Title: Population age structure and savings behaviour in South Africa; the relevance of the life cycle hypothesis.

Authors: Promise M Nduku, Beatrice D. Simo-Kengne

Abstract

This paper investigates the relationship between age dependency ratio and the saving rate in South Africa for the period 1970-2014.In the process it explores the extent to which the Life Cycle Hypothesis holds. It attempts to advance in the field by testing the traditional Life Cycle Hypothesis using Autoregressive Distributed Lag model (ADRL) bounds testing and Toda and Yamamoto (1995) granger causality test. Diagnostic tests are also conducted whilst functional stability is tested by applying the cumulative recursive residuals (CUMSUM) and CUMSUM of square (CUMSUMSQ).

The study finds a cointegration relationship between the rate of savings, age dependency ratio, growth rate of income per capita and the real interest rate. The significance of the error correction term establishes that the long run relationship exists in an equilibrating manner. Confirmation of the relationship between savings rate, age dependency ratio and real interest rate is enhanced by the Granger causality test. In particular, a unidirectional relationship between age dependency ratio, real interest rate and savings rate exists. CUMSUM tests confirm the long run relationship between the variables and reveals the stability of the model. In the period under study, the Life Cycle hypothesis does not hold in the case of South Africa as the age dependency ratio contrasts with the expected negative sign, however statistically significant. The sign of coefficient of the real interest rate also deviated from expectations in this regard suggesting a negative impact on saving rates. The GDP per capita growth coefficient is not significant in the long run, suggesting the irrelevance of income in explaining savings rate. Policies that aim to prop up savings through population age structure management will be futile.

Key words: Life Cycle hypothesis, dependency ratio, saving rate, Cointegration, Bounds testing, Granger causality.

1. Introduction

The world has been experiencing significant demographic transitions since the mid-20th century. The key characteristics of these changes are the declining fertility and mortality rates resulting in significant increases in the elderly fraction of the population and relative decrease of the young population (Hondroyiannis & Papapetrou, 2001; Curtis et al, 2017). These demographic shifts have serious implications on long-term macroeconomic dynamics of economies. Given that changes in population structure re inevitable, it implies that it is essential to analyse thoroughly their potential effects on economies and businesses. This is garnering interest in several countries, international organisations as well as scientific institutions, becoming one of the central issues on the agenda (Kasnauskiene and Andriuškaitė, 2017). Based on theory and empirical investigations, several economists and policy makers have been concerned about the probable impact of demographic changes on economies and business. Three main areas can be identified where research has focused in evaluating and modelling the impact of demographic shifts namely labour market, economic growth, consumption and savings trends (Kasnauskiene & Andriuškaitė, 2017). This paper focuses on the relationship between population age structure and savings rates in South Africa.

The rate of savings is one of the most researched aggregates in macroeconomics, highlighting its significance in the comprehension of a myriad of economic phenomena. In academic and policy discourse, the key role played by savings in the enhancement of sustainable economic growth through its influence on investment, has received significant attention (Salman and Zaib, 2012; Chipote and Tsegaye, 2014). The demographic structure of the population is one of the key factors that influence savings in an economy (Cigno, 1992; Mohsin, 2002; Demery and Duck, 2006; Apergis and Christou, 2012; Brookins et al.2015). Most savings models that consider demographic factors emphasise the fact that people at different ages save at different rates, affecting aggregate savings through variations in the population age structure (Kelly and Shmidt, 1996; Deaton and Paxson, 1997; Higgins and Williamson, 1997; Higgins, 1998; Bloom et al. 2007). At the heart of this theoretical underpinning is the life-cycle hypothesis, which argues that economic players face negative savings when they are still young and earn petite or zero income, and in their industrious years, positive savings are realised. Dissavings are rea;ised once more when they are old and in retirement (Apergis and Christou, 2012). The

Life cycle hypothesis, therefore, makes a prediction that, overall, the lower the age dependency ratio, the higher the savings rate. Further, as the population ages and the age dependency ratio rises, there should be a decline in savings rate. The expectation is that as a nation's young dependency ratio increases, it exerts negative pressure on its savings rate since children consume without contributing positively to income, like elderly people. In addition, given that the young dependency ratio naturally drops as the population ages, the prospect is to offset, partially, the negative pressure on savings rate resulting from the growth in the old dependency ratio (Horioka, 2010).

The fact that the analysis of savings behaviour relative to age structure has developed into one of the essential issues in empirical macroeconomics is not astonishing (Jappelli & Modigliani, 1998). Often, the East Asian miracle, for instance, is attributable to the rapid economic transition, which made significant contributions to the national savings rates and economic growth through the lowering of fertility rates and changes in the population age composition (Higgins and Williamson, 1997; Mason, 2010). Comprehension of the factors affecting aggregate savings rate, including demographics, is an imperative precondition in the designing a few policy interventions. These include tax and social security system design as well as the provision of financial markets guidelines and regulation policies (Japelli and Pagno, 1997). Brookins et al. (2015) purport that the cohort impact of young versus old dependency on savings rates is an interesting phenomenon that needs continued investigation. Growths in the dependency ratio may exert a mounting pressure on health and education expenditure by the government to improve quality of life. If fiscal policies are not amended, then this leads to reduction in public savings to the detriment of the economy (Apergis and Christou, 2012). A comprehension of factors influencing savings, age structure included is also critical for the design of policies in the quest to encourage savings.

Following the formulation of the Life cycle hypothesis and its variants, an extensive strand of literature that investigated the impact of dependency ratio on savings exists, using both macroeconomic and microeconomic data. The evidence is not conclusive across countries as well as approaches. Investigations that employed cross-country data sets have realised more success than studies that used time series for individual countries in discovering significant demographic effects. The earlier works of Leff (1969) and Modigliani (1970), Kelly and Schmidt (1996), Loayza et al. (2000), Masson et al. (1998), as well as recent studies, Apergis and Christou (2012) and Brookins et al. (2015) find some evidence in support of the life-cycle model. According to Wong and Ki Tang (2013), panel data studies assume some form of homogeneity to make inferences across sections in the sample. This presents challenges in estimation efficiency. Keho (2012) extends the criticism on cross-country studies, pointing out that they assume the same savings behaviour across countries. The differences in institutional, social, economic, and demographic structures challenge the efficiency of these studies since results represent average relationships, which may or may not apply to individual country time series. To derive more useful policy implications, more individual country time series is necessary for in depth econometric analysis (Keho, 2012).

Attempts were made for individual countries such as Horioka (1997); Jappelli and Modigliani (1998); Elbadawi and Mwega (2000); Thornton (2001); Mohsin (2002);Serres and Pelgrin(2003) ;Modigliani and Cao (2004), Hirioka and Wan(2006) , Demery and Duck (2006) and results reflect that higher age dependency ratios are linked to depressed savings rates, in support of the Life cycle hypothesis. Other studies, however, including Ram (1982), Husain (1995), Faraquee and Husain (1998), and Baharumshash et al. (2003), and Chipote and Tsegaye, (2014) present evidence reflecting insignificant or even positive relationship between dependency ratio and savings rate thereby invalidating the Life cycle hypothesis.

An extensive strand of literature assessing savings behaviour in South Africa exists, either outside or within Life cycle hypothesis framework. These studies are conducted at both macro level (Odhiambo, 2007; Mahlo, 2011; Simlet et al. 2011; Mongale et al.,2013; Chipote, and Tsegaye; 2014; Kapingura and Alagidede) and microeconomic level (Spio and Groenewald, 1996; Ting and Kollamparambill, 2015; Esson; 2003; Greyling & Maleka ;2016). In a majority of instances, these studies mainly focus on the determinants of household savings; with only few of them making use of age dependency as demographic variable. The commonly used techniques of estimation in micro level studies are age cohort ordinary least square and panel data estimation methods. Macro level studies usually employ cointegration-based methodologies particularly the Vector Error correction model. More importantly, the age variable commonly adopted in micro level studies to capture the demographic effect generates contrasting results (that is, either validate or refute the Life cycle hypothesis)

In examining the relationship between age dependency ratio and savings rate, this paper exploits the Autoregressive Distributed Lag model (ADRL) bounds testing method developed by Pesaran et al. (2001). The bounds testing approach is an innovative and more efficient cointegration methodology in small samples that overcomes the deficiencies of standard time series analysis approaches used in earlier South African studies. Generally, since it is based on a single equation, rather than on a VAR in the case of Johansen, it reduces the number of parameters to be estimated. The number of lags can be applied separately to each variable unlike in the Engel –Granger method (1987) and the Johansen and Juselius (1990) approach. Additionally, the Autoregressive Distributed Lag bounds testing procedure produces unbiased and efficient estimates of the asymptotic long run parameter estimates regardless of whether the variables are integrated of order zero I (0), integrated of order one I (1) or both. In other words, it does not require pre-testing of the order of integration of the time series variables (Pesaran et al., 2001; Nkoro and Uko, 2016, Murthy and Okunade, 2016). Moreover, the Toda and Yamamoto (1995) test for Granger causality is summoned to complement the Autoregressive Distributed Lag model on order to establish long run causality since cointegration alone only implies correlation amongst the variables.

To the best of author’s knowledge, no other study has primarily investigated the relationship between population age structure and savings rate in South Africa at the macro level using these methodologies. The main objective of this paper is to investigate the impact of total age dependency ratio on savings rates in South Africa. This is achieved through the application of contemporary autoregressive distributed lag model techniques and the Toda and Yamamoto (1995) granger causality test to South African time series data for the periods 1970-2014.Hence its adds to the existing South African literature on savings by analysing the impact of population structure on the gross national savings. Further, the study uses a more recent data and longer period than current studies that primarily investigated the determinants of savings in South Africa.

The remainder of the paper is structured as follows. The next section presents an overview of savings performance and demographic trends in South Africa. Section 3 reviews the literature on the demographics-savings nexus. Chapter 3 discusses the ADRL methodology used to determine the long run relationship between age structure and savings rates. Chapter 4 presents the results and analysis thereof whilst Chapter 5 details the conclusion and policy recommendation derived from the empirical findings.

2. Overview of South Africa’s savings performance demographic trends

South Africa’s savings pattern has not been impressive, despite the potential benefits, characterised by low household savings since the 1990’s (Chipote and Tsegaye, 2014, Reserve Bank of South Africa, 2017). Prinsloo (2000) defines savings as the amount of income or resources generated in an economy for a given year that not for current consumption but used in ways that will provide future returns to the economy. Gross savings is gross disposable income less consumption expenditure and net household savings is defined as the household disposable income less household consumption, plus the variation in net equity of households in pension funds (OECD, 2017). The amount that society saves currently for future consumption has crucial implications for elderly welfare, economic growth, and levels of consumption. Indeed, savings vary across countries, within countries across time, often in a dramatic fashion (Bloom et al., 2002).

Based on the World Bank (2017) data, South Africa’s gross savings as a percentage of gross domestic product (GDP) has declined from about 21% in 1960 to around 16% in 2015. It has been on a gradual decline since then, averaging approximately 23% in the 1960’s, 25% in the 1970’s, around 24% in the 1980’s and roughly 17% in the 1990’s. It reached as high as 35% in 1980.Between 2000 and 2009, the savings rate averaged roughly 16% and as of 2015, was in that vicinity. This is shown in Figure 1 below.

A trend examination of the South Africa’s net domestic savings expressed as percentage GDP shows that net domestic savings, between 1960 and 2017, averaged 4.89 %, and 1.63% during the 1990s. The rate deteriorated to merely 0.35% between 2000 and 2005, and diminished further to a negligible -0.63% between 2006 and 2008, before slightly improving to an average of - 0.20% in the period between 2009 and 2011(Chipote and Tsegaye, 2014, Tradingeconomics, 2017). Figure A1 in appendix illustrates this. The rate of household savings in South Africa is currently in the negative, rising from -0.50 % in the last quarter of 2016 to -0.30 % in the first quarter of 2017. In 1972, household savings reached an all-time high rate of 23.80 % and the lowest being -2.70 % in 2017(Tradingeconomics, 2017). Moreover, South Africa gross domestic savings rate performance is dismal at global level as shown in Figure A2 in appendix.

Figure 1: SA Gross savings (% GDP), 1960-2016.

Source: OECD, 2017

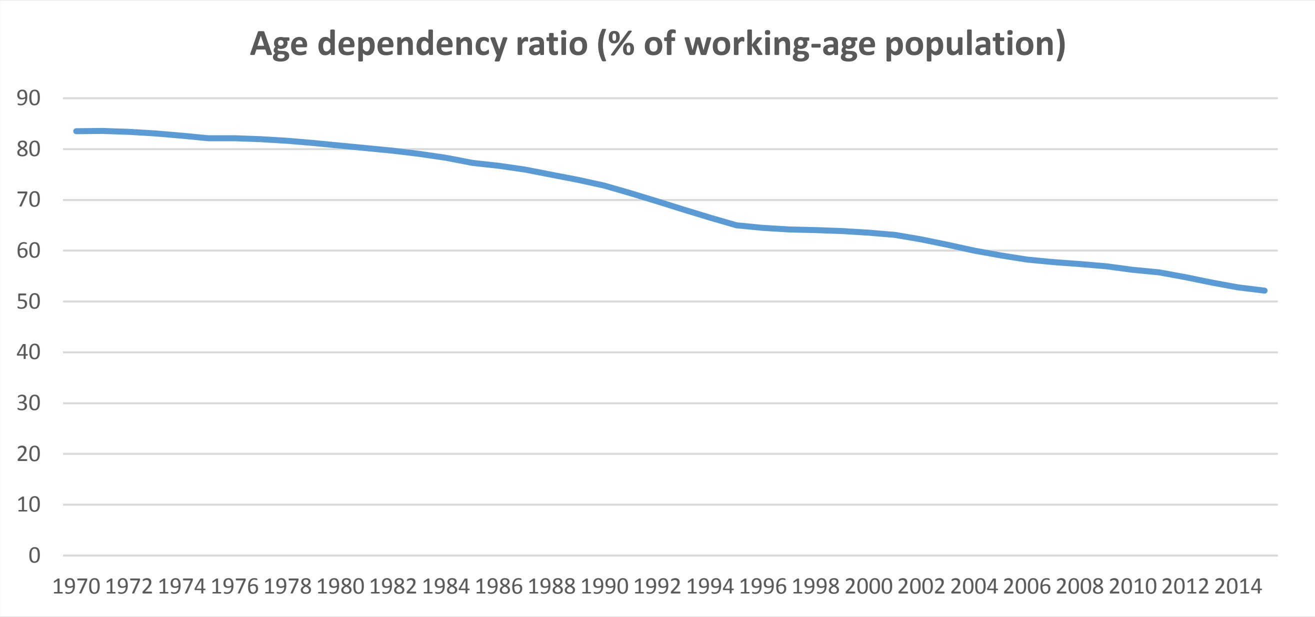
South Africa’s gross savings as a percentage of GDP compares poorly relative to other BRICS countries. For instance, regarding Figure A3 in appendix, in 2011 South Africa’s savings rate stood at 16.6% as compared to 17.23% for Brazil, 33.76 for Russia, 34.98% for India and China’s 52.78%. This is not a coincidence as these economies have enjoyed relatively better growth patterns. A more localised comparison at the same time make the same conclusion as Botswana’s savings rate stood at 26.15% and Nigeria 24.41 % (OECD, 2017).

The low savings levels experienced in South Africa suggest that, to meet investment needs, the economy should depend on external finance. The drawback is that outside evidence has shown that external finance is uncertain, for instance portfolio finance. The global financial crisis of 2008 and the aftermath are testimony to this. The financial crisis led to substantial asset devaluation across the globe, thwarting the availability of liquid credit and emerging markets and South Africa was not spared. Credit market seizure caused mayhem as international banks terminated lending facilities (The Economist, 2008). In October of the same year, the Rand devaluated significantly and this is partly because of country’s current account deficit, which averaged about 6% of the GDP that year (OECD, 2017). Capital investment spending and import consumerism without matching domestic savings coupled with lack of income from exports partly resulted in this deficit (Du Plessis, 2008). Deficit financing, and liquid investments eventually which were withdrawn over a short period also contributed to the rand devaluation.

Given the high level of unemployment and investment needs and subdued growth facing the country, this becomes a crucial issue (Kapingura, 2016). This is compounded by the fact that the future economic well-being of South African households is compromised including the whole economy due to low levels of domestic investment that hamper growth and place a heavy burden on the government finances (Ling, 2015). It therefore becomes important to analyse the behaviour of savings in South Africa.

A segregated analysis of the South Africa's total dependency ratio has been gradually declining from 1970 to 2014 as shown in Figure 2 below. At the same time the old dependency ratio has been rising sharply since the 1990s whereas the young dependency ratio has been declining. Figure A4 and A5 in appendix depict these trends. The old dependency ratio averaged 5.8% between 1990-1999, 7.4% in the 2000-2010 period and stood at 7.74% as of 2015.On the contrary, the young dependency ratio averaged 61.25% in the 1990s, 51.83% between 2000-2010 and dropped to 44.49% by 2015(World Bank, 2017). This pattern is a result of the decline in fertility and mortality rates as fertility rates in South Africa fell by 27% between 2012 and 2016, whereas mortality rate decreased by close to 9% in the same period (World Bank, 2017).

Figure 2: SA total   dependency ratio:1970-2015



Source: World Bank (2017).

The proportion of the elderly population increased by about 0.8 of a percentage point in the period 2001 to 2016, from 7.3% in 2001.It is Important to note that the main sources for households headed by elderly persons were social grants and wages/salaries/commission. Moreover, the number of old-age grant recipients increased from 2.7 million in 2011 to 3.1 million in 2015. As of 2015, only 22.9% of the elderly in South Africa subscribed to medical aid schemes, highlighting the demands of health care by the elderly (SSA, 2017). There is a possibility that this has had a negative impact on the savings rate as more resources channelled towards elderly welfare reduce capacity to save. The statistics above clearly endorse a shift of population age structure towards a seemingly aging, coupled with a decline in young dependency ratio with an overall decrease in age dependency ratio.

This begs an inquiry about why South Africa's persistent decline in the savings rate coincides with an overall decline in the total dependency ratio when, as suggested by the Life Cycle hypothesis, an inverse relationship is expected. To answer this question, this paper investigates the applicability of the Life cycle hypothesis in South Africa by analysing the relationship between age dependency ratio and gross savings rate in South Africa.

The South African economy is quite appealing for such an investigation considering that South Africa has experienced periods of growth over the years and has a sound and developed financial system, yet savings remain low. According to Hlahla(2014), the South

African economy , on average, grew by 3.2% per annum between 1994-2013 , compared to the global average of 3.6% and yet savings remain low .

3. Theoretical framework and literature review

3.1 The Life Cycle Hypothesis

A vast amount of literature investigating the macroeconomic determinants of savings behaviour both on a single country and on cross-country basis exists. Majority of these studies utilise the Life cycle hypothesis in explaining the main drivers of household savings. Modigliani and Brumbergin (1954) formulated this theory and it has received some modifications over the years to address its proposed shortcomings. At the heart of the hypothesis is the conception that, a rational consumer attempts to maximise intertemporal utility given budget constraints (Chipote and Tsegaye, 2014). A perfect annuity market with no bequests is assumed such that individuals select an optimal consumption pattern that is constrained by the present value of their lifetime consumption not exceeding the present value of their lifetime earnings and current assets. A rational forward-looking individual will desist from consuming more in one period than the other (Chawla, 2008).

The Life cycle hypothesis relies on the assumption that a finite horizon (lifetime) consisting of a distinctive period from birth to of retirement exists. This makes it an appropriate benchmark in studying economic decisions made by individuals, with the age structure becoming an essential variable (Eguia & Echevarria, 2004). It emphasises the impact of savings in levelling out consumption patterns in an individual's life. The Life cycle hypothesis divides the individual's lifetime into young, working and retirement period, in its meekest form (Crown, 2002). In this manner, the model structure explicitly illuminates the critical effect of demographic factors (age) and income growth in the explanation of savings patterns. Thus, the Life cycle hypothesis suggests a hump-shaped pattern of savings in which the early (young) and later (retirement) stages of life are characterised by dis-savings whilst the middle stage (working age) is associated with savings. The theory argues that young and old generations do not contribute much to productivity, thereby realising zero or little income, henceforth the tendency is to dis-save. The middle generation have higher productivity levels and generate extra income to save for future use (Crown, 2002). The population (age) structure variations, that is, youth dependency, old dependency and total dependency ratio affects savings behaviour since not only does it alter the demand for health expenditures demand, formation of human capital, and retirement consumption levels, but also has a bearing on government expenditures (Brookins et al. 2015). Simply put, the Life cycle hypothesis suggests that higher dependency ratios depress savings whilst lower dependency ratio will result in higher savings rates.

Several studies have investigated the impact of demographics (dependency ratios) on savings rates and the evidence is mixed not only across countries but also in terms of approaches as well. These can be divided into cross and individual country studies, and the review will treat them as such.

3.2 Empirical Literature

2.3.1 Cross-country studies

Employing a multivariate ordinary least square (OLS) regression analysis, Leff (1969) investigate the relationship between dependency and savings rates for 74 countries, both developed and underdeveloped, using 1964 data set. Aggregate savings as a ratio of Gross domestic product (GDP) and in per capita terms are the dependent variables whilst the independent variables include income per capita, income growth rate and age dependency ratios. The results revealed that dependency ratios are distinct statistically, and quantitatively imperative in influencing savings rates for all the 74 countries as well as within subsets of developed and developing nations. Simply put, the evidence shows that increases in either young dependency ratio or old dependency ratio depresses savings rates. Kelly (1986) analysed pooled time series data for 1962-1984 and cross section data for 67 countries utilising a similar specification to Leff's (1969). Results lead to the conclusion that a systematic variation of the impact of young dependency ratio exists across regions and time. Specifically, young dependency displayed a positive effect on savings in Africa, an insignificant impact in Asia whilst a negative influence exits in Latin America.

Contrasting evidence to Leff(1969) is presented by Ram(1982).This study is conducted using a similar approach and it explores the impact of dependency ratio on savings rates using a sample of 121 countries covering the period 1970-1977.Results do not find any significant relationship between dependency ratios and savings rates. The Life cycle hypothesis.is, therefore, nullified in this study as dependency ratios do not adversely affect rate of savings in these developing countries.

Gupta (1975), following Leff's (1969) savings function as a starting point, estimates a Two stage least square regression model using cross section data of 40 emerging countries in the 1960's. The study estimates a simultaneous equation model, which allows for both indirect and direct impact of dependency rate and external capital flows on the rate of savings. It assumes the dependency ratio to be endogenous, ultimately determined by birth rates hence the specification included extra variables such female labour force participation rate and infant mortality rate. The study finds dependency rates a major determinant of the savings rates.

Deaton and Paxson (1997), adopt Ordinary least squares regressions(OLS) to test the life cycle patterns of consumption using average consumption, income, and savings rates as well as control variables such as size of household and number of children. They make use of time series data from household surveys of United States (1980-1992), Britain (1969-1992), Taiwan (1976-1990) and Thailand (1976, 1981, 988, 1990 and 1992). Their methodology is a disintegrated approach that relies on simulation by explicitly modelling the age profile of savings such that age-savings rates are aggregated using past or anticipated population age structure. The findings, although consistent with age specific savings rates decreasing with age, display a weak correlation, thereby failing to provide full support of the life cycle hypothesis.

Bloom et al. (2003) conduct a global investigation to determine whether longevity (aging) plays a significant role in the determination of national savings rates by also adopting OLS and instrumental variable regressions using gross domestic savings as the dependent variable. They use annual data from 1960 to 1997. Their analysis excludes socialist countries and countries with populations less than 1 million and major oil producers. The results lead to the conclusion that when the population is stable, higher savings rate will offset increases in old age dependency. In disequilibrium phase, that is, when a rise in longevity is experienced, there can be substantial effect on aggregate savings.

In contrast to the above studies, Loayza et al. (2000) make use of the method of Generalised Moment (GMM) estimation to investigate the policy and non-policy factors behind savings disparities across nations using data from 150 countries drawn from the

World Bank. The paper considers both national and private savings ratios and the core regressors include income reflated variables namely the growth rate of disposable income per capita, term of trade, monetary/ financial variables including the ratio of M2 to GDP, credit flow relative to income and more importantly old and young dependency ratios. The paper concludes that old and young dependency ratios do have a significant negative impact on private savings. Using panel data from the World Bank covering years 1990-2000, Schrooten and Stephan (2005) employ the same technique to conduct an analysis of the factors affecting private savings in ten EU-accession countries namely Bulgaria, Hungary, Poland, Estonia, the Czech Republic, Latvia, Slovenia, Lithuania, Romania, and the Slovak Republic. Their results are consistent with Loayza et al. (2000). Particularly, for the EU-accession countries, the dependency ratio demonstrates negative influence on savings rates, in line with the Life cycle hypothesis.

Similarly, in a recent study, Brookins et al. (2015) evaluate the impact of demographic structure on savings rates by households in Pakistan, India and Bangladesh by using two approaches: the fixed effect method and GMM. The panel data estimation covers period 1970-2010, with dependency ratios as the main independent variables whilst inflation is a proxy for macroeconomic stability. The results show that whilst the young dependency ratio is significant and negatively affects the household savings rate, the old dependency ratio has an insignificant impact on household savings. Wong and Ki Tang (2013) also find no discernible impact of the old dependency ratio on savings for 22 OECD countries based on fixed effects approach using panel data from 1961-2010.

Apergis and Christou (2012) apply a different methodology, panel vector Error Correction Model (ECM). With a data set of annual time series for a sample spanning for the period 1960-2005 of 16 African countries, their study examines the impact of age dependency ration on the rate of domestic savings, measured by gross domestic savings as a percentage of Gross domestic product(GDP). The findings indicate evidence of panel cointegration, and panel causality analysis revealed negative causal influence of dependency ratio on savings rate. Generally, variations in the non-working population size are crucial to the future path of Africa's domestic savings rates.

In investigating whether dependency rates affect savings rates in Africa, Keho (2012) adopts the bounds testing cointegration technique with the Autoregressive Distributed Lag framework and Toda and Yamamoto causality test using the same number of countries as Apergis and Christou (2012). Results show that the impact of dependency ratio is negative for two countries, positive for five and no relationship for 9 countries.

A methodologically threefold investigation into savings behaviour was conducted by Agrawal et al. (2009) using data from seven Asian countries. The study employs the Error correction model, dynamic OLS and Autoregressive Distributed Lag models techniques. The results support the Life cycle hypothesis as the dependency ratio negatively affecting savings behaviours.

3.3.2 Individual country studies

Following Loayza (2000), Schrooten and Stephan (2005), Hirioka and Wan (2006) conduct a dynamic panel analysis to determine factors influencing the rate of savings by households in China. The study is carried out within the Life cycle hypothesis framework and uses panel data over the period 1995-2004 extracted from the country's household survey. The study is at provincial level, covering 31 provinces in China. Their results show that dependency ratios are significant only in one of the four samples drawn, thereby providing mixed support for the Life cycle hypothesis. The coefficients of the age variable are found not to be significant in urban and rural household samples, young and overall dependency ratios are in fact positive, whilst the old dependency is insignificant in all samples: urban, rural and pooled.

Demery and Duck (2006), adopt the methodology employed by Deaton and Paxson (1997) in examining the savings age profiles in the United Kingdom(UK) using data drawn from Family Expenditure survey covering the period 1969-1998.The UK savings rate is found to fall as the percentage of the elderly rises, though individual rate of savings is positive and increasing. This provides inconclusive results in relation to the Life cycle hypothesis. Narayan and Narayan (2006) adopt the Autoregressive Distributed Lag methodology to examine savings behaviour in Fiji using data from 1970 to 2000. The evidence finds no significant effect of the age dependency ratio on savings rate.

Thornton (2001) tests the applicability of the simple Life cycle hypothesis for the United States by applying cointegration techniques, the Error Correction model to time series data on personal savings and age structure for the period 19560-1999. The findings reveal a cointegration relationship between personal savings and both young and old dependency ratios, with both ratios exerting a significant negative effect on the rate of savings. This constitutes an evidence that supports the Life cycle hypothesis. Applying cointegration techniques as well, Mohsin (2002) runs an Error Correction Model to Pakistan time series data for the period 1972-1999 to investigate the influence of age structure on household savings and obtain the same result. The model includes household savings rate, young and old dependency ratios and the results are in support of the Life cycle hypothesis as both dependency ratios depress the savings rate of households in Pakistan.

Jogernsen (2011) tests the Life cycle hypothesis in the context of Brazil with a sample of 38 observations using the Error Correction model and finds no evidence of the Life cycle hypothesis as dependency ratio positively affects private savings. Likewise, in the context of South Africa, Chipote and Tsegaye (2014) investigate the determining factors of household savings using time series data for the period 1990-2011.According to the results, a positive relationship is reported between the regressed savings rates and dependency ratios, as well as with interest rate and inflation, thereby refuting the applicability of the Life cycle hypothesis. The results establish long run equilibrium relationship amongst the variables, with the data showing a negative association between income level and household savings rates.

Uddin et al. (2016) make use of three econometric methodologies, dynamic OLS (DOLS), fully modified OLS (DOLS) and vector error correction model(VECM) to investigate the effect of population age structure and savings on economic growth using data Australian data from 1971 to 2014. The evidence supports the Life cycle hypothesis since the dependency ratio is negatively related savings rate.

3.3.3 South African studies

Using microeconomic data, Spio and Groenewald (1996) test the applicability of the Life cycle hypothesis amongst rural households in South Africa using the age cohort technique. The evidence does not support the life cycle prediction; indeed, they find that young and

middle age do not find it necessary to save due to strong family ties, but they do save when there is enough money. Similarly, Ting and Kollamparambill (2015), also invalidates the Life cycle hypothesis, noting that income ratio is smooth over age and cohort variables.
Esson (2003) uses OLS, logistic modelling approaches to invalidate the Life cycle hypothesis by concluding that amongst low-income savers in Khayelitsha and Mitchell's Plain, the retired household members save more than the young members do. Their primary reason is to cater for funeral costs. Presenting contrasting results, Zwane, Greyling & Maleka (2016) apply panel data techniques to micro level data to investigate the determinants of savings in South Africa and found evidence in support of the Life cycle hypothesis. They find that savings rise if the age structure increases by one year. Moreso, they incorporate the age squared variable to capture the Life cycle hypothesis and the results show that as an individual become older, the prospect of savings diminish, hence the elderly are net dissevers.

At the macro level, Odhiambo (2007) investigates the determinants of savings in South Africa within the Life cycle hypothesis framework by adopting the cointegration based error correction model using household data from 1968 to 2004. However, the study did not consider age, relying only on the real GDP growth rate together with terms of trade, real deposit rate and inflation rate variables, to conclude about the relevance of the life cycle hypothesis. The study, therefore, validates the Life cycle hypothesis from the income point of view. In a similar fashion, Mahlo (2011) and Simlet et al. (2011) reach the same conclusion. The former includes household consumption, debt and income variables as the major explanatory variables and the latter, government balance, real house price and corporate savings amongst the regressors. Mongale et al. (2013) employ the cointegrating vector autoregressive (CVAR) approach to estimate determinants of savings in South Africa and use variables similar to Mahlo (2011). The results also validate the Life cycle hypothesis based on the income coefficient, without allowing for the influence of demographic variables.

Chipote and Tsegaye (2014), using vector error correction model (VECM) on data from 1990 to 2011, explore the determinants of household savings and estimate the long-run relationship between age dependency ratio and savings rate in the South African context. Their results are inconsistent with the Life cycle hypothesis as the age dependency ratio has a positive and insignificant relationship with household savings. In the same vein, Kapingura and Alagidede (2016) investigate the relationship between the development of the financial sector and mobilisation of savings while controlling for the age dependency ratio. However, they find evidence in support of the Life cycle hypothesis; the age coefficient being negative and significant.

The literature reviewed presents mixed results in terms of the applicability of the Life cycle hypothesis in different countries. In time series analysis, earlier studies employed OLS regressions whilst recent studies, due to improvements in econometric methodologies, employ cointegration and panel techniques in examining demographics changes and savings rates. There is limited use of the Autoregressive Distributed Lag methodology despite its superiority over traditional cointegration techniques, in examining savings behaviour. Consequently, this paper applies the Autoregressive Distributed Lag cointegration technique in analysing the relationship between age structure and savings rate in South Africa, where empirical evidence on such relationship is yet to be provided, at the macro level. Chief amongst the variables affecting rate if savings include income, inflation, interest rate and demographic factors. The study, subject to data availability, will consider these variables based on their relevance to South Africa.

4. Model Specification, Data and Methodology

4.1 Model Specification

Modigliani and Brumbergin (1954) hypothesised that household savings rates are dependent on age. Analogous to Hussein and Thirwall (1999), the study categorises the determinants of savings based on factors that have a bearing on the capability to save and those that relate to the disposition to save. It is assumed that savings capacity is dependent on economic variables such as income (non-linearly or linearly) as well as life cycle variable namely population age structure (dependency ratio). Economic policy factors influence willingness to save and variables such as interest rate, inflation and financial deepening degree are fixed across households. According to Hussein and Thirwall (1999), the Life cycle hypothesis can be tested with a simple relationship analysis between the savings rate and the income per capita. The other method is to include the age structure (dependency ratio) together with income. This study includes the real interest as a variable that provides motivation to save. It is also appropriate as it adjusts for inflation, a measure of uncertainty.

In functional format, the equation is:

$$\mathrm{S} = \mathrm{f}(\mathrm{DR}, \mathrm{IR}, \mathrm{Y}) \tag{1}$$

The general form of savings model is:

$$\mathrm{SR}_{\mathrm{t}=}\delta_0 + \delta_1 \mathrm{DR}_\mathrm{t} + \delta_2 \mathrm{Y}_\mathrm{t} + \delta_3 \mathrm{RIR}_\mathrm{t} + \varepsilon_\mathrm{i} \tag{2}$$

Where, SR= savings rate; DR= dependency ratio; IR=real interest rate and Y= income.

This paper considers the total age dependency ratio (ADR) as a proxy for population age structure and gross savings as a percentage of gross domestic product (GSP) as a proxy for savings rate. The growth rate of per capita income (GDPG) as a proxy for income and real interest rate capture capability and willingness to save. Gross national income less total consumption, plus net transfers, define the gross savings and includes corporate savings, personal savings and government savings (Hu, 2015)

The time series model estimated is:

$$\mathrm{GSP}_\mathrm{t} = \delta_0 + \delta_1 \mathrm{ADR}_\mathrm{t} + \delta_2 \mathrm{RIR}_\mathrm{t} + \delta_3 \mathrm{GDPG}_\mathrm{t} + \varepsilon_\mathrm{i} \tag{3}$$

The coefficients δ_1 and δ_2 indicate the long run estimates of dependency ratio and real interest rate respectively with respect to savings rate whilst δ_3 measures the long run growth in GDP per capita impact on the savings rate. The coefficients of the dependency ratio δ_1 and the real interest rate are expected to be negative, thus, their increases should adversely affect savings rate. The coefficient of income, δ_3 , on the other hand is expected to be positive as it is hypothesised that the more income one has, the higher the ability to save.

The construction of the variables is as follows:

$$\text{GSPGDP} = \left(\frac{\text{Gross savings}}{\text{GDP}}\right)\% = \left(\frac{\text{Gross savings} - \text{consumption} + \text{net transfers}}{\text{GDP}}\right)\%$$

$$\text{ADR} = \left(\frac{\text{People youner than } 15 + \text{People older than } 64}{\text{Working age population}(15 - 64}\right)$$

4.2 Data

The study employs yearly data for the period 1970 -2014, to yield 45 observations for each of the variables. All the data is extracted from the World Development indicators, a data set maintained by the World Bank and it is in percentage form.

4.3 Test for Unit Root

A crucial requirement in when carrying out cointegration analysis is the determination of the level of stationarity or non-stationarity of the data series. A stationary series implies that the first two moments of the data generating process is dependent on time (Nkoro and Uko, 2016).

It is therefore of crucial importance to detect the existence of stationarity or absence thereof in the series so that spurious regression can be avoided. Moreso, since Autoregressive Distributed Lag is sensitive to I (2) variables, it is necessary to test the level of integration of the variables. To this end, the paper carries out unit root tests by adopting the Dicky-Fuller generalized least square (DF-GLS) and the Kwiatkoswki-Phillips-Schmidt-Shin (KPSS) test. Whilst most literature extensively uses Dickey- Fuller and Phillips Perron tests to determine the integration order, these tests have poor size and power properties. This affects their reliability for data sets with small sample sizes in that they tend to over-reject the null hypothesis when it should not, accepting it when it is false (DeJong et al., 1992). The suggested tests have improved power properties; hence adequate for the relatively short sample size used in this studies.

The DF-GLS test for unit root performs a modified Dickey –Fuller t test proposed by Elliot, Rothberg, and Stock (1996). The test is essentially an augmented Dickey –Fuller test, except that the time series is transformed via generalised least squares before the test is performed. The ADF test was operatalised with lagged difference in terms of the regression equation:

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \sum_{j=1}^{\rho} \delta_t \, \Delta y_{t-1} + \varepsilon_t \qquad (5)$$

Where α is a constant; β is the coefficient on the time trend, ρ is the lagged difference terms; and ε_t is the error term. Assuming a homoscedastic error term, the null hypothesis in the DF-GLS indicates H_0: y = 0, that there is a unit root (non-stationary). The alternative indicates $H_1: y < 0$, that is, there is no unit root (stationary). The DF-GLS is performed analogously but on GLS detrended data.

The KPSS test, on the contrary, is more intuitive and, as its null hypothesis suggests stationarity, hence it has the opposite null and alternative. It is therefore complementary to the DF-GLS. Its statistic is characterised as follows:

$$KPSS = (T^{-2} \sum_{t=1}^{T} \hat{S}_t) / \hat{Z}^2 \qquad (6)$$

If the DF-GLS test fails to reject the null hypothesis, and the KPSS rejects the null hypothesis, there is evidence from both test is supportive of a unit root in the series. If there is non-stationarity in the time series in their levels but stationary with their first differences, then the cointegration test need to be applied in the estimation process (Uddin, 2016).

4.4 Lag length selection criteria

Lag length estimation of an autoregressive process is crucial for econometric exercise. The Autoregressive distributed lag bounds test procedure requires, as with all cointegration tests, selection of an appropriate lag length of the variables to avoid spurious regression and to have robust standard errors. In addition, to avoid autocorrelation and heteroskedasticity problems. The Akaike information criterion (AIC) and the final prediction error (FPE) surpass all other criterion when dealing with small sample cases (observations 60 and below). These criterions minimise the probability of under estimation whilst maximising the probability of true lag length recovery (Liew, 2004). Consequently, this paper uses Akaike information criterion (AIC) and the final prediction error (FPE) in this regard.

3.4 Methodology

3.4.1 Autoregressive Distributed Lag (ADRL) bounds test to cointegration

In analysing the long run relationship between age dependency ratio and savings rate, this paper deviates focus from the traditional cointegration techniques proposed by Engle and Granger (1987) as well as Johansen and Juselius (1990). Instead, it employs Autoregressive Distributed Lag model (ADRL) bounds testing method developed by Pesaran et al. (2001). The autoregressive distributed lag model is advantageous in that it performs well in small samples for developing countries, as in this study, thereby alleviating the challenges related to omitted variable bias and autocorrelations (Haug, 2002; Panopoulou and Pittis, 2004; Hassler and Wolters, 2006; Akinboade et al., 2008; Nkoro and Uko, 2016). It is possible to use even when the explanatory variables are endogenous and it simultaneously estimates both the short-run and long run elements of the model. It also corrects for residual correlation and endogeneity. Upon selection of the appropriate lag, structure cointegration can be tested using OLS. More importantly, it is applicable where the variable are integrated of order zero I (0), integrated of order one I(1) or a combination of the two.

An unrestricted error correction model is operated for equation (3) in an ADRL representation of savings rate and dependency ratio constructed as:

$$\Delta \mathrm{GSP_t} = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta \mathrm{GSP}_{t-i} + \sum_{i=1}^{n} \alpha_{2i}\, \Delta \mathrm{ADR}_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta \mathrm{GDPG}_{t-i} + \sum_{i=1}^{n} \alpha_{4i}\, \Delta \mathrm{RIR}_{t-i} + \beta_1 \mathrm{GSP_{t-1}} + \beta_2 \mathrm{ADR_{t-1}} + \beta_3 \mathrm{GDPG_{t-1}} + \beta_4 \mathrm{RIR_{t-1}} + \varepsilon_t \quad (7)$$

Regarding the above model,Δ is the first difference operator, whilst the αs represent the short run coefficients, $\beta_1 - \beta_4$ represent the long run relationship and ε_t is the error term. The null and alternative hypothesis of cointegration are:

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ No cointegration

$H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ Cointegration

The subsequent step is to make a comparison of the calculated F-statistic and the critical values generated based on Pesaran et al. (2001). One set of critical values assumes that all model variables are I (1) and the other set assumes that they are I (0). The null is rejected if the F-statistics calculated is more than the upper bounds value. If the calculated F-statistic is lower than the lower critical bounds value, this is an indication of absence of cointegration. If the F-statistic falls within the bounds, then the decision is inconclusive regarding the existence or absence of cointegration.

According to Granger (1988), if variables are cointegrated it is possible to examine casual relations among variables within the ECM framework. If cointegration exists, the short-run and long run models can be estimated by the simple OLS to derive the residuals and estimate the speed of adjustment. In this sense, individual coefficients of lagged terms capture the short run dynamics whilst the error correction term (ECT) will contain long run correlation information. Further, significance of lagged independent variables is a depiction of short run relationship whereas ECT statistical significance signifies long run causality.

Hence, ADRL bounds test version of the error correction model pertaining to the variables in equation (7) can be parametrised in equation (8) as follows:

$$\Delta \mathrm{GSP_t} = \theta_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta \mathrm{GSP}_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta \mathrm{ADR}_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta \mathrm{GDPG}_{t-i} + \varphi \mathrm{ECM_{t-1}} + \varepsilon_t \quad (8)$$

Where, θ_0 is the drift component, Δ is the difference operator whilst ε_t is the common white noise residuals. ECM represents the error correction term that is derived from the long run cointegrating relationship from the autoregressive distributed lag model specified in (8). It represents the speed of adjustment of the dependent variable to equilibrium because of shocks to independent variables. φ is expected to display a negative and significant sign as an indication for the existence of a long run correlation.

3.4. 2 Toda and Yamamoto (1995) Granger causality test

Causality refers to the ability of one variable to predict, hence causing the other (Asteriou and Hall, 2007). In complementing the cointegration analysis, the study implements Granger causality test proposed by Toda and Yamamoto (1995) to test for causality. The advantage of the approach is that it does not require pre-testing for the cointegration properties of the system. More importantly, implementation is possible irrespective of whether the underlying variables are stationary, cointegrated or non-cointegrated or of different orders. It also works well with small samples. The procedure involves determining the maximum likely order of integration (d_{max}) of the series in the model. Estimation of the following augmented level VAR essential:

$$z_t = \Phi_0 + \Pi t + \sum_{i=1}^{p^*} \Phi_i z_{t-i} + u_t \tag{9}$$

Where, $z_t = (\mathrm{GS_t}, \mathrm{ADR_t}, \mathrm{GDPG_t}, \mathrm{RIR_t})$, $p^* = \mathrm{k} + d_{max}$ and Φ_i are (4X4) coefficient matrices.

Following the estimation of equation (6), there is application of a standard Wald test for the first lagged k explanatory variables to make causal inferences. The last lagged (d_{max}) coefficients are not included since the inclusion of extra lags is to ensure that the computed Wald-statistic for Granger causality test carries the standard asymptotic distribution properties for valid inferences to be made (Toda and Yamamoto, 1995).

3.5 Diagnostic tests:

The study follows Narayan and Smyth (2005) by employing Pesaran and Pesaran (1997) test for stability of parameters by applying the cumulative recursive residuals (CUMSUM) and CUMSUM of square (CUMSUMSQ) in the assessment of constancy of parameters after estimating the error correction model. The study applies diagnostic test to ensure valid inferences and reliable conclusions. These include serial correlation, heteroscedasticity and normality test of residuals.

4. EMPIRICAL RESULT ANALYSIS

4.1 Unit root test

Table 1: Unit root test results

Panel 1: ADF- GLS Unit root test results

Variables	At Level		At first difference		Remarks
	Intercept	Trend & intercept	Intercept	Trend & intercept	
GSP	-1.411449	-2.588105	-5.150851***	-6.197609***	I(1)
RIR	-3.298643***	-3.734534**	-7.629692	-7.643123	I(0)
ADR	-0.271913	-2.652072	-1.936116*	-2.516349	I(1)
GDPG	-4.049140***	-4.489646***	-6.661486	-7.005693	I(0)

Panel 2: KPSS Unit root test results

Variables	At Level		At first difference		Remarks
	Intercept	Trend & intercept	Intercept	Trend & intercept	
GSP	0.675403***	0.111538**	0.170125***	0.133799***	I(1)
RIR	0.500462***	0.141810***	0.134978	0.136121	I(0)
ADR	0.846877	0.111130***	0.233152***	0.129196**	I(1)
GDPG	0.167579***	0.174054***	0.500000***	0.500000	I(0)

*** Statistical significance at 1% level, **Statistical significance at 5% level, *Statistical significance at 10% level.

Table 1(DF-GLS in panel 1 and KPSS in panel 2) above clearly indicate that not all the variables are stationary at levels; hence-a mix of I (0) and I (1) level of integration. This meets the requirements of autoregressive distributed lag cointegration approach to determine the presence of any linear combination amount the variables under stud

4.2 Autoregressive distributed lag (ARDL) estimation results

4.2.1 Lag length selection

Table 2: Optimal lag selection criteria

Lag	FPE	AIC
0	28.1956	21.5984

1	33.0101	14.8431
2	14.1446	13.9695
3	13.4307*	13.8512*
4	20.2757	14.1307
5	27.1025	14.1854

* indicates the lag order selected by the criterion

Table 3 above gives a report of the optimal lag length. The Akaike Information Criterion suggests 3 lags whilst the final prediction error (FPE) also selects 3 optimal lag length.

4.2.2 Bounds test

Table 3: ADRL (2, 2, 2, 3) bounds test for cointegration

Variables	**F-statistics**	**Cointegration**
F(GSP), ADR, GDPG, RIR	3.626681*	Cointegration
Critical values	Lower bound	Upper bound
1%	3.65	4.66
5%	2.79	3.67
10%	2.37	3.2

*** Statistical significance at 1% level, **Statistical significance at 5% level, *Statistical significance at 10% level. A maximum lag length k=3 was selected based on the Alkaike criterion.(2, 2, 2, 3) indicates the corresponding lag length for each variable.

Based on the empirical findings in Table 4, the F statistic falls outside the bounds at 10% level of significance. The conclusion is that a long run relationship between savings rate, age dependency ratio, real interest rate and GDP per capita exists. The results base on equation (7) estimation.

4.2.3 Long run estimates

Table 5: Estimated long run coefficients

Variables	Coefficient	p-value
C	9.8111	0.1437
ADR	0.21400***	0.0068
RIR	-0.6105***	0.0006
GDPG	-0.0933	0.7283

*** Statistical significance at 1% level, **Statistical significance at 5% level, *Statistical significance at 10% level.

Table 5 presents the marginal effects of the explanatory variables on the dependent variable. The empirical evidence reveal that the coefficients of age dependency and real interest rate variables are statistically significant at 5% level. However, the signs of the coefficients contrast with the expected results. The growth rate of per capita income coefficient is not statistically significant. The results seem to suggest that the 1% increase in dependency ratio will result in a 0.21% increase higher the savings, invalidating the Life Cycle hypothesis. The findings are contrary to most cross-country studies including Leff (1969); Bloom et al. (2003); Loayza et al. (2000);Brookins et al. (2015) as well as Apergis, and Christou (2012) who use a related methodology, the Error correction model of cointegration. The results also contrast single country studies carried out by Thornton (2001) and Mohsin (2002) that utilise cointegration techniques. All these studies find a negative impact of dependency ratios on savings rates. In the South African context, the results contrast Greyling at al. (2016) who report that savings decrease as individuals become older.

The non-applicability of life cycle hypothesis is parallel to some cross-country studies such as Ram (1982) who found that dependency ratios did not adversely affect rate of savings in developing countries, citing sample coverage and period covered a possible justification for these findings. In addition, partly in tandem with Deaton and Paxson (1997) and Bloom et al. (2003) who find correlation to be weak. It is important to note that, from an individual country analysis, the results are very similar to Chipote and Tsegaye (2014) who find a long run equilibrium relationship between dependency ratio and savings rates in South Africa using cointegration techniques. They also find a positive impact of dependency ratio on savings rates. Additionally, the findings are parallel to Jogernsen (2011), Esson (2003), Spio and Groenewald (1996) and Ting and Kollamparambill (2015), with the latter three invalidating the life cycle hypothesis in South Africa.

Overall, the results also seem to conform to the suggestions by Horioka (2010) who put forward the idea that the natural decline in young dependency ratio as the population ages is expected to offset the negative pressure at least partially on savings rate resulting from the growth in the old dependency ratio. The pattern of the age dependency ratios in South Africa currently follows this trajectory. However, savings continue to decline despite the decrease in young dependency ratio. The only logical conclusion in this regard is perhaps that the growth in the old dependency ratio is depressing savings more than the drop in young dependency ratio is causing a rise in savings, resulting in only a partial offset.

Similarly, the real interest rate variable also deviates from expectations. According to the evidence in this paper, a 1% increase in the real interest rate will lead to a 0.61% percent decline in the savings rate. Higher interest rates discourage savings. This is in correspondence with the income effect dominating the substitution effect and supports findings by Hussein and Thirlwall (1999), Aaron and Muellabauer, 2000, Odhiambo (2006), Narayan and Narayan (2013) as well as Simlet et al. (2011). According to Prinsloo (2000), households in South Africa increase consumption following a rise in interest rates, with the expectation of realising higher future incomes derived from these interest rate increases, thereby depressing savings. South Africans are generally, according to the findings, are net borrowers.

The income variable GDP per capita is not statistically significant at standard level, and does not conform to the expected sign. Hence, growth in income does not have a bearing on the savings rate, thereby invalidating the life cycle hypothesis further. These results contrast findings by Odhiambo (2007) who find that savings in South Africa are influenced by growth rate of income and Mongale et al. (2013) whose results show as household disposable income rises, there is a proportional increase in savings rate.

However, the findings resonate the sentiments by Mishi (2012) who, in discerning the determinants of savings in South Africa, purports that the population is not forward looking and the love for better economic status hinders the improvement of a savings culture. South Africa is an “avaricious” society, were people strive by any means to acquire material possessions as reflected by increased household debts and the sprouting of “loan sharks” Mishi (2012). In addition, in tandem with Kapingura and Alagidede (2016) who purport that the availability of cheap credit in South Africa has consequently led to a shift from future consumption to current population and this is reflected by the low savings rate, despite a number of financial products being on offer. Hence, even with higher incomes, South Africans do not save.

4.2.4 Short run estimates

Table 6: Short run dynamics in the ECM

Variables	Coefficient	p-value
D (GSP (-1))	0.2786	0.0523
D(ADR)	-0.4875	0.6249
D (ADR (-1))	2.4692	0.0193
D(GDPG)	0.1437	0.1916
D (GDPG (-1))	0.4689	0.0001
D(RIR)	-0.2901	0.0000
D (RIR (-1))	0.2145	0.0161
D (RIR (-2))	0.3058	0.0001
CointEq (-1)	-0.5476	0.0001

*** Statistical significance at 1% level, **Statistical significance at 5% level, *Statistical significance at 10% level.

The short run analysis is useful in discovering whether the equilibrium conditions affect the short-run dynamics, in other words, the cointegrating vectors. The ECM has a correct negative sign and is statistically significant, signifying long run relationship between savings, income, real interest rate and dependency ratio. It measures the speed of adjustment to equilibrium in the event of a shock to the system caused by the independent variables. In this case, there is correction of about 55 percent of the disequilibrium from the previous year following a deviation from the equilibrium. The change in the savings rate is a function of the disequilibrium in the cointegrating equation with age dependency ratio, growth rate of per capita income and real interest rate.

Overall, the results of the study seem to be in tandem with the propositions made by Apergis and Christou (2012) for whom the life cycle hypothesis may be less applicable in the African context due to peculiarities in culture that include income uncertainty and substantial prevalence of intergenerational transfers within relatives and families. Private transfers from children to aged parents are quite common than in the western world (Attias-Donfut, 1995, Altonji et al., 1997). These intergenerational transfers have the potential of mitigating the need for life cycle savings, as children become an effective substitute for life cycle savings. Furthermore, the foundation of Africans altered by social constraints, thereby impeding savings and investment trends. In this sense, support provided to dependents is organised within families, implying substantial amounts of private transfers. Many households can be seen to possess noteworthy savings, held in the form that is non-financial such as livestock, stocks of goods for trading, jewellery, grain and even construction material. It is also estimated that Africa loses great amount of domestic revenues through capital flight, evasion of taxes, and profit repatriation by multinational organisations, high debt repayments as well as inadequate financial services and inclusion (Apergis and Christou, 2012).

4.3 Diagnostics tests

Table 7: Diagnostics test results

Test	Null Hypothesis	p-value
Langrage Multiplier(LM)	No serial correlation	0.6237
Jarque Bera(JB)	Normality of residuals	0.3722
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	0.5504

4.5 Granger causality test

The existence of cointegration only implies correlation hence the paper, to ascertain the predictive properties of age dependency ratio, growth rate of income and real interest rate, conducts a Granger causality test. The Granger causality test is out to determine if there any causal correlation between current values of savings rate and the past values of the independent variables.

Table reports p- values.

*** Statistical significance at 1% level, **Statistical significance at 5% level, *Statistical significance at 10% level

Table 8: Toda and Yamamoto(1995) granger causality test

Dependent variable / **Regressors**	GSP	ADR	GDPG	RIR
GSP	-	0.2558	0.6157	0.2550
ADR	0.0076***	-	0.9655	0.2246
GDGP	0.0628*	0.1577	-	0.3282
RIR	0.0556*	0.0490**	0.0852*	-

The test reveals a unidirectional relationship between age dependency ration, real interest rate and growth rate in per capita income with gross savings rate. In line with the short run and long run relationships presented above, the granger causality test confirm that the dependency ratio and real interest rate granger cause the savings rate due to the significance of the p-values. Growth rate of income also granger causes gross savings albeit in the short run as per Autoregressive Distributed Lag error correction model estimation. The result also shows that real interest rate granger causes growth rate of income per capita as suggested by the theory.

3.5.5 Tests for stability

This study finally examines the stability of the selected Autoregressive Distributed Lag based on error correction model. The cumulative sum (CUMSUM) and the cumulative sum squares (CUSUMSQ) proposed by Borensztein et al (1998) are exploited to this end. Other studies including Pesaran and Pesaran (1997) and Mohsen (2002) conduct these tests for this purpose. The test is on the residuals of the ECM model equation (5).

Figure 8: CUMSUM test

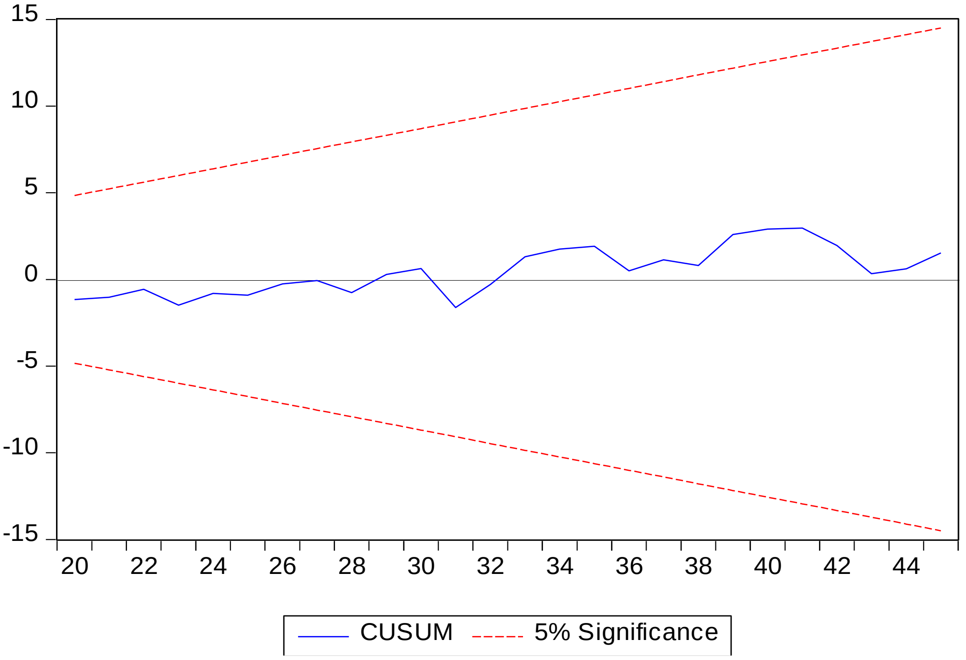


Figure 9: CUSUMSQ test

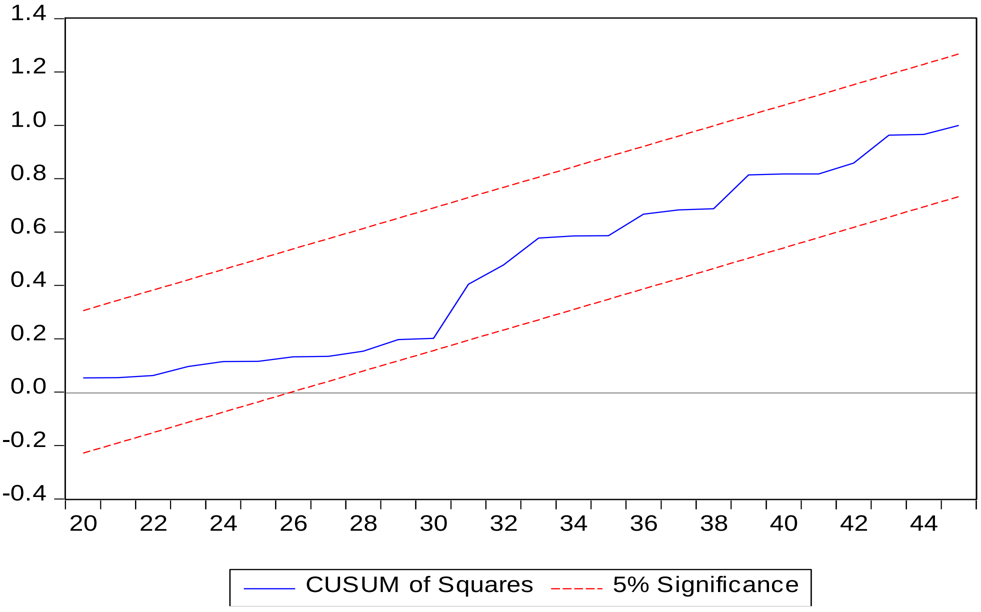


Figure 8 and 9 reflect the stability test results. In both graphs, the CUMSUM and the CUSUMSQ both stay within the 5% bounds, confirming the long run relationship amongst the variables, thereby indicating stability of the coefficients.

5. CONCLUSION

Against a backdrop of falling savings rate and total dependency, the main aim of the paper is to investigate the applicability of the life cycle hypothesis in South Africa. The objective is achieved using the Autoregressive Distributed Lag bounds test and the Toda and Yamamoto (1995) granger causality test using data from 1970 to 2104. The study finds a cointegration relationship between the rate of savings, age dependency ratio, growth rate of income per capita and the real interest rate. The significance of the error correction term establishes that the long run cointegration exist in an equilibrating manner. Diagnostic and stability tests confirm the appropriateness of the model specification. Unexpectedly, a positive relationship between age dependency ratio and the savings rate is found in both short and long run; thereby rejecting the applicability of the life cycle hypothesis the South African economy. In addition, the growth rate of income per capita, according to the results, does not affect the savings rate in the long-run. Real interest rates are negatively related to the savings rate in the long-run, implying that the income effect is greater than the substitution effect. The Granger causality test provides a confirmation of the relationship, as unidirectional relationship between age dependency ration, real interest rate and growth rate in per capita income with gross savings rate is established.

The results suggest the irrelevance of demographic factors as instruments to boost savings in South Africa. Since demographics does not play a critical role in driving savings behaviour, changes in population structure are unlikely to affect savings dynamics. This implies that public policy aimed at reducing the dependency ratio in anticipation of propping up savings rates as proposed by the Life cycle hypothesis will be an inefficient use of public resources. Nevertheless, the claim is made with a strong caveat that the population structure and its impact on savings be recognised as a multifaceted phenomenon. For instance, cultural factors (consumerism) and intergenerational transfers are relevant in South Africa and potentially have a bearing on the rate of savings regardless of age.

The study offers some areas of further research. Firstly, the paper examined the relationship between age dependency ratio and savings rate within a setting that includes four variables. The evidence may suggest that several other factors are at work to account for the study findings. A re-examination of the topic that incorporates more factors may be a probe that can aid in comprehending the association between demographics and savings. Secondly, an interesting line of inquiry would be one that quantifies active and inactive classes by referring to age intervals that are less wide and/or separating the economic effects of various elements of the population. Dividing the dependency ratio into old and young could provide more insights.

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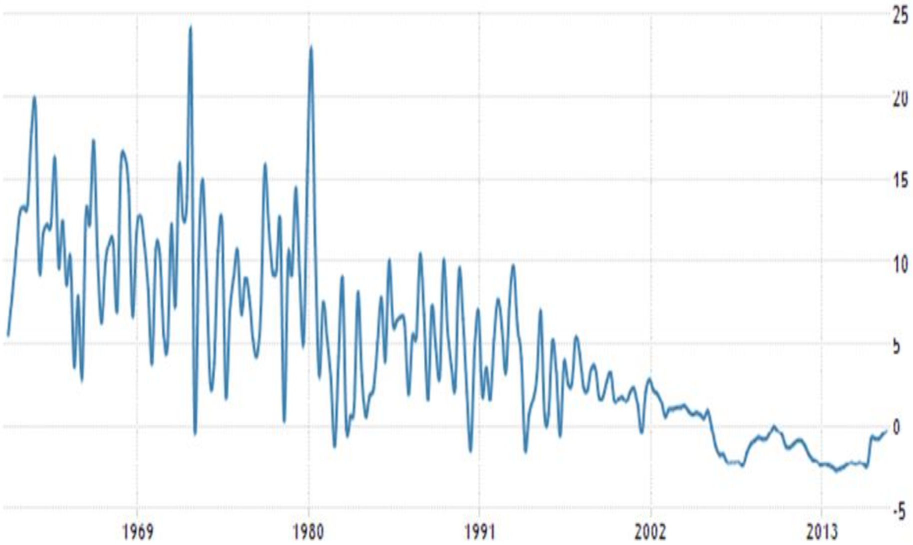
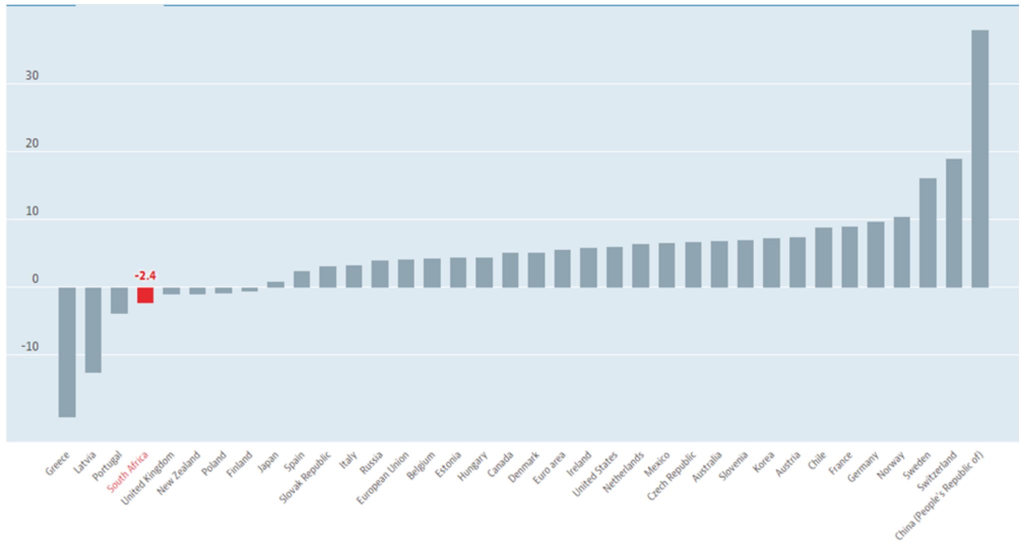
Appendix A

Figure A1: SA net household savings (% GDP) 1960-2017



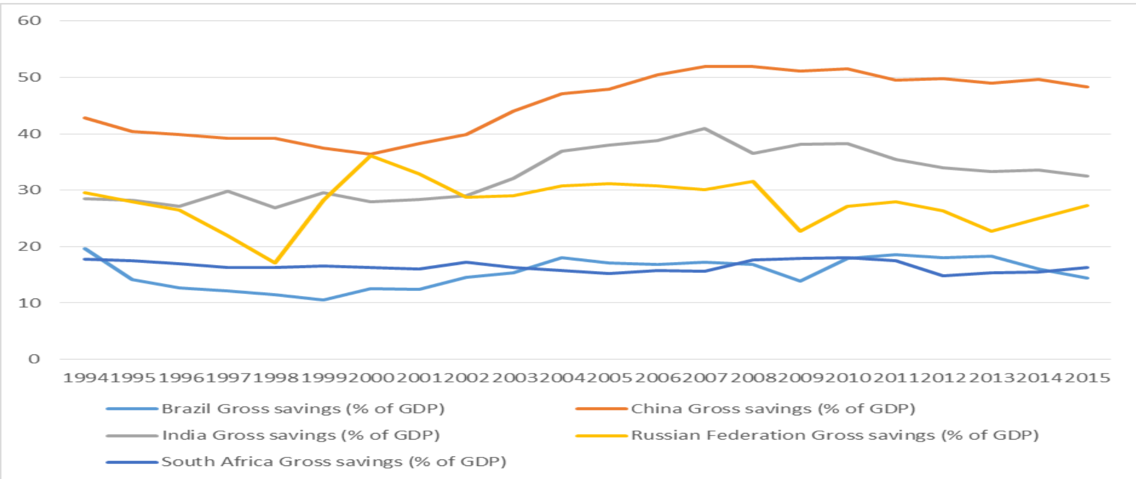
Source: Tradingeconomics (2017)

Figure A2: SA net household savings (%GDP) 2015: Global comparison



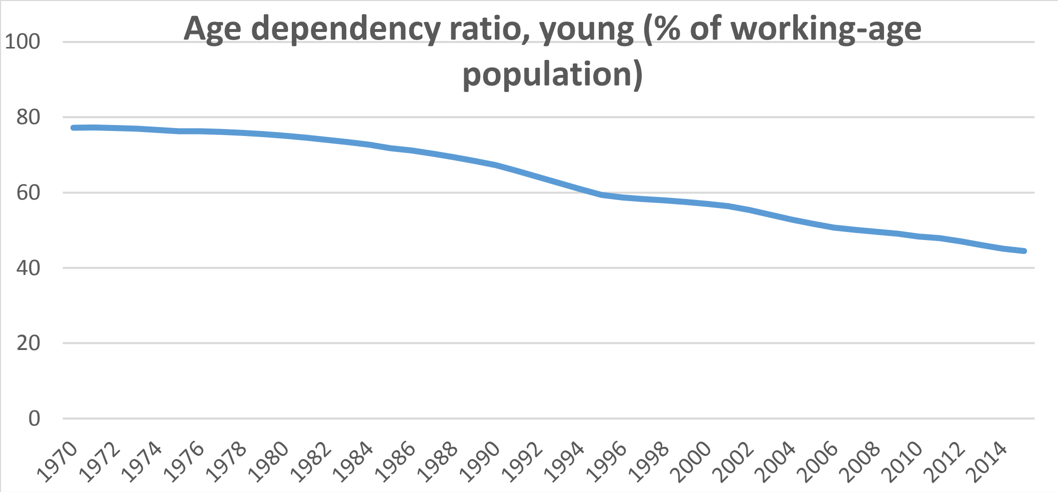
Source: OECD (2017).

Figure A3: SA Gross savings (% GDP), 1994-2015: BRICS Comparison



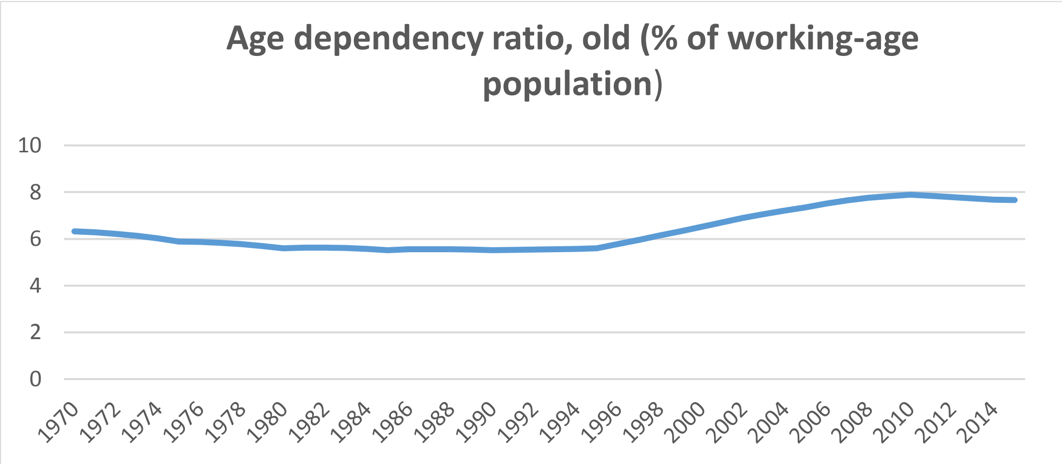
Source: World Bank (2017).

Figure A4: SA Young dependency ratio: 1970-2015



Source: World Bank (2017).

Figure A5: SA old dependency ratio:1970-2015



Source: World Bank (2017).