SAVING AND INVESTMENT IN SOUTH AFRICA: 1994-2018

by

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DECLARATION

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ABSTRACT

South Africa has relatively low saving and investment rates compared to other upper middle-income countries. In addition, limited information is available on the magnitude of the correlation between these variables. The aim of the study is to determine the relationship between saving and investment in South Africa from 1994 to 2018. During this period, investment increased from 16.1% to 18.2% as a percentage of gross domestic product (GDP). At the same time, gross saving decreased from 17.7% to 14.4%. These diverging trends are concerning because it contradicts the expectations of economic theory. The study adopts an autoregressive distributed lag (ARDL) methodology to empirically test the long-run and short-run relationship between saving and investment. Additional control variables used include the interest rates, gross domestic product, and inflation. The results reveal a cointegrating relationship between all the variables. Furthermore, the results show a weak positive short-run effect that saving has on investment and no long-run effect. Recommendations include that policy measures should be directed towards curtailing inflation and increasing GDP, in order to support long term investment.

Keywords: Autoregressive distributed lag, gross fixed capital formation, gross saving, investment

ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
CUSUM	Cumulative Sum of Recursive Residuals
CUSUMQ	Cumulative Sum of Squares of Recursive Residuals
EU	European Union
GDP	Gross Domestic Product
GNP	Gross National Product
HD	Harrod-Domar Model
I	Investment
IFS	International Financial Statistics
IMF	International Monetary Fund
LFT	Loanable Fund Theory
S	Saving
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
QTM	Quantity Theory of Money
SA	South Africa
Stats SA	Statistics South Africa
SARB	South African Reserve Bank
NDC	National Development Commission
NDP	National Development Plan
NT	National Treasury
PP	Philips-Perron
ECM	Error Correction Model
VECM	Vector Error Correction Model
VAR	Vector Autoregressive

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CHAPTER 1: INTRODUCTION

1.1. Introduction

Saving and investment are important concepts for any economy given their significant contribution in providing, inter alia, capital to increase a country's production capacity (Al-Afeef & Al-Qudah, 2015). In addition, Kim (2001) stresses that the gap between saving and investment demonstrates the financial instability a country may experience. By definition, saving makes funds available whereas investment is the allocation of funds for purchasing various capital goods, such as equipment and machinery. Saving and investment are therefore linked in that saving provides a source of funds for investment (Snowdon & Vane, 2005).

In 2018, SA's gross saving was 14.4% of GDP compared to 17.7% in 1994 (SARB, 2019). Factors that contributed towards this deterioration include the increasing cost of living, deteriorating business and consumer confidence, and increasing government deficit and debt-service costs (National Treasury, 2019; Old Mutual, 2018). At the same time, investment as a ratio of GDP increased from 16.1% in 1994 to 18.2% in 2018 (SARB, 2019). This implies that trends in saving, and investment rates were moving in opposite directions. In addition, it provides evidence that SA is an open economy, and that the country relies on foreign saving to finance a portion of its investment spending. The country is therefore exposed to the risks of financial instability associated with international financial markets (Bosworth et al., 1999).

In 2011, the National Development Plan (NDP) was adopted as a long-term vision and plan for the country. Essentially, the NDP aims to eliminate poverty and reduce inequality by 2030. The NDP also raised concerns about the low level of saving among South Africans, and the challenges of insufficient and under-maintained infrastructure. Insufficient saving within the South African economy was identified as one of the factors that likely contributed to the relatively low investment rate of 18.2% for 2018, which fell short of the NDP's target of 30% by 2030 (National Development Plan, 2011). It was also below the global investment rate of 24.4% in 2018 (World Bank, 2021).

Although SA is characterised as a lucrative emerging market with quality infrastructure and sophisticated financial systems, it recorded low levels of investment (Patel et al., 2014; South Africa Investment Conference, 2018). Not only does SA have low saving and investment rates as compared to the majority of upper middle-income countries, but it also has developmental challenges, such as high poverty and unemployment rates. In 2015, 18.8% of SA's population spent merely $1.90 per day. This rose to 27.6% of the population during the first quarter of 2019 (Statistics South Africa, 2019; World Bank, 2019).

The low level of saving and investment have policy implications, for example, tax incentives that the government designs such as exempting investment returns from taxation. Additionally, the government can take a direct policy approach by deciding to cut expenditure in favour of raising government saving. This in turn strengthens the domestic saving efforts of the country (Prinsloo, 2000). Saving and investment are two critical macroeconomic variables. They have the potential to strengthen, and provide for the appropriate, accurate and reliable design of economic policies (Seka, 2011; Sekantsi & Kalebe, 2015).

The rationale for the study includes the observed relatively low rates of saving and investment in SA, as compared to other upper-middle income countries. The study builds on earlier research for the period 1960-2010, which found a correlation of 0.72 between saving and investment in SA. Thus, implying a relatively strong and positive correlation (World Bank, 2011). However, these findings contrast with the divergent relationship between saving and investment, as highlighted above. Furthermore, limited research has been done on the relationship between saving and investment in developing countries, particularly in South Africa.

According to the National Development Plan (2011), an increase in saving and investment could help SA to achieve some of its macroeconomic objectives by 2030. These include GDP per capita of R110 000, an unemployment rate of 6.0% and an average annual growth rate of 5.4% (National Development Plan, 2011). A high level of saving can help to maintain high levels of investment, which in turn supports economic growth. To achieve this, domestic saving should exceed 20% of GDP to support 3% real economic growth per year (Prinsloo, 2000). Therefore, it is necessary to assess the economic impact of saving and investment. The potential insight gained from such a study could positively influence SA economic policy.

1.2. Background of investment and saving trends in South Africa

As a background to the study, this section provides insight into developments pertaining to investment and saving in South Africa. Specifically, it analyses the components and trends of the variables for the period 1994-2018.

1.2.1. Household, corporate, and general government saving trend

Gross saving in South Africa comprises household, corporate and general government saving (SARB, 2019). During the period 1994 to 2018, corporate saving (measured as a percentage of GDP) has been the dominant, followed by household saving.

Government saving has been lagging the other two types of saving and recorded a negative saving rate in the early years of the period 1994-2018, and only started recording marginal positive results during the middle and the late years of the period (see Figure 1.1). Measured as a size of the economy, corporate saving declined from 17.2% in 1994 to 10.0% in 2007 and that can be attributed to, among others, the East Asian crisis that begins in 1997, major corporate accounting scandals that unfolded between 2002/03, and global financial crisis that manifested in late 2007. Thereafter it rose strongly to reach 16.5% in 2010, after which the trend again started to decrease gradually towards 2018.

Both household and general government saving as a percentage of GDP have been lagging significantly compared to corporate saving. The household saving rate decreased from 3.6% in 1994 to merely 1.2% in 2018. Similarly, General government saving was supported by the strong economic growth recorded during the middle 2000’s, however, post the 2008-09 intensified Global Financial Crisis it has mostly hovered at or close to the zero percent line. In 2018 general government saving recorded a meagre rise of 0.2%.

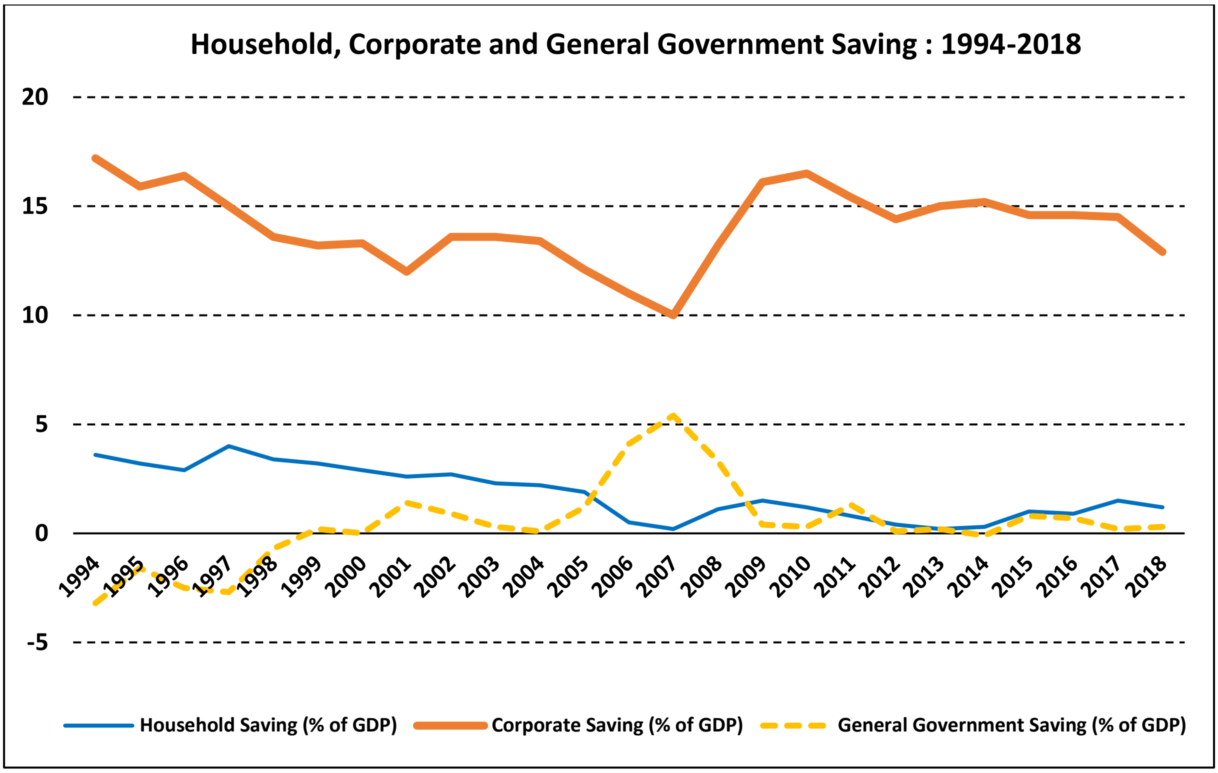

Figure 1.1: Household, corporate and general government saving trend
Source: SARB, Author's compilation

1.2.2. Private Business enterprises, public corporations, and general government investment.

Investment in South Africa is usually measured by using the gross fixed capital formation which includes private business enterprises, public corporations, and general government investment. The private business enterprises component of the GFCF was the main driver of total GFCF during the period of analysis (see Figure 1.2). From 1994 to 2002 Gross fixed capital formation (GFCF) investment by private business enterprises averaged around 11% of GDP. It rose strongly after 2002, to peak in 2008 at 15.9%. Subsequently to 2010, the rate plateaued up to 2018 at around 12.5%.

The remaining contribution to total GFCF is to a large extent shared between public corporations and the general government. Public corporations' investment averaged around 2.0% of GDP during the early 2000's after which it peaked at 4.6% in 2009. The general government investment contribution to the total GFCF-investment has been relatively steady throughout the entire period of 1994-2018, with an average rate of 3%. Overall, private business enterprises, public corporations, and general government investment contributions to the total GFCF are 68.8%, 15.1% and 16.1%, respectively.

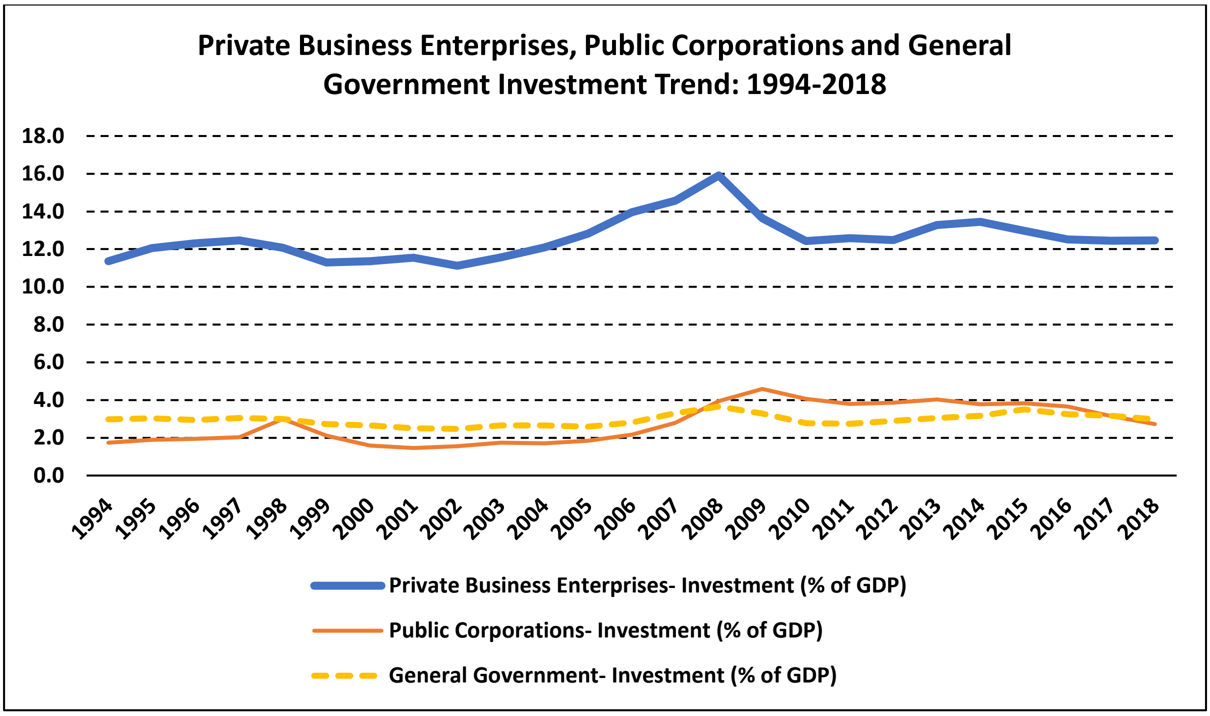

Figure 1.2: Private business enterprises, public corporations, and general government investment trend

Source: SARB, Author's compilation

1.2.3. Gross domestic saving and domestic investment (GFCF)

For the period 1994 to 2018, domestic saving and investment tracked each other relatively well more specifically starting from 1994 up to 2003, with saving outperforming during various years. However, from 2003 onwards, diverging trends are most evident. Domestic investment peaked in 2008 at 23.5% of GDP but declined again to around 18.2% of GDP in 2018. Within the same period, the total domestic saving as a percentage of GDP has been hovering below the total domestic investment trend and only managed to reach a peak of 18% around 2009 and 2010 (see Figure 1.3).

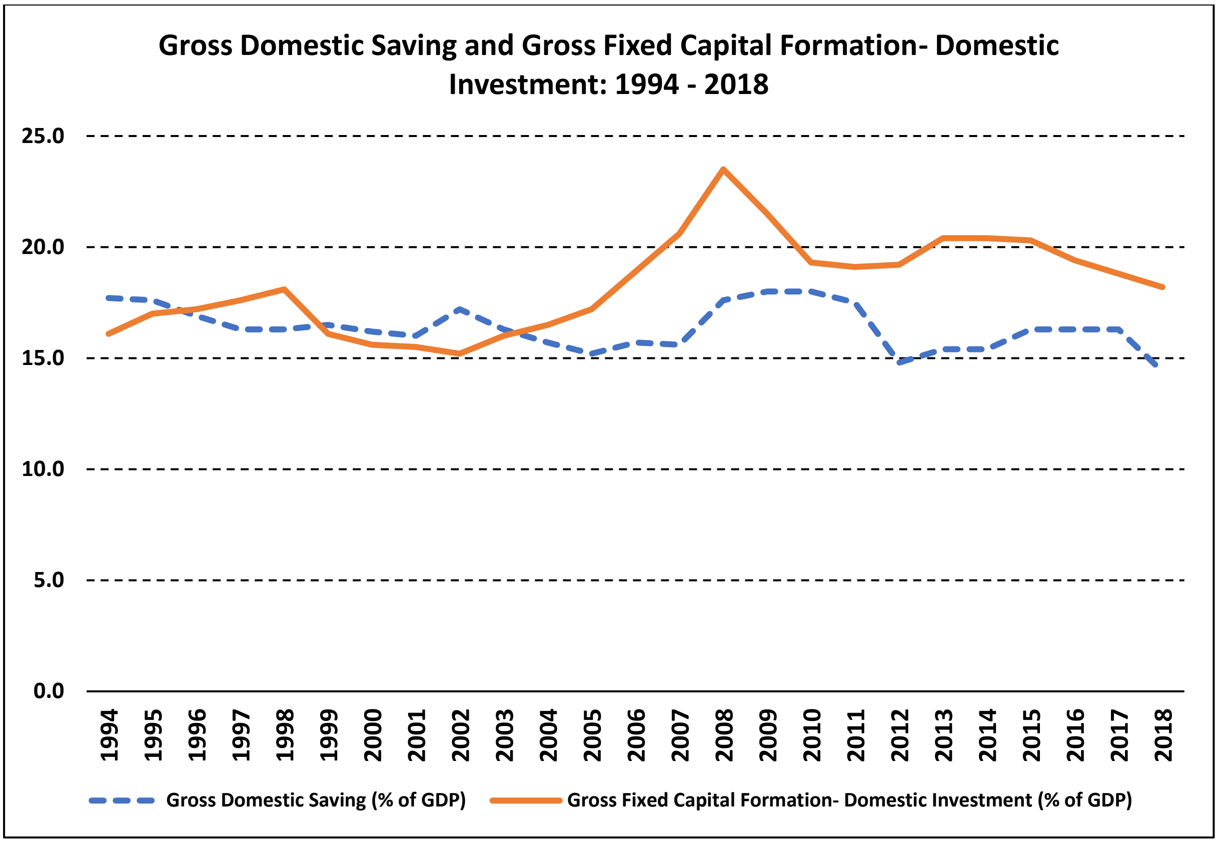

Figure 1.3: Gross domestic saving and gross fixed capital formation (Domestic investment) trend

Source: SARB, Author's compilation

In summary, both saving, and investment are dominated by the contribution of the corporate sector, which accounted for 86.2% and 68.8% of gross saving and investment (gross fixed capital formation), respectively. After 2003, investment and saving trends diverge from one another. This diverging trend is concerning as it contradicts the economic theory.

The difference between domestic and foreign saving could suggest that the remaining proportion of domestic investment needs to be financed by the foreign sector. (Patel et al., 2014).

1.3. Statement of the problem

South Africa's saving and investment rates appear to be diverging, with a recorded decrease in saving from 17.7% to 14.4% of GDP. At the same time, investment increased from 16.1% to 18.2% of GDP during 1994-2018 (SARB, 2019). These figures are low compared to the targets set in the NDP, as well as in comparison to those of South Africa's peers. This is concerning as it occurs despite incentive measures, such as tax incentives, to stimulate both saving and investment.

It is evident that unattended low saving and investment rates will bring about insufficient levels of economic growth and development, as it has been suggested that slow rates of development in third world countries are, amongst other reasons, as a result of low levels of national saving that limit the capacity of these countries to investment in capital formation (Jagadeesh, 2015). Therefore, should SA fail to act swiftly to improve its prevailing low saving and investment rates, economic growth could ultimately be hampered further. This is concerning, given that saving avails scare resources for investment and creates capital formation that in turn support technical progress, innovation, and production. This translates into an increased level of national output, income, employment, and economic growth (Jagadeesh, 2015; Odhiambo, 2009). The ripple effects of increased output, income, employment, and economic growth resulting from increased saving and investment are enormous to also incorporates the potential of solving the fundamental problems of unemployment, poverty, inequality, and freeing the economy from the burden of foreign debts (Jagadeesh, 2015).

Additionally, the mismatch between saving and investment is likely to occur most importantly because the SA is an open economy, which implies that domestic investment needs to be financed by both domestic and foreign saving. In light of this, policy makers should utilise research-based policies to achieve sustained saving and investment environments. This study aims to contribute to a better understanding of the relationship between domestic saving and investment within the South African context.

1.4. Research aim and objectives

The aim of the study is to determine the relationship between saving and investment in SA for the period 1994-2018. The study is guided by the following research objectives:

i. To analyse the trend of saving and investment in SA for the period 1994-2018.
ii. To investigate the long run relationship between saving and investment in SA for the period 1994-2018.
iii. To determine the long run effect of saving on investment in SA for the period 1994-2018.
iv. To determine the short run effect of saving on investment in SA for the period 1994-2018.

1.5. Research questions

The study provides answers to the following research questions:

i. What is the trend of saving and investment in SA for the period 1994-2018?
ii. What is the relationship between saving and investment in South Africa for the period 1994-2018?
iii. What is the long run effect of saving on investment in SA for the period 1994-2018?
iv. What is the short run effect of saving on investment in SA for the period 1994-2018?

1.6. Rationale of the study

Findings from existing empirical studies that have investigated the saving and investment nexus, remain ambiguous and mostly skewed towards developed countries. Research on the topic in African countries, including SA, are lacking (Adebola & Dahalan, 2012). This points to a dire need for research on saving and investment. Previous studies used cross-sectional and panel data approaches. However, grouping different countries with different dynamics might not give a clear picture if one is interested in understanding specific issues in a single country. Additionally, these previous studies predominantly used the bivariate modelling approach and have given less attention to multivariate modelling. The former approach would normally lead to a problem of omitting influential variables of the model (Koop, 2013). Therefore, the current study utilised the multivariate time series approach to supplement saving and investment variables with other variables that are perceived to be influential to the variables of interest. The economic policymakers such as National Treasury (NT), South African Reserve Bank (SARB) and civil society could benefit from this research. Furthermore, the results could assist these institutions in developing knowledge-driven economic policies.

1.7. Definition of terms and limitations of the study

1.7.1. Investment

Academic literature defines ‘investment’ as the purchase of capital goods, namely, residential, and non-residential buildings, machinery, and equipment (Keynes, 1936). Investment stimulates capital which is a factor of production (Mankiw et al., 2018). Furthermore, investment improves the long run production capacity of a country. In this instance, investment comprises the purchase of capital stock by public corporations, government, and business enterprises which are proxied by gross fixed capital formation (SARB, 2019). Capital stock and investment terms are used interchangeably. In general, countries that invest more in capital stock tend to be far ahead in terms of output growth compared to those with less investment in capital stock (Abel & Bernanke, 2001). Based on this, the current study defines investment as the allocation of funds to capital stock. It is also known as capital formation. A further distinction can be made between domestic investment and foreign direct investment (FDI), with the former referring to the carrying out of investment activities in a host country by a resident investor of a host country. In contrast, FDI refers to the process in which the residents of foreign countries acquire ownership of assets for the purpose of controlling the production and distribution activities of a firm in a host country (Moosa, 2002). Moreover, FDI is closely related to foreign saving in the sense that the latter is channelled in the form of capital inflows to the host countries by means of FDI (Ijirshar, 2019). That makes FDI an important source of capital (Fry, 1993). However, FDI falls beyond the scope of this research.

1.7.2. Saving

According to Keynes (1936), saving is the proportion of the current income that is not spent or consumed. In aggregate terms, saving is defined as the residual of current income after consumption spending has been deducted. Saving is a flow variable that considers resources that occur over a period of time, as opposed to savings which are a stock variable looking at resources that exist at a specific point in time. Saving comprises household saving, government saving, and corporate saving and the aggregate of these components gives gross saving according to the South African Reserve Bank database (SARB, 2019). The focus of this study is on aggregate saving in the South African economy, therefore gross saving is used.

1.8. Division of chapters

The layout of chapters is as follows:

Chapter 2 presents the theoretical framework, and theories related to saving and investment.

Chapter 3 provides the literature review including a summary of previous empirical studies.

Chapter 4 describes the research methodology, including the data collection, model specification and econometric techniques used.

Chapter 5 provides the data analyses and empirical results.

Chapter 6 gives the conclusions and policy recommendations.

CHAPTER 2: THEORETICAL FRAMEWORK

2.1. Introduction

Chapter 2 outlines the main theories pertaining to saving and investment. The theories that are discussed include the Austrian school of economic thought, Keynesian school of economic thought, Monetarism theory, Loanable funds theory (LFT), Harrod-Domar (HD) Model, Solow Neoclassical model, and Endogenous growth model. These theories were chosen given their alignment with the aim of this study. In addition, they provide insight into identifying, defining, and interpreting the relationship between saving and investment.

2.2. The Austrian school of economic thought

This Austrian school was founded in the 1870s with the publication of Carl Menger's "Principle of Economics" (Boettke, 2019). The Austrian school is cited as being the advocate for the marginalist revolution, in which the marginalising of phenomena, such as investment, is key in determining the fundamental mechanism of change. Menger in collaboration with other Austrian economists, such as Leon Walrus and William Stanley Jevons, pioneered and ensured the extensive use of the marginalist revolution in analysing economic issues (Garrison, 2004; Hagemann et al., 2010; Samuels et al., 2003; Snowdon & Vane, 2005). According to this theory, investment is a continuous process in which multiple stages of production take place which produces a consumable output (that is the consumption of an output that occurs once at the end of the production process). Furthermore, inputs in the factor market are transformed into outputs in the product or good market. Saving is defined as unconsumed income which is proportional to the total output after the deduction of consumption spending. From the intertemporal choice model, which refers to the choice between current and future consumptions (Loewe, 2006), the unconsumed income occurs as a result of a decreased current consumption (Lewin & Cachanosky, 2019; Snowdon & Vane, 2005).

The Austrian school, analogous to other schools of economic thought, found it necessary to explore the question "*is there a market mechanism that brings saving and investment in line with one another without at the same time having perverse effects on the macroeconomy?*" (Snowdon & Vane, 2005). This question often forms the centre of macroeconomic debate while also differentiating various schools of economic thought. As for Austrian theory, the connection between saving and investment has the potential to give a positive effect on economic growth. This is highlighted in other parts of the Austrian theory as well.

The application of multiple stages of the production process which captures the transformation of inputs into outputs was employed with the intention to disaggregate investment to better understand the fundamental changes thereof (Boettke, 2019). Saving and intertemporal choice are linked in the sense that it is through intertemporal choice that current consumption is sacrificed in favour of raising unconsumed resources. As a result, the unconsumed resources bring saving and investment together when they are reallocated from the relatively late stage of the production process to an early stage of the production process. Theoretically, presupposing that the rational economic agents, by exercising their intertemporal preferences of forgoing current consumption to carry out future consumption that could increase significantly, will give rise to additional resources in the form of increased saving which could lead to an increase in the productive capacity of the economy (Snowdon & Vane, 2005). Moreover, it is noted that such additional resources will increase consumable output in the subsequent future to more than it was initially when the forgoing of the current consumption for future consumption were exercised to free up the resources.

The Austrian theory acknowledges that during the intertemporal choices in which future consumption is favoured, and as a result, consumable output decreases due to a decrease in current consumption, two cases might unfold. Firstly, firms' production capacity might diminutively decrease due to the current decrease in demand for consumable output. Secondly, the business community (firms) will shift most of their resources to an early stage of the production processes (Snowdon & Vane, 2005). Therefore, in this case, the investment spending is insignificantly affected because what mostly transpired is the reallocation of resources from an end to an early stage of the production process (Oppers, 2002). Another perspective to that there is a decreased demand for consumable output which suppresses investment. This is accompanied by a decrease in the cost of borrowing which, in turn, stimulates investment, therefore, suggesting a trade-off between consumption spending and investment spending.

However, saving should not be associated with a permanent reduction in consumption but rather with an increase in demand for future consumption. In other words, a forgone current consumption changes people's saving behaviour which allows the economy to make a possible transition from a no-growth economy to an economy that experiences secular growth (Snowdon & Vane, 2005).

There is a strong relationship between the allocation of resources, also known as capital structuring, and saving behaviour as well as consumable output. This is indicated by the fact that forgone current consumption is expected to give rise to saving together with growing consumable output, which will lead to continuous growth in consumable output, but at a changing rate. That further suggests a link between consumption preferences and production preferences (Lewin & Cachanosky, 2019; Snowdon & Vane, 2005).

Presumably, in an economy that is not growing, the level of investment spending that is financed by saving will be sufficient to offset the level of capital depreciation. Based on the assumption that tastes, and technology are constant, the macroeconomy tends to settle into what is called 'intertemporal equilibrium' and yields consumable goods at a constant rate. The economy is expected to start to grow as saving makes enough resources available to finance both the additional investment spending and capital depreciation. This is because the growth rate could be either positive, negative or zero, depending on the relationship between saving, investment, and capital depreciation (Garrison, 2004). In a stationary or no-growth economy, saving finances depreciated capital investment and makes no room for additional investment. The consumable outputs also tend to be constant over time. In a situation where the economy's saving rates exceeds depreciated capital investment rates, the economy grows, and the rate of consumable output rises over time. Each stage of production starts to yield increased outputs (Lewin & Cachanosky, 2019; Minford & Peel, 2002; Oppers, 2002; Snowdon & Vane, 2005).

2.3. The Keynesian school of economic thought

The advent of the Keynesian theory can be traced back to around the 1930s. The theory had been pushed by the inability of the classical theory to adequately account for the collapse of output and employment which took place before the early 1930s. It is widely accepted to have been pioneered by John Maynard Keynes, who in 1936 published his seminal work under the title of "The general theory of employment, interest and money". Topics covered in this work which are especially important for this study encompasses the macroeconomic concepts of saving and investment, and by extension output and income (Keynes, 1936; Levacic & Rebmann, 1982; Samuels et al., 2003; Screpanti & Zamagni, 2005; Snowdon & Vane, 2005). According to Keynesian theory, saving is a residual, meaning it is what remains after the consumption process has taken place. Thus, it is predominantly dependent upon the income (which is the total value of all finished output sold) of economic agents (i.e., household, firms, and government). Simply put, saving is equal to the excess of income over consumption spending. Increased saving by means of less consumption spending, would lead to lower income for the suppliers of consumer products which consequently will lead to decreased demand for the inputs with which to produce the consumable outputs (Beveridge, 2013). This will adversely affect the future attempt of rising saving.

In contrast to the Austrian theory, the Keynesian approach is to formulate investment on the aggregate level, therefore neglecting the fundamentals of the different stages of the production process addressed by Austrian theory (Snowdon & Vane, 2005). The Keynesian theory defines investment as the value of capital equipment which among others include fixed capital, such as plant, machinery and building infrastructure, and brought about to produce output (Levacic & Rebmann, 1982). Investment is the proportion of the total value of income allocated to capital goods and is subjected to drastic changes or shifts owing not only to changes in the rate of interest but rather to uncertainties, such as economic policy uncertainty inherent in the investment decisions (Drobetz et al., 2018). In as much as an investment is not only influenced by changes in the interest rate which represents the cost of borrowing, it is also a self-financing phenomenon, in a sense that increased investment leads to increased income, which supports saving (Snowdon & Vane, 2005). In the equilibrium state, in which income (output) and aggregate expenditure are equal, investment can be demonstrated by the following identity:

$$Y = C + I \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 2.1$$

Where:

Y represents income which is also equal to output.

C denotes consumption spending.

I denotes investment spending.

The identity assumes two sectors, namely households and firms, with aggregate expenditure consisting of investment and consumption spending, and this identity serves to highlight that investment spending is the proportion of output (income) (Minford & Peel, 2002).

Analogous to the Monetarist theory, the Keynesian theory applies an equation of exchange to demonstrate the role of investment spending on the overall output (income) in the economy. This is done through introducing disaggregated output that contains consumption and investment spending, which was not considered by the Monetarist theory. The disaggregation was to a less extent compared to the disaggregation that took place in Austrian theory. The equation of exchange can be demonstrated as follows:

$$MV = P(Q_c + Q_I) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.2.$$

Where:

Q_C denotes consumption spending.

Q_I denotes investment spending.

Q is the overall output consisting of consumption and investment spending.

The above equation of exchange could be interpreted to state that changes in consumption spending will give effect to profit expectations and simultaneously cause the investment spending to change in the same direction. Alternatively put, changes in investment spending will first influence the level of income, which will, in turn, affect consumption spending and saving (Screpanti & Zamagni, 2005).

According to Keynes (1936:37), the amount of saving and investment are the outcomes of collective decisions of consumers and investing firms, respectively (Keynes, 1936). According to this theory, there is not much difference between saving and investment. This is because the value of the two are essentially equal since each of these are equal to the excess of income over the consumption spending (Abel & Bernanke, 2001).

The only situation in which saving can be in excess of investment would be where the investors' return is not reflective of the costs incurred, therefore incentivising investors to contract output which gives effect to saving (Keynes, 1936). Simply put, investors determine the employment volume of capital equipment (which consequently gives effect to output and income) taking into consideration the user cost of that capital equipment and the returns in a form of maximised profits. Since it cannot be concluded that saving and investment will be equal, the measures and mechanisms that could be put in place to bring about harmony between saving and investment are perverse and tend to have indirect influence rather than a direct influence over the two variables. For instance, measures intended to increase saving and not stimulate investment spending would instead impinge aggregate demand and total income, since the production plans of investors are much dependent upon the demand for consumable output (Screpanti & Zamagni, 2005; Snowdon & Vane, 2005).

2.4. The Monetarist Theory

The monetarism theory is largely associated with Milton Friedman which he popularised in 1963 with his seminal work titled "*A Monetary History of the United States, 1867-1960*" in collaboration with Anna Schwartz (Jahan & Papageorgiou, 2014). The proponents of this theory are called monetarists who are also known as modern quantity theorists. The quantity theory of money (QTM) approach to macroeconomic analysis is the cornerstone of the monetarism theory. The approach was later usurped by the Keynesian school of economic thought (Morgan, 1978). The QTM stressed changes in the money stock as the predominate cause of change in nominal income. This theory highlights the role that money stock plays in influencing nominal income in the economy. Therefore, it has an indirect influence on both saving and investment as these are dependent on the changes in income. The QTM can be mathematically expressed with the equation of exchange as follows:

$$MV = PQ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.3$$

Where:

M denotes money supply.

V denotes the velocity of money.

P denotes the price of goods and services and

Q denotes the quantity of goods and services.

The equation of exchange states that multiplying money supply (M) by the velocity of money (V) which represents the rate at which the money is spent for a given period equals nominal expenditure (P*Q) in the economy (Arnon, 2011; Spindt, 1985). Alternatively, as the supply of money (money stock) increases so does the aggregate demand for goods and services. Increased demand for goods and services stimulates economic growth. This occurs when real GDP (a measure of economic growth) increases as a result of increased aggregate demand. It is widely known that monetarism uses monetary policy to change and adjust the interest rate in order to control the money supply (Arnon, 2011; Leijonhufvud, 2001; Nelson, 2018). The adjusting of the interest rate does not only trigger changes in money supply, it also triggers changes in investment and saving. For instance, an increase in interest rate increases the cost of borrowing incurred by investors. This means that investors can borrow less which leads to less investment spending. This in turn affects money income. Contrarily, an increase in interest rate incentivises savers to save rather than spend. As a result, it reduces the money supply.

The monetarist theory paid less attention to the relative movements of sub-aggregates being consumption, investments and saving and no focus was given at all to the stages of production as applied by the Keynesian and the Austrian schools of economic thought, respectively. In examining both the long- term and short- term movements of real output that is attributable to changes in money, the Monetarist theory adopted the aggregate output approach rather the sub-aggregates such as consumption, investment and saving (Snowdon & Vane, 2005). This is due to their assertion that changes within the aggregate output as explored by Austrian theory would be irrelevant in dealing with macroeconomic issues.

It is evident that the monetarism theory paid little attention to saving and investment, nor by extension the concepts' interrelatedness. Saving and investment only occurred as the by-product of the actions of money supply, interest rate and money income which made it impossible for monetarists to keep track of changes in consumption, investment and saving in the overall output.

2.5. The Loanable Funds Theory

The loanable funds theory (LFT) owes its origin to Knut Wicksell who first discovered it during 1898. The LFT was further revived by the work of Ohlin and Robertson during the 1930s (Bertocco, 2007; Ohlin, 1937; Wicksell, 1898). The theory has been primarily used to determine the rate of interest through the interaction between saving and investment (Bertocco, 2007). Additionally, the monetary authorities mostly use the interest rate as one of their monetary tools to influence either the level of saving or investment. However, such a strategy only holds for the short term (Ahmad & Premaratne, 2019; Matsheka, 1998). The LFT outlines the saving and investment nexus in a form of supply and demand for loanable funds, respectively (Lieberman & Hall, 2013). The level of interest reflects the saving preferences and plays a role in both allocating the scarce resources to stages of production and determining the overall level of investment. The loanable funds cover all the avenues in which unconsumed resources are made available to the investment community to stimulate the productive capacity of the economy thereby implying that investment is financed by saving (Snowdon & Vane, 2005).

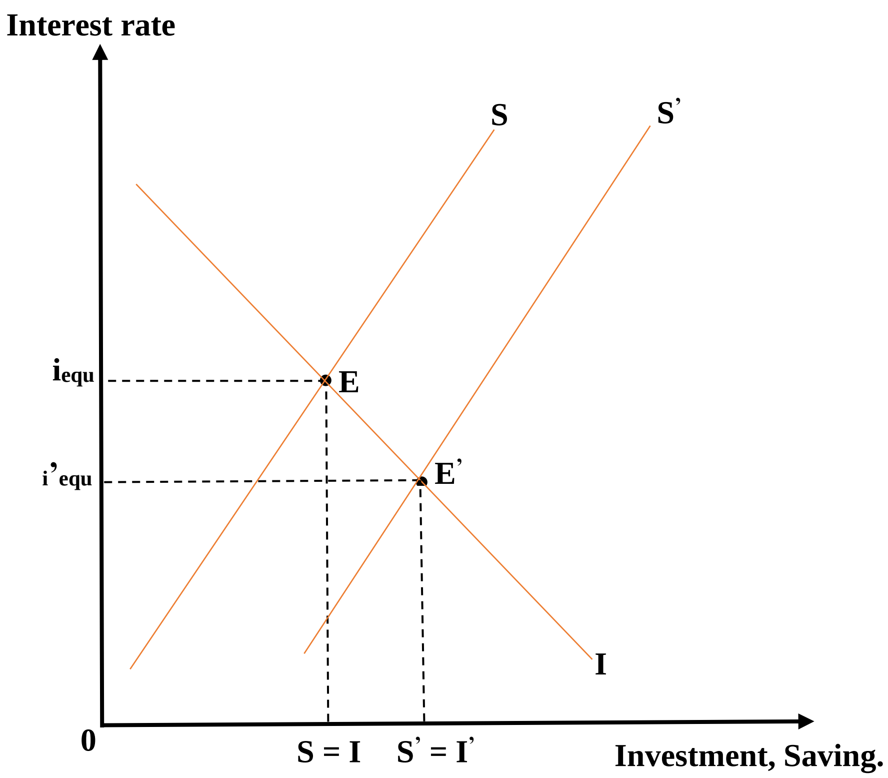

Figure 2.1: Loanable funds theory

Source: Author's complilation and Snowdon & Vane (2005).

Figure 2.1 represents the loanable funds market, with the supply and demand for loanable funds that account for saving and investment, respectively. The demand for loanable funds reflects the willingness of investors to allocate resources available to them in the form of saving during various stages of the production process (Lieberman & Hall, 2013) (Lieberman, Hall 2013). The market is equilibrated by the rate of interest, meaning that it plays the allocation role of resources over time in accordance with saving behaviour (Dillard, 1948; Screpanti & Zamagni, 2005). As depicted by Figure 2.1, a decline in the rate of interest, as a result of an increase in saving, as illustrated by a rightwards shift in the supply of loanable funds (from S to S'), would cause the market to move along its demand for loanable funds curve (Snowdon & Vane, 2005). The decrease in the rate of interest is depicted by the movement from i_{equ} to i'_{equ} and this informs the new equilibrium at point E'.

A decreased rate of interest which brings about a lower cost of borrowing is expected to lead to an increase in various stages of the production process, particularly the early stage which would have been highly favoured as compared to the final stage, due to the decreased demand in consumable output. All investment activities and available resources are transferred from the early stage to the final stage of the production process as a result of a decreased demand for consumable output (Koop, 2013; Oppers, 2002; Snowdon & Vane, 2005).

In contrast, the loanable funds market includes both saving and investment activities. Using the example of an increase in saving resulting from an initial income will lead to a rightwards shift of the supply of loanable funds in which the dominating income effect will eventually prevail and allow suppliers of consumable output to only realise low income. The low income would have been brought about by a decrease in consumption spending as a result of an increase in saving, as they are both income-dependent (Keynes, 1936). The economy declines as consumption spending and the level of income fall and with decreased income, it triggers a leftward shift of the saving curve. However, a rise in investment spending as a result of a fall in borrowing costs will exactly offset the decline in consumption spending. Therefore, the aggregate spending will remain unchanged and what will change is only the composition of the aggregate spending (Dillard, 1948).

2.6. The Harrod-Domar Model

The Harrod-Domar (HD) Model is used to determine the growth rate of an economy that is supported by the level of capital and saving. The model was independently developed by Roy F Harrod and Evsey D Domar in 1939 and 1946, respectively (Domar, 1946; Harrod, 1939). The HD model postulates that the rate of economic growth depends on the level of saving as well as the productivity of investment (capital-output ratio). The discovery of HD was triggered by Keynesian theory's focus on the short run static effects of saving and investment rather than also giving full coverage of the long run effects. The approach needed to be modified to be able to probe the long run dynamics of the economy (Snowdon & Vane, 2005). Additionally, Keynesian theory, having emphasised the impact of investment spending on aggregate demand (Keynes, 1936), triggered the HD model to put focus on emphasising the impact of investment spending on the productive capacity of the economy. The HD model, in stressing the impact of both the productivity of investment and saving on the rate of economic growth, takes into consideration the complexity of the functioning of the economy. The HD model makes various assumptions, including a closed economy with only two sectors (household and firms), fixed technology and constant capital-labour and capital-output ratios.

With a two-sector economy the simple national income equation is:

$$Y_t = C_t + S_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2.4)$$

Where:

Y_t denotes gross domestic product or income (assumed to be equal).

C_t denotes consumption spending.

S_t denotes saving.

This implies that households use their income for both consumption spending and saving. For the equilibrium in this simple closed economy to hold, requires that saving and investment balance, which can be written mathematically as follows:

$$S_t = I_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.5)$$

And the equation connotes that the overall saving is simply transferred to the overall investment activities. Additionally, higher income implies higher saving which would mean higher investment in turn (Blanchard, 2011). Substituting equation (2.5) into (2.4) leads to the following equation:

$$Y_t = C_t + I_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.6)$$

Which asserts the assumption, that the real growth of gross domestic product is proportional to the proportion of investment in the gross domestic product (Mohr & Associates, 2015). And for the economy to experience growth, there is a need for a net additional capital stock (Thong & Hao, 2019).

Such a capital stock required can be mathematically written as:

$$K_{t+1} = (1 - \theta)K_t + I_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.7)$$

Where θ denotes the depreciation rate of the capital stock and change in investment spending leads to change in capital stock (Domar, 1946). From the equation, capital stock at year t + 1, K_{t+1}, is equal to the capital stock in year t, which is still strong in year t + 1, $(1 - \theta)K_t$ plus the additional capital stock added in year t - that is, an investment which took place in year t (Blanchard, 2006; Thong & Hao, 2019). It is assumed that change in the overall investment spending is dependent upon changes in total saving. It is further assumed that total saving is a proportion of gross domestic product or income which mathematically is written as follows:

$$S_t = sY_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.8)$$

As a given capital-output ratio is $v = \frac{K}{Y}$ $or\ K = vY$ and $S_t = I_t$, equation (2.5) can then be mathematically rewritten as follows:

$$vY_{t+1} = (1 - \theta)vY_t + sY_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.9)$$

The simplified version of equation (2.9) where v is divided and Y_t subtracted from both sides of the equation, becomes:

$$Y_{t+1} - Y_t = [{}^{S}/_{v} - \theta]\, Y_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.10)$$

And dividing both sides of equation (2.10) by Y_t , yields equation (2.11)

$$\frac{Y_{t+1} - Y_t}{Y_t} = \left(\frac{s}{v}\right) - \theta \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.11)$$

Where the $\frac{Y_{t+1} - Y_t}{Y_t}$ part of the equation, measures the growth rate of the gross domestic product (GDP) or income, which is determined by both the saving rate (s) and capital-output ratio (v) (Screpanti & Zamagni, 2005). Depreciation which accounts for capital stock that is worn and torn, affects capital stock in two ways. Firstly, capital stock increases if investment exceeds depreciated capital and secondly, the capital stock tends to decline if depreciated capital is in excess of investment. Moreover, the model highlights that if more resources in the form of saving can be devoted to investment activities, the economic growth prospects can be relatively realised. However, the holding of capital-output ratio constant by the model is highly unlikely to hold in practical terms and has appeared to be a weakness of the model (Sato, 1964). For instance, the productivity of investment cannot be given, as it reflects the investment decisions that have been taken and their efficiency.

In summary, the HD model highlights how the correlation between saving and investment supports growth in the economy. This is due to saving, which is proportional to investment (that is additions to capital stock), having the potential to give rise to the overall output/income. In turn, the increased output will support additional saving, which again gives rise to more investment spending. Therefore, the Harrod-Domar model establishes that an increase in the saving rate has the potential of giving rise to long term economic growth (Blanchard, 2006; 2011; Thong & Hao, 2019).

2.7. The Solow-Neoclassical Model

The Solow model was developed independently by Robert Solow and Trevor Swan in 1956 and was an extension to the HD model (Solow, 1956; Swan, 1956). It explores the role of changes in productive capacity (technological changes) on economic growth (Snowdon & Vane, 2005). The main aim of the model is to estimate and explain long run economic growth. Despite this, the model remains relevant to the current study for several reasons. Firstly, capital accumulation and changes in productivity which are strongly linked to investment, play an integral part in influencing the long-term economic growth in the model. Secondly, the growth of saving, which also took part in terms of influencing the long run rate of economic growth. The Solow model considers the following assumptions (Snowdon & Vane, 2005; Solow, 1956; 1957):

- All the output/income that is saved is automatically invested.
- One sector exists to produce one commodity that can be used for both consumption and investment or either consumption or investment purposes.
- The economy has closed boundaries to international transactions and the government sector is excluded.
- The depreciation rate of capital stock, technological progress, and population growth are determined externally (exogenously)
- Capital-output ratio (K/Y) and capital-labour ratio are not fixed.
- The model is concerned with a long run and the economy is invariably producing the potential level of output/income.

In accordance with these assumptions, the Solow theory can be modelled with the following production function (Solow, 1957):

$$Y = A_t F(K, L) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (2.12)$$

Where:

Y denotes the output/income.

A_t denotes technological progress - that is, the way inputs are transformed into an output/income.

K denotes capital.

L denotes labour input.

For simplicity purposes and a clear focus on the relationship between output per worker and capital per worker, technological progress is held constant. Therefore, equation 2.12 can be rewritten as follows:

$$Y = F(K, L) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots \dots \dots \dots \dots \dots \dots \dots . \dots . \dots \dots \dots \dots \dots \dots \dots . . (2.13)$$

And from equation (2.13) salient points are drawn: (1) the equation demonstrates positive but diminishing marginal return regarding capital and labour, (2) the production function demonstrates constant returns to scale so that a one percent change in inputs will lead to the same change in output (Solow, 1957). With these salient points, where y denotes output per worker (Y/L) and k denotes capital per worker (K/L), equation (2.13) can be written as equation (2.14).

$$y = f(k) \quad \ldots \quad (2.14)$$

The equation implies that as the capital-labour ratio approaches infinity, the marginal product of capital (MPK) approaches zero; and as the capital-labour ratio approaches zero the MPK approaches infinity. Additionally, as the capital-labour ratio increases the output per worker tends to increase as well but such an increase has boundaries because of a diminishing marginal return. This dictates that as more capital is being accumulated, the output per worker will eventually start to decrease. Having established that output per worker depends on capital per worker, clear comprehension of how the capital-labour ratio evolves in conjunction with determination of saving that is believed to finance investment (that is, capital accumulation).

The determination of saving could be given by the following equation:

$$Y = C + sY \quad \ldots \quad (2.15)$$

Where Y denotes aggregate output/income (aggregate output comprises consumption and investment – equal saving), C denotes consumption and s is the proportion of income saved (Mohr & Associates, 2015). Moreover, given the assumption of a closed economy without government intervention, domestic investment is equal to private domestic saving.

The determination of capital accumulation could also be given by the following equation:

$$K_{t+1} = I_t + (1 + \theta)K_t = sY_t + K_t - \theta K_t \quad \ldots \quad (2.16)$$

The equation comprises the accumulation of capital stock (denoted by K_{t+1}) of which the proportion of it wears out (depreciated capital, denoted by θ), and such a decline in capital stock is counteracted by a flow of investment spending (that is, denoted by I_t) which contributes to capital stock.

In per worker terms, equation (2.16) can be re-written as equation (2.17):

$$\frac{K_{t+1}}{L} = \frac{sY_t}{L} + \frac{K_t}{L} - \frac{\theta K_t}{L} \quad \ldots \quad (2.17)$$

Eliminating $\frac{K_t}{L}$, from both sides of the equation (2.17) yields (2.18)

$$\frac{K_{t+1}}{L} - \frac{K_t}{L} = \frac{sY_t}{L} - \frac{\theta K_t}{L} \quad \text{……………………………………………………} (2.18)$$

Letting Z = $\frac{K_{t+1}}{L} - \frac{K_t}{L}$, s F (k) = $\frac{sY_t}{L}$ and θk= $\frac{\theta K_t}{L}$, equation (2.18) yields (2.19)

$$Z = \text{ s F(k)} - \theta k \quad \text{……………………………………………………} (2.19)$$

The Solow model (2.19) postulates that change in capital stock per worker is determined by the combination of both the flow of investment spending per worker and depreciated capital or investment required to offset a decline in capital stock (Solow, 1956; 1994). In a steady-state economy, the flow of investment (equivalent to saving) should be sufficient to cover the depreciated capital. Assuming that the saving (investment) per worker is in excess of the depreciated capital, the economy is experiencing capital deepening and the capital stock tends to rise (Blanchard, 2011).

Moreover, the increase in the saving rate tends to give rise to the steady-state output per worker. However, this only takes place temporarily; in the long run, an increase in the saving rate only gives temporary rise to growth, especially during the transition period to the new steady state. It, however, triggers an increase that is permanent to the level of output per worker which is subject to diminishing marginal returns. In summary, an increase in the saving rate (that is equivalent to the investment rate) has a temporary positive impact on economic growth and has no effect on the long-term economic growth (Snowdon & Vane, 2005). It is merely through technological progress that the long run growth can be achieved.

2.8. The Endogenous Growth Model

The endogenous growth model was developed in the mid-1980s by several economists including Paul Romer and Robert Lucas. The discovery of this theory was driven by an attempt to examine the long run economic growth that depends upon the changes in investment activities, rather than inexplicable exogenous variables, such as technological changes (Romer, 1994). The accumulation of capital forms an integral part of the endogenous growth model. In the context of the endogenous growth model, investment is approached from a broader context to incorporate not only the physical capital but also the human capital formation as well as research and development (R&D).

Assumptions of the endogenous growth model include a constant saving rate, and a production function that has an increasing return to scale. However, from the firm's perspective, both the constant return to scale and diminishing marginal returns to capital still hold (Aghion & Howitt, 1998). The differing perspective of the aggregate and firm production function approaches is that new ideas and knowledge (increase in broader investment) bring about positive spill overs (positive externalities) which cannot be entirely captured by an inventor. This gives the effect that output cannot be a constant return to scale of all inputs combined (Snowdon & Vane, 2005). Simply put, an investment in knowledge by an individual firm gives effect to the production potentials of other firms, provided the costs associated with an investment are only incurred at once by the initial investor or inventor of the knowledge.

The endogenous growth theory is given by the following function:

$$Y = F\ (K, L, A) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (2.20)$$

Where:

A denotes the technological change (the growth of knowledge or new ideas) that is dependent upon an increase in capital stock. Hence, the deepening of capital cultivates the technological spill overs that give rise to capital productivity across the board. The technology is treated as endogenous rather than exogenous input.

K denotes capital.

L denotes labour input.

Y represents the total output or income.

Equation 2.20 shows that the driving force behind the long run growth includes improvements in ideas or knowledge about how to best transform the given inputs into outputs during the production process. Such growth is then considered to be an investment-driven process. Furthermore, the accumulation of capital plays quite a critical role in the growth process because the increase in the stock of capital in a given economy, the more productive firms are going to be via the so-called “a process of learning by doing” (Blanchard, 2011). In essence, the improvement in aggregate knowledge resulted from the externalities taking place between firms.

2.9. Conclusion

The theories discussed in this chapter explore the saving and investment nexus. However, the theories provide an inconclusive causal link between the two variables. Conflicting theories include those of the Keynesian school of economic thought versus the Austrian school of economic thought. The Keynesians argue that increased investment, as a component of aggregate demand, gives rise to income or output which should result in an increase in saving. In contrast, the Austrian's asserts that increased saving makes funds available that give effect to capital stock that is strongly linked to investment. The Keynesian theory further indicates that higher saving would suppress the output of the economy due to the trade-off between saving and consumption expenditure. Other theories (LFT, HD, and Endogenous growth theory) succeeded in emphasising the positive effects of increased saving and investment on long run economic growth. An exception is the Solow model which asserts that it is through technological change that long run economic growth gets to increase significantly, leaving increased saving as having an insignificant influence over the short run economic growth.

In as much as the theoretical framework helps in describing the research problem, it also assists with a theoretical understanding of the relationship between saving and investment. Additionally, this helps to shape the focus of the empirical literature review which is the focus of the next chapter. It also serves as a guideline for the identification of the study's methodology, which is dealt with in Chapter 4.

CHAPTER 3: EMPIRICAL LITERATURE REVIEW

3.1. Introduction

Chapter 3 builds on the theoretical framework established in chapter 2. The chapter summarises the findings from empirical literature that focus on the relationship between investment and saving. The chapter is organised as follows: sections 3.2 and 3.3 look at empirical studies conducted in emerging economies and advanced economies respectively, while section 3.4 focuses on studies for South Africa. Given the volume of literature, and varying results, the details are captured in the form of a table in each of the three sections. Lastly, section 3.6 provides the concluding remarks of the chapter.

3.2. Emerging economies

This section looks at empirical literature for emerging economies. For the purposes of this study, emerging economies are defined as having high nascent levels of development, sustained gross national product (GNP), and optimal real income per capita powered by rapid industrialisation as well as progressive institutional change (Onyiriuba, 2016). The emerging economies also exercise economic policy reforms that intend to open up the economy to participate in the international financial market in which economic forces prevail.

The study finds mixed results for empirical studies on the relationship between investment and saving. For example, some studies revealed the presence of a single long run relationship between investment and saving (Mishra, Das et al., (2010); Mishra, (2011); Nurul, Zulkifli et al., (2014); Hundie, (2016); Cavallo and Pedemonte, (2016), Joshi, Pradhan et al., (2019); Kaur and Sarin, (2019); Otoo, Appiah et al., (2020)). However, the study by Tehranchian and Behravesh (2011) found the existence of both the long and short run relationship between investment and saving. Verma and Saleh, (2011) and Brahmasrene and Jiranyakul, (2009) suggest that there is no sign of a long-term relationship between saving and investment. Furthermore, Driouche and Bengana, (2016) whose study focuses on cross -sectional countries, reported a mixed result.

The granger causality tests also indicate mixed results pertaining to the investment and saving nexus. These include unidirectional causal relationship, bidirectional causal relationship, and no-causal relationship, while unidirectional causal relationship featured most prominently. Granger causality test finds that the direction of unidirectional causal relationships, mostly runs from saving to investment, implying that saving precedes investment. This suggests that policy plans should be in favour of saving for a country looking to revive or stimulate its economy.

Various methodologies and data types were used including time series analysis, cross-sectional analysis, and panel data analysis. The preferred approach seems to be the time series analysis, coupled with ARDL, VECM, and Granger causality. In general, ARDL seemed to be the preferred estimation technique. Table 3.1 summarises the findings of the empirical literature pertaining to the relationship between investment and saving in emerging economies.

Table 3.1: Empirical literature on emerging economies

Author	Country	Methodology	Findings
Sekantsi and Kalebe (2015)	Lesotho	Adopted the Autoregressive Distributed Lag (ARDL) approach to co-integration and Vector Error Correction Model (VECM) based on the granger-causality test.	The results show the presence of a long and short-run unidirectional causal link, running from saving to investment. Additionally, the results revealed short-run granger causality that runs from economic growth to saving. In the long term, a causal link flows from saving to economic growth. Investment, therefore, granger-causes economic growth.
Ahmad and Premaratne (2019)	Nigeria	Two stages least squares	The interest rate was revealed to have no influence on saving.
Titus and Ifeanyi (2016)	Nigeria	Employed ordinary least squares regression	A presence of a positive relationship between economic growth, investment, and gross saving.
Johnson (2015)	Nigeria	Applied error correction model (ECM) (25 years of data range applied)	A presence of positive relationship was revealed among economic growth, investment, and saving.
Tehranchian and Behravesh, (2011)	Iran	Applied ARDL model and ECM on the time series data over a period 1959-2008.	The results indicated the existence of the relationship between investment and saving, with saving having a strong effect on domestic gross investment of which the long-run effect is much stronger

			compared to the short-run effect.
Hundie (2016)	Ethiopia	Applied ARDL bounds cointegration test on an annual time series data spanning from 1969/70-2010/11 within the multivariate framework.	The results indicated the presence of a long and short-run relationship among saving, investment, labour, human capital, and economic growth with GDP introduced as a predetermined variable. A 1% increase in investment causes a 0,33% and 0.128% increase in economic growth during the short and long run respectively, ceteris paribus.
Ramakrishma and Rao (2012)	Ethiopia	Employed VECM estimation technique.	Presence of a bidirectional granger-causality causal relationship between investment and saving.
Ang (2007)	Malaysia	Applied ARDL bounds testing approach. The period of the study covers 1965-2003.	Finds a significant cointegrated relationship between investment and saving.
Alrasheedy and Alaidarous (2019)	Saudi Arabia	Utilised the granger-causality test.	The study revealed a sign of a unidirectional Granger-causality that runs from private saving to private investment. There is also a presence of a bidirectional Granger-causality between the GDP and private saving.
Verma and Saleh (2011)	Saudi Arabia	Applied ARDL cointegration approach and Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root test with the period ranging from 1963-2007.	The study revealed the presence of a long-run relationship between investment and saving.
Joshi, Pradhan et al. (2019)	Nepal	Applied unit root test to account for structural breaks and ARDL approach to cointegration.	The study found a cointegrated relationship amon investment, saving, and economic growth. The study also found a statistically strong and positive impact of investment on

			economic growth. In the long run, gross domestic saving was found to have a negative influence on economic growth.
Kaur and Sarin (2019)	China, Japan Macao, and Korea	Adopted the ARDL bounds cointegrating technique.	The results indicated the presence of a cointegrating relationship between saving and interest.
Driouche and Bengana (2016)	Algeria, Libya, Tunisia, Morocco, and Mauritania	Applied the ARDL model.	The existence of a cointegrated relationship between investment and saving was found in the case of Algeria, Libya, and Mauritania. However, in the case of Tunisia and Morocco, the results revealed no sign of a cointegrating relationship between investment and saving.
Otoo, Appiah et al. (2020)	Ghana	Employed ADF, granger-causality test, and cointegration on data spanning from 1980-2017.	The results revealed the existence of both a long and short run relationship between investment and saving. Moreover, results showed that saving precedes investment, implying that saving granger causes investment.
Nurul, Zulkifli et al. (2014)	China, India, and Malaysia	Employed ARDL co-integration approach.	The results indicated the presence of a long-run relationship between investment and saving.
Anoruo (2001)	Indonesia, Singapore, Malaysia, Thailand and the Philippines.	Applied granger-causality test based on VECM.	Results revealed that investment granger causes saving in the case of Singapore and Indonesia, whereas in the case of the Philippines the causal link/direction runs from saving to investment. Malaysia and Thailand have recorded a bidirectional causality between investment and saving.
Brahmasrene and Jiranyakul (2009)	North Asia and South Asia	Used the ARDL bounds cointegrating technique.	The results found no sign of a positive correlation between investment and saving.

Cavallo and Pedemonte (2016)	Latin America and Caribbean countries	Applied cointegration test on a panel data covering the period 1980-2013.	Results revealed a significantly and positively correlated relationship between investment and saving with a 0.39 correlation coefficient.
Mishra, Das et al. (2010)	India	Employed Phillip-Perron Unit root test and Johansen's cointegration test on an annual time series data for the period 1950/51-2008/9.	The results revealed a sign of a cointegrated relationship between investment and saving.
Mishra (2011)	India	Applied VECM for the period 1950/51-2008/9.	The findings revealed the presence of a long and short-term relationship between investment and saving. Furthermore, the causality test recorded a unidirectional causality that runs from saving to investment.
Khundrakpam and Ranjan (2010)	India	Employed ARDL cointegrating approach.	The results revealed the sign of a cointegrating relationship between investment and saving.
Irandoust (2019)	Belarus, Estonia, Lithuania, Latvia, Ukraine, and Russian Federation	Applied panel granger-causality approach.	The findings revealed that there is bidirectional causality relationship between saving and investment.

Source: Author's compilation

3.3. Advanced economies

This section discusses the findings of empirical studies which focussed on developed economies. For this purpose, developed economies are characterised by among others, high per capita GDP, industrialisation, technological advancement, and developed infrastructure (United Nations, 2021).

As far as the relationship and direction of causality between investment and saving is concerned, empirical studies including Eiriksson (2011), Behera (2015), and Hwang and Kim (2018) have reported the existence of saving and investment relationship. As for the direction of causality, the studies of Narayan (2005), Onafowara, Oweye et al. (2011), and Andrade and Masson (2015) found the presence of bidirectional causality between saving and investment. The unidirectional causal relationship which oftentimes runs from saving to investment was also found to exist. These findings are therefore in contrast with the theoretical postulation of Keynesian theory (see Section 2.3) which asserts that investment should precede saving.

The methodology used in these studies includes ARDL, Granger causality test, and ECM in which the ARDL is the preferred method of estimation. Table 3.2 provides a summary of the empirical studies on advanced economies.

Table 3.2: Empirical literature on advanced economies

Author	**Country**	**Methodology**	**Findings**
Dritsaki (2015)	Greece	Applied unit root test, cointegration test based ARDL bounds testing, and augmented Granger causality tests on an annual time series data spanning for a period 1980-2012.	The findings showed the presence of a long-run relationship between investment and saving. The results further revealed a long and short-run unidirectional causality that runs from saving to investment. Variance decomposition shows that saving gives rise to investment in the long term.
Andrade and Masson (2015)	Twenty-four (24) Members of the European Union (EU)	Employed quantile regression method and granger causality test for panel data models.	The results showed the sign of a bidirectional causal relationship between investment and saving.
Behera (2015)	Newly industrialised countries (NICs)	Applied unit test, cointegration, ECM, and granger causality test on a panel of cross-sectional and time-series data.	The results showed the sign of a cointegrated relationship between saving-investment and interest rate differential was found to exist.
Onafowara, Oweye et al. (2011)	Eight advanced economies of the European Union (EU). Belgium, Denmark, France, Germany, Italy, Luxembourg, Netherlands,	Adopted the ARDL bounds testing cointegration approach, unrestricted error correction model for ARDL, and vector autoregressive (VAR) analysis of variance decompositions.	The results indicated the sign of a cointegrating relationship between investment and saving in six countries. Evidence is found of causality between investment and saving, where the long-term direction of causality runs from saving to investment in the United Kingdom and Netherlands; while causality runs from investment to saving in Germany, Denmark and

	and the United Kingdom.		Luxembourg. Bidirectional causality was found to exist in Belgium, Italy, and France.
Eiriksson (2011)	Organisation for economic cooperation and development (OECD) Countries, including Japan.	Employed the two-country Real Business Cycle (RBC) model	The results found the presence of a positively correlated relationship between investment and saving.
Tsoukis and Alyousha (2001)	Australia, Germany, and the UK.	Employed granger causality test using quarterly data for the period 1980s and 1990s.	The results recorded the presence of a causal link that flows from saving to investment in Australia and the UK. However, in the case of Germany, the causality goes from investment to saving.
Narayan (2005)	Japan	Applied granger causality test using the time series data.	The findings revealed a sign of bidirectional causality between investment and saving.
Schmidt (2001)	Canada, France, Japan, the United States, and the United Kingdom.	Used the Johansen maximum likelihood estimates (MLE) approach.	The results showed an insignificant positive impact of saving on investment in the United States, Japan, and the United Kingdom, whereas in Canada and France saving has much of an impact on national investment rates.
Gur, Erden et al. (2011)	86 set of countries	Applied the cointegration and regression approach for the periods 1970-2008.	The results revealed that productive shocks, the openness measure, interest rate differentials, and the country size have no impact on the investment and connection.
Hwang and Kim (2018)	19 OECD Countries	Applied multilevel factor approach on panel data for a period 1961-2005.	Results discovered that country-specific and global factors account for 50% of the correlation between investment and saving. Furthermore, the results revealed a significant estimated coefficient of 0,955 which suggested a strong

			correlation between investment and saving.
Felmingham and Cooray (2008)	Australia	Adopted the cross-spectral analysis of time series	The results revealed the presence of a long-term relationship between investment and saving.
Attanasio, Picci et al. (2000)	OECM Countries (123 countries)	Applied panel granger-causality test over the period 1961-1994.	The results showed the existence of a positive causal link/direction that runs from saving to investment. The results further revealed that growth positively granger causes investment.

Source: Author's compilation

Having dealt with the findings from the rest of the world, section 3.4 looks at empirical findings for South Africa.

3.4. South Africa (emerging economy)

The review of the empirical studies that explore the relationship between investment and saving for South African revealed mixed results. However, the majority of studies have found some evidence of a relationship between saving and investment.

Notably, Mitra (2017) found the presence of a positive long-run relationship between investment and saving. Similarly, Konya (2015) found the existence of a positively correlated relationship between the two phenomena. As far as the causal link is concerned, a bidirectional causal relationship is found to be existing and dominating (see, for instance, Afzal (2007), Mitra (2017), Odhiambo (2009), and Muyambiri and Odhiambo (2017)). Analogous to the findings from the literature pertaining to emerging and advanced economies, in the SA context, the use of the ARDL method is also the preferred method of estimation.

Both time series and panel data analysis are used. The panel data approach bears the shortcoming of utilising a pool of countries with varying dynamics (including different economic policies and structures of economies). Moreover, the utilisation of the bivariate framework which has been defaulted for bearing the problem of omitting control variables that are influential to saving and investment also dominated the South African literature. Importantly what is missing from these studies is the magnitude of the statistically estimated coefficients of the two variables of interest, namely investment and saving, for SA specifically.

Table 3.3 provides further details in terms of the methodologies utilized in these empirical studies looking at South Africa.

Table 3.3: Empirical literature on South African context

Author	**Country**	**Methodology**	**Findings**
Mitra (2017)	SA	Applied granger causality test, VECM of a time series analysis within the bivariate framework.	The results show a positive long term correlation between investment and saving. A causal relationship (bidirectional) was found to exist between domestic saving and domestic investment in the short term.
Afzal (2007)	SA, Pakistan and Sri Lanka, India, Philippines, Iran, and Malaysia	Applied granger causality test on annual data over the period of 1960-2006.	For SA, the results showed signs of a bidirectional causal relationship between investment and saving. No sign of causality was found between the two series in India, the Philippines, Iran, and Malaysia. In Pakistan and Sri Lanka, the unidirectional causal relationship that flows from saving to investment was found.
Adedeji and Thornton (2007)	Six African countries including South Africa	Applied panel cointegration technique for the period spanning 1970-2000.	The results indicated that investment and saving in these six African countries are cointegrated with a saving-retention ratio of 0,73 implying that capital is relatively mobile among these countries.
Kónya (2015)	Brazil, Russia, India, China, and SA.	Applied univariate time series of ARDL model on a country-by-country basis on annual sample period spanning from 1970-2011	A correlation coefficient of the ARDL model suggested a relatively statistically significant positive correlation between investment and saving in all the BRICS countries except China. The capital is more mobile between SA and Russia than in India, China, and Brazil.
Behera (2016)	Brazil, Russia, India, China, and SA	Applied cointegration, and error correction model over the period 1970-2013.	The results revealed that investment and saving are cointegrated in the case of SA, Brazil, and Russia, whereas in China and India there is no evidence of the cointegrated relationship between investment and saving. Furthermore, the results suggested a significant degree of

			capital mobility between SA and China.
Odhiambo, (2009)	SA	Applied Johansen-Juselius cointegration test and causality test based on VECM.	Empirical results revealed bidirectional causality between saving and economic growth in the short run and went further to reveal unidirectional causality that runs from economic growth to saving in the long run.
Room (2005)	SA	Used Johansen VECM estimation technique over the period 1946-1992.	The results suggested that the private saving rate directly affects the steady-state output per capita and indirectly affects growth through influencing the private investment rate. Contrastingly, output per capita affects the private saving rate.
Muyambiri and Odhiambo (2017)	SA	Adopted ARDL bounds testing approach to cointegration, and ECM-based trivariate granger causality test.	The results in which saving ratio serves as an intermittent variable in the model of investment and bank-based financial development, reported a long and short term bidirectional causal relationship between investment and saving. In the case of market-based financial development, the results revealed the presence of a short and long term unidirectional causal relationship that flows from saving to investment.

Source: Author's compilation

3.6. Conclusion

This chapter provided an analysis of the findings from the empirical literature on the link between investment and saving. Separate analyses are provided for emerging and advanced economies, as well as for South Africa. The research finds mixed results as far as the cointegrating relationship and causal relationship between investment and saving, which were more evident amongst emerging economies. This is likely due to the application of different methodologies, data time-period and the use of a pool of countries with different dynamics.

Concerning SA, mixed results are also observed although most studies had reported a strong link between saving and investment. This largely concurs with the theoretical stance of both the Austrian School and HD theory. Regarding the direction of causality, bidirectional causal relationship emerged strongly from most of the studies reviewed. This could have been influenced by these studies mostly using the same estimation techniques. Time series analysis appeared to be the preferred method for country-specific analysis.

The next chapter outlines the methodology used in this study and is informed by findings from the theoretical and empirical literature reviews.

CHAPTER 4: METHODOLOGY

4.1. Introduction

This chapter outlines the methodological approach and data used in the study. The methodology utilises findings from Chapters 2 and 3 which highlight the autoregressive distributed lag (ARDL) model as the preferred technique. The ARDL model is therefore also utilised in this study based on its capabilities to produce robust results and for its ability to accommodate data series that contains a mixed order of integration, but not exceeding I (1), that is, data that becomes stationary after differencing once. The rest of the chapter reads as follows: section 4.2 discusses the sources and type of data used, while section 4.3 covers the model specification in which the functional form of the relationship is established. Section 4.4 discusses the econometrics estimation techniques utilised and section 4.5 outlines diagnostic and specification tests relevant to check the accuracy of the estimates and stability of the model. Lastly, the concluding remarks summarise the chapter.

4.2. Data sources

The data were collected from the South African Reserve Bank (SARB), International Monetary Fund (IMF), and Federal Reserve Bank of St. Louis. Secondary time series data is used spanning the period 1994Q1 to 2018Q4 and gives a total of 96 observations. The adopted time period presents economic conditions that are free from economic sanctions that had been imposed and led to the isolation of the country to participate in the international capital market, which occurred under the apartheid period. The data that spans this period is relevant most importantly in the analysis of the long run relationship between investment and saving.

A potential problem when using time series data is structural breaks, which occur when there is an abrupt and significant change in the trend of the data at a certain point in time. This sudden change(s) could influence the parameters of the model, thereby threatening the stability of the model. Additionally, structural breaks might cause confusion in determining whether the series is stationary or non-stationary. Therefore, to check for the presence of structural breaks, the study utilised the parameter stability test, particularly the ordinary least squares (OLS) cumulative sum of squares (CUSUM) statistical test, as well as unit root test method that accommodates structural breaks (Brooks, 2008)

The time series used include:

- Gross fixed capital formation (series code: KBP6009D), sourced from the SARB
- Gross saving (series code: KBP6203L), sourced from the SARB
- Gross domestic product (GDP) (series code: KBP6006D), sourced from the SARB.
- Lending rate (series code: FILR_PA), sourced from the International Financial Statistics (IFS) of the International Monetary Fund
- GDP implicit price deflator (series code: ZAFGDPDEFQISMEI), sourced from the Federal Reserve Bank of St. Louis.

Furthermore, gross fixed capital formation and lending rate are used as proxies for domestic investment and interest rate respectively.

4.3. Model specification

To test the main aim of the study, investment is expressed as follows:

$$\mathrm{INV} = \mathrm{F}\ (\mathrm{SAV}, \mathrm{GDP}, \mathrm{IR}, \mathrm{INF}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.1)$$

The above functional form (4.1) shows investment as a function of saving, gross domestic product (GDP), interest rate, and the inflation rate. From this functional form, saving is assumed to have a positive influence on the investment for the period covered in this study. The functional form is influenced by previous empirical studies. Economic theories that support the stance that saving predicts investment have been acknowledged and considered as opposed to those that criticise such a postulation. To account for all potential factors that are influential to investment in this study, the error term which accounts for omitted variables that appear to be influential to the dependent variable should be considered (Brooks, 2008). The specified linear regression model of the established functional form becomes:

$$\mathrm{LINV_t} = \alpha_0 + \mathrm{B_1 LSAV_t} + \mathrm{B_2 LGDP_t} + \mathrm{B_3 LIR_t} + \mathrm{B_4 LINF_t} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.2)$$

Where:

INV_t	Investment at time t.
SAV_t	Saving at time t.
GDP_t	Gross domestic product at time t.

IR_t	Interest rate at time t.
INF_t	Inflation rate at time t.
L	Natural logarithm.
α_0	Constant term.
$B_1, B_2, B_3,$ and B_4	slope coefficients of the explanatory variables to be estimated.
ε_t	denotes error or disturbance term at time t.
t	time subscript that represents observation number.

Equation (4.2) is specified in log-linear form.

The empirical literature in Chapter 3 showed that the focus of most previous studies was on the bivariate regression model where only two variables comprising saving and investment are considered. That approach omitted control variables that are influential to the relationship between saving and investment. This has the risk of being regarded as a misspecification of the model. According to Gujarati (2004) and Brooks (2008), the exclusion of these relevant variables from the model would consequently yield biased and inconsistent estimated coefficients. For instance, inferences made on the statistical significance of the estimated parameters would be misleading. Having considered these shortcomings, the study applies a multivariate regression model in which interest rate, the inflation rate as well as the gross domestic product are included as additional explanatory variables. The rationale behind including these selected additional variables was their influential impact on the variables of interest. Moreover, all the variables incorporated in the regression model are converted to their natural logarithm to limit the problems associated with heteroscedasticity (Joshi et al., 2019; Mishra, 2011; Tehranchian & Behravesh, 2011).

4.3.1. Justification of control variables

The inclusion of control variables in the regression model was guided by economic theory and empirical studies. Key among the empirical studies are Ahmad and Premaratne (2019) and Johnson (2015) who both mention the importance of including control variables, given their influence on the variable(s) of interest. The interest rate in this case is proxied by the lending rate. Interest rate is a rate of return to the lender as a result of the lenders having lent their saving to the borrower for a period of time (Snowdon & Vane, 2005).

Gross domestic product (GDP) measures the total value of all final goods and services produced within the borders of a specific country during a particular period (Mohr & Associates, 2015). Alternatively, GDP can be defined as the measure of total spending that took place within the borders of a specific country. The first and the second definition of GDP link to GDPs that have been measured by production and expenditure methods, respectively. These methods are assumed to be identical, except that the one measures the total value of production whereas the other measures the total value of expenditure. The income method is another method used to measure GDP. This method measures the total value of income. These three methods are assumed to be identical. From the expenditure method, the components of GDP include household final consumption expenditure, government final consumption expenditure, gross fixed capital formation (investment), and exports and imports of goods and services (Statistics South Africa, 2020). With investment being a component of GDP, the increase thereof will result in an increase in GDP. This implies a positive connection between investment and GDP. With all three methods of measuring GDP assumed to be identical and increase in GDP, thereby implying an increase in income. The increase in GDP then means an increase in saving, provided that all increased income is not all allocated to consumption expenditure. Therefore, saving and GDP are assumed to have a relatively positive relationship.

The inflation rate measures the general increase in the price level in an economy over a period of time (Mohr & Associates, 2015). It can be measured using different approaches including gross domestic product (GDP) deflator and consumer price index (CPI). This study utilises the GDP price deflator approach, due to it being seen as a more comprehensive measure of inflation since all goods and services that are produced within the border of a country are included in its construction (Cowen & Tabarrok, 2013). The prices of the imported goods and services are excluded. The goods and services for the development of the price index are final outputs that are produced within the boundary of SA. This strikes a good balance as the purpose of the study is to explore the connection between domestic saving and investment.

4.4. Econometrics estimation techniques

This section provides an analysis of econometrics estimation techniques used to examine the relationship between the variables of concern, as discussed in the literature review. These techniques include the ARDL approach, ARDL bounds cointegrating test, and ARDL-ECM approach. The motivation behind the use of the ARDL approach in this study centres around the capabilities associated with the approach which is covered in the subsequent section (4.4.1).

The rest of the estimation techniques are based on the ARDL approach and are explained in the section that follows.

4.4.1. Autoregressive distributed lag (ARDL) approach

ARDL is a dynamic (that is, it incorporates dynamic effects) time series model that accounts for the lag values of both the dependent and independent variables. It contains the long- and short-term dynamics of the variables. This is necessitated by the postulations that time lag values of dependent and independent variables have an influence over the dependent variable. Simply put, it is assumed that it is not only the current values of the independent variables but also the past values thereof that are influential to the dependent variable; the past values of the dependent variable (which are included as explanatory variables) have influence over the dependent variable (Pickup, 2015). Furthermore, the OLS estimation of the ARDL model is carried out the same way as other conventional and static time series models but the interpretation of the results is somewhat different (Koop, 2013). The ARDL model has the following advantages over other econometric estimation models (Menegaki, 2019):

- The model is more reliable in a small sample size which usually appears to be a serious drawback for other techniques.
- The model can accommodate different lags in different variables and makes it possible to host sufficient lags that enable the capturing of the mechanism of the data generating process.
- The model can be employed regardless of whether the variables are stationary at levels, I (0) or are stationary at the first difference, I (1). This would mean that variables with mixed order of integration, being I (0) and I (1) can be accommodated by the model and the dependent variable is strictly expected to be integrated of order one I (1).
- The model further provides unbiased and robust results and accurate t- statistics regardless of the presence of endogeneity of some independent variables.
- Additionally, in the model through the error correction mechanism, the short-run adjustments can be integrated with the long- run equilibrium.
- The model gained wider traction for its ability to estimate short-run and long-run effects simultaneously as well as testing the hypothesis on the long-run coefficients.

Despite, all these advantages, there is a minor drawback that is associated with the model which is the fact that all the explanatory variables are not supposed to be integrated of order that is above one. This highlights that, variables cannot be integrated of order two I (2) and above as that will not be accommodated by the model. This is due to the fact that it threatens the validity of both the established critical values and F-statistics as they are primarily meant for I (0) and I (1) variables (Menegaki, 2019; Shrestha & Bhatta, 2018).

The following set of equations was tested under the ARDL (N, V, P, R, F) model:

$$\Delta LINV_t = \alpha_0 + \sum_{i=1}^{N} B_{1i}\,\Delta LINV_{t-i} + \sum_{i=0}^{V} B_{2i}\,\Delta LSAV_{t-i} + \sum_{i=0}^{P} B_{3i}\,\Delta LGDP_{t-i} + \sum_{i=0}^{R} B_{4i}\,\Delta LIR_{t-i} + \sum_{i=0}^{F} B_{5i}\,\Delta LINF_{t-i} + \theta_1 LINV_{t-1} + \theta_2 LSAV_{t-1} + \theta_3 LGDP_{t-1} + \theta_4 LIR_{t-1} + \theta_5 LINF_{t-1} + \mu_{1t} \quad (4.3)$$

$$\Delta LSAV_t = \alpha_0 + \sum_{i=0}^{N} B_{1i}\,\Delta LINV_{t-i} + \sum_{i=1}^{V} B_{2i}\,\Delta LSAV_{t-i} + \sum_{i=0}^{P} B_{3i}\,\Delta LGDP_{t-i} + \sum_{i=0}^{R} B_{4i}\,\Delta LIR_{t-i} + \sum_{i=0}^{F} B_{5i}\,\Delta LINF_{t-i} + \theta_1 LINV_{t-1} + \theta_2 LSAV_{t-1} + \theta_3 LGDP_{t-1} + \theta_4 LIR_{t-1} + \theta_5 LINF_{t-1} + \mu_{2t} \quad (4.4)$$

$$\Delta LGDP_t = \alpha_0 + \sum_{i=0}^{N} B_{1i}\,\Delta LINV_{t-i} + \sum_{i=0}^{V} B_{2i}\,\Delta LSAV_{t-i} + \sum_{i=1}^{P} B_{3i}\,\Delta LGDP_{t-i} + \sum_{i=0}^{R} B_{4i}\,\Delta LIR_{t-i} + \sum_{i=0}^{F} B_{5i}\,\Delta LINF_{t-i} + \theta_1 LINV_{t-1} + \theta_2 LSAV_{t-1} + \theta_3 LGDP_{t-1} + \theta_4 LIR_{t-1} + \theta_5 LINF_{t-1} + \mu_{3t} \quad (4.5)$$

$$\Delta LIR_t = \alpha_0 + \sum_{i=0}^{N} B_{1i}\,\Delta LINV_{t-i} + \sum_{i=0}^{V} B_{2i}\,\Delta LSAV_{t-i} + \sum_{i=0}^{P} B_{3i}\,\Delta LGDP_{t-i} + \sum_{i=1}^{R} B_{4i}\,\Delta LIR_{t-i} + \sum_{i=0}^{F} B_{5i}\,\Delta LINF_{t-i} + \theta_1 LINV_{t-1} + \theta_2 LSAV_{t-1} + \theta_3 LGDP_{t-1} + \theta_4 LIR_{t-1} + \theta_5 LINF_{t-1} + \mu_{4t} \quad (4.6)$$

$$\Delta LINF_t = \alpha_0 + \sum_{i=0}^{N} B_{1i}\,\Delta LINV_{t-i} + \sum_{i=0}^{V} B_{2i}\,\Delta LSAV_{t-i} + \sum_{i=0}^{P} B_{3i}\,\Delta LGDP_{t-i} + \sum_{i=0}^{R} B_{4i}\,\Delta LIR_{t-i} + \sum_{i=1}^{F} B_{5i}\,\Delta LINF_{t-i} + \theta_1 LINV_{t-1} + \theta_2 LSAV_{t-1} + \theta_3 LGDP_{t-1} + \theta_4 LIR_{t-1} + \theta_5 LINF_{t-1} + \mu_{5t} \ldots\ldots\ldots (4.7)$$

Where:

Δ denotes first difference operator,

B_1, B_2, B_3, B_4, B_5 and Θ_1, Θ_2, Θ_3, $\Theta 4$, Θ_5 denote the short run and long run coefficients, respectively.

μ_1 μ_2 μ_3 μ_4 and μ_5 denote the error or disturbance terms of the respective equations.

N, V, P, R, and F denote the optimal lag length of the respective variables.

From the above equations (4.3 to 4.7), it should be noted that in each equation the dependent variable is dependent on its own lagged values, the lagged values, and current values of the explanatory or independent variables, as well as on the error terms. The coefficients, B_1 - B_5 of the first differenced variables measure the short-run relationship between the variables. The more these coefficients are statistically significant, the more it can be proven that there is a sign of a link between the variables tested (Menegaki, 2019; Muyambiri & Odhiambo, 2017). The coefficients Θ_1 – Θ_5 are used to measure the long run relationship between the variables. Alternatively, the F-statistics (Wald test statistics) can be utilised to test the hypothesis of the short-term and long-term relationship in the presence of more than one coefficient of the same variable (Gujarati, 2004).

4.4.2. Unit root tests

The unit root tests are performed with the main purpose of discerning whether variables are stationary or non- stationary (Brooks, 2008). These tests are necessary as the presence of non-stationary properties would lead to spurious regression. The stationary series are considered to have constant variance, mean, and auto-covariance for each given lag. In cases where the series are non-stationary, the stationarity can be induced through the application of the de-trending and differencing methods. The de-trending method helps to remove what is called deterministic non-stationary trend and the differencing method helps to remove stochastic non-stationary trend (Koop, 2013). The differencing method is mostly applicable since the economic data is widely taken to suffer from the stochastic trend.

The test is examined under the null hypotheses and alternative hypotheses that there is a unit root and stationary, respectively. The null hypothesis is given by H_0: series contains the unit root, and the alternative hypothesis is denoted by H_1: series is stationary. The test statistics and critical values are compared at different significant levels (1%, 5%, and 10%), and if the test statistics are more negative than the critical values, the null hypothesis of series containing unit root is rejected (Brooks, 2008). In other words, the series is considered to be stationary. The commonly used methods for testing the existence of a unit root with the intention of establishing whether a certain series is stationary or non- stationary are Augmented Dickey-Fuller (ADF) and Philips-Perron (PP). Therefore, the study utilised these methods due to their popularity and ability to ascertain whether or not a variable is stationary or non-stationary. In addition to ADF and PP tests, the study adopted the Perron's test for structural change. The ADF test is a widely preferred method used to test for a unit root in the time series data. The test is capable of accounting for the presence of the correlated error terms by augmenting the model by adding more lagged values of the dependent variables. The adding of lagged difference terms helps for the realisation of serial uncorrelated error terms in the model.

The ADF model for testing the unit roots in time series is as follows:

$$\Delta Y_t = \alpha_0 + \emptyset Y_{t-1} + \sum_{i=1}^{N} \beta_i \Delta Y_{t-i} + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots \quad (4.8)$$

Where:

ΔY_t: First difference of Y_t

Ø: coefficient of the Y_{t-1}

Under the ADF model, the null hypothesis is that Ø = 0 against the alternative hypothesis that Ø < 0. If the test statistics are less negative than the critical values, the null hypothesis is not rejected, and the series is non-stationary. Contrastingly, if the test statistics are more negative than the critical values, the null hypothesis is rejected in favour of the alternative hypothesis, and the series is stationary (Brooks, 2008). Similarly, the PP test is a unit root test and tests the null hypothesis that there is an existence of non-stationarity against the alternative hypothesis of stationarity (Brooks, 2008). The test applies a non-parametric approach for correction of t-statistics which might be oversized by the presence of autocorrelation (Phillips & Perron, 1987). Additionally, the test allows for the presence of autocorrelation of residuals and the results also tend to be robust. In the case of ADF, this problem is addressed through augmenting the test by use of lags of the dependent variable. The Perron's test for structural change is an econometric procedure that accounts for possible structural breaks in the variables when testing for unit roots (Enders, 2015). One of the advantages of Perron's test is that it is applicable regardless of the actual knowledge of the occurrence of the breakpoint in the variables. In other words, when the break date of the series is unknown. Moreover, the Perron's test allows for structural breaks under the null and alternative hypothesis. That is, the null hypothesis of unit root with structural breaks is tested against the alternative hypothesis of stationarity with structural breaks.

4.4.3. ARDL bounds co-integrating test.

The next step is to determine if a long run relationship exists between the variables, more specifically between saving and investment. These variables are considered cointegrated if there is an existence of a long run relationship. Additionally, cointegration is commonly associated with a long run equilibrium due to the view that a set of cointegrating variables might show some deviations in the long run, but their relationship or connection usually converges in the long run (Brooks, 2008). There are several commonly used methods for testing cointegration, which among them include Engle-granger, (Engle & Granger, 1987) and Johansen cointegrating approach, (Johansen & Juselius, 1990) as well as recent the ARDL bounds cointegrating test (Pesaran et al., 2001).

The ARDL bounds cointegrating test is a recently discovered cointegrating technique developed and popularised by Perasan, and Shin, (1999) and Pesaran, Shin, and Smith, (2001). It has gained huge traction compared to conventional cointegrating methods for good reasons. In addition to advantages established in the ARDL approach which are also associated with the ARDL bounds test, it is highly regarded for its ability to provide robust results in the presence of a small sample size. This is a problem for other conventional cointegrating methods, such as Johansen and Juselius (Menegaki, 2019). Additionally, within the ARDL bounds test variables are not required to hold the same order of integration of I (1) whereas with the conventional cointegration methods, variables are required to hold the same order of integration of I (1) to avoid the possibility of providing unreliable results (Brooks, 2008; Johansen & Juselius, 1990).

Equation (4.3) which was established under the section of the ARDL approach is used to test the null hypothesis of no cointegration against the alternative hypothesis of cointegrating relationship. The F-statistics is compared against the lower and upper critical values and the null hypothesis will be rejected in favour of the alternative hypothesis if the F-statistics exceeds both the lower and upper bounds critical values (Nkoro & Uko, 2016). The null hypothesis of no cointegration will not be rejected if the F-statistics is lower than the lower bounds critical values. If the F-statistics is found to be lying within the lower and upper bounds critical values, the results are considered inconclusive. The existence of a cointegrating relationship between the variables paves a way for an examination of a long run equilibrium which is tested by the application of the ARDL -ECM based model.

4.4.4. ARDL- Error Correction Model (ECM) approach

The sign of a cointegrating relationship between the underlying variables makes it possible to reparameterise the ARDL model into ECM. Alternatively, by way of the linear transformation in which the short-term dynamics are integrated with the long run equilibrium without compromising the long run information, the ECM can be derived from the ARDL model (Nkoro & Uko, 2016). This is done by replacing the long run component of the ARDL model with the lagged residuals to construct the ECM.

The ECM can be specified as follows:

$$\Delta \mathrm{LINV}_t = \alpha_0 + \sum_{i=1}^{N} B_{1i}\,\Delta \mathrm{LINV}_{t-i} + \sum_{i=0}^{V} B_{2i}\,\Delta \mathrm{LSAV}_{t-i} + \sum_{i=0}^{P} B_{3i}\,\Delta \mathrm{LGDP}_{t-i} + \sum_{i=0}^{R} B_{4i}\,\Delta \mathrm{LIR}_{t-i} + \sum_{i=0}^{F} B_{5i}\,\Delta \mathrm{LINF}_{t-i} + \varphi \mathrm{ECM}_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots.(4.9)$$

Where:

ECM_{t-1} denotes the one period lag error correction term and φ is the coefficient of $ECM_{t-1.}$ Error correction term (also known as equilibrium correction model) measures the degree of correction for any disequilibrium that happened in the previous quarter. The φ which is an adjustment parameter that is expected to be less than zero, and holds a negative sign that is statistically significant, measures the speed of adjustment back to the long run equilibrium after an occurrence of a deviation in the short run (Brooks, 2008; Gujarati, 2004).

4.5. Diagnostic and specification tests

Residual and stability diagnostic tests are carried out to ascertain whether the ARDL estimates are true and reliable. Moreover, to check for the misspecification of the ARDL model, there are appropriate tests in place that the study carried out.

4.5.1. Residual diagnostic tests

Heteroskedasticity test is adopted to check the variance of the error terms that change systematically with independent variables. Heteroskedasticity occurs when the variance of the error terms is not constant. The White's test statistics is adopted to test whether or not there is an existence of a heteroscedasticity. The applicable joint null hypothesis to White's test is that the slope coefficients are zero and the error terms are homoscedastic. If F-statistic and Chi-square statistic of Lagrange Multiplier (LM) test for White's test are statistically significant, therefore the null hypothesis will be rejected in favour of the alternative test of heteroscedasticity (Brooks, 2008). This implies that the application of OLS in the presence of heteroscedasticity would lead to misleading inferences, as OLS standard errors are probably to be wrong. A commonly used method to address that is to transform the sampled data into natural logarithm as well as the application of generalised least squares (GLS).

In addition to homoscedasticity, another assumption of classical linear regression model (CLRM) is that the error terms are considered to be uncorrelated. The error terms that are correlated are statistically known to be serially correlated or autocorrelated (Brooks, 2008; Gujarati, Damodar, 2011; 2004). Testing methods applicable for discerning whether the residual series from the estimated model is serially correlated would be, among others, Durbin-Watson test which only tests for the relationship between current error term and its immediate previous value. If DW test statistic is statistically significant the null hypothesis of that the error term and its immediate previous value are independent of each other is rejected in favour of the alternative hypothesis that the error term and its immediate previous value are dependent upon each other (Gujarati, 2004). DW test would not be applicable in this study, as among its conditions is the fact that there must not be lags dependent variable and the DW test cannot check for the correlation between the error term and its distant previous values (error term at time t and t -2). As opposed to DW test, the Breusch-Godfrey test statistic would be appropriate for the study for its ability to execute joint test for serial correlation which accounts for error term and several lags of error term simultaneously (Brooks, 2008). Breusch-Godfrey test statistic is tested under the null hypothesis that the current error term and its previous values are independent from one another (not autocorrelated). The null hypothesis of no autocorrelation is rejected if the chi-square statistic is statistically significant (Brooks, 2008). The ramifications associated with the presence of serial correlation are analogous to those identified under heteroscedasticity.

The other assumption of CLRM is that the error term is normally distributed; implying that the entire distribution is not skewed, is symmetrical about its mean value and has a kurtosis of 3. Kurtosis measures the fatness of the tails of the distribution. The skewed distribution can be illustrated by having one tail that is longer than the other tail. Under this approach, the tested null hypothesis is that residuals are normally distributed, and such a null hypothesis is rejected in favour of the alternative if the histogram is not bell-shaped and the p-value for Jarque-Bera test statistic is statistically significant (Brooks, 2008; Gujarati, 2004).

4.5.2. Stability diagnostic test

There are two common tests for parameter stability tests and the tests are cumulative sum (CUSUM) and cumulative sum of squares. Both CUSUM and CUSUM of squares are widely applied as opposed to other stability tests (for instance, chow test), as the application of the latter requires a prior knowledge of the type of the coefficient variation demonstrated by the parameters of the model (Caporale & Pittis, 2004). The tests are performed under the null hypothesis of parameter stability against the alternative hypothesis of parameter variation. With CUSUM statistic that is assumed to be zero, the null hypothesis is rejected against the alternative hypothesis of parameter variation provided the CUSUM statistic lies outside a standard error band of ±2 that is plotted around zero. Similarly, with CUSUM of squares which takes the value that ranges between zero and one, the null hypothesis of parameter stability is rejected against the alternative hypothesis of parameter instability, if the statistic lies outside the standard error band of ±2 that is plotted around zero (Brooks, 2008).

Ramsey RESET test was applied in this study to check whether there is a presence of misspecification of the functional form employed in the study. The null hypothesis applicable to Ramsey RESET test is that the linear regression model is appropriately specified, and if both F -statistic and chi-square statistic are statistically significant, the null hypothesis would be rejected in favour of the alternative hypothesis of misspecification of the model (Brooks, 2008).

4.6. Conclusion

This chapter provided a detailed description of the econometric techniques which have been identified to be appropriate and reliable in helping to explore the established objectives of the study. These econometric techniques include the ARDL approach, ARDL bounds testing for cointegration, and ARDL-ECM based. The sign of a cointegrated relationship between the selected variables would mean that saving and investment have a cointegrating relationship. Key among the reasons why the ARDL approach is the preferred is its ability to accommodate a series of mixed order of integration but not exceeding I (1), which means that all the variables in this study do not have to be integrated of the same order of I (1) as it is the requirement for other econometric estimation techniques. The next chapter presents the data analysis in which the established econometrics estimation techniques in this chapter were applied, and the results thereof analysed.

CHAPTER 5: DATA ANALYSIS AND EMPIRICAL RESULTS

5.1. Introduction

This chapter gives a detailed analysis of the empirical results established with the application of the models and estimation techniques covered in the previous chapter. The study utilised the EViews 10 statistical package. The unit root test results which help to determine the order of integration of series are reported. The results of the cointegrating relationship between the variables are also reported. The ARDL bounds cointegrating test has been applied to produce the results. Moreover, both the long-run and short-run coefficients results, and the analysis of these results are reported. These results are produced through an application of ARDL approach and ARDL- ECM approach. Lastly, the concluding remarks that summarise the chapter are provided.

5.2. Econometric estimation techniques results

5.2.1. Unit root test results

This study applied the commonly used ADF and PP tests to determine the presence of unit root in the series. Furthermore, Perron's test for structural change is also adopted to account for possible structural breaks when testing for the presence of unit root. The ADF, PP and Perron's tests results for all the variables are reported in Table 5.1 below. The ADF test results show that LINV and LSAV series are both stationary at first difference and the presence of the unit roots in these variables are statistically significant at 1% level for the model that contains the intercept only as well as the model that contains intercept and trend. This is interpreted as the variables being integrated of order one I (1). The ADF test results further revealed that the control variables of LGDP is stationary at first difference, with LIR and LINF being stationary at levels, although statistically significant at different levels. LIR is stationary and statistically significant at 10% level. LINF is stationary and statistically significant at 5% level. The LGDP is integrated of order one I (1), whereas LIR and LINF are integrated of order zero I (0).

Similarly, the PP test results revealed that LINV, LSAV and LGDP are stationary at first difference and with the LINF being stationary at level. Contrastingly, with the PP test, the results revealed that the LIR is only stationary at first difference. Overall, both the ADF and PP tests signal that there is a presence of mixed results contained within the variables and these mixed results take the form of I (0) and I (1). The results of the Perron unit root test indicate that all the variables are non-stationary with structural breaks at levels, however, with first difference all variables are stationary with structural breaks at the 1% level.

Given that the ARDL technique is capable of accommodating series with different order of integration, therefore, the combination of the variables which are stationary at levels and first difference are well suited for the model and pose no threat to the robustness of the results.

Table 5.1: Unit root test results

	Augmented Dickey – Fuller (ADF) test (t-statistic)			
Variables	**Level**		**First Differences**	
	Intercept	**Intercept & Trend**	**Intercept**	**Intercept & Trend**
LINV	-1.699399	-0.935531	-6.124406	-6.339391
	(0.4284)	(0.9471)	(0.0000) ***	(0.0000) ***
LSAV	-1.724426	-3.105018	-10.59264	-10.78592
	(0.4159)	(0.1109)	(0.0000) ***	(0.0000) ***
LGDP	-1.651926	-0.549978	-5.311119	-5.581584
	(0.4524)	(0.9795)	(0.0000) ***	(0.0001) ***
LIR	-1.639855	-3.230796	-5.797510	-5.766607
	(0.4585)	(0.0845) *	(0.0000) ***	(0.0000) ***
LINF	-2.903625	-0.207091	-9.385708	-10.31947
	(0.0485) **	(0.9921)	(0.0000) ***	(0.0000) ***
	Phillip- Perrons (PP) test (t- Statistic)			
LINV	-1.806175	-0.786694	-6.069380	-6.302982
	(0.3756)	(0.9628)	(0.0000) ***	(0.0000) ***
LSAV	-1.793189	-2.931285	-13.80970	-14.86231
	(0.3819)	(0.1574)	(0.0001) ***	(0.0000) ***
LGDP	-1.944560	-0.249166	-5.253457	-5.550800
	(0.3109)	(0.9911)	(0.0000) ***	(0.0001) ***
LIR	-1.309726	-2.577635	-5.776917	-5.745898
	(0.6227)	(0.2914)	(0.0000) ***	(0.0000) ***
LINF	-2.968341	-0.151347	-9.410930	-10.33292
	(0.0414) **	(0.9933)	(0.0000) ***	(0.0000) ***
	Perron's test for structural change (t-statistic)			
LINV	-2.967460	-3.044053	-7.274896***	-7.260536***
LSAV	-2.775657	-4.699910	-12.69776***	-12.65479***
LGDP	-2.716623	-3.431632	-6.417299***	-6.734670***
LIR	-4.744329	-4.623013	-7370116***	-7.436673***
LINF	-1.541949	-3.012375	-6.645037***	-6.675579***

Source: Author's calculations

Note: *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively. The probability value is indicated in parentheses.

5.2.2. VAR Lag Order Selection Criteria results

The previous studies of Liew (2004) and Hacker and Hatemi-J (2009) have identified Akaike's Information Criteria (AIC), Final Prediction Error (FPE) and Schwarz Information Criteria (SC) as the most preferred criteria for determining the optimal lag order selection. The popularity and acceptability of these criteria have been supported by, among others, their ability to minimise the chances of under estimation while simultaneously maximising the chances of obtaining the accurate lag length. These widely used criteria are argued to lead to consistent estimated results in the presence of non-stationary and stationary series (Gonzalo & Pitarakis, 2002). The chosen optimal lag length for the study is 3, and this is based on the AIC results, which has reported more negative value than the other preferred criteria. These results are reported in Table 5.2.

Table 5.2: VAR Order Selection Criteria results

LAG	LOGL	LR	FPE	AIC	SC	HQ
0	482.1564	NA	2.15e-11	-10.37297	-10.23591	-10.31765
1	1205.285	1351.935	5.52e-18	-25.54966	-24.72734*	-25.21777*
2	1241.460	63.69961	4.35e-18	-25.79260	-24.28501	-25.18412
3	1268.999	45.49952*	4.17e-18*	-25.84780*	-23.65494	-24.96274
4	1280.293	17.43284	5.74e-18	-25.54985	-22.67173	-24.38822
5	1300.891	29.55311	6.57e-18	-25.45415	-21.89075	-24.01593
6	1316.020	20.06298	8.62e-18	-25.23957	-20.99091	-23.52478
7	1332.827	20.46065	1.12e-17	-25.06146	-20.12753	-23.07009
8	1349.881	18.90759	1.49e-17	-24.88872	-19.26952	-22.62077

Source: Author's calculations
Notes:
***** Indicates lag order selected by the criteria.
LR: Sequential modified LR test statistics (each test at 5% level).
FPE: Final Prediction Error.
AIC: Akaike Information Criteria.
SC: Schwarz Information Criteria.
HQ: Hannan-Quinn Information Criteria.

5.2.3. ARDL bounds cointegrating test results

The cointegrating relationship between the series has been tested through the application of the ARDL bounds cointegrating test. The results of the test are reported in Table **5.3** and are based on the AIC optimal lag length selected ARDL (2, 3, 0, 3, 0). The results revealed that there is an existence of cointegrating relationship among the variables. This is shown by F- statistics of 8.38 which exceeds upper bound (5.06) and lower bound (3.74) critical values at 1% level of significance. This implies that over the period covered in the study, investment, saving, gross domestic product, interest rate and the inflation rate are cointegrated.

Table 5.3: F-Bounds Test for Cointegration

Dependent Variable	Regressors	Asymptotic critical values						F-Statistic (Bounds test)
		10%		5%		1%		
		I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	
LINV	LSAV, LGDP, LIR & LINF	2.45	3.52	2.86	4.01	3.74	5.06	8.38***

Source: Author's calculations
Notes: *** denotes statistical significance at 1 % levels, respectively.

5.2.4. Long run and short run estimated coefficients results

The long run and short run effects are estimated using the ARDL model and ARDL- ECM model. The results of the long run and short run coefficients are presented in Table 5.4 and Table 5.5, respectively.

Table 5.4: Long run estimated coefficients

Dependent	Regressors	Coefficient	Std. Error	t- Statistic	Prob.
LINV	LSAV	-0.006584	0.137875	-0.047754	0.9620
	LGDP	3.840561***	0.339479	11.31309	0.0000
	LIR	0.122064**	0.058672	2.080455	0.0405
	LINF	-0.882870***	0.168991	-5.224349	0.0000
	C	-9.609571***	1.739956	-5.522882	0.0000

Source: Author's calculations
Notes: ** and *** denote statistical significance at 5% and 1 % levels, respectively.

The long run estimated coefficient of LSAV that is statistically insignificant and negative, (see Table 5.4), reveals that saving has no long run effect on investment within the period of the study. Economic reasoning maintains that the non-existence of a long run impact of domestic saving on domestic investment, can be attributed to foreign saving which the South Africa economy is highly reliant on in order to finance the other portion of domestic investment (Nowak & Ricci, 2005). This is evidently connected to the economic theory which maintains that investment can be financed by domestic and foreign saving. Also, it should be noted that foreign saving is influenced by the stability of the economic policy direction of a specific country. That supports the prevailing non existing long run effect between domestic saving and investment. Furthermore, the results reported in Table 5.4 reveal that LGDP, LIR and LINF have a long run effect on the LINV. The long run coefficient of LGDP is positive and statistically significant at 1% level. This positive elasticity implies that a 1% increase in gross domestic product (GDP) will result in 3.84% increase in investment. Regarding the LIR, the long run coefficient is positive and statistically significant at 5% level and this positive result implies that a 1% increase in the interest rate will result in 0.12% increase in investment. As for the LINF, the long run coefficient is negative and statistically significant at 1% level. This negative result suggests that a 1% increase in the inflation rate will result in 0.88% decrease in investment. Overall, the results reveal that among all the explanatory variables, only saving is not statistically significant in determining investment in the long run and this is the variable of interest.

Table 5.5: Short run estimated coefficients

Dependent	Regressor	Coefficient	Std. Error	t-Statistic	Prob.
DINV	D (LINV (-1))	0.270149***	0.079459	3.399868	0.0010
	D (LSAV)	0.044428*	0.024905	1.783895	0.0781
	D (LSAV (-1))	-0.015723	0.024715	-0.636177	0.5264
	D (LSAV (-2))	0.044466*	0.025123	1.769932	0.0804
	D (LIR)	0.061794*	0.033509	1.844083	0.0687
	D (LIR (-1))	0.010033	0.037869	0.264933	0.7917
	D (LIR (-2))	-0.082286***	0.032688	-2.517330	0.0137
	C	-9.609571***	1.449169	-6.631092	0.0000
	ECM_{t-1}	-0.239494***	0.036106	-6.633070	0.0000

Source: Author's calculations
Notes: *, ** and *** denote statistical significance at 10%, 5% and 1 % levels, respectively.

It should be noted that the short run coefficients are reported in differenced form. According to the results (see Table 5.5), both the contemporaneous and two-period lag LSAV have a short run impact on LINV. The short run estimated coefficients of both the contemporaneous LSAV and two-period lag of LSAV are positive and statistically significant at the 10% level. The result of both the contemporaneous and two-period lag LSAV implies that a 1% increase in the saving will result in 0.04% increase in investment. It is only for a one-period lag of LSAV, that a negative and statistically insignificant relationship is reported. Therefore, it can be concluded that a statistically significant positive shot run relationship exists between saving and investment in SA for the period covered by the study. This is supported by the net short run effect of saving of 0.088894 on investment. The net short run effect of saving is given by adding the 0.044428 and 0.044466 coefficients of contemporaneous saving and two-period lag saving, respectively. The statistically insignificant coefficient of the one-period lag of saving is treated as zero. This concurs with the empirical findings of Hundie (2016). However, this was found in the context of Ethiopia. The one-period lag of LINV is revealed to have a short run effect on the contemporaneous LINV. This is revealed by a positive short-run estimated coefficient that is statistically significant at 1% level. This positive coefficient implies that a 1% increase in one-period lag of investment will result in 0.27% increase in the contemporaneous investment.

Regarding the LIR, mixed results are revealed, suggesting that the interest rate has either positive or negative short run effects on investment. The short run coefficient of the current LIR is positive and statistically significant at 10% level whereas the short run coefficient of two-period lag LIR is negative and statistically significant at 1% level. The one period lag error correction term (ECM_{t-1}) is -0.23 and statistically significant at 1% level. This implies that if investment deviates upward (downward) in its long run relationship with the cointegrating variables by 1% in the previous period, therefore in the current period it adjusts downwards (upwards) by 0.23%. It will take over two quarters for the half-life (50%) of the disequilibrium to be reduced and over four quarters for the disequilibrium to be fully eliminated. Overall, the empirical results reveal that across all the variables of the model, it is only one-period lag investment, two-period lag and current saving, as well two-period lag and current interest rate that are statistically significant in determining the investment rate in the short run.

5.2.5. Diagnostic test results

The diagnostic test results are reported in Table 5.6 and Figure 5.1 and indicate that the ARDL model passed both the residual and stability diagnostic tests. The residuals have proven to be accurate and reliable as there is no sign of serial correlation, heteroscedasticity, and skewed distribution but rather normally distributed model. For heteroscedasticity and serial correlation, this is confirmed by the fact that F-statistics and Chi-square are statistically insignificant and therefore their null hypothesis cannot be rejected. The null hypothesis of no serial correlation is not rejected in favour of the alternative hypothesis. Moreover, the model is normally distributed as the p-value for Bera-Jarque statistic is statistically insignificant, and the null hypothesis is not rejected. The model appeared to be correctly specified, as the F-statistic is statistically insignificant, and the null hypothesis is not rejected.

Table 5.6: Residual diagnostic test results

Diagnostic test	Statistic		Prob.
Serial Correlation LM Test:	F-statistic:	1.167928	0.3161
Breusch- Godfrey	Obs*R-squared:	2.686617	0.2610
Heteroskedasticity Test: White	F-statistic:	1.270124	0.2446
	Obs*R-squared:	73.25219	0.3099
Normality Test:	Skewness:	0.261406	
	Kurtosis:	2.785095	0.524302
	Jarque Bera:	1.291395	
Ramsey RESET test	F-statistic:	2.418372	0.1237
	t-statistic:	1.555112	0.1237

Source: Author's calculations

From the results, it is clear that there is stability of the coefficients of the estimated ARDL model. This is given by cumulative sum (CUSUM) line which is lying inside a standard error band of ±2 that is plotted around zero at 5% level of significance. Similarly, the cumulative sum (CUSUM) of squares result proves that the parameters of the model are stable, as the CUMSUM of squares line is within the critical bounds at 5% level of significance (see Figure 5.1)

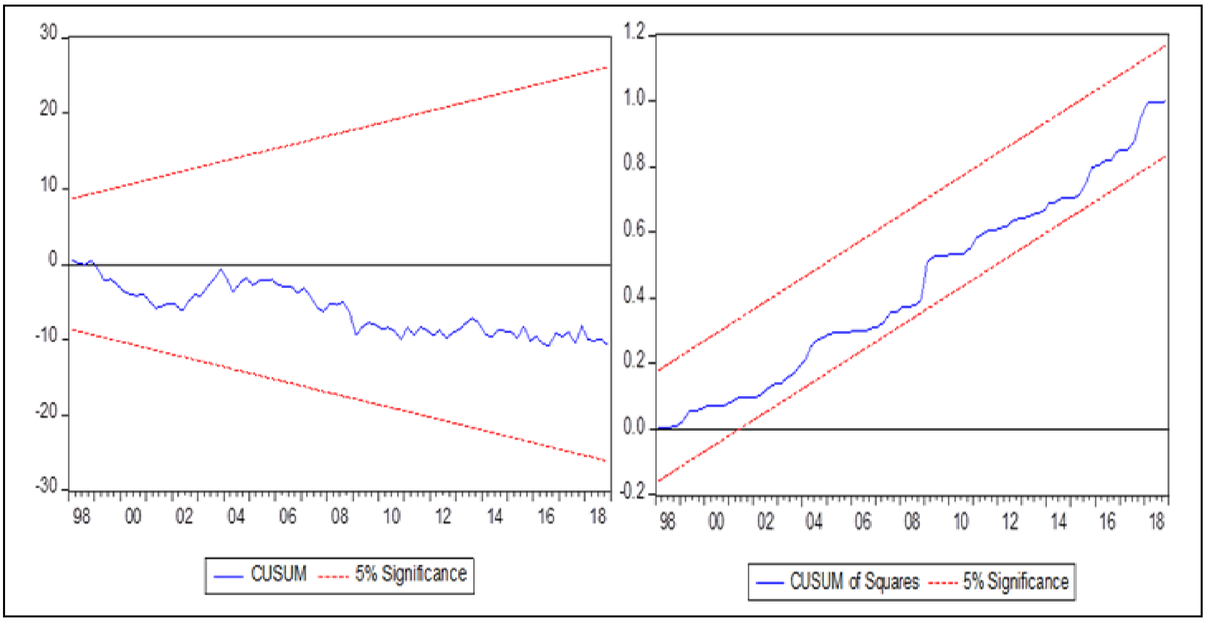

Figure 5.1: CUSUM AND CUSUM of Squares Test results

Source: Author's compilation

5.3. Conclusion

The study applied the ARDL bounds cointegrating test to determine the long run relationship between saving and investment. The additional control variables used include gross domestic product (GDP), interest rate and the inflation rate. The results revealed the existence of a cointegrating relationship between the variables. In determining the long run and short run effects of saving on investment, the ARDL-ECM approach was adopted. In the short run, saving was found to have a positive effect on investment. However, in the long run, it is concluded that saving has no effect on investment, given the lack of statistical significance of saving in determining the investment in the long run. The results suggest that to stimulate investment in the short run the policy direction should be directed towards increasing saving. For investment to be stimulated in the long run, it should only be through increasing GDP and interest rate and decreasing the inflation rate, as saving has no influence over investment. The model that produced these results has been correctly specified and the estimated parameters are accurate, reliable, and stable and these have been confirmed by the adoption of Ramsey RESET test as well as stability and residual diagnostic tests. The next chapter provides a summary, recommendations, and conclusion of the study.

CHAPTER 6: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1. Introduction

This chapter summarises the main findings of the study and provide conclusions and recommendations. Section 6.2 provides a summary of the findings with recommendations to follow in section 6.3. In section 6.4 areas for future research are identified followed by concluding remarks in section 6.5.

6.2. Summary of findings

The aim of the study is to examine the relationship between saving and investment in South Africa during the period 1994Q1-2018Q4. To achieve this aim, the study was guided by four objectives. Firstly, the study analysed the trend between saving and investment. Secondly, the long run relationship between investment and saving was examined. Thirdly, the study determined the long run effect of saving over investment. Fourthly, the study determined the short run effect of saving over investment. The trend analysis, which sought to establish the direction of trend that saving and investment took during the period of analysis, indicated that these variables have taken a diverging trend. This annual trend has shown a declining saving whereas with respect to investment it has shown an increasing trend.

In examining the second objective, the ARDL bounds cointegrating test was adopted and a cointegrating relationship between the variables was found to exist. This result confirms the empirical findings of, among others, Adedeji and Thornto (2007), Onafowara, Oweye et al. (2011), Behera (2015), Dritsaki (2015), Khundrakpam and Ranjan (2010), Mishra, Das et al. (2010), Nurul, Zulkifli et al. (2014), Kaur and Sarin (2019), and Joshi, Pradhan et al. (2019) in as far as the existence of the cointegrating relationship between these variables of interest is concerned.

The ARDL approach was adopted to help achieve the third objective, which has to do with determination of the long run effect that saving has on investment. The result, unexpectedly, revealed a negative and statistically insignificant coefficient for saving. In other words, this leads to the conclusion that saving has no effect on investment in the long run. However, in the short run, saving was found to have a positive and statistically significant effect on investment. This fourth objective was achieved through the utilisation of the ARDL-ECM approach.

The study adopted control variables which include the gross domestic product (GDP), interest rate and the inflation rate. The GDP and interest rate have a positive and statistically significant impact on investment whereas the inflation rate has a negative and statistically significant impact on investment, all in the long run.

6.3. Recommendations

In accordance with the findings of the study, the following recommendations could be considered:

- In the short run, policy measures should be directed towards increasing saving in order to stimulate investment since saving was found to have a positive short run effect on investment.
- In the long run, policy measures should be directed towards increasing gross domestic product (GDP) and interest rate for investment to be increased.
- Policy measures should also be directed towards decreasing long run inflation rate in order to stimulate investment.

6.4. Areas for future research

- The current study examined the relationship between saving and investment over a relatively short period 1994-2018. Future studies should consider expanding the period, and ultimately increase the sample size. Different frequencies of data (e.g., monthly, or annual) could also be considered.
- Given that the current study has been limited to the relationship between investment and saving, future studies could seek the determinants of both saving and investment. This could also be complemented with an examination of the direction of causality between the variables.
- As mentioned in Chapter 1, the focus of this research was on domestic investment. Future research could broaden its scope to also include foreign direct investment (FDI).

6.5. Conclusion

The investment and saving nexus are a highly debated and contentious subject matter in the theoretical and empirical economic literature. This current situation therefore suggests that no consensus has been reached in as far as the relationship between these variables is concerned. Additionally, in South Africa during the analysis period, these variables of interest appeared to have diverging trends and to be low compared to the prevailing global averages of investment and saving, when measured as a percentage of GDP. The study contributes to the ongoing debates on the relationship between investment and saving in several ways. The study adopted the multivariate modelling approach and considered adding control variables that are influential to the primary variables, and this approach has received less attention, particularly in examining the relationship among the investment and saving. With the application of ARDL bounds cointegrating test, the study was able to determine and reveal the existence of a long run relationship among the variables.

Furthermore, in a South Africa context, it could be concluded that over the period 1994Q1-2018Q4, the postulation of the classical school of economic thought is supported which states that saving has a positive impact on investment. This is confirmed by the established short run positively significant results reported in the study. The empirical findings suggest that to stimulate investment in the short run, South African policymakers should implement policy measures directed towards increasing saving, as increased saving will result in increased investment. While foreign saving does not fall within the scope of the current study, however, the economic reasoning maintains that the non-existence of a long run impact of domestic saving on domestic investment observed in the study can be attributed to foreign saving. Therefore, to attract high foreign saving in order to boost domestic investment the policymakers should consider adopting business friendly policy measures.

Given that the control variables (GDP, interest rate and inflation) have an influence on investment in the long run, it is therefore suggested that special policy measures that support increasing GDP and higher interest rate should be implemented, as the outcome will translate into an increased investment. At the same time, policy measures that suppress inflation should be implemented if South African policymakers wish to achieve increased investment in the long run.

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APPENDICES

APPENDIX 1: UTILISED DATA

1.1. LOGGED DATA

YEAR	LGDP	LINV	LSAV	LIR	LINF	LFCE
1994Q1	14.30	12.25	11.27	2.72	3.11	12.92
1994Q2	14.31	12.27	11.32	2.72	3.12	12.95
1994Q3	14.32	12.30	11.33	2.75	3.12	12.97
1994Q4	14.34	12.34	11.59	2.79	3.15	13.00
1995Q1	14.34	12.36	11.38	2.84	3.18	13.03
1995Q2	14.35	12.40	11.42	2.86	3.20	13.06
1995Q3	14.35	12.40	11.58	2.92	3.24	13.10
1995Q4	14.35	12.41	11.61	2.92	3.26	13.13
1996Q1	14.37	12.44	11.54	2.92	3.27	13.16
1996Q2	14.39	12.47	11.60	3.00	3.29	13.19
1996Q3	14.40	12.49	11.60	2.97	3.30	13.22
1996Q4	14.41	12.50	11.59	2.99	3.32	13.25
1997Q1	14.41	12.52	11.62	3.01	3.35	13.27
1997Q2	14.42	12.53	11.67	3.01	3.36	13.29
1997Q3	14.42	12.54	11.63	3.01	3.38	13.31
1997Q4	14.42	12.54	11.66	2.96	3.40	13.33
1998Q1	14.42	12.56	11.72	2.94	3.42	13.35
1998Q2	14.42	12.56	11.74	2.97	3.45	13.37
1998Q3	14.42	12.59	11.71	3.22	3.46	13.39
1998Q4	14.42	12.60	11.74	3.16	3.48	13.42
1999Q1	14.43	12.53	11.80	3.04	3.49	13.44
1999Q2	14.44	12.49	11.86	2.93	3.50	13.47
1999Q3	14.45	12.48	11.85	2.82	3.53	13.50
1999Q4	14.46	12.50	11.83	2.74	3.55	13.53
2000Q1	14.47	12.51	11.87	2.67	3.56	13.56
2000Q2	14.48	12.53	11.90	2.67	3.59	13.58
2000Q3	14.49	12.55	11.95	2.67	3.62	13.61
2000Q4	14.50	12.57	12.04	2.67	3.64	13.63
2001Q1	14.51	12.57	12.03	2.67	3.65	13.66
2001Q2	14.51	12.57	11.93	2.66	3.67	13.69
2001Q3	14.51	12.57	12.01	2.59	3.68	13.72
2001Q4	14.52	12.56	12.14	2.56	3.71	13.75
2002Q1	14.53	12.58	12.21	2.66	3.76	13.78
2002Q2	14.55	12.59	12.18	2.73	3.78	13.81
2002Q3	14.55	12.61	12.29	2.79	3.80	13.83
2002Q4	14.56	12.63	12.31	2.83	3.82	13.85
2003Q1	14.57	12.65	12.27	2.83	3.83	13.87
2003Q2	14.57	12.68	12.18	2.80	3.84	13.90
2003Q3	14.58	12.71	12.32	2.67	3.85	13.93
2003Q4	14.59	12.75	12.35	2.47	3.87	13.96
2004Q1	14.60	12.78	12.37	2.44	3.89	13.99
2004Q2	14.61	12.80	12.32	2.44	3.91	14.02

2004Q3	14.63	12.84	12.35	2.41	3.91	14.05
2004Q4	14.64	12.87	12.37	2.40	3.93	14.08
2005Q1	14.65	12.88	12.40	2.40	3.94	14.10
2005Q2	14.67	12.91	12.42	2.35	3.95	14.13
2005Q3	14.68	12.94	12.44	2.35	3.97	14.15
2005Q4	14.69	12.97	12.44	2.35	3.99	14.18
2006Q1	14.71	12.99	12.46	2.35	3.99	14.20
2006Q2	14.72	13.02	12.59	2.37	4.01	14.24
2006Q3	14.74	13.05	12.64	2.43	4.04	14.27
2006Q4	14.75	13.09	12.59	2.50	4.06	14.30
2007Q1	14.76	13.14	12.75	2.53	4.09	14.33
2007Q2	14.77	13.16	12.72	2.54	4.10	14.36
2007Q3	14.78	13.17	12.63	2.59	4.11	14.39
2007Q4	14.80	13.19	12.71	2.65	4.14	14.41
2008Q1	14.80	13.24	12.90	2.67	4.17	14.44
2008Q2	14.82	13.27	12.95	2.72	4.18	14.45
2008Q3	14.82	13.31	12.89	2.74	4.21	14.47
2008Q4	14.81	13.34	13.03	2.73	4.22	14.49
2009Q1	14.80	13.26	12.98	2.64	4.24	14.50
2009Q2	14.79	13.23	13.02	2.46	4.25	14.53
2009Q3	14.80	13.20	13.04	2.37	4.28	14.55
2009Q4	14.80	13.19	13.04	2.35	4.30	14.57
2010Q1	14.81	13.18	13.04	2.34	4.30	14.59
2010Q2	14.82	13.18	13.12	2.30	4.32	14.62
2010Q3	14.83	13.18	13.09	2.29	4.33	14.64
2010Q4	14.84	13.17	13.19	2.22	4.35	14.67
2011Q1	14.85	13.20	13.17	2.20	4.36	14.69
2011Q2	14.86	13.22	13.14	2.20	4.38	14.72
2011Q3	14.86	13.25	13.17	2.20	4.41	14.74
2011Q4	14.87	13.26	13.23	2.20	4.42	14.76
2012Q1	14.87	13.25	13.14	2.20	4.42	14.79
2012Q2	14.88	13.27	13.05	2.20	4.43	14.81
2012Q3	14.88	13.26	13.07	2.14	4.44	14.83
2012Q4	14.89	13.27	13.08	2.14	4.46	14.85
2013Q1	14.89	13.29	13.16	2.14	4.48	14.87
2013Q2	14.90	13.32	13.22	2.14	4.50	14.89
2013Q3	14.91	13.35	13.18	2.14	4.50	14.91
2013Q4	14.92	13.36	13.26	2.14	4.52	14.92
2014Q1	14.92	13.33	13.23	2.20	4.53	14.94
2014Q2	14.92	13.32	13.25	2.20	4.55	14.95
2014Q3	14.92	13.33	13.28	2.22	4.56	14.97
2014Q4	14.94	13.35	13.37	2.22	4.58	14.98
2015Q1	14.94	13.37	13.45	2.22	4.58	14.99
2015Q2	14.93	13.35	13.43	2.22	4.60	15.01
2015Q3	14.93	13.38	13.37	2.25	4.61	15.03
2015Q4	14.93	13.35	13.35	2.27	4.62	15.05
2016Q1	14.93	13.34	13.35	2.34	4.64	15.07
2016Q2	14.94	13.32	13.48	2.35	4.67	15.08

2016Q3	14.94	13.31	13.48	2.35	4.68	15.10
2016Q4	14.94	13.34	13.57	2.35	4.70	15.11
2017Q1	14.94	13.33	13.56	2.35	4.71	15.13
2017Q2	14.95	13.34	13.50	2.35	4.72	15.15
2017Q3	14.96	13.32	13.54	2.33	4.73	15.16
2017Q4	14.96	13.35	13.55	2.33	4.75	15.18
2018Q1	14.96	13.33	13.42	2.32	4.74	15.19
2018Q2	14.96	13.32	13.45	2.30	4.76	15.20
2018Q3	14.96	13.32	13.51	2.30	4.77	15.21
2018Q4	14.97	13.31	13.46	2.32	4.77	15.23

Source: Author’s compilation

APPENDIX 2: DATA RESULTS.

2.1. ARDL LONG RUN FORM AND BOUNDS TEST RESULTS.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LINV)
Selected Model: ARDL(2, 3, 0, 3, 0)
Case 3: Unrestricted Constant and No Trend
Date: 10/16/21 Time: 15:15
Sample: 1994Q1 2018Q4
Included observations: 97

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.609571	1.739956	-5.522882	0.0000
LINV(-1)*	-0.239494	0.042312	-5.660131	0.0000
LSAV(-1)	-0.001577	0.032949	-0.047857	0.9619
LGDP**	0.919791	0.158854	5.790178	0.0000
LIR(-1)	0.029234	0.016153	1.809824	0.0739
LINF**	-0.211442	0.054365	-3.889333	0.0002
D(LINV(-1))	0.270149	0.086213	3.133527	0.0024
D(LSAV)	0.044428	0.027725	1.602486	0.1128
D(LSAV(-1))	-0.015723	0.029899	-0.525865	0.6004
D(LSAV(-2))	0.044466	0.027929	1.592123	0.1151
D(LIR)	0.061794	0.035684	1.731693	0.0870
D(LIR(-1))	0.010033	0.039909	0.251391	0.8021
D(LIR(-2))	-0.082286	0.036098	-2.279527	0.0252

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSAV	-0.006584	0.137875	-0.047754	0.9620
LGDP	3.840561	0.339479	11.31309	0.0000
LIR	0.122064	0.058672	2.080455	0.0405
LINF	-0.882870	0.168991	-5.224349	0.0000

EC = LINV - (-0.0066*LSAV + 3.8406*LGDP + 0.1221*LIR -0.8829*LINF)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.399546	10%	2.45	3.52
k	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06
Actual Sample Size	97		Finite Sample: n=80	
		10%	2.548	3.644
		5%	3.01	4.216
		1%	4.096	5.512

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-5.660131	10%	-2.57	-3.66
		5%	-2.86	-3.99
		2.5%	-3.13	-4.26
		1%	-3.43	-4.6

Source: Author's compilation

2.2. ARDL – ECM MODEL TEST RESULTS

ARDL Error Correction Regression
Dependent Variable: D(LINV)
Selected Model: ARDL(2, 3, 0, 3, 0)
Case 3: Unrestricted Constant and No Trend
Date: 10/16/21 Time: 15:11
Sample: 1994Q1 2018Q4
Included observations: 97

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.609571	1.449169	-6.631092	0.0000
D(LINV(-1))	0.270149	0.079459	3.399868	0.0010
D(LSAV)	0.044428	0.024905	1.783895	0.0781
D(LSAV(-1))	-0.015723	0.024715	-0.636177	0.5264
D(LSAV(-2))	0.044466	0.025123	1.769932	0.0804
D(LIR)	0.061794	0.033509	1.844083	0.0687
D(LIR(-1))	0.010033	0.037869	0.264933	0.7917
D(LIR(-2))	-0.082286	0.032688	-2.517330	0.0137
CointEq(-1)*	-0.239494	0.036106	-6.633070	0.0000

R-squared	0.574951	Mean dependent var	0.010446
Adjusted R-squared	0.536310	S.D. dependent var	0.022926
S.E. of regression	0.015612	Akaike info criterion	-5.393409
Sum squared resid	0.021448	Schwarz criterion	-5.154519
Log likelihood	270.5803	Hannan-Quinn criter.	-5.296814
F-statistic	14.87934	Durbin-Watson stat	2.130873
Prob(F-statistic)	0.000000		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8.399546	10%	2.45	3.52
k	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-6.633070	10%	-2.57	-3.66
		5%	-2.86	-3.99
		2.5%	-3.13	-4.26
		1%	-3.43	-4.6

Source: Author's compilation

2.3. RESIDUAL DIAGNOSTICS TEST RESULTS.

2.3.1. Serial correlation LM test.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.997890	Prob. F(3,81)	0.3982
Obs*R-squared	3.457238	Prob. Chi-Square(3)	0.3264

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 10/16/21 Time: 15:21
Sample: 1994Q4 2018Q4
Included observations: 97
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINV(-1)	0.234077	0.231273	1.012125	0.3145
LINV(-2)	-0.203969	0.185629	-1.098800	0.2751
LSAV	0.009419	0.028385	0.331839	0.7409
LSAV(-1)	-0.009212	0.032735	-0.281402	0.7791
LSAV(-2)	0.013582	0.033670	0.403378	0.6877
LSAV(-3)	-0.009981	0.029384	-0.339685	0.7350
LGDP	-0.146925	0.239496	-0.613477	0.5413
LIR	0.002197	0.036381	0.060400	0.9520
LIR(-1)	-0.022714	0.065538	-0.346576	0.7298
LIR(-2)	0.015564	0.063658	0.244494	0.8075
LIR(-3)	0.005201	0.036241	0.143512	0.8862
LINF	0.038407	0.073002	0.526107	0.6003
C	1.562857	2.573308	0.607334	0.5453
RESID(-1)	-0.307790	0.255437	-1.204952	0.2317
RESID(-2)	0.079447	0.129707	0.612511	0.5419
RESID(-3)	0.098543	0.120634	0.816879	0.4164

R-squared	0.035642	Mean dependent var	-6.77E-16
Adjusted R-squared	-0.142943	S.D. dependent var	0.014947
S.E. of regression	0.015980	Akaike info criterion	-5.285372
Sum squared resid	0.020683	Schwarz criterion	-4.860677
Log likelihood	272.3405	Hannan-Quinn criter.	-5.113646
F-statistic	0.199578	Durbin-Watson stat	1.993959
Prob(F-statistic)	0.999434		

Source: Author’s compilation

2.3.2. Heteroskedasticity Test: White

Heteroskedasticity Test: White

F-statistic	1.270124	Prob. F(68,28)	0.2446
Obs*R-squared	73.25219	Prob. Chi-Square(68)	0.3099
Scaled explained SS	49.03060	Prob. Chi-Square(68)	0.9599

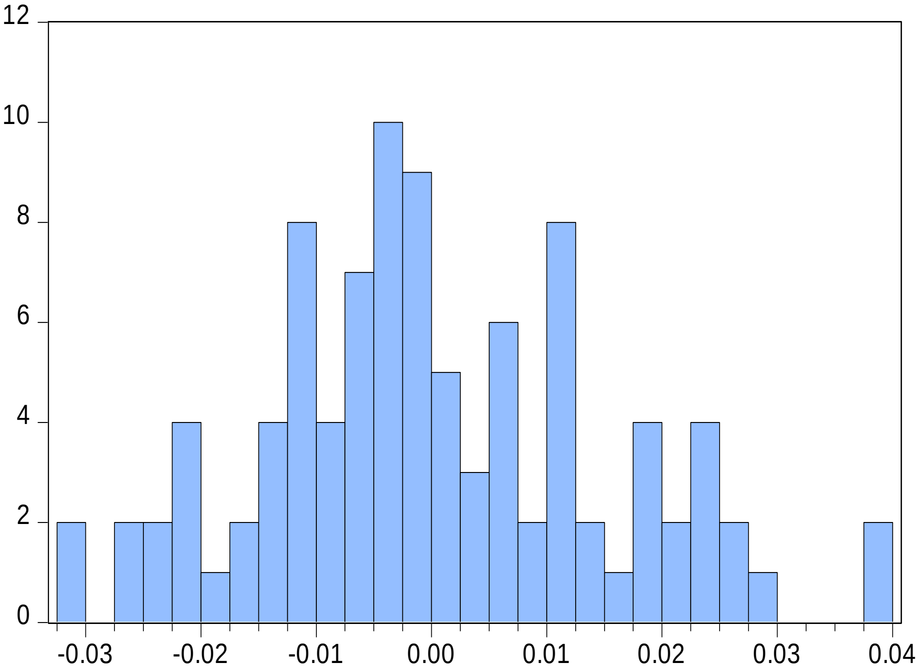
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/16/21 Time: 15:23
Sample: 1994Q4 2018Q4
Included observations: 97
Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.680250	0.679130	2.474120	0.0197
LINV(-1)^2	0.082263	0.024224	3.395883	0.0021
LINV(-1)*LINV(-2)	-0.054935	0.022538	-2.437474	0.0214
LINV(-1)*LSAV	-0.053230	0.025203	-2.112055	0.0437
LINV(-1)*LSAV(-1)	-0.007651	0.013020	-0.587618	0.5615
LINV(-1)*LSAV(-2)	-0.006658	0.011530	-0.577499	0.5682
LINV(-1)*LSAV(-3)	-0.008749	0.017236	-0.507577	0.6157
LINV(-1)*LGDP	-0.011456	0.016169	-0.708540	0.4845
LINV(-1)*LIR	-0.017705	0.106966	-0.165516	0.8697
LINV(-1)*LIR(-1)	-0.071186	0.167089	-0.426037	0.6733
LINV(-1)*LIR(-2)	0.022227	0.054948	0.404500	0.6889
LINV(-1)*LIR(-3)	0.030296	0.071531	0.423535	0.6751
LINV(-1)*LINF	0.006922	0.030795	0.224778	0.8238
LINV(-1)	-0.229055	0.101127	-2.265026	0.0314
LINV(-2)*LSAV	0.047214	0.020060	2.353598	0.0258
LINV(-2)*LIR	0.040651	0.105353	0.385853	0.7025
LINV(-2)*LIR(-1)	0.031677	0.158999	0.199226	0.8435
LINV(-2)*LIR(-3)	-0.026685	0.065953	-0.404608	0.6888
LSAV^2	0.012902	0.008898	1.450056	0.1582
LSAV*LSAV(-1)	-0.020473	0.017134	-1.194866	0.2422
LSAV*LSAV(-2)	0.006974	0.016460	0.423689	0.6750
LSAV*LSAV(-3)	-0.000531	0.012618	-0.042052	0.9668
LSAV*LGDP	-0.002704	0.011639	-0.232312	0.8180
LSAV*LIR	0.004005	0.036514	0.109694	0.9134
LSAV*LIR(-1)	0.035293	0.073465	0.480403	0.6347
LSAV*LIR(-2)	-0.046487	0.078723	-0.590510	0.5596
LSAV*LIR(-3)	0.010530	0.040910	0.257388	0.7988
LSAV*LINF	-0.009712	0.021909	-0.443276	0.6610
LSAV(-1)^2	0.004690	0.011681	0.401480	0.6911
LSAV(-1)*LGDP	0.008706	0.009469	0.919430	0.3657
LSAV(-1)*LIR	0.002065	0.050247	0.041092	0.9675
LSAV(-1)*LIR(-1)	-0.043068	0.094381	-0.456325	0.6517
LSAV(-1)*LIR(-2)	0.083543	0.103109	0.810238	0.4246
LSAV(-1)*LIR(-3)	-0.032710	0.055231	-0.592233	0.5584
LSAV(-1)*LINF	0.021831	0.019426	1.123846	0.2706
LSAV(-2)^2	-0.002388	0.009688	-0.246510	0.8071
LSAV(-2)*LSAV(-3)	0.002965	0.015212	0.194875	0.8469
LSAV(-2)*LGDP	0.002919	0.015161	0.192540	0.8487
LSAV(-2)*LIR	-0.018652	0.037332	-0.499638	0.6212
LSAV(-2)*LIR(-1)	0.061426	0.076430	0.803691	0.4283
LSAV(-2)*LIR(-2)	-0.057484	0.110046	-0.522361	0.6055
LSAV(-2)*LIR(-3)	0.012506	0.060975	0.205099	0.8390
LSAV(-2)*LINF	-0.003961	0.030634	-0.129302	0.8980
LSAV(-3)*LGDP	0.003196	0.016297	0.196111	0.8459
LSAV(-3)*LIR	0.025475	0.036593	0.696159	0.4921
LSAV(-3)*LIR(-1)	-0.041485	0.057242	-0.724727	0.4746
LSAV(-3)*LIR(-2)	0.010550	0.080535	0.130999	0.8967
LSAV(-3)*LIR(-3)	0.011357	0.046932	0.241982	0.8106
LSAV(-3)*LINF	0.005492	0.021394	0.256723	0.7993
LGDP*LIR	-0.010999	0.033375	-0.329553	0.7442
LGDP*LIR(-1)	0.025035	0.038437	0.651305	0.5202
LGDP*LIR(-2)	-0.001700	0.039476	-0.043073	0.9659
LGDP*LIR(-3)	-0.012257	0.021150	-0.579556	0.5668
LIR^2	0.028442	0.027013	1.052882	0.3014
LIR*LIR(-1)	-0.093433	0.110762	-0.843542	0.4061
LIR*LIR(-2)	-0.032913	0.072171	-0.456045	0.6519
LIR*LIR(-3)	0.065080	0.039642	1.641710	0.1118
LIR*LINF	-0.028146	0.057445	-0.489971	0.6280
LIR	-0.172825	0.235377	-0.734248	0.4689
LIR(-1)^2	0.094040	0.092161	1.020397	0.3163
LIR(-1)*LIR(-2)	-0.061775	0.126752	-0.487370	0.6298
LIR(-1)*LIR(-3)	-0.035555	0.069747	-0.509772	0.6142
LIR(-1)*LINF	-0.000489	0.082177	-0.005951	0.9953
LIR(-2)^2	0.045961	0.077647	0.591927	0.5586
LIR(-2)*LIR(-3)	-0.017662	0.071926	-0.245556	0.8078
LIR(-2)*LINF	-0.022072	0.068916	-0.320272	0.7511
LIR(-3)^2	0.004155	0.021871	0.189958	0.8507
LIR(-3)*LINF	0.015641	0.053927	0.290036	0.7739
LINF^2	-0.021784	0.021457	-1.015263	0.3187

R-squared	0.755177	Mean dependent var	0.000221
Adjusted R-squared	0.160608	S.D. dependent var	0.000297
S.E. of regression	0.000272	Akaike info criterion	-13.40090
Sum squared resid	2.07E-06	Schwarz criterion	-11.56940
Log likelihood	718.9435	Hannan-Quinn criter.	-12.66033
F-statistic	1.270124	Durbin-Watson stat	2.146174
Prob(F-statistic)	0.244602		

Source: Author’s compilation

2.3.3. Normality Test



Series: Residuals	
Sample 1994Q4 2018Q4	
Observations 97	
Mean	-6.77e-16
Median	-0.001296
Maximum	0.037899
Minimum	-0.032435
Std. Dev.	0.014947
Skewness	0.261406
Kurtosis	2.785095
Jarque-Bera	1.291375
Probability	0.524302

Source: Author’s compilation

2.4. STABILITY DIAGNOSTICS TEST RESULTS

2.4.1. Ramsey RESET test

Ramsey RESET Test
Equation: UNTITLED
Specification: LINV LINV(-1) LINV(-2) LSAV LSAV(-1) LSAV(-2) LSAV(-3) LGDP LIR LIR(-1) LIR(-2) LIR(-3) LINF C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.555112	83	0.1237
F-statistic	2.418372	(1, 83)	0.1237

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000607	1	0.000607
Restricted SSR	0.021448	84	0.000255
Unrestricted SSR	0.020840	83	0.000251

Unrestricted Test Equation:
Dependent Variable: LINV
Method: ARDL
Date: 10/16/21 Time: 15:28
Sample: 1994Q4 2018Q4
Included observations: 97
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LINV(-1)	2.096027	0.692087	3.028561	0.0033
LINV(-2)	-0.530411	0.187931	-2.822369	0.0060
LSAV	0.095287	0.042725	2.230221	0.0284
LSAV(-1)	-0.122494	0.049834	-2.458046	0.0161
LSAV(-2)	0.124600	0.051731	2.408602	0.0182
LSAV(-3)	-0.089629	0.040131	-2.233424	0.0282
LGDP	1.840095	0.612401	3.004725	0.0035
LIR	0.136449	0.059639	2.287918	0.0247
LIR(-1)	-0.049810	0.064576	-0.771350	0.4427
LIR(-2)	-0.187193	0.086607	-2.161396	0.0335
LIR(-3)	0.159591	0.061258	2.605237	0.0109
LINF	-0.434482	0.153222	-2.835646	0.0057
C	-26.01731	10.69100	-2.433571	0.0171
FITTED^2	-0.040686	0.026163	-1.555112	0.1237

R-squared	0.998279	Mean dependent var	12.95285
Adjusted R-squared	0.998009	S.D. dependent var	0.355145
S.E. of regression	0.015846	Akaike info criterion	-5.319037
Sum squared resid	0.020840	Schwarz criterion	-4.947429
Log likelihood	271.9733	Hannan-Quinn criter.	-5.168777
F-statistic	3703.093	Durbin-Watson stat	2.102041
Prob(F-statistic)	0.000000		

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

Source: Author’s compilation

2.5. UNIT ROOT TEST RESULTS.

2.5.1. Augmented Dickey -Fuller (ADF) Unit Root Test.

a) Augmented Dickey- Fuller Unit root test at level, containing constant without trend and constant with trend.

Saving- LSAV

Null Hypothesis: LSAV has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.724426	0.4159
Test critical values:	1% level	-3.499167	
	5% level	-2.891550	
	10% level	-2.582846	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LSAV)
Method: Least Squares
Date: 10/16/21 Time: 15:30
Sample (adjusted): 1994Q4 2018Q4
Included observations: 97 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSAV(-1)	-0.017072	0.009900	-1.724426	0.0880
D(LSAV(-1))	-0.290130	0.096873	-2.994958	0.0035
D(LSAV(-2))	-0.338470	0.097006	-3.489174	0.0007
C	0.250804	0.124891	2.008185	0.0475

R-squared	0.174620	Mean dependent var	0.022001
Adjusted R-squared	0.147995	S.D. dependent var	0.071272
S.E. of regression	0.065787	Akaike info criterion	-2.564437
Sum squared resid	0.402493	Schwarz criterion	-2.458263
Log likelihood	128.3752	Hannan-Quinn criter.	-2.521505
F-statistic	6.558458	Durbin-Watson stat	1.902260
Prob(F-statistic)	0.000452		

Null Hypothesis: LSAV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.105018	0.1109
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LSAV)
Method: Least Squares
Date: 10/16/21 Time: 15:44
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSAV(-1)	-0.211657	0.068166	-3.105018	0.0025
C	2.435681	0.773641	3.148336	0.0022
@TREND("1994Q1")	0.004843	0.001653	2.930213	0.0042

R-squared	0.099592	Mean dependent var	0.022123
Adjusted R-squared	0.080834	S.D. dependent var	0.070610
S.E. of regression	0.067696	Akaike info criterion	-2.517748
Sum squared resid	0.439943	Schwarz criterion	-2.439108
Log likelihood	127.6285	Hannan-Quinn criter.	-2.485930
F-statistic	5.309195	Durbin-Watson stat	2.167459
Prob(F-statistic)	0.006502		

Source: Author’s compilation

Investment- LINV

Null Hypothesis: LINV has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.699399	0.4284
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINV)
Method: Least Squares
Date: 10/17/21 Time: 09:20
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINV(-1)	-0.009848	0.005795	-1.699399	0.0925
D(LINV(-1))	0.411063	0.092344	4.451411	0.0000
C	0.133520	0.075156	1.776564	0.0788

R-squared	0.213709	Mean dependent var	0.010617
Adjusted R-squared	0.197155	S.D. dependent var	0.022870
S.E. of regression	0.020492	Akaike info criterion	-4.907429
Sum squared resid	0.039893	Schwarz criterion	-4.828297
Log likelihood	243.4640	Hannan-Quinn criter.	-4.875421
F-statistic	12.91020	Durbin-Watson stat	2.059546
Prob(F-statistic)	0.000011		

Null Hypothesis: LINV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.935531	0.9471
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINV)
Method: Least Squares
Date: 10/17/21 Time: 09:22
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINV(-1)	-0.018851	0.020150	-0.935531	0.3519
D(LINV(-1))	0.422264	0.095783	4.408550	0.0000
C	0.243701	0.247858	0.983227	0.3280
@TREND("1994Q1")	0.000122	0.000261	0.466689	0.6418

R-squared	0.215527	Mean dependent var	0.010617
Adjusted R-squared	0.190490	S.D. dependent var	0.022870
S.E. of regression	0.020577	Akaike info criterion	-4.889335
Sum squared resid	0.039800	Schwarz criterion	-4.783826
Log likelihood	243.5774	Hannan-Quinn criter.	-4.846659
F-statistic	8.608534	Durbin-Watson stat	2.070587
Prob(F-statistic)	0.000042		

Source: Author’s compilation

Gross domestic product (GDP)- LGDP

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.651926	0.4524
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 10/17/21 Time: 09:35
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.004077	0.002468	-1.651926	0.1019
D(LGDP(-1))	0.510919	0.087324	5.850818	0.0000
C	0.063097	0.036391	1.733856	0.0862

R-squared	0.318758	Mean dependent var	0.006696
Adjusted R-squared	0.304416	S.D. dependent var	0.005992
S.E. of regression	0.004997	Akaike info criterion	-7.729728
Sum squared resid	0.002372	Schwarz criterion	-7.650596
Log likelihood	381.7567	Hannan-Quinn criter.	-7.697721
F-statistic	22.22554	Durbin-Watson stat	2.046246
Prob(F-statistic)	0.000000		

Null Hypothesis: LGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.549978	0.9795
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 10/17/21 Time: 09:35
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.008616	0.015665	-0.549978	0.5836
D(LGDP(-1))	0.518614	0.091583	5.662793	0.0000
C	0.127937	0.223974	0.571214	0.5692
@TREND("1994Q1")	3.47E-05	0.000118	0.293434	0.7698

R-squared	0.319381	Mean dependent var	0.006696
Adjusted R-squared	0.297659	S.D. dependent var	0.005992
S.E. of regression	0.005021	Akaike info criterion	-7.710235
Sum squared resid	0.002370	Schwarz criterion	-7.604726
Log likelihood	381.8015	Hannan-Quinn criter.	-7.667559
F-statistic	14.70319	Durbin-Watson stat	2.055207
Prob(F-statistic)	0.000000		

Source: Author’s compilation

Interest rate-LIR

Null Hypothesis: LIR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.230796	0.0845
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIR)
Method: Least Squares
Date: 10/17/21 Time: 09:52
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIR(-1)	-0.103351	0.031989	-3.230796	0.0017
D(LIR(-1))	0.528396	0.087155	6.062750	0.0000
C	0.305495	0.095666	3.193339	0.0019
@TREND("1994Q1")	-0.000888	0.000323	-2.750164	0.0071

R-squared	0.307641	Mean dependent var	-0.004137
Adjusted R-squared	0.285544	S.D. dependent var	0.056624
S.E. of regression	0.047862	Akaike info criterion	-3.201032
Sum squared resid	0.215332	Schwarz criterion	-3.095523
Log likelihood	160.8506	Hannan-Quinn criter.	-3.158356
F-statistic	13.92255	Durbin-Watson stat	1.965959
Prob(F-statistic)	0.000000		

Null Hypothesis: LIR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.639855	0.4585
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIR)
Method: Least Squares
Date: 10/17/21 Time: 09:51
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIR(-1)	-0.028700	0.017501	-1.639855	0.1043
D(LIR(-1))	0.496147	0.089296	5.556233	0.0000
C	0.070891	0.044772	1.583363	0.1167

R-squared	0.251932	Mean dependent var	-0.004137
Adjusted R-squared	0.236183	S.D. dependent var	0.056624
S.E. of regression	0.049488	Akaike info criterion	-3.144052
Sum squared resid	0.232658	Schwarz criterion	-3.064920
Log likelihood	157.0585	Hannan-Quinn criter.	-3.112045
F-statistic	15.99692	Durbin-Watson stat	1.904779
Prob(F-statistic)	0.000001		

Source: Author's compilation

Inflation rate -LINF

Null Hypothesis: LINF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.903625	0.0485
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINF)
Method: Least Squares
Date: 10/17/21 Time: 10:01
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINF(-1)	-0.005273	0.001816	-2.903625	0.0046
C	0.037909	0.007331	5.171035	0.0000

R-squared	0.079967	Mean dependent var	0.016783
Adjusted R-squared	0.070482	S.D. dependent var	0.009271
S.E. of regression	0.008938	Akaike info criterion	-6.576954
Sum squared resid	0.007750	Schwarz criterion	-6.524527
Log likelihood	327.5592	Hannan-Quinn criter.	-6.555742
F-statistic	8.431036	Durbin-Watson stat	2.041160
Prob(F-statistic)	0.004567		

Null Hypothesis: LINF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.207091	0.9921
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINF)
Method: Least Squares
Date: 10/17/21 Time: 10:02
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINF(-1)	-0.005516	0.026636	-0.207091	0.8364
C	0.038672	0.083737	0.461825	0.6453
@TREND("1994Q1")	4.22E-06	0.000461	0.009150	0.9927

R-squared	0.079968	Mean dependent var	0.016783
Adjusted R-squared	0.060801	S.D. dependent var	0.009271
S.E. of regression	0.008985	Akaike info criterion	-6.556753
Sum squared resid	0.007750	Schwarz criterion	-6.478113
Log likelihood	327.5593	Hannan-Quinn criter.	-6.524935
F-statistic	4.172105	Durbin-Watson stat	2.040670
Prob(F-statistic)	0.018304		

Source: Author’s compilation

b) Augmented Dickey – Fuller Unit root test at first difference, containing constant without trend and constant with trend.

Saving-LSAV

Null Hypothesis: D(LSAV) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.59264	0.0000
Test critical values:	1% level	-3.499167	
	5% level	-2.891550	
	10% level	-2.582846	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LSAV,2)
Method: Least Squares
Date: 10/16/21 Time: 15:52
Sample (adjusted): 1994Q4 2018Q4
Included observations: 97 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAV(-1))	-1.613829	0.152354	-10.59264	0.0000
D(LSAV(-1),2)	0.328715	0.097852	3.359304	0.0011
C	0.035827	0.007572	4.731687	0.0000

R-squared	0.647763	Mean dependent var	-0.000534
Adjusted R-squared	0.640268	S.D. dependent var	0.110831
S.E. of regression	0.066474	Akaike info criterion	-2.553581
Sum squared resid	0.415363	Schwarz criterion	-2.473951
Log likelihood	126.8487	Hannan-Quinn criter.	-2.521383
F-statistic	86.43282	Durbin-Watson stat	1.885203
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LSAV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.78592	0.0000
Test critical values:	1% level	-4.055416	
	5% level	-3.456805	
	10% level	-3.154273	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LSAV,2)
Method: Least Squares
Date: 10/16/21 Time: 15:54
Sample (adjusted): 1994Q4 2018Q4
Included observations: 97 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAV(-1))	-1.645031	0.152517	-10.78592	0.0000
D(LSAV(-1),2)	0.345179	0.097683	3.533668	0.0006
C	0.055746	0.014806	3.765136	0.0003
@TREND("1994Q1")	-0.000377	0.000241	-1.561408	0.1218

R-squared	0.656761	Mean dependent var	-0.000534
Adjusted R-squared	0.645689	S.D. dependent var	0.110831
S.E. of regression	0.065971	Akaike info criterion	-2.558840
Sum squared resid	0.404752	Schwarz criterion	-2.452666
Log likelihood	128.1037	Hannan-Quinn criter.	-2.515909
F-statistic	59.31603	Durbin-Watson stat	1.907477
Prob(F-statistic)	0.000000		

Source: Author's compilation

Investment-LINV

Null Hypothesis: D(LINV) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.124406	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINV,2)
Method: Least Squares
Date: 10/17/21 Time: 09:28
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINV(-1))	-0.563590	0.092024	-6.124406	0.0000
C	0.005859	0.002319	2.527040	0.0131

R-squared	0.280944	Mean dependent var	-0.000285
Adjusted R-squared	0.273454	S.D. dependent var	0.024276
S.E. of regression	0.020693	Akaike info criterion	-4.897890
Sum squared resid	0.041105	Schwarz criterion	-4.845136
Log likelihood	241.9966	Hannan-Quinn criter.	-4.876552
F-statistic	37.50834	Durbin-Watson stat	2.072178
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LINV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.339391	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINV,2)
Method: Least Squares
Date: 10/17/21 Time: 09:29
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINV(-1))	-0.595188	0.093887	-6.339391	0.0000
C	0.011863	0.004650	2.551233	0.0123
@TREND("1994Q1")	-0.000112	7.54E-05	-1.486494	0.1405

R-squared	0.297289	Mean dependent var	-0.000285
Adjusted R-squared	0.282495	S.D. dependent var	0.024276
S.E. of regression	0.020563	Akaike info criterion	-4.900475
Sum squared resid	0.040171	Schwarz criterion	-4.821343
Log likelihood	243.1233	Hannan-Quinn criter.	-4.868468
F-statistic	20.09532	Durbin-Watson stat	2.051544
Prob(F-statistic)	0.000000		

Source: Author’s compilation

Gross domestic product (GDP)- LGDP

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.311119	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 10/17/21 Time: 09:40
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.453438	0.085375	-5.311119	0.0000
C	0.002995	0.000770	3.887123	0.0002

R-squared	0.227103	Mean dependent var	-7.54E-05
Adjusted R-squared	0.219052	S.D. dependent var	0.005706
S.E. of regression	0.005042	Akaike info criterion	-7.721816
Sum squared resid	0.002441	Schwarz criterion	-7.669062
Log likelihood	380.3690	Hannan-Quinn criter.	-7.700478
F-statistic	28.20798	Durbin-Watson stat	2.071333
Prob(F-statistic)	0.000001		

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.581584	0.0001
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 10/17/21 Time: 09:43
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.493740	0.088459	-5.581584	0.0000
C	0.004759	0.001351	3.521007	0.0007
@TREND("1994Q1")	-2.95E-05	1.87E-05	-1.582601	0.1168

R-squared	0.246956	Mean dependent var	-7.54E-05
Adjusted R-squared	0.231103	S.D. dependent var	0.005706
S.E. of regression	0.005003	Akaike info criterion	-7.727431
Sum squared resid	0.002378	Schwarz criterion	-7.648299
Log likelihood	381.6441	Hannan-Quinn criter.	-7.695424
F-statistic	15.57736	Durbin-Watson stat	2.039991
Prob(F-statistic)	0.000001		

Source: Author’s compilation.

Interest rate- LIR

Null Hypothesis: D(LIR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.797510	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIR,2)
Method: Least Squares
Date: 10/17/21 Time: 09:56
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIR(-1))	-0.519309	0.089575	-5.797510	0.0000
C	-0.002068	0.005058	-0.408800	0.6836

R-squared	0.259323	Mean dependent var	0.000169
Adjusted R-squared	0.251607	S.D. dependent var	0.057706
S.E. of regression	0.049921	Akaike info criterion	-3.136547
Sum squared resid	0.239244	Schwarz criterion	-3.083792
Log likelihood	155.6908	Hannan-Quinn criter.	-3.115209
F-statistic	33.61112	Durbin-Watson stat	1.881694
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LIR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.766607	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIR,2)
Method: Least Squares
Date: 10/17/21 Time: 09:57
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIR(-1))	-0.519334	0.090059	-5.766607	0.0000
C	-0.001926	0.010375	-0.185604	0.8532
@TREND("1994Q1")	-2.81E-06	0.000179	-0.015686	0.9875

R-squared	0.259325	Mean dependent var	0.000169
Adjusted R-squared	0.243732	S.D. dependent var	0.057706
S.E. of regression	0.050183	Akaike info criterion	-3.116141
Sum squared resid	0.239243	Schwarz criterion	-3.037010
Log likelihood	155.6909	Hannan-Quinn criter.	-3.084134
F-statistic	16.63067	Durbin-Watson stat	1.881655
Prob(F-statistic)	0.000001		

Source: Author's compilation

Inflation rate- LINF

Null Hypothesis: D(LINF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.385708	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINF,2)
Method: Least Squares
Date: 10/17/21 Time: 10:10
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINF(-1))	-0.965494	0.102869	-9.385708	0.0000
C	0.016310	0.001980	8.237303	0.0000

R-squared	0.478520	Mean dependent var	-5.20E-05
Adjusted R-squared	0.473088	S.D. dependent var	0.012803
S.E. of regression	0.009294	Akaike info criterion	-6.498738
Sum squared resid	0.008292	Schwarz criterion	-6.445984
Log likelihood	320.4382	Hannan-Quinn criter.	-6.477400
F-statistic	88.09152	Durbin-Watson stat	1.984967
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LINF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.31947	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINF,2)
Method: Least Squares
Date: 10/17/21 Time: 10:11
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINF(-1))	-1.049916	0.101741	-10.31947	0.0000
C	0.023041	0.002830	8.142225	0.0000
@TREND("1994Q1")	-0.000105	3.28E-05	-3.197610	0.0019

R-squared	0.529193	Mean dependent var	-5.20E-05
Adjusted R-squared	0.519281	S.D. dependent var	0.012803
S.E. of regression	0.008877	Akaike info criterion	-6.580551
Sum squared resid	0.007486	Schwarz criterion	-6.501420
Log likelihood	325.4470	Hannan-Quinn criter.	-6.548544
F-statistic	53.39050	Durbin-Watson stat	2.024590
Prob(F-statistic)	0.000000		

Source: Author's compilation.

2.5.2. Phillips -Perron (PP) Unit Root Test.

a) PP Unit root test at level, containing constant without trend and constant with trend.

Saving – LSAV

Null Hypothesis: LSAV has a unit root
Exogenous: Constant
Bandwidth: 15 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.793189	0.3819
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

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

Residual variance (no correction)	0.004841
HAC corrected variance (Bartlett kernel)	0.001635

Phillips-Perron Test Equation
Dependent Variable: D(LSAV)
Method: Least Squares
Date: 10/17/21 Time: 10:18
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSAV(-1)	-0.013999	0.010197	-1.372893	0.1730
C	0.197774	0.128137	1.543451	0.1260

R-squared	0.019061	Mean dependent var	0.022123
Adjusted R-squared	0.008948	S.D. dependent var	0.070610
S.E. of regression	0.070293	Akaike info criterion	-2.452287
Sum squared resid	0.479291	Schwarz criterion	-2.399860
Log likelihood	123.3882	Hannan-Quinn criter.	-2.431075
F-statistic	1.884834	Durbin-Watson stat	2.429802
Prob(F-statistic)	0.172951		

Null Hypothesis: LSAV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.931285	0.1574
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Residual variance (no correction)	0.004444
HAC corrected variance (Bartlett kernel)	0.004020

Phillips-Perron Test Equation
Dependent Variable: D(LSAV)
Method: Least Squares
Date: 10/17/21 Time: 10:50
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSAV(-1)	-0.211657	0.068166	-3.105018	0.0025
C	2.435681	0.773641	3.148336	0.0022
@TREND("1994Q1")	0.004843	0.001653	2.930213	0.0042

R-squared	0.099592	Mean dependent var	0.022123
Adjusted R-squared	0.080834	S.D. dependent var	0.070610
S.E. of regression	0.067696	Akaike info criterion	-2.517748
Sum squared resid	0.439943	Schwarz criterion	-2.439108
Log likelihood	127.6285	Hannan-Quinn criter.	-2.485930
F-statistic	5.309195	Durbin-Watson stat	2.167459
Prob(F-statistic)	0.006502		

Source: Author’s compilation

Investment – LINV

Null Hypothesis: LINV has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.806175	0.3756
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

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

Residual variance (no correction)	0.000487
HAC corrected variance (Bartlett kernel)	0.001048

Phillips-Perron Test Equation
Dependent Variable: D(LINV)
Method: Least Squares
Date: 10/17/21 Time: 10:59
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINV(-1)	-0.014087	0.006112	-2.304655	0.0233
C	0.192849	0.079055	2.439434	0.0165

R-squared	0.051914	Mean dependent var	0.010728
Adjusted R-squared	0.042140	S.D. dependent var	0.022780
S.E. of regression	0.022295	Akaike info criterion	-4.748916
Sum squared resid	0.048215	Schwarz criterion	-4.696489
Log likelihood	237.0713	Hannan-Quinn criter.	-4.727704
F-statistic	5.311437	Durbin-Watson stat	1.169225
Prob(F-statistic)	0.023318		

Null Hypothesis: LINV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.786694	0.9628
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Residual variance (no correction)	0.000485
HAC corrected variance (Bartlett kernel)	0.000964

Phillips-Perron Test Equation
Dependent Variable: D(LINV)
Method: Least Squares
Date: 10/17/21 Time: 11:00
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINV(-1)	-0.001669	0.021425	-0.077905	0.9381
C	0.040620	0.263869	0.153940	0.8780
@TREND("1994Q1")	-0.000166	0.000275	-0.604880	0.5467

R-squared	0.055514	Mean dependent var	0.010728
Adjusted R-squared	0.035837	S.D. dependent var	0.022780
S.E. of regression	0.022368	Akaike info criterion	-4.732518
Sum squared resid	0.048032	Schwarz criterion	-4.653878
Log likelihood	237.2596	Hannan-Quinn criter.	-4.700700
F-statistic	2.821297	Durbin-Watson stat	1.188195
Prob(F-statistic)	0.064474		

Source: Author's compilation

Gross domestic product – LGDP

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.944560	0.3109
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

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

Residual variance (no correction)	3.26E-05
HAC corrected variance (Bartlett kernel)	7.99E-05

Phillips-Perron Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 10/17/21 Time: 11:12
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.007742	0.002716	-2.850791	0.0053
C	0.120390	0.039872	3.019454	0.0032

R-squared	0.077307	Mean dependent var	0.006737
Adjusted R-squared	0.067794	S.D. dependent var	0.005975
S.E. of regression	0.005769	Akaike info criterion	-7.452568
Sum squared resid	0.003229	Schwarz criterion	-7.400141
Log likelihood	370.9021	Hannan-Quinn criter.	-7.431356
F-statistic	8.127010	Durbin-Watson stat	0.970537
Prob(F-statistic)	0.005328		

Null Hypothesis: LGDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.249166	0.9911
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Residual variance (no correction)	3.21E-05
HAC corrected variance (Bartlett kernel)	7.47E-05

Phillips-Perron Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 10/17/21 Time: 11:13
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	0.012916	0.017380	0.743115	0.4592
C	-0.175048	0.248727	-0.703773	0.4833
@TREND("1994Q1")	-0.000156	0.000130	-1.203287	0.2318

R-squared	0.091016	Mean dependent var	0.006737
Adjusted R-squared	0.072079	S.D. dependent var	0.005975
S.E. of regression	0.005756	Akaike info criterion	-7.447335
Sum squared resid	0.003181	Schwarz criterion	-7.368695
Log likelihood	371.6431	Hannan-Quinn criter.	-7.415518
F-statistic	4.806217	Durbin-Watson stat	1.005821
Prob(F-statistic)	0.010249		

Source: Author’s compilation

Interest rate – LIR

Null Hypothesis: LIR has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.309726	0.6227
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

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

Residual variance (no correction)	0.003114
HAC corrected variance (Bartlett kernel)	0.005978

Phillips-Perron Test Equation
Dependent Variable: D(LIR)
Method: Least Squares
Date: 10/17/21 Time: 11:19
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIR(-1)	-0.018266	0.019786	-0.923174	0.3582
C	0.042330	0.050607	0.836439	0.4050

R-squared	0.008710	Mean dependent var	-0.004096
Adjusted R-squared	-0.001510	S.D. dependent var	0.056336
S.E. of regression	0.056379	Akaike info criterion	-2.893456
Sum squared resid	0.308320	Schwarz criterion	-2.841030
Log likelihood	145.2261	Hannan-Quinn criter.	-2.872244
F-statistic	0.852250	Durbin-Watson stat	1.028862
Prob(F-statistic)	0.358207		

Null Hypothesis: LIR has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.577635	0.2914
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Residual variance (no correction)	0.003027
HAC corrected variance (Bartlett kernel)	0.005955

Phillips-Perron Test Equation
Dependent Variable: D(LIR)
Method: Least Squares
Date: 10/17/21 Time: 11:28
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIR(-1)	-0.069129	0.036370	-1.900732	0.0603
C	0.201869	0.108380	1.862594	0.0656
@TREND("1994Q1")	-0.000605	0.000364	-1.660531	0.1001

R-squared	0.036387	Mean dependent var	-0.004096
Adjusted R-squared	0.016312	S.D. dependent var	0.056336
S.E. of regression	0.055875	Akaike info criterion	-2.901572
Sum squared resid	0.299711	Schwarz criterion	-2.822932
Log likelihood	146.6278	Hannan-Quinn criter.	-2.869754
F-statistic	1.812526	Durbin-Watson stat	1.008345
Prob(F-statistic)	0.168783		

Source: Author’s compilation

Inflation rate - LINF

Null Hypothesis: LINF has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.968341	0.0414
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

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

Residual variance (no correction)	7.83E-05
HAC corrected variance (Bartlett kernel)	7.47E-05

Phillips-Perron Test Equation
Dependent Variable: D(LINF)
Method: Least Squares
Date: 10/17/21 Time: 11:36
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINF(-1)	-0.005273	0.001816	-2.903625	0.0046
C	0.037909	0.007331	5.171035	0.0000

R-squared	0.079967	Mean dependent var	0.016783
Adjusted R-squared	0.070482	S.D. dependent var	0.009271
S.E. of regression	0.008938	Akaike info criterion	-6.576954
Sum squared resid	0.007750	Schwarz criterion	-6.524527
Log likelihood	327.5592	Hannan-Quinn criter.	-6.555742
F-statistic	8.431036	Durbin-Watson stat	2.041160
Prob(F-statistic)	0.004567		

Null Hypothesis: LINF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.151347	0.9933
Test critical values:	1% level	-4.053392	
	5% level	-3.455842	
	10% level	-3.153710	

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

Residual variance (no correction)	7.83E-05
HAC corrected variance (Bartlett kernel)	7.47E-05

Phillips-Perron Test Equation
Dependent Variable: D(LINF)
Method: Least Squares
Date: 10/17/21 Time: 11:37
Sample (adjusted): 1994Q2 2018Q4
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINF(-1)	-0.005516	0.026636	-0.207091	0.8364
C	0.038672	0.083737	0.461825	0.6453
@TREND("1994Q1")	4.22E-06	0.000461	0.009150	0.9927

R-squared	0.079968	Mean dependent var	0.016783
Adjusted R-squared	0.060801	S.D. dependent var	0.009271
S.E. of regression	0.008985	Akaike info criterion	-6.556753
Sum squared resid	0.007750	Schwarz criterion	-6.478113
Log likelihood	327.5593	Hannan-Quinn criter.	-6.524935
F-statistic	4.172105	Durbin-Watson stat	2.040670
Prob(F-statistic)	0.018304		

Source: Author's compilation

b) PP Unit root test at first difference, containing constant without trend and constant with trend.

Saving- LSAV

Null Hypothesis: D(LSAV) has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-13.80970	0.0001
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Residual variance (no correction)	0.004748
HAC corrected variance (Bartlett kernel)	0.002335

Phillips-Perron Test Equation
Dependent Variable: D(LSAV,2)
Method: Least Squares
Date: 10/17/21 Time: 10:55
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAV(-1))	-1.215863	0.100065	-12.15069	0.0000
C	0.026771	0.007394	3.620702	0.0005

R-squared	0.605975	Mean dependent var	-0.000959
Adjusted R-squared	0.601871	S.D. dependent var	0.110338
S.E. of regression	0.069621	Akaike info criterion	-2.471316
Sum squared resid	0.465314	Schwarz criterion	-2.418562
Log likelihood	123.0945	Hannan-Quinn criter.	-2.449978
F-statistic	147.6393	Durbin-Watson stat	2.131644
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LSAV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-14.86231	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Residual variance (no correction)	0.004690
HAC corrected variance (Bartlett kernel)	0.001814

Phillips-Perron Test Equation
Dependent Variable: D(LSAV,2)
Method: Least Squares
Date: 10/17/21 Time: 10:55
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAV(-1))	-1.224647	0.100298	-12.21002	0.0000
C	0.040638	0.014751	2.754908	0.0070
@TREND("1994Q1")	-0.000271	0.000249	-1.086081	0.2802

R-squared	0.610807	Mean dependent var	-0.000959
Adjusted R-squared	0.602614	S.D. dependent var	0.110338
S.E. of regression	0.069556	Akaike info criterion	-2.463248
Sum squared resid	0.459608	Schwarz criterion	-2.384116
Log likelihood	123.6992	Hannan-Quinn criter.	-2.431241
F-statistic	74.54753	Durbin-Watson stat	2.146509
Prob(F-statistic)	0.000000		

Source: Author’s compilation

Investment- LINV

Null Hypothesis: D(LINV) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.069380	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Residual variance (no correction)	0.000419
HAC corrected variance (Bartlett kernel)	0.000403

Phillips-Perron Test Equation
Dependent Variable: D(LINV,2)
Method: Least Squares
Date: 10/17/21 Time: 11:02
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINV(-1))	-0.563590	0.092024	-6.124406	0.0000
C	0.005859	0.002319	2.527040	0.0131

R-squared	0.280944	Mean dependent var	-0.000285
Adjusted R-squared	0.273454	S.D. dependent var	0.024276
S.E. of regression	0.020693	Akaike info criterion	-4.897890
Sum squared resid	0.041105	Schwarz criterion	-4.845136
Log likelihood	241.9966	Hannan-Quinn criter.	-4.876552
F-statistic	37.50834	Durbin-Watson stat	2.072178
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LINV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.302982	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Residual variance (no correction)	0.000410
HAC corrected variance (Bartlett kernel)	0.000399

Phillips-Perron Test Equation
Dependent Variable: D(LINV,2)
Method: Least Squares
Date: 10/17/21 Time: 11:04
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINV(-1))	-0.595188	0.093887	-6.339391	0.0000
C	0.011863	0.004650	2.551233	0.0123
@TREND("1994Q1")	-0.000112	7.54E-05	-1.486494	0.1405

R-squared	0.297289	Mean dependent var	-0.000285
Adjusted R-squared	0.282495	S.D. dependent var	0.024276
S.E. of regression	0.020563	Akaike info criterion	-4.900475
Sum squared resid	0.040171	Schwarz criterion	-4.821343
Log likelihood	243.1233	Hannan-Quinn criter.	-4.868468
F-statistic	20.09532	Durbin-Watson stat	2.051544
Prob(F-statistic)	0.000000		

Source: Author's compilation.

Gross domestic product- LGDP

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.253457	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Residual variance (no correction)	2.49E-05
HAC corrected variance (Bartlett kernel)	2.39E-05

Phillips-Perron Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 10/17/21 Time: 11:15
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.453438	0.085375	-5.311119	0.0000
C	0.002995	0.000770	3.887123	0.0002

R-squared	0.227103	Mean dependent var	-7.54E-05
Adjusted R-squared	0.219052	S.D. dependent var	0.005706
S.E. of regression	0.005042	Akaike info criterion	-7.721816
Sum squared resid	0.002441	Schwarz criterion	-7.669062
Log likelihood	380.3690	Hannan-Quinn criter.	-7.700478
F-statistic	28.20798	Durbin-Watson stat	2.071333
Prob(F-statistic)	0.000001		

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.550800	0.0001
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Residual variance (no correction)	2.43E-05
HAC corrected variance (Bartlett kernel)	2.38E-05

Phillips-Perron Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 10/17/21 Time: 11:16
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.493740	0.088459	-5.581584	0.0000
C	0.004759	0.001351	3.521007	0.0007
@TREND("1994Q1")	-2.95E-05	1.87E-05	-1.582601	0.1168

R-squared	0.246956	Mean dependent var	-7.54E-05
Adjusted R-squared	0.231103	S.D. dependent var	0.005706
S.E. of regression	0.005003	Akaike info criterion	-7.727431
Sum squared resid	0.002378	Schwarz criterion	-7.648299
Log likelihood	381.6441	Hannan-Quinn criter.	-7.695424
F-statistic	15.57736	Durbin-Watson stat	2.039991
Prob(F-statistic)	0.000001		

Source: Author's compilation

Interest rate- LIR

Null Hypothesis: D(LIR) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.776917	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Residual variance (no correction)	0.002441
HAC corrected variance (Bartlett kernel)	0.002406

Phillips-Perron Test Equation
Dependent Variable: D(LIR,2)
Method: Least Squares
Date: 10/17/21 Time: 11:34
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIR(-1))	-0.519309	0.089575	-5.797510	0.0000
C	-0.002068	0.005058	-0.408800	0.6836

R-squared	0.259323	Mean dependent var	0.000169
Adjusted R-squared	0.251607	S.D. dependent var	0.057706
S.E. of regression	0.049921	Akaike info criterion	-3.136547
Sum squared resid	0.239244	Schwarz criterion	-3.083792
Log likelihood	155.6908	Hannan-Quinn criter.	-3.115209
F-statistic	33.61112	Durbin-Watson stat	1.881694
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LIR) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.745898	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Residual variance (no correction)	0.002441
HAC corrected variance (Bartlett kernel)	0.002407

Phillips-Perron Test Equation
Dependent Variable: D(LIR,2)
Method: Least Squares
Date: 10/17/21 Time: 11:35
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIR(-1))	-0.519334	0.090059	-5.766607	0.0000
C	-0.001926	0.010375	-0.185604	0.8532
@TREND("1994Q1")	-2.81E-06	0.000179	-0.015686	0.9875

R-squared	0.259325	Mean dependent var	0.000169
Adjusted R-squared	0.243732	S.D. dependent var	0.057706
S.E. of regression	0.050183	Akaike info criterion	-3.116141
Sum squared resid	0.239243	Schwarz criterion	-3.037010
Log likelihood	155.6909	Hannan-Quinn criter.	-3.084134
F-statistic	16.63067	Durbin-Watson stat	1.881655
Prob(F-statistic)	0.000001		

Source: Author’s compilation

Inflation rate- LINF

Null Hypothesis: D(LINF) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.410930	0.0000
Test critical values:	1% level	-3.498439	
	5% level	-2.891234	
	10% level	-2.582678	

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

Residual variance (no correction)	8.46E-05
HAC corrected variance (Bartlett kernel)	9.05E-05

Phillips-Perron Test Equation
Dependent Variable: D(LINF,2)
Method: Least Squares
Date: 10/17/21 Time: 11:38
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINF(-1))	-0.965494	0.102869	-9.385708	0.0000
C	0.016310	0.001980	8.237303	0.0000

R-squared	0.478520	Mean dependent var	-5.20E-05
Adjusted R-squared	0.473088	S.D. dependent var	0.012803
S.E. of regression	0.009294	Akaike info criterion	-6.498738
Sum squared resid	0.008292	Schwarz criterion	-6.445984
Log likelihood	320.4382	Hannan-Quinn criter.	-6.477400
F-statistic	88.09152	Durbin-Watson stat	1.984967
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LINF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.33292	0.0000
Test critical values:	1% level	-4.054393	
	5% level	-3.456319	
	10% level	-3.153989	

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

Residual variance (no correction)	7.64E-05
HAC corrected variance (Bartlett kernel)	7.31E-05

Phillips-Perron Test Equation
Dependent Variable: D(LINF,2)
Method: Least Squares
Date: 10/17/21 Time: 11:39
Sample (adjusted): 1994Q3 2018Q4
Included observations: 98 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINF(-1))	-1.049916	0.101741	-10.31947	0.0000
C	0.023041	0.002830	8.142225	0.0000
@TREND("1994Q1")	-0.000105	3.28E-05	-3.197610	0.0019

R-squared	0.529193	Mean dependent var	-5.20E-05
Adjusted R-squared	0.519281	S.D. dependent var	0.012803
S.E. of regression	0.008877	Akaike info criterion	-6.580551
Sum squared resid	0.007486	Schwarz criterion	-6.501420
Log likelihood	325.4470	Hannan-Quinn criter.	-6.548544
F-statistic	53.39050	Durbin-Watson stat	2.024590
Prob(F-statistic)	0.000000		

Source: Author's compilation

2.5.3. Perron's test for structural change

a) Perron's test at level, containing constant without trend and constant with trend.

Saving- LSAV

Perron Unit Root Test
Date: 07/03/22 Time: 18:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LSAV has a unit root with a structural break in the intercept
Chosen lag length: 2 (Maximum lags: 3)
Chosen break point: 2011Q4

	t-Statistic
Perron Unit Root Test	-2.775657
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LSAV has a unit root with a structural break in both the intercept and trend
Chosen lag length: 2 (Maximum lags: 3)
Chosen break point: 2007Q4

	t-Statistic
Perron Unit Root Test	-4.699910
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Investment- LINV

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LINV has a unit root with a structural break in the intercept
Chosen lag length: 1 (Maximum lags: 3)
Chosen break point: 2004Q2

	t-Statistic
Perron Unit Root Test	-2.967460
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LINV has a unit root with a structural break in both the intercept and trend
Chosen lag length: 1 (Maximum lags: 3)
Chosen break point: 2005Q2

	t-Statistic
Perron Unit Root Test	-3.044053
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Gross domestic product- LGDP

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LGDP has a unit root with a structural break in the intercept
Chosen lag length: 1 (Maximum lags: 3)
Chosen break point: 2003Q4

	t-Statistic
Perron Unit Root Test	-2.716623
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LGDP has a unit root with a structural break in both the intercept and trend
Chosen lag length: 1 (Maximum lags: 3)
Chosen break point: 2005Q1

	t-Statistic
Perron Unit Root Test	-3.431632
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Interest rate- LIR

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LIR has a unit root with a structural break in the intercept
Chosen lag length: 1 (Maximum lags: 3)
Chosen break point: 1998Q3

	t-Statistic
Perron Unit Root Test	-4.744329
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LIR has a unit root with a structural break in both the intercept and trend
Chosen lag length: 1 (Maximum lags: 3)
Chosen break point: 1998Q3

	t-Statistic
Perron Unit Root Test	-4.623013
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Inflation rate- LINF

Perron Unit Root Test
Date: 07/03/22 Time: 20:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LINF has a unit root with a structural break in the intercept
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2000Q1

	t-Statistic
Perron Unit Root Test	-1.541949
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 20:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: LINF has a unit root with a structural
break in both the intercept and trend
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2007Q3

	t-Statistic
Perron Unit Root Test	-3.012375
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

b). Perron's test at first difference, containing constant without trend and constant with trend.

Saving- LSAV

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLSAV has a unit root with a structural
break in the intercept
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2008Q1

	t-Statistic
Perron Unit Root Test	-12.69776
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLSAV has a unit root with a structural
break in both the intercept and trend
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2008Q1

	t-Statistic
Perron Unit Root Test	-12.65479
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Investment- LINV

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLINV has a unit root with a structural break in the intercept
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2008Q3

	t-Statistic
Perron Unit Root Test	-7.274896
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLINV has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2009Q1

	t-Statistic
Perron Unit Root Test	-7.260536
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Gross domestic product- LGDP

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLGDP has a unit root with a structural break in the intercept
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2009Q1

	t-Statistic
Perron Unit Root Test	-6.417299
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 19:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLGDP has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 2009Q1

	t-Statistic
Perron Unit Root Test	-6.734670
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Interest rate- LIR

Perron Unit Root Test
Date: 07/03/22 Time: 20:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLIR has a unit root with a structural break in the intercept
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 1998Q3

	t-Statistic
Perron Unit Root Test	-7.370116
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 20:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLIR has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (Maximum lags: 3)
Chosen break point: 1998Q3

	t-Statistic
Perron Unit Root Test	-7.436673
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author's compilation

Inflation rate-LINF

Perron Unit Root Test
Date: 07/03/22 Time: 20:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLINF has a unit root with a structural break in the intercept
Chosen lag length: 3 (Maximum lags: 3)
Chosen break point: 2006Q1

	t-Statistic
Perron Unit Root Test	-6.645037
1% critical value:	-5.92
5% critical value:	-5.23
10% critical value:	-4.92

Perron Unit Root Test
Date: 07/03/22 Time: 20:07
Sample:1994Q1 2018Q4
Effective observations: 100
Null Hypothesis: DLINF has a unit root with a structural break in both the intercept and trend
Chosen lag length: 3 (Maximum lags: 3)
Chosen break point: 2006Q1

	t-Statistic
Perron Unit Root Test	-6.675579
1% critical value:	-6.32
5% critical value:	-5.59
10% critical value:	-5.29

Source: Author’s compilation