International Journal of Academic Research in Business and Social Sciences
Nov 2015, Vol. 5, No. 11
ISSN: 2222-6990

Estimating Consumption Function under Permanent Income Hypothesis: A Comparison between Nigeria and South Africa

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DOI: 10.6007/IJARBSS/v5-i11/1917 URL: http://dx.doi.org/10.6007/IJARBSS/v5-i11/1917

Abstract

The aim of this study was to estimate the consumption function of Nigeria and South Africa under the Permanent Income Hypothesis using a time series data on final household consumption expenditure, real GDP and real interest rate from 1980 to 2013. The study estimated parameter MPC long run time series employing Cagan's adaptive expectation model. The result shows exist of a long run relationship between consumption and income for the two countries. Data for Nigeria suggested that the behavior of consumers in Nigeria is forward looking in the sense that their consumption behavior is based on expected future income while in case of South Africa, the study showed that past consumption has effect on current consumption as posited by Duesenberry in the Relative income hypothesis in South Africa. Moreso, it was revealed that the behavior of consumers in South African is also forward-looking although not as much as Nigerians. The policy implication of these findings is that the impact of government policy of tax reductions will be greater on consumption if such a policy is perceived by consumers as permanent. Thus, a tax cuts aimed at the bottom of the income distribution are likely to be more expansionary than tax cuts aimed at the top.

Keywords: Consumption, Permanent Income Hypothesis, Cagan's Adaptive Expectation Model, MPC.

1.0 INTRODUCTION

There has been much theoretical and empirical research on understanding consumer behaviour since the seminal work of Hall (1978) most of which is done in advanced economy such as U S and U K. However, there are few attempt at testing the consumption theories with Africa data. In this paper we seek to redress the situation and investigate whether the permanent income hypothesis (PIH) is consistent with Nigeria and South Africa data over the 1970-2013 periods. The permanent income hypothesis, proposed by Milton Friedman, simply posits that households spend a fixed fraction of their permanent income on consumption. Under Friedman's framework, only changes in permanent income can alter one's consumption. As he states in his *A Theory of the Consumption Function* (1957): "The transitory components of a

consumer unit's income have no effect on his consumption except as they are translated into effects lasting beyond his horizon. His consumption is determined by longer-range income considerations plus transitory factors affecting consumption directly. The transitory components of income show up primarily in changes in the consumer units' assets and liabilities, that is, in his measured savings." (page 221, as cited in (Mei, 2012)). Therefore, consumers plan their expenditure on the grounds of a long-run view of the resources that will accrue to them in their lifetime (Alimi, 2013).

According to Roche (1995), there are at least two justifications for examining and testing the Permanent Income Hypothesis; first, is its implication for policymaking especially in the area of income tax. For instance the impact of government policy of tax cuts will be greater on consumption if such a policy is perceived by consumers as permanent. Therefore a tax cuts aimed at the bottom of the income distribution are likely to be more expansionary than tax cuts aimed at the top because of the fact that lower income households have a higher MPC (Palley, 2008). Second, the PIH forms important part of other theoretical developments, such as the expansionary fiscal contractions debate. In the line of the debate, it is suggested that reduction in government expenditures will make way for income tax cuts in the future. Hence, the rational forward-looking agents will perceive an increase in their permanent disposable incomes; therefore they will increase their consumption spending and consequently lead to output growth. Barry and Devereux (1992) suggest that this output growth argument might be too promising because increase consumption might not bring about increase employment.

We provide some recent empirical findings from literature on consumption function under permanent income hypothesis in Table 1 below;

Table 1: Summary of Literature Review on Consumption Function under Permanent Income Hypothesis

Author(s) And Year	Country of Study/Sample	Econometrics Techniques	Findings/Conclusion
Osei-Fosu *et al* (2014)	Ghana	FMOLS	The results confirmed that indeed the Permanent Income Hypothesis holds in Ghana.
Gupta, R and Ziramba, E. (2009)	US	Bayesian VAR	The study does not find evidence for the US data to be consistent with PIH.
Manitsaris, A. (2006)	15 European Union Member States	OLS	The study shows strong support for the PIH and adaptive expectation model
Paz, L (2006)	Brazil	OLS	The study rejected the PIH due to the presence of both liquidity constraints and myopia.
Khan, K. and Mohammed, N. (2011)	Pakistan	ordinary least square (OLS) method and instrumental variable (IV)	This study indicates the invalidity of PIH and validity of Keynesian absolute income hypothesis (AIH) for Pakistan
Nwala, K. (2010)	Cameroon, Ghana, Kenya, Nigeria, Senegal and South Africa.	FMOLS	The result shows that PIH hold in five out of the six countries.
Altunc and	Organizatio	OLS	The empirical result provides

Aydin (2014)	n of Islamic Cooperatio n (D-8)		evidences supporting the consumption formed in accordance with the PIH and the adaptive expectations
Wang, K. (2011)	10 Asian Countries	Panel study	The study finds that consumption and current income are strongly co-integrated, liquidity constraints exist in all ten Asian countries, and this implies that the PIH is not upheld.
DeJuan, J., Seater, J. and Wirjanto,T. (2006)	11 West-German States	OLS	It is found that the response of consumption to income innovations is found to be much weaker than is predicted by the PIH.

Thus, the object of this study is to test the validity of the permanent income hypothesis for Nigeria and South Africa. The paper is therefore structured as follows: the next section describes the data and method adopted in this study. This is followed by results and interpretation and the final section concludes this study.

2.0 DATA AND METHODS

Model Specification

Friedman postulated that income, Y, is made up of two components: a permanent component (Y^P) and transitory component (Y^T) and he argued that some of the factors that give rise to the transitory component of income were specific to particular consumer but that for any considerable group of consumers the transitory components tend to average out so that the mean of the transitory component is expected to be zero (Fernandez-Corugedo, 2004). Similarly, consumption expenditures comprise permanent (C^P) and transitory components (C^T). According to Friedman, the permanent component relates to the amount that consumers plan to consume to maximize their lifetime utility; assuming there is no uncertainty, the total consumption would be equal to permanent consumption, given that temporary consumption relates to all 'other' factors.

The PIH gives rise to a consumption function of the form:

$$C^P = k(r, w, u) \times Y^p \quad (1)$$

$$Y = Y^P + Y^T \quad (2)$$

$$C = C^P + C^T \quad (3)$$

where C = current consumption spending, C^P = permanent consumption, C^T = transitory consumption, Y = current income, Y^P = permanent income, Y^T = transitory income, r = rate of interest at which the consumer can borrow or lend, w = ratio of wealth to income and u = consumer's taste preferences. Equation (1) defines the relationship between permanent consumption and permanent income, and the marginal propensity to consume out of permanent income, k(·) is independent of the size of permanent income but it does depend on

other variables: r, w and u. The equations (2) and (3) provide a means of linking actual measured variables (C, Y) to their relevant components (Fernandez-Corugedo, 2004).

Thus, permanent consumption expenditure is assumed to be determined by permanent income, such that;

$C^P_t = \alpha + \beta Y_t^P$ (4)

where α and β are parameters to be estimated.

Following Manitsaris (2006) and Osei-Fosu, et al (2014) equation (4) is estimated by combining the partial adjustment and the adaptive expectations model, in order to transform the unobservable permanent consumption expenditure (C^P_t) and permanent income (Y_t^P) variables in (4) into the observable variables C_t and Y_t respectively. Thus, the model obtained is as follows (see Gujarati and Potter, 2009);

$C_t - C_{t-1} = \theta(C^P_t - C_{t-1}) + \varepsilon_t \quad (0 < \theta \leq 1)$ (5)

$Y^P_t - Y^P_{t-1} = (Y_t - Y^P_{t-1}) + \varepsilon_t \quad (0 < \boldsymbol{\psi} \leq 1)$ (6)

where θ is the partial adjustment coefficient and $\boldsymbol{\psi}$ is the adaptive expectations coefficient. By substituting equation (3) into (4) we obtained a new equation which is as follows;

$C_t = \alpha + \beta Y^P_t + C_t^T$ (7)

Expressing Equation (7) as an econometric model begets

$C_t = \alpha + \beta Y^P_t + \upsilon_t$ (8)

where $\upsilon_t = \varepsilon_t + C_t^T$

Make Y^P_t the subject from (8) and lag it by one thereafter.

Thus we have

$Y^P_t = \frac{1}{\beta} C_t - \frac{\alpha}{\beta} - \frac{1}{\beta} \upsilon_t$ (9)

$Y^P_{t-1} = \frac{1}{\beta} C_{t-1} - \frac{\alpha}{\beta} - \frac{1}{\beta} \upsilon_{t-1}$ (10)

Following Koutsoyiannis (1977, pp 316) we substitute (9) and (10) into equation (6)

$C_t = \alpha\boldsymbol{\psi} + \beta\boldsymbol{\psi} Y_t + (1-\boldsymbol{\psi})C_{t-1} + [\upsilon_t - (1-\boldsymbol{\psi})\upsilon_{t-1}]$ (11)

Equation (11) can be restated as follows:

$C_t = \Omega + \Omega_1 Y_t + \Omega_2 C_{t-1} + \eta_t$ (12)

Where: $\Omega = \alpha\boldsymbol{\psi}$ (13)

$\Omega_1 = \beta\boldsymbol{\psi}$ (14)

$\Omega_2 = (1-\boldsymbol{\psi})$ (15)

$\eta_t = [\upsilon_t - (1-\boldsymbol{\psi})\upsilon_{t-1}]$ (16)

Finally, the consumption function under the permanent income hypothesis and the adaptive expectations model, are estimable since all the variables involved are expressed in actual and not in observable variables. The specific model for estimation is presented in the log-linear form because it allows the regression coefficients to be interpreted as elasticity;

$\ln C_t = \Omega + \Omega_1 \ln Y_t + \Omega_2 \ln C_{t-1} + \eta_t$ (17)

This study incorporate real interest rate variable (RIR_t) to equation (17), so as to assess the effect of interest rate on consumption, having identified it as one of the factors determining consumption in equation (1). Therefore, we estimated the model given by equation (14) as

$\ln HFCE_t = \Omega + \Omega_1 \ln RGDP_t + \Omega_2 \ln HFCE_{t-1} + \Omega_3 RIR_t + \eta_t$ (18)

where Ω_i are the elasticity coefficients, $HFCE_t = C_t$ and $RGDP_t = Y_t$.

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Data and Sources

This study employed annual time series data, which covers the period 1980 to 2013. The data for the trivariate model are Real GDP (RGDP), Household Final Consumption Expenditures (HFCE) and Real Interest Rate, obtained from World Bank and International Financial Statistics. Data for Real GDP (RGDP), Household Final Consumption Expenditures are in Billion Rand for South Africa and Naira for Nigeria while real interest rate is given in percentage. For data Analysis Real GDP (RGDP), Household Final Consumption Expenditures variables are transformed to logarithm form.

Preliminary Tests.

In this study, we first examine the stationarity of our variables. A non-stationary time series has a different mean at different points in time, and its variance increases with the sample size (Harris and Sollis (2003). The problem with non-stationary data is that the standard OLS regression procedures can easily lead to incorrect conclusions (Asteriou and Hall, 2007). In the case of spurious regression, t-values of the coefficients are highly significant, coefficient of determination (R^2) is very close to one and the Durbin Watson (DW) statistic value is very low, which often lead investigators to commit a high frequency of Type 1 errors. Mostly in the literature to find out the order of integration ADF (Dicky & Fuller, 1979) and PP (Philip & Perron, 1988) tests have been used extensively. Due to their poor size and power properties, both tests are not reliable for small sample data set (Dejong et al, 1992). These tests seem to over-reject the null hypotheses when it is true and accept it when it is false. While newly proposed tests such as Dicky-Fuller generalized least square (DF-GLS) de-trending test developed by Elliot et al. (1996) seem to solve this arising problem.

Hence, the unit root tests are conducted using Augmented Dickey Fuller (ADF) and DF-GLS. If a unit root is detected for more than one variable, we further conduct the test for cointegration employing error correction model (ECM) and Johansen system cointegration tests. The major advantage of the ECM method of that it enables one to analyse both the short run and long effects of the variables as well as the adjustment coefficient. Another important advantage of ECM is that all the terms in the ECM model are stationary and the standard OLS estimation is therefore valid.

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3. ESTIMATION RESULTS AND PRESENTATIONS

Table 1 shows the summary statistics of the variables used for the study for Nigeria and South Africa. For Nigeria data, the average household final consumption expenditures is N98.58 billion while that of real GDP is N161.26 billion. This implies that about 61 percent of Nigeria's income goes into household consumption. Whereas for South Africa only about 20 percent of her income is spent on household consumption, given average household final consumption expenditures of N32.76 billion and real GDP of N174.80 billion.

Table 1: Summary Statistic of Variables for Nigeria and South Africa

Country		Variables		
Nigeria		HFCE	RGDP	RIR(%)
	Mean	98.58529	161.2676	5.000294
	Median	71.35000	101.9500	7.320000
	Maximum	371.5000	515.0000	23.71000
	Minimum	24.80000	47.00000	-42.31000
	Std. Dev.	89.49768	129.4327	12.11378
	Skewness	1.436134	1.238284	-1.664421
	Kurtosis	4.122069	3.610826	7.994744
	Jarque-Bera	13.47102	9.217532	51.04059
	Probability	0.001188	0.009964	0.000000
	Sum	3351.900	5483.100	170.0100
	Observations	34	34	34
South Africa		HFCE	RGDP	RIR(%)
	Mean	32.76765	174.8059	15.23529
	Median	25.80000	136.5000	15.37500
	Maximum	83.20000	416.6000	24.00000
	Minimum	10.20000	59.10000	8.000000
	Std. Dev.	21.55615	103.9819	4.399527
	Skewness	1.034743	1.027478	0.064686
	Kurtosis	2.943027	2.790413	2.011752
	Jarque-bera	6.071858	6.044597	1.407275

	probability	0.048030	0.048689	0.494782
	sum	1114.100	5943.400	518.0000
	Sum Sq.Dev.	15334.03	356804.1	638.7426
	Observations	34	34	34

Table 2 shows the result of (ADF) unit root test constant only while Table 3 presents DF-GLS for Nigeria and South Africa.

Unit Root Test

Table 2: ADF unit root test constant only

VARIABLES/COUNTRY	AT LEVEL		DIFFERNCE		DECISION
NIGERIA	Statistic	Probability	Statistic	Probability	
LnHFCE LnRGDP	0.7209 -0.4625	0.9908 0.8856	-4.2197*** -2.6294	0.0024 0.0980	I(1) I(1)
RIR	-7.7539***	0.0000	-	-	I(0)
SOUTH AFRICA	Statistic	Probability	Statistic	Probability	
LnHFCE LnRGDP	5.4387*** -0.1269	0.0001 0.9382	- -4.1542***	- 0.0028	I(0) I(1)
RIR	-2.2522	0.1928	-5.9642***	0.0000	I(1)

Table 3: DF-GLS Unit Root Test

Country	Nigeria		Decision	South Africa		Decision
Variables	At levels	At First Difference		At levels	At First Difference	
LnHFCE	-0.520606	-4.293834***	I(1)	0.079697	-5.530392***	I(1)
LnRGDP	-0.714295	-2.549763**	I(1)	-0.400216	-4.193980***	I(1)
RIR	-7.219749	-	I(0)	-1.949449*	-	I(0)

The unit root results reported in Tables 2 and 3 show that under the two unit root test only real interest rate is stationary at level and the other variables are non-stationary at level but become stationary after taking their first difference i.e. I(1). But for South Africa data, only household consumption variable is stationary at level under ADF test and only real interest rate is stationary at level under DF-GLS test. Thus we apply the ECM and Johansen cointegration tests to test long run relationship among the variables.

Table 4: Results of Cointegration tests: Error Correction Model and Johansen Cointegration tests

Country	Error Correction Model			Johansen Test			
	ECM-statistic	Prob.	Conclusion	Trace-statistic	5% critical value	Prob.	Conclusion
Nigeria	-0.1301	0.3133	Not Cointegrated	39.5663	29.7970	0.0028**	Cointegrated
South Africa	-0.8131	0.0004***	Cointegrated	28.8720	29.7970	0.0636*	Not Cointegrated

The two tests suggest different conclusion. For example, ECM test shows that the South Africa variables are cointegrated but Nigeria's variables are not, whereas the reverse holds under Johansen cointegration test. We therefore proceed to estimate the long run regression model formulated in equation (15) and presented the result in table 5.

Table 5: Regression results for equation 15 for Nigeria and South Africa

Panel A: Nigeria				
Variable	Coefficient	Std-Error	t-Statistic	Prob.
C	-0.181116	0.783379	-0.231198	0.8189
LnRGDP	0.902895	0.134428	6.716578	0.0000
LnHFCE(-1)	0.049926	0.145531	0.343058	0.7342
RIR	0.001534	0.001419	1.080893	0.2893
AR(1)	0.828822	0.138255	5.994879	0.0000
R-squared	0.973758	Mean dependent var.	4.249553	
Adjusted R-squared	0.969870	S.D. dependent var.	0.835884	
S.E of regression	0.145092	Sum squared resid.	0.568398	
Durbin-Watson	2.346413			
Panel B: South Africa				
Variable	Coefficient	Std-Error	t-Statistic	Prob.
C	-2.0250	0.3570	-5.6723	0.0000
LnRGDP	0.9015	0.1178	7.6562	0.0000
LnHFCE(-1)	0.2264	0.1207	1.8756	0.0708
RIR	0.0048	0.0062	0.7724	0.4461
R-Squared	0.982032	Mean dependent var.	3.319368	
Adjted R-Squared	0.980173	S.D. dependent var.	0.626021	
S.E of Regression	0.088150	Sum squared resid.	0.225341	
Durbin –Watson stat	2.130566			

We report the estimation results for Nigeria in panel A of table 5, including the estimated first-order autoregressive coefficient of the error term using OLS, to take into account the problem autocorrelation. It is only the coefficient of income variable that is statistically significant with

expected positive sign. The coefficient of determination (R^2) is high and the Durbin-Watson statistics of 2.346413 shows the absence of serial correlation. In case of South Africa, both income variable and lag of household consumption are statistically significant with expected positive signs. Again, the coefficient of determination (R^2) is high and the Durbin-Watson statistics of 2.130566 shows the absence of serial correlation.

From table 5, the estimated models are;

For Nigeria:

$$\ln HFCE_t = -0.1811 + 0.9028 \ln RGDP_t + 0.0499 \ln HFCE_{t-1} + 0.0015 RIR_t \quad (19)$$

For South Africa:

$$\ln HFCE_t = -2.0250 + 0.9015 \ln RGDP_t + 0.2264 \ln HFCE_{t-1} + 0.0048 RIR_t \quad (20)$$

We first computed the adaptive expectation coefficient in order to derive the long run MPC.

From Equation (15), adaptive expectation coefficient is expressed as

$$= 1 - \Omega_2$$

Thus, adaptive expectation coefficient for Nigeria $=1 - 0.0499 = 0.9501$

and Adaptive expectation coefficient for South Africa $\boldsymbol{\psi} = 1 - 0.2264 = 0.7736$

The long run MPC or the elasticity of consumption out of permanent income (β) is obtained from equation (14) - $\Omega_1 = \beta\boldsymbol{\psi}$. We therefore

Table 7: Short-Run and Long-Run Elasticity of Consumption with respect to income and Adjusted Coefficient for Nigeria

Country	Elasticity of Consumption with respect to actual income	Adaptive expectation coefficient(λ)	Elasticity of consumption with Respect to permanent income(β)
Nigeria	0.9029	0.9501	0.9503
South Africa	0.9015	0.7736	1.1650

For Nigeria, the result shows that with an elasticity of consumption with respect to actual income at 0.9029. In order words, the short run marginal propensity to consume out of current income is about 0.90 suggesting that a 1 naira increase in the current or observed real income (as measured by real GDP) would increase mean consumption by about 0.90 naira. However, suppose there is a sustained rise in income, then eventually MPC out of permanent income will be about 0.95 naira. In order words, when consumers have had time to adjust to the 1 naira change in income, they will increase their consumption ultimately by about 0.95 naira. Moreso, the real interest rate introduced to the model and the lagged of household consumption are not statistically significant. This suggests that the behavior of consumers in Nigeria is forward looking in the sense that their consumption behavior is based on expected future income. An adaptive expectation coefficient of 0.93 implies that in long run expectations of households in

Nigeria are realized by 93%. Therefore, this result exhibits a strong support for the permanent income hypothesis for Nigeria.

In case of South Africa, the short run MPC is 0.90 suggesting that a 1 rand increase in the current real income would increase the average consumption by about 0.90 rand while the long run MPC is 1.165. The long run MPC exceeds Keynes upper limit value of one. Thereby suggesting that in South Africa when consumers have had time to adjust to the 1 rand change in income, they will increase their consumption ultimately by about 1.16 rand. The study also found that previous consumption (Ct-1) was statistically significant and then implies that past consumption has effect on current consumption as posited by Duesenberry in the Relative income hypothesis. It can therefore be concluded that the relative income hypothesis hold in South Africa and also describe the behavior of consumers in South Africa is forward-looking although not as much as Nigerians. These findings are in agreement with previous study like Nwala (2010) and Osei-Fosu *et al* (2014).

4.0 SUMMARY AND CONCLUSION

The aim of this study is to estimate the consumption function of Nigeria and South Africa under the Permanent Income Hypothesis using a time series data on final household consumption expenditure, real GDP and real interest rate from 1980 to 2013. The study estimated parameter MPC long run time series employing Cagan's adaptive expectation model. The result shows exist of a long run relationship between consumption and income for the two countries. The study found for Nigeria that when consumers have had time to adjust to the 1 naira change in income, they will increase their consumption ultimately by about 0.95 naira. Also, data for Nigeria this suggests that the behavior of consumers in Nigeria is forward looking in the sense that their consumption behavior is based on expected future income. In case of South Africa, the study shows that past consumption has effect on current consumption as posited by Duesenberry in the Relative income hypothesis in South Africa. Moreso, it is revealed that the behavior of consumers in South African is also forward-looking although not as much as Nigerians.

The policy implication of our findings is that the impact of government policy of tax cuts will be greater on consumption if such a policy is perceived by consumers as permanent. Therefore a tax cuts aimed at the bottom of the income distribution are likely to be more expansionary than tax cuts aimed at the top because of the fact that lower income households have a higher MPC (Palley, 2008).

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