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Estimation of the consumption function under the permanent income hypothesis: Evidence from Zambia

Lincoln Daka, Humphrey Fandamu, Kapena Sumbye

Department of Economics, School of Business, The Copperbelt University P.O. Box 21692, Kitwe, Zambia

Abstract

The aim of this paper is to examine Zambia's consumption function under the permanent income hypothesis (PIH) by adopting Cagan's adaptive expectations principle. The study employs annual time series data from 1971-2014 to estimate both the short-run and long-run elasticities of consumption for Zambia. The autoregressive distributed lag (ARDL) cointegration approach is used. It is found that there is a wide difference between the elasticity to consume out of current income and the elasticity to consume out of permanent income. Therefore, we conclude that the permanent income hypothesis (PIH) is valid in the case of Zambia. Inflation negatively affects consumption in the long run. It is also found that increases in the interest rates tend to lower significantly interest-sensitive consumption expenditure in Zambia. The overall conclusion drawn from the study is that government policies that are aimed at improving the disposable income of Zambian households, in order to stimulate consumption and economic growth, must be permanent or sustained long enough for their full effect to materialize.

Keywords: permanent income hypothesis, consumption, autoregressive distributed lag model

1. Introduction

Consumption consists of the expenditures on goods and services by households (individuals and non-profit institutions) except new houses (these are counted as residential investment). Such expenditures can be broken down into three subcategories, namely nondurable goods, durable goods, and services. Nondurable goods are tangible goods that are expected to last less than one year, such as food and clothing. Durable goods are tangible goods that last a long time. They include goods such as automobiles, radios, TVs sets appliances etc. Services are intangible items such as recreation, entertainment, education and medical care (DerLorme and Ekelund, 1983; Abel, Bernanke and Smith, 1999) [6, 1]. According to empirical studies, all forms of consumption together make up two-thirds of GDP (Mankiw, 2006) [19]. Therefore, a little disturbance in this component will have a far reaching effect on the nation's aggregate demand performance.

In Zambia, household final consumption expenditure, as a percentage of GDP in 2013 was 73.42%. The living conditions monitoring survey (LCM) report for 2010 shows that average monthly household expenditure increased from K604 in 2006 to K969 in 2010. This translates into a daily average household expenditure of K32. Average household expenditure was relatively higher on non-food (K486) than on food items (K470) for the 2010 household expenditure. Data from Zambia Demographic Surveys ( ) indicate that household final consumption expenditure has been growing steadily over the years as shown by figure 1.

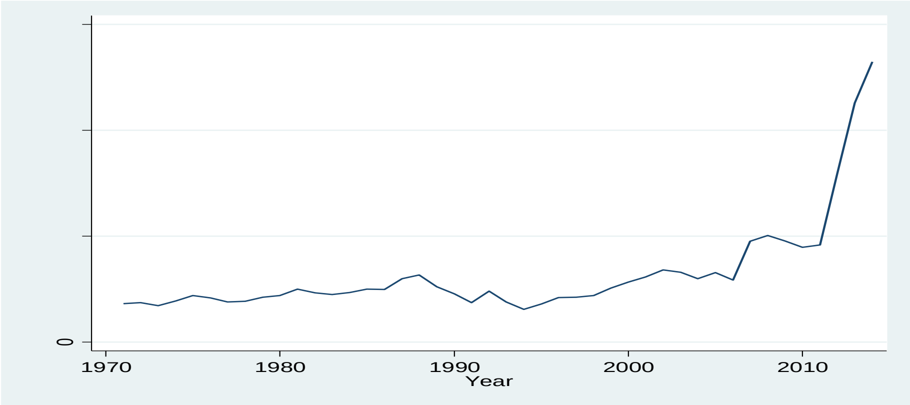


Fig 1: Household Final Consumption Expenditure for Zambia 1971-2014

Because consumption is so large and plays an important role in national welfare and business cycle fluctuations, macroeconomists have devoted much attention, time and energy to studying how households decide how much to consume, their response to uncertainty over future incomes, their response to movements in interest rates, and their expectations of future shifts in taxes and wages, all of which are key determinants of government policy.

The concept of the consumption function, which was coined from Keynes' *fundamental psychological law*, shows the relationship between consumption and disposable income. According to the simple Keynesian consumption function, consumption depends solely on disposable income in the current period. Two implications of this Absolute Income Hypothesis (AIH) are worth noting. Firstly, household consumption is volatile rather than smooth, because any change in current income is reflected in a change in consumption. Secondly, there should be no difference between the effect on consumption of transitory and permanent changes in personal income (Carlin & Sosckice, 2006) [5]. However, these predictions are too extreme and unrealistic because they do not consider individuals' expected path of income or time preference for consumption and ability to borrow, which is captured by the real rate of interest. Therefore, there are contradictions between the simple Keynesian consumption function and empirical evidence.

Alternative views of consumption taking these factors into account were proposed in Milton Friedman's permanent income hypothesis (PIH) in 1957 and in the closely related Life-Cycle Hypothesis (LCH) by Franco Modigliani and Richard Brumberg in 1954. They suggested consumption was a function not of a measured total income as in the Keynesian consumption function but of average or expected income or value of life time resources. Since the publication of Friedman's A Theory of Consumption Function (1957) [8], a number of researchers, including Motaqed (2011) [21], Khan *et al*., (2010) [16], Manitsaris (2006) [18]; Katsouli (2011) [14] and Hayashi (1982) [12] have empirically tested the permanent income hypothesis (PIH) using historical data from European countries, Pakistan, Iran and other countries. To the best of the researchers' knowledge, empirical work on the applicability of the permanent income hypothesis to Zambia is nonexistent. It is, therefore, the objective of this paper to replicate these studies in Zambia, by modeling Zambia's consumption function under the PIH and testing the consistency of Zambia's household final consumption with the predictions of the PIH.

2. Theoretical Foundations of the PIH

The reason the PIH has endured so much is that, beyond its simple intuitive appeal, it is a special case of an intertemporal optimization model of consumer behaviour, which is the most coherent and logically consistent model we have at present. This model has its roots in the works of Irving Fisher (1907) and Ramsey (1928) and has since been developed in many directions. Let us recall the basic elements of this model. Since the PIH includes the notion of shocks to income, which may reflect real but transient or even permanent fluctuations to income, the theoretical framework should allow for uncertainty. Consider a consumer who maximizes expected lifetime utility, subject to a lifetime budget constraint. Expectations are rational and there are no liquidity constraints, in the sense that the individual can borrow and lend at a constant interest rate. Thus the situation we have is that the optimal consumption plan at time zero maximizes the sum of expected utility subject to a life-time budget constraint.

$$\max_{c_t, t=1,\ldots T} \left\{ E_0 \sum_{t=1}^{T} \beta^t U(C_t) \right\}$$

Subject to

$$A_0 + \sum_{t=1}^{T} R^t (y_t - c_t) = 0$$

Where A_0 is initial non-human wealth. The problem gets solved in each period to allow for revisions due to news on income. The key implication of this model

$$U'(c_t) = \frac{R}{\beta} E_t \lambda_t$$

is that the marginal utility of consumption in each period is equal to the expected marginal utility of wealth multiplied by a factor depending on the interest rate and the rate of time preference. This expresses very closely the ideas underlying the PIH. Under certain circumstances this yields a version of the PIH, where permanent income is defined as total lifetime wealth. Thus for example, if the rate of return is equal to the discount rate $R=\beta$ and there is no uncertainty, consumption will be constant if preferences do not change over time. In this case we can write consumption as a constant proportion to total wealth, which provides a version of the PIH when transitory shocks are all measurement error. However a better insight can be obtained by using the quadratic utility function. With quadratic utility and assuming expected utility maximization we get that consumption that is expected to remain the same.

$$c_t = E_t c_{t+1}$$

It is this consumption which formed the basis of a test of the PIH by Hall (1978) [11]. This combined with the budget constraint gives the result that consumption is proportional to expected wealth

$$c_t = \frac{r}{[(1+r) - (1+r)^{-T}]} E_t W$$

Where

$$E_t W = A_t + E_t \sum_{s=t}^{T} R^S y_s$$

Is the expected life-cycle Wealth. This provides an immediate justification for the PIH and shows how the average (marginal) propensity to consume relates to the interest rate. It is also very closely related to the ideas expressed in the work of Modigliani and Brumberg (1954) and Ando and Modigliani (1963) on the Life-Cycle Hypothesis, who introduce formally life-cycle considerations. It is vital to note that one of the key motivations for PIH is to model the reaction of consumption to changes in income. As shown by Sargent (1978), Flavin (1981) [7] and later elaborated by Campbell (1987) this version of the PIH implies that consumption changes are equal to the annuity value of all revised changes in future incomes. Thus for the infinite horizon case we can write

$$\Delta c_t = \frac{r}{1+r} \sum_{s=0}^{\infty} \frac{1}{(1+r)^s} (E_t - E_{t-1}) y_{t+s}$$

The term $(E_t\text{-}E_{t-1})y_{t+s}$ reflects revisions in expectations on the income flow. In the simplest case where the income process contains a deterministic component possibly time varying but known in advance, plus a transitory component we get that consumption does not react (much) to current income fluctuations. In fact the reaction is zero for anticipated changes and the reaction to unanticipated transitory shocks equals the annuity value of the shock.

This will typically be very small, at least for a young individual. This reflects very clearly the thinking of Friedman and it is an intuition that finds expression in modern economic analysis. However, there are doubts on whether this is a good description of the income process. If the shocks to income are permanent, then all future levels of income will be revised upwards or downwards by the same amount leading to a reaction of consumption, which is equal to the change in current income. This is perfectly consistent with the PIH, since Friedman explicitly argued that changes over time should reflect (unexpected) changes in permanent income.

In discussing permanent income Friedman explicitly allowed for the possibility for some form of Liquidity constraints, when he stated that the discounted sum of future incomes does not have much intuitive appeal as a measure of permanent income because economic agents can borrow and lend at the same interest rate (Friedman, 1957) [8]. So how do liquidity constraints affect the argument and are they really important from an empirical point of view? With liquidity constraints in the model discussed above, individuals with positive assets will always behave as in the PIH, but individuals with zero assets, may have consumption behaviour such that consumption tracks predictable changes in income, whether transitory or not, in the presence of borrowing restrictions. Whether this will be detectable in the data will depend on the proportion of individuals who are thus constrained.

Thus on closer examination it follows that the PIH and its implications for policy requires us to take a stance on the definition of permanent income and on how capital markets operate. These observations have given rise to a large literature on testing for liquidity constraints (LCs) based both on macroeconomic aggregate data and on microeconomic data. Two of the best known tests of LCs on aggregate data are the one by Flavin (1981) [7] and Blinder and Deaton (1985) [3]. Flavin (1981) [7] estimates a structural time-series model of consumption and income and tests whether lagged income growth matters for consumption, once one controls for innovations to consumption due to unexpected changes or "surprises" in current income.

Blinder and Deaton (1985) [3] implement a similar "excess sensitivity" test which states that under the null only income surprises should matter for consumption growth. Predictable income growth should not matter. The findings of both these papers is that the version of the PIH with perfect capital markets, as expressed in the equation above, is rejected – in line with Friedman's suspicions. In both papers, predictable changes in income are shown to affect consumption. Nevertheless, the sensitivity of consumption to these predictable income changes is actually quite low, with a marginal propensity to consume out of current income in the Blinder and Deaton paper of about 0.15, once Permanent income is controlled for. This is not too say that this is not important, but to lay the ground for arguing that a more general version of the PIH, with similar foundations is in fact consistent with the data, although the version of the PIH developed here is probably too restrictive.

2.1 A Brief Review of literature on the transition from Permanent-Income Hypothesis to The Life-Cycle Model.

For the purposes of this study, we discuss, in this section, two initially distinct theoretical paths that eventually merged into one; the lifecycle model developed by Franco Modigliani, Albert Ando, and Richard Brumberg in the mid-1950s and the permanent-income hypothesis introduced by Milton Friedman in 1957. Much of the literature in this section is drawn from Oguz (1996). Modigliani's life-cycle hypothesis (LCH) emphasizes that income varies somewhat predictably over a person's life and that consumers use saving and borrowing to smooth their consumption over their lifetimes. According to this hypothesis, consumption depends on both income and wealth.

Friedman's permanent-income hypothesis (PIH) emphasizes that individuals experience both permanent and transitory fluctuations in their income. Because consumers can save and borrow, and because they want to smooth their consumption, consumption does not respond much too transitory income. Consumption depends primarily on permanent income. The basic idea underlying both theories is that the consumer plans his expenditures not on the basis of the income received during the current period but rather on the basis of long-run or lifetime income expectation.

Friedman points out that a person does not plan his expenditures for one day according to what income he expects to receive on that particular day. In terms of theory of consumption function, this means that the consumer plans his expenditure for a given period, whether it is a day or a year, on the basis of a longer run view of the resources that will be available to him. In a sense, these views reflect a return to the pre-Keynesian views of the importance of wealth and interests. Modigliani and his associates postulate that the typical individual has an income stream which is relatively low at the beginning and end of his life, when his productivity is low, and high during the middle of his life.

In many respects these theories are very similar but there are also some key differences. Both theories divide the current income of the consumer unit into permanent Y^p and transitory Y^T components, and the same is true for current consumption expenditures (C^P and C^T), respectively. The PIH assumes the absence any correlation between Y^p and Y^T, between C^P and C^T, or between Y^T and C^T. In the LCH also, no correlation is assumed between Y^p and Y^T, but over time Y^T may add to Y^p because when it is invested, the yield on the investment raises permanent income. In both cases, the key relationship is that permanent consumption, C^P, is a linear multiple, *k*, of permanent income Y^p. To Friedman, the multiple depends on the interest rate, on the ration of nonhuman to total wealth and on a catch-all variable which includes age and tastes as major components. Modigliani accepts the same determining variables but allows the multiple to vary with time and stresses the age of consumer unit. In both formulations permanent income is obtained as the product of the estimated wealth is discounted. Friedman puts more emphasis on estimating wealth on the basis of the flow of current and past incomes as a proxy for YP whereas Modigliani puts more emphasis on current income plus nonhuman net worth for estimating for estimating household resources.

In both approaches consumption is defined to include the real consumption of goods and services rather than monetary expenditures; durables are expenditures only to the extent that they are depreciated in a particular period, not the amount spent for their acquisition. By either formulation, the central hypothesis is that the proportion of permanent income saved by the consumer unit is independent of its income in particular period, and that transitory income has no (Friedman) or little (Modigliani) effect on current consumption. In both models, an increase in real income may raise the saving ratio, in the PIH because this increases permanent income, and consumption, relative to their measured components. In the LCH the effect varies with the age of household, being positive for younger households and negative for older, and the retired, households. Modigliani specifically allows for a positive secular relationship because of income growth due to both population increase and high productivity.

2.2 A Brief Survey of Empirical Literature on LC-PI Hypothesis

While such hypothesis seem simple in theory, testing them gives rise to a great many empirical problems, primarily because of the difficulty of separating the permanent from the transitory components of income and consumption. A substantial empirical work evolved in the attempt to test LCH and PIH. Since both theories are closely related, in the literature both theories are combined as the Life Cycle-Permanent Income (LCPI) theory of consumption. In simple terms, LCPI hypothesis suggest that consumers choose current consumption after considering the state of resources available to them over their entire lifetime. Consumers behave as if their budget must be met not on a period by period basis, but on a lifetime basis. Hall (1978) [11] developed stronger implication of the basic LCPI theory for consumption. Hall showed that, under rational expectations, consumption must follow a 'random walk' or first order autoregressive process (AR (1)) if the LCPI hypothesis is true. This is the only information available at time, *t-1*, useful in predicting consumption at time *t* is the consumption at time *t-1*. No other variable known at *t-1* can increase the accuracy of the prediction. Hall's random-walk hypothesis combines the permanent-income hypothesis with the assumption that consumers have rational expectations about future income. It implies that changes in consumption are unpredictable, because consumers change their consumption only when they receive news about their lifetime resources.

Bilson (1980) [2] tested the rational expectations and LCPI model and reached an ambiguous conclusions; aggregate consumption was demonstrated to be independent anticipated changes in income in both Germany and the U.K. On the other hand, the tests suggested that lagged innovations in income influenced consumption in German and U.S. samples, and the anticipated change in income was significant in predicting consumption in the U.S.

Flavin (1981) [7] developed a structural econometric model of consumption and showed that the LCPI hypothesis proposed by Hall (1978) [11] can be thought of as a test based on the reduced form of this structural model. Using this structural version of Hall's model she found that consumption was more sensitive to income changes than predicted by the LCPI theory.

Blinder and Deaton (1985) [3] reproduced Flavin's finding that the change in consumption was predictable from past income. In their empirical work, lagged income and the forecast of current income based on past lagged information are both significant, contrary to the implications of LCPI theory.

Mankiw and Campbell (1990) [20] re-examines the consistency of the permanent-income hypothesis with aggregate postwar U.S. data. The permanent-income hypothesis is nested within a more general model in which a fraction of income accrues to individuals who consume their current income rather than their permanent income. This fraction is estimated to be about 50%, indicating a substantial departure from the permanent-income hypothesis. Their results cannot be easily explained by time aggregation or small-sample bias, by changes in the real interest rate.

Manitsaris (2006) [18] examined the consumption function under the permanent income hypothesis using annual data covering the period from 1980 to 2005 for selected 15 European Union member-states. The specifications adopted refer to the combined partial adjustment and adaptive expectations model, and the adaptive expectations model. The results show strong support for the hypothesis, supporting thus the consumption function under the permanent income hypothesis and the adaptive expectations model.

Khan *et al* (2010) [16] estimated the consumption function for Pakistan under the permanent income hypothesis (PIH) using the annual data from 1970 to 2010. The consumption function under PIH was estimated through ordinary least square (OLS) method and instrumental variable (IV) approach. The results of both OLS and IV approach showed a small difference between marginal propensity to consume (MPC) out of current income and MPC out of permanent income. Therefore, they concluded that, these results indicate the invalidity of PIH and validity of Keynesian absolute income hypothesis in a case of Pakistan.

3. Methodology and Data

Theoretical Framework and Model Specification

According to Milton Friedman's (1957) [8] permanent income hypothesis actual consumption expenditure C_t is made up of two parts namely, permanent C_t^p and transitory C_t^T. This can be expressed as follows

$$C_t = C_t^p + C_t^T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Similarly, actual income Y_t is the sum of permanent income, Y_t^p and transitory income, Y_t^T

That is,

$$Y_t^T = Y_t^p + Y_t^T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

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

$$C_t^p = \alpha + \beta Y_t^T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

where α and β are parameters to be estimated. The purpose of this paper is to estimate a version of the consumption function in (3), or the so called 'consumption function under the permanent income hypothesis' for Zambia. Since C_t^p and Y_t^T are not directly observable, we need to specify the mechanism that generates permanent consumption and permanent income. Following Manitsaris (2006) [18], Gujarati (2004) [10] and Koutsoyiannis (1977) [17] we combine Cagan's adaptive expectations hypothesis, we

$$Y_t^P - Y_{t-1}^P = \delta(Y_t - Y_{t-1}^P) \quad 0 < \delta < 1 \ldots\ldots\ldots\ldots(4)$$

Where δ is the adaptive expectations coefficient. Substituting (1) into (3), the following equation is obtained,

$$C_t = \alpha + \beta Y_t^P + C_t^T \ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Which is written in econometric terms as

$$C_t = \alpha + \beta Y_t^P + u_t,$$

for $u_t = C_t^T + \varepsilon_t \ldots\ldots\ldots\ldots\ldots(6)$

From (6) $Y_t^p = -\dfrac{\alpha}{\beta} + \dfrac{1}{\beta}C_t - \dfrac{1}{\beta}u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$

Lagging (7) one period yields

$$Y_{t-1}^p = -\frac{\alpha}{\beta} + C_{t-1} - \frac{1}{\beta}u_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

Substituting (7) and (8) in the 'adaptive expectations' equation in (4) we obtain

$$C_t = \alpha\delta + \beta\delta Y_t + (1-\delta)C_{t-1} + [u_t - (1-\delta)u_{t-1}] \ldots\ldots\ldots\ldots\ldots\ldots(9)$$

$$C_t = \theta_1 + \theta_2 Y_t + \theta_3 C_{t-1} + \omega_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)$$

Equation (10) is the short-run consumption function under the permanent income hypothesis and the adaptive expectations model, and is estimable in the sense that all the variables involved are expressed in actual and not in observable variables. From the short-run consumption function in equation (ix), $\theta_1 = \alpha\delta$ is the autonomous consumption; $\theta_2 = \beta\delta$ is the short-run MPC; $\beta = \dfrac{\theta_2}{\delta}$ measures the long-run MPC and the adjustment coefficient, δ is given as $\theta_3 = 1 - \delta \Rightarrow 1 - \theta_3$

In order to assess the effects of interest rates *(IR)* on consumption, we incorporate this variable into the estimable function in equation (9). This yields

$$C_t = \theta_2 Y_t + \theta_3 C_{t-1} + \varphi IR + \eta_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

By assuming that equation (11) satisfies all the Classical Linear Regression (CLR) assumptions, we use the Ordinary Least Squares (OLS) estimation procedure to estimate the parameters and the coefficients examined on the basis of theoretical and statistical criterion. As *a priori* we expect the parameters in (11) to assume the following theoretical signs: $\theta_1 > 0, \theta_2 > 0, \theta_3 > 0, \varphi < 0$. In order to achieve stationarity in the series and minimize the presence of heteroscedasticity and autocorrelation, we estimated the log-linear form of the model specified in equation (11). By using the log linear form of the equations, the estimated parameters give the elasticities of the regressand with respect to the regressors (i.e. the percentage change in the dependent variable due to a percentage change in the respective independent variables).

3.1 Data Source

The data on the variables in this study, household final consumption expenditure, and income (GDP), are taken from World Development Indicators, published by United Nations, Department of Economic and Social Affairs, Statistics Division. Data on real interest rate (IR), which is proxied by the lending rate, is taken from the Bank of Zambia, and World Bank World Development Indicators database. The data are annual and span the time period 1971 to 2014. All the variables are measured in real terms.

4. Presentation and Analysis of Empirical Results

This section presents the empirical results and as well as the analysis

4.1 Augment-Dickey Fuller Unit Root Test Results

Before estimating Zambia's consumption function under the permanent income hypothesis, we examined the stationarity of the variables employed in this study by testing for unit root for each variable using the *Augmented Dickey-Fuller (ADF).* Presented in Table 1 are the results of the ADF unit root test statistics for the natural log of household consumption expenditure (C), income (GDP) and the rate of interest (IR).

Table 1: Augmented Dickey-Fuller Unit Root Test Results: Level

ADF test for unit root with intercept and no trend		
Level		
	ADF Statistic	*P value*
LogCons	*-1.348*	*0.9969*
LogGDP	*3.814*	*0.0000*
IR	*-1.458*	*0.5542*
LogINF	*-1.739*	*0.4114*

The test results at the levels indicate that, at 1% significance level, the unit-root null hypothesis is rejected for income (GDP). The income variable (GDP) is thus stationary at its natural log level. However, consumption and interest rate have a unit root at their log level but achieved stationarity at their first difference at 1% significant level as shown in table 2 below.

Table 2: Augmented Dickey-Fuller Unit Root Test Results: First Difference

ADF test for unit root with intercept and no trend		
First Difference		
	ADF Statistic	*P value*
d. LogCons	-5.473	0.0000
LogGDP	3.814	0.0000
d.IR	-5.461	0.0000
d.INF	-5.492	0.0000

Having ascertained the stationarity of the variables, we proceed with the estimation of the parameters of the permanent income consumption function.

4.2 The ARDL Cointegration Approach

When some of the series are stationary at level and some of them are stationary at first difference level I (1), we cannot apply on the traditional cointegration test. This problem can be removed by the Autoregressive Distributed Lag (ARDL) model and the bound test approach which was developed by Pesaran, Shin and Smith (2001) to observe the long run relationship between the variables. A large number of past studies have used the Johansen cointegration technique to determine the long-term relationships between variables of interest. In fact, this remains the technique of choice for many researchers who argue that this is the most accurate method to apply for I(1) variables. Recently, however, a series of studies by Pesaran and Shin (1996); Pesaran and Pesaran (1997); Pesaran and Smith (1998) and Pesaran *et al*. (2001) have introduced an alternative cointegration technique known as the 'Autoregressive Distributed Lag (ARDL)' bound test.

This technique has a number of advantages over Johansen cointegration techniques. First, the ARDL model is the more statistically significant approach to determine the cointegration relation in small samples (Ghatak and Siddiki 2001), while the Johansen co-integration techniques require large data samples for validity.

A second advantage of the ARDL approach is that while other cointegration techniques require all of the regressors to be integrated of the same order; the ARDL approach can be applied whether the regressors are I (1) and/or I(0). This means that the ARDL approach avoids the pre-testing problems associated with standard cointegration, which requires that the variables be already classified into I(1) or I(0) (Pesaran *et al*, 2001).

If we are not sure about the unit root properties of the data, then applying the ARDL procedure is the more appropriate model for empirical work. As Bahmani-Oskooee (2004: 485) explains, the first step in any cointegration technique is to determine the degree of integration of each variable in the model but this depends on which unit root test one uses and different unit root tests could lead to contradictory results. For example, applying conventional unit root tests such as the Augmented Dickey Fuller and the Phillips-Perron tests, one may incorrectly conclude that a unit root is present in a series that is actually stationary around a one-time structural break (Perron, 1989; 1997) The ARDL approach is useful because it avoids these problems.

Yet another difficulty of the Johansen cointegration technique which the ARDL approach avoids concerns the large number of choices which must be made: including decisions such as the number of endogenous and exogenous variables (if any) to be included, the treatment of deterministic elements, as well as the order of VAR and the optimal number of lags to be used. The estimation procedures are very sensitive to the method used to make these choices and decisions (Pesaran and Smith 1998). Finally, with the ARDL approach it is possible that different variables have different optimal numbers of lags, while in Johansen-type models this is not permitted.

According to Pesaran and Pesaran (1997), the ARDL approach requires the following two steps. In the first step, the existence of any long-term relationship among the variables of interest is determined using an F-test. The second step of the analysis is to estimate the coefficients of the long-run relationship and determine their values, followed by the estimation of the short-run elasticity of the variables with the error correction representation of the ARDL model. By applying the ECM version of ARDL, the speed of adjustment to equilibrium will be determined.

Our ARDL model for estimating the permanent income hypothesis in Zambia adopted for this study is defined as follows:

$$\ln cons = \beta_0 + \sum_{i=1}^{p} \theta \ln cons_{t-1} + \sum_{i=0}^{q1} \theta_2 \ln gdp_{t-1} + \sum_{i=1}^{q2} \theta_3 \ln ir_{t-1} + \mu_t$$

Where lncons is the natural log of consumption, lngdp is the natural log of income and lnir is the natural log of the interest rate. This involves selecting the orders of the ARDL (*p, q1, q2,*) model in the three variables using the Akaike Information Criterion (AIC).

We then estimate an Error Correction Model (ECM) to capture short-run dynamics of the system. The ECM generally provides the means of reconciling the short-run behaviour of an economic variable with its long-run behaviour. The ECM is specified as follows:

$$\Delta \ln cons = \gamma + \sum_{i=1}^{p} \beta_{1i} \Delta \ln cons_{t-i} + \sum_{j=1}^{q} \beta_{2j} \Delta \ln gdp_{t-j} + \sum_{k=1}^{q} \beta_3 \Delta \ln ir_{t-k} + \rho ECM_{t-1} + \mu_t$$

From the equation above, β_i represent the short-run dynamics coefficients of the model's convergence to equilibrium. ECM_{t-1} is the Error Correction Model. The coefficient of the Error Correction Model, ρ measures the speed of adjustment to obtain equilibrium in the event of shocks to the system.

4.3. Results of the Bounds Test for cointegration

We now estimate whether a long-run relationship exists among the variables using the bounds testing procedure as developed by Pesaran *et al*. (2001).

Table 3: Bounds Test for cointegration Pesaran/Shin/Smith (2001) ARDL Bounds Test H0: no levels relationship
F = 5.528 t = -3.540

	Critical values for the bounds test based on the Akaike information criterion, AIC	
Significance level	*I(0)*	*I(1)*
1%	2.72	3.77
5%	3.23	4.35
10%	4.29	5.61

The calculated F – statistic (F – statistic = 4.873) is higher than the upper bound critical value at 5 percent level of significance. This implies that the null hypothesis of no cointegration cannot be accepted at 5 percent and therefore, there is cointegration among the variables as shown in the table above. The estimation coefficients for the ARDL long term model are presented in the table below in Table 4.**4.4.**

4.4. Results of the long – run Model

Table 4: Zambia's long run consumption function under PIH, 1971-2014 Dependent Variable: Iog*Cons*

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob-value**
logGDP	*1.90118*	*0.2598769*	*7.32*	*0.000*
IR	*-0.0017456*	*0.0017175*	*-1.02*	*0.322*
logINF	*-0.1532945*	*.0443021*	*-3.46*	*0.002*
Cons	*-15.80657*	*5.437269*	*-2.91*	*0.009*

R^2=0.7902, Adj. R^2=0.6120, Ramsey F=0.31 (p-value = 0.8164), Breusch-Pagan LM = 3.68 (p value = 0.0551) Breusch – Godfrey LM = 0.16 (p-value = 0.3362), JB = 2.083 (p value = 0.352) ARCHLM test =0.152(p-value =0.6967), Durbin –Watson d statistic = 2.162857

The long - run coefficients of estimation are presented in table 4. From Table 4, the long-run elasticity to consume out of current income is 3.2%. This suggests that if the increase in income is sustained, the elasticity to consume out of permanent income will be 3.2. This is elastic, suggesting that if Zambian households have had enough time to adjust to 1% change in their income, they will increase their consumption ultimately by 3.2%.

To augment the overall performance or the predictive power of the model understudy, we introduce real interest rate as one of the regressands. The estimated results suggest that current consumption and interest rate are negatively related, such that a 1% rise in the interest rate reduces current consumption by 1.17%. The interest rate elasticity of consumption is statistically insignificant. Inflation is also found to be negatively related to consumption. A 1% increase in inflation decreases consumption by 0.15%.

4.5. Results of the Error Correction Model

Table 5: shows the ARDL results of Zambia's consumption function under the permanent income hypothesis (PIH).

Table 5: Estimated Short Run Error Correction Model, Zambia's consumption function under PIH, 1971-2014
Dependent Variable: *d.logCons*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob-value*
d.logGDP	*0.3387471*	*0.8424116*	*-0.39*	*0.072*
d.IR	*-0.211443*	*0.107117*	*1.97*	*0.063*
d.logINF	*0 .2649163*	*0.052239*	*5.07*	*0.000*
Ecm(-1)	*-0.4180749*	*0.1668576*	*-2.51*	*0.021*
Cons	*-20.62054*	*6.317926*	*-3.26*	*0.004*

R^2=0.7902, Adj. R^2=0.6120, Ramsey F=0.31 (p-value = 0.8164), Breusch-Pagan LM = 3.68 (p value = 0.0551) Breusch – Godfrey LM = 0.16 (p-value = 0.3362), JB = 2.083 (p value = 0.352) ARCHLM test =0.152(p-value =0.6967), Durbin –Watson d statistic = 2.162857

The results show that the elasticity of current consumption with respect to current income is 0.34 percent. This implies that, in the short-run, 1% rise in the current income of Zambian households, as measured by real GDP, would raise the current household final consumption expenditure by 0.34%. The short-run elasticity to consume out of current income is statistically significant at 5% level and is consistent with apriori expectations. This result suggests that, current consumption is considerably less responsive to changes in current income in Zambia. In the short run, inflation seems to aid consumption in Zambia.

Given the short-run elasticity as 0.338% and the long-run elasticity as 1.9%, the adjustment coefficient of 0.418 suggests that in any given time period Zambian households adjusts their consumption by 41.8% towards their desired or long-run level. In other words, 41.8% of their expectations are realized in any given period.

Since there is a wide difference between elasticity to consume out of current income and the elasticity to consume out of permanent income and the expectation coefficient is small, we conclude that the permanent income hypothesis (PIH) is valid in the case of Zambia.

This provides an empirical support for Duesenberry's relative-income hypothesis (RIH) that present consumption is not influenced merely by present levels of absolute and relative income, but also by levels of consumption attained in previous periods (Branson, 1989) [4].

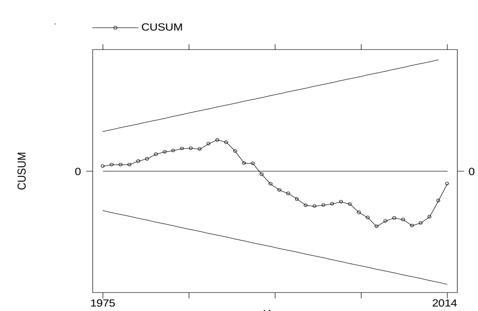
5. Model Diagnostic Tests

Reported in Table 5 are some diagnostic test statistics for overall significance, autocorrelation, heteroscedasticity, normality and specification. The adjusted coefficient of determination, which is a better measure of the overall significance of the model, is as high as 0.79, suggesting that about 79% of the total variation in Zambia's consumption expenditure is explained by the variation in the income level, the rate of interest and the lagged consumption expenditure. Thus, these variables are jointly important determinants of consumption behavior in Zambia.

The Breusch-Pagan *(LM)* test statistic for heteroscedasticity is given as 3.68. Since its p-value of 0.0551 is greater than the assumed 5% significance level, we do not reject the null hypothesis of homoscedasticity in the variance of the residuals of the model. Also, the Breusch-Godfrey LM test for autocorrelation (LM) statistic for is given as 0.16. Since it p-value of 0.3362 is greater than the assumed 5% significance level, we do not reject the null hypothesis of no serial correlation in the residuals of the model. Although the sample size is not large enough, an application of the Jarque–Bera test shows that the JB statistic is about 2.083, and the probability of obtaining such a statistic under the normality assumption is about 35.3 percent. Therefore, we do not reject the hypothesis that the error terms are normally distributed. Moreover, the model is correctly specified using the Ramsey's RESET test for specification, given that the p value of the F-statistic is greater than the significance level of 5%.

Graphical representation of *CUSUM* recursive residuals (fig. 2) also gives the same conclusion of stability of the model. Thus the diagnostic results reported suggest that the model was well specified and stable over the study period.

Fig. 2 Stability Test



The figure above shows the outcome of the CUSUM test of stability which shows the model to be stable, given the fact that the CUSUM line that is in the middle lies in between the two boarder lines, the two bands at 5% critical and does not stray out.

6. Summary of Findings, and Conclusion

Drawing on relevant theoretical stipulations and empirical research carried out in most for developed countries on consumption function, the objective of this paper is to replicate these studies in the case of Zambia and empirically investigate the validity of the permanent income hypothesis in Zambia. Following Manitsaris (2006) [18], Gujarati (2004) [10] and Koutsoyiannis (1977), this study utilizes the ordinary least squares (OLS) econometric estimation method to estimate Zambia's consumption function under the permanent income hypothesis and adaptive expectation model. The study uses annual time series data on household final consumption expenditure, real GDP and interest rate for the period 1971-2014 obtained from the World Bank database, and various Monetary Policy reports of the Bank of Zambia.

The following intriguing results are obtained. It is found that there is a considerable difference between the elasticity to consume out of current income and the elasticity to consume out of permanent income and the expectation coefficient is quiet small. Therefore, we conclude that the permanent income hypothesis (PIH) is valid in the case of Zambia. The statistical significance of the coefficient lagged consumption also provides empirical evidence in support of Duesenberry's relative-income hypothesis (RIH) in Zambia. Interest rate is found to be an important determinant of consumption in Zambia. This is because it is found that interest rate and consumption are not only negatively related, but the interest rate elasticity of consumption is also highly statistically significant. Finally, the estimated parameters of Zambia's consumption function under the permanent income hypothesis are found to be structurally stable throughout the entire period of the study.

The diagnostics tests show there is stationarity in the variables, homoscedasticity, normality and no serial autocorrelation in the residuals and that the model is correctly specified. The overall conclusion drawn from this paper is that the life-cycle-permanent-income hypothesis under rational expectations that current consumption is primarily determined by the average expected life time (permanent) income cannot be rejected in the case of Zambia. The policy implication of this result is that temporary fiscal policy changes that affect the income of consumers in Zambia would not have any significant impact on household final consumption expenditure. Thus, to encourage consumption in order to stimulate economic growth, government policies that aim at improving the disposable income and for that matter the purchasing power of Zambian households must be permanent or sustained long enough for their full effect to materialize.

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