Terminal is the largest coal export facility in the world (StatsSA, 2012).

The South African economy has grown substantially since the fall of the apartheid government in 1994 but the growth rate has declined markedly in recent years and it is only expected to grow at between 2% and 3.5% in the foreseeable future. In order to reduce the unemployment rate, the economy needs to grow at about 6% plus. The government has introduced a number of incentive schemes to encourage investment but needs to address the current high rate of labour unrest and strikes by relaxing the inflexible labour laws (Roubini, 2016).

2.4 UNEMPLOYMENT IN SOUTH AFRICA.

2.4.1 Types of unemployment

Perhaps, there is a need to look at different types of unemployment namely: Seasonal, structural, frictional and cyclical.

2.4.1.1 Seasonal unemployment

Seasonal unemployment occurs when people are unemployed at certain times of the year, because they work in industries where they are not needed all year round. Njoku & Inugba (2011) argues that seasonal unemployment is due to seasonal variations in the activities of certain industries caused by climate changes, changes in taste or by the permanent nature of such industries. For instance, in the agricultural sector in South Africa, farm workers in Vineyards in the western cape are classified as seasonal workers. They tend to be on high demand during the harvesting period and are unemployed during off period seasons (Banda, et al., 2016).

2.4.1.2 Frictional unemployment

This is when workers leave their jobs but have not yet found new ones. Most of the time workers leave voluntarily, either because they need to move or they have saved up enough money to allow them to look for a better job (Sweezy, 1934). Frictional unemployment also occurs when students are looking for that first job or when parents are returning to the work force. It also happens when workers are fired or in some cases, laid off due to business-specific reasons such as a plant closure. Frictional unemployment is a short term and a natural part of the job search process. In fact, frictional unemployment is good for the economy as it allow workers to move to jobs where they can be more productive (Chatterjee, 1995). This type of unemployment is very common in South Africa, mostly amongst unemployed unskilled labourers as they move from one place to another because there is lack of communication facilities such as telephones, internet and employment stations (Mafiri, 2002).

2.4.1.3 Structural unemployment

This type of unemployment is typically experienced in South Africa. It occurs when there is a change in the structure of an industry or the economic activities of the country (Njoku & Inugba, 2011). Other factors that bring about an increase in unemployment rates are sudden changes in technology, inflation, recession and change in taste and preference, among others. Smit et al. (2006) note that the South African economy experienced rapid technological advancement which led many industries to be more capital intensive, resulting in structural unemployment as human labor is no longer required. According to Yager (2010) structural unemployment is when shifts occur in the economy that creates a mismatch between the skills workers have and the skills needed by the employers. If workers stay unemployed for too long, their skills will likely become outdated. Unless they are willing and able to take lower level and unskilled jobs, they may stay unemployed even when the economy recovers (Pissarides, 1989). If this happens, structural unemployment leads to a higher rate of natural unemployment.

2.4.1.4 Cyclical unemployment

Cyclical unemployment relates to cyclical trends in growth and production that occur within the business cycle. Cyclical unemployment is caused by the contraction phase of the business cycle. That is when demand for goods and services fall dramatically, forcing businesses to lay off workers to cut costs (Barro & Sal-Martin, 1995). Cyclical unemployment tends to create more unemployment. This is because the laid off workers have less money to buy the things they need, further lowering demand (Sweezy, 1934). When business cycles are at their peak, cyclical unemployment will be low because total economic output is being maximized. Mafiri (2002) explains that in South Africa, cyclical unemployment has a dimension that makes it uneasy to address successfully. It could turn to an overlying large scale structural unemployment. As a result, the unemployment problem become severe, complex and difficult to alleviate.

2.4.2 Causes of unemployment

Government describes those who want to work as people who actively looked for jobs within the past four weeks. It determines the number of people currently unemployed through a monthly survey called the current population survey.

People become unemployed for many reasons, the commonest being the following:

2.4.2.1 Lack of skilled and technical training

The business environment is such that there is high demand for skilled employees. This has been necessitated by the incorporation of technology in many business processes. Technologies have been introduced in almost every sphere of the job environment. There is, therefore, a growing demand for skilled and specialized workers. Lack of skilled and technical training will thus make it difficult for an individual to find gainful employment (Aliber, 2007).

2.4.2.2 Lack of education

A majority of those without employment in South Africa are those who lack education. Going to school equips one with relevant skills and the training required in the job place. There are several causes of lack of education. In many cases, people from poor backgrounds lack money to finance their education especially at the tertiary level and therefore drop out of school. Areas with widespread poverty have high unemployment rates. Cultural practices like early marriages also cause girls to drop out of school and start families. It explains why regions where this practice is prevalent, have so many women without jobs or reasonable sources of income (Godfrey, 2003).

2.4.2.3 Underpayment

It can be very frustrating when one works without being adequately compensated for the job done. Underpayment occurs when qualities are not recognized. The employer's primary focus is to increase profit margins at the expense of workers. Workers sometimes have to work very long hours to make ends meet. A person can also be underpaid when he or she is working at a job that does not match the level of education that one has attained. For example, after obtaining a degree in Economics,

you are working as a waiter at Wimpy restaurant. The amount of money spent to acquire a degree dictates that the person is also compensated accordingly. Underpayment leads many people to quit employment due to frustration. This increases the unemployment rate in the country (Kingdon, 2003).

2.4.2.4 Employment of children at lower wages

This is another unethical business practice geared towards increasing profits. It occurs mainly in countries or regions with weak labor laws and institutions. Children are employed as unskilled workers and therefore paid as such. Because of the young age, they are easily manipulated and taken advantage of. A lot of them do not have much responsibilities and therefore the small amount of money paid seems sufficient to them (Levinsohn, 2007).

2.4.3 Consequences of unemployment

Unemployment is undesirable. It brings economic, social and political problems to the society and the economy as a whole. Some of these problems are difficult to value or measure, more specifically the long term social problems. They have countless consequences, for example the high crime rate and robbery among the youth have been traced to unemployment (Smith, 1987).

These are some of the common effects of unemployment.

2.4.3.1 Loss of income

Unemployment normally results in a loss of income. The majority of the unemployed experience a decline in their living standards and are worse off out of work. This leads to a decline in spending power and the rise of falling into debt problems. The unemployed for example may find it difficult to keep up with their mortgage repayments (Dixon, 1992).

2.4.3.2 Loss of national output

Unemployment involves a loss of potential national output (i.e. GDP) and is a waste of scarce resources. If some people choose to leave the labour market permanently because they have lost the motivation to search for work, this can have a negative effect on long run aggregate supply and thereby damage the economy's growth potential. When unemployment is high there will be an increase in spare capacity, in other words the output gap will become negative and this can have negative effects on prices, profits and output. For instance, the GDP of South Africa is growing at a very low pace and this encourages firms not hire more workers, resulting in a high rate of unemployment (McDonald, 1994).

2.4.3.3 Fiscal costs

The government loses out because of a fall in tax revenues and higher spending on welfare payments for families with people out of work. The result can be an increase in the budget deficit which then increases the risk that the government will have to raise taxes further or scale back plans for public spending on public and merit goods. These problems are closely linked to the surge in unemployment (Kirk, 2010).

2.4.3.4 Social unrest

Many people, especially youths, engage in criminal activities when they do not have jobs. Idleness forces them to find something to occupy themselves with. Areas with high rates of unemployment have very high crime rates. Economic stress also causes societal unrest as citizens become frustrated with their situations and try to find ways to attain better lives. This can be perpetrated through civil unrest to get the elected leaders to act and remedy the situation. This is a problem in South Africa, the youth are stealing from their families and the community. Some of them settle for dangerous drugs. These are caused by lack employment in the country (Smith, 1987).

2.4.3.5 Mental stress

Financial success is a key ingredient for peace of mind. When one is always worried about where the next meal will come from or where to get the cash to pay for basic needs such as clothing and education, stress sets in. Depression can also occur when the self-esteem of a person is damaged. An individual who has gone through school, earned a degree and spent a lot of money in the process can become so frustrated with life when he or she is unable to get employment. Depression can lead one to drugs and alcohol abuse as a coping mechanism. There are so many graduates in South Africa with high qualifications but are still struggling to find jobs; this is stressful especially after spending a lot of money to obtain degrees (Gilley, 1993).

2.4.3.6 Decreased demand for consumables

Consumerism is fueled by the purchasing power of the middle class. It leads to increased sales in the retail sector and fuels its growth and that of the country's economy. When people have jobs and are well paid, their purchasing power also improves. Lack of jobs, underpayment and underemployment cause a decrease in the purchasing power of citizens (Weston, 1993).

2.5 LABOUR MARKET IN SOUTH AFRICA

The South African workforce is composed of all the people who are either working or available to work and are actively seeking work. In South Africa, the overall percentage of the working age population that participates in the work force is about 62%. Workforce participation should not be confused with employment. Not everyone in the work force is necessarily working and the work force is composed of both the employed and the unemployed (Saunders, 2013).

The employed are members of the workforce who currently hold jobs and the unemployed are members of the work force who are actively seeking work but unable to find it. South Africa has one of the highest rates of unemployment in the world. According to this definition, the overall unemployment rate of South Africa in 2012 was 25.2%. There are also people who have given up looking for work. If the

definition of unemployment were expanded to include these discouraged workers the rate of unemployment would be 33.8% in 2012 (StatsSA, 2012).

The economy of South Africa grew at an average rate of 4.6% between the years of 2003 and 2008 but has been severely affected by the global financial crisis of 2008. As a result, by the end of the 2008 financial year about 800,000 jobs were lost in the country. Those most affected by job losses were the youth and those with lower levels of education (Goldman Sachs Report, 2013). Unemployment is higher amongst women, 37.5% of females are unemployed, whilst 30.6% of males are unemployed (StatsSA, 2012). There is a very high rate of youth unemployment and over 62.4% of 15-24 year olds in the workforce are unemployed. Unemployment is lowest amongst the 45-54 (18.4%) and 55-65 (11.5%) age groups. Unemployment is highest amongst those who left school without a Grade 12 and lowest amongst those with a Diploma or a Degree.

The number of people employed in each sector of the economy varies greatly. Some sectors have fared better than others in terms of growth in the last few years. The wholesale and retail trade is the biggest employer of people in South Africa, employing 22.8% of the labour force, followed by community, social and personal services (CSP), which employs 21.5% of the workforce. The manufacturing, utilities and construction industries have all had a net decrease in jobs between 2010 and 2012 (StatsSA, 2012).

After the devastating global financial crisis, which triggered the collapse of world markets and a recession locally, South Africa struggled to return to sustained economic growth. Indeed, the year-on-year GDP growth has been below one percent since the third quarter of 2015, and dipped to -0.1 percent in the first quarter of 2016, the lowest since the 2009 global recession (Statistics South Africa, 2016). The picture is even gloomier when population growth is factored in: per capita GDP has been stagnant since 2013, growing only marginally in 2014 and falling marginally in 2015. In this weak economic environment, the labour force face significant difficulties to retain or find employment, particularly at lower skill levels (Warwick, 2014). The South African economy saw a decline in employment of 6.4 percent from 2008 to 2009 sparked by the local effects of the global financial crisis. Subsequently,

employment increased steadily, peaking at 16.0 million jobs in the fourth quarter of 2015.

One of the key issues facing the South African labour market is as an excess of unskilled labour. The government in its aims to redistribute wealth more equitably in South Africa has pushed for an increase in skilled labour. In 2012 unskilled labour accounted for a still high 28.9% of all labour. The government has sought to “up-skill” the labour force by introducing the Skills Development Act (SDA) in 1998 (amended in 2003 and 2006). The Act seeks to develop the skills of the South African workforce, increase investment in education and training in the labour market, encourage employers to make opportunities for learning for their employees, and to redress inequality in employment prospects (StatsSA, 2015).

Using the broad definition of unemployment which includes discouraged job seekers, unemployment has followed an upward trend. In 2008, unemployment was at its lowest, averaging around 5.5 million. For the next six years, the level of unemployment increased continuously, surpassing 8.0 million in 2016. The unemployment rate has risen continually since the 2009 global recession, reaching a high of 34.4 percent in the second quarter of 2016. Despite government’s various efforts to tackle this problem, unemployment remains one of the greatest challenges faced by a significant number of South Africans, particularly the youth (Statistics South Africa, 2015).

2.6 THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND UNEMPLOYMENT

In the short run, the relationship between economic growth and unemployment rate may be a lose one. It is not unusual for the employment rate to show sustained decline even after broad measures of economic activity have turned positive (Levine, 2013). Unemployment may not fall appreciably when the economic growth first recovers after recession ends because some firms may have underutilized workers on their payrolls. Laying off workers when products demand decreases and rehiring them when product demand increases has costs. Employers may initially be able to increase output to meet rising demand at the outset of recovery without hiring

additional workers by raising the productivity of their current employees. This temporarily boosts labour productivity growth above its trend rate in the long run.

Once the labour is fully utilized, output can grow no faster than the rate of productivity growth until firms start adding workers. As an economic expansion progresses, output will be determined by the rates of growth in the labour supply and labour productivity. If employment growth is more rapid than labour force growth, the unemployment rate will fall (McCarthy & Potter, 2012). Over an extended period of time, there is a negative relationship between changes in the rates of real GDP and unemployment. This long run relationship between these two variables was most famously noted in the early 1960's by the economist Arthur Okun. Okun's law has been widely accepted in the economic profession (Alan, 1997). It states that the real GDP growth about equal to the rate of potential output growth, usually is required to attain a stable unemployment rate (Knotek, 2011).

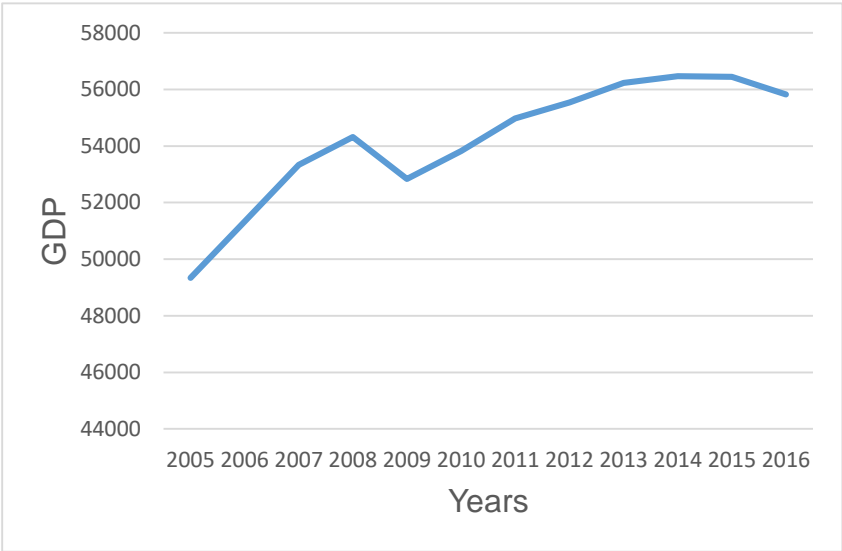
The key to the long run relationship between changes in the rates of GDP growth and unemployment is the rate of growth in potential output. Potential output is an unobservable measure of the capacity of the economy to produce goods and services when available resources such as labour and capital are fully utilized (Gordon, 2008). The rate of growth of potential output is a function of the rate of growth in potential productivity and the labour supply when the economy is at full employment (Mitra, 2002). When the unemployment rate is high, then the actual GDP falls short of potential GDP. This is referred to as the output gap. In the absence of productivity growth, as long as each new addition to the labour force is employed, growth in output will equal growth in the labour supply. If the rate of GDP growth falls below the rate of labour force growth, there will not be enough new jobs created to accommodate all new job seekers (Basu & Fernald, 2009). As a result, the proportion of the labour that is employed will fall. Put differently, the unemployment rate will rise. If the rate of output growth exceeds the rate of labour force growth, some of the new jobs created by employers to satisfy the rising demand for goods and services will be filled by drawing from the pool of unemployed workers. In other words, the unemployment rate will fall (Weidner & Williams, 2010).

If GDP growth equals labour force growth in the presence of productivity growth, more people will be entering the labour force than are needed to produce a given

amount of goods and services. The share of the labour force that is employed will fall (Levine, 2013). Expressed differently, the unemployment rate will rise. For as long as GDP growth exceeds the combined growth rates of the labour force and productivity, the unemployment rate will fall in the long run. Knowing the rate of the GDP might be useful to policy makers interested in undertaking stimulus policies to bring down the unemployment rate. Apparently, the trend of output growth is necessary when tackling the unemployment rate (Bernanke, 2012).

2.7 TRENDS OF THE VARIABLES

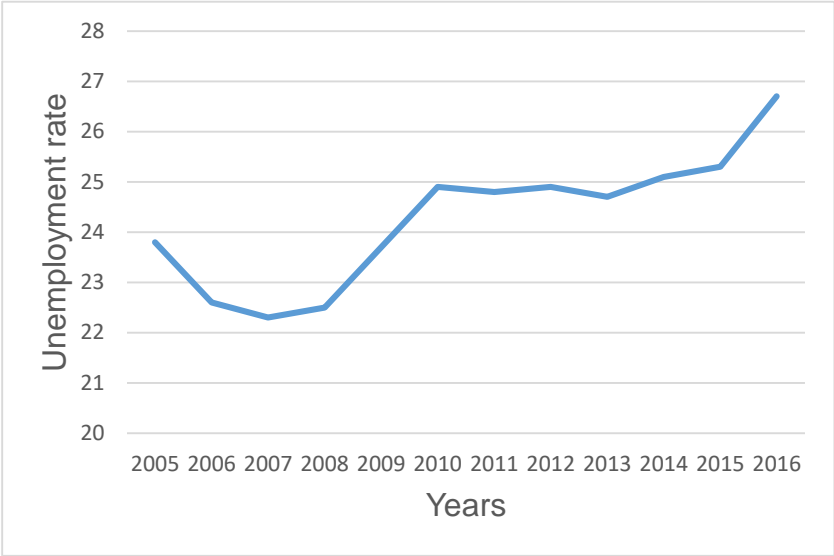
Figure 2.1: The trend of the GDP growth in South Africa during 2005 to 2016.



Source: Own computation

Figure 2.1 shows the trend of the real GDP from 2005 to 2016 in South Africa. It is clear from the graph that the economy of South Africa has been growing but at a very slow pace. From 2005 to 2007 it shows an upward trend which represents a rise in GDP until the recession in the economy in 2008 showing a downfall. However the economy slowly recovered after 2009 and seems to be doing well after the recession though growing very slowly.

Figure 2.2: The trend of the Unemployment rate during 2005 to 2016.



Source: Own computation

The graph shows that the rate of unemployment in South Africa has increased from a record high of 23.8% in 2005 to 22.6% in 2006 and it went lower and lower until 2008. The unemployment rate was better in the previous years until the economy experiences a recession in 2008. Perceived from the graph, it clearly shows that the unemployment started to be bit higher after recession in 2009, it goes higher and higher each year. The rate is currently sitting at the high rate of 26.7% (2016) from 25.3% in 2015. National Planning Commission (2011: 19) supports the above results when they emphasise that “jobless in South Africa has reached its highest level since 2008. The importance of growth for employment was emphasised in a negative fashion after the 2008 global recession which resulted in the loss of approximately 1 million South African jobs and disproportionately affected young people”.

CHAPTER 3: THEORETICAL AND EMPIRICAL LITERATURE REVIEW

3.1 INTRODUCTION

This chapter comprises two main sections, namely, the theoretical and empirical framework. Under the theoretical framework, I will look at the theories of economic growth and thereafter unemployment. The chapter starts, though, with a brief definition of economic growth and unemployment.

3.2 THEORETICAL FRAMEWORK

In this section the following theories are discussed: Okun's law, endogenous growth theory, Harrod-Domar theory, neoclassical theory, classical theory of unemployment and Keynesian theory of unemployment.

3.2.1 Theories of economic growth and unemployment.

3.2.1.1 Okun's law.

Okun's law focused on the explanation of the relationship between economic growth and unemployment in an economy. The law uses the rule of thumb as a tool for explaining and analysing the relationship between jobs and growth. The rule narrates the perceived relationship between the unemployment levels and the growth rate of real GDP. The theory argued that unemployment has negative correlation with economic growth in any given economy. It believed that a percentage decrease in unemployment rate leads to 3 percent increase in economic growth (Okun, 1962). When the growth rate of unemployment rose by 1% above the trend rate of growth, it can only result to 0.3% reduction in unemployment. In testing the validity of the theory, Kwani (2005) found that Okun's theory indeed showed existence of inverse relationship between economic growth and unemployment. The validity of the theory was tested by employing US real GDP data and the result indeed supported the theoretical relationship of economic growth and unemployment. More so, Sogner & Stiassny (2010) stated that if real GDP performance increases by 3% and unemployment reduces by 0.3%, it implies that the increase in the real GDP

performance for each percentage reduction in unemployment rate accounts for average 2% growth rate in real GDP of the country.

Okun's law is also known as the Okun's rule of thumb because it is based on the approximation of empirical observations than the results derived from the theory. The theory comprises of two version, namely the gap version and the difference version. The difference version describes the relationship between the quarterly changes in unemployment rate and quartely changes in the real GDP (Baily & Okun, 1965). The gap version states that for every 1% increase in the unemployment rate, the country's GDP becomes roughly 2% lower than its potential level.

There would also be other factors that might affect the Okun coefficient such as labour market regulation and labour union. For instance in Japan, unemployment rates tend to vary less for a given GDP due to the strong social job protection. Okun coefficients can change over time because the relationship of unemployment to output growth depends on laws, technology, preferences, social customs, and demographics. Two methods were postulated in measuring Okun's coefficient. Okun's law can be expressed in this form.

The initial form of the Okun's law can be written as the gap method:

$$U_t - U_t^* = \beta(y_t - y_t^*) \quad (2.1)$$

Where

y_t = The real output (real GDP)

y_t^* = Potential output

U_t = The natural level of unemployment

U_t^* = Potential unemployment

β = Okun's coefficient

This is saying that the change in unemployment (unemployment in year t minus unemployment in year $(t - 1)$) is equal to a negative parameter, β which is less than one, which shows the responsiveness of unemployment to output multiplied by the difference between output growth in year t and the normal growth rate of output. The parameter is negative because it is saying when output growth goes above the

normal growth rate, then unemployment will fall. When output growth is below the normal growth rate, unemployment will rise. That means when output growth is on the normal growth rate then unemployment will be stable (McBride, 2010).

The second method is the use of Okun's first-difference method. This method helps to indicate the sensitivity of output to unemployment changes.

Given:

$$\Delta U = a - b\left(\frac{\Delta Y}{Y}\right) \quad (2.2)$$

Then,

$$\Delta bU_t = a - \left(\frac{\Delta Y}{Y}\right) \quad (2.3)$$

This is based on the assumption that an increase in output will need more factor input leading to a lower unemployment rate. The difference version, written as a linear regression model is given by:

$$U_t - U_{t-1} = \alpha + \beta(Y_t - Y_{t-1}) + \varepsilon_t \quad (2.4)$$

Where U_t represents the unemployment rate in year t , Y_t symbolizes the level of real GDP and ε_t is the error term which satisfy the usual properties. The parameter β is called the Okun's coefficient and is expected to have a negative sign. Thus β estimate gives a negative coefficient between output growth and unemployment rates.

In other words, a 2% increase in GDP corresponds to 1% decline in the rate of cyclical unemployment (0.05% increase in labour force participation; 0.05% increase in hours worked; and 1% increase in the labour productivity). Okun's law declares that a 1% increase in cyclical unemployment leads to a 2% decrease in real GDP (Case & Fair, 1999). The relationship alters depending on the country and time period under consideration. In the United States, for example estimates based on data from most recent years give about a 2% decrease in output for every 1% increase in unemployment (Abel & Bernanke, 2005).

3.2.1.2 Endogenous growth theory

A new stage in the development of the theory of economic growth occurred in the 80-90s, which allowed to talk about the new growth theory. It reflects the impact of imperfect competition and the role of possible changes in the profit rate. Most importantly, the scientific and technical progress has been considered as an endogenous growth factor generated by internal causes. For the first time in formal mathematical and economic models, the American economists Romer (1955) and Lucas (1937) hypothesized about the endogenous character of the most important technological innovations based on investment (contribution) in technological development and in human capital. Endogenous growth models look similar to the neoclassical ones, but they differ significantly in initial assumptions and conclusions (UN, 2011). On the basis of the Solow model, the state with the help of economic policy instruments (such as changes in taxation, and government spending) is not able to provide long-term impact on the growth rate. The impact of the state on economic growth is only short run and possibly through the impact on the savings rate (Baye & Jansen, 1995)

Endogenous growth theory overcomes the shortcoming of neoclassical theory. First of all, they reject the neoclassical premise of diminishing marginal productivity of capital, assume the possibility of production scale effect throughout the economy, and often focus on the impact of external effects on the profitability of investments (Romer, 1989a). Positive externalities act as an important prerequisite. In the theories of endogenous growth, technological progress is not the only possible cause of economic growth in the long term. The value of intensive, high-quality determinants of economic growth (parameter A in neoclassical theory) is defined in the theories of endogenous growth with the following factors (Rebelo, 1991):

- The quality of human capital, which depends on investment in human development (education, health),
- Creation of the necessary conditions and prerequisites for the protection of intellectual property rights in the conditions of imperfect competition.
- State support for the development of science and technology.

- The role of government in creating a favourable investment climate and attracting new technologies.

Therefore, the theories of endogenous growth in contrast to neoclassical ones are in favour of state's intervention in the development process. These theories can be divided into two groups. The first group includes theories in which human capital emerges as an important determinant of economic growth. These are the theories of Romer (1989b) and Lucas (1988). A key factor in the endogenous growth theory of Romer is the variable called "knowledge" or "information". It assumes that the information contained in the inventions and discoveries are available to everyone and can be used at the same time. The Romer's theory assumes that the total amount of human capital remains constant during the considered time interval. The basic idea of the theory of Romer is as follows: "there is an exchange between consumption today and knowledge that can be used for the expansion of consumption tomorrow (Romer, 1989b)".

Romer (1989) formulates the idea as "research technology," which produces "knowledge" from the past consumption. Thus, the rate of economic growth is in theory of Romer directly dependent on the value of human capital, focused in obtaining new knowledge. In reality, this means that the sphere of research affects the economy not only directly through the application and development of new ideas. Its existence is a necessary (but not sufficient) condition for economic growth, because it provides human capital accumulation. The theory of Romer implies that countries with greater accumulation of human capital will have higher rates of economic growth. Therefore, according to this theory, the development of free international trade will also contribute to higher growth, since the exchange of products expands the boundaries of the economic system and thus leads to an increase in the total human capital. In contrast to the Romer's theory, in the theory of Lucas (1988), accumulation of human capital is a strong economic process that requires certain resources, and is the cause of alternative costs.

Lucas (1988) suggests that people can choose one of two ways to spend their time: to participate in current production or to accumulate human capital. In fact, the allocation of time between these alternative ways determines the rate of economic

growth. For example, a decrease in time spent on production, leads to a reduction in the current product output, but at the same time on accelerated investment in human capital increases the product output growth. Thus, the distinguishing feature of theories of this group is the inclusion of the education factor and human capital in the production function. In the second group of theories, R&D (research and development activities) is a key factor of growth.

Similarly, the theory of Grossman & Helpman (1994) describes the effect of endogenous high-tech innovations on economic growth rates (UN, 2011). On the example of two countries trading with each other, these authors, in particular, have shown that with subsidies for R&D in a country that has a relatively scientific and technical excellence, there will be an increase in the overall rate of economic growth. Protectionist trade policy can contribute to economic growth of countries with a lower level of R & D, but however, has the opposite effect if it is carried out in the country with a high scientific and technical potential. The theory takes into account the possibility of inflow/outflow of capital for R & D funding and predicts under certain conditions, the formation of transnational corporations. This group also includes the theory of endogenous technological progress of (Aghion & Howitt, 1992).

According to the endogenous growth theory, economic growth is driven by technological progress, which in turn is ensured by competition between firms, generating and implementing long- term products and technological innovation (Romer, 2011). Each innovation brings to market new interim goods (product, technology), which can be used in a more effective production of goods than it was before. The main motivation for the firms within the research sector is the prospect of monopoly rents in the case of successful patenting of innovations. This rent covers costs associated with the development and implementation of innovations. Thus, endogenous growth theories allowed formalizing the relationship between the mechanisms of economic growth and the process of obtaining and accumulating new knowledge, which is materialized in technological innovations. These theories examine the reasons for the differences in growth rates of different countries, the effectiveness of various measures of the state's scientific, technical and industrial policies, as well as the impact of the processes of international integration and trade on economic growth (Farmer, 1999).

3.2.1.3 Harrod-Domar theory.

Harrod-Domar theory is considered as the extension of Keynes 'short term analysis of full employment and income theory. The Harrod-Domar growth model provides a long term theory of output. The Economists started paying their attention towards economic stability after the Great Depression of 1930s and the ruin caused by World War II. Harrod and Domar provided a model that focuses on the requirements necessary for steady economic growth. According to Baumol (1970) capital accumulation constitutes a major factor for the growth of an economy. Harrod (1939) and Domar (1946) emphasized that capital accumulation do not only generates income, but also increases production capacity of the economy. For instance, if a construction plan is established, it would generate income for suppliers of different materials such as cement, bricks, steel and machinery with simultaneous increase in capital and production capacity of the economy.

The newly generated income from capital accumulation produces demand for goods and services (Ackley, 1961). According to this theory, the most necessary condition for the growth of an economy is that the demand created due to newly generated income should be sufficient enough, so that the output produced by the new investment (increase in capital) should be fully absorbed (Gustav, 1967). If the output is not fully absorbed, there would be excess or idle production capacity. This condition should be satisfied consecutively to maintain full employment level and achieve steady economic growth in the long term. Following are the main assumption of Harrod-Domar model:

- Constant-capital output ratio

Assumes that the relation between capital and output always remains the same. According to this assumption, the national output (which is equal to national income) is directly proportional to capital stock, which is expressed as follows (Scarfe, 1977):

$$Y = K(k), (k > 0) \tag{2.6}$$

Where:

Y = National output

K = Total capital stock

k = Output/capital ratio (constant)

As Harrod-Domar model has assumed that the output/capital ratio is constant, therefore, any type of increase in the national output would result in the k time increase in capital stock, which is as follows:

$$\Delta Y = k\Delta K \quad (2.7)$$

Therefore, the increase in the growth of national output per unit time is equal to the increase in the growth of capital stock per unit time. In case, the economy is in equilibrium and the capital stock is utilized completely, then the capital/output ratio (k) can be easily determined. After that, the extra capital required to produce the extra output can also be obtained (Brems, 1967). The capital stock and the net investment (I) are equal to each other. Therefore, the change in national output can be represented as follows (Nitisha, 1986):

$$\Delta Y = kI \quad (2.8)$$

- Constant saving-income ratio

Assumes that society saves a constant proportion of national income. Therefore, saving is a function of income and saving function can be written as follows:

$$S = sY, (s > 0) \quad (2.9)$$

Where:

S = Saving per unit time

s = Constant propensity to save

Y = National income

At equilibrium, savings become equal to investment, which is as follows:

$$S = I = sY \quad (2.10)$$

On the basis of these assumptions, Harrod-Domar has determined the growth rate, which is as follows:

$$\Delta Y_t = kI_t \quad (2.11)$$

In such case, ΔY_t can be calculated with the help of following formula:

$$\Delta Y_t = Y_t - Y_{t-1} \quad (2.12)$$

Or

$$Y_t - Y_{t-1} = kI_t \quad (2.13)$$

Where:

Y_t = Income in time period t

Y_{t-1} = Income in time period $t - 1$

According to the assumption of Harrod-Domar model, at equilibrium in time period t :

$$I_t = S_t = sY_t \quad (2.14)$$

As $I_t = sY_t$, therefore, we can substitute sY_t in place of I_t while calculating the income in time period t , which is represented as follows:

$$Y_t - Y_{t-1} = k * sY_t \quad (2.15)$$

The warranted growth rate can be calculated as follows:

$$GW = Y_t - \frac{Y_{t-1}}{Y_t} = k.s \quad (2.16)$$

Or

$$Gw = \frac{\Delta Y}{Y_t} = k \cdot s \quad (2.17)$$

The warranted growth rate shows that the growth rate is equivalent to the output/capital ratio (k) times the constant propensity to save. The growth rate, $\frac{\Delta Y}{Y}$ is related to the equilibrium condition where $I = S$, therefore the growth rate in such condition can also be regarded as equilibrium growth rate. The equilibrium growth rate shows the capacity of utilizing capital stock. Warranted growth rate refers to the growth rate at which the amount of production is accurate, that is neither too much nor too less (Domar, 1946).

One more growth rate given by Harrod-Domar model was target growth rate, which takes place due to increase in marginal propensity to save and invest or output/capital ratio. The increase in marginal propensity to save would result in the increase in saving, which further leads to an increase in investment (Hagemann, 2009). Consequently, the income and production capacity of a nation also increase, which further increases the output of the nation. The increase in the production capacity in a particular period increases the income for coming years. The increase in income leads to increase in saving and investment, and higher incomes in succeeding years. According to the principle of acceleration, the investment increases at a faster rate (Sato, 1964).

The assumptions of the employment of labour aspect as per the Harrod-Domar model are as follows:

- Considers that labour and capital are complementary to each other not substitutes.
- Regards capital/output ratio as constant

According to such assumptions, along with the capital/output ratio, the economic growth would occur when the potential labour force is not completely utilized. This denotes that the potential labour supply restricts economic growth at full employment condition (Cassel, 1924). Therefore, economic growth would occur when the increase in labour exceeds the full employment condition. In addition, the actual

growth rate becomes equal to warranted growth rate only when the warranted growth rate becomes equal to growth rate of labour force (Scarfe, 1977). In case the increase in the growth rate of labour is slow, then economic growth can only be normalized with the help of labour saving technology. In such a condition, the economic growth in the long term is dependent on the growth rate of labour force ($\frac{\Delta L}{L}$) and labour saving technology. Therefore, maximum growth rate in the long run would be equal to $\Delta L/L$ plus m , which is the rate of substitution of capital in place of labour.

This growth rate is termed as the natural growth rate (G_n) that can be calculated with the help of the following formula:

$$G_n = \frac{\Delta L}{L} + m \qquad 2.18$$

The Harrod-Domar model provides more relevant theory of economic growth. However, the model is not free from limitations. Some of the shortcomings of the model are impractical assumptions. The Harrod-Domar model involves assumptions that cannot be applied in practical situations. According to the Harrod-Domar model, savings becomes equal to investment when warranted and actual growth rate are equal to each other. This can be possible only under certain conditions, which are as follows (Domar, 1949):

- Keeping marginal propensity to consume as constant
- Assuming output/capital ratio as constant
- Assuming that the technology for production is given
- Keeping economy at equilibrium initially
- Considering government expenditure and foreign trade negligible
- Assuming that there are no adjustment gaps between demand and supply as well as investment and saving.

However, these conditions cannot always be fulfilled, therefore the warranted growth may not be equal to actual growth rate always. This makes the model unrealistic.

3.2.1.4 Neoclassical Theory

The collective work of Swan (1956), Solow (1956), Meade (1962) and Phelps (1961) is termed as neoclassical theory of economic growth. The assumptions adopted by this theorists in the neoclassical theory are based on the views and norms given by neoclassical economists such as Alfred Marshall, Wicksell and Pigou. The following are the assumptions of the neoclassical theory:

- A perfect competition in commodity as well as factor markets
- A making factor payments equal to the marginal revenue productivity
- A maintaining a variable ratio between capital and output
- A full employment condition

According to the neoclassical theory, economic growth is determined with the help of certain factors such as stock of capital, supply of labour and technological development overtime. The production function for the neoclassical theory can be expressed as follows (Mustafa, 2011):

$$Y = F(K, L, T) \quad (2.19)$$

Where:

Y = National output

K = Capital stock

L = Labour supply

T = Scale of technological development

According to the assumption of constant return to scale, increase in national output (ΔY) would be equal to the marginal product of capital (MP_k) times ΔK and marginal product of labour MP_l times ΔL . Therefore,

$$\Delta Y = \Delta K . MP_k + \Delta L . MP_l \quad (2.20)$$

When the equation of increase in national output is divided by Y , then we get the following:

$$\frac{\Delta Y}{Y} = \Delta K \left(\frac{MP_K}{Y} \right) + \Delta L \left(\frac{MP_L}{Y} \right) \quad (2.21)$$

The first term on the right hand side is multiplied by $\frac{K}{K}$ and the second term by $\frac{L}{L}$.

The resultant equation would be as follows:

$$\frac{\Delta Y}{Y} = \frac{\Delta K}{Y} \left(K \cdot \frac{MP_K}{Y} \right) + \frac{\Delta L}{Y} \left(L \cdot \frac{MP_L}{Y} \right) \quad (2.22)$$

The $K \cdot MP_K$ and $L \cdot MP_L$ represent the total stake of capital and labour in the national output, whereas $K/Y^* MP_K$ and $\frac{L}{Y^*} MP_L$ represent the relative stake of capital and labour in the national output. Therefore:

$$\left(K \cdot \frac{MP_K}{Y} \right) + \left(L \cdot \frac{MP_L}{Y} \right) = 1 \quad (2.23)$$

Let us assume that $(K \cdot MP_K / Y) = b$, then $\left(L \cdot \frac{MP_L}{Y} \right) = 1 - b$. Putting the value of $\left(K \cdot \frac{MP_K}{Y} \right)$ and $\left(L \cdot \frac{MP_L}{Y} \right)$ in the following equation, we get:

$$\frac{\Delta Y}{Y} = b \frac{\Delta K}{K} + (1 - b) \Delta T / T \quad (2.24)$$

In the equation 2.24, the value of b and $1 - b$ represent the elasticity of output with reference to the capital and labour respectively. Therefore, according to the neoclassical theory, economic growth rate is represented as follows:

- Economic growth (at a given level of technology) = Elasticity of output with reference to the increase in capital stock + Elasticity of output with reference to the increase in labour.

Therefore, in case of technological development, the economic growth rate can be expressed as follows:

- Economic growth (at a given level of technology) = Elasticity of output with reference to the increase in capital stock + Elasticity of output with reference to the increase in technological progress.

These are some of the limitations of the neoclassical theory.

- Regards technology as a constant factor, which is not true. This is due to the fact that a technology keeps advancing with time.
- Does not include the investment functions, therefore, the neoclassical theory has failed to describe the expectations of entrepreneurs and capital accumulation by them.
- Considers capital assets as homogeneous, which is not real.

The neoclassical theory does not explain the intrinsic characteristics of economies that causes them to grow over a period (Enebong, 2003). In the neoclassical theory, the long run rate of growth is exogenously determined by either the savings rate of the Harrod-Domar model or technical progress of the Solow model. However, the savings rate and rate of technological progress remain unexplained.

Dasgupta & Sighn (2005) state that the neoclassical theory perceives rising GDP as a temporary phenomenon resulting from technological change or a short-term equilibrating process in which an economy approaches its long run equilibrium. The neoclassical theory credits the bulk of economic growth to a completely independent process of technological progress. According to this theory, it was expected that the free market reforms imposed on highly indebted countries by World Bank and International Monetary Fund should have prompted higher investment, rising productivity, and improved standard of living (Solow, 1957).

According to Solow (1956), the neoclassical school of economic thought seeks to explain income distribution in a symmetrical way through the relative scarcities of the factors of production, labour, capital and land. Interestingly, the exogenous growth model can be considered as the starting point of neoclassical growth theory. The model was discovered by Cassel (1932). Cassel presented two models: stationary economy and economy growing along a steady-state path. The first model, assumes Z primary factors of production such as labour and technology. The N goods

produced in the economy are pure consumption goods, that is, there are no produced means of production or capital goods contemplated in the model. Goods are produced exclusively by combining primary factor services at fixed technical coefficient of production (Enebong, 2003).

3.2.1.5 Classical theory of unemployment

The view of most economists goes with their thinking at that particular time. The two major schools of economic thought are the classical and keynesian. The classical school of thought emphasizes the role of money in explaining short term changes in national income. The theory argues that technological advancement, shifting patterns of industrial production, and foreign competition disrupt the matching of jobs and workers in the labour market (Rodriguez, 2015). Traditionally, this theory sees that unemployment in terms of aggregate and that involuntary unemployment is a short term phenomena resulting from the discrepancy between the price level and the wage level. Unemployment is the result of too high real wages. At times the wage level in the classical view would be reduced and there would be no unemployment except for frictional search unemployment caused by time delay between quitting one job and starting another (Mouhammed, 2011). This school of thought states that the problem of urban unemployment is traceable to the fault of workers and various trade union powers. They believe strongly in the theory of demand and supply. Therefore, they insist that urban unemployment is inevitable when labour supply is more than the demand or output production capacity of the economy (Wicksell, 1965).

There is some evidence to support this view. Leube (1984) contends that unemployment is due to the discrepancy between the distribution of labour among industries and the distribution of demand among producers, and also by a distortion of the system of relative prices and wages. To a large extent, therefore unemployment is caused by powerful trade unions. These trade unions create structures that misdirect labour and other economic resources. Unions are able to set higher wages compared to market determined wages generating unemployment particularly in industries that become less profitable. In short, unemployment problem

is caused by resources being in the wrong places and can only be corrected if wages and prices are determined by the equilibrium of supply and demand.

- Labour demand

The labour demand schedule determines the amount of labour that firms employ at a given real wage. In the classical production function among other economic theories the production of goods and services (Y) uses two factors, namely labour (L) and capital (K):

$$Y = F(L, K) \quad (2.27)$$

Under the classical production function a couple of assumptions need to be taken into consideration:

- ❖ Constant returns to scale for the production function:

$$\rightarrow XY = F(XK, XL)$$

- ❖ Diminishing marginal returns to either factors of production:

$$\rightarrow F_L > 0; F_{LL} < 0$$

On the other hand, firms select the level of labour that maximizes their profits by taking prices of labour and capital also as given:

$$\max_L \pi = (pY - wL) + rK \quad (2.28)$$

$$\text{where } pF_k(K, L) - rK = 0 \text{ and } pF_l(K, L) - wL = 0 \quad (2.28a)$$

Price (p) is the output price per unit, and wages (w) and capital rents (r) represent the cost of each factor of production respectively. Equation (2.28a) means that marginal product of capital equals the price of capital and the marginal product of labour equals labour cost.

If we want to identify the sign of the labour demand with respect to real wages, we can use the theorem of the implicit function that provides us the following equation (Dalziel, 1993):

$$\frac{\partial L^d}{\partial \frac{w}{p}} = -\frac{-1}{F_{LL}(K,L)} < 0 \quad (2.29)$$

We can demonstrate, thus, a negative correlation between employment and real wages which denotes a negative-sloped curve for the labour demand. By similar argument, improvement in productivity and stock of capital are key factors to improve employment while increases in real wage have a negative effect on it.

- Labour supply

The labour supply curve determines the size of the labour force: total individuals willing to work at a particular real wage. We can consider as part of this labour force all individuals whose opportunity costs in terms of consumption of goods are lower than the real wage.

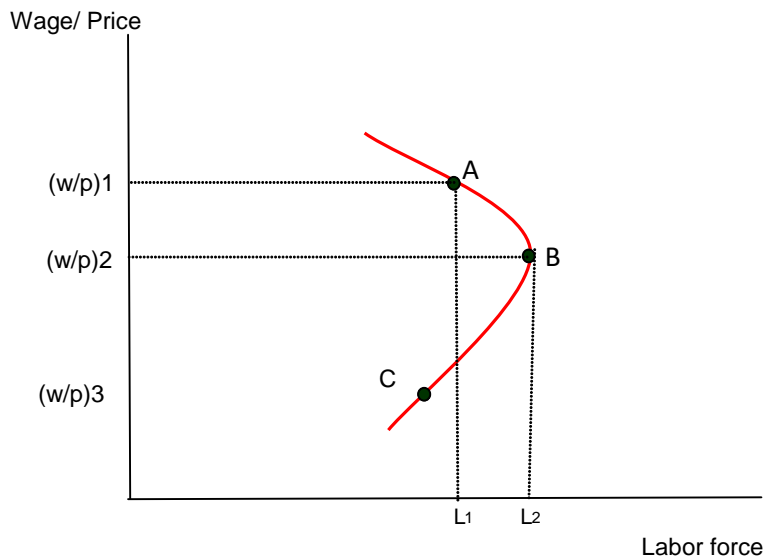
The slope of the labour supply curve shows the relationship between the real wage and employment. It shows that the real wage is positively related to employment:

$$L\left(\frac{w}{p}\right) = \frac{\bar{L}}{2} - \frac{m}{2\frac{w}{p}} \quad (2.30)$$

The slope of the labour supply can also be positive or negative depending on the so-called income effect and substitution effect (Edgar, 1959).

$$\text{net effect} = \text{substitution effect}(+) - \text{income effect}(-) \quad (2.31)$$

When the net effect is positive, and the substitution effect is bigger than the income effect, workers will work more hours when their wages increase. But when income effect is bigger, then workers will prefer to work less.



Source: Galí (2013)

Figure 3.1: Labour Supply curve

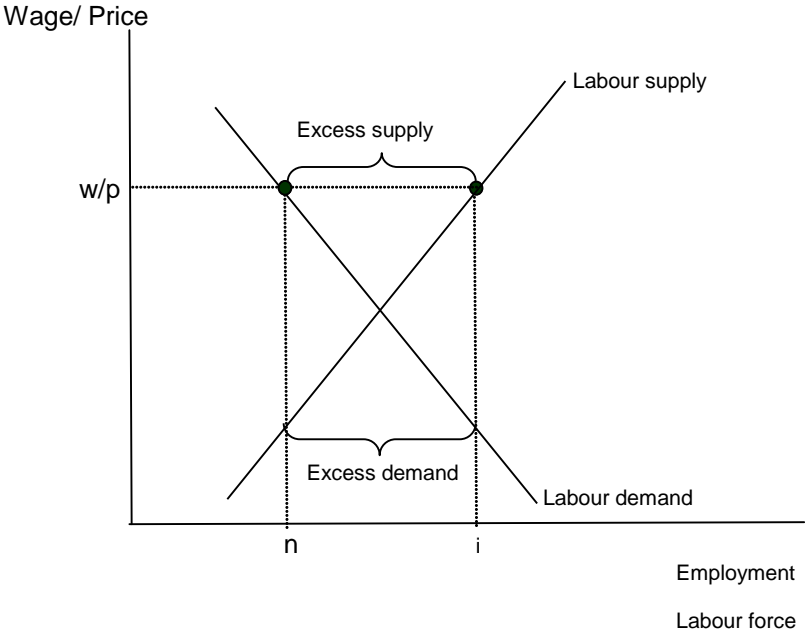
A to B shows negative relationship between the real wage and labour force whereas B to C shows positive relationship. The diagram clearly shows that an increase in the real wage will inspire more work effort up to a point B after which high wage ceases to inspire more work effort, demonstrated by the backward bending curve.

❖ Wage equation

Wage equation explains how the salaries are set up by external agents (like labour unions) and employees through collective or individual bargaining. The situation in the labour market and the ability of agents to influence the level of real wages plays significant role also. Generally, wages are fixed according to a given level of unemployment but they are also subject to other measures of the labour market like labour taxes or unemployment insurance. Blanchard (1998) remarks several key factors in the process of configuring a wage equation: the wage itself, productivity, reservation wage (minimum wage a worker is willing to accept) and the labour market conditions. Classical perspective approves higher wages when the labour is performing well.

$$(w = \tilde{w}(L) \text{ where } \frac{d\tilde{w}}{dL} > 0 \tag{2.36}$$

In the figure 2.2, unemployment occurs as if the real wage is above the competitive level, where labour supply and labour demand intersect. To reduce unemployment requires reducing the wage till it comes back to the equilibrium level, i.e., at the point of intersection of the demand and supply curves.



Source: Gali (2013)

Figure 3.2: Labour demand and supply diagram.

According to the classical theory, a high demand for wages by workers without a corresponding increase in productivity renders products costly, thereby discouraging competitiveness among local industries and foreign countries. The implication of these trends is the reduction of sales which leads to mass retrenchment of workers resulting in unemployment.

3.2.1.6 Keynesian theory of unemployment.

John Maynard Keynes in the 1930s have reformed the thinking in several areas of macroeconomics including unemployment, money supply and inflation. In his publication in 1936 as in the general theory of unemployment , interest and money, cyclical or Keynesian unemployment, also known as demand deficient

unemployment, occurs when there is insufficient aggregate demand in the economy (Akiri & Okunakpo, 2016). Cyclical unemployment varies with the business cycle, though it can also be persistent as during the great depressions. In other words, cyclical unemployment rises during economic down turns and falls when the economy improves.

Keynes (1936) argues that this type of unemployment exists due to inadequate effective demand. If demand for most goods and services falls, less production is needed, wages do not fall to meet the equilibrium level and mass unemployment results. The Keynesians are less concerned about labour market imbalances. They argue that the labour market imbalances are a long process if the government's macroeconomic policies stimulate expansion, in which case virtually everyone in the queue would be absorbed. Where such policies are cautious and fail to keep pace with an increasingly productive labour force or the invasion of workers into the market, unemployment would increase. Keynes (1936) believes that government intervention is beneficial to an economy. The government uses spending on goods and services to reduce disruptive business cycles through fiscal and monetary policies. Government intervention decreases the price of goods and services, making them more affordable, thus increasing consumer spending and demand. When demand increases, firms need to produce more. So they will have to hire more employees. The newly employed workers will have more income, leaving them with more money to spend. This increases demand and consumer spending.

The Keynesian framework as examined by Thirlwall (1979) postulates that increases in employment, capital stock and technological changes are largely endogenous. Thus, the growth of employment is demand determined and that the fundamental determinants of long term growth of output also influence the growth of employment. In the Keynesian theory, employment depends upon effective demand which results in increased output; output creates income and income provides employment. Keynes (1936) regards employment as a function of income. Effective demand is determined by aggregate supply and demand functions. The aggregate supply function depends on physical or technical conditions which do not change in the short run, thus it remains stable. Keynes (1936) concentrated on aggregate demand function to fight depression and unemployment. Thus, employment depends on

aggregate demand which in turn is determined by consumption demand and investment demand.

Employment depends on the quantity of output (total income or production) that firms produce under the assumption that prices are completely fixed. Moreover, the production by firms is governed by demand. As a result, the aggregate demand for goods sets up the income at a certain price, that finally leads to a new employment level. It is so because firms will hire new workers according to their specific production needs. Real wage is determined when firms have employed all workers (Mankiw, 2002).

This is an important remark because it also permits macroeconomic indicators such as interest rate a place in the models of the theory of employment. The real interest rate has a negative relationship with production because the higher the interest rate is, the more expensive the loans are which implies less investment by firms and less consumption by individuals, both affecting negatively the level of output and employment (Nickell, 2003). This theory states that the interest rate affects the level of production and subsequently labour demand. This substantiates the relevance of monetary policies to influence labour demand. The potency of direct wage adjustments measured by the wage flexibility on employment is reduced. Consequently measures like subsidies, payroll taxes or, cuts in nominal wages are no longer the only decisive factors (Gali, 2013).

3.3 EMPIRICAL FRAMEWORK

The empirical relationship between GDP and unemployment rate substantiates the theories of economic growth and unemployment. The increase in unemployment has been more pronounced on average in European countries compared to the US, although the GDP growth rate has been following a similar pattern in both regions. Implicitly, this suggests that the relationship between these variables is not the same among economies (Haruyama & Leith, 2000). This empirical evidence is highlighted in certain empirical and econometric studies. Caballero (1993) found a weak positive relationship between growth and unemployment in the US and UK from 1966 to 1989. Bean & Pissarides (1993) performed a cross-country analysis of OECD

countries and found a negative relationship between growth and unemployment during 1975 to 1985.

Zaglar (2009) investigated the link between growth and unemployment of UK for the period 1982 to 1999. Structural change played significant role in job creation and job destruction of an economy. Fixed effects panel regression method was used and the results showed a robust and negative relationship between growth and unemployment. Rapid growth economies would face structural unemployment for a shorter period. Unemployment could be minimized through efficient planning and improvement in human capital. Kemal (1987) found that growth rate in Pakistan was really good but the employment generation was not so good. Unemployment increased at a high rate and manpower planning experience did not produce significant results to minimize unemployment in Pakistan.

Hewartz and Niebuhr (2011) developed an econometric model to study the relationship between growth and unemployment, taking Okun's law as a starting point. In their study, they found that the relationship between these variables changes across countries and crucially depends on labour market framework. Khalifa (2009) sets a proposal for a strategy to hamper unemployment in Egypt to increase employment rate and to enhance small business based on statistical data for the period 1982 to 2004. Understanding how to cope with unemployment is a crucial point to understand the nature of the relationship with economic variables such as growth, investment and inflation rate. Khleifa (1995) presented an analytical study of the condition of labour force in Jordan and its role in economic growth. The study concluded that economic policies supporting the growth are the same policies to reduce unemployment.

Pissarides (1989) found that technological progress helped to reduce unemployment due to capitalization effect. Rapid growth raised the return of firms and new firms were launched to share the profit and in turn more jobs were created. Quick innovation made the labourers unemployed. Growth and technological progress had significant role in minimizing unemployment but this growth remain limited to few areas and regional disparities emerged. There are lots of theories to elaborate the issue of unemployment. Different aspects are involved in this issue. Regional

theories of unemployment have to take account of mechanisms that sooner or later bring the economy back towards ordinary state of unemployment (Pissarides, 1989).

Bankole and Fatia (2013) estimated the Okun's coefficient and checked the validity of Okun's law in Nigeria using the time series annual data during the period 1980-2008. Engle granger co-integration test and fully modified OLS were employed. The empirical evidences showed that there is positive coefficient in the regression, implying that Okun's law interpretation is not applicable to Nigeria. It was recommended that government and policy makers should employ economic policies that are more oriented to structural changes and reform in labour market.

Ball, et al. (2012) asked how well Okun's Law fits short-run unemployment movements in the United States since 1948 and in twenty advanced economies since 1980. It was found that Okun's Law is a strong and stable relationship in most countries, one that did not change substantially during the great recession. Accounts of breakdowns in the Law, such as the emergence of jobless recoveries are flawed. It is also found that the coefficient in the relationship varies substantially across countries. This variation is partly explained by idiosyncratic features of national labour markets, but it is not related to differences in employment protection legislation.

Owyang and Sekhposyan (2012) examined whether Okun's law contributed to the great recession of U.S, they considered various specifications of Okun's law to assess the degree of time variation in the unemployment and output fluctuations over the business cycle. They paid specific attention to the three most recent U.S. recessions and the great recession. The paper found a great degree of instability in the historical performance of Okun's law. The breakdowns in Okun's law seem to be highly correlated with the business cycle: The detected break dates of the largest changes in the coefficients appear to be around recessions. The most robust finding of this study is that recessions contribute to the increase in the unemployment rate on average (Morgenstern, 1941). The correlation between unemployment and output fluctuations changes significantly during the great recession and the three most recent recessions. The statistical significance of the slope changes depends on the specification at hand. Nevertheless, it appears that periods of high unemployment

are correlated with increased sensitivity of the unemployment rate to output growth or gap fluctuations, though these shifts might not always result insignificant changes (Rodrik, 2006).

Irfan (2010) estimated the Okun's coefficient and checked the validity of Okun's law in some Asian countries, for this purpose, they used the time series annual data during the period 1980-2006. Engle Granger Cointegration technique is employed to find out the long run relationship between variables and error correction mechanism (ECM) is used for short run dynamic (Granger, 1983). After getting empirical evidences, it can be said that Okun's law interpretation may not be applicable and the principle of NAIRU does not hold its validity in some Asian developing countries.

Pierdzioch, et al. (2009) used data covering the period 1989-2007 for G7 countries to test the relevance of Okun's law to professional economists' forecasts of output growth and unemployment. Their results confirmed the consistency between Okun's law and professional economists 'forecasts of changes in unemployment rate and the real output growth rate. They also found a direct relationship between magnitude of unemployment and the size of the output gap. In a nut-shell, literature reveals that Okun's law has been revisited in several countries where the disparity between real output and unemployment is alarming. Therefore, it is imperative to test for the empirical validity of this law in Nigeria where this disparity is even more alarming.

Noor, et al. (2007) examined whether there exist an Okun type relationship between output and unemployment in the Malaysian economy. The empirical results show that there was an inverse relationship between output and unemployment. Naimy (2005) applied Okun type relationship to the Lebanese equation in order to estimate the Lebanese potential output. An empirical study covering 400 households is carried out to investigate the employment status using the BLS (Bureau of Labour Statistics) criterion in determining the most useful measures of the labour market.

The main finding was that the impact of unemployment in Lebanon seems to be extremely harmful: the economy is \$32 billion below its potential output. Unemployment in Lebanon is continuously growing because of the present financial and economic deadlock situation (Stephanie, 2010). It is the human resources of the

nation, not its physical capital or its natural resources that ultimately determine the character and pace of its economic growth and social development. Capital and natural resources are passive factors of production; human beings are the active agents who accumulate capital, exploit natural resources, build social economic and political organizations, and carry forward national development. Clearly, a country that is unable to develop the skills and knowledge of its people and to utilize them effectively in the national economy will be unable to develop anything else (Moosa, 1997).

Barreto and Howland (1993) corrected a fundamental error in the literature examining the Okun's Law relationship between the unemployment rate and the rate of growth of output. Since Okun's original work, authors who mistakenly assume that unbiased coefficient estimates of the reverse regression are reciprocals of their direct regression analogues have reported biased estimates of the Okun coefficient on unemployment, output gaps, and potential GNP. Okun's (1962) original work states that a one percent point reduction in unemployment rate would increase output by approximately 3 percent. Therefore, to avoid the waste of unemployment, the economy must continually expand.

Nwakanna and Arewa (2012) conducted an empirical evaluation of the relationship between economic growth and unemployment using the first difference and output gap models of Okun's law. The study finds no evidence to support the validity of Okun's law in Nigeria. Marinkov & Geidenhys (2007) tried to give answer of the question of unemployment responds to changes in output in South Africa. In this case, they estimated the relationship between economic activity and unemployment rate. The results indicated the presence of Okun's law relationship in South Africa over the period 1970-2005 with more evidence in favour of asymmetries during recessions.

Amassoma & Nwosa (2013) examined the relationship between unemployment and productivity growth in Nigeria for the period between 1986 and 2010, using Johansen cointegration test and error correction model (ECM) technique. Stationarity test was rate and conducted through the applications of the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests, and the results showed that all the variables were

integrated of the same order at first difference. The results of the Johansen cointegration test indicated that long run equilibrium relationship exist among the variables under study. Nwankwo (2014) investigated the impact of unemployment on Nigerian economic development using a selected local government area in Anambra State, Nigeria. The results indicated that unemployment has negative impact on economic growth and development of the state.

Stephan (2010) investigated the impact of economic growth on unemployment in Nigeria between the years 1986 to 2010; the results reveal that unemployment has a negative and insignificant relationship with economic growth. Moosa (2008) investigated validity of Okun's negative long run impact of unemployment and output growth for selected Arab countries using traditional approaches to cointegration. He failed to validate the significant long run relationship between unemployment and economic growth. Kreishan (2011) determines the relationship between unemployment and growth of Jordan from 1970 to 2008, using Johansen cointegration and ordinary least square estimation technique. The estimation result of this study failed to determine the significant long run relationship between economic growth and unemployment level. Hussain, et al. (2010) examine relationship between growth and unemployment in Pakistan from 1972 to 2006 using Johansen cointegration and VECM. Their results conform long run and the short run equilibrium relationship between unemployment and economic growth. Similarly, Ahmed et al. (2011) investigates the equilibrium relationship between economic growth and unemployment in Pakistan from 1974 to 2009 using ordinary least square estimation technique. Their results failed to determine any relationship between economic growth and unemployment level.

Several studies have been carried out to examine the relationship between economic growth and unemployment. However, different results were obtained due to the econometric techniques, countries researched and period of study used. The present study, therefore aims to investigate the relationship between economic growth and unemployment using the Vector Error Correction Model (VECM) during 2005-2016 using quarterly times series data.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

Chapter three provided an overview of the existing literature that explain the relationship between economic growth and unemployment. The relationship of such variables were examined from both the theoretical and empirical perspective. Chapter four explains the methods that were used to analyse data to acquire solid results in order to achieve the aim and objectives laid out in the study. It starts with the specification of model. This is followed by the explanation of the various techniques that were used to analyse data. To be specific, a graphical method of visual inspection is conducted on the onset. The Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests are used to test for the existence of a unit root in the time series. Then the Johansen cointegration test and Vector Error Correction Model (VECM) technique were employed. Cointegration test is applied to examine the long run equilibrium relationship among variables, while the VECM is employed to investigate the short run dynamics and the long run relationship among variables under the study. The granger causality test, variance decomposition and impulse response on the other hand, were applied.

4.2 MODEL SPECIFICATION

The study modifies the model adopted by Mosikari (2013) of economic growth (GDP) as a function inter alia unemployment rate (UN), labour productivity (LP) and government budget deficit (GD), unlike Banda, et al., (2014) where they treats unemployment rate as a dependent variable. In this research study, the regression analysis is conducted to examine the relationship between dependent variable and the independent variables given below. The dependent variable is gross domestic product as a proxy of economic growth (GDP) and the independent variables are unemployment rate (UN), labour productivity (LP) and government deficit (GD). Therefore the economic growth function is specified as follows in equation 4.1:

$$GDP_t = f(UN_t, LP_t, GD_t) \quad (4.1)$$

Where t is a time trend, GDP_t , UN_t , LP_t and GD_t are gross domestic product, unemployment rate, labour productivity and government deficit respectively. In this case, the linear regression model become:

$$GDP_t = \alpha + \beta_1 UN_t + \beta_2 LP_t + \beta_3 GD_t + \varepsilon \quad (4.2)$$

From the equation 4.2 above, α is the intercept term, $\beta_1, \beta_2, \beta_3, \beta_4$ are the parameter estimates or coefficients of explanatory variables and ε is the error term. The error term represent variables that might influence the GDP but are not included in the model.

4.3 DATA SOURCES

The study employs quarterly time series data of the South African GDP, unemployment rate, government deficit and labour productivity for the estimation of the regression model covering the period from 2005 to 2016. The period of study covered helps to provide a clear understanding into the trends of post-apartheid era. This is the period when many economic development strategies and policies were implemented by the South African government to subdue the level of unemployment plus other apartheid legacy. The research study uses secondary data sourced from the electronic database of the South African Reserve Bank (SARB).

4.4 ESTIMATION TECHNIQUES

The study used the time series econometric technique called the Vector Error Correction Model (VECM) to investigate the relationship between economic growth and its independent variables. The study used the VECM instead of Vector Autoregression (VAR) because VAR models are misspecified when variables are cointegrated. The VAR models normally recommend short run relationships between variables and long run relationships are removed when differenced. However, the VECM can differentiate between long and short run relationship and recognise the

causation that the usual granger causality cannot notice among variables (Oh & Lee, 2004).

In this research study, the following techniques are employed: visual inspection, unit root test, choice of lag length, Johansen cointegration test, vector error correction model, diagnostic test and stability test. It is then followed by VECM granger causality test, impulse response and variance decomposition.

4.4.1 Unit root test

The theory behind the estimation of unit root test is based on stationary time series. As the model obtains economic variables of time series in nature, the empirical analysis begins by checking out the statistical properties of these variables. A series is stationary if the mean and auto covariance of the series do not depend on time. The purpose of analyzing these properties is to verify whether the variables in the model are stationary as a way of avoiding spurious regression that might lead to the misleading results (Asteriou & Hall, 2011). Another reason for running stationarity tests is that the results obtained with non-stationary time series can only be used for that particular time period and cannot be generalized to future period (Banda, et al., 2014). The most commonly used stationary tests are Augmented Dickey-Fuller unit root test (Said & Dickey, 1984) and Phillips Perron unit root test (Phillips & Perron, 1988). In most cases, if the variables are found to be stationary in the model, they are likely to have a fixed variance and some elements of autocorrelation overtime (Mosikari, 2013).

4.4.1.1 Visual Inspection

This is the method used to test for stationary. This can be in the form of graphs or correlogram test. According to Mah (2013), the method is good because it gives an initial indication about the nature of the time series. In this case, it shows whether the logged variables are increasing, decreasing or remaining constant. Gujarati & Porter (2009) emphasise that when the logged variable is increasing or decreasing, it means that the mean of the logged variable is changing over time and therefore the logged variable is non stationary. When it is constant, it means that it has been fluctuating around the trend line and the variable is stationary. However, it is not

influenced by the time and such conclusions need to be verified by more robust techniques such as the Augmented Dickey-Fuller and Phillips Perron unit root tests.

4.4.1.2 Augmented Dickey Fuller (ADF) Test

A Dickey Fuller test assumes that all the error terms are uncorrelated. Due to the possibility of the error terms being correlated Dickey & Fuller (1976) went beyond their first estimation technique and improved the simple Dickey Fuller test to obtain and apply the now recognized Augmented Dickey-Fuller (ADF) unit root test. The Augment Dickey Fuller unit root test is applied on models that incorporate the lagged values of the dependent variables so as to control the serial correlation in the error term.

For the ADF test, the following regression is estimated for each variable in the model as used by Mosikari (2013) and Madito & Khumalo (2014).

$$\Delta Y_t = \alpha_0 + \beta_t + \sigma_1 Y_{t-1} + \sum_{i=1}^t \gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (4.3)$$

Where α_0 is a constant, β_t the coefficient on a time trend and σ_1 is the parameter to be estimated and ε_t is the error term which is assumed to be normally distributed.

The null hypothesis to be tested using the ADF test is the existence of a unit root in the time series. The critical value should be greater than the test statistics and the probability value (PV) should be less than 1%, 5% and 10% levels of significance in order for a variable to be stationary. The Augmented Dickey-Fuller statistic used in the test is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of significance (Dickey, 1988).

4.4.1.3 Phillips-Perron

The Phillips-Perron test is an alternative procedure for testing the presence of a unit root in a general time series setting. The Phillips & Perron (1988) included the linear trend in their specification. The ADF unit root test alters the Dickey-Fuller test in

order to take into consideration the possibility of serial correlation in the error terms by including the lagged differenced terms of the independent variables. Phillips & Perron (1988) go beyond this by using non-parametric statistical methods in order to pay attention to serial correlation in the error terms without adding the lagged differenced terms (Gujarati & Porter, 2008).

For the PP test, the following regression is estimated for each variable in the model:

$$\Delta Y_t = \mu_0 + \mu_1 Y_{t-1} + \varepsilon_t \quad (4.4)$$

Where μ_0 and μ_1 are parameters estimates and ε_t is error term. The null hypothesis that a unit root exists in the time series is tested using the PP test and when critical value is greater than the test statistics and the probability value (PV) is less than 1%, 5% and 10% levels of significance, then the time series is considered to be stationary.

4.4.2 The choice of lag length

In order to get good results, it is important to select the lag for our variables. The choice of lag length is done using unrestricted VAR. Lag length criteria is important because it provides a lag where the error terms will reveal normality, no autocorrelation and no heteroskedasticity. Lag length is influenced by excluded variables. It therefore affect the behavior of the model in the short run. In this case, a good lag is needed. There are few criteria for choosing the suitable lag length such as Aikake's Information Criterion (AIC), Schwarz Information Criterion (SC), Hannann-Quin Criterion (HQ), sequential modified Likelihood Ratio (LR) and Final Prediction Error (FPE). According to (Mah, 2013) and (Davidson & MacKinnon, 2004) these information criteria are calculated as follows:

$$AIC = -2 \frac{l}{T} + 2 \frac{k}{T} \quad (4.5)$$

$$SC = -2 \frac{l}{T} + \frac{(k \log T)}{T} \quad (4.6)$$

$$HQ = -2 \frac{l}{T} + 2^k \frac{\log(\log(T))}{T} \quad (4.7)$$

$$LR = (T - m) \{ \log|\Omega_{n-1}| - \log|\Omega_n| \} - X^2(k^2) \quad (4.8)$$

Where l is the log likelihood l is computed as:

$$l = -\frac{T}{2} (1 + \log 2 \prod) + \log(\hat{e} \hat{e}' / T) \quad (4.9)$$

Mah (2013) explains that the SC is an alternative to the AIC that imposes a large penalty for additional coefficients. The HQ employs another penalty function. In the sequential modified likelihood ratio (LR) test, m is the number of parameters in the equation under the alternative. The modified LR statistics is compared to the critical value whereby we start from the maximum lag then we decrease one lag at a time until we get a rejection. The selected lag is indicated by an asterisk for each of the criteria, this is the one which minimises the criteria. According to Liew (2004), the AIC and the FPE results are superior when the number of observations are sixty and below than the SC and HQ criterion when wanting to have a good lag length criteria.

4.4.3 Johansen cointegration test

The Johansen cointegration test is a test that allows for more than one cointegrating relationship, unlike the Engle Granger method. This test is subject to asymptotic properties, that is the large samples (Phillips & Ouliaris, 1990). If the sample size is too small then the results will not be reliable and one should use the Auto Regressive Distributed Lags (Giles, 2014). The Johansen cointegration test is based on eigenvalues of transformations of the data and represent linear combination of the data that have maximum correlation. The eigenvalues are guaranteed to be non-negative or real.

According to Johansen (1988) the Johansen methodology starts from the Vector autoregression (VAR) of order p as follows:

$$Y_t = \mu + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \varepsilon_t \quad (4.10)$$

Where Y is a $n \times 1$ vector variables that are integrated of the order one $I(1)$ and ε_t is a $n \times 1$ vector innovations. This VAR can be written as:

$$\Delta Y_t = \mu + \prod Y_{t-1} + \sum_{t=1}^{n-1} \Gamma_t \Delta Y_{t-1} + \varepsilon_t \quad (4.11)$$

$$\text{Where } \prod = \sum_{t=1}^p A_{t-1} \text{ and } \Gamma_t = - \sum_{j=t+1}^p A_j \quad (4.12)$$

The $n \times r$ matrices α and β exist if the coefficient matrix \prod has a reduced rank $r \times n$. $\prod = \alpha\beta^1$ and $\beta^1 Y_t$ are stationary, r is the number of cointegration relationship, α is the adjustment parameter in the vector error correction model and each column of β is the cointegrating vector.

The johansen tests are called maximum eigenvalue test and the trace test. Let r be the rank of \prod . The Johansen tests are likelihood ratio tests. For both test statistics, the initial Johansen test is a test of the null hypothesis of no cointegration against the alternative of cointegration (Gregory & Hansen, 1996). The tests differ in terms of the alternative hypothesis. The trace and maximum eigenvalue tests are given as:

$$J_{trace} = T \sum_{i=r+1}^n \ln(1 - \bar{\lambda}_i) \quad (4.13)$$

$$J_{max-eigen} = -T \ln(1 - \bar{\lambda}_{r+1}) \quad (4.14)$$

Where T is the sample size and $\bar{\lambda}$ is the i^{th} largest canonical correlation. The null hypothesis of the trace test is r cointegrating vectors and the alternative hypothesis is n cointegrating vectors. The maximum eigenvalue test considers the null

hypothesis of r cointegrating vectors while the alternative hypothesis is the $r+1$ cointegrating vectors (Thomas, 1985).

4.4.4 Vector Error Correction Model

The vector error correction model (VECM) is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with non-stationary series that are known to be integrated (Amassoma & Nwosa, 2013). The conventional vector error correction model is employed to examine the short run dynamics and cointegrating equation among the series. The error correction term is estimated for the coefficient such that when the series fails to cointegrate, it means that the short run model becomes the next estimation method. The concept of VECM is used to explain the relationship between short run dynamics and the long run equilibrium relationship among the data series. The application of VECM is important as it is used to correct temporary short run deviation of series from the long run equilibrium relationship (Eze, Atuma, Egbeoma, 2016). The model of VECM is presented as:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 \mu_{t-1} + \varepsilon_t \quad (4.15)$$

Where:

$Y_t = Y_t - Y_{t-1}$, α_1 and α_2 represent the dynamic adjustment coefficients of the variables, while μ_{t-1} is the residual lag, it represents the short run deviation from the equilibrium position, it is estimated to correct long run equilibrium error and ε_t is the error term. The decision to apply VECM based on ordinary least square is borne out from the fact that the study employed more than one explanatory variable (Asoluka & Okezie, 2011). So there is a need to apply the method in the investigation. The model is demonstrated below:

$$\Delta LGDP_t = \beta_0 + \beta_1 \Delta LDGP_{t-1} + \beta_2 UN_{t-1} + \beta_3 LP_{t-1} + \beta_4 GD_{t-1} + \varepsilon_t \quad (4.16)$$

Where ΔL represents the change in natural logarithm of the variable, for instance $\Delta LGDP_t$ represent the natural logarithm of the gross domestic product, β_0 is a constant, $\beta_1, \beta_2, \beta_3, \beta_4$ are the parameters of the explanatory variables and ε_t is the error term of the long run equilibrium error. The method of vector error correction model is estimated to investigate the dynamic behavior of the relevant variables of the study, following the confirmation of long run equilibrium relationship. It overcomes the problems of spurious regression using the appropriate differenced variables in order to determine the short-term adjustment in the model (Mah, 2013).

4.4.5 VECM granger causality

Granger causality test in a Vector Error Correction Model (VECM) framework examine the direction of the causal relationship between the variables. The selected approach of causality test using the VECM is popular for its modelling of variables that are individually non-stationary, but linked together by long run relationships (Asteriou & Hall, 2011). The Granger causality test can be implemented in a VECM framework by running the following regressions (Ageli, 2013; Odhiambo, 2009).

$$y_t = \alpha_0 + \sum_{i=1}^n \alpha_{1i} y_{t-i} - i + \sum_{i=1}^n \alpha_{2i} DER_VOL_{t-i} + ECT_{t-1} + \mu_t \quad (4.17)$$

$$Dervol_t = \beta_0 + \sum_{i=1}^n \beta_{1i} DER_VOL_{t-i} + \sum_{i=1}^n \beta_{2i} y_{t-i} + ECT_{t-1} + \varepsilon_t \quad (4.18)$$

Where, in the preceding equations:

- n denotes the number of lagged variables.
- $\alpha_1, \alpha_2, \beta_1$ and β_2 are the parameters to be estimated
- α_0 and β_0 are constant terms that represent the intercepts of the equations
- μ_t and ε_t are mutually uncorrelated white noise residual or the error terms
- ECT_t is the error correction term lagged one period

4.4.6 Diagnostic test

The diagnostic tests are conducted to ensure the validity and reliability of the vector error correction model. The following diagnostic tests are used: Breusch-Pagan test, White test, ARCH, Breusch-Godfrey, Jarque-Bera, Ljung-Box Q and the Ramsey RESET.

4.4.6.1 Normality test

The Jarque-Bera is a type of Lagrange multiplier test for normality (Jarque & Bera, 1987). Normality is one of the assumptions for many statistical tests, like the T test or F test, and the Jarque-Bera test usually run to confirm normality before these tests. Normal distribution has a skew of zero of which it is perfectly symmetrical around the mean and a kurtosis of three. Kurtosis tells how much data is in the tails and gives an idea about how peaked the distribution is (Jarque & Bera, 1987). The null hypothesis that residuals are normally distributed is tested.

4.4.6.2 Serial/Autocorrelation tests

The Ljung-Box Q proposed by Box & Pierce (1970) is a diagnostic tool used to test lack of fit or robustness of a time series model. The test is applied to the residuals of a time series after fitting an ARMA model to the data. The test examines autocorrelations of the residuals (Ljung & Box, 1978).

Breusch-Pagan Test is proposed by Breusch & Pagan (1980) is used to check for the presence of serial correlation in the model. The Breusch-Pagan test's alternative null hypothesis is less specific and is given by:

$$\sigma_i^2 = \sigma^2 h(z_i' \alpha) \quad (4.19)$$

Where h is an unknown, continuously differentiable function (that do not depend on i) such that $h(0) > 0$ and $h(0) = 1$. A test for $H_0 : \alpha = 0$ versus $H_1 : \alpha \neq 0$ can be derived independently of the function h . The simple variant of the Breusch-Pagan test can be computed as the number of observation multiplied by the R^2 of a

regression of e_i^2 (the squared OLS residuals) on z_i and a constant. The Breusch-Pagan test is a Lagrange multiplier test for heteroskedasticity. The main characteristic of Lagrange multiplier tests is that they do not require that the model is estimated under the alternative and they are often computed from the R^2 of some auxiliary regression.

The Breusch-Godfrey test is used to test for serial correlation in a time series as extended by Breusch (1978) and Godfrey (1978). The test makes use of the residuals from the model being considered in a regression analysis, and a test statistic is derived from it. The null hypothesis of no serial correlation of any order is tested.

4.4.6.3 Heteroscedasticity tests

The White test (White, 1980) does not require additional structure on the alternative hypothesis and exploits further the idea of a heteroskedasticity consistent covariance matrix for the OLS estimator. The conventional estimator is:

$$\hat{V}\{b\} = s^2 \left(\sum_{i=1}^N x_i x_i' \right)^{-1} \quad (4.20)$$

If there is no heteroskedasticity, the equation above will give a consistent estimator of $V(b)$ while if there is, it will not. White (1980) has devised a statistical test based on this observation. A simple operational version of this test is carried out by obtaining NR^2 in the regression of e_i^2 on a constant and all first moments, second moments and cross products of the original regressors. The test statistic is asymptotically distributed as Chi-squared with P degrees of freedom, where P is the number of regressors in the auxiliary regression, excluding the intercept.

The most common model of heteroskedasticity employed in the time series context is the Autoregressive Conditional Heteroskedasticity (ARCH) which was proposed by

Engle (1982). An ARCH model starts from the premise that we have a static regression model:

$$y_t = \beta_0 + \beta_1 + \varepsilon_t \quad (4.21)$$

All of the Gauss–Markov assumptions hold, so that the OLS estimators are Best Linear Unbiased Estimators (BLUE). This implies that $Var(\mu_t|Z)$ is constant. One of the assumptions of the classical linear regression model is that there is no heteroskedasticity. Breaking this assumption means that the Gauss–Markov theorem does not apply, meaning that OLS estimators are not the best linear unbiased estimators (BLUE) and their variance is not the lowest of all other unbiased estimators (Tofallis, 2008).

4.4.6.4 Ramsey RESET

Adding to the diagnostic test, the Ramsey RESET is used to determine whether the error correction model is correctly specified or not. According to Austeriou & Hall (2011), if the equation is incorrectly specified, it may lead to the misspecification bias and wrong functional forms that may result in having high R-squared and misleading results.

4.4.7 Stability test

To test stability model different tests are used that are based on recursive residuals. The two most important are the CUSUM and CUSUM of squares test, which utilises data ordered chronologically rather than according to the value of the explanatory variable (Steward, 2005). The CUSUM test is based on a plot of the sum of the recursive residuals. If this sum goes outside a critical bound, one concludes that there was a structural break at the point at which the sum began its movement toward the bound. The CUSUM of squares test is similar to the CUSUM test but plots the cumulative sum of squared recursive residuals expressed as a fraction of these squared residuals summed over all observations (Marno, 2004).

The CUSUM test is based on the cumulated sum of the residuals:

$$W_t = \sum_{j=k+1}^T \frac{w_j}{\hat{\sigma}} \quad (4.22)$$

with

$$\sigma^2 = \frac{\sum_{j=k+1}^T (W_j - \bar{W})^2}{T-k-1} \quad (4.23)$$

and

$$\bar{W} = \frac{\sum_{j=k+1}^T w_j}{T-k} \quad (4.24)$$

Where k is the minimum sample size for which we can fit the model. The CUSUM test is performed by plotting W_t against t . Under null hypothesis, W_t , the cumulative sum with constant parameters has a mean of zero, $E(W_t) = 0$ and variance equal to the number of residuals being summed, in fact each term has variance 1 and they are independent. But with nonconstant parameter, W_t will tend to diverge from the zero mean value (Pittis & Caporale, 2014). The significance of the departure from the zero line may be assessed by reference to a pair of straight lines that pass through the points.

$$(k, \pm a\sqrt{t-k}) \quad (4.25)$$

and

$$(t, \pm 3a\sqrt{t-k}) \quad (4.26)$$

where a is a parameter depending on the significance level α chosen.

The second test statistic , the CUSUM of squares is based on cumulative sums of squared residuals:

$$S_t = \frac{\sum_{k+1}^t W_j^2}{\sum_{k+1}^T W_j^2} \quad (4.27)$$

with

$$t = k + 1, \dots, T \quad (4.28)$$

The expected value of S_t is $E(S_t) = \frac{t-k}{T-k}$, which goes to zero at $t = k$. The significance of departures from the expected value line is assessed by reference to a pair of lines drawn parallel to the $E(S_t)$ line at a distance C_s above and below. This value depends on both the sample size $T - k$ and the significance level α .

4.4.8 Impulse response function

Granger causality may not be able to reveal the complete story about the interaction between variables in a model. It is therefore important to look at the impulse response relationship in a higher dimensional system (Rossi, 2010). An impulse response function describes the evolution of the variable of interest along a specified time horizon after a shock in a given moment.

The impulse response function :

$$y_{t+n} = \sum_{i=0}^{\infty} \Psi_{i\Phi_{t+n-i}} \quad (4.29)$$

$$\{\Psi_n\}_{i,j} = \frac{\partial y_{it+n}}{\partial \Phi_{jt}} \quad (4.30)$$

the response of $Y_{i,t+n}$ to a one time impulse in $Y_{j,t}$ with all other variables dated t or earlier held constant. The response of variable i to a unit shock in a variable j is sometimes depicted graphically to get a visual impression of the dynamic interrelationships within the system. If the variables have different scales, it is sometimes useful to consider innovations of one standard deviation rather than unit shocks (Rossi, 2010). For instance, instead of tracing an unexpected unit increase in investment in the investment/income/consumption system with $Var(\epsilon_{1,t}) = 2.25$, one may follow up on a shock of $\sqrt{2.25} = 1.5$ units because the standard deviation of $\epsilon_{1,t}$ is 1.5. The impulse responses are zero if one of the variables do not Granger cause the other variables taken as a group. An innovation in variable k has no effect on the other variable if the former variable does not granger cause the set of the remaining variables (Veigi, 2010).

4.4.9 Variance Decomposition

Variance decomposition is used to aid in the interpretation of a vector auto regression (VAR) model once it has been fitted (Rossi, 2010). The variance decomposition indicates the amount of information each variable contributes to the other variables in the auto regression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. Variance decomposition analysis is named as an out of sample causality test, which is used to provide an indication of the dynamic properties of the system (Espinoza, 2011). Variance decomposition analysis is a convenient method to partition the variance of forecast error of a certain variable into proportions attributable to innovations or shocks in each variable in the system (Ooi, Wafa, Lajuni, & Ghazali, 2009). A vector autoregression (VAR) can be written as a vector moving average (VMA) as follows;

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^k \alpha_i \Delta X_{t-i} + \epsilon_{1t} \quad (4.31)$$

$$\Delta Y_t = \mu_0 + \sum_{j=0}^{\infty} \alpha_1^j \varepsilon_{t-j} \quad (4.32)$$

Where $\mu = (1 + \alpha_1 + \alpha_2 + \dots)\alpha_0$ is the unconditional mean of X_t . Equation (4.32) is the vector moving average representation of Equation (4.31) in that variables Y_{it} are expressed in terms of the current and past values of the various types of shocks ε_{it} . Ooi, et al. (2009) believes that the vector moving average representation of equation (4.31) is an important feature as it allows a tracing out of the time path of the various shocks on the variables contained in the vector autoregression system.

4.5 SUMMARY

Chapter four describes the research process relevant to deal with time series data in order to determine the relationship economic growth and unemployment in South Africa. The econometric modelling relating to economic growth and unemployment was specified, based on both theoretical and empirical foundations. The chapter also provided descriptions of variables used, specified the Vector Error Correction Model (VECM) model, and presented the econometric techniques appropriate for time series data. The analytical framework presented in chapter four was applied to the South African quarterly time series data (2005Q1 to 2016Q4) in chapter five to achieve the objectives laid out for the study in chapter one.

CHAPTER 5: DATA INTERPRETATION AND ANALYSIS OF RESULTS

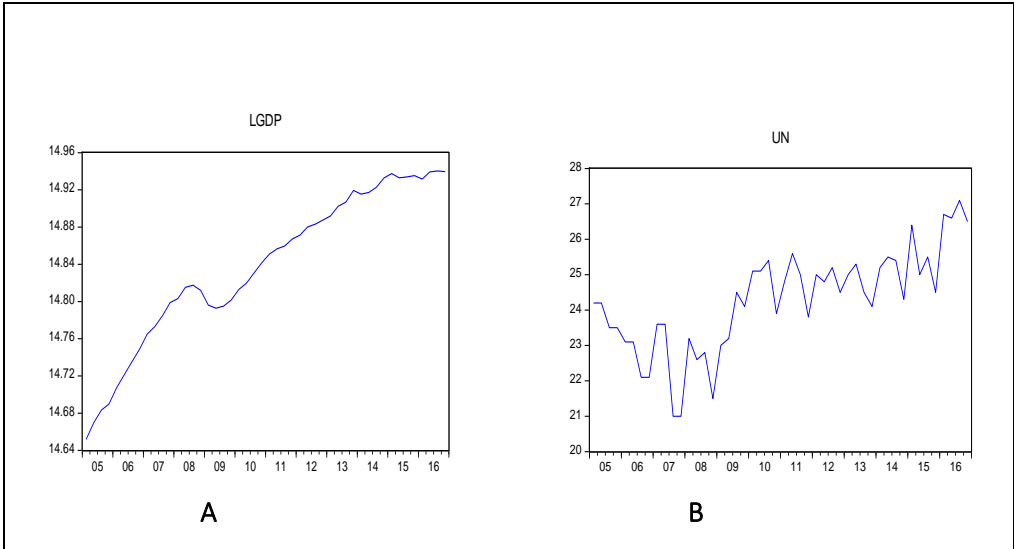
5.1 INTRODUCTION

Chapter four described the details of the research methodology and the research process used to realise a more robust outcome in determining the relationship between economic growth and unemployment. Using the Johansen (1988) multivariate cointegrating procedures, the model was estimated over the sample period 2005Q1 to 2016Q4. The technique used for the assessment of the relationship is the Vector Error Correction Model (VECM). Chapter five offers the results as highlighted from empirical research conducted by using econometric tools and techniques to conduct a unit root test, optimal lag length selection test, Johansen cointegration test and the estimation of the VECM. Diagnostic tests were conducted to determine the reliability of the results obtained from the VECM model. These results were complemented by VECM Granger causality tests, impulse response functions and variance decompositions.

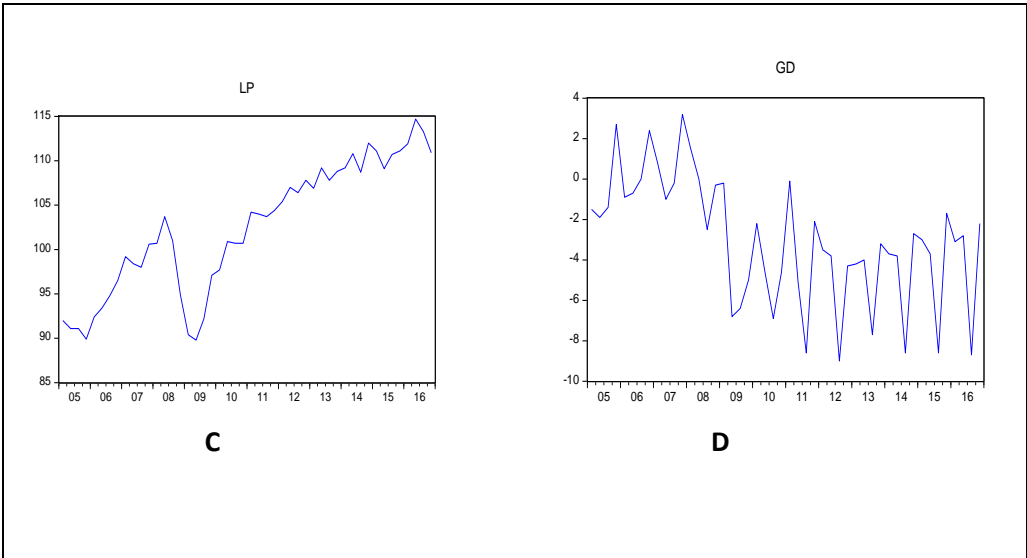
5.2 VISUAL INSPECTION RESULTS

The visual inspection shows that our variables are increasing or decreasing hence, they are not stationary at level form (Gujarati & Porter, 2009). In figure 5.1, the results shows that LGDP has been trending upward with fluctuation and this means that the series is more likely to increase overtime. Similarly, UN and LP increase while GD decreases. This is a clear indication that all variables are non-stationary at level. Therefore, it is necessary to proceed with visual inspection at first difference.

Figure 5.1: Selected variables at level form



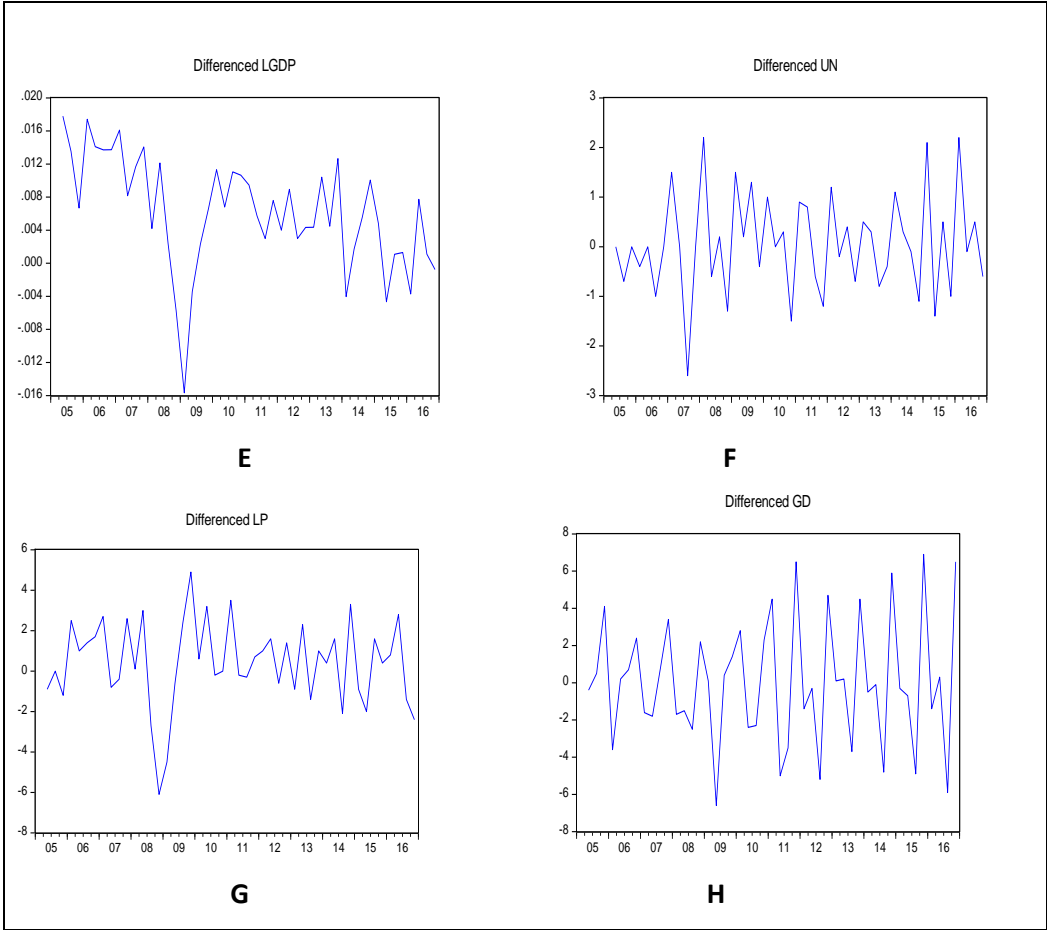
Source: Own computation



Source: Own computation

The time series data is then transformed by differencing it to remove the trend component from the time series. The results are presented in figure 5.2 below.

Figure 5.2: Selected variable at first difference



Source: Own computation

The white noise process has no trending behaviour and it continually crosses the mean value of zero. The impression we get is that all variables seem to be stationary at first difference, that is, they are $I(1)$ variables since visually variances seem not to be influenced by time. In order to verify the conclusions made using informal test results, more efficient tests need to be conducted such as the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests.

5.3 UNIT ROOT TEST RESULTS

The table 5.1 summarizes the results of the unit root tests from both the Augmented Dickey Fuller (ADF) test and the Phillips Perron (PP) test.

Table 5.1: ADF and PP test results

Series	Model	ADF Lags	ADF Statistic	PP Bandwidth	PP Statistic	Conclusion & Order of Integration
LGDP	Trend & Intercept	1	-2.156523	3	-2.378996	Do not reject H_0
	Intercept	1	-2.261544	3	-3.206740***	Hence, the series is non-stationary at I(0).
	None	1	2.252628	4	-3.877501	
DLGDP	Trend & Intercept	0	-4.298214***	0	-4.298214***	Reject H_0
	Intercept	0	-3.843557***	1	-3.755741***	Series contains unit root, hence it's stationary, I(1)
	None	0	-3.004665***	1	-2.870438***	
UN	Trend & Intercept	0	-4.523532***	7	-4.493154***	Do not reject H_0
	Trend	3	0.291912	9	-2.446132	The series is non-stationary at I(0)
	None	3	1.315758	13	0.633897	
DUN	Trend & Intercept	2	-8.375122***	16	-13.28905***	Reject H_0
	Trend	2	-8.031559***	19	-13.62515***	The series contains unit root, hence it's stationary at I(1)
	None	3	-3.168145***	22	-12.07292***	
LP	Trend & Intercept	0	-2.390187	0	-2.390187	Do not reject H_0
	Intercept	0	-1.162553	2	-1.256063	The series is non-stationary at I(0)
	None	0	1.215778	3	1.123458	
DLP	Trend & Intercept	0	-5.537419***	4	-5.431686***	Reject H_0 The series is contain unit root, hence it's

Series	Model	ADF Lags	ADF Statistic	PP Bandwidth	PP Statistic	Conclusion & Order of Integration
						stationary at I(1).
	Intercept	0	-5.597245***	4	-5.499704***	
	None	0	-5.597245***	2	-5.409133***	
GD	Trend & Intercept	5	-1.929364	2	-5.713275	Do not reject H_0
	Intercept	3	-1.082012	2	-4.291834***	The series is non-stationary at I(0)
	None	7	-0.121921	10	-3.307298	
DGD	Trend & Intercept	2	-14.37206***	11	-17.73906***	Reject H_0
	Intercept	2	-14.46129***	11	-17.98996***	The series contain unit root, hence its stationary at I(1)
	None	6	-2.775678***	11	-17.69108***	

Source: Own computation

*** represent stationary at 1% level of significance

** represent stationary at 5% level of significance

*represent stationary at 5% level of significance

The results in table 5.1 reveal that the variables could not pass the ADF and PP test when they are at level. Based on the decision rule, the failure to reject the null hypothesis implies that the variables are non-stationary and they require the first order differencing to make them stationary. LGDP, LP, UN and GD became stationary at first difference. In this regard, the null hypothesis is rejected in favour of alternative hypothesis and making the series to be stationary. Therefore, all variables used are integrated at the same order which is I (1).

5.4 LAG LENGTH CRITERIA

Table 5.2 shows that the selection of lag order was made using the maximum of 4 lags to allow adjustment in the model and produce well behaved residuals. Information criterion LR, FPE, AIC and HQ chose the most lag order of 4. However, lag 4 produced positive and insignificant coefficient of the error correction model (ECM) while looking for a negative coefficient. Therefore, lag 1 was chosen as the most favourable lag for the data set. The information criterion SC is seems to be the

best lag choice as evidenced by (Banda, et al., 2016) who used the same lag criteria in their study using quarterly data to produce significant results. Thereafter, the Johansen cointegration test was performed using lag 1 tested by the trace and maximum eigenvalue test.

Table 5.2: Choice of lag length results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-205.3246	NA	0.159339	9.514757	9.676956	9.574908
1	-41.06177	291.1933	0.000189	2.775535	3.586530*	3.076291
2	-18.78257	35.44418	0.000145	2.490117	3.949908	3.031478
3	-6.267168	17.63534	0.000179	2.648508	4.757095	3.430474
4	27.57521	41.53383*	8.74e-05*	1.837490*	4.594874	2.860061*

Source: Own computation

5.5 JOHANSEN COINTEGRATION TEST RESULTS

Johansen cointegration test used provide the number of cointegrating equations and allow us to impose theory based restrictions. When there is cointegration, it means variables share the same trend and the long run equilibrium as suggested theoretically. The cointegration results are analysed by the trace test and the maximum eigenvalue test in table 5.3.

Table 5.3: Trace test and Maximum eigenvalue test

Hypothesised No of CEs	Eigen Value	Trace Statistic	0.05 Critical Value	Prob**	Max Eigen Statistic	0.05 Critical Value	Prob**
None*	0.601060	82.85990	47.85613	0.0000	42.27147	27.58434	0.0003
At most 1*	0.447282	40.58842	29.79707	0.0020	27.27373	21.13162	0.0060
At most 2	0.140533	13.31470	15.49471	0.1038	6.966355	14.26460	0.4931
At most 3*	0.128908	6.348343	3.841466	0.0117	6.348343	3.841466	0.0117

Source: Own computation

Trace tests indicates 2 cointegrating eqn(s) at the 0.05 level

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

*denotes rejection of the hypothesis at the 0.05 level

Table 5.3 illustrate the results of Johansen cointegration tests. The results highlights that there are two cointegrating equations in both the trace test and the maximum eigenvalue test at 5% level of significance. The decision rule states that the null hypothesis is rejected where there is no cointegration between the variables. The null hypothesis of no cointegrating equation of the trace statistic is rejected at none as the test statistic of 82.86 is greater than the critical value of 47.86 at 5% level of significance. This implies that there is cointegration at none. Moving on to the test for null hypothesis of at most 1 cointegrating vector, the trace statistic of 40.59 is greater than the critical value of 29.80. Therefore, there is a cointegration of variables for at most 1. The null hypothesis of no cointegration is not rejected at most 2 since the trace statistic of 13.31 is less than the critical value of 15.49. Therefore, it is concluded that there are two cointegrating equations at 5% level of significance with the trace test. The probability value of the trace test is only significant at none and at most 1, hence proving that there are two long run relationships between the variables.

The maximum eigenvalue test shows that the maximum eigenvalue statistic of 42.27 is greater than the critical value of 27.58 at 5% level of significance. This means that there is a cointegration at none. Moving on to at most 1, the null hypothesis is also rejected as the test statistic of 27.27 is greater than the critical value of 21.13 at 5% level of significance. However, the null hypothesis of no cointegration of at most 2 is accepted since the test statistic is greater than the critical value. The probability value of the maximum eigenvalue is also significant at none and at most 1, confirming that there are two cointegration relationship between the variables. In conclusion, the presence of cointegrating equations at these tests means that there is a long run relationship in this model.

Since the long run regression model is needed to show the relationship between economic growth and its determinants, the normalised cointegrating coefficients are as follows:

$$LGDP + 0.019515UN - 0.09781LP + 0.015897GD = 0 \quad (5.1)$$

Where the economic growth long run equation from Johansen cointegration is:-

$$LGDP = -0.011886 - 0.019515UN + 0.09781LP - 0.015897GD \quad (5.2)$$

Adjustment coefficients are: -0.105437 for LGDP, 17.12867 for UN, 23.07643 for LP and -84.77343 for GD. Since the Johansen test does not provide the level of significance, the explanation of the long run equation 5.2 was done under the VECM estimates whereby the level of significance were described alongside. After the Johansen cointegration test, VECM estimates were conducted to obtain the long run equation.

5.6 VECTOR ERROR CORRECTION MODEL (VECM) RESULTS

Variables can have either the short or long run effects, this study employed the vector error correction model to examine the short run dynamics and the long run relationship among variables of this study.

Table 5.4: Vector error correction model

Cointegrating Eq:	CointEq1	CointEq2		
LGDP(-1)	1.000000	0.000000		
UN(-1)	0.000000	1.000000		
LP(-1)	-0.008298 (0.00048) [-17.3378]	-0.072760 (0.03018) [-2.41048]		
GD(-1)	0.002455 (0.00136) [1.80570]	0.688807 (0.08572) [8.03513]		
C	-13.98201	-14.67243		
Error Correction:	D(LGDP)	D(UN)	D(LP)	D(GD)
CointEq1	-0.105437 (0.05991) [-1.75994]	17.12867 (7.87387) [2.17538]	23.07643 (24.0825) [0.95823]	-84.77343 (22.5106) [-3.76593]

CointEq2	0.000126	0.167247	-0.038074	-2.214215
	(0.00084)	(0.11028)	(0.33730)	(0.31528)
	[0.15054]	[1.51655]	[-0.11288]	[-7.02295]
D(LGDP(-1))	0.105185	-15.26694	84.25321	6.759196
	(0.23354)	(30.6937)	(93.8775)	(87.7500)
	[0.45040]	[-0.49740]	[0.89748]	[0.07703]
D(UN(-1))	-0.000211	-0.458444	0.217626	1.053474
	(0.00121)	(0.15870)	(0.48538)	(0.45370)
	[-0.17476]	[-2.88880]	[0.44836]	[2.32197]
D(LP(-1))	0.000651	0.178935	0.101360	-0.485297
	(0.00050)	(0.06623)	(0.20256)	(0.18934)
	[1.29245]	[2.70177]	[0.50039]	[-2.56308]
D(GD(-1))	-0.000280	0.074876	-0.012182	0.349867
	(0.00043)	(0.05677)	(0.17363)	(0.16230)
	[-0.64805]	[1.31896]	[-0.07016]	[2.15572]
C	0.004877	0.103516	-0.160535	0.164147
	(0.00162)	(0.21314)	(0.65190)	(0.60935)
	[3.00705]	[0.48567]	[-0.24626]	[0.26938]
R-squared	0.408250	0.566182	0.063335	0.687862
Adj. R-squared	0.317212	0.499440	-0.080767	0.639841

Source: Own computation

The previous period's deviation from long run equilibrium is corrected in the current period at an adjustment speed of 10.5%. This is shown by the value of error correction term (ECT) as -0.105437 which implies that the relationship between the variables met a priori expectation of the study and that the condition for stability is satisfied. The negative sign and the value of the ECT with its t-statistical value of -1.755994 shows that there is no significant impact of economic growth on unemployment in South Africa, as short run elasticities are showing insignificant impact. This indicates that the speed of adjustment for a deviation of the series from short run towards long run equilibrium relationship is high. However, a 1 percent change in LGDP is associated with a 0.0002% decrease in change in UN, ceteris paribus, in the short run; a 1 percent change in LGDP is associated with a 0.00065% increase in change in LP, ceteris paribus; and a 1 percent change in LGDP is

associated with a 0.0002 decrease in change in GD, ceteris paribus. The results also showed the value of R-squared (R^2) as 0.408250. This indicates that 40.8% of the variations in the real GDP are explained by the explanatory variables, while the remaining 59.2% of the variations is attributed to the effects of other variables not included in the model. This finding of the study is in line with the findings of Zangler (2006), Stephen (2012) and Eze, et al., (2016).

5.7 VECM GRANGER CAUSALITY TEST RESULTS

In order to determine the short run causality among variables, Granger causality/Block Exogeneity Wald test based upon VEC model is performed. The results are presented in table 5.5 below.

Table 5.5: Summary of VEC granger causality test results

	LGDP	UN	LP	GD
Dependant Variable				
LGDP	-	0.030542 (0.8613)	1.670438 (0.1962)	0.419966 (0.5170)
UN	0.247404 (0.6189)	-	7.299547*** (0.0069)	1.739665 (0.1872)
LP	0.805471 (0.3695)	0.201029 (0.6539)	-	0.004923 (0.9441)
GD	0.005933 (0.9386)	5.391541** (0.0202)	6.569367*** (0.0104)	-

Source: Own computation

*, **, ***, represents statistical significance at 10%, 5%, 1% respectively and figures in parentheses are p-values.

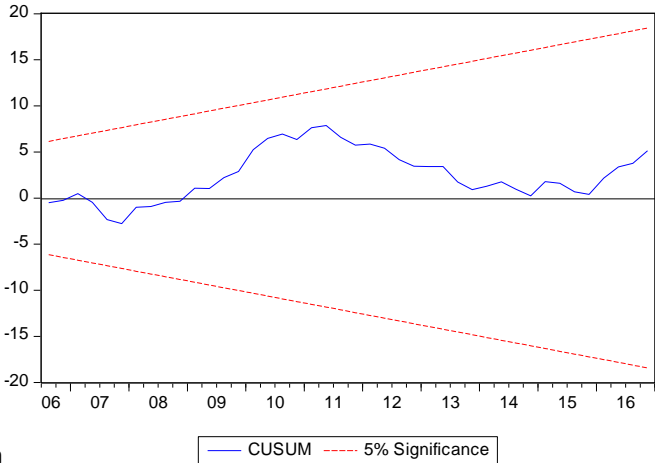
In order to analyse short run causal relationships among LGDP, UN, LP and GD for each equation in the VECM, we consider χ^2 (Wald) statistic for the significance of the lagged endogenous variables in that equation. The result results in Table 5.5 revealed that LP granger cause the UN at 1% level of significance, which leads to the rejection the null hypothesis since a unidirectional causality exist between LP and UN. Also, the results shows that UN granger cause GD at 5% level of significance, while LP granger cause GD at 1% level of significance. Therefore, unidirectional causality exist between UN and GD as well as LP and GD. In this case, the null

hypothesis is rejected where causality exist among the variables. Hence other relationships were not supported by the research results.

5.8 STABILITY TEST RESULTS

The stability test was carried out using the CUSUM and CUSUM of squares test. The results are summarised in figure 5.3 and figure 5.4.

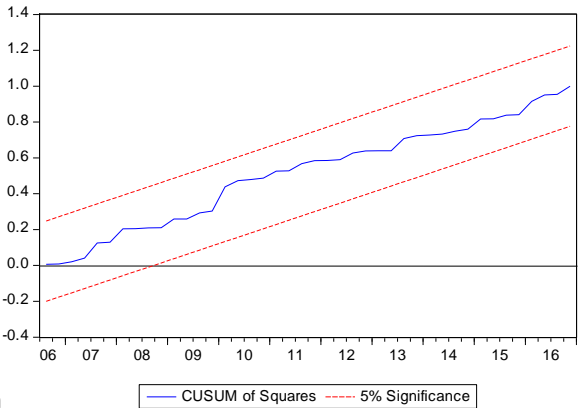
Figure 5.3: CUSUM test results



Source: Own computation

The CUSUM test indicates graphically that the cumulative sum of errors collected is within the 5% critical lines. The equation parameters are well thoroughly considered as stable if the sum of the recursive errors are within the 5% critical line for the entire period. According to the graph of the CUSUM test above, it can be concluded that the model is stable throughout the observation period because the whole sum of recursive errors remained within the two 5% critical lines.

Figure 5.4: CUSUM of Squares test results



Source: Own computation

The CUSUM of squares test is similarly calculated and interpreted as CUSUM test, but the difference is that with the CUSUM of squares use double recursive errors. The equation parameters are considered as stable if the whole sum of the recursive errors remain within the 5% critical lines. According to the graph of the CUSUM of squares test above, it can be concluded that the model is stable throughout the observation period because the whole sum of recursive errors remained within the two 5% critical lines.

5.9 DIAGNOSTIC TEST RESULTS

The test is conducted to assist in deciding whether or not the model is correctly specified or it is of good fit. The probability values are used to decide if the null hypothesis should be accepted or rejected. The decision rule of this test states that: Reject the null hypothesis if the probability value is less than the 5% level of significance. The results are summarised in table 5.6.

Table 5.6: Summary of diagnostic test results

Test	H_0	t-statistic	P-value	Conclusion
Jarque-Bera	Residuals are normally distributed	0.485038	0.785038	Do not reject H_0 since $PV > LOS$, hence residuals are normally distributed
Ljung-Box Q	No Autocorrelation	0.7972	0.372	Do not reject H_0

	(order 1)			since $PV > L.O.S$, hence there is no autocorrelation
Breusch-Godfrey	No-Serial correlation	7.699812	0.0908	Do not reject H_0 since $PV > LOS$, hence there is no serial correlation
Breusch Pagan Godfrey	No-Heteroskedasticity	6.470668	0.0920	Do not reject H_0 since $PV > LOS$ hence, there is no heteroskedasticity
Arch	No-Arch Heteroskedasticity	0.793144	0.3732	Do not reject H_0 since $PV > LOS$ hence, there is no heteroskedasticity
White CT	No-Heteroskedasticity	9.471819	0.3041	Do not reject H_0 since $PV > LOS$ hence, there is no heteroskedasticity
White NCT	No-Heteroskedasticity	2.146734	0.5425	Do not reject H_0 since $PV > LOS$ hence, there is no heteroskedasticity.

Source: Own computation

Jarque-Bera test statistic is used to test for normality. Its null hypothesis states that the residuals are normally distributed as the probability value is greater than 5% level of significance. Therefore, we accept the null hypothesis and reject the alternative.

Ljung-Box Q test is used to test for autocorrelation. It is used to check whether any of a group of autocorrelations of a time series are different from zero. The null

hypothesis shows that there is no autocorrelation because the probability value is greater than 5% level of significance. Therefore, we accept H_0 .

Breusch-Godfrey test is used to test for serial correlation. This is used to show whether the error term from one observation is correlated with that of another. The null hypothesis states that there is no serial correlation as the probability value is greater than the level of significance. We therefore accept the null hypothesis.

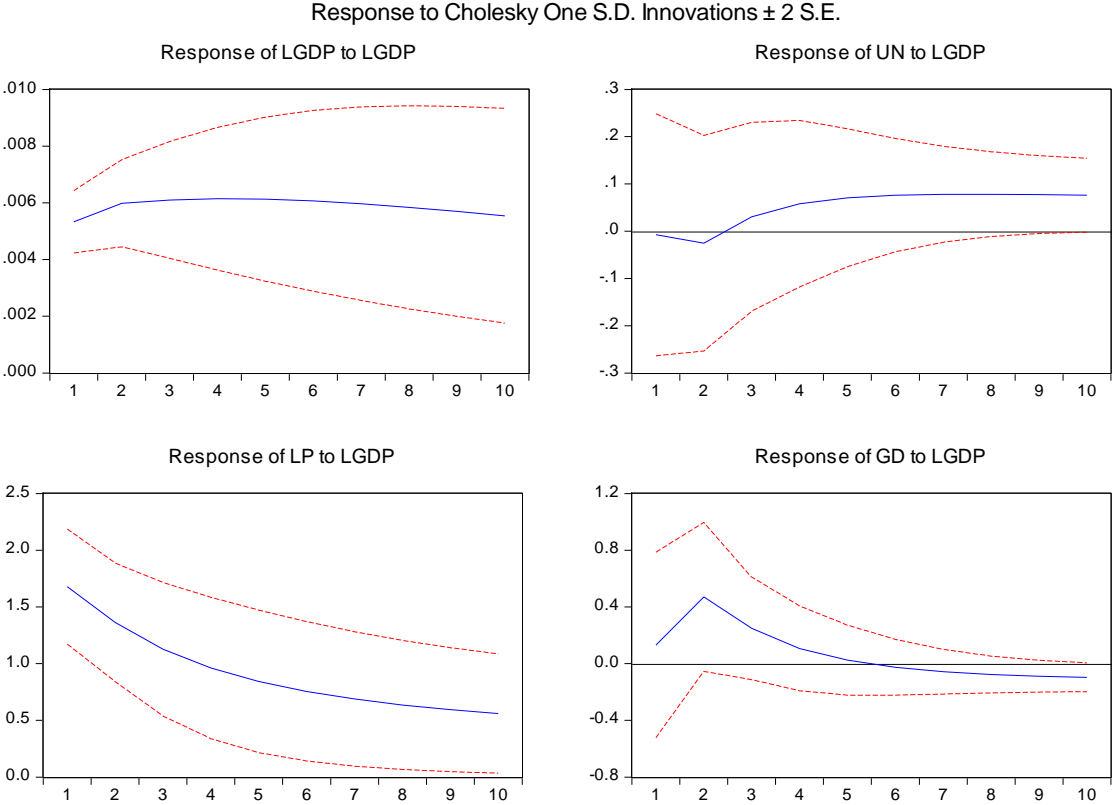
Breusch-Pagan Godfrey, Arch and white tests are used to test for heteroskedasticity. If the residuals are heteroskedastic, it means that variances of error terms are not constant from one another. The null hypothesis that there is no heteroskedasticity is considered to be true as the probability value is greater than the 5% level of significance. Therefore, we can conclude that our residuals are homoscedastic.

In conclusion, the results in table 5.6 show that there is no serial correlation, no autocorrelation, no heteroskedasticity and residuals are normally distributed in this model.

5.10 IMPULSE RESPONSE FUNCTIONS

Figures below displays the impulse response functions of the log of first difference of the variables (economic growth, unemployment rate, labour productivity and government budget deficit) to one standard deviation structural shocks. The combined graphs are based on the output of the unrestricted VAR with analytic response standard error over 10 period and Cholesky degrees of freedom adjusted, which show the response to cholesky one standard deviation innovation. Each graph as shown in plots includes a point estimation of impulse response functions as well as lower and upper bounds for a 95% confidence interval. As usual, the solid lines depict the variable percent change in response to a standard deviation of one in the respective macro variables whereas the dotted lines represent the 95% error bounds.

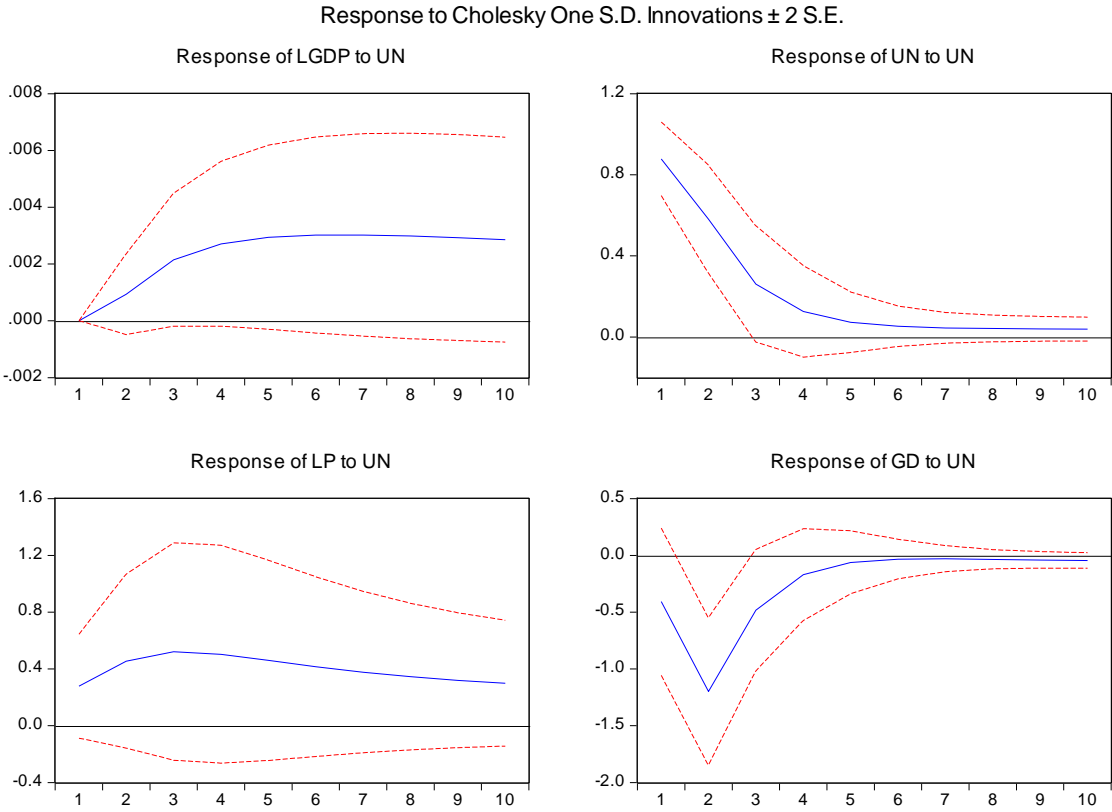
Figure 5.5: Response to LGDP



Source: Own computation

The graphs shows that LGDP to its own shocks is strong and positive for the whole period. This means that any increase in the real GDP consistently reduces the deviation between the short term equilibrium values of the real GDP level and its long run equilibrium values. The response of UN to LGDP is negative at the initial until it recovers from the 3rd quarter towards the end of the period. It starts first by causing the deviation between the short run equilibrium values of the LGDP to decline after an unanticipated increase in the unemployment rate. The response of LP to LGDP is strong and positive from the initial period to the end of the period. Finally, the response of GD also has a predictable and stable relationship with the LGDP. As can be observed from the graph, the impact of the shock will first cause LGDP to increase up to the 5th quarter and thereafter decreases until the end of the period.

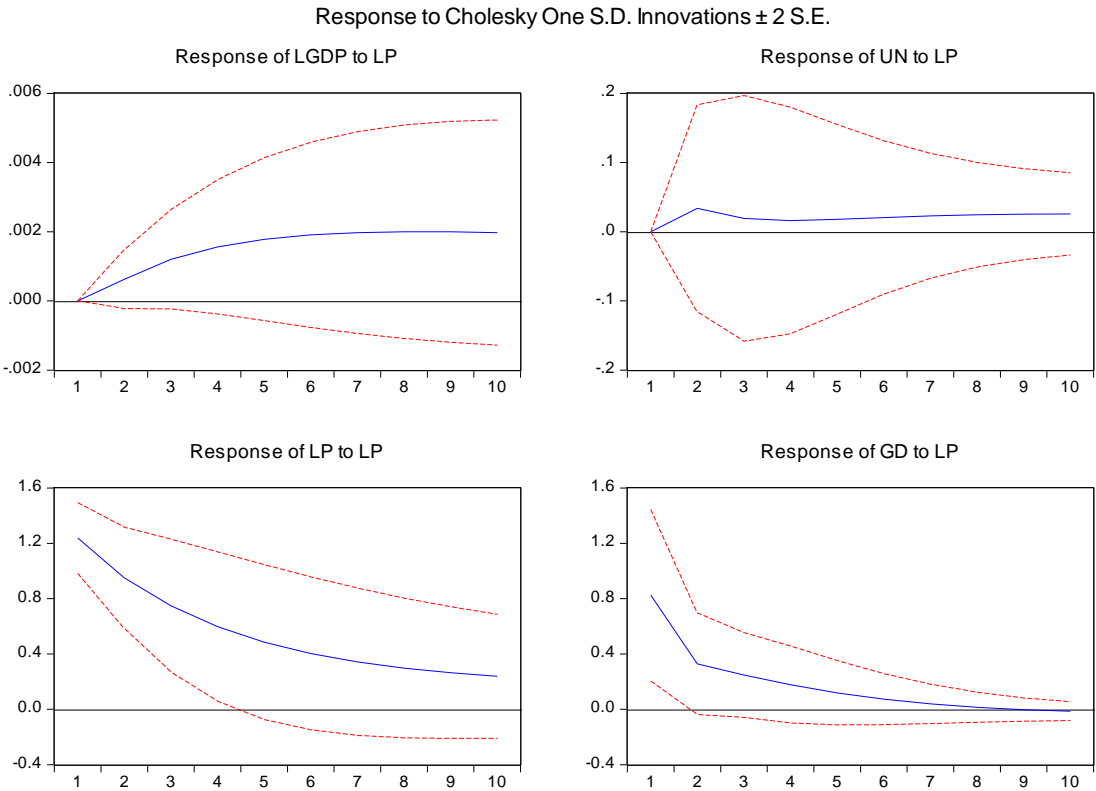
Figure 5.6: Response to UN



Source: Own computation

The graphs reveals that the reaction of LGDP to the UN shock is seems to be improving shown by the upward trend from the 1st quarter even though it remained stable but positive from the 3rd quarter to the last quarter. The response of UN to its own shock is positive throughout the period, though it was strong at the beginning and starts falling down as observed by the downward trend until it becomes very low from the 4th to the end of the period. The LP is also responding positively to the UN shock. The reaction of GD to UN is negative for the entire period. It seems like it was trying to recover after reaching its peak at the 2nd quarter but unfortunately it failed to cross the zero but it subsides to zero from the 5th quarter to the 10th. In this case, any increase in the GD increases the deviation between the short term equilibrium values of the UN and its long run equilibrium values.

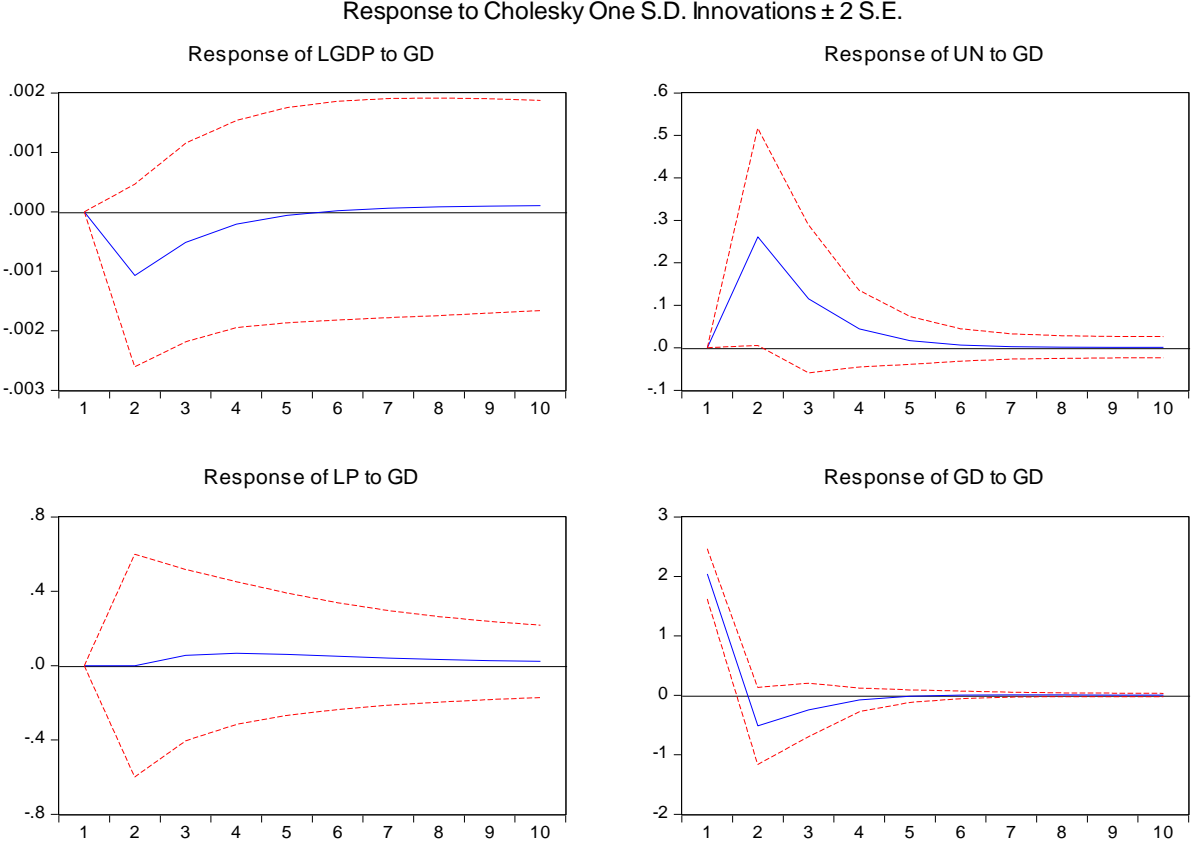
Figure 5.7: Response to LP



Source: Own computation

The graphs reveal that the response of LGDP to shocks from the LP is seen to be significant from the beginning of the period and it is responding positively. This positive response allow us to justify the increase in the real GDP in South Africa due to the event of the labour productivity. The response of UN to LP shows a recovery from the 1st quarter till it reaches peak in the 2nd quarter, afterwards it subdue but remains positive throughout the period. The reaction of LP to its own shock shows a downfall, but it is responding positive to itself. GD shows a positive reaction to the LP, observed from the graph it subdue from the beginning until it reach a trough at the 2nd quarter and seen to be decreasing from the 2nd quarter before it subsides to zero from the 8th towards the end of the period.

Figure 5.8: Response to GD



Source: Own computation

A one standard deviation shock to the government budget deficit (GD) decreases the economic growth (LGDP). However, the effect is not statistically significant and dies out of the system. The reaction of UN to GD shows an increasing effect from the beginning of the period (1st quarter), it then reaches the peak at the 2nd quarter and drop down until it dies out of the system. The effect of UN is statistically insignificant as well. The reaction of LP to the GD shock seen to be from the 2nd quarter to the end though it is very weak. The response of GD to its own shock shows a strong and positive effect at the beginning then drops down and become negative at the 2nd quarter and reduces until it dies out of the system.

5.11 VARIANCE DECOMPOSITION RESULTS

The results of variance decomposition analysis are presented on tables below. The results reflect that the proportion of the forecast error variance in each variable are explained by its own innovations (shocks) and innovations in other macroeconomic

variables. The study performed variance decomposition for 10 quarters period. The results are summarised in tables below.

Table 5.7: Summary of Variance decomposition of LGDP

Period	SE	LGDP	UN	LP	GD
1	0.005506	100.0000	0.000000	0.000000	0.000000
2	0.009929	96.42718	0.221986	2.587107	0.763731
3	0.014136	93.91102	1.087089	4.624913	0.376976
4	0.018016	91.76064	1.713277	6.241949	0.279358
5	0.021615	90.41137	2.010532	7.383702	0.194396
6	0.025047	89.38281	2.230463	8.241949	0.144777
7	0.028293	88.50969	2.451797	8.920097	0.118415
8	0.031345	87.80989	2.623732	9.464620	0.101758
9	0.034227	87.26667	2.749106	9.896522	0.087704
10	0.036964	86.82256	2.852909	10.24687	0.077658

Source: Own computation

Usually own series shock explains most of the error variance, although the shock will also affect other variables in the system. In terms of explaining its own shocks, LGDP explains 100% variance by its own innovation in the first quarter. As time goes on, its contribution are progressively tumbling until it reaches to about 86.82% in the last quarter. However, it remains the highest contribution over the 10 quarters forecasted compared to other variables. The variance decomposition also demonstrate the crucial role played by other variables. At the 2nd quarter, the fraction of LGDP forecast error variance attributable to variation in UN is about 0.22%. It then decreases to about 1.08% in the 3rd quarter but when time goes on it recovered from the 5th quarter until it reaches the average value of about 2.85% in the 10th quarter. The variance of LP accounts for about 2.5% in the 2nd quarter, increases to about 4.6% in the 3rd quarter and keeps on increasing in the long term until it reaches average value of about 10.24% in the last quarter. The results also show that GD explains about 0.76% in the 2nd quarter, declines to about 0.36% in the short term and decreases further to about 0.07 in the long term.

Table 5.8: Summary of Variance decomposition of UN

Period	SE	LGDP	UN	LP	GD
1	0.723630	3.473430	96.52657	0.000000	0.000000
2	1.022086	2.032862	75.87467	3.059194	19.03327
3	1.141047	3.685920	78.31467	2.727925	15.27148
4	1.210145	4.003560	79.75134	2.501474	13.74362
5	1.317997	5.842280	78.82262	2.862857	12.47225
6	1.413439	8.192007	76.65333	3.234355	11.92031
7	1.504874	11.17432	73.94426	4.122131	10.75929
8	1.591843	13.73231	71.39523	4.933671	9.938789
9	1.683350	16.24911	68.70839	5.764863	9.277636
10	1.771434	18.59703	66.16541	6.533702	8.703852

Source: Own computation

The reaction of LGDP on UN shock explains to about 3.47% in the 1st quarter, 3.68% in the 3rd quarter and increases further until the last period where it reached the value of 18.59%. in terms of explaining its own shock, the UN explains about 96.52% in the first quarter, the average values seems to be decreasing as time goes by but it remain the highest contribution towards its own shock. In the 3rd quarter representing the short term, it contributed about 78.31% and it kept on decreasing until reaching the 66.16% in the long term. The contribution of LP to the UN shock starts at the 2nd quarter and it explained about 3.05%, the values of LP seems to be decreasing in the short term and recovering in the long term. In the 3rd quarter, LP explains about 2.72% whereas in the last quarter it explains 6.53 to the UN shock. GD also starts contributing to the UN shock in the 2nd quarter. It explains to about 19.03% in the 2nd quarter, the average values decreases as time moves on and end up explaining about 8.70% in the long term (last quarter).

Table 5.9: Summary of Variance decomposition of LP

Period	SE	LGDP	UN	LP	GD
1	2.213246	65.56456	2.903984	31.53146	0.000000
2	3.364576	71.50837	3.238307	25.24248	0.010839

3	4.238526	74.09090	2.818370	23.07926	0.011469
4	4.893131	75.67423	2.624182	21.69075	0.010839
5	5.433691	76.71258	2.455374	20.82220	0.009844
6	5.883415	77.48617	2.336155	20.16919	0.008487
7	6.278609	78.10890	2.219701	19.66391	0.007485
8	6.632515	78.62855	2.124620	19.23992	0.006918
9	6.957337	79.06439	2.042277	18.68700	0.006329
10	7.258593	79.44003	1.970883	18.58316	0.005934

Source: Own computation

In the variance decomposition of LP, it can be noted that many of the fluctuations in the labour productivity are influenced by the shocks from the LGDP. A shock to the LGDP is likely to lead the LP to fluctuate by 65.56% in the first quarter before it increases to 74.09% in the third quarter. The contribution kept on increasing until the last quarter where it contributed to about 79.44%. UN is contributing better in the short term than in the long term, it explains 2.90% in the first quarter and the explanatory power drops until it reaches 1.97% in the 10th quarter. In terms of contribution to its own shock, LP explains more in the short term than in the long term where it explains 31.53% in the first quarter before it declines to about 18.58% in the last quarter. GD indicates poor contribution to the GD because it seen to be explaining from the 2nd quarter with 0.01% and the explanatory power keeps on decreasing till it reaches about 0.005% in the 10th quarter.

Table 5.10: Summary of Variance decomposition of GD

Period	SE	LGDP	UN	LP	GD
1	2.068785	4.031873	0.223046	9.520080	86.22500
2	2.335120	4.287970	9.672417	8.414598	77.62501
3	2.777147	13.08767	15.20101	7.976484	63.73483
4	2.950842	19.71578	14.48731	9.130473	56.66644
5	3.100749	23.21145	14.72397	10.49972	51.56486
6	3.266738	25.62854	16.09260	10.90426	47.37461
7	3.435138	28.58944	16.77569	11.36290	43.27197

8	5.574517	31.09581	16.98405	11.92949	39.99065
9	3.708923	32.98578	17.38000	12.40716	37.22705
10	3.844571	34.59694	17.81638	12.72895	34.85773

Source: Own computation

The variance decomposition of GD indicates that both short and long run dynamics in GD are explained mostly by its own fluctuations with about 86.22 in the 1st quarter and 34.85% in the 10th quarter. The explanatory power of government budget deficit on itself goes on declining while other variables gain more explanatory power, with the LGDP explaining 4.03% in the 1st quarter and 34.59% in the last quarter. The unemployment rate explains 0.22% in the 1st quarter and 17.81% in the last quarter. The labour productivity explain 9.52% at the beginning and 12.72% in the last quarter. This suggests LGDP, UN and LP contribute significantly to the GD in the long run as compared to the short run. The government budget deficit contributes more to itself in the short run compared to the long run, but it still remains the highest contribution to its own short compared to other variables.

5.12 SUMMARY

In this chapter, the study made use of Eviews 9 to perform and present the estimated results in both tabular and graphical form. The study used quarterly time series data from 2005 to 2016 to estimate the coefficient of the error correction model. Tables that show the complete results of the study are found in the appendices section.

CHAPTER 6: SUMMARY OF THE STUDY

6.1 CONCLUSION AND RECOMMENDATIONS

The main purpose of the study was to investigate the relationship between economic growth and unemployment in South Africa for the period 2005 to 2016 using the quarterly time series data. Cointegration test and its associated vector error correction model (VECM) and granger causality test were used in the analysis. Variables such as GDP used as common proxy for economic growth, unemployment rate (UN), labour productivity (LP) and government budget deficit (GD) were employed in the investigation. All the variables were found stationary at first difference. In order to achieve the aim and objectives of the study, Johansen Cointegration test was used and it confirmed the long run relationship exist among variables. The results of the vector error correction model (VECM) showed that economic growth (LGDP) has a negative and insignificant impact on unemployment (UN). The study also tested the granger causality between the variables to determine the short run relationship.

Based on the findings (See chapter 5), the study therefore recommends that the government needs to cut taxes for businesses and individuals to increase investment spending to stimulate economic growth and hence increases employment. The study also recommend that government should as a matter of urgency create more employment opportunities to absorb the teeming population of the unemployed labour force in the country through modernization of the agricultural sector, bring in modern equipment in the facilities of agriculture to make the sector more attractive to all citizens despite one's qualification and profession, as that alone would go a long way in reducing unemployment level in the country. More so, the government should apply its appropriate legislative functions to discourage gender discrimination in the labour market in order to encourage females to participate actively in the labour market. Similarly, economic diversification policies should be pursued by government as a way of creating employment opportunities and promoting economic growth of the country.

However, in order to achieve a significant growth rate that will benefit the economy and boost the demand for labour through employment creation, policymakers should create policies that support and promote accelerated and sustained economic growth. The government should employ a monitoring team to ensure that funds released by the government to all sectors of the economy are well appropriated in productive programmes. This will discourage corrupt government officials and politicians who misappropriate* government funds for their personal welfare in the name of executing projects or activities to aid growth in the country. Furthermore, government spending should tend towards local production to cushion inflation and related shocks in the economy.

6.2 LIMITATION OF THE STUDY

It is important to note that it is rare to cover all aspects of a particular field of enquiry in a single study. Obviously, every study has its limitations. This study focuses on the relationship between economic growth and unemployment in South Africa. This means that it is limited to the South African context, using a quarterly time series data from 2005 to 2016 for the empirical analysis.

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8. APPENDICES

Appendix A: Data used

Date	GDP	UN	LP	GD	LGDP
2005/01	2308029	24.2	92	-1.5	14.65190
2005/02	2349448	24.2	91.1	-1.9	14.66969
2005/03	2381486	23.5	91.1	-1.4	14.68324
2005/04	2397433	23.5	89.9	2.7	14.68991
2006/01	2439551	23.1	92.4	-0.9	14.70732
2006/02	2474200	23.1	93.4	-0.7	14.72143
2006/03	2508372	22.1	94.8	0	14.73514
2006/04	2543057	22.1	96.5	2.4	14.74888
2007/01	2584351	23.6	99.2	0.8	14.76498
2007/02	2605530	23.6	98.4	-1	14.77315
2007/03	2636065	21	98	-0.2	14.78480
2007/04	2673414	21	100.6	3.2	14.79887
2008/01	2684648	23.2	100.7	1.5	14.80306
2008/02	2717424	22.6	103.7	0	14.81519
2008/03	2723918	22.8	101	-2.5	14.81758
2008/04	2708410	21.5	94.9	-0.3	14.81187
2009/01	2666281	23	90.4	-0.2	14.79620
2009/02	2657131	23.2	89.8	-6.8	14.79276
2009/03	2663293	24.5	92.2	-6.4	14.79507
2009/04	2681051	24.1	97.1	-5	14.80172
2010/01	2711577	25.1	97.7	-2.2	14.81304
2010/02	2730077	25.1	100.9	-4.6	14.81984
2010/03	2760428	25.4	100.7	-6.9	14.83090
2010/04	2789950	23.9	100.7	-4.6	14.84153
2011/01	2816474	24.8	104.2	-0.1	14.85100
2011/02	2832667	25.6	104	-5.1	14.85673
2011/03	2841114	25	103.7	-8.6	14.85971
2011/04	2862777	23.8	104.4	-2.1	14.86730

2012/01	2874224	25	105.4	-3.5	14.87129
2012/02	2900027	24.8	107	-3.8	14.88023
2012/03	2908700	25.2	106.4	-9	14.88322
2012/04	2921353	24.5	107.8	-4.3	14.88756
2013/01	2934110	25	106.9	-4.2	14.89191
2013/02	2964829	25.3	109.2	-4	14.90233
2013/03	2978123	24.5	107.8	-7.7	14.90680
2013/04	3016106	24.1	108.8	-3.2	14.91948
2014/01	3003940	25.2	109.2	-3.7	14.91544
2014/02	3009101	25.5	110.8	-3.8	14.91715
2014/03	3025823	25.4	108.7	-8.6	14.92269
2014/04	3056440	24.3	112	-2.7	14.93276
2015/01	3071177	26.4	111.1	-3	14.93757
2015/02	3056876	25	109.1	-3.7	14.93290
2015/03	3060197	25.5	110.7	-8.6	14.93399
2015/04	3064154	24.5	111.1	-1.7	14.93528
2016/01	3052752	26.7	111.9	-3.1	14.93155
2016/02	3076468	26.6	114.7	-2.8	14.93929
2016/03	3079882	27.1	113.3	-8.7	14.94040
2016/04	3077530	26.5	110.9	-2.2	14.93964

Appendix B: Unit root test Economic Growth (LGDP)

Null Hypothesis: LGDP has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	2.252628	0.9934
Test critical values:		
1% level	-2.616203	
5% level	-1.948140	
10% level	-1.612320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares

Date: 09/16/17 Time: 14:13
Sample (adjusted): 2005Q3 2016Q4
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	0.000174	7.74E-05	2.252628	0.0293
D(LGDP(-1))	0.522054	0.124703	4.186378	0.0001
R-squared	0.281646	Mean dependent var		0.005868
Adjusted R-squared	0.265320	S.D. dependent var		0.006663
S.E. of regression	0.005711	Akaike info criterion		-7.450253
Sum squared resid	0.001435	Schwarz criterion		-7.370746
Log likelihood	173.3558	Hannan-Quinn criter.		-7.420469
Durbin-Watson stat	2.188347			

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.261544	0.1884
Test critical values:		
1% level	-3.581152	
5% level	-2.926622	
10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 09/16/17 Time: 14:13
Sample (adjusted): 2005Q3 2016Q4
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	0.000174	7.74E-05	2.252628	0.0293
D(LGDP(-1))	0.522054	0.124703	4.186378	0.0001
R-squared	0.281646	Mean dependent var		0.005868
Adjusted R-squared	0.265320	S.D. dependent var		0.006663
S.E. of regression	0.005711	Akaike info criterion		-7.450253
Sum squared resid	0.001435	Schwarz criterion		-7.370746
Log likelihood	173.3558	Hannan-Quinn criter.		-7.420469
Durbin-Watson stat	2.188347			

Null Hypothesis: LGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.156523	0.5016
Test critical values:		
1% level	-4.170583	
5% level	-3.510740	

10% level

-3.185512

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LGDP)

Method: Least Squares

Date: 09/16/17 Time: 14:14

Sample (adjusted): 2005Q3 2016Q4

Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.098889	0.045856	-2.156523	0.0368
D(LGDP(-1))	0.402884	0.131533	3.062987	0.0038
C	1.460212	0.674212	2.165806	0.0361
@TREND("2005Q1")	0.000434	0.000266	1.630511	0.1105
R-squared	0.397074	Mean dependent var		0.005868
Adjusted R-squared	0.354007	S.D. dependent var		0.006663
S.E. of regression	0.005355	Akaike info criterion		-7.538463
Sum squared resid	0.001205	Schwarz criterion		-7.379451
Log likelihood	177.3846	Hannan-Quinn criter.		-7.478896
F-statistic	9.220082	Durbin-Watson stat		2.094080
Prob(F-statistic)	0.000083			

Null Hypothesis: D(LGDP) has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.004665	0.0035
Test critical values:		
1% level	-2.616203	
5% level	-1.948140	
10% level	-1.612320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LGDP,2)

Method: Least Squares

Date: 09/16/17 Time: 14:15

Sample (adjusted): 2005Q3 2016Q4

Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.287036	0.095530	-3.004665	0.0043
R-squared	0.163844	Mean dependent var		-0.000403
Adjusted R-squared	0.163844	S.D. dependent var		0.006522
S.E. of regression	0.005964	Akaike info criterion		-7.384584
Sum squared resid	0.001601	Schwarz criterion		-7.344831
Log likelihood	170.8454	Hannan-Quinn criter.		-7.369693
Durbin-Watson stat	2.407321			

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.843557	0.0049
Test critical values:		
1% level	-3.581152	
5% level	-2.926622	
10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 09/16/17 Time: 14:16
 Sample (adjusted): 2005Q3 2016Q4
 Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.480003	0.124885	-3.843557	0.0004
C	0.002607	0.001150	2.267894	0.0283
R-squared	0.251356	Mean dependent var		-0.000403
Adjusted R-squared	0.234341	S.D. dependent var		0.006522
S.E. of regression	0.005707	Akaike info criterion		-7.451658
Sum squared resid	0.001433	Schwarz criterion		-7.372152
Log likelihood	173.3881	Hannan-Quinn criter.		-7.421874
F-statistic	14.77293	Durbin-Watson stat		2.186238
Prob(F-statistic)	0.000386			

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.298214	0.0071
Test critical values:		
1% level	-4.170583	
5% level	-3.510740	
10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 09/16/17 Time: 14:16
 Sample (adjusted): 2005Q3 2016Q4
 Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.588602	0.136941	-4.298214	0.0001
C	0.006267	0.002375	2.638956	0.0115
@TREND("2005Q1")	-0.000122	6.95E-05	-1.749297	0.0874

R-squared	0.301093	Mean dependent var	-0.000403
Adjusted R-squared	0.268586	S.D. dependent var	0.006522
S.E. of regression	0.005578	Akaike info criterion	-7.476925
Sum squared resid	0.001338	Schwarz criterion	-7.357666
Log likelihood	174.9693	Hannan-Quinn criter.	-7.432250
F-statistic	9.262314	Durbin-Watson stat	2.085002
Prob(F-statistic)	0.000452		

UNEMPLOYMENT RATE (UN)

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.298214	0.0071
Test critical values:		
1% level	-4.170583	
5% level	-3.510740	
10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 09/16/17 Time: 14:16
 Sample (adjusted): 2005Q3 2016Q4
 Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.588602	0.136941	-4.298214	0.0001
C	0.006267	0.002375	2.638956	0.0115
@TREND("2005Q1")	-0.000122	6.95E-05	-1.749297	0.0874

R-squared	0.301093	Mean dependent var	-0.000403
Adjusted R-squared	0.268586	S.D. dependent var	0.006522
S.E. of regression	0.005578	Akaike info criterion	-7.476925
Sum squared resid	0.001338	Schwarz criterion	-7.357666
Log likelihood	174.9693	Hannan-Quinn criter.	-7.432250
F-statistic	9.262314	Durbin-Watson stat	2.085002
Prob(F-statistic)	0.000452		

Null Hypothesis: UN has a unit root
 Exogenous: Constant
 Lag Length: 3 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	0.291912	0.9753
Test critical values:		
1% level	-3.588509	
5% level	-2.929734	
10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(UN)

Method: Least Squares

Date: 09/16/17 Time: 14:20

Sample (adjusted): 2006Q1 2016Q4

Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-1)	0.032855	0.112551	0.291912	0.7719
D(UN(-1))	-0.591371	0.168686	-3.505753	0.0012
D(UN(-2))	-0.477756	0.164364	-2.906690	0.0060
D(UN(-3))	-0.518020	0.146314	-3.540479	0.0011
C	-0.624899	2.718365	-0.229881	0.8194
R-squared	0.389241	Mean dependent var		0.068182
Adjusted R-squared	0.326599	S.D. dependent var		1.039851
S.E. of regression	0.853312	Akaike info criterion		2.627262
Sum squared resid	28.39752	Schwarz criterion		2.830011
Log likelihood	-52.79977	Hannan-Quinn criter.		2.702451
F-statistic	6.213741	Durbin-Watson stat		1.678197
Prob(F-statistic)	0.000573			

Null Hypothesis: UN has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.523532	0.0038
Test critical values:		
1% level	-4.165756	
5% level	-3.508508	
10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(UN)

Method: Least Squares

Date: 09/16/17 Time: 14:21

Sample (adjusted): 2005Q2 2016Q4

Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN(-1)	-0.596571	0.131882	-4.523532	0.0000
C	13.28802	2.968824	4.475854	0.0001
@TREND("2005Q1")	0.050866	0.013516	3.763396	0.0005
R-squared	0.321809	Mean dependent var		0.048936
Adjusted R-squared	0.290982	S.D. dependent var		1.011644
S.E. of regression	0.851836	Akaike info criterion		2.578857
Sum squared resid	31.92751	Schwarz criterion		2.696952
Log likelihood	-57.60314	Hannan-Quinn criter.		2.623297
F-statistic	10.43923	Durbin-Watson stat		2.127801
Prob(F-statistic)	0.000195			

Null Hypothesis: D(UN) has a unit root
 Exogenous: None
 Lag Length: 3 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.168145	0.0022
Test critical values:		
1% level	-2.619851	
5% level	-1.948686	
10% level	-1.612036	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(UN,2)
 Method: Least Squares
 Date: 09/16/17 Time: 14:24
 Sample (adjusted): 2006Q2 2016Q4
 Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-1.564349	0.493774	-3.168145	0.0030
D(UN(-1),2)	0.192829	0.389383	0.495217	0.6232
D(UN(-2),2)	-0.084742	0.277803	-0.305045	0.7620
D(UN(-3),2)	-0.375648	0.160502	-2.340461	0.0245
R-squared	0.796065	Mean dependent var		-0.004651
Adjusted R-squared	0.780377	S.D. dependent var		1.727916
S.E. of regression	0.809769	Akaike info criterion		2.504273
Sum squared resid	25.57332	Schwarz criterion		2.668106
Log likelihood	-49.84187	Hannan-Quinn criter.		2.564689
Durbin-Watson stat	2.050534			

Null Hypothesis: D(UN) has a unit root
 Exogenous: Constant
 Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.031559	0.0000
Test critical values:		
1% level	-3.588509	
5% level	-2.929734	
10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(UN,2)
 Method: Least Squares
 Date: 09/16/17 Time: 14:26
 Sample (adjusted): 2006Q1 2016Q4
 Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-2.522204	0.314037	-8.031559	0.0000
D(UN(-1),2)	0.959077	0.234739	4.085726	0.0002
D(UN(-2),2)	0.503341	0.135821	3.705915	0.0006
C	0.167713	0.128757	1.302559	0.2002
R-squared	0.773324	Mean dependent var		-0.013636
Adjusted R-squared	0.756323	S.D. dependent var		1.708745
S.E. of regression	0.843498	Akaike info criterion		2.583990
Sum squared resid	28.45957	Schwarz criterion		2.746189
Log likelihood	-52.84778	Hannan-Quinn criter.		2.644141
F-statistic	45.48780	Durbin-Watson stat		1.675475
Prob(F-statistic)	0.000000			

Null Hypothesis: D(UN) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.375122	0.0000
Test critical values:		
1% level	-4.180911	
5% level	-3.515523	
10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UN,2)
Method: Least Squares
Date: 09/16/17 Time: 14:26
Sample (adjusted): 2006Q1 2016Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UN(-1))	-2.649494	0.316353	-8.375122	0.0000
D(UN(-1),2)	1.048388	0.235661	4.448717	0.0001
D(UN(-2),2)	0.544969	0.135129	4.032939	0.0002
C	-0.256125	0.282121	-0.907854	0.3695
@TREND("2005Q1")	0.016938	0.010089	1.678845	0.1012
R-squared	0.788602	Mean dependent var		-0.013636
Adjusted R-squared	0.766920	S.D. dependent var		1.708745
S.E. of regression	0.824954	Akaike info criterion		2.559667
Sum squared resid	26.54143	Schwarz criterion		2.762416
Log likelihood	-51.31267	Hannan-Quinn criter.		2.634856
F-statistic	36.37149	Durbin-Watson stat		1.686435
Prob(F-statistic)	0.000000			

LABOUR PRODUCTIVITY (LP)

Null Hypothesis: LP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.215778	0.9406
Test critical values:	1% level	-2.615093	
	5% level	-1.947975	
	10% level	-1.612408	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LP)
 Method: Least Squares
 Date: 09/16/17 Time: 14:27
 Sample (adjusted): 2005Q2 2016Q4
 Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LP(-1)	0.003667	0.003016	1.215778	0.2303
R-squared	-0.004667	Mean dependent var		0.402128
Adjusted R-squared	-0.004667	S.D. dependent var		2.114596
S.E. of regression	2.119525	Akaike info criterion		4.361308
Sum squared resid	206.6497	Schwarz criterion		4.400673
Log likelihood	-101.4907	Hannan-Quinn criter.		4.376121
Durbin-Watson stat	1.657812			

Null Hypothesis: LP has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.162553	0.6828
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LP)
 Method: Least Squares
 Date: 09/16/17 Time: 14:27
 Sample (adjusted): 2005Q2 2016Q4
 Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LP(-1)	-0.049312	0.042417	-1.162553	0.2511
C	5.443929	4.347707	1.252138	0.2170
R-squared	0.029158	Mean dependent var		0.402128
Adjusted R-squared	0.007584	S.D. dependent var		2.114596
S.E. of regression	2.106562	Akaike info criterion		4.369613
Sum squared resid	199.6922	Schwarz criterion		4.448343
Log likelihood	-100.6859	Hannan-Quinn criter.		4.399240
F-statistic	1.351530	Durbin-Watson stat		1.628837
Prob(F-statistic)	0.251139			

Sample (adjusted):
2005Q2 2016Q4

Null Hypothesis: D(LP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.469995	0.0000
Test critical values: 1% level	-2.616203	
5% level	-1.948140	
10% level	-1.612320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LP,2)
Method: Least Squares
Date: 09/16/17 Time: 14:29
Sample (adjusted): 2005Q3 2016Q4
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LP(-1))	-0.810485	0.148169	-5.469995	0.0000
R-squared	0.399280	Mean dependent var		-0.032609
Adjusted R-squared	0.399280	S.D. dependent var		2.753991
S.E. of regression	2.134512	Akaike info criterion		4.375853
Sum squared resid	205.0264	Schwarz criterion		4.415606
Log likelihood	-99.64461	Hannan-Quinn criter.		4.390744
Durbin-Watson stat	1.988638			

Null Hypothesis: D(LP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.597245	0.0000
Test critical values: 1% level	-3.581152	
5% level	-2.926622	
10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LP,2)
Method: Least Squares
Date: 09/16/17 Time: 14:29
Sample (adjusted): 2005Q3 2016Q4
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LP(-1))	-0.847411	0.151398	-5.597245	0.0000
C	0.359780	0.321574	1.118807	0.2693
R-squared	0.415897	Mean dependent var		-0.032609
Adjusted R-squared	0.402622	S.D. dependent var		2.753991
S.E. of regression	2.128567	Akaike info criterion		4.391280
Sum squared resid	199.3551	Schwarz criterion		4.470786
Log likelihood	-98.99943	Hannan-Quinn criter.		4.421063
F-statistic	31.32915	Durbin-Watson stat		1.969928
Prob(F-statistic)	0.000001			

Null Hypothesis: D(LP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.537419	0.0002
Test critical values:		
1% level	-4.170583	
5% level	-3.510740	
10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LP,2)
Method: Least Squares
Date: 09/16/17 Time: 14:30
Sample (adjusted): 2005Q3 2016Q4
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LP(-1))	-0.846453	0.152860	-5.537419	0.0000
C	0.601814	0.667906	0.901045	0.3726
@TREND("2005Q1")	-0.009897	0.023868	-0.414655	0.6805
R-squared	0.418223	Mean dependent var		-0.032609
Adjusted R-squared	0.391164	S.D. dependent var		2.753991
S.E. of regression	2.148883	Akaike info criterion		4.430767
Sum squared resid	198.5611	Schwarz criterion		4.550027
Log likelihood	-98.90765	Hannan-Quinn criter.		4.475443
F-statistic	15.45575	Durbin-Watson stat		1.979499
Prob(F-statistic)	0.000009			

GOVERNMENT DEFICIT (GD)

Null Hypothesis: GD has a unit root
Exogenous: None
Lag Length: 7 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.121921	0.6355

Test critical values:	1% level	-2.624057
	5% level	-1.949319
	10% level	-1.611711

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GD)

Method: Least Squares

Date: 09/16/17 Time: 14:30

Sample (adjusted): 2007Q1 2016Q4

Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GD(-1)	-0.009061	0.074315	-0.121921	0.9037
D(GD(-1))	-0.696907	0.170797	-4.080326	0.0003
D(GD(-2))	-0.291682	0.206347	-1.413551	0.1671
D(GD(-3))	-0.120505	0.210260	-0.573125	0.5706
D(GD(-4))	0.440235	0.203128	2.167284	0.0378
D(GD(-5))	0.246245	0.215840	1.140867	0.2624
D(GD(-6))	-0.153935	0.210851	-0.730063	0.4707
D(GD(-7))	-0.425163	0.171410	-2.480393	0.0186

R-squared	0.809978	Mean dependent var	-0.115000
Adjusted R-squared	0.768411	S.D. dependent var	3.573087
S.E. of regression	1.719502	Akaike info criterion	4.098803
Sum squared resid	94.61401	Schwarz criterion	4.436579
Log likelihood	-73.97606	Hannan-Quinn criter.	4.220932
Durbin-Watson stat	2.052109		

Null Hypothesis: GD has a unit root

Exogenous: Constant

Lag Length: 3 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.082012	0.7147
Test critical values:		
	1% level	-3.588509
	5% level	-2.929734
	10% level	-2.603064

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GD)

Method: Least Squares

Date: 09/16/17 Time: 14:31

Sample (adjusted): 2006Q1 2016Q4

Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GD(-1)	-0.133841	0.123696	-1.082012	0.2859
D(GD(-1))	-0.753671	0.134740	-5.593513	0.0000
D(GD(-2))	-0.741818	0.121891	-6.085930	0.0000
D(GD(-3))	-0.773151	0.106304	-7.272994	0.0000
C	-0.698553	0.464304	-1.504516	0.1405

R-squared	0.738040	Mean dependent var	-0.111364
Adjusted R-squared	0.711172	S.D. dependent var	3.467941
S.E. of regression	1.863765	Akaike info criterion	4.189719
Sum squared resid	135.4712	Schwarz criterion	4.392468
Log likelihood	-87.17382	Hannan-Quinn criter.	4.264908
F-statistic	27.46941	Durbin-Watson stat	1.573219
Prob(F-statistic)	0.000000		

Null Hypothesis: GD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.929364	0.6216
Test critical values:		
1% level	-4.192337	
5% level	-3.520787	
10% level	-3.191277	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GD)
Method: Least Squares
Date: 09/16/17 Time: 14:31
Sample (adjusted): 2006Q3 2016Q4
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GD(-1)	-0.406151	0.210510	-1.929364	0.0621
D(GD(-1))	-0.399910	0.234562	-1.704918	0.0973
D(GD(-2))	-0.130128	0.248061	-0.524582	0.6033
D(GD(-3))	-0.187779	0.219882	-0.853998	0.3991
D(GD(-4))	0.585810	0.194478	3.012220	0.0049
D(GD(-5))	0.412746	0.167130	2.469606	0.0187
C	-0.235933	0.699910	-0.337091	0.7381
@TREND("2005Q1")	-0.044555	0.039303	-1.133631	0.2649

R-squared	0.796829	Mean dependent var	-0.035714
Adjusted R-squared	0.755000	S.D. dependent var	3.508305
S.E. of regression	1.736524	Akaike info criterion	4.111291
Sum squared resid	102.5275	Schwarz criterion	4.442276
Log likelihood	-78.33711	Hannan-Quinn criter.	4.232610
F-statistic	19.04952	Durbin-Watson stat	2.217088
Prob(F-statistic)	0.000000		

Null Hypothesis: D(GD) has a unit root
Exogenous: None
Lag Length: 6 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.775678	0.0067
Test critical values:		
1% level	-2.624057	
5% level	-1.949319	

10% level

-1.611711

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GD,2)

Method: Least Squares

Date: 09/16/17 Time: 14:32

Sample (adjusted): 2007Q1 2016Q4

Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GD(-1))	-2.048371	0.737972	-2.775678	0.0090
D(GD(-1),2)	0.344432	0.703226	0.489789	0.6275
D(GD(-2),2)	0.047123	0.657747	0.071643	0.9433
D(GD(-3),2)	-0.079760	0.590202	-0.135140	0.8933
D(GD(-4),2)	0.352609	0.470210	0.749898	0.4586
D(GD(-5),2)	0.590602	0.323645	1.824848	0.0771
D(GD(-6),2)	0.429542	0.165085	2.601952	0.0138
R-squared	0.929124	Mean dependent var		0.102500
Adjusted R-squared	0.916238	S.D. dependent var		5.851911
S.E. of regression	1.693642	Akaike info criterion		4.049268
Sum squared resid	94.65796	Schwarz criterion		4.344821
Log likelihood	-73.98535	Hannan-Quinn criter.		4.156131
Durbin-Watson stat	2.055918			

Null Hypothesis: D(GD) has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-14.46129	0.0000
Test critical values:		
1% level	-3.588509	
5% level	-2.929734	
10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GD,2)

Method: Least Squares

Date: 09/16/17 Time: 14:33

Sample (adjusted): 2006Q1 2016Q4

Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GD(-1))	-3.473144	0.240168	-14.46129	0.0000
D(GD(-1),2)	1.618504	0.176349	9.177848	0.0000
D(GD(-2),2)	0.809006	0.101223	7.992327	0.0000
C	-0.299132	0.282220	-1.059928	0.2955
R-squared	0.901227	Mean dependent var		0.054545
Adjusted R-squared	0.893819	S.D. dependent var		5.731815
S.E. of regression	1.867739	Akaike info criterion		4.173842

Sum squared resid	139.5379	Schwarz criterion	4.336041
Log likelihood	-87.82452	Hannan-Quinn criter.	4.233993
F-statistic	121.6559	Durbin-Watson stat	1.573167
Prob(F-statistic)	0.000000		

Null Hypothesis: D(GD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-14.37206	0.0000
Test critical values:		
1% level	-4.180911	
5% level	-3.515523	
10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GD,2)
Method: Least Squares
Date: 09/16/17 Time: 14:34
Sample (adjusted): 2006Q1 2016Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GD(-1))	-3.470631	0.241485	-14.37206	0.0000
D(GD(-1),2)	1.618924	0.177300	9.131005	0.0000
D(GD(-2),2)	0.809356	0.101769	7.952875	0.0000
C	-0.729315	0.635369	-1.147860	0.2580
@TREND("2005Q1")	0.016888	0.022318	0.756705	0.4538

R-squared	0.902656	Mean dependent var	0.054545
Adjusted R-squared	0.892672	S.D. dependent var	5.731815
S.E. of regression	1.877798	Akaike info criterion	4.204721
Sum squared resid	137.5188	Schwarz criterion	4.407470
Log likelihood	-87.50386	Hannan-Quinn criter.	4.279910
F-statistic	90.41019	Durbin-Watson stat	1.601630
Prob(F-statistic)	0.000000		

Appendix C: Lag length criteria

VAR Lag Order Selection Criteria
Endogenous variables: LGDP UN LP GD
Exogenous variables: C
Date: 09/16/17 Time: 09:54
Sample: 2005Q1 2016Q4
Included observations: 44

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-205.3246	NA	0.159339	9.514757	9.676956	9.574908
1	-41.06177	291.1933	0.000189	2.775535	3.586530*	3.076291

2	-18.78257	35.44418	0.000145	2.490117	3.949908	3.031478
3	-6.267168	17.63534	0.000179	2.648508	4.757095	3.430474
4	27.57521	41.53383*	8.74e-05*	1.837490*	4.594874	2.860061*

* 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: Johansen Cointegration test

Date: 09/16/17 Time: 09:55
 Sample (adjusted): 2005Q3 2016Q4
 Included observations: 46 after adjustments
 Trend assumption: Linear deterministic trend
 Series: LGDP UN LP GD
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.601060	82.85990	47.85613	0.0000
At most 1 *	0.447282	40.58842	29.79707	0.0020
At most 2	0.140533	13.31470	15.49471	0.1038
At most 3 *	0.128908	6.348343	3.841466	0.0117

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.601060	42.27147	27.58434	0.0003
At most 1 *	0.447282	27.27373	21.13162	0.0060
At most 2	0.140533	6.966355	14.26460	0.4931
At most 3 *	0.128908	6.348343	3.841466	0.0117

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'S11*b=l):

LGDP	UN	LP	GD
51.95782	1.013954	-0.504946	0.825951
52.40875	-0.200702	-0.420310	-0.009606
8.850246	0.325221	-0.263885	-0.096695
0.710292	1.216478	-0.072029	0.132278

Unrestricted Adjustment Coefficients (alpha):

D(LGDP)				
	-0.000229	-0.001785	0.001737	0.000185

D(UN)	0.191966	0.136514	0.002001	-0.226062
D(LP)	0.041469	0.399204	0.744642	0.034672
D(GD)	-2.093164	0.457610	0.225937	-0.112722

1 Cointegrating Equation(s): Log likelihood -44.58228

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	UN	LP	GD
1.000000	0.019515	-0.009718	0.015897
	(0.00374)	(0.00051)	(0.00156)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.011886
	(0.04415)
D(UN)	9.974158
	(5.58753)
D(LP)	2.154633
	(17.0601)
D(GD)	-108.7562
	(16.0943)

2 Cointegrating Equation(s): Log likelihood -30.94542

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	UN	LP	GD
1.000000	0.000000	-0.008298	0.002455
		(0.00047)	(0.00134)
0.000000	1.000000	-0.072760	0.688807
		(0.02981)	(0.08465)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.105437	0.000126
	(0.05916)	(0.00083)
D(UN)	17.12867	0.167247
	(7.77483)	(0.10889)
D(LP)	23.07643	-0.038074
	(23.7795)	(0.33306)
D(GD)	-84.77343	-2.214215
	(22.2274)	(0.31132)

3 Cointegrating Equation(s): Log likelihood -27.46224

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	UN	LP	GD
1.000000	0.000000	0.000000	0.019493
			(0.00840)
0.000000	1.000000	0.000000	0.838199
			(0.11113)
0.000000	0.000000	1.000000	2.053217
			(1.00797)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.090066	0.000691	0.000407
	(0.05597)	(0.00082)	(0.00053)
D(UN)	17.14639	0.167897	-0.154839
	(7.83050)	(0.11416)	(0.07459)
D(LP)	29.66670	0.204099	-0.385229
	(22.2938)	(0.32501)	(0.21236)
D(GD)	-82.77384	-2.140736	0.804976

Appendix E: Vector Error Correction Model (VECM)

Vector Error Correction Estimates

Date: 10/26/17 Time: 11:30

Sample (adjusted): 2005Q3 2016Q4

Included observations: 46 after adjustments

Standard errors in () & t-statistics in []

Cointegrating Eq:	CointEq1	CointEq2		
LGDP(-1)	1.000000	0.000000		
UN(-1)	0.000000	1.000000		
LP(-1)	-0.008298 (0.00048) [-17.3378]	-0.072760 (0.03018) [-2.41048]		
GD(-1)	0.002455 (0.00136) [1.80570]	0.688807 (0.08572) [8.03513]		
C	-13.98201	-14.67243		
Error Correction:	D(LGDP)	D(UN)	D(LP)	D(GD)
CointEq1	-0.105437 (0.05991) [-1.75994]	17.12867 (7.87387) [2.17538]	23.07643 (24.0825) [0.95823]	-84.77343 (22.5106) [-3.76593]
CointEq2	0.000126 (0.00084) [0.15054]	0.167247 (0.11028) [1.51655]	-0.038074 (0.33730) [-0.11288]	-2.214215 (0.31528) [-7.02295]
D(LGDP(-1))	0.105185 (0.23354) [0.45040]	-15.26694 (30.6937) [-0.49740]	84.25321 (93.8775) [0.89748]	6.759196 (87.7500) [0.07703]
D(UN(-1))	-0.000211 (0.00121) [-0.17476]	-0.458444 (0.15870) [-2.88880]	0.217626 (0.48538) [0.44836]	1.053474 (0.45370) [2.32197]
D(LP(-1))	0.000651 (0.00050) [1.29245]	0.178935 (0.06623) [2.70177]	0.101360 (0.20256) [0.50039]	-0.485297 (0.18934) [-2.56308]
D(GD(-1))	-0.000280 (0.00043) [-0.64805]	0.074876 (0.05677) [1.31896]	-0.012182 (0.17363) [-0.07016]	0.349867 (0.16230) [2.15572]
C	0.004877 (0.00162) [3.00705]	0.103516 (0.21314) [0.48567]	-0.160535 (0.65190) [-0.24626]	0.164147 (0.60935) [0.26938]
R-squared	0.408250	0.566182	0.063335	0.687862
Adj. R-squared	0.317212	0.499440	-0.080767	0.639841
Sum sq. resids	0.001182	20.42200	191.0398	166.9150

S.E. equation	0.005506	0.723630	2.213246	2.068785
F-statistic	4.484368	8.483231	0.439513	14.32414
Log likelihood	177.8150	-46.59451	-98.01950	-94.91457
Akaike AIC	-7.426739	2.330196	4.566065	4.431068
Schwarz SC	-7.148467	2.608468	4.844337	4.709340
Mean dependent	0.005868	0.050000	0.430435	-0.006522
S.D. dependent	0.006663	1.022796	2.128940	3.447215

Determinant resid covariance (dof adj.)	8.73E-05
Determinant resid covariance	4.51E-05
Log likelihood	-30.94542
Akaike information criterion	2.910670
Schwarz criterion	4.341781

Appendix F: VECM granger causality test

VEC Granger Causality/Block Exogeneity Wald Tests

Date: 10/26/17 Time: 13:34

Sample: 2005Q1 2016Q4

Included observations: 46

Dependent variable: D(LGDP)

Excluded	Chi-sq	df	Prob.
D(UN)	0.030542	1	0.8613
D(LP)	1.670438	1	0.1962
D(GD)	0.419966	1	0.5170
All	2.155844	3	0.5407

Dependent variable: D(UN)

Excluded	Chi-sq	df	Prob.
D(LGDP)	0.247404	1	0.6189
D(LP)	7.299547	1	0.0069
D(GD)	1.739665	1	0.1872
All	14.57693	3	0.0022

Dependent variable: D(LP)

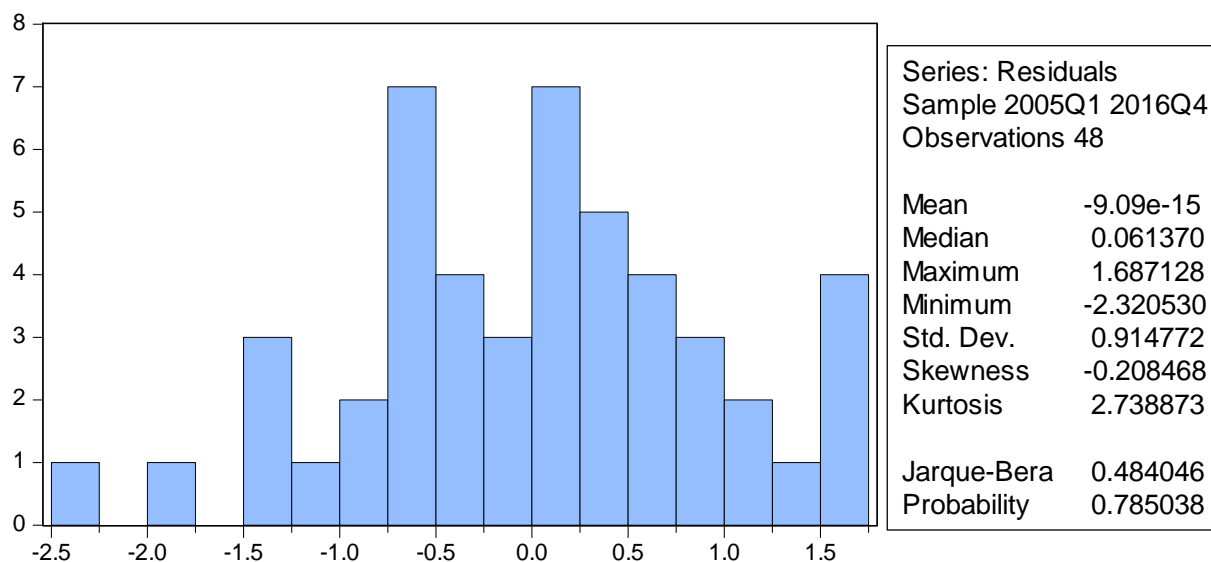
Excluded	Chi-sq	df	Prob.
D(LGDP)	0.805471	1	0.3695
D(UN)	0.201029	1	0.6539
D(GD)	0.004923	1	0.9441
All	0.947719	3	0.8139

Dependent variable: D(GD)

Excluded	Chi-sq	df	Prob.
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D(LGDP)	0.005933	1	0.9386
D(UN)	5.391541	1	0.0202
D(LP)	6.569367	1	0.0104
All	10.15567	3	0.0173

Appendix G: Normality tests on residuals



Appendix H: Autocorrelation

Date: 09/16/17 Time: 17:33
Sample: 2005Q1 2016Q4
Included observations: 48

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
. *.	. *.	1	0.125	0.125	0.7972 0.372

Appendix I: Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	8.215641	Prob. F(1,43)	0.0064
Obs*R-squared	7.699812	Prob. Chi-Square(1)	0.0920

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 09/16/17 Time: 18:21
Sample: 2005Q1 2016Q4
Included observations: 48
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP	5.078383	4.969710	1.021867	0.3126
LP	-0.035402	0.050027	-0.707657	0.4830
GD	0.096451	0.059588	1.618615	0.1128
C	-71.41836	68.94565	-1.035865	0.3061
RESID(-1)	0.506892	0.176846	2.866294	0.0064
R-squared	0.160413	Mean dependent var		3.04E-15
Adjusted R-squared	0.082312	S.D. dependent var		0.908512
S.E. of regression	0.870319	Akaike info criterion		2.658418
Sum squared resid	32.57057	Schwarz criterion		2.853335
Log likelihood	-58.80204	Hannan-Quinn criter.		2.732078
F-statistic	2.053910	Durbin-Watson stat		1.972072
Prob(F-statistic)	0.103673			

Appendix J: Heteroskedasticity (Breusch-Pagan-Godfrey)

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.285207	Prob. F(3,44)	0.0920
Obs*R-squared	6.470668	Prob. Chi-Square(3)	0.0908
Scaled explained SS	4.727264	Prob. Chi-Square(3)	0.1929

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 09/16/17 Time: 17:41

Sample: 2005Q1 2016Q4

Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.566635	2.275346	-0.249032	0.8045
GDP	1.48E-06	2.16E-06	0.685858	0.4964
LP	-0.022340	0.061622	-0.362535	0.7187
GD	0.152779	0.059691	2.559499	0.0140
R-squared	0.134806	Mean dependent var		0.819375
Adjusted R-squared	0.075815	S.D. dependent var		1.091913
S.E. of regression	1.049706	Akaike info criterion		3.014552
Sum squared resid	48.48280	Schwarz criterion		3.170485
Log likelihood	-68.34924	Hannan-Quinn criter.		3.073479
F-statistic	2.285207	Durbin-Watson stat		1.929454
Prob(F-statistic)	0.091974			

Appendix K: Heteroskedasticity (ARCH)

Heteroskedasticity Test: ARCH

F-statistic	0.772428	Prob. F(1,45)	0.3841
Obs*R-squared	0.793144	Prob. Chi-Square(1)	0.3732

Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 09/16/17 Time: 17:52
 Sample (adjusted): 2005Q2 2016Q4
 Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.714512	0.200693	3.560222	0.0009
RESID^2(-1)	0.135061	0.153674	0.878879	0.3841
R-squared	0.016875	Mean dependent var		0.819352
Adjusted R-squared	-0.004972	S.D. dependent var		1.103718
S.E. of regression	1.106458	Akaike info criterion		3.081827
Sum squared resid	55.09124	Schwarz criterion		3.160556
Log likelihood	-70.42292	Hannan-Quinn criter.		3.111453
F-statistic	0.772428	Durbin-Watson stat		1.885488
Prob(F-statistic)	0.384136			

Appendix L: Heteroskedasticity (White CT)

Heteroskedasticity Test: White

F-statistic	1.198476	Prob. F(8,39)	0.3251
Obs*R-squared	9.471819	Prob. Chi-Square(8)	0.3041
Scaled explained SS	7.012738	Prob. Chi-Square(8)	0.5353

Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 09/16/17 Time: 18:27
 Sample: 2005Q1 2016Q4
 Included observations: 48
 Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	438.2731	687.5620	0.637431	0.5276
LGDP^2	-2.200608	3.541265	-0.621419	0.5379
LGDP*LP	0.793761	1.119790	0.708848	0.4826
LGDP*GD	2.780913	3.394723	0.819187	0.4177
LP^2	-0.005516	0.010291	-0.536021	0.5950
LP*GD	-0.014232	0.024805	-0.573755	0.5694
LP	-10.74741	14.74793	-0.728740	0.4705
GD^2	0.039288	0.026266	1.495806	0.1428
GD	-39.38639	47.99895	-0.820568	0.4169
R-squared	0.197330	Mean dependent var		0.808199
Adjusted R-squared	0.032679	S.D. dependent var		1.084228
S.E. of regression	1.066365	Akaike info criterion		3.133749
Sum squared resid	44.34824	Schwarz criterion		3.484599
Log likelihood	-66.20998	Hannan-Quinn criter.		3.266336
F-statistic	1.198476	Durbin-Watson stat		2.070646
Prob(F-statistic)	0.325145			

Appendix M: Heteroskedasticity (White NCT)

Heteroskedasticity Test: White

F-statistic	0.686656	Prob. F(3,44)	0.5650
Obs*R-squared	2.146734	Prob. Chi-Square(3)	0.5425
Scaled explained SS	1.589397	Prob. Chi-Square(3)	0.6618

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 09/16/17 Time: 18:54

Sample: 2005Q1 2016Q4

Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.838508	38.91581	-0.227119	0.8214
LGDP^2	0.046851	0.190157	0.246383	0.8065
LP^2	-4.51E-05	0.000299	-0.151062	0.8806
GD^2	-0.010391	0.007391	-1.405937	0.1668
R-squared	0.044724	Mean dependent var		0.808199
Adjusted R-squared	-0.020409	S.D. dependent var		1.084228
S.E. of regression	1.095236	Akaike info criterion		3.099472
Sum squared resid	52.77985	Schwarz criterion		3.255406
Log likelihood	-70.38733	Hannan-Quinn criter.		3.158400
F-statistic	0.686656	Durbin-Watson stat		1.837803
Prob(F-statistic)	0.565014			

Appendix N: Stability test on Ramsey RESET

Ramsey RESET Test

Equation: UNTITLED

Specification: LGDP UN LP GD C

Omitted Variables: Squares of fitted values

	Value	Df	Probability
t-statistic	0.252147	43	0.8021
F-statistic	0.063578	(1, 43)	0.8021
Likelihood ratio	0.070918	1	0.7900

F-test summary:

	Sum of Sq.	Df	Mean Squares
Test SSR	5.04E-05	1	5.04E-05
Restricted SSR	0.034163	44	0.000776
Unrestricted SSR	0.034112	43	0.000793

LR test summary:

	Value	Df
Restricted LogL	105.8385	44
Unrestricted LogL	105.8740	43

Unrestricted Test Equation:

Dependent Variable: LGDP
 Method: Least Squares
 Date: 09/17/17 Time: 08:33
 Sample: 2005Q1 2016Q4
 Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UN	-0.036210	0.124118	-0.291738	0.7719
LP	0.074815	0.256717	0.291430	0.7721
GD	-0.040300	0.138283	-0.291431	0.7721
C	55.61710	165.4140	0.336230	0.7383
FITTED^2	-0.216576	0.858928	-0.252147	0.8021
R-squared	0.892131	Mean dependent var		14.83801
Adjusted R-squared	0.882097	S.D. dependent var		0.082027
S.E. of regression	0.028166	Akaike info criterion		-4.203083
Sum squared resid	0.034112	Schwarz criterion		-4.008167
Log likelihood	105.8740	Hannan-Quinn criter.		-4.129424
F-statistic	88.90800	Durbin-Watson stat		0.732508
Prob(F-statistic)	0.000000			