THE ANALYSIS OF INVESTMENT ACTIVITY IN SOUTH AFRICA: (1994- 2015)

by

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DECLARATION

I declare that **"The analysis of investment activity in South Africa: (1994- 2015)"** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted before for any other degree at any other institution.

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Full names   **Date**

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ABSTRACT

Investment as one of the important macroeconomic variables can ensure infrastructure development and growth in the economy by raising the productive capacity. The study seeks to examine the determinants of investment activity in South Africa by means of the Cointegrated Vector Autoregression approach. The results of this study could assist policy makers to come up with policies that could encourage investment. The findings will add to the existing theory and knowledge as there is limited research on investment, more especially in South Africa. The empirical results revealed that the long and short run relationship exists amongst the variables under investigation. Furthermore, it was found that there is positive relationship between economic growth, interest rate, inflation and investment. Taxation and investment are negatively related in South Africa both in the long and short run. This indicates that investment activity can be explained by tax, economic growth, interest rates and inflation. The study recommend that the government should also find methods of increasing its revenue base. This could be done by creating a tax policy and system that is able to capture the informal sector because various un-registered businesses go unrecorded when estimating the tax to be collected in a fiscal year. This may be another way of increasing the level economic growth (GDP) since it will generate more fund for government to spend.

KEY CONCEPTS: Gross fixed capital formation, Economic growth, taxation, interest rates, inflation.

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LIST OF ACCRONOMICS

ADF   Augmented Dickey Fuller

CPI   Consumer Price Index

CPIX   Consumer Price Index excluding mortgage interests

DW   Durbin Watson

ECT   Error Correction Term

EG   Engle and Granger

FDI   Foreign Direct Investment

FIFA   Federation of International Football Associations

GDP   Gross Domestic Product

GFCF   Gross fixed capital formation

IMF   International Monetary Fund

J-B   Jarque- Bera

LM   Langrage Multiplier

NDP   National Development Plan

PP   Phillip Perron

R&D   Research and Development

SA   South Africa

SARB   South African Reserve Bank

StatsSA   Statistics South Africa

VAR   Vector Auto Regression

VECM   Vector Error Correction Model

SVAR   Structural Vector Auto Regression

CHAPTER 1

ORIENTATION TO THE STUDY

1.1   Introduction and background

Investment as one of the important macroeconomic variables can ensure infrastructure development and growth in the economy by raising the productive capacity (Fedderke, Perkins & Luis, 2001; Cheteni, 2011; Ugwuegbe & Uruakpa, 2013). Investment activities can promote technical progress through the introduction of new technology and can reduce poverty through an increase in the level of employment. In the long run, through the production process, investment activities can create new capital goods. To ensure growing capital stock in the country there must be higher rate of investment (Gkionis, Gogos, Zarkos, Kosma & Konstantopoulou, 2015).

According to Majeed and Khan (2008); Naqvi (2002); Ugwuegbe and Uruakpa (2013) and Hassett and Hubbard (2002) interest rate, net capital inflow, private sector output, domestic credit of the banking system, capital stock for private sector, corporate tax, inflation rates and gross domestic product (GDP) identified as the main determinants of investment. The above mentioned variables are significant determinants of private investment. Change in the volume of bank credit have a positive effect on the private investment (Majeed and Khan, 2008; Naqvi, 2002; Ugwuegbe & Uruakpa, 2013 and Hassett and Hubbard, 2002).

In terms of the relationship between private and public investment, the results indicated that there is a "crowding out" effect. This means there is a negative relationship between private and public investment. The reason for crowding out effect was because of the deficit finance from public investment and deficit finance may lead to a rise in the level of tax burden and interest rate (Majeed & Khan, 2008; Hassett & Hubbard, 2002). In contrast, the study by Mamatzakis (2001) indicated that the public investment tend to crowd in the level of private investment. This means that public and private investment are positively related, because enhancement in the marginal productivity of private capital by public investment tend to encourage the level of private investment.

Some of the strategies that were placed in order to encourage the level of private investment in the Sub Sahara African are as follows, African development bank and African enterprise fund. The main reason for the introduction of this strategies was that many Sub Sahara African countries are suffering when it comes to the encouragement of private investment as well as ensuring growth in the gross domestic product (GDP) (Pfeffermann & Madarassy, 1990). In addition, other African countries such as Botswana also introduce the strategies such Botswana export development and investment authority and in Kenya they introduce the Kenya investment promotion centre (Mutenyo, Asmah, & Kalio, 2010).

Investing in fixed capital stock can hasten the growth rate of the economy (Gkionis, et al., 2015; Majeed & Khan, 2008). Gross fixed capital formation (GFCF), also known as net investment is the total amount of fixed capital accumulation. It measures the increase in the capital stock less the disposal of fixed assets and excludes land purchases, and can therefore be used as a measure of investment activity of a country (Mishkin, 2016).

During the 1980's and the early 1990's South Africa experienced a low gross fixed capital formation, due to civil conflicts and the apartheid regime. South African GFCF increased from R51289 million rand in 1994 to R74018 Million rand in 1997 fourth quarter and this increase has increased the GDP as well as the availability of credit (Fedderke, 2005). In the first quarter of 1998 the investment decreased by R2653 from last quarter of 1997.

In the third and fourth quarter of 1998 the investment started increasing but in the first quarter of 1999 it decreased because of Asian financial crises. The Asian financial crises affected many countries especially developing countries and South Africa was one of those countries (Fedderke, 2005). From 2000 the investment in South Africa has been increasing until first quarter of 2009 where the world was faced with financial crises. In 2015 the GFCF is around R161182 million (South African Reserve Bank (SARB), 2015).

1.2 Statement of the problem

Many developing countries, especially in Africa are faced with a growing inability to encourage investment. Fluctuations in gross fixed capital formation (net investment) need to be addressed by the policy makers of a country, with particular concern with declining trends. This is due to the fact that GFCF is associated with value of acquisition of new or existing fixed assets. GFCF as a component of GDP which measures how much of the new value added in the economy is invested rather than consumed. The implication is that a decreasing GFCF can results into slow growth rate in the economy, lack of innovation and difficulties when it comes to the matters related to prediction of investment return (Majeed & Khan, 2008). For example, in South Africa there was a drastic decline for GCFC in 2008 and it fluctuated after 2010. Based on the slow growth of investment activities as indicated by the trends in GCFC, it was interesting to find out what determines the investment activity in South Africa. Many South African studies were based on the specific investment and mostly of them they were done before the 2008 financial crises. For example, the study by Fedderke, Perkins, & Luiz which was done in 2001 and was focused more on the specfic investment which was the infrastructure investment in the long run economic growths in South Africa. Furthermore, the study by Cheteni (2011) also focused on the transport infrastructure investment and transport sector productivity. The confusion remains on what determine the investment in South Africa especially after the 2008 financial crises.

1.3 Research aim and objectives

1.3.1 Aim of the study

The aim of the study is to analyse the investment activity in South Africa from 1994 to 2015.

1.3.2 Objectives of the study

The objectives arising from the aim are:

- To review the trends of investment activity in South Africa.
- To examine the determinants of investment activity in South Africa.
- To forecast for the investment rate in South Africa in years ahead.

1.4 Research questions

- What are the trends of investment activity in South Africa?
- What are the determinants of investment activity in South Africa?
- What will be the forecast for the investment rate in South Africa in years ahead?

1.5 Definition of concepts

The following definition will be adopted for the purpose of the study:

- **Gross fixed capital formation (net investment)** is also known as net investment is the total amount of fixed capital accumulation. It measures the increase in the capital stock less the disposal of fixed assets and excludes land purchases, and can therefore be used as a measure of investment activity of a (Mohr, 2012; Mishkin, 2016).

- **Economic growth** is the capacity of the country economy's productive to increase or expand in the long run. It can be measured as nominal GDP or rea GDP (Mishkin, 2016). In short, economic growth has got to do with the ability of the economy to expand in the long run performance (Mishkin, 2016).

- **Gross Domestic Product** is the total value of all final goods and service produced within the boundaries of a country in a particular period (Mishkin, 2016).

- **Interest rate** is the interest that is charged borrower on a portion of a loan (Mishkin, 2016).

- **Corporate tax** is what the corporate has to pay on the income earned. Corporate tax is usually imposed by the national level in many counties. Furthermore, locals or state level may impose the similar tax (Hassett & Hubbard, 2002).

- **Inflation rate** is the rising in the prices of services and goods in general. In addition, this rising prices tend to reduce the currency purchasing power (Mishkin, 2016).

1.6   Ethical considerations

This research exclusively uses secondary data. This data is in the form of time series and it is collected from the SARB. Therefore, no ethical clearance need to be taken into account except for plagiarism, bias and incorrect referencing. The researcher conducted this study taking into consideration the rules of the university as well as the requirement for master's degree.

1.7   Significance of the study

Low economic growth, high unemployment and high instability characterise the economy in most developing countries around the world (Elbadawi & Schmidt-Hebbel, 1999). A study on investment might help to contribute the solution to the above mentioned socio economic issues since investment may lead to ensure infrastructure development and increasing growth of a country through promotions in the productive capacity. It can also promote technical progress through the introduction of new technology and help to reduce poverty through an increase in the level of employment (Veemon, Michele, & Charles, 1996).

The intention of this study is to help the investors in terms of determinants to lookout for when making investment decision. Furthermore, the results of this study could assist policy makers to come up with policies that could encourage investment. The findings will add to the existing theory and knowledge as there seem to be a limited research on investment, more especially in South African context.

1.8   Structure of the dissertation

The dissertation is prearranged as follows: chapter 2 reviews the trend of South African investment as well as determinants of investment namely inflation, taxation, interest rate and credit availability from 1994 to 2015.

Chapter 3 reviews the theoretical framework and empirical literature review. The first section discusses the main investment theories namely the accelerator theory, the rigid accelerator theory, the flexible accelerator theory, the Junankar approach of flexible accelerator theory of investment, Jorgenson neoclassical theory, Tobin's Q theory of investment and Harrod-Domar growth model. The second section discusses the empirical literature all over the country.

In Chapter 4 presented the methodology of Johansen cointegration and Vector Error Correction Model (VECM) approach. The data issues were addressed in this section.

Chapter 5 discusses the research findings from the various econometric tests performed in this study. Chapter 6 presented the conclusion and policy recommendation of the study

CHAPTER 2

REVIEW OF TRENDS OF SOUTH AFRICAN INVESTMENT

2.1 Introduction

The section reviews the trend of South African investment as well as determinants of investment namely inflation, taxation, interest rate and credit availability from 1994 to 2015.

2.2 The analysis of investment trend in South Africa

Investing in fixed capital stock can accelerate the economic growth of a country (Gkionis, et al., 2015; Majeed & Khan, 2008). Figure 2.1 presents the trend of investment in South Africa between 1994 and 2015.

Figure 2.1: Investment ratio of GDP of South Africa
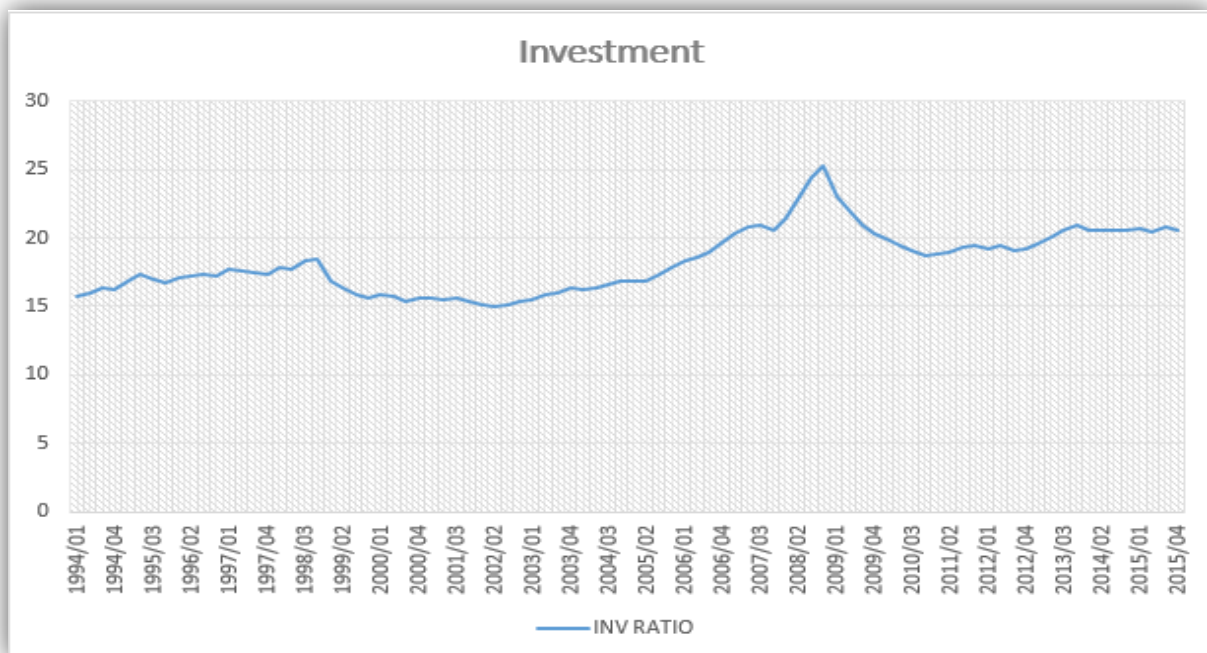
Source: own computation

From 1994 to first quarter of 1999 the investment in South Africa have been increase. This could be due to the new democratic era and investors started to have confident to invest in the country. From 1994 to 1998 there was an increase of 2.8 per cent which helped the economy to do well from that period even if it did not last

long because of Asian financial crises in 1998-1999 which affected many countries including South Africa. As indicated in figure 2.1 from 1999 to 2002 there was a decline of 1.9 per cent in the investment in South Africa. After the introduction of inflation targeting, the investor started to have confident in investing in South Africa knowing that the cost of capital (interest rate) is not affecting their investment.

From 2002 to 2008 the investment increased by 10.3 per cent and declined in the second quarter of 2008 from 25.3 per cent to 18.7 of 2010 first quarter. This dramatic decline could be attributed to the 2007/2008 financial crises which affected both developing and developed countries. In second quarter of 2010 investment started to increase mainly because of the FIFA soccer world cup. Even if the increase in the level of investment is not convincing, from 2013-2015 the South Africa investment was increasing at the rate that was not convincing for that period when compared to the period from 2002 to 2008.

2.3 The Analysis of gross domestic product trend in South Africa.

The GDP as a measure of economic growth in a country. Figure 2.2 presents the trend of GDP.

Figure 2.2: Gross domestic product in South Africa
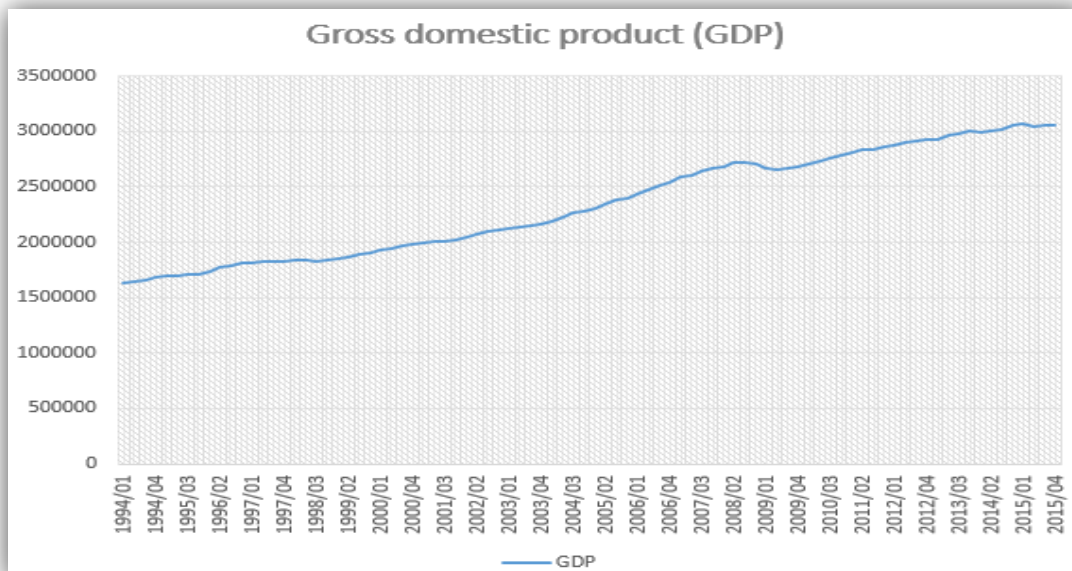
Source: own computation

Economic growth in South Africa has been fluctuating from 1994 to 2015. In 1998 there was declined due to the Asian financial crisis and from 1999 the economic growth started to pick up. Between 2000 and 2001 the economy was strengthened by the announcement of the adoption of the new policy or strategy called inflation targeting by South African Reserve Bank (SARB).

The introduction of inflation targeting has been successful when it comes to the stabilizing of the economy, boosting the confident of investors and also when it comes to the matter of the exchange rate. The reason why inflation targeting is successful is because it reduces the inflationary expectation that might directly translate into inflation (Nattrass, Wakeford, & Muradzikwa, 2000).

The South African government introduced the Accelerated and Shared Growth Initiative South African (ASGISA) in 2004 with the aim of increasing the GDP or economic growth above 6 % mark by 2010 (Remain, 2012). In the 2005/2006 financial year, the government recorded the lowest budget deficit of about 0.5 % and in 2007/ 2008 they recorded 0.6 % of GDP as the highest budget surplus.

The ASGISA policy has failed to reach the target of 6 % and above, but the increase in the real GDP growth in 2007/2008 has increased productivity, strengthened public finance and others. Due to the world financial crises in 2008, the South African GDP decreased from 2723918 to 2657131 million in 2009 and the real GDP increased from 2681051 to 2789950 million from 2009 to 2010. According to the SARB (2011), this was because of the low interest rate and inflation targeting, faster global economic growth, strong commodity price and the 2010 FIFA world cup. Since 2013 growth has been declining and it appears it will be difficult to produce 11 million jobs by 2030 as is outlined in the national development plan (NDP).

2.4 The Analysis of availability of credit trend in South Africa.

Availability of capital is another factor that affects the level of investment. For example if there is availability of capital in the country, it will be easy for the firm to borrow since most of the firms depend on the external funds (Gkionis, et al. (2015);

Ugwuegbe and Uruakpa (2013); Ainabor, Shuaib and Kadiri (2014), Majeed and Khan (2008)). Figure 2.3 presents the trend of availability of credit.

Figure 2.3: Availability of capital in South Africa
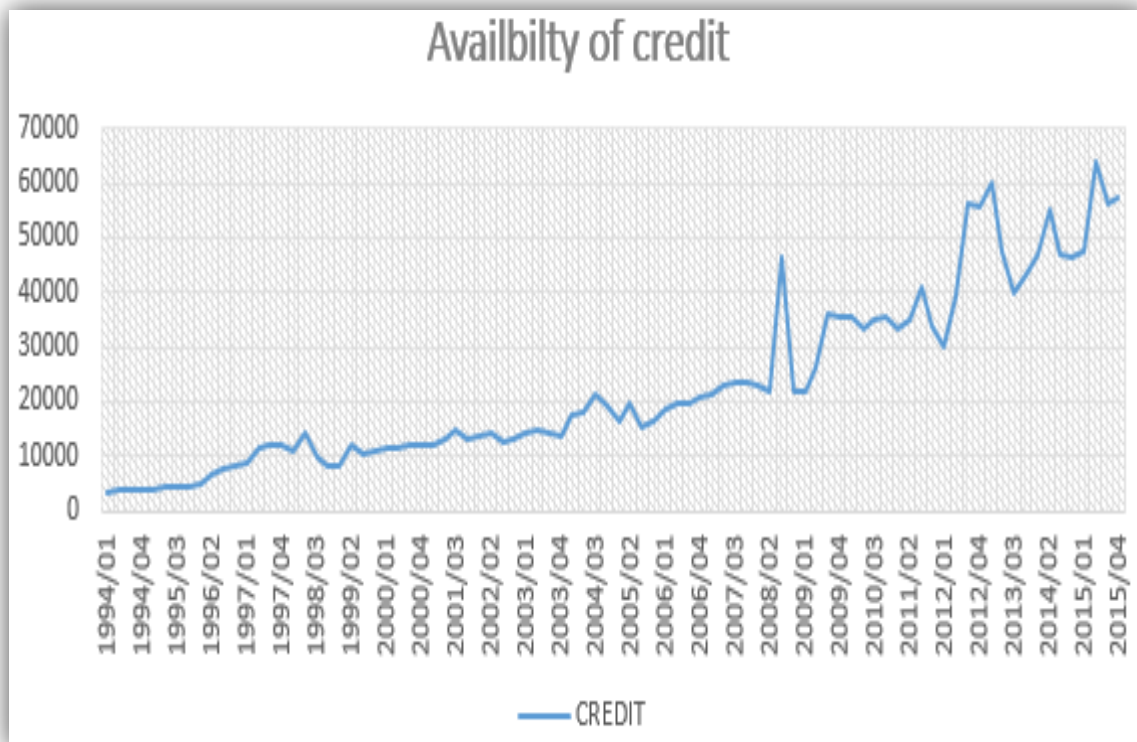
Source: own computation

Figure 2.3 indicates the availability of credit to the private sector from 1994 to 2015 quarterly. From 1994 to1998 second quarter the availability of credit increased from appropriately 3430 million rand to 14502 million rand in the third quarter of 1998, then drop because of the Asian financial crises.

In the first quarter of 1999 the graph shows that it started recovering and from that time to 2004 credit was increasing. In the first quarter of 2008 it increased dramatically from 21 648 million rand to 46 362 million rand of 2008 second quarter. In the third quarter of 2008, the availability credit slump from 46 362 million rand to 21 920 million rand due to the world financial crises.

Another increase was recorded in 2009 until the second quarter of 2011 where it declined from 40 866 million rand to 30127 million rand in the first quarter of 2012. In the second quarter same year the availability of credit started to increase until the

last quarter. This was due the stability of interest rate in 2012. In the last quarter of 2014 again the availability of credit increase from 46 234 million rand to 47 688 million rand of first quarter of 2015 where the availability of credit started to decline due to the problem with currency which forced SARB to increase the interest in order to stabilise the economy.

2.5 The analysis of interest rate trend in South Africa

Interest rate is the interest that is charged borrower on a portion of a loan (Mishkin, 2016). Figure 2.4 presents the trend of interest rate.

Figure 2.4: Interest rates in South Africa

Source: own computation

Figure 2.4 shows the trend of interest rate from 1994 to 2015 in South Africa. The line graph shows that the interest rate has been increasing from 1994 to 1997 and started decline in the third quarter of 1997 but in there was an increase due to Asian financial crises which affected many developing countries especially in Africa. The third quarter of 1998 recorded a declined from appropriately 26% to 20%.

From 1998 to 2001 the interest rate has been declining almost every quarter. In 2000-2001 after the announcement of inflation targeting in by the reserve bank, there was an increase because interest rate was used as an instrument to influence the level of inflation. Furthermore, the increase in those years was due to a currency

crises which forced the SARB to increase the level of interest rate to stabilise the economy and the currency.

In 2008 the interest rate was for the first time above the 15% after the introduction of inflation targeting in 2002. The reason was because of the world financial crises in 2008 which affected many economies around the world and leads to a decline in investment in many developing countries. From 2010 to 2015 the level of interest has been hovering between 7% and 10% in South Africa.

2.6   **The analysis of corporate tax trend**

Corporate tax as another determinants of investment is explained below (Hassett & Hubbard, 2002). Figure 2.5 presents the trend of taxation.

Figure 2.5: Taxation trend in South Africa
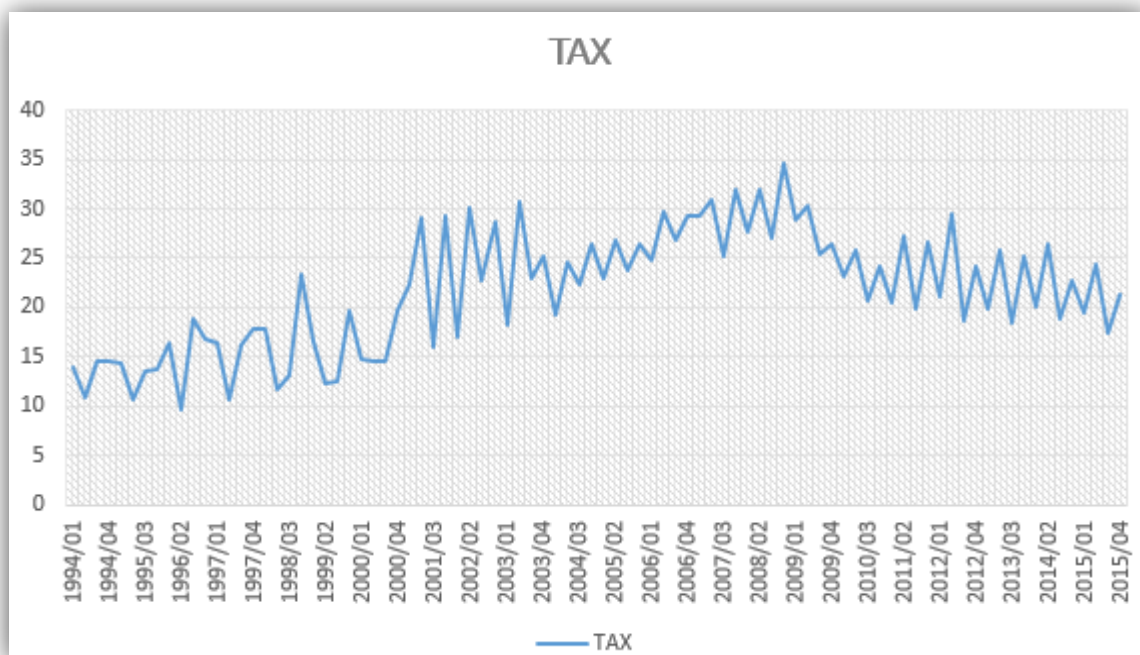
Source: own computation

Figure 2.5 indicates that the tax has been hovering around 10% to 35% from 1994 to 2015with a slight increase from 1994 to 2003. From those years there is an increase of 16.7%. From the last quarter of 2003 to last quarter of 2014 the tax declined by 11.4% and in the first quarter of 2005 it was increasing up until the last quarter of

2008. From 2008 to 2011 there was again a declined in the tax rate and since 2011 to 2015 it hovered around 18.5% to 29.4%.

2.7   **The analysis of inflation trend in South Africa**

The trend of inflation rate in South Africa post 1994 to 2015 has been presented in Figure 2.6.

Figure 2.6: Inflation rate trend in South Africa
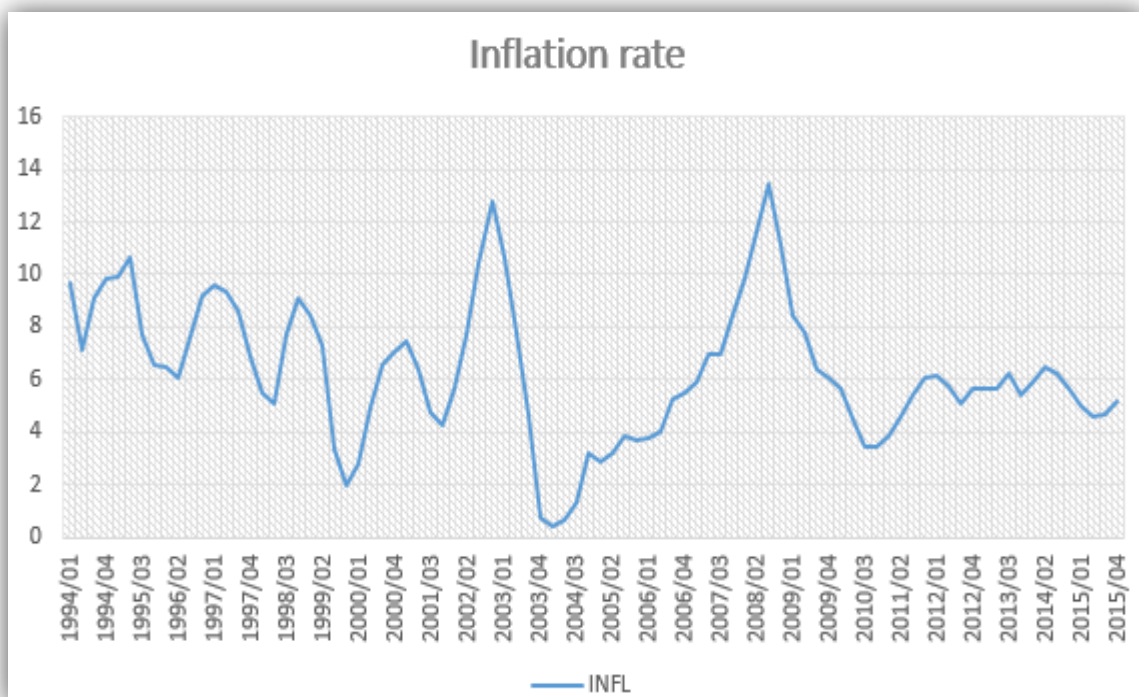
Source: own computation

From 1994 first quarter to second quarter of the same year there was a decline in the level of inflation from 9. 7% to 7. 2%. In 1995 it went up to 10.6% which means that there was an increase of 3.4 per cent.

The trend indicates that from 1998 to 1999, there was a significant decline and it was from this period where many developing countries were affected by major decline of inflation rate due to the Asian financial crises.

The inflation rate has been fluctuating from the lowest 0.43% in the year 2004 in the first quarter to the highest of 13.4% in the year 2008 in the third quarter. The increase from that period was because of the decline in the value of rand, increase in the price of energy, high food price and increase in the administered prices (Van der Merwe, 2005). Increase in the level of inflation rate affect investment of those who invest in bond or fixed income. As a results it also leads to a rise in the level of interest rate which in turn affect the bond price negatively. From that period there was an increase of 12. 97%. From 2009 to 2010 last quarter there was a significant decline of 10% from that period. From the period of 2012 to 2015 the inflation rate in South Africa was just fluctuating around 5 per cent to 6.7%.

2.8 Summary

South African investment has been doing well since 1998 and was then affected by the financial crises that affected many countries especially developing countries. The availability of credit has been increasing since 2010. The study by Gkionis, et al. (2015); Ugwuegbe and Uruakpa (2013); Ainabor, Shuaib and Kadiri (2014), Majeed and Khan, (2008) indicated the positive relationship between the level of investment and changes in credit to firms which is availability of capital. The inflation rate, interest rate and taxation has been fluctuating from 1994 to 2015. In 2008-2009 there was financial crises which affected many countries and South Africa was one of those countries. Those above mentioned variables were also affected by global financial crises.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

This section is divided into theoretical framework and empirical literature review. The first section discusses the main investment theories namely the accelerator theory, the rigid accelerator theory, the flexible accelerator theory, the Junankar approach of flexible accelerator theory of investment, Jorgenson neoclassical theory, Tobin's Q theory of investment and Harrod-Domar growth model. The second section discusses the empirical literature all over the country.

3.2 Theoretical framework

3.2.1 The accelerator theory of investment

The accelerator theory of investment suggests that in a firm, an increase in the rate of output will entail a comparable increase in the capital stock. Assuming that capital output ratio is some fixed constant, v the desired capital stock is constant part of output and can be denoted as follows:

$$K_{t=}vY_t \quad \text{..} \quad (3.1)$$

where: $_t$ is the period,

Yt is the rate of output,

Kt is capital stock and

v is the positive constant (the accelerator) (Clark, 1917). Some changes in the level of output will lead to the same changes in the level of capital stock. The equation below explain the above statement:

$$K_t - K_t - 1 = v\ (Y_t - Y_t - 1)$$

And $int = v\ (Y_t - Y_t - 1)\ [int = K_t - K_t - 1 = v\Delta Yt$ ....(3.2)

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Where: $\Delta Yt = Yt - Yt - 1$, and int demonstrate the level of net investment.

The equation 3.2 shows the naive accelerator. Equation 3.2 Indicate that any change in the net investment will be due to the change in the level of output. For example, the level of net investment will be zero as long as the level of output is constant ($0 = \Delta Y$). The larger the amount of output, the more the net investment will be positively constant. Figure 3.1 demonstrates the relationship between the level of investment and the level of output at a specific period.

Figure 3.1: The relationship between the level of investment and the level of output
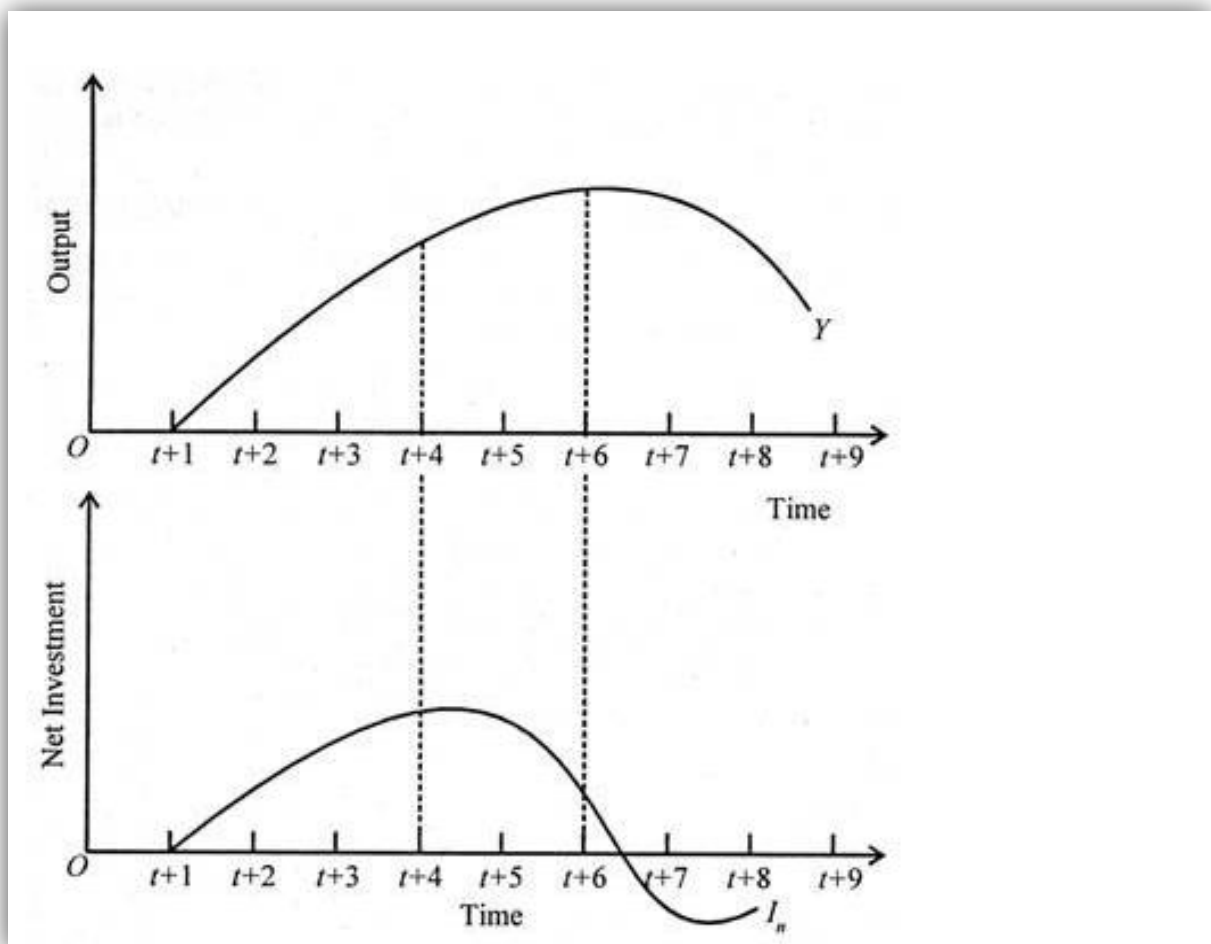
Source: (Clark, 1917)

The figure 3.1 explains equation 3.2 by means of graphical illustration. The upper graph indicates the level of total output while the lower graph indicates the level of

net investment at a specific time period. It shows that the total level of output has been increasing at an increasing rate from period t+1 to t+4. Then from period t+6 the level of output started to decline. The lower graph indicate an increase in the level of net investment from t+1 to t+4 and a decline from t+5 period.

Figure 3.1 indicates that increase in the output leads to a rise in the level of net investment because output determines the level of net investment. From t+4 to t+6, the level of output is increasing at a decreasing rate and t+7 indicates that output started to decline while the level of net investment is negative. This shows that a decline in the total output leads to a negative net investment.

Under the simple acceleration principle, fixed technical value of production is assumed to be the best capital stock of output. This is demonstrated on the isoquants curve in figure 3.2.

Figure 3.2: The isoquant curve
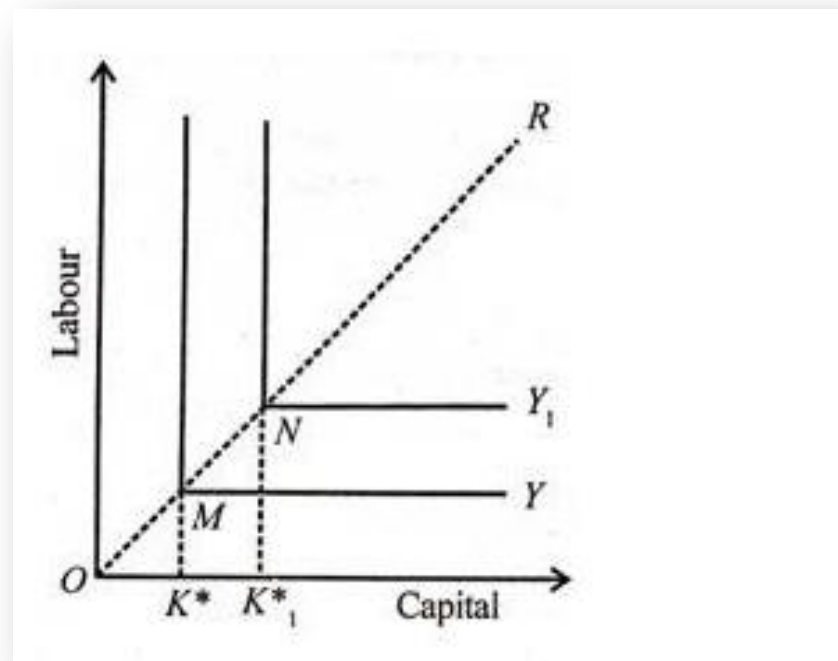
Source: (Clark, 1917)

Figure 3.2 shows the two isoquant, namely Y and Y_1. If the firm was producing at Y and at Y the best capital stock was K*. For it to increase the level of output from Y to Y_1, it must rise its greatest capital stock from K* to K* $_1$.The line OR shows the

constant return to measure. The capital-labour ratio remains constant under the constant return to measure, meaning that the simple accelerator will be constant as well.

Figure 3.3 is an illustration of the isocost and isoquant of the firms
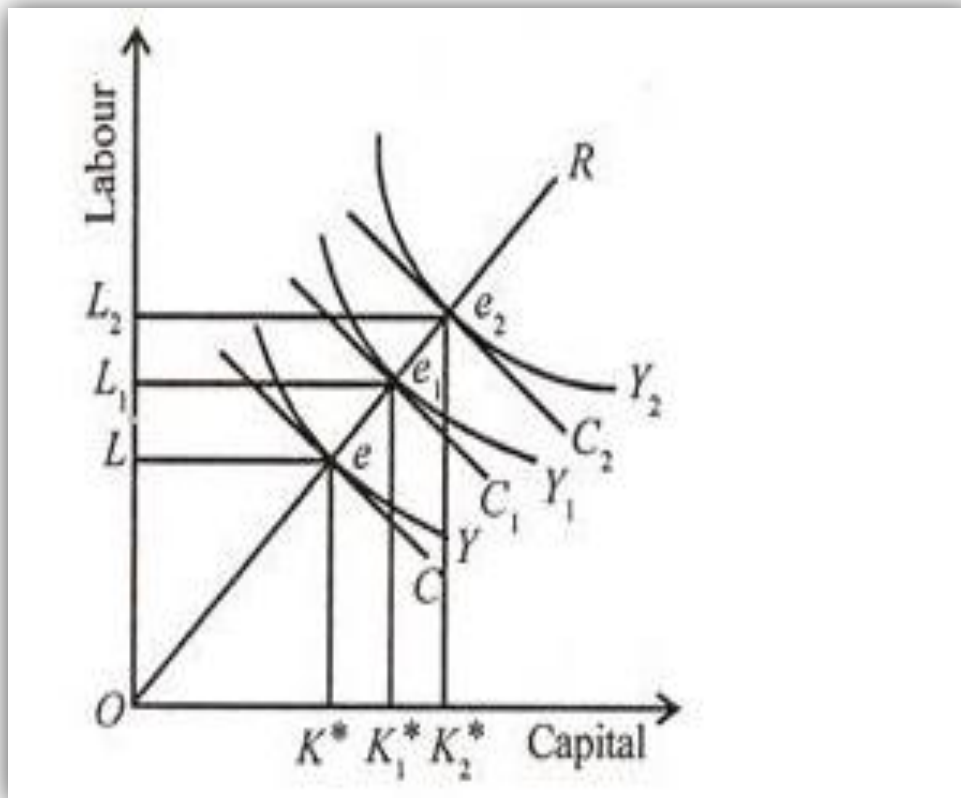
Source: (Clark, 1917)

The figure 3.3 shows the relationship between isocost (C, C1 and C2) which shows the constant cost and isoquants (Y, Y1 and Y2). They are parallel to each other. The OR line show the equilibrium point (e, e1 and e2). This that an increase in the level of output by the firm lead to an increase in the capital and labour at the same time. The figure 3.3 indicate that increased the level of output from Y to Y1. This increase lead to an increase in the labour from L to L1 and capital from K* to K1. This indicated that a change in the level of output lead to a change in the level of investment (Clark, 1917).

3.2.2 The rigid accelerator theory

The rigid accelerator theory of investment focuses on output growth as function of investment. The assumption of this theory is that optimal stock of capital is attained in each time period. The theory or model did not take into consideration some factors such as profits and financial factors among others. That is one of the reason why the flexible accelerator model was formulated (Goodwin, 1948; Koyck, 1954; Lucas, 1967; Gould, 1968; Treadway, 1971).

3.2.3 The flexible accelerator theory

The flexible accelerator theory of investment developed by Koyck, Chenery, Junankar and Goodwin is also known as the capital stock adjustment model. The Koyck, Chenery, Junankar and Goodwin are the developer of this. The theory in various forms comes in various forms and Koyck approach is the most accepted one. Its main aim was to remove the point that capital stock is optimally adjusted without any time lag. The theory suggests that between the level of capital stock and the level of output there are lags in the adjustment process. If there is continuity for some time in the increase of demand for output, the firm will eventually increase its demand for capital stock (Koyck, 1954).

3.2.4 Junankar approach of flexible accelerator theory of investment

The adjustment of lags between the level of capital stock and output is captured by by Junankar's approach. It was started by discussing the approaching flexible accelerator theory of investment at a firm level and then expanded to the aggregate level. The approach assumes that if there is a rise in the demand for output, the firm needs to ensure that it uses its inventories and capital stock more intensively (Lucas, 1967; Gould, 1968; Treadway, 1971).

If the level of demand for output keeps on increasing, the demand for capital stock has to be increased to satisfy the demand and that makes the decision making to lag. Suppose each and every firm adopts a unique delivery and decision lags and then a rise of demand on capital stock is due to aggregate and is given out over time (Lucas, 1967; Gould, 1968; Treadway, 1971). Equation 3 indicates that the previous level of output are the determinants of the capital stock at time (t). Thus

$$K_t = f(Y_t, Y_t - 1 \ldots \ldots, Y_t - n) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \text{ (3.3)}$$

The equation 3.3 can also be demonstrated in figure 11.

Figure 3.4: The K-curve
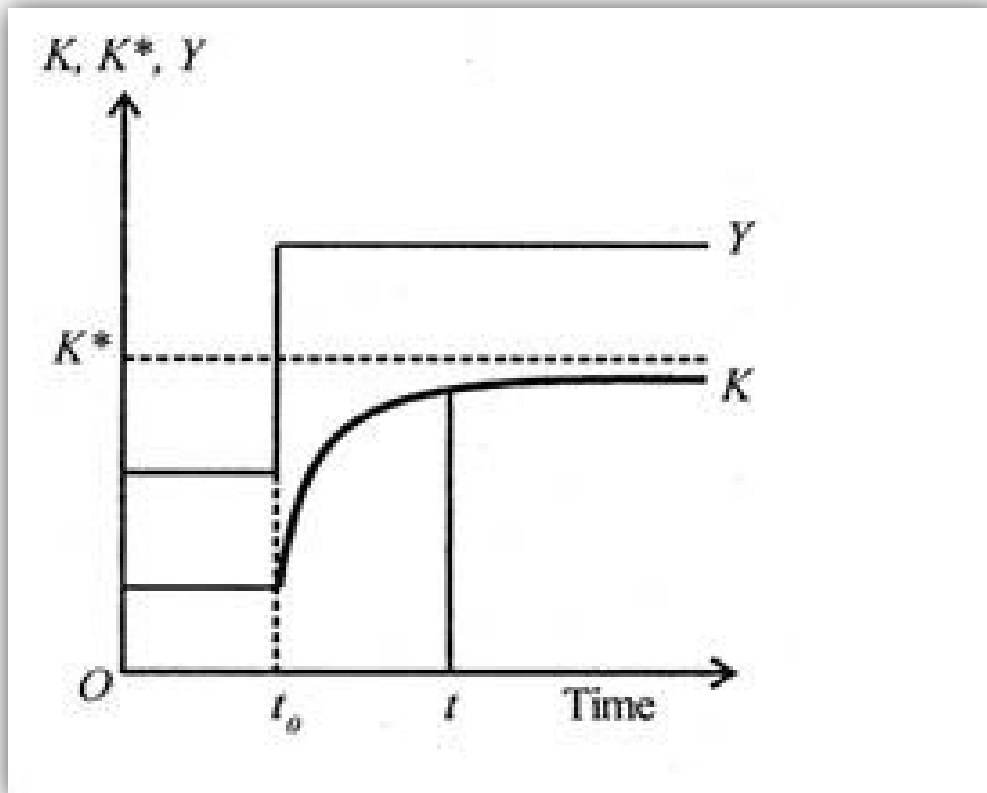
Source: (Lucas, 1967)

Figure 3.4 illustrates the fixed relation concerning the level of capital stock and output where to indicate the initial period. Furthermore, figure 3.4 indicates that increase in the demanding of output lead. It is shown by the K curve. The K curve depends on the previous total level of output and T curve indicates the increase in the level of output. The optimal capital stock is shown by the dotted line K in period t is equal to the actual capital (K) (Lucas, 1967; Gould, 1968; Treadway, 1971).

3.2.5 Jorgenson neoclassical theory

This theory focuses on what determines the level of optimal capital stock. In his equation, Jorgenson followed the theory of profit maximization of the firm (Jorgenson, 1963). The following are the assumptions of Jorgenson neoclassical theory of investment:

- perfect competition adopted by firms,
- No insecurity or uncertainty,
- No changes in the adjustment cost,
- Diminishing return to scale apply,
- Full employment and perfectly flexible price of capital and labour,
- Input are homogenous both capital and labour when producing homogenous output, firm lend and borrow at any rate of interest because financial market is perfect,
- Real unit cost are equal to the MPP (that the input adopted),
- Fully utilized capital stock
- The value of discounted rental charges and capital goods price are equal,
- Present value is maximized by firm (Jorgenson, 1963).

The theory assumed that present value is maximized by firm as illustrated in equation 3.4:

$$R_{(t)} = P_{(t)} \, Q_{(t)} Q - W_{(t)} \, L_{(t)} - q_{(t)} \, I_{(t)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.4)}$$

Where: L = represent labour service, t= time,

w= is the wage rate, q= is the price of goods,

p= price, I= investment,

Q= output and R= is the net receipt.

The below equation indicate the integral of discounted net receipts.

$$W = \int o \; \infty e{-}rtR_{(t)} \, dt \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.5)}$$

Where: w represent net wealth,

 e= represent expanded used for non-stop discounting,

r= represent interest rate at constant.

Under this theory there are two constraints which maximise the subject of the present value, namely; change and constant rate of capital service. In order to obtain the net investment, the replacement investment needs to be deducted from total investment as illustrated in equation 3.6 which indicates the constraint of this theory (Jorgenson, 1963).

$$K_{(t)} = I_{(t)} \, I - \delta \, K_{(t)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.6)}$$

Where k (t) = is the change in the rate of capital service flow at period,

δ= represent the depreciation rate devoted to the stock capital and

I & K are function of time (Jorgenson, 1963).

3.2.6 Tobin's Q theory of investment

This theory was proposed by James Tobin and is based on the fluctuation of stock market and investment decision (Tobin, 1969). Tobin's Q theory of investment is based on the ratio below:

$$q = MCS / RCC \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..\text{(3.7)}$$

Where: MCS means market value of capital stock

        RCC means replacement cost of capital

The market value is the capital stock of a firm and the replacement cost is the capital of a firm. The theory clarifies the net investment by relating the net investment to the value of capital stock of a firm to the cost of its real capital replacement. As illustrated in figure 3.5 which indicates the relation between the capital stock and the

net investment, an increase in the market value which in turn can lead to increase in the investment and the value of q may be because of increase in the demand for shares (Tobin, 1969).

Figure 3.5: The relation between the capital stock and the net investment
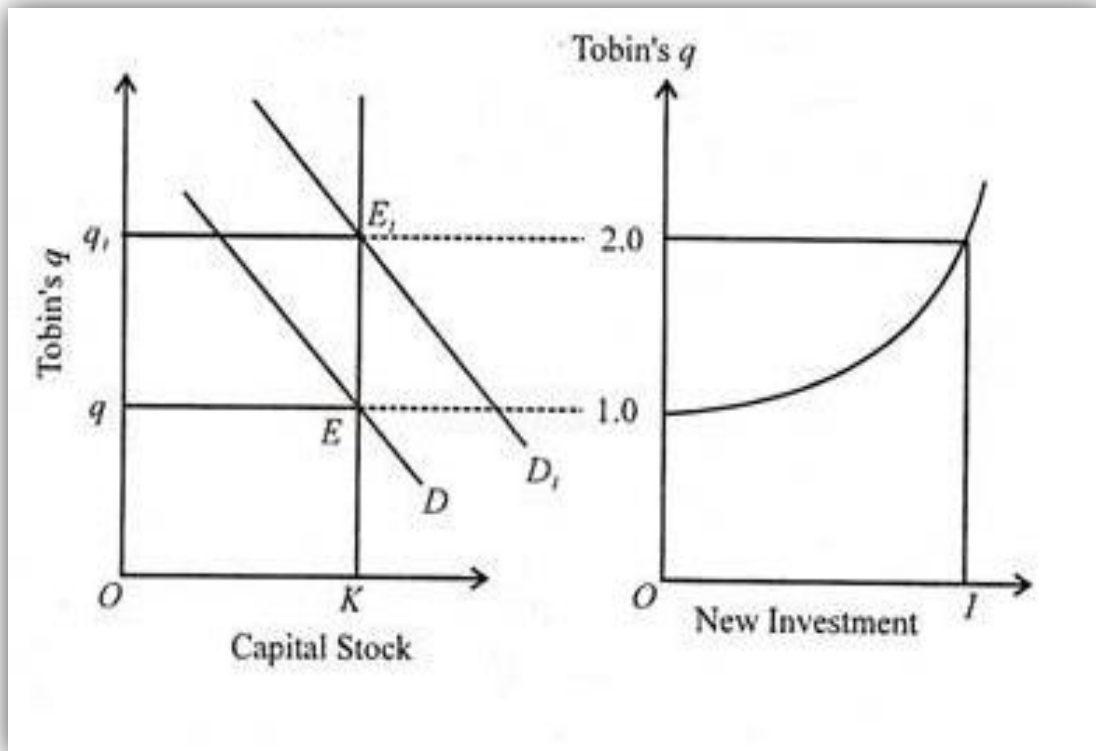
Source: (Tobin, 1969)

The left hand side of figure 3.5 indicates the demand for capital whereas the right side shows the increase of new investment. Demand curve illustrate the demand of capital. The theory assumes that replacement cost of capital stock and market value are equal and they are represented by q on the curve. In the short run, the initial equilibrium is at point e, where the available supply of capital stock intercepts with the demand for capital (Tobin, 1969).

The demand for capital for capital is determined by the wealth and other asset real return such real estate and government bonds. People will tend to invest in the share if the government's real interest rates decline and that will increase the demand for

capital. An increase in the demand for capital means that the market worth will be raised beyond its replacement cost. That indicates that unity is below the Tobin's q as indicated by the shift of the demand curve from D to D_1. Point E_1 on shows the new equilibrium. This means that the replacement cost will tend to increase in the long run and be equal to the market value of capital. The increase from q to q_1 of Tobin's q will lead to an increase in the value of new investment (Tobin, 1969).

3.2.7 Harrod-Domar growth model

This growth model represents the Keynesian economics school of thoughts. It models growth as an outcome of the equilibrium between saving and investment. Nafziger (1997) is of the opinion that Harrod made this model in an attempt of starting the rate of growth in income which would persuade the equilibrium between savings and investment. The fundamental variables in the model include capital collected and the ratio of the increase in output in order to increase investments. This can be portrayed as ΔK and $\Delta K / \Delta Y$ respectively. Change within the output is caused by the change in capital stock ($\Delta Y = \Delta K$), the change in capital stock is due to investments therefore $\Delta K = I$.

To identify whether or not the actual growth rate will make a situation in which desired investment equals the desired savings, Harrod differentiate between three different growth rates namely; the actual growth rate (g), the warranted growth rate (gw) and the natural growth rate (gn). The actual growth rate is seen as the ratio of saving out the income s to the ratio of change in capital to the change in output (k/ Y), it is illustrated as follows

$$G = s/c \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.8)$$

Changing the expressions for *s* and *c* into equation (3.8) makes $s/c = S/Y / (I) / Y / Y$, which represents the output growth, when savings (S) = investment (I) and Y/Y shows the growth of output.

Harrod (1939) provides that the warranted growth rate is the growth that encourages investments, so that investments and savings are in equilibrium and the capital stock is used fully. The desired expenditure equals output, that is $g = gw$. This provides

the basis for economic agents and entrepreneurs to continue investing while encouraging economic growth.

If the desired stage of saving is not equal to the desired level of investment, it means that the output growth rate will change into a recessionary gap.

Harrod (1939) conducted an analysis of two possible events. The 1st one is when the growth rate is greater than the warranted growth rate, $g > gw$ ($/Y > I/Y$), the 2nd one is when the actual growth rate is less than the warranted growth rate, $g < gw$ ($/Y < I/Y$). With the 1st event ($g > gw$) the investment is not enough to keep a constant capital stock growth then an inflationary gap opens. An increase in investments means that the inflationary gap becomes broader because of an increase in the actual output, emanating from an increased demand for factor input.

At a later stage when $g < gw$, the necessary investment is above the current capital stock growth rate. Resources become idle and investment is not encouraged, this happens within a recessionary gap. The importance of the disequilibrium is that it will make the situation bad itself, this is because when $g > gw$ the incentive to invest is introduced while when $g < gw$ there will be disincentive when investing (Harrod, 1939).

He discovered that the rate of investment provides a basis for supply which equals demand at the potential income level. This equilibrium requires that

$$\Delta Yd = \Delta Ys \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.9)$$

where $\Delta Yd = \Delta I/s$, represent that change in the level of investment *I/s* causes a change in the level of demand *Yd* and also causes a change in the level of supply *Ys* by

$$\Delta Ys, = I\,\partial \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(3.10)$$

(∂) resembles capital stock productivity, therefore the investment growth rate I/I be equated to investment and capital stock productivity for full equilibrium to exist

Domar's growth analysis shows that there is no guarantee of full employment of labour, even in the presence of full use of capital stock, hence giving an allowance

for Harrod's natural growth rate. This follows Thirwall (2003) preposition in which the actual growth rate cannot be above the natural growth rate.

This occurs when all active labour force is employed and it is of more importance when establishing the economy in the long run relationship between capital growth and labour force growth which increases to full employment (Elbadawi & Schmidt-Hebbel, 1999).

The Harrod-Domar growth model gives a clear description of the development challenges facing less developed nations with regards to production methods. Thirwall (2003) believes that developing countries can change the capital labour ratio when shifting towards the use of more labour-intensive production methods without causing damage on the output levels.

Harrod-Domar's growth model failed to achieve the steady growth at its potential level therefore giving rise to the introduction of the other growth models which allows the economic variables to be changed, i.e. the neoclassical growth model as well as the new endogenous growth model (Harrord, 1939).

3.3 Empirical literature

Gkionis, et.al (2015) investigate the determinants of investment in Greece from 2001 to 2013. The study used the quarterly data with variables such as private credit growth, real long term interest rate, taxation and investment as a percent of GDP was used. The OLS results indicated a statistically significant and positive relation between changes in credit to firms and the investment rate and on the other hand it indicated that investment rate, taxation and real interest rate are negatively related.

Michaelides, Roboli, Economakis and Milos (2005) used the multiple linear regression model to examine the determinants of investment in Greece from 1960 to 1999. The results revealed that profitability, output growth and investment are positive related. In other words, increase in profitability of a firm or output growth in the economy will increase or encourage the level of investment. Furthermore, investment and interest rate are negatively related, meaning that the rise in the level of interest rate will discourage or decrease the level of investment. In conclusion, the

study revealed that incorporate of Greece in the European Union (EU) financial area in 1992 and oil crises seemed to have been influenced the level of investment.

By means of annual data Majeed and Khan (2008) examined the determinants of private investment and the relationship between public and private investment in Pakistan from 1970 to 2006. Variable such as interest rate, net capital inflow, private sector output, domestic credit of the banking system and capital stock for private sector was used in the study. The results indicated that these variables are significant determinants of private investment in Pakistan. Change in the volume of bank credit has a positive effect on the private investment. In terms of the relationship between private and public investment, the results indicated that there is a "crowding out" effect. In conclusion, the public sector used most of the financial and physical resources that had a negative influence on the private investment in Pakistan.

Naqvi (2002) investigated the relationship between public investments, private investment and economic growth in Pakistan. Using the annual data for 37 years the cointegration VAR was employed to examine this relationship. The results indicated that past government investment was not benefiting private investment because of the time build characteristics. The accelerator based model was also used to check if economy can generate investment in both investment (public and private). The results indicated that if the economy is growing, the investment will eventually grow as well hence it was concluded that investment cannot itself be source of economic growth.

Fedderke, Perkins and Luis (2001) examined the relationship between in infrastructure investment in the long run economic growth in South Africa from 1875-2001 by VECM approach. The results indicate that in South Africa infrastructure play an important role in the economic growth both directly or indirectly, For example an increase in the infrastructure leads to an increase in the economic growth even though causality of economic growth to infrastructure is very weak.

Ainabor, et. al., (2014) investigated the impact of capital formation on the Nigerian growth. The time series data was used from 1960 to 2010. The Herrod–Domar model was used to check the impact and relationship of capital formation on growth

in Nigeria. The results of Herrod–Domar model and error correction indicated that the same results. The results indicated that capital formation, saving ratio are directly related to the growth rate of the national income. In conclusion, the more the saving and invest-out, the more the growth the rate of GDP.

Ugwuegbe and Uruakpa (2013) examined the capital formation on economic growth in Nigeria. The study employed the following variables capital formation, inflation rate, stock market capitalization, interest rate on economic growth. The researched used the Ordinary least square (OLS) technique, Phillip-Perron, Johanes cointegration test and vector error correction model (VECM). The result indicated that capital formation play an important role in Nigeria because of significant and positive impact on the economic growth.

Veemon, Michele and Charles (1996) investigated the investment behaviour of private and public sector in Malawi from 1967 to 1988. The study employed a neo classical flexible accelerator model. The researchers used variable such interest rate, expected level of output, private and public investment to perform the above mentioned model. The results indicate that private and public investment have a two way causal relationship and real interest rate and private investment are negatively related. The public investment, expected level of output and private investment are positively related. Meaning that if the public investment increases in Malawi, the private investment tend to increase also.

Cheteni (2011) investigated the impact of transport infrastructure investment and transport sector productivity on South African growth. The Study used the annual data from 1975-2011. The researcher collected the data from World Bank database, South African Reserve Bank and Quantec. The VECM results indicated inflation, exchange rate and domestic fixed transport investment have influenced the economic growth of South Africa. When using the BVAR model, the results revealed that multi factor productivity including the above mentioned variable is also another factor that have influence on the economic growth.

Fielding (1998) examined the manufacturing investment in South Africa from 1960 – 1993. The study used the quarterly data and was collect at SARB. The econometric

techniques such as unit root to test the stationarity and VAR. The results indicated that the wage elasticity is negative. In conclusion from the study, firm's productivities are affected by the outside economies of scales.

Muyambiri and Chiwira (2007) employed the pairwise causality to assess the directional, cointegration approach and VEC model to test the short run relationship between private and public investment. The aim of the study was to investigate the causal relationship between private investment and public investment in Zimbabwe from 1970 to 2007. The study followed the investment flexibility accelerator theory for both public and private investment. I. They were found t to be insignificant between the relationship of private and public investment and the causality results indicated the unidirectional. In conclusion, the study indicated that private investment precedes public investment in Zimbabwe.

Majeed and Syed (2007) investigated the importance of public policy and private investment in Pakistan from 1970 to 2004. The study followed the flexible accelerator theory of investment and employed the OLS technique was used in the estimation. The results revealed that economic growth, interest rate, change in the bank credit to the private sector and public investment are important for the private investment. There was a positive relationship between economic growth and private investment and this support the flexible accelerator theory investment. The interest rate and public investment are negatively related. Public investment is the substitution of private investment and any increase in the interest rate discourage the level of private investment. In conclusion, infrastructure investment and not tightening the monetary policy can be a solution to encourage the level of investment in Pakistan.

Lucky and Uzah (2014) employed the granger causality test to assess the directional, cointegration approach and VEC model to investigate the determinants of capital formation in Nigeria from 1975 to 2014. The results indicated that broad supply, term of trade, gross national saving, external debt trade and exchange rate have negative effect on the capital formation. In other word, increase in those variable or factors will discourage the level of capital formation. Other factor such as commercial bank lending rate, inflation, credit to private sector, public expenditure, government revenue and public expenditure are positively related to capital formation even if they have insignificant effect. It recommends that public and

government expenditure should be directed to infrastructure investment and the same time discourage the capital flight by coming with policies that will encourage the level of investment. Furthermore, non-oil sectors should be strengthened and enhance the financial sector.

Akkina and Celebi (1996) examined the determinants of private fixed investment and the relationship between private and public investment in Turkey from 1970 to 1996. The study covers the financial liberalisation as well as financial repression and the neoclassical investment model and flexible accelerator investment model were adopted. The results indicated that public investment and private investment are substitute. In other word the positive of public investment tend to affect the private investment negatively. The results between lending rate and private fixed investment indicated that they are negatively related meaning any increase in the rate of lending leads to discouragement in the private fixed investment by private sector. Furthermore the study supported the neoclassical investment because of the results found.

Kanu and Nwaimo (2015) examined the relationship between capital expenditure and fixed capital formation by employing the cointegration approach, VAR technique and granger causality test. The researchers used macroeconomic variable such as import, inflation, national savings and economic growth. The results indicated that capital expenditure has a negative relationship with fixed capital formation. Furthermore, national saving and import are positively related to the fixed capital formation. The study concluded that in order to encourage the level of fixed capital formation in the economy, the federal or the Nigerian government need to ensure that they decrease the level of capital expenditure since they are negatively related. The study recommend the increase in the level of gross national saving which can attract the foreign direct investment (FDI), reduction the level of inflation and focus on the goods and service that need to be exported to the rest of the world.

Ibe and Nathaniel (2016) employed the multiple linear regression was used to determine the impact of capital formation on economic growth in Nigeria. In addition the study included exploratory variable such as saving, external debt, interest rate and inflation rate. The study found that capital formation and economic growth are positive related in Nigeria in both the long and short run. Furthermore it was revealed

that the rate of saving is not enhanced the economic growth. The study recommended an increase in the level of infrastructure as well as the increase in the level of saving.

Shauib and Ndidi (2015) investigated the impact of capital formation on economic development in Nigeria from 1960 to 2013. The study revealed that capital formation have a positive impact on the economic development. In other word, an increase in the capital formation the more there will be economic development in the country. Exploratory variable such as interest rate, inflation and saving were used when running the test. The study recommended that government should encourage savings domestically by interest rate, improve the level of infrastructure and maintain one digit inflation rate.

Njuru, Ombuk, Wawire and Okeri (2014) investigated the impact of government expenditure on private investment in Kenya from 1963- 2012. The VAR technique was adopted in the study and the results indicated that public expenditure does not encourage the level of private investment. Meaning that there is crowding out. The study recommended that if government spend more on project that are valuable such as road and improving the health of people, there will be a crowding in or that will be a way of encouraging the level of investment. Similarly study was done in Cameroon and the results from the study revealed the insignificantly crowds in of public expenditure to private investment. The study concluded that Cameroon government need to make sure that they focus on quality education and research, good governance, infrastructural development and maintenance and industrialization (Mbella & Forgha, 2013).

Tchouassi & Ngangué (2014) examined the relationship between private and public expenditure in Africa. The study used the panel data and employed independent variables such as public investment, GDP, trade openness, external debts and domestic credit. The results revealed that public investment and private investment are negatively related. In other word there is a crowding out. Other independent variables are positively related to private investment. This means any increase in those variable, the more private investment will be in country. The study at the end

concluded that encouraging those factor that are positively related to private investment may be another way of increasing the standard of living.

In Pakistan, Rahman, Ullah and Jebran (2015) revealed that inflation, government expenditure on health, transport and communication are crowding in the private investment in the long run while debt, service expenditure and community service are crowding out private investment. In conclusion they recommend that government should increase spending on things that will encourage investors to invest. A similar study was done in Turkey where variables such as interest rate and government spending were revealed to be the crowing out of private investment while GDP and transfer payment were the crowding in of private investment (Karagol, 2004).

Governments play an important role in the taxation (corporate tax) because they can encourage or discourage the level of investment in the country. If the government charges a heavy tax, there will be less investment in the country (McBride, 2012). As such, Hassett & Hubbard (1996) argues that taxation has a negative effect on the gross fixed capital formation. The corporate income taxes increases the cost of capital and at the same time discourage the level of investment (McBride, 2012; Arnold, Brys, Heady, Johansson, Schwellnus & Vartia, 2011).

The cost of capital is also known as the return rate of investment. The cost of capital can affect the level of investment if the cost of capital is high. For example, if the cost of capital is high, private investors won't go for borrowing which will discourage investment (Gkionis, et al., 2015; Majeed & Khan, 2008). This indicates that investment and real interest rate are negatively related.

Availability of capital is another factor that affects the level of investment. For example if there is availability of capital in the country, it will be easy for the firm to borrow since most of the firms depend on the external funds. Several studies such as Gkionis, et al. (2015); Ugwuegbe and Uruakpa (2013); Ainabor, Shuaib and Kadiri (2014), Majeed and Khan, (2008) indicated the positive relationship between the level of investment and changes in credit to firms which is availability of capital.

Profitability is another determinants of investment. Michaelides, et al. (2005) indicated that an increase in the profitability of a firm means more investment in the future. Furthermore, Romer (1996) indicated that profitability and investment are positively related, that is, firms with higher profit tend to investment more.

Taxation, economic growth, cost of capital, profitability, inflation and interest rates have been found to be determinants of investment activity. For example, the study by Gkionis, et al. (2015) which was to find the determinants of investment activity in Greece used the above mentioned determinants. The results indicated that investment, taxation and interest rate are negatively related while GDP and availability of credit are positively related to investments. Similar study was done in Malawi by Veemon, et al. (1996) applied the same determinants of investments but the results revealed contradiction when it comes to the interest rate and investment. The study revealed that interest rate and investment are positively related.

Table 3.1 Empirical literature summary of determinants of investment

Author(s)	Periods	Country(s)	Variables	Methodology
Gkioinis, et.al	2001-2013	Greece	Private credit growth, real long term interest rate, investment and taxation	OLS Regression
Ugwuegbe and Uruakpi		Nigeria	Stock market capitalization, interest rate, capital formation, inflation rate economic growth	Cointegration, VECM framework
Veeman	1967-1988	Malawi	Expected level of output, interest rate, public and private investment	Cointegration, VAR framework
Fedderke	1875-2001	South Africa	Infrastructure investment	Cointegration, VECM framework
Majeed and khan	1970-2006	Pakistan	Net capital inflow, interest rate, private sector output, domestic credit of banking system and capital	OLS Regression

			stock for private sector	
Ainabour, et.al	1960-2010	Nigeria	Saving, growth rate of national income and investment	OLS Regression
michaelides	1960-1999	Greece	Profit, output growth, investment and interest rate	OLS Regression

Akina and Celebi	1970- 1996	Turkey	Interest rate, public and private investment	Cointegration, VAR framework
Cheteni	1975- 2011	South Africa	Real exchange rate, inflation rate, real GDP, multi factor productivity, gross domestic fixed capital formation	Cointegration, VECM framework
Muyambiri	1970- 2007	Zimbabwe	Private and public investment	Cointegration, VECM framework
Kanu and Nwaimo	1981-2011	Nigeria	Import, inflation rate, investment, national saving and economic growth	Cointegration, VAR framework
Fielding	1960- 1996	South Africa	Nominal interest rate, price of capital goods and of output and capital depreciation	Cointegration, VAR framework
Njuru, Ombuk, Wawire and Okeri	1963- 2012	Kenya	GDP, Private investment and government expenditure	Cointegration, VAR framework
Rahman, Ullah and Jebran	1974- 2010	Pakistan	Inflation, government expenditure on health, transport and, communication, debt, service expenditure and community service	Cointegration, VECM framework

Source: own computation

3.4 **Summary**

From literature a number of variables have been empirically found, namely total investment to GDP ratio, per capita output growth (net per capita stock GDP), real long term interest rate (cost of capital), private credit growth and taxation (corporate tax). The study followed the theory of accelerator of investment.

Gkionis,et al., (2015)'s result revealed that taxation and investment are negatively related. Ugwuegbe and Uruakpa, (2013); Ainabor, et. al., (2014) indicated that per capita output growth (net per capita stock GDP), private credit growth and investment are positively related. This study will provide the relationship between interest rates and investment with the South African data so as to indicate the country's position.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

The study is guided by quantitative research methodology based on the Johansen cointegration and Vector Error Correction Model (VECM) approach. The study followed the theory of accelerator investment.

4.2 Data

The study employed secondary quarterly data over the period 1994-2015 sourced from South African Reserve Bank (SARB).

4.3 Model specification

This study analyses the investment activity in South Africa for the period from 1994 to 2015 and the model is specified as follows:

$$Inv = f(GDP, RIR, DT, DC, INFL) \quad \text{…….………..………….……………} \tag{4.1}$$

The linear relationship is as follows:

$$_{INV} = \propto_0 {}_+ \propto_1 GDP_{t\,+} \propto_2 RIR_{t\,+} \propto_3 DT_{t\,+} \propto_4 DC_t + \propto_5 INFL_t + \varepsilon \text{…………………..…….} \tag{4.2}$$

Where

Inv	=	ratio of Gross fixed capital formation to GDP,
GDP	=	real Gross Domestic product used as a proxy for economic growth (in 2005 prices),
RIR	=	real interest rate,
DT	=	annual changes in the corporate tax rate,
DC	=	private credit annual growth,
INFL	=	inflation rate,
$\propto_0$	=	intercept,
't'	=	time trend,

$'\varepsilon'$ = random error term and

$\propto_1 - \propto_5$ = slope coefficients.

4.4 Estimation techniques

The analysis includes unit root testing, Johansen cointegration analysis, VECM, Granger causality, diagnostic and stability, the impulse response and the variance decomposition to analyses the data.

4.4.1 Stationarity/Unit root test

When putting Johansen's co-integration method into operation, the VAR, VECM and the Granger causality include the initial testing of the series which ensures I (1) testing of unit roots in order to validate the characteristics within the time series data. Two different unit root tests are used in this case, the Augmented Dickey-fuller (ADF) test as well as the Philip-Perron (PP) test. Both these tests always behave in a similar manner and are both included to ensure the exact conclusion with regards to the unit root test and are based on trend and intercept, intercept and none at a 1%, 5% and 10% level of significance

Equation illustrating the ADF test is as follows

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{p} \alpha_1 \Delta Y_{1=i} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots4.1$$

As mentioned earlier, the PP test is similar to the ADF test. Reason for conducting a PP test is because normally the ADF test loses power for sufficiently larger values of P and the number lags. The PP is a more comprehensive theory of the unit roots no-stationarity (Asteriou & Hall, 2007).

The regression of PP which is serially correlated as follows

$$Y_t = b_0 + b_1 Y_{t-1} + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots4.2$$

The study used the ADF to test the stationarity and the PP was used as another test to confirm the ADF results in chapter 5. Reason for conducting a PP test is because

normally the ADF test loses power for sufficiently larger values of P and the number lags (Asteriou & Hall, 2007).

4.4.2 Cointegration

Co-integration analysis starts a long term relationship by calculating the long-run equilibrium of the variables in question firstly, and then correlates within the error correlation model estimation. If the cointegration vector is detected while testing for co- integration then, an opinion is given that the test series will move slowly in the long-term and will return back to the equilibrium levels which will be followed by any short-term drift that may take place (Brooks, 2002).

Engle-Granger introduced the co-integration analysis in the early 1980s along with the improvement and additions made in the subsequent years (2009). Cointegration is considered a modelling process that includes non-stationarity with both long-term relations as well as short-term dynamics. When testing the time series data in terms of economics with the use of co-integration, the time series data in its rank form must be stationary and integrated in the order of 1, written as I (1). Integration of order 1 means that the series becomes stationary after differentiating once. Variables are co-integrated if they are I (1) and when having a linear combination which remain stationary without being differentiated at all (2009) (Brooks, 2002).

Three main co-integration techniques which have been consistently used throughout the past studies include: Engel-Granger two steps estimation and Johannsen's maximum likelihood methods which uses either the Trace statistic or Eigenvalue statistic. The Johansen's method is usually used due to reasons which relate mainly to the short-falls of Engle- Granger two steps estimation method (Granger, 1969).

The Johansen cointegration approach was employed to determine the long run relationship among the variables. The starting point when running the Johansen approach cointegration is to determine the lag length (the vector auto-regression (VAR)). Then, the Johansen cointegration tests followed by employing the trace test and eigenvalue test statistics to determine how many cointegration equation(s) exist for the series.

Johansen's method takes the following starting point: the vector auto-regression (VAR) of the order of p:

$$X_t = \Pi_1 X_{T-1} + \Pi_2 X_{T-2} + \ldots\ldots\ldots\ldots\ldots + \Pi_P X_{T-P} + \mu_T \ldots\ldots\ldots\ldots\ldots\ldots 4.3$$

Where Xt is an $nx1$, the vector of the variables which are integrated with regard to the order of one 'that is I (1)' will be $nx1$ for innovations while through Π_P are mxm coefficient matrices.

Reparametrising of the equation ......1 that is subtracting $Xt-1$ on both sides lead to

$$\Delta X_t = \Gamma \Delta x_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots\ldots\ldots\ldots\ldots \Gamma_{p-1} \Delta X_{t-p+1} - \Pi X_{t-p} + \mu_t \ldots\ldots\ldots\ldots 4.4$$

where $\Gamma = \Pi_1 - 1, \Gamma_2 = \Pi_2 - \Gamma_1, \Gamma_3 = \Pi_3 - \Gamma_2 \, and \, \Pi = 1 - \Pi_1 - \Pi_2 - \ldots\ldots\ldots - \Pi_p$

The matrix Π influence the extent to which the system is co-integrated and is called the impact matrix

Returning back to the general reparametrized equation 4.3 if we consider the first system as:

$$\Delta X_{1t} = r_{11} \Delta X_{t-1} + r_{12} \Delta X_{t-2} + \ldots\ldots.. + r_{1-p} \Delta X_{t-p} \Delta X_{t-p} - \Pi_1^i X_{t-p} + \mu_{1t4} \ldots\ldots\ldots 4.5$$

where r_{11} is the first row of $\Gamma_j, j = 1,2\ldots\ldots p-1$ and Π_1^i is the first row of Π.

Here ΔX_{1t} is stationary, that is I(0);j=1,2,......p-1 are all I(0), μ_{1t} is assumed to be I(0) and so for a meaningful equation, $\Pi_1^i X_{t-p}$ must be stationary, I(0).

If no components of X are cointegrated, they should be zero. On the other hand, if they happen to be cointegrated then all the rows of II must be cointegrated but it is not a necessity. This is because the number of distinct co- integration vector is decided on the row rank of II source. The matrics II is of the order $mxm.$ If it has a rank of m, that is m number of linearly independent rows and then forms a basis of

combination of the rows would lead to stationarity, meaning $Xt - p$ has stationary components if the rank of II is $r < m$

This VAR can be re-written as

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_j \Delta Y_{t-1} + \varepsilon_1 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 4.6$$

where $\Pi = \sum_{i=1}^{p} A_i - 1$ and $\Gamma_i = -\sum_{j=i}^{p} A_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 4.7$

Yt is an $nx1$ vector of numbers that are integrated of the order of one- commonly denoted by I(1)

Π is (nxn) matrix of parameters, Γ is $(nxn))$ matrices of the parameters and ε_{tj} is the sequence of random *P*-dimension white noise vectors.

If the coefficient matrix Π has a reduced rank r>n, then there exist n^{x}r matrices α and β each with rank r such that $\Pi = \alpha\beta^1$ and $\beta^1 Y_t$ is stationary

We may write $\Pi = \beta\alpha^i$ for a suitable mxr matrices, and β and α

$$\alpha^i = \begin{matrix} \alpha_1 \\ \alpha_2 \\ . \\ . \\ .r_r \end{matrix} \qquad \text{and } \beta = \beta_{1,}\beta_2\dots\dots\dots\beta_r$$

Then $\Delta X_{t-p} = \beta\alpha^i X_{t-p}$ and all linear combinations of $\alpha^i X_{t-p}$ are stationary. It must be well-known that unit root test need to performed to access the order of integration of each variables before applying Johansen's procedure.

The Johansen's procedure guesses the VAR subject to $\Pi = \beta\alpha^i$ for several values of *r* number of co-integration vectors, using the maximum likelihood estimators.

The main question is how do we detect the number of co-integrating vector?

Likelihood ratio test proposed by Johannsen's are

- The trace test

- And the eigenvalue test

4.4.2.1 The trace test

The trace test is employed to test the null idea of R cointegrating vectors against different ideas of cointegrating vectors

The test is given y

$$Jtrace\ test = -T \sum_{i=r+1}^{n} in(1 - \overset{\Lambda}{\lambda}_{I})..4.8$$

4.4.2.2 The maximum eigenvalue test

The maximum eigenvalue test examinations the null hypothesis of R co-integration against the different hypothesis of $(R + 1)$ co- integrating vectors

Its test study id given

$$Jmax = -T(1 - \overset{\Lambda}{\lambda}_{R} + 1)...4.9$$

T is the size of the sample, and $\overset{\Lambda}{\lambda}_{I}$ the largest canonical correlation

β^{1}　　=　　matrix of co-integrating vectors

α　　=　　speed of adjusting coefficients

r　　=　　number of co-integrating relationship

Π decides the extent to which the system is co-integrated and is called impact matrix, this is the number of distinct co-integrating vectors which depends on the row rank

Π Matrix is of the order MxM if it has the rank M, M is the number of linearly independent rows, and it forms a foundation for M –dimensional vector space.

Any of these linear combination of the rows would lead to stationarity, which simply means that the stationary components would be $r < m$ if the rank is Π ⬚

If Π is equal to zero, this simply implies that there is no co-integration. The variables could be I (1), but that can simply be corrected by working out the differences. If II takes a full rank then the entire *Yt* must be stationary because the left and right side variables are stationary (because of limited variables which are either (I)0) or I(1)). When II is not more than full rank but then equal to zero. This is a situation of co-integration, where the II can be written as $\Pi = \alpha\beta^{1}$ (yes, this can β correspond to the co-integration matrix. β and nxr are *NXR* matrices. α and β are identical up to non- singular transformation since $\Pi = \alpha\beta^{1} = \alpha f^{-1}(\beta f^{1})^{1}$ for any non- singular f.

This lack of identification can sometimes render results from multivariate co-integration analysis impossible to interpret (Brooks, 2002).

VAR was familiarised by Sims in 1980 as a method that might be used by macroeconomics to describe the combined dynamic actions of a collection of variables without any need of strong limits of the kind required to recognise underlying structural parameters. It has turn into common practice of time series modelling.

$$\mathrm{Y}_{t} = \beta_{y0} + \beta_{yy1}\mathrm{Y}_{y-1} + ...+ \beta_{yyp}\mathrm{Y}_{t-p} + \beta_{yx1}\mathrm{X}_{t-1} + ...+ \beta_{yxp}\mathrm{X}_{t-p} + V_{t}^{y} ....4.10$$

$$\mathrm{X}_{t} = \beta_{x0} + \beta_{xy1}\mathrm{Y}_{t-1} + ...+ \beta_{xyp}\mathrm{Y}_{t-p} + \beta_{xx1}\mathrm{X}_{t-1} + ...+ \beta_{xxp}\mathrm{X}_{t-p} + V_{T}^{X} ....4.11$$

$$\mathrm{Y}_{t} = \beta_{y0} + \beta_{yy1}\mathrm{Y}_{t-1} + ...+ \beta_{yyp}\mathrm{Y}_{t-p} + \beta_{yp1}\mathrm{P}_{t-1} + ...+ \beta_{ypp}\mathrm{P}_{t-1} + V_{t}^{y} ....4.12$$

$$\mathrm{P}_{t} = \beta_{p0} + \beta_{py1}\mathrm{Y}_{t-1} + ...+ \beta_{pyp}\mathrm{Y}_{t-p} + \beta_{pp1}\mathrm{P}_{t-1} + ...+ \beta_{ppp}\mathrm{P}_{t-p+} + V_{t}^{p} ....4.13$$

$$Y_t = \beta_{y0} + \beta_{yy1}Y_{t-1} + \ldots\ldots + \beta_{yyp}Y_{t-p} + \beta_{ys1}S_{t-1} + \ldots\ldots + \beta_{ysp}S_{t-p} + V_t^y \ldots\ldots\ldots\ldots 4.14$$

$$S_t = \beta_{s0} + \beta_{sy1}Y_{t-1} + \ldots\ldots + \beta_{syp}Y_{t-p} + \beta_{ss1}S_{t-1} + \ldots\ldots + \beta_{ssp}S_{t-p} + V_t^s \ldots\ldots\ldots\ldots 4.15$$

Estimating the equation of a VAR involve classifying limits. A usual limit takes place in the form of reality about the dynamic link between a pair of change. A VAR system covers a set of m changes, each of which is stated by means of a linear function of P lags of its own self and of entirely the other $m-1$ variables, plus the error tem.

The study adopts the subscription agreement that β_{xyp} represents the value of Y in the equation for X at $LAG\ P$. β_{ayp} value at the equation for Z at $LAG\ P$, β_{ayp} the value at the equation for 1 at lag P. The key feature of the equation is that n current changes appear on the left hand side of the equation. This makes it reasonable, though not always convinced, that the returns (1) are weakly exogenous and that, if all the changes are stationary and ergodic, OLS can yield asymptotically necessary estimators.

The error terms in (1) represents that part of Y, X, Z and A that are not correlated to previous values of the two changes: unstable idea in each changes. This idea will be in general be allied with one another since there will usually be more or less tendency for the movement in Y, X, Z and A to be correlated, possibly because of contemporaneous causal relationship (or because of the common effect of the other variables).

The impression in Y is the portion y that cannot be forecast past values of X and Y, Z and Y and A and Y. Some of this unstable variation in that we measure by Vt is certainly in line to ε_t^y and exogenous shock to Yt, which has the link to what is happening with X, Z and A. Conversely, if X has a contemporaneous influence on Y, then portion of V_t will be in line to the indirect influence of the existing shock to Y, ε_t^x, which enters the Yt equation (1) over the error term since existing X is not acceptable to be on the right size same thing with Z and A, When the changes of a VAR are co-integrated we sue a vector error correctional model (VECM) to analyse the short-run relationship between the co-integrated changes (Brooks, 2002).

4.4.3 Vector error correction model

The VECM was employed in the study because variables are cointegrated and to check the short run dynamics of the variables. It is important when checking the short run relationship and the speed of adjustment (Aziakpono, 2006).

If two I(1 series X and Y are co-integrated then there is a unique α_0 and α_1 such that $\mu_t \equiv y_t - \alpha_0 - \alpha_1 x_t$ in the solitary equation model of co-integration where we believed of Y as the dependent change and X as an exogenous return, and the VECM is follows:

$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_1 + \lambda \mu_{t-1} + \varepsilon_t = \beta_0 + \beta_1 \Delta X_1 \lambda (Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}) + \varepsilon_t \dots\dots\dots\dots\dots 4.16$$

The equation 4.16 is the appropriate specification of VECM and all its terms are 1(0) as long as the value (the co-integrating vector) are known or at least consistently estimated. The μ_{t-1} term is the extent by which Y was below or above the previous period of its long-run equilibrium value. The value X (which is expected to be negative) signifies the amount of correlation of the period ($t-1$) dis-equilibrium that occurs in period t.

All the terms in both equations are 1 (0) if the changes are co-integrated with co-integrating vectors $(1-\alpha_0, -\alpha_1)$ in other words , if $y_t - \alpha_0 - \alpha_1 x_1$ is stationary , the values are yet again the error – correctional coefficients, meaning the response of each change on the degree of deviation from long run balance in the previous period. We expect $\lambda_y \lhd 0$ for the similar as above: if y_{t-1} is above its long run values in relation to x_{t-1} the error – correctional term in parenthesis is encouraging and this have to lead, other things constant to the sinking movement in y in period t. The anticipated sign of λ_x depends on the sign of α_1 (Aziakpono, 2006).

4.4.4 Granger causality test

The Pairwise Granger Causality test was employed to check the direction of causality in the series. Causality is defined as, Xt is a Granger cause of Yt if Yt can be predicted with greater accuracy by using past values of Xt (Granger, 1969).

$$W_t = U_1 + \omega_1 (B) V_{t-i} + \varphi_1(B)W_{t-1} + \varepsilon_{1t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.4.17$$

$$V_t = U_2 + \omega_2 (B) V_{t-i} + \varphi_2(B)W_{t-1} + \varepsilon_{2t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.4.18$$

Equation 4.17 and 4.18indicated that $\omega_1 (B)$ is not zero statistically when V_t granger causes W_t. Similarly, $\varphi_2(B)$ is not zero if not zero if W_t granger causesV_t . There is no causality if those two scenarios does not exist between two variables. On the other hand, if those scenarios exists, it means there is feedback causality or bidirectional or bilateral exist. Furthermore, in terms of rejecting and no rejecting the null hypothesis, reject the null hypothesis when there is low probability and high F-statistic. Similarly, do not reject the null hypothesis when there is high probability and F- statistic (Granger, 1969).

4.4.5 Diagnostic

The research adopted some of the diagnostic tests to enhance that the results yield true estimations of the model. The research started by employing the Jarque- Bera test to determine if the model residuals is normally distributed (Gujarati & Porter, 2009).

The Breusch- Pegan and Ljung- Box Q are also employed to determine if there is an autocorrelation or not in the model. The Breusch- Pegan employed 2 lags to determine if there is autocorrelation or not. The order 6 is computed in the Ljung- Box Q test (Asteriou & Hall, 2007).

In addition, the White test with no cross terms, White test without cross term and ARCH test to determine if heteroskedasticity exist in the model are employed. A series of random variables is heteroskedastic if the random variables have random variances (Asteriou & Hall, 2007). The White test without cross terms means

reciprocal while white test with cross terms means that in the model variables tend to influence each other (Asteriou & Hall, 2007).

4.4.6 Stability testing

The Ramsey Rest test to determine whether the equation is correctly specified or not specified correctly. However, if the model is not specified, the following will be the effect, the misspecification bias and functional form will be wrong which result in high R^2. Furthermore, this may be misleading results (Asteriou & Hall, 2007).

4.4.7 Generalised Impulse Response Function

According to Brooks (2002) the dependent changes in a VAR shock from each of the variables is responsible from wishful analysis traces. The overtime VAR system are separately in a unit shock applied on the error term for changes in equation effects.

The orthogonalisation of shocks is not required by the method adopted and changes in VAR is different to ordering. Amongst the different shock the approach fully takes historical pattern into account (Lutkepohl, 1993).

4.4.8 Variance Decomposition

Variable decomposition was applied to determine the shocks to a variable which will have an effect on the variable direction, but will also be passed to other variables through the dynamic structure of the VAR (Brooks, 2002).The variance of decomposition analysis is important in ordering of variables Lutkepohl (1993) by Sims (1981). In addition, with different analysis and ordering the problem of variable may be solved with results that are sensitive when changing ordering. Ordering sometimes may be less significance when residuals are not contemporaneously correlated.

4.5 Summary

This chapter focused on the methodology of the study which includes the data collection, data analysis method as well as techniques that will be used in the next chapter. Johansen and Juselius approach was employed in the study. Econometric

techniques such as stationarity testing, VECM, Cointegration analysis, granger causality and diagnostic tests were used in this chapter.

For stationarity, Augmented Dickey-Fuller and Phillip-Perron tests were employed. The diagnostic test such Jarque Bera, Breusch- Pegan, Ljung- Box Q, Ramsey stability test, ARCH and white with cross terms and not with cross terms were adopted for the following reason, to check the autocorrelation langrage multiplier, residual normality test and heteroscedasticity. For the shocks and responsiveness of variable to toward each other, the variance of composition and impulse response were employed.

CHAPTER 5

DISCUSSION / PRESENTATION / INTERPRETATION OF FINDINGS

5.1 Introduction

This chapter discusses the research findings from the various econometric tests performed in this study.

5.2 Empirical tests results

This section presents the results all the empirical analysis undertaken.

5.2.1 Stationarity/Unit root tests results

The results of the unit root tests are presented in figures 5.1 and 5.2 followed by those of formal tests results in table 5.1.Figure 5.1 shows investment; log GDP, corporate tax; availability of credit; inflation rate and interest rates respectively in level forms. They all appear to be nonstationary because they are trending.

Figure 5.1 Variables at level

INV RATIO

TAX

LGDP

LCREDIT

IR
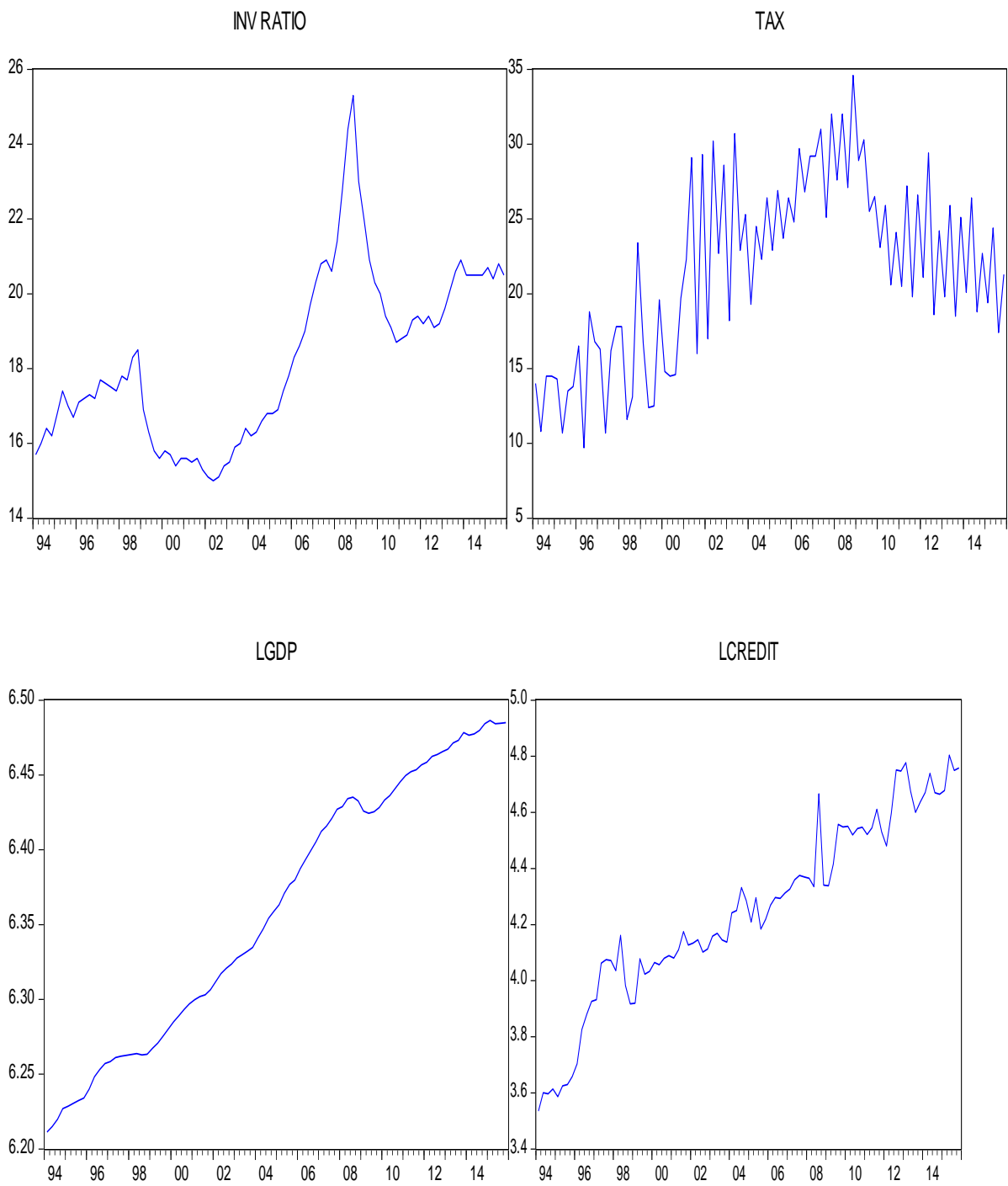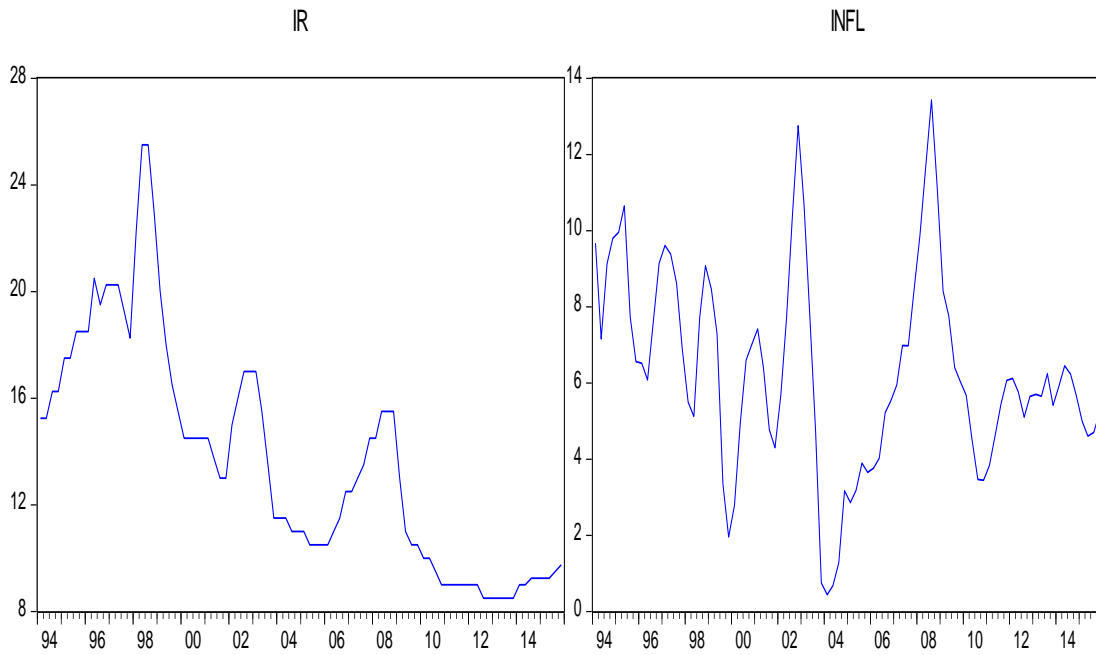
INFL

Figure 5.2 presents investment, log GDP, corporate tax, availability of credit, inflation rate and interest rate at first difference respectively. They all appear to be stationary because they are oscillating around mean on the X-axis,

Figure 5.2 Variables at first difference

Differenced INV RATIO
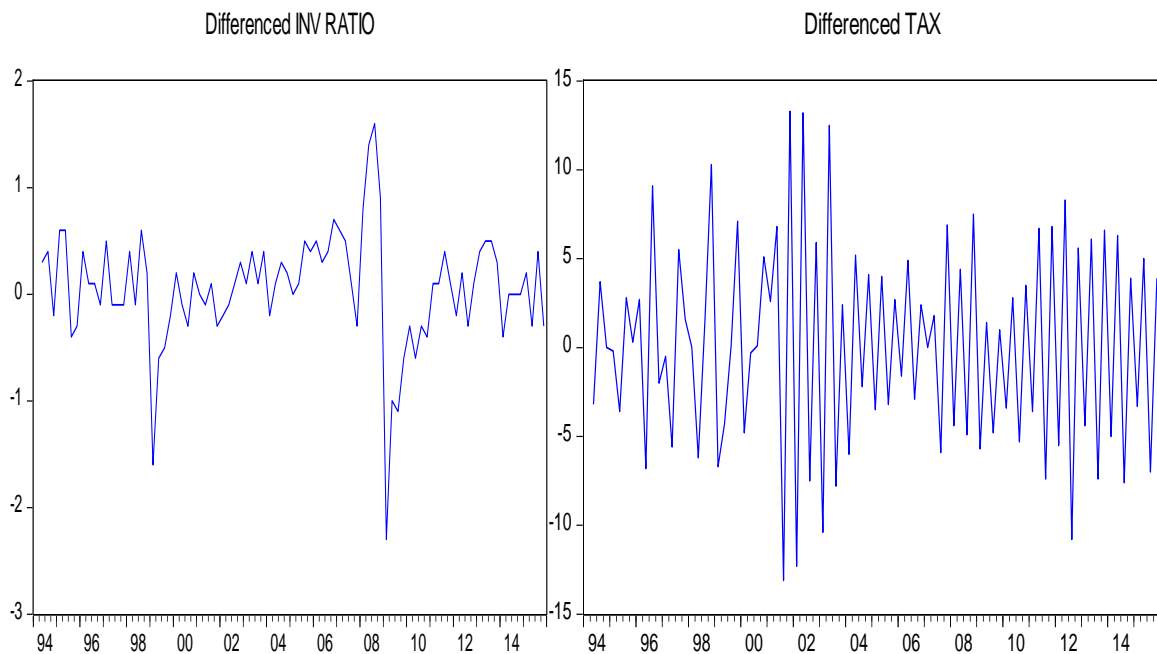
Differenced TAX
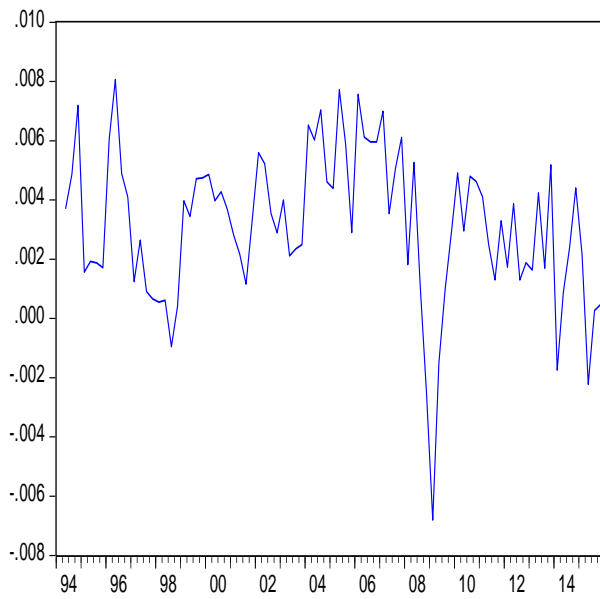
Differenced LGDP

Differenced LCREDIT
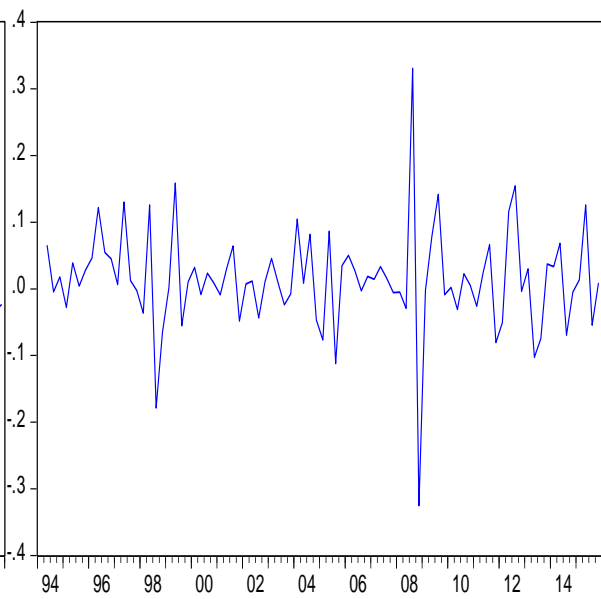
Differenced IR
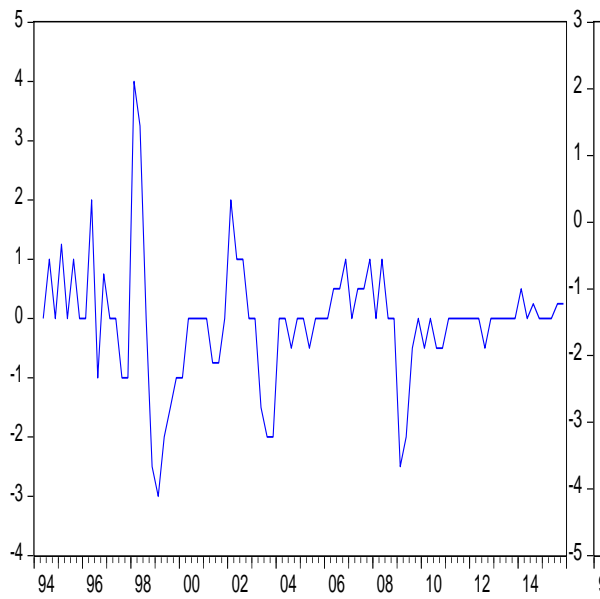
Differenced INFL
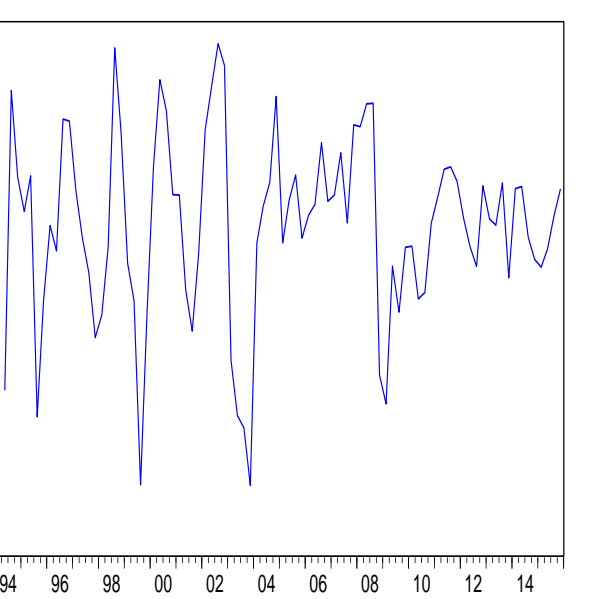
The table 5.1 presents Phillips-Perron (PP) and ADF tests results.

Table 5.1: PP and ADF Test Results

Augmented Dickey-Fuller				Phillips-Perron			
Order of integration	variable	intercept	Trend and intercept	None	intercept	Trend and intercept	None
Level	INV	-1.712255	-2.331707	0.314028	-1.477192	-1.951196	0.553056
1st diff	DINV	-5.9381***	-5.9026***	-5.941***	5.9158***	-5.8802***	-5.9198***
Level	LGDP	-1.199669	-1.218642	3.583***	-1.2600	-0.9187	7.088***
1st diff	DLGDP	- 4.752***	-4.868***	-2.892***	-4.705***	-4.831***	-2.602***
Level	TAX	-1.564798	-0.430102	0.332692	-4.724***	-6.790***	-0.543586
1st diff	DTAX	-12.278***	-12.600***	-12.299***	-37.305***	-58.864***	-35.170***
Level	IF	-3.1695**	-3.24670*	-1.184793	-2.704211*	-2.706822	-1.466369
1st diff	DIF	-4.045***	-4.0112***	-4.057***	-5.823***	-5.836***	-5.859***
Level	IR	-1.608351	-3.905**	-0.945412	-1.369099	-2.917564	-0.815045
1st diff	DIR	-5.514***	-5.473***	-5.516***	-5.066***	-5.031***	-5.109***
Level	Credit	-1.50211	-4.892410	2.930474	-0.815774	-4.452***	1.612770
1st diff	Credit	-8.137***	-8.168***	-11.74***	-19.37***	-26.70***	-11.98***

Source: Eviews

The table 5.1 presents the unit root test results. All variables in the level form are non-stationary in the model. Furthermore, all variables at first difference become stationary.

5.2.2 Cointegration tests results

The starting point of a Johansen approach was to determine the lag length and the results are presented in table 5.2.

Table 5.2. Lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-516.9027	NA	0.019165	13.07257	13.25122	13.14419
1	-19.41951	907.9068	1.88e-07	1.535488	2.786052	2.036875
2	77.11130	161.6891	4.19e-08	0.022218	2.344694*	0.953365*
3	109.1545	48.86582	4.81e-08	0.121139	3.515526	1.482046
4	155.3104	63.46436	4.02e-08*	-0.132759	4.333541	1.657909
5	184.4345	35.67702	5.41e-08	0.039139	5.577351	2.259566
6	224.0933	42.63325	6.03e-08	-0.052332	6.557792	2.597855
7	256.8020	30.25557	8.85e-08	0.029950	7.711986	3.109898
8	322.6440	51.02757*	6.57e-08	-0.716101*	8.037847	2.793607

Source: Eviews

As indicated by the asterisks, a Lag 2 criterion has been selected on table 5.2. Therefore, a choice to employ 2 lag can be used since the information criteria tactic produced well-disposed results and the Johannes co-integration test will be piloted using this lag for the VAR (Gujarati & Porter, 2009).

Following the selection of the lag length, the Johansen cointegration approach was employed based on the trace test and eigenvalue test statistics to determine the number of cointegrating equation(s) the series, (Gujarati, 2004). The results of both the trace test and maximum eigenvalue test statistics are presented in tables 5.3 and 5.4 respectively.

Table 5.3 Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.365679	107.0361	95.75366	0.0067
At most 1	0.313646	68.34413	69.81889	0.0652
At most 2	0.210174	36.35335	47.85613	0.3788
At most 3	0.090371	16.29826	29.79707	0.6911
At most 4	0.054697	8.247216	15.49471	0.4393
At most 5	0.039956	3.465974	3.841466	0.0626

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Source: Eviews

Trace analysis

The trace test results in table 5.3 indicates that there is at least one (1) cointegration equation at the 0.05 level. This means that the null hypothesis of no co-integration vectors at none rejected because the *t*-statistic of 107.0361 is greater than the 5% critical value of 95.75366.

Table 5.4 Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.365679	38.69198	40.07757	0.0710
At most 1	0.313646	31.99078	33.87687	0.0825
At most 2	0.210174	20.05509	27.58434	0.3374
At most 3	0.090371	8.051045	21.13162	0.9005
At most 4	0.054697	4.781242	14.26460	0.7692
At most 5	0.039956	3.465974	3.841466	0.0626

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Eviews

In table 5.4 the maximum eigenvalue test results indicate that there is no cointegration equation at the 0.05 level hence the null hypothesis of no co-integration vectors at none is not rejected. The reason is that the maximum eigenvalue of 38.69198 is less than the 5 % critical value of 40.07757. The same applies At most one (1) the maximum eigenvalue of 31.99078 is less than the 5 % critical value 33.87687.

5.2.3 Vector error correction model results

The discovery of at least one co-integration equation in the previous section implies that a Vector error correction model (VECM) can be used. This will help differentiate between the long and short term effects of variables.

Table 5.5 Normalized cointegration coefficients (standard error in parentheses)

INV RATIO	TAX	LGDP	IR	CREDIT	INF
1.000000	0.402475	-23.65516	-0.085253	-11.69906	-2.811851
	(0.19557)	(44.4843)	(0.41325)	(9.98354)	(0.48918)

Source: Eviews

Table 5.5 shows the influence on explanatory variables on investment in the long run and it is captured equations 5.1 to 5.3 as follows:

$$INV\ RATIO\ +\ TAX\ +\ LGDP\ +\ IR\ +\ CREDIT + INF\ =\ 0\ ………………….5.1$$

Thus: $INV\ RATIO\ +\ 0.402475\ TAX\ -\ 23.65516\ LGDP\ -0.085253\ IR\ -$
$11.69906\ CREDIT\ -\ 2.811851\ INF\ ……………………………………5.2$

$$INV\ RATIO\ =\ -0.402475\ tax\ +\ 23.65516\ LGDP\ +\ 0.085253\ IR\ +11.69906$$

$$CREDIT\ +\ 2.811851\ INF\ ………………………………………….5.3$$

In equation 5.3 the normalised co-integrating coefficients show that there is a negative relationship between investment and taxation in South Africa. This is indicated by 0.402475 from tax. This means that when the government increase the corporate tax the investment in South Africa tend to decline. The implication is that 1% rise in the level of taxation it will lead to 0.402475% decline in the investment. This revealed that the level of taxation and investment are negatively related. This is in line with Hassett & Hubbard (1996), McBride 2012 and Arnold, Brys, Heady, Johansson, Schwellnus & Vartia (2011) who also found that when government increases the level of corporate tax, the investment tend to suffer. The corporate

income taxes increases the cost of capital and at the same time discourage the level of investment (McBride, 2012 and Arnold, Brys, Heady, Johansson, Schwellnus & Vartia, 2011).

The relationship between interest rate and investment in equation 5.3 is in line with Malawi by Veemon, et al. (1996) who found also found a positive relationship between them. Even though the flexible accelerator theory of investment indicated that when the cost of capital is high, private investors would not go for borrowing which will discourage investment.

That indicate that investment and interest rate are negatively related. The Equation 5.3 shows that in South Africa when interest rate increases, the level of investment tend to increase. This implies that 1 % increase in interest rate will lead to 0.085253 increase in investment.

The Equation 5.3 also shows that there is a positive relationship between investment and availability of credit, inflation rate and economic growth in South Africa. This is indicated by 11.69906 of availability of credit, 2.811851 of inflation rate and 23.65516 of economic growth. This means that any increase in the above mentioned variables, it will lead to an increases the level of investment in South Africa.

The results of this study are generally in line with most of the previous studies such as Gkionis et al., (2015), Ugwuegbe & Uruakpa (2013), (Ainabor, Shuaib & Kadiri (2014) and Majeed & Khan (2008)). The result indicate that 1% increase in credit availability leads to 11. 69906. This indicates that availability of makes easy for the firm to borrow since most of the firms depend on the external funds.

Table 5.6 Short Run Terms and speed of adjustment

Error Correction:	D(INV_RATIO)	D(TAX)	D(LGDP)	D(IR)	D(LCREDIT)	D(INFL)
CointEq1	-0.015365	-0.030462	0.000152	0.019051	-0.000987	0.100418

	(0.01091)	(0.09007)	(4.8E-05)	(0.02398)	(0.00190)	(0.02404)
	[-1.40883]	[-0.33820]	[3.16181]	[0.79431]	[-0.51858]	[4.1775]

Source: Eviews

The results from the error correction model are presented in Table 4.6.The speed of adjustment indicated by the coefficients of the error correction terms in this case is -0.015365. It indicates that there is deviation from equilibrium of only 1. 5365% and is corrected in one quarter as the variable moves towards restoring the equilibrium level (Gujarati & Porter, 2009). This indicate that the speed of adjustment is approximately 1. 5%.

The negative sign shows that even if there can be a shock in the economy, equilibrium level will be restored. This indicated that investment has no strong pressure from restoring in the long run whenever there is a shock or disturbance in the economy. The low speed of adjustment by investment might reflect the existence of some factors affecting investment in South Africa.

5.2.4 Granger Causality Test

The Granger Causality test was employed to check the direction of causality in the series (Granger, 1969). The table 5.8 below show the results of Granger causality test.

Table 5.7 Granger causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.
TAX does not Granger Cause INV_RATIO	86	1.78019	0.1751
INV_RATIO does not Granger Cause TAX		2.24659	0.1123
LGDP does not Granger Cause INV_RATIO	86	4.29838	0.0168
INV_RATIO does not Granger Cause LGDP		4.74556	0.0112
IR does not Granger Cause INV_RATIO	86	4.42564	0.0150
INV_RATIO does not Granger Cause IR		1.33427	0.2691

LCREDIT does not Granger Cause INV_RATIO	86	6.19986	0.0031
INV_RATIO does not Granger Cause LCREDIT		1.74768	0.1807
INFL does not Granger Cause INV_RATIO	86	2.16154	0.1217
INV_RATIO does not Granger Cause INFL		0.05675	0.9449

Source: Eviews

The table 5.7 presents the Granger Causality test result. The first and second direction of causality runs between taxation to investment result, shows that the level of significance (5%) is less than the P- value. Thus, the study does not reject Ho. This implies that tax does not predicts the level of investment in South Africa.

As far as interest rate is concerned, the causality runs from interest rate to investment. The result shows that the level of significance (5%) is greater than the P-value. Thus, reject Ho. This implies that interest rate does predict the level of investment in South Africa. The second direction of causality runs from investment to interest rate. The result shows that probability value (P-value) is greater than the level of significant (5%). Therefore, we don't reject H_o. This implies that investment does not predict interest rate in South Africa.

The direction of availability of credit and investment is unidirectional. The results indicate that availability of credit does predict investment in South Africa. This is because the probability value of direction from availability of credit to investment is less than the level of significant (5%). Therefore, reject Ho. Furthermore from table 5.8, inflation and investment does not predict each other in South Africa since the result indicate that probability value (P- value) in both directions are greater than the level of significant (5%).

5.2.5 Diagnostic tests results

The study performed diagnostic test to ensure that the results of the error correction model yields true estimates as presented in table 5.9.

Table 5.8 Diagnostic test results

TEST	H0	T-	P-	COCLUSION

STATISTIC			VALUE	
Jarque-Bera	Residuals are normally distributed	1.381621	0.501170	Do not reject Ho since PV > L.O.S. Hence, residuals are normally distributed
Ljung-Box Q	No Serial correlation (Order 6)	0.8859	0.990	No serial correlation in the model since PV > L.O.S. So Do not reject Ho.
Breusch-Godfrey	No Serial correlation	0.026949	0.9866	No serial correlation in the model since PV > L.O.S. So Do not reject Ho.
Arch	No ARCH Heteroskedasticity	0.101384	0.7502	No heteroskedasticity in the model since PV > L.O.S. So Do not reject Ho.
White (NCT)	No Heteroskedasticity	0.200814	0.6541	No heteroskedasticity in the model since PV > L.O.S. So Do not reject Ho.
White (CT)	No Heteroskedasticity	0.229482	0.8916	No heteroskedasticity in the model since PV > L.O.S. So Do not reject Ho.

Source: Eviews

Table 5.8 present the diagnostic test results. The results were tested based on 1%, 5% and 10% level of significance. The Jarque-Bera test P- value of 0.060254 is greater than two level of significance (1% and 5%) but less than one level of significance (10%). This indicate that model is normally distributed.

The Ljung-Box Q test indicate that the all levels of significance (1%, 5% and 10 %) are less than the P- value. This is evidenced by the order (6) and the P- value is 0.1338. This implies that there is no serial correlation the model. This test again indicates that there is free serial correlation in the model at all levels of significance when compared to the P- value of 13%.

The White test (CT) with "cross terms", and that with "no cross terms" (NCT) also indicate that there model does not contain the heteroskedasticity. This is evidenced by comparing the P- value and the levels of significance at 1%, 5% and 10%. The P-

values of 0.1562 and 0.1374 respectively are greater the 1%, 5% and 10% levels of significance when compared.

5.2.6 Stability tests results

Table 5.9 Stability test results

Test	H0	t-statistic	P value	CONCLUSION
Ramsey RESET	Equation is correctly specified	0.920724	0.3373	The equation is correctly specified since PV > L.O.S. So Do not reject Ho.

Source: Eviews

The stability test results indicate that the P- value of 0.5899 is greater than all level of significance. This implies that the equation of Ramsey RESET is correctly specified and this means that the model is worthy to be analysed.

5.2.7 Generalised Impulse Response Function results

The study employed impulse response to trace out the response of the future and current values. Each variable was traced out by checking what will happen to one unit increase in the current value of one of the VAR error. The below figure shows the impulse response.

Figure 5.3: Impulse response functions

Response of INV_RATIO to Cholesky
One S.D. Innovations
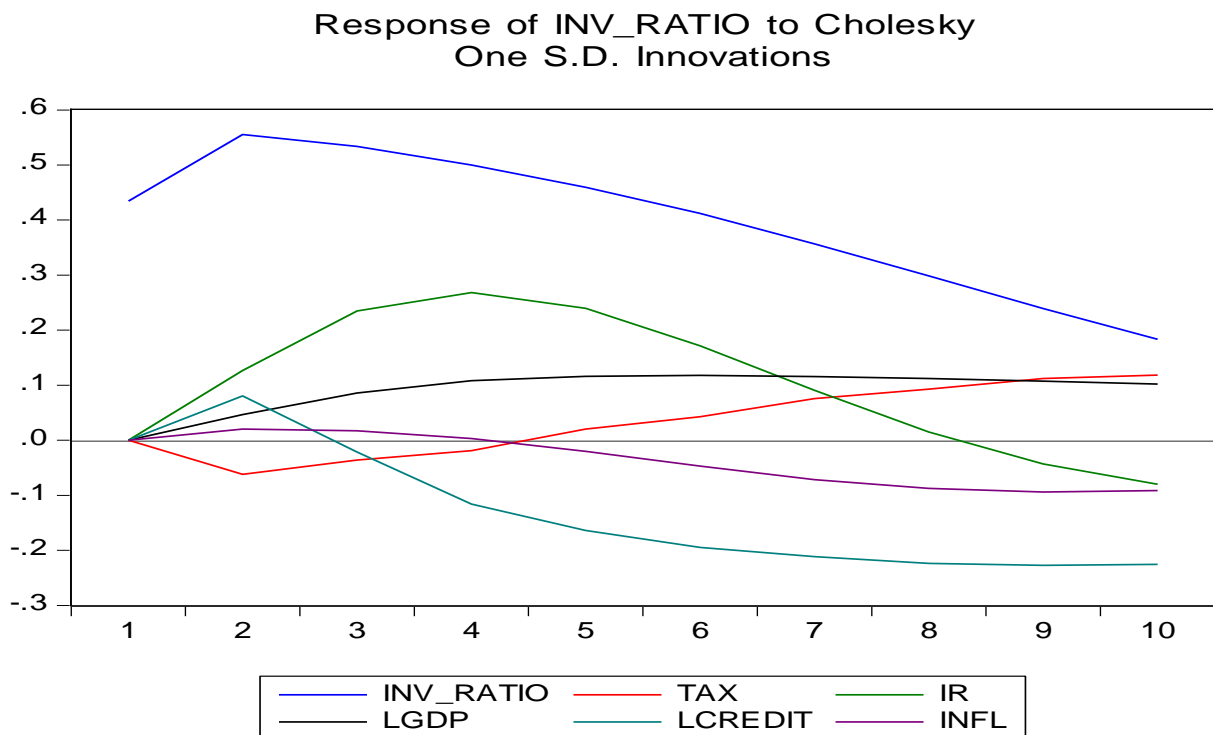
Source: Eviews

Figure 5.3 shows that investment by itself produce large positive impact and it has a positive impact of nearly 6% from first year to the second year and from third year to the tenth year the shock dies. Innovation on tax indicates up and down from the first year until the tenth year. In the second year the shock dies and it was negative that year. Innovation on GDP indicates a greater positive impact because of a rise from the first to the sixth year and from the seven year to tenth the shock die.

Innovation on availability of credit from first year to second is rising with a positive impact until the second year. From the third year the shock dies and becomes negative up until the tenth year. Innovation on interest rate starts by increasing from first to third a year and then become constant up to fifth year. From sixth to the tenth year the shock dies and eventually becomes negative during the ninth year. Innovation on inflation is negative from fourth year up until tenth year even if from first year to second year there was a positive impact of nearly 1%.

5.2.8 Variance Decomposition results

Variance decompositions was employed to check shocks to a variable that will affect that variable directly, but will also be transmitted to the other variables through the dynamic structure of the VAR. The below table 5.10 show the results of variance decomposition analysis.

Table 5.10: Variance Decomposition

Period	S.E.	INV_RATIO	TAX	LGDP	LCREDIT	IR	INFL
1	0.425143	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.734582	95.55325	0.019079	1.244188	1.732282	1.176980	0.274218
3	1.008691	85.24627	0.120100	8.142790	0.927091	5.372659	0.191094
4	1.243187	77.72393	0.083544	14.36753	0.696969	7.000677	0.127349
5	1.431316	72.07005	0.104206	19.25554	0.743577	7.691671	0.134956
6	1.585263	68.28691	0.097986	22.75918	1.080080	7.423567	0.352282
7	1.716868	65.84524	0.114474	25.04731	1.377251	6.743555	0.872172
8	1.838946	64.11262	0.108598	26.56333	1.656600	5.954441	1.604412
9	1.956540	62.77257	0.106472	27.65835	1.853040	5.261214	2.348350
10	2.070723	61.68343	0.095811	28.56736	2.017744	4.714122	2.921539

Source: Eviews

In the table 5.10, the variance decomposition covers the period of 10 years. According to Brooks (2002) all of the variance in the first year in investment is explained by its shocks. The above results indicate that investment explains about 72% of its variance for the 5th year ahead forecast error variance. The remaining 28 % account explanatory variables of the error variance. In the 28% of explanatory, 0.10% is the taxation 19% is the logged gross domestic product, 0.74% is the availability of credit, 7.69% is the interest rate and 0.15% is the inflation rate.

In the 10th year the table shows a declined by 10% in investment. Furthermore table 4.7 shows that in the 10th year investment explains 61.86% of its own variation. The remaining 38.14% explains the explanatory variables. These indicated that there is

an increase of 10.14% that explains the explanatory variables. In the 38.14% of explanatory, 0.096 % is the taxation, 28.57% is the logged gross domestic product, 2.02% is the availability of credit, 4.71% is the interest rate and 2.92% is the inflation rate. The taxation decreased by 0.01%, the logged gross domestic product decreased by 9.57%, availability of credit increased by 1.28, the interest rate decreased by 4.77% and the inflation rate increased by 2.77% in the 38.14% of explanatory variables. The economic theory and variance decomposition results are well matched. Innovation to the explanatory variables continuous to clarify or explain the important proportion of the variance in investment.

5.3 Summary

The main aim of this chapter was to present the results of the tests performed to examine the investment activity in South Africa. The unit root tests results indicated that variables are stationery at first difference while cointegration analysis indicates the presence of cointegration relationship between investment and its determinants. The VECM indicated that there is positive relationship between economic growths, interest rate, inflation and investment while taxation and investment are negatively related in South Africa both in the long and short run. This indicate that the policy maker need to make sure that they implement policies that will lead to an increase in the level of investment of the country. For example decreasing the rate of taxation and ensuring an increase in the level of economic growth. Variance decomposition results are well matched. Innovation to the explanatory variables continuous to clarify or explain the important proportion of the variance in the investment. Moreover, the Granger Causality indicated that GDP, interest rate and the availability of credit do predict the level of investment in South Africa.

CHAPTER 6

SUMMARY, RECOMMENDATIONS, CONCLUSION

6.1   Introduction

This chapter presents the conclusion and policy recommendation of the study. The first section summaries each chapter of this dissertation. The second one comes with recommendation as well as policy implication to the findings and the last part is the study limitation and ethical consideration.

6.2   Summary and Interpretation of Findings

The study was aiming at exploring the investment activity in South Africa. Chapter two of the dissertation is based on the trend of South African investment as well as the other determinants of investment

The availability of credit has been increasing since 2010. This has been found to be in line with empirical studies by Gkionis, et al. (2015); Ugwuegbe and Uruakpa (2013); Ainabor, Shuaib and Kadiri (2014), Majeed and Khan, (2008) indicated the positive relationship between the level of investment and changes in credit to firms which is availability of capital.

The inflation rate, interest rate and taxation has been fluctuating from 1994 to 2015. In 2008-2009 there was global financial crises which affected many countries and South Africa was one of those countries.

In chapter three theoretical literature and empirical literature were discussed. The theoretical literature discussed the accelerator theory of investment, the rigid accelerator theory of investment, the flexible accelerator theory of investment, Junanker approach of flexible accelerator theory, Jorgenson neoclassical theory of investment and Tobins Q theory of investment. The study followed the accelerator theory of investment which indicate that investment is the function of cost of capital, output growth, taxation and profitability.

From empirical literature, a number of variables have been empirically found, namely total investment to GDP ratio, per capita output growth (net per capita stock GDP), real long term interest rate (cost of capital), private credit growth and taxation (corporate tax).

Several studies have shown that taxation has a negative relationship on investment while per capita output growth (net per capita stock GDP) and private credit growth are positively related.

Chapter four focused on the methodology of the study which included the data collection, data analysis method as well as techniques that was used in the next chapter. Johansen and Juselius cointegration approach was adopted as methodology to determine the determinants of investment in South Africa.

Econometric techniques and test such stationarity testing, VECM, Cointegration analysis, Granger Causality and Diagnostic tests were used in this chapter. For stationarity, Augmented Dickey fuller and Phillip Perron were employed. The diagnostic tests were used to check the autocorrelation Langrage multiplier, residual normality test and heteroscedasticity. For the shocks and responsiveness of variable to toward each other, the variance of composition and impulse response were employed.

The results indicated that variable are stationery in the first level. Therefore, a choice to employ lag length of 2 was used since the information criteria tactic produced well-disposed results. The results indicated that there is a cointegration relationship between investment and its determinants. The VEC model indicated that there is positive relationship between economic growths, interest rate, inflation and investment while taxation and investment are negatively related in South Africa both in the long and short run.

The speed of adjustment indicated that investment has no strong pressure from restoring in the long run whenever there is a shock or disturbance in the economy. The low speed of adjustment by investment reflect the existence of some factors affecting investment in South Africa.

The economic theory and variance decomposition results are well matched. Innovation to the explanatory variables continuous to clarify or explain the important

proportion of the variance in investment. Moreover, the Granger Causality indicated that GDP, interest rate and the availability of credit do predict the level of investment in South Africa.

6.3   Conclusions

The results indicate that the policy makers need to make sure that they implement policies that will lead to an increase in the level of investment of the country. For example decreasing the rate of taxation and ensuring an increase in the level of economic growth.

6.4   Recommendation of the study

The government should also find methods of increasing its revenue base. The normalised co-integrating coefficients show that there is a negative relationship between investment and taxation in South Africa. This is indicated by 0.402475 from tax. This means that when the government increase the corporate tax, the investment in South Africa tend to decline. The implication is that 1% rise in the level of taxation it will lead to 0.402475% decline in the investment.   Moreover, government can increase its revenue by creating a tax policy that will encourage investors to invest and system that is able to capture the informal sector because various un-registered businesses go unrecorded when estimating the tax to be collected in a fiscal year. This may be another way of increasing the level economic growth (GDP) since it will generate more funds for government to spend. Furthermore, government should also make efforts to reduce unnecessary spending.

The South African financial markets are integrated with the global capital markets, high domestic borrowing will attract international capital inflows which will eventually eliminate the excess demand for loanable funds and thus, reducing the interest rate until equilibrium is restored. If such action was to be taken, crowding out is likely not to occur. However, a means of regulation might be required because large capital inflows will lead to the appreciation of the Rand and thus, crowd out South African net exports.

6.5   Limitations of the study

The dissertation was focusing on the investment activity in South Africa. The study period is 1994 to 2015 meaning that any occurrence or correlation after or before this period will not be analysed. Furthermore, some of the variables that theories suggested were not included due to the availability of data.

6.6   Area of future research

Further research, in this study, much attention was given to those five determinants of investment but however, the impact of public investment on the private investment was not taken into consideration. Therefore, studies need to be carried out with the notion of understanding the relationship between public and private investment. As this may be important in the future to know where government needs to spend their fund to encourage the level of private investment.

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APPENDICES

Appendix A: Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 08/14/16   Time: 16:08
Sample (adjusted): 1994Q4 2015Q4
Included observations: 85 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
INV_RATIO(-1)	1.000000
TAX(-1)	0.402475
	(0.19557)
	[2.05801]
LGDP(-1)	-23.65516
	(44.4843)
	[-0.53176]
IR(-1)	-0.085253
	(0.41325)
	[-0.20630]
LCREDIT(-1)	-11.69906
	(9.98354)
	[-1.17183]
INFL(-1)	-2.811851
	(0.48918)
	[-5.74806]
C	192.0408

Error Correction:	D(INV_RATIO)	D(TAX)	D(LGDP)	D(IR)	D(LCREDIT)	D(INFL)
CointEq1	-0.015365	-0.030462	0.000152	0.019051	-0.000987	0.100418
	(0.01091)	(0.09007)	(4.8E-05)	(0.02398)	(0.00190)	(0.02404)
	[-1.40883]	[-0.33820]	[3.16181]	[0.79431]	[-0.51858]	[4.17758]
D(INV_RATIO(-1))	0.295783	0.191437	0.000233	0.247461	-0.004020	-0.550138
	(0.11273)	(0.93101)	(0.00050)	(0.24790)	(0.01967)	(0.24845)
	[2.62390]	[0.20562]	[0.47027]	[0.99821]	[-0.20442]	[-2.21425]
D(INV_RATIO(-2))	-0.137728	-0.031585	-0.001158	-0.302483	-0.013365	-0.038549
	(0.11115)	(0.91799)	(0.00049)	(0.24444)	(0.01939)	(0.24498)
	[-1.23911]	[-0.03441]	[-2.36821]	[-1.23746]	[-0.68920]	[-0.15735]
D(TAX(-1))	0.009629	-0.879380	-0.000127	0.046616	0.001835	-0.011583
	(0.01454)	(0.12012)	(6.4E-05)	(0.03199)	(0.00254)	(0.03206)
	[0.66200]	[-7.32065]	[-1.98384]	[1.45740]	[0.72325]	[-0.36134]
D(TAX(-2))	0.015902	-0.023202	-7.46E-05	0.043406	0.000509	0.010273
	(0.01451)	(0.11980)	(6.4E-05)	(0.03190)	(0.00253)	(0.03197)
	[1.09629]	[-0.19368]	[-1.16945]	[1.36073]	[0.20101]	[0.32132]

D(LGDP(-1))	39.75792	200.4201	0.338677	22.29197	4.012213	24.74463
	(25.6918)	(212.188)	(0.11300)	(56.5003)	(4.48231)	(56.6255)
	[1.54749]	[0.94454]	[2.99717]	[0.39455]	[0.89512]	[0.43699]
D(LGDP(-2))	65.55079	222.4618	0.146188	-25.85783	-1.376910	-26.84230
	(25.0351)	(206.765)	(0.11011)	(55.0561)	(4.36774)	(55.1781)
	[2.61836]	[1.07592]	[1.32765]	[-0.46966]	[-0.31525]	[-0.48647]
D(IR(-1))	0.082511	-0.654084	-0.000269	0.523869	0.013505	0.383106
	(0.05407)	(0.44652)	(0.00024)	(0.11890)	(0.00943)	(0.11916)
	[1.52614]	[-1.46484]	[-1.13225]	[4.40606]	[1.43180]	[3.21503]
D(IR(-2))	0.067626	1.327388	-1.61E-05	-0.108592	-0.024540	0.305601
	(0.05971)	(0.49314)	(0.00026)	(0.13131)	(0.01042)	(0.13160)
	[1.13258]	[2.69169]	[-0.06127]	[-0.82698]	[-2.35571]	[2.32215]
D(LCREDIT(-1))	1.097057	-4.936682	-0.002141	2.377116	-0.370513	-0.064342
	(0.68865)	(5.68759)	(0.00303)	(1.51446)	(0.12015)	(1.51782)
	[1.59304]	[-0.86797]	[-0.70691]	[1.56961]	[-3.08386]	[-0.04239]
D(LCREDIT(-2))	-1.134548	7.673878	-0.006598	-0.437779	-0.263951	0.188920
	(0.69985)	(5.78007)	(0.00308)	(1.53908)	(0.12210)	(1.54250)
	[-1.62113]	[1.32764]	[-2.14358]	[-0.28444]	[-2.16177]	[0.12248]
D(INFL(-1))	-0.000150	-0.047464	0.000320	0.048612	-0.003177	0.536446
	(0.04575)	(0.37787)	(0.00020)	(0.10062)	(0.00798)	(0.10084)
	[-0.00327]	[-0.12561]	[1.59108]	[0.48313]	[-0.39796]	[5.31970]
D(INFL(-2))	-0.080084	-0.215153	1.53E-05	-0.027052	-0.000814	-0.006697
	(0.04872)	(0.40238)	(0.00021)	(0.10714)	(0.00850)	(0.10738)
	[-1.64377]	[-0.53471]	[0.07119]	[-0.25249]	[-0.09576]	[-0.06236]
C	-0.292448	-1.220525	0.001764	-0.068326	0.014122	0.054998
	(0.10072)	(0.83183)	(0.00044)	(0.22149)	(0.01757)	(0.22199)
	[-2.90363]	[-1.46728]	[3.98247]	[-0.30848]	[0.80370]	[0.24775]
R-squared	0.472592	0.705932	0.553157	0.336233	0.247403	0.609545
Adj. R-squared	0.376024	0.652088	0.471341	0.214698	0.109604	0.538053
Sum sq. resids	12.83302	875.3523	0.000248	62.06417	0.390611	62.33962
S.E. equation	0.425143	3.511254	0.001870	0.934956	0.074172	0.937029
F-statistic	4.893892	13.11080	6.760970	2.766557	1.795386	8.526070
Log likelihood	-40.25801	-219.7187	420.9986	-107.2443	108.1548	-107.4325
Akaike AIC	1.276659	5.499264	-9.576437	2.852806	-2.215407	2.857235
Schwarz SC	1.678978	5.901583	-9.174118	3.255125	-1.813088	3.259554
Mean dependent	0.048235	0.080000	0.003120	-0.076471	0.013673	-0.046203
S.D. dependent	0.538210	5.952886	0.002572	1.055050	0.078605	1.378658

Determinant resid covariance (dof adj.)	2.68E-08
Determinant resid covariance	9.09E-09
Log likelihood	63.29209
Akaike information criterion	0.628422
Schwarz criterion	3.214758

Appendix B: RAMSEY TEST

F-statistic	0.806748	Prob. F(1,18)	0.3809
Log likelihood ratio	0.920724	Prob. Chi-Square(1)	0.3373

Appendix E: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.010922	Prob. F(2,17)	0.9891
Obs*R-squared	0.026949	Prob. Chi-Square(2)	0.9866

Appendix C: Heteroskedasticity Test: White

F-statistic	0.099436	Prob. F(2,18)	0.9058
Obs*R-squared	0.229482	Prob. Chi-Square(2)	0.8916
Scaled explained SS	0.093947	Prob. Chi-Square(2)	0.9541

Appendix D: Heteroskedasticity Test: White

F-statistic	0.183443	Prob. F(1,19)	0.6732
Obs*R-squared	0.200814	Prob. Chi-Square(1)	0.6541
Scaled explained SS	0.082211	Prob. Chi-Square(1)	0.7743

Appendix E:Heteroskedasticity Test: ARC

F-statistic	0.091711	Prob. F(1,18)	0.7655
Obs*R-squared	0.101384	Prob. Chi-Square(1)	0.7502

Appendix F: Ljung-Box Q

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.033	0.033	0.0268	0.870
. | . |	. | . |	2	-0.007	-0.008	0.0281	0.986
. |* . |	. |* . |	3	0.074	0.075	0.1749	0.982
. *| . |	. *| . |	4	-0.145	-0.151	0.7726	0.942
. | . |	. | . |	5	-0.019	-0.006	0.7839	0.978
. | . |	. | . |	6	0.056	0.050	0.8859	0.990
.**| . |	.**| . |	7	-0.308	-0.300	4.1575	0.761
. *| . |	. *| . |	8	-0.072	-0.068	4.3515	0.824
.**| . |	***| . |	9	-0.316	-0.370	8.3797	0.496
. *| . |	. | . |	10	-0.082	-0.023	8.6718	0.564
. |**. |	. |* . |	11	0.262	0.200	11.980	0.365
. | . |	. | . |	12	-0.013	-0.040	11.989	0.447