DETERMINANTS OF HOUSEHOLD SAVING IN SOUTH AFRICA

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Abstract

Households saving plays an important role in the economic development of both developed and developing nations, due to its significance influence on the circular flow of income in the economy. The benefits of saving include hedging against unforeseen circumstances, accumulation of assets, funds available for household investment, provision for retirement, savings can help the purchase of homes and housing, improve debt settlement, and the acquisition of social services. Despite these benefits, South Africa has been characterised by low and declining household savings rates. Household savings figures declined from an average of 5.9 percent of GDP year in the 1970s to 1.6 percent in the 1990s to less than 0.5 percent in the new millennium. The aim of this study is to investigate the determinants of households saving in South Africa, in a bid to explain the downward trends. The results show that there is a negative and significant correlation between rate of household savings and real GDP. We also found a negative long run relationship between household savings and government budget balance. The results have shown that both the inflation rate and financial deepening have a negative influence on the level of household savings. The interest rate coefficient is positive but insignificant. The study employed the Augmented Dickey Fuller, and Kwiatkowski–Phillips–Schmidt–Shin tests to test for stationarity. The Baysian vector

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autoregressive model is employed to identify the relationship between household saving and its determinants. The study will use quarterly data from SARB for the period 198 0 to 2016.

Keywords: Household savings; life cycle hypothesis; cointegration; Bayesian Vector AutoRegressive model; South Africa. *JEL Classification* E21, C22

1 Introduction

Households saving plays an important role in the economic development of both developed and developing nations, due to its significance influence on the circular flow of income in the economy (Iyoha, Oyefusi, and Oriakhi, 2003). Savings are important means of improving well-being, insuring against times of shocks, and providing a buffer to help people cope in times of crisis (Rutherford, 1999; Zeller and Sharma, 2000). At household level the benefits of saving include hedging against unforeseen circumstances, accumulation of assets, funds available for household investment, provision for retirement, savings can help the purchase of homes and housing, improve debt settlement, and the acquisition of social services. The sustenance of household savings increases the possibility of future investment both at the micro and macro- levels in the economy.

Economic theory postulates that households' saving is the difference between households' income and consumption. Household income is the aggregate income a household earns from all sources in a particular period. Consumption on the other hand, is the total amount of goods and services that is consumed by households during a particular period (Rutherford, 1999). Solow (1956) has suggested that savings influence growth of the economy, as higher savings lead to capital accumulation and hence economic growth.

Keynes (1936) stated that savings depend upon disposable income. Duesenberry (1949) proposed that consumption/ saving was a function of ratio of current income to previous level of income. Friedman (1957) hypothesized that household savings was based on permanent income. Ando and Modigliani (1963) postulated that households were net dis-savers in their early and old age but they saved more in their middle age. Apart from income, other variables might be responsible for household to sufficiently save part of their remuneration..

As the theories on savings determinants develop, the general model assumptions of the Life Cycle Model and Permanent Income Hypothesis have been modified to investigate other factors that

impact savings (Harjes and Ricci, 2005). Jongwanich (2010) ascribed the attractiveness of the Life Cycle Model to its flexibility in incorporating other relevant theoretical features relating to developing countries without changing its basic structure. This model therefore allows for the consideration of variables that may be unique to South Africa to gain further insight into the respective country's household saving behaviour.

Despite these benefits, South Africa has been characterised by low and declining household savings rates. Household savings figures declined from an average of 5.9 percent of GDP year in the 1970s to 1.6 percent in the 1990s to less than 0.5percent in the new millennium (South African Reserve Bank, 2016).

Household savings as a percentage of GDP in South Africa averaged to 0.135percent in the 1970s, the increased to 0.3 percent in the 1980s, and further rose to 0.65 percent in the 1990s, before dwindling to an average of -0.01percent between 2000 and 2009. Between 2010 and 2016, these figures further decreased to a low of -1percent (South African Reserve Bank, 2016). Simleit, Keeton, and Botha, (2011) argued that low household savings act as a barrier on economic growth and development and further put pressure on the country's current account.

The aim of this study is to investigate the determinants of households saving in South Africa, in a bid to explain the downward trends. The study will use quarterly data from SARB for the period 1980 to 2016.The general objective is to identify factor that influence household saving. The paper is structured as follows: section two present a literature review of the determinants of household savings,section three will provide the methodology, section four and five will present the results and conclusion respectively.

2 Literature review

Bérubé and Côté (2000) used quarterly time series data for Canada between 1965 and 1998 to analyse long run trends between household saving and its determinants. To get more precise

results, the authors used Cointegration technique using 5 different estimation methods namely, Engel and Granger (1987), Error-correction framework, Philips and Loretan (1991), Stock and Watson (1993) leads-and-lags procedure, and the fully modified procedure developed by Philips and Hansen (1990). These different procedures enable the authors to compare the validity of the results across different estimation methods. The variables used include expected long run interest rate, expected inflation, all-government fiscal balances as a share of nominal GDP (a proxy for the public pension benefit replacement rate), unemployment rate, ratio of net worth to personal disposable income, and the dependency ratio. The results showed that there is a significant long run relationship for household saving. They found that Inflation has a strong positive impact on household indicating a measurement problem as inflation is expected to negatively impact household saving. In addition they also found that persistent increase in government dissaving would be offset by household saving.

Metin-Ozcan, Gunay and Ertac (2003) examined the empirical determinants of private savings behaviour in Turkey for the period 1968-1994 using the ordinary east squares (OLS) estimation method. They identified six explanatory variables including government policies proxied by public savings; income variable; financial variables measured as the ratio of M2 to gross national product (GNP), and real interest rate on saving deposits; external variable measured as the terms of trade and current account deficit; demographic factors such as urbanization ratio, youth dependency ratio, old dependency ratio and life expectancy ratio; uncertainty variables (inflation). The study found that government savings to Gross Private Domestic Investment ratio (GPDI) and the Turkish economic crisis had significant negative effects on saving behaviour. In addition, the study found that a deeper financial system, inflation and terms of trade shocks all had a positive impact on private savings. The effect of the current account deficit as well as the growth of income was statistically insignificant in Turkey. The study found that financial market development, macroeconomic stability, life expectancy, external factors and economic crisis have a significant impact on household saving in Turkey. This study used OLS to estimate time series data, as such the results are not reliable as the OLS would produce biases estimators.

Prema-Chandra and Pang-long (2003) analysed the relationship between social service payment and household saving for Taiwan from 1952 to 1999. They used time series data from Taiwan statistical data book. They the Unrestricted Error Correction modelling because it minimises the possibility of spurious results while retaining long run information. They found that household saving rises with both the level and the rate of growth of household disposable income. The real deposit rate has a significant positive impact on household saving. Increased availability of social security provision and enhanced credit availability have a negative impact on household saving. Furthermore they found that both old and young dependency ratio in population have a negative impact on saving rate. Lastly the study concluded that public saving crowds out private saving.

Bulir and Swiston (2006) examined the factors influencing Mexico's private saving rate using annual data for the period 1980–2004. They used public savings, external savings, real growth, the level of development, private credit and dependency ration as the explanatory variables. Results obtained using OLS method showed that saving in Mexico is also influenced by the level of financial development, incomes, GDP growth, and demographics. The paper found out that movements in private saving have not been associated with similar shifts in investment, as changes in public saving and external saving have tended to offset movements in private saving.

Horiaka and Wan (2007) used generalized method of moments (GMM) estimator applied to panel data to investigate the household saving behaviour in China. The variables included were lagged saving rate, income growth rate, real interest rate, inflation rate and the age structure of the population. They posited that in the short run the lagged saving coefficient is positive. This implies that the higher the saving in the previous period the higher current saving will be. Income growth was positive and highly significant while real interest rate was insignificant. The age structure and inflation rate were both insignificant.

Nwachukwu and Egwaikhide (2007) did an error-correction model of the determinants of private saving in Nigeria using annual data for the period 1970-2005. The model allowed separation of long and short run effects of various factors on saving rate. The explanatory variables included in

the model were real per capita gross national disposable income (GNDI); growth rate of real per capita GNDI; real interest rate; rate of inflation; public saving rate; external debt service ratio; terms of trade and the degree of financial depth. The study indicated that real interest rate shows that the real rate of return on bank deposits has a statistically significant negative effect on saving behaviour in Nigeria. On the other hand the variables terms of trade changes, external-debt-service ratio and the inflation rate showed a strong positive relationship with the private saving rate, and lastly the income growth variable was found to have a significantly negative impact on the private savings rate. The coefficient for public saving rate was both positive and significant, thus rejecting any substitutability between public and private saving. Results indicated that the coefficient for real per capita is positive and statistically significant which provides support for the argument that, for countries in the initial stages of development, the level of income is an important determinant of the capacity to save.

In 2010, Kim analysed the determinants of personal saving in the USA for the period 1950 – 2007. Kim (2010) used OLS and found similar results to Kulikov, Paabut and Staehr (2007) for Estonia. Kim (2010) further found that the coefficients of lagged private saving, tax, and real estate loan were negative. This implies that the higher the amount of personal saving in the period, the lower the amount of private saving in the current period. Kim (2010) however, found that, old dependency ratio to be insignificant in determining personal saving, while the employment rate was only significant at 5 percent. Surprisingly, Kim (2010) found that economic growth negatively impacts personal saving. This implies that during good economic times, people save less and during bad economic times people save more as they expect the bad economic times prevail and as take precaution for the future.

Larbi (2013) used Fully modified OLS (FMOLS) based on the Philips and Hansen (1990) to investigate the determinants of private saving in Ghana. Using data collected from the World Bank, and the Ministry of Finance and Economic Planning, Larbi (2013) posited that the Ricardian Equivalence was confirmed for Ghana, since fiscal deficit had a positive relationship to private

saving. In addition, income, inflation and financial development positive influence private saving, while the interest rate and dependency ration were both negative. The variable of real exchange rate was statistically insignificant in explaining private saving.

Mansoor and Khattak (2014) used a short time span of 5 years to assess the determinants of household saving. They use OLS regression to analyse how per capita income, inflation rate, employment status, and tax burden impact household saving in Pakistan. They found that income and employment have a strong positive influence of household saving while tax and inflation have a negative impact on saving. Caution should to be used in the results as the time span of 5 years is too short to analyse trends and determinants of saving.

Simleit, Keeton and Botha (2011) used quarterly data to investigate the determinants of household saving in South Africa from 1981Q1 to 2009Q4. They used data collected from the Thomson DataStream and the South African Reserve Bank (SARB) and the Vector Error Correction Model (VECM) to analyse the data. The variables included were Real GDP in logarithm, government budget balance as a percentage of GDP (proxy for government policy), interest rate (91-day treasury bill rate), inflation rate proxied as the real housing price index, and corporate saving as a percentage of GDP. The result revealed that South Africa household saving is counter cyclical such that Real GDP and household saving are negatively related. This implies that during good economic times, household save less in anticipation that the good times will continue, while in bad economic times household will save more. They also found that interest rate negatively impacts on household savings, pointing to the income effect being greater than the substitution effect. The authors also found that the Ricardian equivalence holds true for South Africa as the government budget balance is negatively related to household saving. Lastly they also found a negative relationship between household saving and corporate saving.

For South Africa, Mahlo (2011), used panel data method to examine household savings and income, consumption, interest rate and debt in South Africa. Using data from 1990 to 2009, he found a positive correlation between household savings and income, yet the nexus between savings,

consumption and debt was negative. Implicitly, Mahlo (2011) concluded that household income is the key factor in household saving behaviour in South Africa.

Mishi (2012) studied the trends and determinants of household saving in South Africa with a VECM method between 1963 and 2011. The variables included in the VECM were ratio of household saving to household disposable income, growth rate of real disposable income (GDP per capita), interest rate (proxy: risk premium), public saving (proxy was government debt to GDP), and financial deepening (ratio of M2 to GDP). In contrast to the results by Simleit, Keeton and Botha (2011), the income variable (disposable per capita income) was found to be positive. However, this difference could stem from the different proxy used to measure income in the two studies. Government debt to GDP ratio and inflation had also had a positive impact on household saving. In addition, financial deepening was reported to have a negative impact, while echoed the results of Simleit, Keeton and Botha (2011), and Mahlo (2011) with a negative coefficient for interest rate.

Still in South Africa, Mongale, Mukkedem-Petersen, Petersen and Meniago (2013), used Cointegration Vector Autoregressive (CVAR) to analysed data sourced from the SARB between 1994 and 2010 to investigate household saving. They used, household disposable income, household debt, real GDP growth rates, foreign savings, inflation and interest rate as variable in the model. They found the presences of a long run relationship between the dependent variable of household savings and the independent variables. They echoed the results of Mahlo (2011) and Mishi (2012), with positive sign for disposable income, and real GDP and countered the results of Simleit, Keeton and Botha (2011). The interest rate and inflation were positive while higher the household debt the lower the household saving rate.

Chipote and Tsegaye (2014) used Error-correction model to investigate determinants of household saving in South Africa. They collected data from the SARB and the World Bank data between from 1990 to 2011. The variables included were household disposable income (GDP per capita), age dependency ratio, real interest rate (GDP deflator), inflation rate (as CPI excluding food and

non-alcoholic beverages for all urban areas). They echo the finding of Simleit, Keeton and Botha (2011) in that the level of income and household saving are negatively related. These two studies used the same proxy for income which is GDP per capita and concluded that household saving in South Africa is counter cyclical. Chipote and Tsegaye (2014) attributed these results to the heavy reliance on debt to finance spending which results in very little saving. In addition, they found that the age dependency ratio, inflation and real interest rate showed positive relationship with household saving.

Ehikioya and Mohammed (2014) investigated the determinants of private saving in Nigeria using annual data from 1981 to 2010. They used the VECM to analyse data collect from Central Bank of Nigeria, and African Development Bank. The variables used included budget deficit ratio GDP, Financial Deepening (M2/GDP), real interest rate, GDP per capita, population, inflation rate, terms of trade. The results revealed that Income, financial deepening and interest rate have positive effect on household saving, while inflation, budget deficit and population negatively impacts saving. Population was found to be insignificant. They also established the presence of a long run relationship.

Samantaraya and Patra (2014) used Autoregressive Distributive Lag (ARDL) to investigate factors influencing household saving in India 1992 – 2012. Variable include real GDP, age dependency ratio, interest rate, inflation, gross fiscal deficit-GDP ratio, personal income tax to GDP ratio, share of agriculture in total GDP, and external terms of trade. They found the existence of a long run relationship among the variables. Income and age dependency showed a positive impact while interest rate and inflation were negative. The terms of trade and fiscal were insignificant in explaining household saving in India.

In 2008, Du Plessis studied the determinants of private savings in South Africa using qualitative analysis. The qualitative study was conducted with reference to primary data in the form of opinions of senior South African economists, which data was gathered during in-depth exploratory interviews. Results of the study indicated that the declining household savings cannot simply the

attributed to low income levels and the country's large population, but also on a large number of variables as well. For example the study revealed that household savings in South Africa negatively affected by the expectation of future income, increased access to credit, negative impact of HIV/AIDS on life expectancy and lastly inequality.

3 Methodology

The methodology is divided into the theoretical framework and the empirical framework.

3.1 Theoretical Framework

The Life Cycle Hypothesis has provided economic researchers with a wide range of possible determinants of household saving which can be tested empirically. The LCH can be explained using the Over-Lapping generations model (OLG) developed by Allais (1947) and Samuelson (1958). OLG captures the changes in behaviour of economic agent throughout their lifetime. The OLG model assumes that an individual live for n-period and divides the population into young and old. The young people are the consumers while the old people are the workers (Hviding and Mérette, 1998). These groups are relevant because of the contracting decisions with regards to labour supply, saving decision hence consumption, and tax payment.

The model assumes that time is discrete and goes on forever. Individuals can live for two time periods and in each time period a new generation is born. Furthermore the model assumes that economic agents work in the first period and consume their savings in the second period. The underlying assumption is that individuals aim to maximise utility.

The preference of agents is described by a utility function that is separable in time and concave in each period's consumption. The individual utility is given by the sum of current consumption and discount future consumption. Therefore the generation born in time t will have the following

utility function:

$$U_t = U_{(C_{1t})} + \beta.U_{(C_{2t+1})}, \theta \leq 0, U^{'} > 0, U^{''} < 0 \tag{1}$$

Lifetime utility depends on consumption today and consumption in the future. The parameterβ is some number, such as 1 or 0.9, that captures the weight that an individual places on the future relative to today. For example, if β=1, then the individual treats utility flows today and in the future equally. Alternatively, if $\beta < 1$, a given flow of utility is worth more when it occurs today.

Future consumption is given by the assumption that individuals consume from their savings. Therefore the future consumption is total of the rate of return on savings, such consumption (C) and income (Y) is given in the second period by the equation:

$$C_{(2t+1)} = (1 + r_{t+1}).S_t \tag{2}$$

Therefore, in a decentralised economy, individuals will maximise utility as follows:

$$maxU_t = U_{(C_{1t})} + \beta.U_{(C_{2t+1})} \tag{3}$$

Subject to:

$$(C_{1t}) + S_t = w_t \tag{4}$$

and

$$(C_{2t+1}) = r_{t+1}.S_t \tag{5}$$

Where:

(C_{1t}) = consumption of generation born in time t in the first period.

(C_{2t+1})= second period consumption of the same generation.

S_t = saving of the young generation in period t.

w_t = saving of the young generation in period t.

r_t = the interest rate from t - 1 to t.

Assuming the saving S_t is the only decision variable, the above equation can be re-written as:

$$U_t = U(w_t - S_t) + \frac{1}{1+\theta}.[(1 + r_{t+1}).S_t] \tag{6}$$

To maximise this function, take the first order condition (F.O.C) and set it equal to zero;

$$\frac{dU_t}{dS_t} = U(w_t - S_t) + \frac{1}{1+\theta}.U^{'}[(1 + r_{t+1}).S_t].(1 + r_{t+1}) = 0 \tag{7}$$

Simplifying the F.O.C

$$U^{'}(C_{1t}) - (\frac{1 + r_{t+1}}{1+\theta}).U^{'}(C_{2+1}) = 0 \tag{8}$$

Thus first-order condition for maximisation can be written in the form of the consumption Euler equation.

$$U^{'}(C_{1t}) = \beta.r_{t+1}[U'(C_{2t+1})] \tag{9}$$

The Euler equation essentially suggests that an individual must be indifferent between consuming one more unit today on the one hand and saving that unit and consuming in the future on the other. If the individual consumes today, he/she gets the marginal utility of consumption today — the left-hand side of the equation $U^{'}(C_{1t})$. However, if the individual saves that unit instead, he/she gets to consume r_{t+1} units in the future, each giving him/her $[U'(C_{2t+1})]$ extra units of utility. Because this utility comes in the future, it must be discounted by the weight β. That is the right side of the Euler equation. The fact that these two sides must be equal is what guarantees that individual is indifferent to consuming today versus in the future.

Solving for consumption and thus for savings, the saving function will be;

$$S_t = f(w_t, r_{t+1}) \tag{10}$$

Savings is a function of wage and interest rate.

3.2 Empirical Model

A review of theoretical literature of the LCH and OLG model provided the basis for the empirical model for household savings. Based on the OLG model and the LCH, additional variables have been added to the theoretical model in line with previous studies of Chipote and Tsegaye (2014); Mongale, Mukkedem-Petersen, Petersen, and Meniago, (2013); Mishi (2012) and Simleit, Keeton, and Botha,(2011).

$$HHS = f(GDP, GP, R, INF, FD) \tag{11}$$

Where;

HHS = Ratio of household savings to GDP

GDP = Real Gross Domestic Product (in logarithm)

R = Real Interest rate (prime lending rate)

GP =Government Policy (government budget balance as a percentage of GDP)

FD = Financial deepening (ratio of M2 to GDP)

INF= Inflation rate (total consumer price percentage)

Income variable: The life-cycle hypothesis posits that an increase in income would increase aggregate savings through increasing the savings of people that participate in the labour force compared to the negative savings of people who are out of the labour force, Loayza, Schmit-Hebbel and Serven (2000).

Real interest rate: Theoretically, the impact of the real interest rate happens through two opposing effect substitution and income effect. Firstly, an increase in real interest rates reduces the present

value of future income flows and therefore has a negative impact on savings (income effect). However, at the same time it increases the net return on savings and makes savings more attractive today Loayza, Schmit-Hebbel and Serven (2000). In other words, it leads to a postponement of consumption and has a positive impact on savings (substitution effect). Therefore, the net impact of real interest rates is determined by the relative strength of these two opposing effects and is an empirical question.

Government policy: in terms of fiscal policy, has an impact on savings as it has a bearing on disposable income. In addition, details and features of taxation and other government policies are also relevant for aggregate savings (Johnson and Babalola, 2014). According to the Ricardian equivalence household are forward looking and make decisions by looking at the government budget.

Financial Deepening: According to Dirschmid and Glatzer (2004), financial trends have a positive impact on saving behaviour as the deeper and broader the financial markets, the more people save. Financial liberalisation has played a major part in the low savings in South Africa. Financial liberalisation often results in higher interest rates, which theoretically should encourage private saving. However, the negative impact of higher interest rates on disposable income tends to neutralise the attractiveness of higher returns on savings (Simleit et al., 2011) The freer access to credit has afforded households the opportunity to maintain higher levels of consumption than would otherwise have been possible, which has naturally discouraged savings.

Macroeconomic Stability: In order to safeguard against future unexpected negative income shocks, individuals prefer saving today, (Aric, 2015a). The paper will use the inflation rate as a proxy for the instability of the economy and expect this variable to have a positive impact on savings.

3.3 Data

The time series data used for analysis was sourced from the South African Reserve Bank (SARB) website. This study will make use of quarterly data from 1980 Q1 to 2016 Q2. Quarterly data is used because it provides a larger number of observations and allows for intra year dynamics. The variables used will include logarithm of real GDP at 2010 prices, the ratio of HHS to RGDP, and government budget balance as a percentage of GDP. Total consumer price in percentage for inflation, and prime overdraft rate as the short term interest rate.

3.4 Overview of Bayesian Vector Auto regressive model

The Bayesian approach was introduced by Thomas Bayes (1701 – 1761) in the field of statistics. In a nutshell, the Bayesian approach explores the evidence about the true state of the world and is expressed in terms of degrees of belief known as Bayesian probabilities. However, it remained an insufficiently used possibility until recent time. Caraiano (2010) explained that the main limitation was owing to the impossibility to compute the posterior distributions from an analytic point of view for most of the cases, in the absence of numerical techniques. The past few decades have seen an improvement in technology and a rise of computational statistical packages which brought the solution to this barrier and this subsequently led to an exponential development of Bayesian techniques.

Bayesian econometrics is characterized by several advantages relative to the classical paradigm, like the coherence of the whole paradigm, which is derived from the systematical application of the Bayes law, the concept of subjective probability, the general character of the Bayesian methods which do not ask for special regularity conditions, the sounder definition of the concepts of confidence interval as well as testing, Poirier (2008). These elements, coupled with the exponential growth of computing power, led to an explosion of Bayesian applications in all fields including macroeconomics and finance.

The macroeconomics concept, as Schorfheide (2008) pointed out, was basically associated with the structural equation models due to Cowles Commission between 1950 and 1970. Following Lucas' critique (1976), who showed that the structural parameters are not inelastic with respect to changes in economic policy, which led to the first major revolution through the introduction of VAR models, due to Sims (1980).

The emergence of the Bayesian approach led to a re-evaluation of the VAR approach based on the Bayesian principles. Thus the unrestricted VAR approach was characterized by several deficiencies, especially due to the over-fitting phenomenon, namely of the type of parameterization proposed (Kadiya and Karlsson; 1997). The unrestricted VAR model estimates many parameters, some of which may be insignificant. This causes a problem of overparameterization, which results in multicollinearity and loss of degrees of freedom leads to inefficient estimates and large out-of-sample. In addition, the classical VAR approach suffers from the loss of degrees of freedom which exponentially decrease with respect to the number of lags included. The Bayesian approach proposes a solution to this problem by the fact that it does not place much emphasis on any of the parameters of the model. However the emphasis falls on the use of prior distributions for the parameters, the prior distributions being a key factor in the Bayesian VAR (BVAR) approach.

This study will use the BVAR approach for estimation of variable because of its superior nature of the unrestricted VAR. Research by Sarantis and Steward (1995); Kadiya and Karlsson (1997); Felix and Nunes (2002); Gupta and Kabundi (2009); Caraiani (2010) have shown that the BVAR produces a more accurate forecast in comparison to structural and unrestricted VAR. In addition BVAR uses new information in estimation and forward looking. Therefore, the BVAR model selected for the study.

3.4.1 Bayesian VAR Specification

Let Y_t be the row of vector of m variables of interest, observed at time t. (Household saving). Let X_t a row of vector of q exogenous variables influencing Y_t. (LRGDP, GP, Fdeep, INF, R).

The general unrestricted VAR can be written as:

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_\rho Y_{t-\rho} + e_t \tag{12}$$

Where, e_t is the error term and c constitutes the vector of the constant term.

Felix and Nunes (2002) explained that BVAR models present a solution to the excessive number of parameters to estimate in unrestricted VAR models by imposing some general restrictions through prior probability distribution functions. The posterior distribution function for each parameter is obtained by combining the prior distribution and the sample likelihood using Bayes rule.

Thus, a prior with a large variance around the prior mean, can be modified by accidental sample variability (noise). An informative prior with reasonable values for the variances can only be influenced by systematic sample variability (signal), diminishing the risks of overfitting and of producing unreliable forecasts, (Dua and Ray; 1995).

This essay will use a prior specification inspired by the well-known Minnesota prior. As in Doan, Litterman and Sims (1984), adapted used in South Africa by Gupta and Sichel (2002), Gupta (2007) and Gupta, Kabundi, Miller and Uwilingiye (2012). Doan et al (1984) suggested that most macroeconomic series can be described as pure random walks. Therefore, prior distributions for the BVAR parameters are assumed to be independent normal distributions, with their means set equal to zero and small standard deviations.

Formally the means of the Minnesota prior take the following form:

$\beta_i \sim \mathrm{N}(1, \sigma^2_{\beta i})$ and $\beta_j \sim \mathrm{N}(0, \sigma^2_{\beta j})$

Where β_i = coefficients associated with the lagged dependent variables in each equation of the VAR model (i.e., the first own-lag coefficient), while β_j is for any other coefficient. Therefore, the prior specification reduces to a random-walk with drift model for each variable, if we set all

variances to zero. The prior variances, $\sigma^2_{\beta i}$ and $\sigma^2_{\beta j}$ specify uncertainty about the prior means β^*_i = 1 and $\beta^*_i = 0$. The smaller the prior variances the more confidence there is that the prior means are the true means.

The standard deviation can be generated using small numbers of hyper-parameters, w, d, and a weighing matrix $f(i,j)$.This approach specifies individual prior variances for a large number of coefficients using only a few small hyper-parameters. As such the specification of the standard deviation of the distribution of a prior imposed on variable j in equation i at lag m, for all i, j, and m equals $S(i,j,m)$, can be defined as:

$$S(i,j,m) = [w.g(m).f(i,j)]\frac{\sigma_i}{\sigma_j} \tag{13}$$

Where: f(i, j) = 1, if i = j and k_{ij} otherwise, with ($0 \leq$, k_{ij} ,≤ 1)

g(m) = m^{-d}, with d > 0

The estimated standard error of the univariate autoregression for variable i equals σ_i. $\frac{\sigma_i}{\sigma_j}$ = scales the variables to account for differences in the units of measurement and, hence, causes the specification of the prior without consideration of the magnitudes of the variables w = overall tightness with the prior getting tighter as the value falls. $g(m)$ = measures the tightness on lag m with respect to lag 1and equals a harmonic shape with decay factor d, which tightness the prior at longer lags. The parameter $f(i,j)$ equals the tightness of variable j in equation i relative to variable i, and by increasing the interaction (i.e., the value of Kij), we loosen the prior.

This paper will follow, Gupta and Sichel (2002), Gupta (2007) and Gupta, Kabundi, Miller and Uwilingiye (2012) and set the value of the overall tightness parameter (w) equal to 0.1 and set the harmonic decay parameter (d) equal to 1, For the six-variable BVAR model with four optimal lags estimated for an initial prior for the period of 1980:1 to 2016:4.

3.4.2 BVAR Result

In analysing the results from our BVAR model, we report results from impulse responses and the forecast error variance decompositions. The E-views 9.0 package was used in this paper. Dua and Ray (1995) explained that because BVARs have complicated dynamics, reporting these statistics is more informative than using the regression coefficients.

Impulse response function (IRF): IRF can be employed to examine dynamic relationships among the variables. IRFs are used to trace out the time path of various innovations (shocks) that are in the BVAR system. Stock and Watson (2001) pointed out that impulse responses trace out the response of current and future values of each of the variables to a one unit increase in the current value of one of the BVAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. IRFs can be achieved through expressing variables in the model in terms of shocks. The advantage is that IRF does not require orthogonalisation of shocks (Warne, 2008). Since the resulting impulse responses are invariant to the ordering of the variables in the BVAR, this approach gives unique and robust results. We use IRFs to interpret results because using individual coefficients from an estimated BVAR is ambiguous (Bjonness, 2012).

Variance Decomposition: Variance of decomposition examines how important each of the shocks is as a component of the overall (unpredictable) variance of each of the variables over time. Variance decomposition provides the proportion of the movements of the dependent variables that are explained by their own shocks compared to the shocks of other variables (Enders, 2004). According to Hamilton (2008), a shock to a specific variable will not only directly affect that variable, but will be transmitted to all the other variables in the system through the dynamic structure of the VAR.

4 Empirical Results

To determine the factors influencing household saving, a BVAR model is used. The factors hypothesized to influence household saving from economic theory in section 3, include, ratio of household saving to GDP (HHS), the log of real GDP (LRGDP), government budget balance as a percentage of GDP as a proxy for government policy, (GP), the prime lending rate (R) as a proxy for interest, ratio of M2 to GDP as financial deepening (FDEEP), and last total percentage change of consumer price as a proxy for inflation (INF).

Unit root test

Table 1 shows the results of the Augmented Dickey-Fuller (ADF) and KPSS tests. The Null hypothesis for ADF is that the series contains a unit root, while the alternative hypothesis is that the series is stationary. For the KPSS, the null hypothesis is that the series is stationary. Rejection of the null hypothesis implies that the series is nonstationary. Table 1 indicates that HHS, LRGDP, GP, R, INF and FDEEP are I(1) based on both the ADF and KPSS tests at 5 percent significance.

Table 1: Result of Unit root test

Variable	ADF		KPSS	
	Level	1st Difference	Level	1st Difference
HHS	-0.1910898 (-1.831)	-3.958845 (-48.38266)	0.002106 1 (0.214)	6.6605 (0.0460)
LRGDP	0.001234 (0.226)	-1.562834 (-11.62)	0.006639 (0.269)	0.004644 (0.0066)
GP	-0.192700 (-2.265)	-2.514431 (-5.783))	-3.019595 (0.121)	0.001521 (0.0528)
R	-0.175745 (-2.789)	-1.714508 (-13.396)	9.250676 (1.175)	0.0584251 (0.061)
INF	-0.051260 (-2.762)	-0.534250 (-7.245)	14.81689 (0.538)	-0.008163 (0.333)
FDEEP	-0.021743 (-2.437)	-0.678522 (-8.669)	2.243446 (1.37)	-0.012245 (0.2645)

Note: Critical values are in parenthesis at 5percent . The appropriate lag was selected using the Akaike Information Criteria (AIC) for ADF test and Schwert criterion and the Bartlett kernel method

4.1 Estimation results

Results are reported using the Impulse Response Function and Variance Decomposition.

4.1.1 Impulse Response Function

BVAR models can be interpreted with Impulse Response Functions (IRFs). The focus is on determining whether a variable has a relationship with household saving and whether it is positive or negative. We take the standard 10 periods which is a little over two years. In our interpretation of the IRFs, we take the procedure of reporting responses, using the Cholesky impulse response measure.

Table 2: Impulse response function of Household Saving

Period	HHS	LRGDP	GP	R	INF	FDEEP
1	0.003	0.000	0.000	0.000	0.000	0.000
2	-0.000517	-0.000213	-9.47E-05	-0.000107	-0.000185	-4.44E-05
3	-0.000949	-6.57E-05	-0.000148	0.000240	-0.000112	-6.77E-05
4	3.93E-05	-7.40E-05	-0.000125	-6.10E-07	4.32E-06	4.37E-05
5	0.001057	-0.000126	-8.62E-05	-0.000201	2.57E-05	8.98E-05
6	-0.000160	-0.000123	-9.30E-05	-4.31E-06	-4.93E-05	2.97E-05
7	-0.000512	-6.67E-05	-0.000105	0.000158	-2.90E-05	9.39E-06
8	5.35E-05	-7.31E-05	-8.94E-05	2.52E-05	2.28E-05	4.57E-05
9	0.000416	-0.000103	-6.79E-05 -	8.79E-05	2.19E-05	5.33E-05
10	-5.05E-05	-9.32E-05	-6.79E-05	1.46E-05	-1.45E-05	2.08E-05

Response of HHS to LRGDP Results from table 1 above shows a negative response of household saving to a one standard deviation shock in real GDP. This implies a negative relationship between LRGDP and HHS in South Africa. These results are not in accordance with LCH and the apriori expectation in section 3. However, Simleit, Keeton, and Botha, (2011) found a similar result for South Africa. They explained that household saving in South Africa is counter cyclical, such that during booming economic times, households are optimistic of good times and save less, while during bad economic times, they save more as a precautionary motive for pessimistic future times. Chipote and Tsegaye, (2014) also found a negative relationship between income and household saving in South Africa.

Response of HHS to GP The results indicate a fluctuating response of HHS to one standard deviation in government policy. This can be attributed to the fact that government policy is unstable due to political stability and economic swings and household do not hold a constant response. This shows that the Ricardian equivalence does not holds true for South Africa. For example, stimulating the economy using debt financing will lead to an increase in saving in anticipation of higher taxes in the future or to household saving less due to the current relief on taxes. In contrast Simlet et al (2011) found the Ricardian equivalence holds true for South Africa while Hondroyiannis (2006) found similar results for European countries and Bérubé, and Côté, (2000) for Canada.

Response of HHS to FDEEP FDEEP has a negative impact on HHS. Intuitively Financial deepening in South Africa has increased the availability and access to credit more than it has encouraged savings. As such, the better the financial system, the less household saving, as the available sources of credit and insurance, cushions against the precautionary motive for saving. Hence the more sophisticated a financial system is, the lower the household saving. Mishi (2012) found similar results to for South Africa.

Response of HHS to R The response HHS to one standard deviation shock in R is predominantly negative, albeit close to zero. This shows that in South Africa, the income effect is higher than the substitution effect, i.e. an increase in interest rate reduces the value of future income and as such decrease saving. Mogale et al. (2011) also found a statistically insignificant interest for South Africa. Aron and Muellenberg (2000) and Simileit et al. (2011) found a negative relationship while Mahlo (2011) and Chipote et al. (2011) found a positive relationship in the South African context.

Response of HHS to INF The INF starts off by generating a negative response and after the third period becomes positive for the rest of the period. It can be said that HHS generally responds positively to a one standard deviation shock in INF. This result is in line with the aprior assumption discussed in chapter 3, that this variable will have a positive effect on household saving. Intuitively

this implies that higher current prices imply even higher future price, and household which like to safeguard against this negative future shock, will save more now.

4.1.2 Variance Decomposition

Table 3 presents the forecast of variance decomposition of the six endogenous variables. Variance decomposition shows how much of a change in a variable is due to its own shock and how much of it is due to shocks to other variables. It also indicates the percentage of the fluctuation in a time series attributable to other variables at the 10 quarters time horizons. It further indicates the amount of information each variable contributes to the other variables in the BVAR model.

Table 3: Variance of decomposition of Household Saving

Period	S.E.	HHS	LRGDP	GP	R	INF	FDEEP
1	0.0033	100.00	0.000	0.000	0.000	0.000	0.000
2	0.0033	99.085	0.408	0.0753	0.108	0.027	0.296
3	0.0035	98.329	0.410	0.6239	0.200	0.069	0.368
4	0.0035	98.143	0.454	0.6253	0.325	0.085	0.368
5	0.0037	97.767	0.532	0.8285	0.396	0.139	0.338
6	0.0037	97.573	0.643	0.8259	0.458	0.144	0.356
7	0.0037	97.324	0.661	1.0237	0.495	0.141	0.355
8	0.0037	97.208	0.699	1.0330	0.546	0.157	0.357
9	0.0037	97.059	0.765	1.0604	0.584	0.176	0.355
10	0.0037	96.961	0.826	1.0635	0.614	0.179	0.356

The column of S.E represents the forecast error of the variable for each forecast period. The forecast error stems from the variation in the current and future values of the shocks to each variable in the system. The table 1 shows that own shocks variation are between 90 and 100 percent over the ten quarters period of forecast. This implies that from a contribution of 100 percent to variations in its forecast errors, the contribution of household savings fell to 99.1 percent at the beginning of the term to 96.9percent at the end of the term. The difference was taken up by other variables. At period 1 HHS is 100 percent because the only source of the one period ahead variation is its own shock.

In addition, the results reveal that after household savings itself, government policy is the most significant group for the error variance. GP was highest in the ninth quarter at 1.1 percent in

explaining the variance in household savings. The contribution of LRGDP, increased from a low of 0.40 per cent in the second quarter increasing throughout the period to a high of 0.82 per cent. This shows that LRGDP explains HHS more in the long run. INF, R and FDEEP appear to be third in line in terms of contribution of innovation to household savings. The contributions are relatively close with minute differences. The highest contribution for INF was 0.8 percent in tenth period while R recorded a high of 0.6 percent also in the tenth period and FDEEP a high of 0.356 percent in the sixth period.

In summary, the variance decomposition analysis shows that "own shocks" constitute the predominant source of variations in household savings in South Africa. The analysis further seems to suggest that the household savings can be explained by the disturbances in the macroeconomic variables used in this study. Furthermore, the results show that the determinant variable have a large impact on household saving in the long run. Finally all the variables can be regarded as endogenous to the system because Sbeiti and Hadadd (2011) maintain that if the shocks do not explain any of the forecast error variance of one macroeconomic variable in all forecast horizons, then this variable is exogenous. At the same time if it happens that shocks can explain all the forecast error variance of the variable at all forecast horizons, this variable is an entirely endogenous variable.

4.1.3 Residual Diagnostics test

The diagnostic tests show the absence of autocorrelation at four lags, while there is no evidence of heteroscedasticity using the white test (no cross term). The Jarque-Bero test suggests that there is a normal distribution. This indicates that the model is fairly well behaved and that all shocks eventually stabilise in the long run.

The root figure in appendix illustrate the inverse roots of the AR characteristic polynomial. It can be seen that all the roots are inside the unit circle. This implies that the BVAR model satisfies the stability condition hence On the other hand, the CUSUM test showed that the parameters

Table 4: Diagonistic Tests

Test	Null Hypothesis	P-value	Conclusion
Lagrange Multiplier (LM)	No serial correlation	0.199	Fail to reject H0
Jarque-Bero (JB)	There is normal distribution	0.263	Fail to reject H0
White test	There is no conditional heteroscedasticity	0.621	Fail to reject H0

of our model were stable since the cumulative sum goes inside the area between the two critical lines, at 5 percent level of significance.

5 Conclusion

This study set out to identify the determinants of household saving in South Africa. This analysis was estimated using the BVAR model and result were interpreted using impulse response functions and the variance decomposition.The BVAR eliminates the problem of over-parameterisation that is faced with an unrestricted VAR. This is because BVAR makes use of restrictions based on prior knowledge of the parameters. In addition BVAR have been shown to produce more accurate results and forecasts in comparison to unrestricted VAR as well as improve out-of-sample performance. More so, this study is the first of its kind to use the BVAR to identify the determinants of household savings, as no other study has so far used this method. Thee results have shown that there is a negative and significant correlation between rate of household savings and real GDP. Furthermore, the analysis revealed that there is a fluctuating relationship between household savings and government budget balance. The results have shown that both the interest rate and financial deepening have a negative influence on the level of household savings. The inflation rate has a positive influence on household savings in South Africa. Therefore government can influence household saving, in a bid to stimulate national saving (and through investment) economic growth by designing policies that impact the determinants of household saving, i.e. lowering the prime lending rate.

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6 Appendix

Figure 1: Inverse Roots of AR Characteristic Polynomial

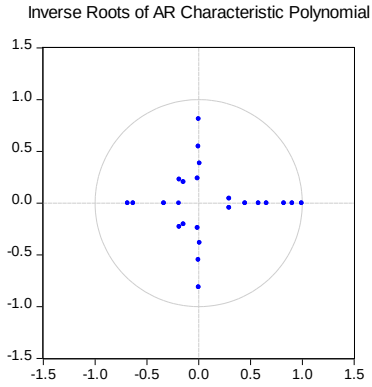

Figure 2: CUSUM Test