

The Impact of Demographic Dynamics on Household Saving in Pre-COVID-19 South Africa

Afamefuna Emmanuel Nwogbo
University of Johannesburg,
South Africa
afamefunan@vut.ac.za

Sivan Chetty
University of Johannesburg,
South Africa
sivanc@uj.ac.za

Joel Hinaunye Eita
University of Johannesburg,
South Africa
jeita@uj.ac.za

This paper examines the effect of demographic dynamics on household saving in pre-COVID-19 South Africa, across all nine provinces of South Africa. The study used panel autoregressive distributed lag (PARDL) and Dumitrescu-Hurlin panel causality methods. The results revealed a long-run relationship between demographic dynamics and household saving in South Africa, showing that the White working age population had a significant effect on South Africa's household saving in both the long-run and short-run, while the Black and Coloured working age population groups significantly impacted household saving only in the long-run. However, the Asian/Indian working age population had no effect on household saving in either the long run or short run. The Dumitrescu-Hurlin panel causality analysis revealed a bidirectional causality running between Asian/Indian, Black, and Coloured population groups and household saving, while a unidirectional causality was found running from the White population group to household saving.

Keywords: demographics, working age population, aged/elderly population, life-cycle hypothesis, household saving, panel ARDL, Dumitrescu-Hurlin panel causality

JEL Classification: J1; E2; C0

Received 2024/09/01 · Revised 2024/11/12 · Accepted 2024/01/16

Published online 2025/06/30 © Author



<https://doi.org/10.26493/1854-6935.23.121-146>

Introduction

The debate on the relationship between demographics and household saving seems to be a perennial one among different economic schools of thought. The discourse on population age structure and household saving has been mainly based on the Modigliani and Ando (1963) life-cycle hypothesis. This hypothesis classifies the life cycle into three stages (structures): pre-reproductive (young dependent), reproductive (working age) and post reproductive (old dependent). These structures of the population are found to be crucial among the various factors that play significant roles in explaining savings (Keho 2012). Many factors impact a country's household saving behaviour, of which the demographic dynamics of a country are among the notable factors that can impact a country's household saving decisions as well as its rates (Modigliani and Ando 1963; Attanasio and Banks 2001). The life-cycle model indicates that a country's changing population age structure plays a role in informing the country's household saving behaviour (Modigliani and Ando 1963). It links the age of individuals to their savings and consumption. The model postulates that individuals seek to maximise their utility through a consumption profile, across their stages of life, that is in harmony with their lifetime earnings.

As population age structure informs the household's consumption-saving decisions, changes in population age structure that adversely impact household saving may have the potential to perpetuate low growth levels, given the role that savings play in the economy (Aron and Muellbauer 2000; Imoughele and Ismaila 2014). In view of this, population age structure can be seen as one of the channels through which demographics affects household saving in a country (Albuquerque and Ferreira 2015; Nagarajan et al. 2016). Conventionally, the a priori expectations based on the life-cycle model are that the young population does not save, and the working population saves, while the aged/elderly population dissaves. These a priori expectations and the emphasis that household saving behaviour is a function of age supports the hump-shaped pattern that the life-cycle hypothesis proposes.

There are numerous studies on the population age structure and household saving relationship. Many of the previous studies are in support of the life-cycle hypothesis, but a few are in disagreement with the life-cycle proposition. Household savings is one of the components of domestic savings and it is essential for investment and long-term eco-

economic growth. Increased household savings helps to improve domestic savings and therefore reduces a country's need to borrow in the international capital markets, thereby helping to avoid the volatility associated with cross-border borrowing (Stals 1995; Asia-Pacific Economic Cooperation 2002; Touny 2008). A high saving ratio to gross domestic product can be viewed as a good economic indicator by foreign investors when assessing a country's economic performance (Mikesell and Zinser 1973).

Although there are numerous studies on the population age structure and saving relationship nationally and globally, none (to the best of our knowledge) has empirically investigated this relationship with population age structure (working age population) disaggregated into four racial groups and according to provinces. Thus, unlike the previous studies, and given South Africa's unique population groupings, this study will focus on the effect of the working age population, disaggregated into the four main racial groups (Asian/Indian, Black, Coloured, and White) and nine provinces, on household saving in South Africa for the period 1995 to 2019.

The remainder of this study is organised as follows. The second section discusses the literature. The third section discusses methodology. The fourth section presents the empirical results, and finally, the conclusions and recommendations of the study are presented in the fifth section.

Literature Review

THEORETICAL REVIEW

Economic theory emphasises the significant role that saving plays in the economy, suggesting that low saving rates constrain investment, which negatively impacts on economic growth (Mongale et al. 2018). Like many contemporary studies, this study is based on the saving theory, which is influenced by these two notable saving hypotheses: Friedman's (1957) Permanent Income Hypothesis (PIH) and Modigliani and Ando's (1963) Life-Cycle Hypothesis (LCH). The PIH follows the pioneering work of Keynes (1936), which defines saving as a linear function of income (Muradoglu and Taskin 1996). The combination of these two hypotheses informs the analysis of the modern theory on consumption and saving behaviour (Simleit et al. 2011).

However, the point of deviation between the LCH and PIH hypotheses is that Friedman's Permanent Income Hypothesis views savings as the outcome of transitory income, which is the difference between current income and permanent income (Ting and Kollamparambil 2015). Fried-

man's hypothesis affirms that transitory incomes, short-term changes in income, have little or no effect on households' spending behaviour, and that such changes contribute to household saving in that period, whereas the Modigliani and Ando Life-Cycle Hypothesis emphasises household saving as the outcome of intertemporal utility-maximisation by the rational household.

The life-cycle model predicts that individuals smooth consumption across all stages of life. The model predicts borrowing prior to labour market entry, wealth accumulation during the working life, and dissaving in retirement (Modigliani and Ando 1963). In view of this, households smooth their consumption over their life cycle given that household saving in each period is household consumption postponed in that given period. This summarises the essence of the Modigliani and Ando (1963) life-cycle approach. The life-cycle model is the model most referred to in the study of household saving (Ozcan et al. 2003:6). The proponents of the life-cycle model, which sees saving to smooth out consumption due to income fluctuations, recognise demographics as one of the forces that influence household consumption-savings decisions (Modigliani and Ando 1963; Attanasio and Banks 2001).

The conventional view is that demographic changes inform household saving. The working population group positively impacts household saving while young and elderly population groups negatively affect households' saving rates (Leff 1969; Muradoglu and Taskin 1996; Athukorala and Tsai 2003). As the composition of population age structures of a household changes, the household's consumption-saving decision will also be affected as the household adjusts to accommodate such changes in demographics (Bloom et al. 2001; Albuquerque and Ferreira 2015). Such changes in socio-demographic factors can exert a ripple effect in the economy, which can influence the pattern and composition of household saving that may have the potential to influence the performance of the economy (Okere and Ndugbu 2015).

The age structure of a country's population influences the saving rate of the country; therefore, households that consist mainly of the young and the elderly will have a low saving rate. This is because there is much dissaving among youths and young adults who are working, as well as in the early stages of establishing a family (Ahmad 2002; Navaneetham and Dharmalingam 2012). For instance, Modigliani and Ando's (1963) life-cycle model predicts that household saving behaviour is a function of age, and an individual borrows when young, saves as middle-aged and

dissaves when old, which supports the hump-shaped pattern that the life-cycle hypothesis proposes.

In contrast, Hock and Weil (2012) argue that population ageing will be neutral on the saving pattern of the household given that a rise in the elderly share of the population, resulting in a decrease in the supply of labour, will lead to a rise in the wage rates as well as saving rates of the working population. This rise in saving of the working population will absorb the dissaving on the part of the elderly population. Nonetheless, empirical results partially support Leff's (1969) findings that the dependency burden has negative and significant effects on the saving ratio for both developed and underdeveloped countries (Doshi 1994:3).

EMPIRICAL LITERATURE

There are numerous studies on the population age structure and household saving relationship, both nationally and globally. Results of some of the empirical studies on the population age structure and household saving nexus provide strong evidence in support of the life-cycle hypothesis (Athukorala and Tsai 2003; Yang and Zhang 2013; Zwane et al. 2016; Hanif et al. 2022; among others), while some of the empirical investigations are not totally in agreement with the life-cycle model (Hock and Weil 2012; Hyung 2013; Nduku and Simo-Kengne 2018; Huizheng 2020; among others).

Loayza et al. (2000) observe that age-related consumer heterogeneity seems to be the cornerstone of the life-cycle hypothesis, which predicts that saving follows a hump-shaped pattern (that is, high at middle age and low at young and old age). The study finds that young and old dependency ratios have a significantly negative impact on the private saving rate. The negative coefficients of the dependency ratios are consistent with the standard life-cycle model of consumption-saving. However, a study by Kraay (2000) is not in harmony with the findings by Loayza et al. (2000). Kraay (2000) finds that the dependency ratio has no significant impact on the household saving rates. This is supported by Athukorala and Tsai (2003)

In like manner, Ozcan et al. (2003) investigate the effects of several policy and non-policy variables on private saving in Turkey covering the period 1968–1994. The results show mixed support for the life-cycle hypothesis. However, the coefficient of the life expectancy rate is negative and statistically significant in all estimations and for every sample. This is in line with the predictions of the life cycle and precautionary saving models.

Horioka and Wan (2007) conducted a dynamic panel analysis of the determinants of the household saving rate in China using a life-cycle model and panel data on Chinese provinces for the period 1995–2004 from China's household survey. This study provides a mixed support for the life-cycle hypothesis as well as the permanent income hypothesis. The study finds that population aging has significant impact on savings for the rural sample but has insignificant effect on savings for the urban sample and overall sample of the study. This is supported by Horioka and Terada-Hagiwara (2010). It is also supported by Yang and Zhang (2013).

Hyung (2013) examines the relationship between the old-age dependency ratio and domestic saving rates using a data set of 15 high income countries for the period 1975–2010 and found that the old-age dependency ratio has no significant effect on the domestic saving rates. Ahmad's (2015) identifies the dependency ratio as one of the variables that significantly impact the private savings rate in Pakistan. This is in line with Zhang et al. (2016). Cruz and Ahmed (2016) find a positive association on the interaction between changes in the share of the working age population and saving.

Curtis et al. (2017) find that age distributions vital in the explanation of the conflicting patterns of household saving in the three countries. The model simulations also reveal that the growing number of retirees adversely impacts Japanese saving rates, whereas decreasing family size increases saving for both China and India. Ha and Hoa (2018) show evidence of a unidirectional causality running from demographics to domestic savings in Vietnam.

Pascual-Saez et al. (2020) examine the effect of population ageing on private savings on a sample of selected European countries over the period 1990–2013. The study reveals that the old-age dependency variable has a significant but negative effect on savings. However, Huizheng (2020) finds that the old-age variable has significant effect on the savings rate of OECD countries, while the effect of old-age dependency ratios on savings is insignificant in BRICS countries.

Hanif et al. (2022) reveal that a rise in the ratio of the working age population has a positive effect on domestic savings in 45 countries. This is supported by Jain and Goli (2022), and it is consistent with the economic life-cycle hypothesis.

In the context of South Africa, many studies have been conducted to assess the life-cycle hypothesis of saving (Prinsloo 2000; Esson 2003; Odhiambo 2007; Du Plessis 2008; Chipote and Tsegaye 2014; Sithebe

2014; Zwane et al. 2016; Nduku and Simo-Kengne 2018; Tshabalala 2018; among others) and to ascertain the contributions of demographic variables in informing household saving decisions. Prinsloo (2000) observes that a country's household saving is influenced by the age distribution of the country. Thus, the life-cycle model of saving behaviour indicates dis-saving among young adults engaged in education and in the early stages of establishing a family, saving among older working adults and dissaving among retired people. Esson (2003) shows that personal income and demographic variables play significant roles in influencing household saving decisions.

Odhiambo (2007) found that that gross domestic savings is positively related to the growth rate of real GDP, as postulated by the life-cycle hypothesis. This is supported by Du Plessis (2008). In line with the Odhiambo (2007) approach, Chipote and Tsegaye (2014) show that the level of income and household saving are negatively related, while the age-dependency ratio and household saving are positively related.

However, Sithebe (2014) reveals that youth dependency negatively impacts household saving while elderly dependency has a weak influence on household saving in South Africa. Zwane et al. (2016) also indicate that a larger households' size puts more pressure on its consumption spending, as more of the budget is diverted to consumption spending as opposed to saving, thereby leading to low saving, which is in line with the findings of Akpan et al. (2011) and Nigus (2015).

Nduku and Simo-Kengne (2018) results indicate a positive and significant relationship between saving and the age dependency ratio in South Africa. However, this is not consistent with the finding of Tshabalala (2018) who indicated that dependency ratio and gross domestic saving have an inverse relationship at the national level.

Most of the studies on household saving (such as Athukorala and Tsai 2003; Horioka and Wan 2007; Simleit et al. 2011; Mongale et al. 2013; Chipote and Tsegaye 2014; Zwane et al. 2016; among others) focused mainly on the determinants of household saving but did not disaggregate population age structure and population groups. They also did not capture the effect of the age structure among population groups on household saving at provincial levels

This study identified this lacuna and has undertaken to empirically test how the working age population of these racial groups impacts household saving in South Africa.

Methodology

The discussion of the model and sources of data used in investigating the impact of demographic dynamics (population age structure) on household saving in the context of South Africa are presented in this section.

MODEL SPECIFICATION

This study adopts and modifies Hanif et al.'s (2022) model by disaggregating the working population into the four population groups in South Africa. This is based on the Life-Cycle Hypothesis (LCH) and is expressed as follows:

$$\begin{aligned} HSG_{it} = & a_0 + \beta_1 AWP_{it} + \beta_2 BWP_{it} + \beta_3 CWP_{it} \\ & + \beta_4 WWP_{it} + \beta_5 TEP_{it} + \beta_6 INF_{it} \\ & + \beta_7 GDP_{it} + \mu_i, \end{aligned} \quad (1)$$

where HSG is household saving growth rate, AWP is the growth rate of the working population of the Asian/Indian race, BWP is the growth rate of the working population of the Black race, CWP is the growth rate of working population of the Coloured race, and WWP is the growth rate of working population of the White race. TEP is the growth rate of the total elderly population, INF is inflation rate, and GDP is the growth rate of provincial total output (proxy for GDP). While α_0 is the constant term, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$, and β_7 represent the elasticities of household saving growth rate relative to the respective explanatory variables, i is for provinces and t is for year. A priori expectations are as follow:

- Working age population: changes in the share of the working age population of a country are expected to impact the country's household saving in the same direction in line with the life-cycle hypothesis. As a result, the changes in the four racial groups' shares of the working population are expected to impact household saving in the same direction, which is in line with the life-cycle hypothesis. The coefficient of this variable (AWP, BWP, CWP, WWP) is expected to be positive.
- Elderly population (TEP): the share of the elderly (aged) population to the working-age population of a country is expected to have a negative impact on the household saving rate as suggested by theory.
- Inflation (INF): the coefficient of inflation can be negative or positive as there is no consensus on the likely effects of inflation on the

household saving rate. The coefficient of inflation can be negative where periods of high inflation tend to be associated with a high negative real rate of interest, which deters opportunities for saving. On the other hand, the coefficient of inflation can be positive where inflation increases uncertainty, causing people to save more to maintain consistent consumption levels in the future.

- GDP: the anticipated coefficient of total output is positive. As total outcome increases, the Life-Cycle Hypothesis predicts that increase in the growth rate of income per capita will lead to an increase in household saving. The growth in provincial total output will lead to a rise in income, thereby resulting in a rise in the household saving growth rate. Thus, the a priori expectation between household saving and the growth rate of total provincial total output is a positive relationship (Nwachukwu and Egwaikhede 2007).

DATA SOURCES

The study used South African annual panel data on the nine provinces in South Africa and the time period for data usage covers the period 1995–2019. The South African provinces in this study are Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, North West, Northern Cape, and Western Cape. The data set used in this study, as shown in table 1, is secondarily sourced from the South African Reserve Bank (<https://www.resbank.co.za/en/home/what-we-do/statistics>), Quantec South Africa (<https://www.easydata.co.za>), and the World Bank (<https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=ZA>). Growth rate of household saving (HSG) is the study's dependent variable, and is sourced from Quantec (Easy Data), Pretoria, South Africa. The following are the variables of interest in this study:

- The explanatory variables comprise the components of population age structure, with inflation rate and economic growth as the control variables.

ESTIMATION TECHNIQUE

The current study employs the panel data technique to investigate how changes in population age structure affect household saving behaviour in South Africa. The panel model is considered appropriate for this study in evaluating the quantitative impact of population age structure

TABLE 1 Variables and a Priori Expectations

Variables	Explanation	Expected sign	Source/s
Growth rate of household saving (HSG) is the study's dependent variable	This is the percentage change in household savings. It is the dependent variable	Dependent variable	Quantec EasyData
Working population (WP) of the four race groups (AWP, BWP, CWP, and WWP)	Growth rate of working population (WP): the share of the total population of a country above the age of 15 and below the age of 65 (also referred to as productive population).	Positive (+)	Quantec EasyData
Total elderly population (TEP)	Growth rate of the share of total population of a country aged 65 years and above (also referred to as old dependency)	Negative (-)	Quantec EasyData
Inflation rate (INF)	A rise in the general price level: consumer price index (CPI)	Negative (-) or Positive (+)	World Bank and South African Reserve Bank (South African Reserve Bank 2019)
GDP	Growth rate of provincial output: measured as percentage change in provincial real total output from one period to another. (It is a proxy for real economic growth (Real GDP).)	Positive (+)	Quantec EasyData

NOTE Working population (WP) is disaggregated in four groups; AWP, BWP, CWP and WWP, representing Asian/Indian, Black, Coloured, and White population groups, respectively. Author's compilation (from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

on the South African household saving rate. The data is tested for stationarity using Levin, Lin, and Chu (LLC), Im, Pesaran, and Shin (IPS) and Hadri LM tests. It is vital to test for stationarity to avoid the problem of spurious regression, which would be the outcome when one or more non-stationary series are regressed on each other (Gujarati 2004).

The panel autoregressive distributed lag technique (PARDL) model is utilised to estimate the long-run and short-run equations, as well as the

error correction term, which affirms the speed of adjustment from short-run deviation to long-run equilibrium. Panel ARDL corrects the problem of serial autocorrelation simultaneously. The problem of endogeneity is reduced when panel ARDL is utilised with sufficient lags (Pesaran and Smith 1995). The panel ARDL technique is appropriate for this study as it is relatively more efficient given the current study's small sample size of 25 years. The panel ARDL model is ideal for panel analysis as it accounts for cross-sectional dependency (CSD), and applying the ARDL technique enables the study to obtain robust and unbiased long-run estimates. The details of PARDL are not included here due to space limitations but can be obtained from the authors on request.

The study also employs the Dumitrescu-Hurlin panel Granger causality test to assess the presence of Granger causality in these panel data settings. The Dumitrescu-Hurlin panel Granger causality test developed by Dumitrescu and Hurlin (2012) extends traditional Granger causality testing to accommodate the complexities of panel data, which includes multiple cross-sectional units observed over time. The null hypothesis (H_0) postulates that X does not Granger-cause Y for all individuals in the panel. The alternative hypothesis (H_1) suggests that X Granger-causes Y for at least one individual in the panel. This flexibility is crucial as it acknowledges that causality may exist for some units but not others.

Empirical Results

DESCRIPTIVE ANALYSIS

Table 2 presents the descriptive summary of the study variables, which aids in understanding the characteristics of the variables involved in this study. The study used a balanced panel data of 225 observations over 9 provinces in South Africa over the period 1995–2019. The descriptive statistics presented in table 2 show that the average growth rate of household saving is 6.13, with the value ranging from -59.01 to 205.91 and with the highest standard deviation of 46.11 across the provinces over the study period, while the total elderly population (TEP) has a mean value of 2.22 ranging from -10.29 to 15.18 and with the lowest standard deviation of 2.20.

CORRELATION ANALYSIS

The correlation matrix for the study variables presented in table 3 shows the absence of multicollinearity among the variables as no two regressors in the matrix have any coefficient that is 0.8 and above. Thus, the

TABLE 2 Descriptive Analysis

Variables	Obs	Mean	Std. Dev.	Max	Min
HSG	225	6.130989	46.11059	205.9064	-59.0132
AWP	225	1.981514	3.466269	19.54239	-13.5057
BWP	225	2.293349	3.120436	19.86516	-13.3487
CWP	225	1.103526	2.556670	14.16989	-10.5881
WWP	225	-1.03826	2.667253	13.34602	-14.2038
TEP	225	2.223374	2.195431	15.18113	-10.2936
INF	225	5.706137	2.263618	10.07458	-0.69203
GDP	225	2.740860	2.412311	11.57068	-3.52281

NOTE Balanced panel data of 225 observations over 9 provinces in the 1995–2019 period Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

TABLE 3 Correlation Matrix of the Study Variables

Probability	HSG	AWP	BWP	CWP	WWP	TEP	INF	GDP
HSG	1							

AWP	0.07988	1						
	0.2327	-----						
BWP	0.11809	0.7910	1					
	0.0771	0.0000	-----					
CWP	0.04438	0.69989	0.60914	1				
	0.5077	0.0000	0.0000	-----				
WWP	-0.1368	0.10662	-0.1383	0.24649	1			
	0.0404	0.1107	0.0382	0.0002	-----			
TEP	0.07987	0.71428	0.79882	0.71414	-0.0475	1		
	0.2327	0.0000	0.0000	0.0000	0.4782	-----		
INF	0.43638	0.07791	0.00251	0.11626	0.1166	-0.0081	1	
	0.0000	0.2444	0.9702	0.0819	0.0810	0.9034	-----	
GDP	-0.1369	0.11147	0.05169	0.12507	0.23498	-0.0959	-0.0766	1
	0.0403	0.0953	0.4404	0.0611	0.0004	0.1517	0.2523	-----

NOTE Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

correlation coefficients in the matrix do not suggest the presence of multicollinearity given that there is no strong linear relationship observed between the study variables.

TABLE 4 Stationarity Test Results

Variables	LLC		Hadri LM		IPS	
	Level	First Difference	Level	First Difference	Level	First Difference
HSG	-8.96809 (0.000)***	-10.0667 (0.000)***	-1.51490 (0.9351)	-0.66919 (0.7483)	-7.38331 (0.000)***	-10.8942 (0.000)***
AWP	-2.00208 (0.0226)**	-3.28465 (0.000)***	2.11351 (0.0173)##	0.11966 (0.4524)	-5.50682 (0.000)***	-7.85521 (0.000)***
BWP	-4.51854 (0.000)***	-14.7223 (0.000)***	0.29134 (0.3854)	-0.31592 (0.6240)	-5.10226 (0.000)***	-7.91289 (0.000)***
CWP	-3.7595 (0.000)***	-2.80849 (0.003)***	2.69965 (0.0035)#	0.02649 (0.4894)	-5.17028 (0.000)***	-7.67739 (0.000)***
WWP	-1.14969 -0.1251	-3.48144 (0.000)***	-0.39269 (0.6527)	-0.19882 (0.5788)	-3.6019 (0.000)***	-7.31119 (0.000)***
TEP	-2.31265** (0.010)**	-9.68973 (0.000)***	5.40911 (0.0000)#	-0.04260 (0.5170)	-0.20301 -0.4196	-5.66127 (0.000)***
INF	-4.86111 (0.000)***	-4.01519 (0.000)***	0.85095 (0.1974)	-1.09729 (0.8637)	-4.28869 (0.000)***	-4.77209 (0.000)***
GDP	-3.85425 (0.000)***	-11.8107 (0.000)***	1.47279 (0.0704)	-0.75447 (0.7747)	-5.1661 (0.000)***	-5.4034 (0.000)***

NOTE ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively (rejection of the null hypothesis of nonstationarity). # and ## indicates rejection of the null hypothesis of stationarity at the 1%, and 5% level, respectively. Figures within parentheses indicate P-values. Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

PANEL UNIT ROOT TEST

table 4 shows the study's results of the panel unit root tests. Levin, Lin, and Chu (LLC), Im et al. (IPS) and Hadri LM tests are employed in this study to attain variable conditions at the level $I(0)$ or 1st difference $I(1)$. With 9 numbers of panels and a 25-year-period, LLC and Hadri LM are suitable for this study. Thus, N (panel) is small relative to T (period) (Hadri 2000; Levin et al. 2002; Baltagi 2013). Both LLC and Hadri tests assume that all panels share a common autoregressive parameter and require balanced datasets. The IPS panel unit root test is incorporated in this study to augment other panel unit root tests. The IPS test relaxes the assumption of a common autoregressive parameter and does not require balanced datasets, though there should not be gaps within any of the panels (Im et al. 2003).

The null hypothesis () for both LLC and IPS is that panel data has unit root, against the alternate hypothesis () that panel data has no unit root. On other hand, the Hadri LM test null hypothesis () is that panel data is stationary (does not have unit root), against the alternate hypothesis () that panel data is non-stationary (has unit root). Testing for unit root using LLC and IPS, the study accepts the null hypothesis, that there is unit root in the panel data, where the *P-value* is greater than 5 percent (0.05), but rejects the null hypothesis where the *P-value* is less than 5 percent (0.05). However, using Hadri LM to test for unit root in the panel data, the null hypothesis (stationarity) is accepted for five variables in levels while the null hypothesis (stationarity) is rejected at all percentage levels for the other three variables (AWP, CWP, and TEP) but only to be accepted at first difference. Thus, there is a combination of levels $I(0)$ and first difference $I(1)$ stationarity among the study variables.

The findings of the three stationarity tests shown in table 4 indicate that none of the considered variables is of order two, $I(2)$. The LLC and IPS test results attest that most variables are stationary at levels. However, there is evidence that WWP and TEP are nonstationary at levels but become stationary at first difference. This study uses evidence of unit root by at least one test to assume a verdict of a combination of stationarity at levels and first difference. This makes the panel autoregressive distributed lag (PARDL) technique the appropriate model for this study. The lag length criteria are not shown here due to space limitation but can be obtained from the authors on request.

ESTIMATION RESULTS

The study's empirical results of the panel autoregressive distributed lag (PARDL) procedure used in this investigation are presented in two versions (regressions) in this subsection. In the first version (regression), the working age population of the four race groups will be incorporated in one regression and presented in table 7. The second version (regression) will run four distinct variations of the regression with the working age population of each of four race groups as the focus variable and will be presented in table 8. Thus, tables 7 and 8 will consist of two sections, A and B, in which the long-run estimates are presented in section A, and the short-run estimates are depicted in section B.

TABLE 5 Empirical Results of the Long-Run Estimated ARDL Model

Dependent variable: HSG

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
AWP	-1.16454	1.876466	-0.6206	0.5368
BWP	-22.1441	2.863559	-7.73307	0.0000***
CWP	-22.2204	2.457183	-9.04304	0.0000***
WWP	21.26393	2.898585	7.335968	0.0000***
TEP	12.30124	1.6387	7.506705	0.0000***
INF	-2.98054	1.280181	-2.32822	0.0226**
GDP	8.182632	1.160225	7.052625	0.0000***

NOTES ***, ** and * indicate statistically significant at the 1%, 5% and 10% levels, respectively

Panel ARDL with Single Regression

The study's empirical results of the panel autoregressive distributed lag (ARDL) procedure used in this investigation are presented in this section. ARDL (1, 2, 2, 2, 2, 2, 2, 2) is the optimal lag-length model selected in the regression. Tables 5 and 6 present the long-run and short-run results of the selected model, respectively.

Long-Run Estimates (ARDL)

The results of the long-run estimate of the impact of demographic dynamics on household saving is presented in table 5. The findings show that except for AWP that has insignificant effect on household saving, the working age population variables for Black, Coloured, and White race groups have a statistically significant relationship with household saving in the South African province in the long run.

Likewise, TEP, INF, and GDP have significant influence in explaining household saving in South Africa in the long run.

The long-run estimates reveal that a 1% increase in the Black working age population reduces household saving by 22.14%; likewise, a 1% increase in the CWP results in a 22.22% decrease in HSG. The negative coefficients of BWP and CWP contradict expectations based on the life-cycle hypothesis. Conversely, a 1% rise in WWP leads to a 21.26% increase in household saving, which aligns with prior expectations and supports findings from Cruz and Ahmed (2016), Hanif et al. (2022), and Jain and Goli (2022). The positive coefficient of TEP suggests that a 1% rise in TEP causes HSG to increase 12.30%. The positive coefficient of TEP also con-

TABLE 6 Short-Run Estimated ARDL Model

Dependent variable: HSG				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
ECT_1	-0.88072	0.022332	-39.4385	0.0000***
$\Delta(\text{AWP})$	7.717857	7.545854	1.022794	0.3097
$\Delta(\text{AWP}(-1))$	-8.40253	22.26839	-0.37733	0.7070
$\Delta(\text{BWP})$	9.164669	8.16697	1.122163	0.2654
$\Delta(\text{BWP}(-1))$	36.51211	22.8758	1.596102	0.1147
$\Delta(\text{CWP})$	14.49358	12.00973	1.20682	0.2313
$\Delta(\text{CWP}(-1))$	-1.0187	18.0441	-0.05646	0.9551
$\Delta(\text{WWP})$	-28.3642	13.82044	-2.05234	0.0437**
$\Delta(\text{WWP}(-1))$	10.40759	20.34023	0.511675	0.6104
$\Delta(\text{TEP})$	-9.82115	4.458541	-2.20277	0.0307**
$\Delta(\text{TEP}(-1))$	11.34002	4.927661	2.301299	0.0242**
$\Delta(\text{INF})$	1.532558	0.872671	1.756169	0.0832*
$\Delta(\text{INF}(-1))$	3.701158	0.742849	4.982386	0.0000***
$\Delta(\text{GDP})$	-4.14378	0.665322	-6.22823	0.0000***
$\Delta(\text{GDP}(-1))$	-3.47932	1.043445	-3.33446	0.0013***
C	61.68701	4.664632	13.22441	0.0000***

NOTES ***, ** and * indicate statistically significant at the 1%, 5% and 10% levels, respectively

tradicts initial expectations of a negative relationship in line with the life-cycle hypothesis but aligns with studies by Hock and Weil (2012) and Nduku and Simo-Kengne (2018). The coefficients for control variables align with expectations: a 1% increase in inflation results in a 2.98% decrease in household saving growth rate (HSG), while a 1% increase in GDP leads to an 8.18% increase in HSG.

Short-Run Estimates and Error Correction Model (ECM)

Table 6 presents the short-run estimates of the study, confirming a cointegration relationship in the model. The negative and statistically significant coefficient of the error correction term (ECT) indicates a long-run equilibrium, with deviations corrected at a rate of 88.07%. The negative coefficient of ECT denotes a long-run relationship between household saving (HSG), and its explanatory variables.

Among the four working age population variables (AWP, BWP, CWP, and WWP), only WWP is statistically significant in the short run when lagged one period (D(WWP)). AWP, BWP, and CWP do not significantly impact household saving in the short run. The total elderly population (TEP) is also significant in the short run. Both control variables, inflation rate (INF) and economic growth (GDP), are statistically significant in explaining household saving in the provinces of South Africa in the short run.

Panel ARDL Regression with Four Variations

In this section, four variations of the panel autoregressive distributed lag model will be conducted with the aim to capture the individual effects of each of the four race groups' working-age population on household saving in South Africa's provinces. The empirical findings for the long-run and short-run estimations of the selected model are presented in tables 7 and 8, respectively. ARDL (1, 3, 3, 3, 3) is the optimal lag-length model selected in the regression.

Long-Run Estimates (PARDL)

The empirical findings of the long-run panel autoregressive distributed lag (PARDL) regression are presented in table 7. The analysis of the long-run equation indicates that the significant coefficients associated with the working age population in variations 1, 2, and 3 are negative, which contradicts expectations derived from the life-cycle hypothesis. This finding diverges from prior expectations and does not corroborate the conclusions of Cruz and Ahmed (2016), Hanif et al. (2022), and Jain and Goli (2022). Notably, Total Elderly Population (TEP) exhibits no significant impact on household saving (HSG) across the four model variations. However, inflation (INF) demonstrates a significant negative effect on HSG across the four variations. The negative coefficient of INF in relation to HSG in South Africa aligns with prior expectations and supports the findings of Hanif et al. (2022).

The significant coefficients of gross domestic product (GDP) in variations 1, 2, and 3 are positive and consistent with expectations. In Variation 1 of the study model, which focuses on the Asian working age population (AWP), it is found that AWP, INF, and GDP significantly influence household saving in the long run. The long-run estimates in variation 1 indicate that a 1% increase in AWP results in a 12.77% decrease in HSG; similarly, a 1% rise in INF leads to a 9.24% reduction in HSG, whereas a 1% increase in GDP leads to a 6.58% increase in HSG.

TABLE 7 Estimated Long-Run PARDL (for four variations)

Dependent Variable: D(HSG)				
Long Run Equation				
Variables	AWP	BWP	CWP	WWP
	Variation 1	Variation 2	Variation 3	Variation 4
	Selected Model: (1, 3, 3, 3, 3)	Selected Model: (1, 3, 3, 3, 3)	Selected Model: (1, 3, 3, 3, 3)	Selected Model: (1, 3, 3, 3, 3)
Focus Variable	AWP -12.7722 (0.0000)***	BWP -26.4852 (0.0000)***	CWP -21.1609 (0.0000)***	WWP 3.026917 (0.4281)
TEP	TEP -2.82587 (0.3505)	TEP 4.685861 (0.0898)*	TEP 1.01724 (0.7320)	TEP -1.3814 (0.6861)
INF	INF -9.24264 (0.0000)***	INF -9.57443 (0.0000)***	INF -8.13003 (0.0003)***	INF -8.46676 (0.0021)***
GDP	GDP 6.579433 (0.0024)***	GDP 9.481895 (0.0001)***	GDP 8.202115 (0.0007)***	GDP -2.69851 (0.2913)

NOTES ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively (rejection of the null hypothesis of nonstationarity. Figures within parenthesis indicate P-values. Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

In Variation 2 with the Black working age population (BWP) as the focus variable, it is observed that BWP, INF, and GDP significantly affect household saving, while TEP has no impact on HSG in the long run within South African provinces. The findings reveal that a 1% increase in BWP results in a 26.49% decrease in HSG; moreover, HSG decreases by 9.57% with a 1% rise in INF, while a 1% increase in GDP leads to a 9.48% increase in HSG in the long run.

Variation 3 in table 7 shows that the Coloured working age population (CWP), INF, and GDP significantly influence HSG, while TEP does not have a significant effect on HSG over the long term. Specifically, an increase of 1% in CWP will result in HSG reducing by 21.16%, while a 1% rise in INF causes HSG to decrease by 8.13%. Conversely, a 1% increase in GDP results in HSG increasing by 8.20% in the long run.

Finally, the long-run results of Variation 4 indicate that only INF has a significant impact on HSG; WWP (White working age population), TEP, and GDP are insignificant predictors of HSG within South African provinces. Thus, a 1% increase in INF leads to an 8.47% reduction in HSG in the long run.

TABLE 8 Sho rt-Run Estimated PARDL Model (four variations)

AWP		BWP		CWP		WWP	
ECT_1	-0.57045 (0.0000)***	ECT_1	-0.58652 (0.0000)***	ECT_1	-0.62691 (0.0000)***	ECT_1	-0.59803 (0.0000)***
$\Delta(AWP)$	-4.46254 (0.6286)	$\Delta(BWP)$	11.27138 (0.0135)**	$\Delta(CWP)$	11.49651 (0.1538)	$\Delta(WWP)$	-5.41711 (0.6598)
$\Delta D(AWP(1))$	0.223238 (0.9481)	$\Delta(BWP(-1))$	6.966073 (0.1106)	$\Delta(CWP(-1))$	-2.22339 (0.7950)	$\Delta(WWP(1))$	-0.58873 (0.9445)
$\Delta(AWP(-2))$	-7.39396 (0.0078)***	$\Delta(BWP(-2))$	-19.2439 (0.0019)***	$\Delta(CWP(-2))$	-0.07335 (0.9925)	$\Delta(WWP(-2))$	11.73173 (0.0774)*
$\Delta(TEP)$	9.56042 (0.2458)	$\Delta(TEP)$	3.695449 (0.5488)	$\Delta(TEP)$	4.144507 (0.5872)	$\Delta(TEP)$	-3.10312 (0.7471)
$\Delta(TEP(-1))$	8.433403 (0.1769)	$\Delta(TEP(-1))$	10.86668 (0.1416)	$\Delta(TEP(-1))$	10.47367 (0.2147)	$\Delta(TEP(-1))$	6.428285 (0.4981)
$\Delta(TEP(-2))$	-5.07126 (0.5400)	$\Delta(TEP(-2))$	7.883387 (0.1562)	$\Delta(TEP(-2))$	-4.79624 (0.0445)**	$\Delta(TEP(-2))$	-3.08126 (0.6681)
$\Delta(INF)$	4.165957 (0.0012)***	$\Delta(INF)$	2.717179 (0.0002)***	$\Delta(INF)$	2.947817 (0.0002)***	$\Delta(INF)$	3.280774 (0.0091)***
$\Delta(INF(-1))$	7.407183 (0.0001)***	$\Delta(INF(-1))$	5.691884 (0.0000)***	$\Delta(INF(-1))$	7.597118 (0.0000)***	$\Delta(INF(-1))$	9.454327 (0.0000)***
$\Delta(INF(-2))$	2.664887 (0.1499)	$\Delta(INF(-2))$	-0.74089 (0.2046)	$\Delta(INF(-2))$	2.047906 (0.0119)**	$\Delta(INF(-2))$	1.389751 (0.3892)
$\Delta(GDP)$	-1.78428 (0.1830)	$\Delta(GDP)$	-4.14896 (0.0038)***	$\Delta(GDP)$	-4.38004 (0.0001)***	$\Delta(GDP)$	1.311287 (0.3001)
$\Delta(GDP(-1))$	-3.26375 (0.0008)***	$\Delta(GDP(-1))$	-3.86151 (0.0000)***	$\Delta(GDP(-1))$	-3.00796 (0.0015)***	$\Delta(GDP(-1))$	-0.47949 (0.7818)
$\Delta(GDP(-2))$	1.91393 (0.4441)	$\Delta(GDP(-2))$	0.286507 (0.8038)	$\Delta(GDP(-2))$	0.972207 (0.2588)	$\Delta(GDP(-2))$	2.496636 (0.0605)*
C	37.02588 (0.0000)***	C	44.45094 (0.0000)***	C	29.31262 (0.0000)***	C	41.81761 (0.0000)***

NOTES Dependent Variable: D(HSG). ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively (rejection of the null hypothesis of nonstationarity. Figures within parenthesis indicate P-values. Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

Short-Run Estimates and Error Correction Model (ECM)

Table 8 presents the short-run estimations for the four variations of the estimated model. The results across these variations affirm the existence of cointegration relationships within the four variations in the study.

The short-run estimates show that the coefficients of the error correction term (ECT) in each of the four variations of the model are negative and statistically significant at the 1% level, which attests to the presence of a long-run relationship in the models. Evidence from table 10 shows the adjustment coefficients (ECT) of the variations 1, 2, 3, and 4 as -0.57045 , -0.58652 , -0.62691 , and -0.59803 , respectively. These coefficients signify a long-run relationship between household saving, each focus variable (race group's working-age population), total elderly population (TEP), inflation (INF), and gross domestic product (GDP) across all four variations of the study. The adjustment coefficient (ECT) implies that any deviations from long-run equilibrium in each variation are corrected at the speed of 57.05% for Variation 1, 58.65% for Variation 2, 62.69% for Variation 3, and 59.80% for Variation 4.

Dumitrescu-Hurlin Panel Granger Causality Test

The results of the causality test shown in table 9 reveal a strong evidence of feedback effects, that is a bidirectional causal relationship, between three of the four race variables (AWP, BWP, and CWP) and household saving (HSG).

This implies that the three race variables working-age population (AWP, BWP, and CWP), individually, homogeneously Granger cause household saving (HSG), and household saving also homogeneously Granger causes AWP, BWP, and CWP for all the individual provinces in the panel. As a result, there is enough evidence to reject the null hypothesis in all the three cases. The results also show that there is a unidirectional causality running from the White race variable (WWP) to household saving (HSG). The study thereby rejects the null hypothesis that WWP does not homogeneously cause HSG in the panel. Also, a unidirectional causality runs from the aged/elderly population variable (TEP) to household saving (HSG), affirming that TEP homogeneously Granger causes HSG, which is evidence to reject the null hypothesis. The outcome of the test shows no evidence of causality between inflation (INF) and household saving (HSG) in any direction. INF does not homogeneously cause HSG, and HSG does not homogeneously cause INF. Therefore, the null hypothesis cannot be rejected for INF and HSG in any direction. Between economic

TABLE 9 Dumitrescu-Hurlin Panel Granger Causality Test Results

Null Hypothesis	W-Stat.	Zbar-Stat.	Prob.	Conclusion
AWP does not homogeneously cause HSG	31.9073	34.8737	0.0000***	Bidirectional causality between AWP and HSG
HSG does not homogeneously cause AWP	0.47778	-2.08393	0.0372**	
BWP does not homogeneously cause HSG	77.3869	88.3526	0.0000***	Bidirectional causality between BWP and HSG
HSG does not homogeneously cause BWP	0.29288	-2.30136	0.0214**	
CWP does not homogeneously cause HSG	29.2957	31.8028	0.0000***	Bidirectional causality between CWP and HSG
HSG does not homogeneously cause CWP	0.35029	-2.23384	0.0255**	
WWP does not homogeneously cause HSG	19.5403	20.3314	0.0000***	Unidirectional causality from WWP to HSG
HSG does not homogeneously cause WWP	0.82743	-1.67278	0.0944*	
TEP does not homogeneously cause HSG	13.9585	13.7679	0.0000***	Unidirectional causality from TEP to HSG
HSG does not homogeneously cause TEP	2.43954	0.22288	0.8236	
INF does not homogeneously cause HSG	1.28263	-1.13752	0.2553	No causality between INF and HSG
HSG does not homogeneously cause INF	0.96619	-1.50962	0.1311	
GDP does not homogeneously cause HSG	2.57707	0.38459	0.7005	Unidirectional causality from HSG to GDP
HSG does not homogeneously cause GDP	7.72293	6.43556	1E-10***	

NOTES ***, ** and * show significance at 1%, 5% and 10% levels respectively. Author's compilation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

growth (GDP) and household saving (HSG), there is a unidirectional causality running from HSG to GDP. This outcome shows enough evidence to reject the null hypothesis that HSG does not homogeneously cause GDP.

Conclusions

This study emphasises the significance of demographic dynamics in influencing household saving decisions across South Africa's nine provinces. Using provincial-level data, the study employs the panel autoregressive distributed lag (PARDL) technique to examine the impact

of demographic dynamics on household saving in South Africa's nine provinces. In the model with all the racial variables incorporated in it, only Asian working age population (AWP) is found to be insignificant in explaining household saving in the long run in South Africa. However, when the working-age population variables are captured separately, the White working-age population (WWP) is found not to have any significant impact on household saving in South African provinces in the long run. However, the two models affirm the existence of a long-run relationship between household saving and independent variables of interest in the regression. The panel causality test indicates bidirectional causality between three racial groups (AWP, BWP, CWP) and household savings, while unidirectional causality runs from WWP and TEP to household savings and from HSG to GDP. No causal relationship exists between inflation and household savings. Given the limited empirical analyses at the provincial level regarding demographics and household savings in South Africa, these findings are particularly valuable. The study highlights the need for policies that address the negative impacts of working age populations on savings.

The study findings have brought to the fore the legacy of the apartheid regime that was characterised by high unemployment, poverty, and inequality that keep sustaining barriers that have continued to disadvantage some groups, particularly the Black and Coloured populations, resulting in persistent economic disparities. The findings of the two models underscore the need for well-informed policy intervention that will address the distinctive challenges that different racial groups face in South Africa. Policymakers need to think in favour of policies that will enhance the economic viability of the country's unique demographics and inclusive environment for all racial groups.

It is crucial to implement policies that stimulate economic activity, as these measures can lead to increased disposable income and foster a more positive saving culture.

References

- Ahmad, M. H. 2002. 'The Impact of the Age Structure of Population on the Household Saving Rate in Pakistan: A Cointegration.' *Savings and Development* 26 (3): 289–300.
- Ahmad, F. 2015. 'Determinants of Savings Behaviour in Pakistan: Long Term- Short Term Association and Causality.' *Timisoara Journal of Economics and Business Administration* 8 (1): 103–36.

- Akpan, S. B., E. J. Udoh, and E. A. Aya. 2011. 'Analysis of Savings Determinants among Agro-Based Firm Workers in Nigeria: A Simultaneous Equation Approach.' *Research on Humanities and Social Sciences* 1 (3). <https://www.iiste.org/Journals/index.php/RHSS/article/view/1261>.
- Albuquerque, P. C., and J. Ferreira. 2015. 'Ageing, Employment, and Remunerations in Portuguese Regions: A Shift-Share Analysis.' *Euro* 41 (122): 239–60.
- Asia-Pacific Economic Cooperation. 2002. '9th APEC Finance Ministers Meeting.' https://www.apec.org/docs/default-source/MinisterialStatements/Finance/02_mm_fin_summary.pdf.
- Aron, J., and J. Muellbauer. 2000. 'Personal and Corporate Saving in South Africa.' *World Economic Review* 14 (3): 509–44.
- Athukorala, P. C., and P. L. Tsai. 2003. 'Determinants of Household Saving in Taiwan: Growth, Demography, and Public Policy.' *Journal of Development Studies* 39 (5): 65–88.
- Attanasio, O. P., and J. Banks. 2001. 'The Assessment: Household Saving-Issues in Theory and Policy.' *Oxford Review of Economic Policy* 17 (1). <https://doi.org/10.1093/oxrep/17.1.1>.
- Baltagi, B. H. 2013. *Econometric Analysis of Panel Data*. 5th ed. Wiley.
- Bloom, D. E., D. Canning, and J. Sevilla. 2001. 'Economic Growth and the Demographic Transition.' NBER Working Paper 8685, National Bureau of Economic Research.
- Chipote, P., and A. Tsegaye. 2014. 'Determinants of Household Savings in South Africa: An Econometric Approach.' *Mediterranean Journal of Social Science* 5 (15): 183.
- Cruz, M., and S. A. Ahmed. 2016. 'On the Impact of Demographic Change on Growth, Savings, and Poverty.' Policy Research Working Paper 7805, World Bank Group.
- Curtis, C., S. Lugauer, and N. C. Mark. 2017. 'Demographics and Aggregate Household Saving in Japan, China, and India.' *Journal of Macroeconomics* 51:175–91.
- Doshi, K. P. 1994. 'Determinants of the Saving Rates: An International Comparison.' *Contemporary Economic Policy* 12 (1): 37–45.
- Du Plessis, G. 2008. 'An Exploration of the Determinants of South Africa's Personal Savings Rate: Why do South African Households Save so Little?' Research Project for Master Thesis, University of Pretoria.
- Dumitrescu, E. I., and C. Hurlin. 2012. 'Testing for Granger Non-Causality in Heterogeneous Panels.' *Economic Modelling* 29 (4): 1450–60.
- Esson, R. 2003. 'Savings and Savers: An Analysis of Saving Behaviour among Cape Town's Poor.' CSSR Working Paper 59, Centre for Social Science Research.
- Friedman, F. 1957. *A Theory of the Consumption Function: The Permanent Income Hypothesis*. Princeton University Press.
- Gujarati, D. N. 2004. *Basic Econometrics*. 4th ed. McGraw-Hill.

- Ha, N. T. T., and L. M. Hoa. 2018. 'On the Causality Relationship between Demographic Changes, Economic Growth and Domestic Savings in Vietnam.' *Journal Economics Malaysia* 52 (2): 27–38.
- Hadri, K. 2000. 'Testing for Stationarity in Heterogeneous Panel Data.' *Econometrics Journal* 3 (2): 148–61.
- Hanif, S., M. A. Nawaz, M. A. Bhatti, and T. I. Ahmad. 2022. 'Demographic Transition and Saving Behaviour: A Study of 45 Developing Countries.' *Pakistan Journal of Social Sciences* 42 (1): 161–72.
- Hock, H., and D. N. Weil. 2012. 'On the Dynamics of the Age Structure, Dependency, and Consumption.' *Journal of Population Economics* 25 (3): 1019–43.
- Horioka, C. Y., and J. Wan. 2007. 'The Determinants of Household Saving in China: A Dynamic Panel Analysis of Provincial Data.' Working Paper 28, Federal Reserve Bank of San Francisco.
- Horioka, C. Y., and A. Terada-Hagiwara. 2010. 'The Determinants and Long-Term Projections of Saving Rates in Developing Asia.' ADB Economics Working Paper 228, Asian Development Bank.
- Huizheng, C. 2020. 'Ageing and Savings: Evidence from OECD Countries and BRICS Countries.' Master's thesis, Jonkoping University.
- Hyung, J. 2013. 'An Analysis on the Effect of Old Age Dependency Ratio on Domestic Saving Rate.' University of California. <https://www.econ.berkeley.edu/sites/default/files/Jinwoo%20Hyung.pdf>.
- Im, K. S., M. H. Pesaran, and Y. Shin. 2003. 'Testing for Unit Roots in Heterogeneous Panels.' *Journal of Econometrics* 115 (1): 53–74.
- Imoughele, L. E., and M. Ismaila. 2014. 'An Econometric Analysis of the Determinants of Private Savings in Nigeria.' *International Journal of Humanities and Social Sciences* 4 (5). https://www.ijhssnet.com/journals/Vol_4_No_5_March_2014/2.pdf.
- Jain, N., and S. Goli. 2022. 'Demographic Change and Private Savings in India.' *Journal of Social and Economic Development* 24 (3). <https://doi.org/10.1007/s40847-022-00175-3>.
- Keho, Y. 2012. 'Does Dependency Rate Really Impede Savings? Some Sub-Saharan African Evidence.' *Journal of African Studies and Development* 4 (3): 66–80.
- Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money*. Macmillan.
- Kraay, A. 2000. 'Household Saving in China.' *The World Bank Economic Review* 14 (3): 545–70.
- Leff, N. H. 1969. 'Dependency Rates and Savings Rates.' *American Economic Review* 59 (5): 886–96.
- Levin, A., C.-F. Lin, and C.-S. J. Chu. 2002. 'Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties.' *Journal of Econometrics* 108 (1). [https://doi.org/10.1016/S0304-4076\(01\)00098-7](https://doi.org/10.1016/S0304-4076(01)00098-7).

- Loayza, N., K. Schmidt-Hebbel, and L. Servén. 2000. 'What Drives Private Saving around the World?' *The Review of Economics and Statistics* 82 (2): 165–81.
- Mikesell, F. R., and J. E. Zinser. 1973. 'The Nature of the Savings Function in Developing Countries: A Survey of the Theoretical and Empirical Literature.' *Journal of Economic Literature* 11 (1): 1–26.
- Modigliani, F., and A. Ando. 1963. 'The Life-Cycle Hypothesis of Saving: Aggregate Implications and Tests.' *American Economic Review* 53 (1): 55–84.
- Mongale, I. P., T. Mashamaite, and N. Khoza. 2018. 'Household Savings, Financing, and Economic Growth in South Africa.' *Business and Economic Horizons* 14 (1): 105–16.
- Mongale, I. P., J. Mukuddem-Petersen, M. A. Petersen, and C. Meniago. 2013. 'Household Savings in South Africa: An Econometric Analysis.' *Mediterranean Journal of Social Science* 4 (13): 337–46.
- Muradoglu, G., and F. Taskin. 1996. 'Difference in Household Savings Behaviour: Evidence from Industrial and Developing Countries.' *The Developing Economies* 34 (2): 138–53.
- Nagarajan, R., A. A. C. Teixeira, and S. Silva. 2016. 'The Impact of an Ageing Population on Economic Growth: An Explanatory Review of the Main Mechanisms.' *Análise Social* 51 (218): 4–35.
- Navaneetham, K., and A. Dharmalingam. 2012. 'A Review of Age Structural Transition and Demographic Dividend in South Asia: Opportunities and Challenges.' *Journal of Population Ageing* 5 (4): 281–98.
- Nduku, P. M., and B. D. Simo-Kengne. 2018. 'Population Age Structure and Savings Behaviour in South Africa: The Relevance of the Life Cycle Hypothesis.' *South Africa Journal of Economics* 19:43–51.
- Nigus, H. 2015. 'Determinants of Household Saving in Gedeo Zone, Southern Ethiopia.' *Journal of Economics and Sustainable Development* 6 (7): 93–102.
- Nwachukwu, T. E., and F. O. Egwaikhide. 2007. 'An Error-Correction Model of the Determinants of Private Saving in Nigeria.' Presented at the African Economic Society (AES) Conference, Cape Town, 15–17 November.
- Odhambo, N. M. 2007. 'The Determinants of Savings in South Africa: An Empirical Investigation.' *African Finance Journal* 9 (2): 37–52.
- Okere, P. A., and M. Ndugbu. 2015. 'Macroeconomic Variables and Savings Mobilisation in Nigeria.' *International Journal for Innovation Education and Research* 3 (1): 105–16.
- Ozcan, K. M., A. Gunay, and S. Ertac. 2003. 'Determinants of Private Savings Behaviour in Turkey.' *Applied Economics* 35 (12): 1405–16.
- Pascual-Saez, M., D. Cantarero-Prieto, and J. R. P. Manso. 2020. 'Does Population Age Affect Savings in Europe?' *Journal of Policy Modeling* 42 (2): 291–306.

- Pesaran, M. H., and R. Smith. 1995. 'Estimating Long-Run Relationships from Dynamic Heterogeneous Panels.' *Journal of Econometrics* 68 (1): 79–113.
- Prinsloo, J. W. 2000. 'The Saving Behaviour of the South African Economy.' Occasional Paper 14, South African Reserve Bank.
- Simleit, C., G. Keeton, and F. Botha. 2011. 'The Determinants of Household Savings in South Africa.' *Studies in Economics and Econometrics* 35 (3). <https://doi.org/10.1080/10800379.2011.12097228>.
- South African Reserve Bank. 2019. *Quarterly Bulletin: Various Issues*.
- Sithebe, A. 2014. 'South African Household Savings and the Influence of Financial Liberalisation.' Research Project for Master Thesis, University of Pretoria.
- Stals, C. 1995. 'Risk Exposures for Borrowing Countries in the International Capital Markets.' Presented at the Conference of the South African Issuers and Investors Forum, Johannesburg, 24 March.
- Ting, L., and U. Kollamparambil. 2015. 'Nature and Determinants of Household Retirement Savings Behaviour in South Africa.' *Development Southern Africa* 32 (6): 675–96.
- Touny, M. A. 2008. 'Determinants of Domestic Saving Performance in Egypt: An Empirical Study.' *Journal of Commercial Studies and Researches* 1. <https://api.semanticscholar.org/CorpusID:158667906>.
- Tshabalala, N. 2018. 'The Impact of Demographic Changes on Savings and the Current Account in South Africa.' Master's thesis, University of Johannesburg.
- Yang, J., and E. Zhang. 2013. 'The Influence of Population Age Structure and Transition of Old-Age Insurance System on Household Saving Rate.' *Social Sciences in China Press* 34 (2): 45–67.
- Zhang, Y., A. Guariglia, and D. Dickinson. 2016. 'Old-Age Dependency and Household Finance.' <https://api.semanticscholar.org/CorpusID:209412812>.
- Zwane, T., L. Greyling, and M. Maleka. 2016. 'The Determinants of household savings in South Africa: A Panel Data Approach.' *International Business and Economics Research Journal* 15 (4): 209–18.