

The Permanent Income Hypothesis: Evidence from Ghana

Sherif Abdul Rahaman

Department of Economics

Ankara Yildirim Beyazit University, Turkey

E-mail: lordshass10@gmail.com

Abstract

This study aims to test the validity of the PIH for Ghana using aggregate annual data of GDP per capita and household consumption expenditure per capita from 1971 to 2017. The data used were taken from UN statistics. The PIH holds that the income a consumer expects to persist throughout his or her life is what determines their consumption. Earlier studies have shown that the PIH implies the magnitude of the revision in permanent income arising from innovation in the income process is proportional to the magnitude of the revision in consumption arising from the same innovation. This study tests this implication. Innovation in the income process here is the part of the income process that could not be forecasted. The study generates the innovation in the income process by estimating an ARMA model for income and then estimates a consumption equation by OLS using the consumption variable and the generated innovation in income variable. The study finds that the magnitude of the revision in permanent income arising from the innovation in income is larger than the magnitude of the revision in consumption resulting from the same innovation. This implies consumption response to changes in income is smaller than what the PIH predicts. This result is taken as evidence that the PIH does not hold for Ghana.

Keywords: Consumption, Income, Permanent Income.

1. Introduction

The quest to understand the consumption behavior of households has long been of interest of economists. The particular question of interest has been how the changes in households' income impact their consumption decisions. This should be no surprise giving the fact that aggregate consumption contributes the largest share in most nations' national accounts. The importance of consumption is evident in the works of prominent economists like John Maynard Keynes, Milton Friedman, Robert Hall and others who took interest in this topic and wrote extensively on it. Several theories have been proposed by economists to explain how consumers make consumption decisions. The two that have received the most attention among economists are Keynes's absolute income hypothesis (AIH), proposed in Keynes (1936) and Milton Friedman's permanent income hypothesis (PIH) proposed in Friedman (1957_a). The former models consumption as depending on the absolute or current disposable income of consumers, while the latter divides income into permanent and transitory components and models consumption as a function of the permanent component only. Permanent income here is defined as income the consumer expects to persist throughout his life while transitory income is not expected to persist (Friedman, 1957_b). Hall (1978) modified the PIH by modeling it under income uncertainty and derived the famous test implication that consumption growth is unpredictable given that consumers can lend and borrow at the same rate and that the utility function is quadratic. Hall tested this implication and took results contradicting it as evidence that the PIH does not hold.

Campbell and Mankiw (1989) proposed a more plausible way of testing the validity of the PIH (Baxa, 2012). Their model allows for the existence of some household who change their consumption significantly in response to even transitory fluctuations in their income. Most studies on this topic after Campbell and Mankiw (1989) have included the rule of thumb model in testing the PIH Roche (1995) and Lunfang, Khan, Khan, and Khan (2018).

This study aims to test the validity of the PIH in Ghana by testing the random walk implication of the theory following (Flavin, 1981; DeJuan, Seater, & Wirjanto, 2006). The test takes advantage of the fact that rational forward-looking consumers will revise their expectations of future consumption when new information becomes available to them today. This new information (the innovation in current income) is the forecast errors in the income process (Flavin, 1981). The study follows DeJuan et al. (2006) and tests the implication that the revision in permanent income arising from this innovation equals the marginal propensity to consume out of the same innovation.

2. Literature Review

Since the proposition of the PIH, many research papers have been written to test the validity of this hypothesis. Some of these researches are reviewed below.

Hall (1978) after deriving the stochastic implications of the LC-PIH, tested these implications with quarterly U.S consumption and income data. Hall's random walk hypothesis implies that current consumption can only be predicted by its own one lag. Lags of other variables are contained in lagged consumption and so are irrelevant in determining consumption in a regression that contains lagged consumption. To test this implication Hall (1978) regressed current consumption on lags of consumption and income in separate regressions to determine the predictive power of lags of income and consumption other than the first lag of consumption. The study found that the collective predictive power of such lags of both consumption and income are insignificant. However, a lagged stock price was found to significantly determine consumption. This contradicts the "stochastic implication" of the PIH that consumption is only determined by its lag one period. Since most of the effect on consumption was found to be from the change in price of stocks in the first lag, Hall concluded that the PIH could be modified to suit these findings. The modification introduced a brief lag during which some part of consumption (which takes time to adjust to changes in permanent income) adjusts to the change in permanent income. In this case, consumption still depends on permanent income but a part of consumption is slow in adjusting to changes in permanent income.

Souleles (1999) examined the relationship between household consumption and income tax refunds. He reasoned that because income tax refunds depend on the previous years' events it is predictable and is also transitory since it doesn't persist over the lifetime of consumers. Under the assumptions of the PIH consumption should therefore not respond to income tax receipts. He tested this using quarterly household survey data from USA's Consumer Expenditure Survey from 1980 to 1991. His study found significant relationship between household consumption and income tax refunds. Since liquidity constrained households increased consumption of nondurables upon refund receipts, Souleles concluded that liquidity constraint was one of the causes of the failure of the PIH. However, liquidity constraint was not wholly responsible for the failure since unconstrained households also increased consumption of durable goods in response to income tax refunds. Unconstrained households should not need to wait on refunds to increase their consumption of durables since they can borrow to fund it.

Using data on disposable personal income and consumption of non-durables and services per capita from 1953Q1 to 1986Q4 for U.S.A Campbell and Mankiw (1989) derived a consumption function different from that of the random walk consumption model derived in Hall (1978). Their approach allowed for the existence of a fraction of households whose consumption responds significantly to changes in their current income rather than their permanent income. This group of consumers they called the rule of thumb consumers. The significance of the coefficient of the fraction of income that goes to these rule of thumb consumers is then tested. Their study estimated that almost fifty percent of income goes to the rule of thumb consumers as the estimated coefficient is about 0.5 and significant. This, they interpreted as evidence to conclude that changes in consumption are predictable and thus rejected the PIH. They estimated another model that allows for varying interest rate to determine if the failure of the constant interest rate assumption in the PIH is responsible for the high estimated coefficient of fraction of rule of thumb consumers' income. They found that the estimate of the fraction of income accruing to rule of thumb consumers remained significant and that interest rate does not predict consumption. They also found evidence of consumers possessing and using information about future income in making present consumption decisions as periods of high consumption are followed by periods of high income growth.

3. Methodology

3.1 Model

The PIH under rational expectation theory assumes a representative consumer who aims to maximize an inter-temporal utility function subject to a wealth constraint. Hall (1978) showed that the solution to this optimization problem is that consumption growth follows a random walk, that is

$$C_{t+1} = C_t + \varepsilon_{t+1} \text{ or } E_t(C_{t+1}) = C_t$$

The model in this study follows Dejuan et al. (2006).

The consumer aims to maximize the utility function (equation one) subject to a constraint (equation 2).

$$E_t \sum_{\tau=0}^{T-1} \frac{U(C_{t+\tau})}{(1+\theta)^\tau} \quad 1$$

$$\sum_{\tau=0}^{\infty} \left(\frac{1}{1+r}\right)^\tau E_t[C_{t+\tau}] = W_t(1+r) + \sum_{\tau=0}^{\infty} \left(\frac{1}{1+r}\right)^\tau E_t[Y_{t+\tau}] \quad 2$$

Substitution $E_t[C_{t+1}]$ for C_t in equation 2 gives

$$C_t = r(W_t + \frac{1}{1+r} \sum_{\tau=0}^{\infty} \left(\frac{1}{1+r}\right)^\tau E_t[Y_{t+\tau}]) \quad 3$$

Equation 3 represents the annuity value of expected life time resources (Inside the outer parenthesis in equation is the present discounted value of expected lifetime resources which when multiplied by r gives the annuity value of expected lifetime resources (DeJuan et al., 2006; Flavin 1981). Defining permanent income as the annuity value of expected life time resource gives

$$Y_t^p = C_t \quad 4$$

Following DeJuan et al. (2006), this study tests a weaker version of equation 3, which is

$$\Delta Y_t^p = \Delta C_t = \frac{r}{1+r} \sum_{\tau=0}^{\infty} \left(\frac{1}{1+r}\right)^\tau (E_t - E_{t-1})Y_{t+\tau} = \theta \quad 5$$

The term $(E_t - E_{t-1})Y_{t+\tau}$ is new information about expected future path of income or revision in expected income (DeJuan et al., 2006; Flavin, 1981). To compute ΔY_t^p , the stochastic process of income should be known (DeJuan et al., 2006). Modelling income as an ARMA(p, q) process as in equation 6, using 6 to calculate the revisions in expected income and substituting the results into equation 5 gives equation 7 (DeJuan et al., 2006).

$$\Delta Y_t = \mu + \rho \Delta Y_{t-1} + \dots + \rho \Delta Y_{t-p} + \epsilon_t + \emptyset \epsilon_{t-1} + \dots + \emptyset \epsilon_{t-q} \quad 6$$

$$\theta = \frac{1 + \sum_{\tau=0}^{\infty} \frac{\emptyset_{\tau}}{(1+r)^{\tau}}}{1 - \sum_{\tau=0}^{\infty} \frac{\rho_{\tau}}{(1+r)^{\tau}}} \epsilon_t \quad 7$$

$$\theta = \chi \cdot \epsilon_t \text{ where } \chi = \frac{1 + \sum_{\tau=0}^{\infty} \frac{\emptyset_{\tau}}{(1+r)^{\tau}}}{1 - \sum_{\tau=0}^{\infty} \frac{\rho_{\tau}}{(1+r)^{\tau}}}$$

The term χ is a function of the ARMA parameters and interest rate, r . It measures the magnitude of the revision in permanent income (θ) that results from the realization of innovation in income ϵ_t . The permanent income hypothesis implies that the magnitude of this revision is proportional to the magnitude of the revision in consumption arising from the same innovation. The magnitude of the revision in consumption arising from the realization of the income innovation can be computed by constructing a consumption regression equation with innovation in income, ϵ_t as independent variable as in equation 8.

$$\Delta C_t = \gamma + \psi \epsilon_t + \xi_t \quad 8$$

The PIH tests $\chi = \psi$.

3.2 Data

The data used in this study is annual data of GDP and household final consumption expenditure from 1971 to 2017 for Ghana. GDP is generally defined as the value of all final goods and services produced within the boundaries of a country in a particular period. The GDP used in this paper is calculated by the expenditure approach. In this case, GDP is more appropriately defined as the total spending on all final goods and services produced within the boundaries of a country in a given period. It is used here as a proxy for income. According to WB the household consumption expenditure (formerly private consumption) is the market value of all goods and services including

durable products purchased by households. It includes payments to government for license and permits acquisition and expenditure of nonprofit institutions serving households. It excludes purchases of dwellings but includes imputed rent for owner-occupied dwellings. This variable is used as a proxy for households' consumption expenditure. Both variables are computed in constant 2010 dollars. In addition, the variables are converted to per capita terms by dividing each observation by the corresponding population. Both GDP by expenditure approach and household consumption expenditure were taken from United Nations' statistical division website (UN statistics, 2018).

The proposition of the PIH that consumption only depends on permanent income is more likely to hold when consumption expenditure on nondurable goods and services are considered Shintani (1996). Consumption expenditure on durable goods is more likely to fluctuate with transitory fluctuations in income which contradicts the PIH. For example, a one million dollars lottery fortune, while it may not change expenditure on nondurables such as expenditure on food significantly, is likely to significantly change expenditure on durables such as spending on vehicles and home appliances. The PIH is thus a better hypothesis under the consideration that the consumption variable is household consumption expenditure on nondurables and service. Indeed, in most studies, models containing consumption of nondurables and services are used or different models are constructed for each class of consumption, Hall (1978) and Shintani (1996). The measure of consumption used in this paper is, however, total household consumption expenditure because data classifying household consumption into durables and nondurables and services was not available to the researcher.

3.3 Results

First the variables are tested for unit roots and the appropriate level to be used for the estimation is determined. As can be seen in Table 1, both variables (GDP per capita and household consumption expenditure per capita) are non-stationary at level and stationary at their first differences.

Table1. Augmented Dickey-Fuller test for GDP_PC and HCE_PC and their first differences

Series	With constant	With constant and trend	With constant, trend and trend squared
	tau-statistics and p-values		
HCE_PC	0.83 (0.994) [0]	0.14 (0.998) [4]	-4.07 (0.040)** [0]
GDP_PC	0.022 (0.971) [0]	-1.51 (0.813) [0]	-3.70 (0.07)* [7]
Δ HCE_PC	-6.59 (0.000)** [0]	-5.30(0.000)**[3]	
Δ GDP_PC	-6.40 (0.000)** [0]	-3.93(0.011)**[9]	

*Note: p-values are in the brackets and number of lags of the dependent variable included in the regression is in the square brackets. It was automatically selected by Gretl, the software used for the test. "***" and "**" show significance at 5% and 10%, respectively.*

The stochastic process of income process is determined next. It is important to estimate the appropriate income process because the residuals from this process are the innovation in income which is central to testing the PIH in this paper. Income is modeled as an ARMA (1 1) process. This is because, ARMA (1 1) is the model with the minimal information criteria among the ARMA models with significant coefficients, (1 1) and (2 2) [Appendix A]. Even though (0 1) and (1 0) have smaller information criterion, the MA and AR coefficients in each of these models respectively are insignificant.

Equation 6 and equation 8 are estimated as

$$\Delta \hat{Y}_t = 13.70 - 0.82\Delta Y_{t-1} + \epsilon_t + 0.93\epsilon_{t-1}$$

(12.50)(0.28) (0.22)

$$\Delta \hat{C}_t = 16.17 + 0.90\epsilon_t \bar{R}^2 = 0.77$$

(4.91) (0.07)

With the constraint $\psi = (1 + 0.93/(1+r)) / (1 + 0.82/(1+r))$ imposed on the consumption equation. The interest rate used here is the yearly average commercial banks' lending rate minus inflation which is used as approximation of the annual real interest rate.

The consumption equation is estimated by heteroskedasticity-corrected OLS method because the usual OLS model showed the residuals are not homoscedastic. The heteroskedasticity-corrected OLS corrects the standard errors of the OLS estimates so that the t statistics computed from these standard errors are reliable and can be used in hypothesis testing.

Table 2. Results of the permanent income hypothesis test

Interest rate ψ	χ	F test (p-value) for $\psi = \chi$		
2018 rate (13.75)		0.90	1.06	0.031
2017 rate (15.87)		0.90	1.06	0.031
2014-2018 average (12.64)		0.90	1.06	0.031
2008-2018 average (9.42)		0.90	1.06	0.031

Note: In computing the value of χ the annual average of commercial banks' lending rate corrected for inflation is used. The 2018 rate, 2017 rate, a five-year average rate between 2014 and 2018 and a ten-year average between 2008 and 2018 are used. These values are computed with data from Bank of Ghana and World Bank. The value of χ using these rates are the same when written in two decimal places. The p-values of an F test of the restriction are reported in the last column of Table 2.

Table 2 provides the results of the test $\psi = \chi$. This is essentially a test of whether the PIH holds or not. If the test reveals ψ is not statistically different from χ , then the conclusion is that the PIH holds in Ghana. If $\psi < \chi$ it shows excess smoothness, that is, consumption response to change in current consumption is less than predicted by the PIH. On the other hand $\psi > \chi$ means consumption responds to innovation in current income beyond what is warranted by the PIH. Consumption is said to be excessively sensitive to income changes in this case (DeJuan et al., 2006).

4. Discussion of Results

From table 2, the restriction that the marginal propensity to consume out of income innovation equals the revision in permanent income arising from the same innovation is rejected. The revision in permanent income is consistently greater than the propensity to consume out of innovation in current income. This constitutes evidence that the PIH does not hold in Ghana rather; there is excess smoothness of consumption to changes in income. This is, however, contrary to what is expected of a developing country like Ghana where liquidity constraint is more likely to hold. Even though the PIH hypothesis, based on its assumptions is more likely not to hold in a developing country, excess sensitivity is more expected as an alternative hypothesis rather than excess smoothness. The result in this study may be due to a change in the saving habits of Ghanaians in the past decade. From WB data of Ghana's saving, the gross savings in local currency increased from 1.322 billion Ghana cedis in 2008 to 63.033 billion in 2018. Its share in GDP increased from 4.382 percent in 2008 to 20.969 percent 2018 averaging 14.568 within this period (WB, 2018).

5. Conclusion

This study tests the validity of the PIH in Ghana using data of GDP per capita and household consumption expenditure per capita from 1971 to 2017. Following DeJuan et al. (2006), the study tests the implication of the PIH that the magnitude of the revision in permanent income arising from innovation in the income process is proportional to the magnitude of the MPC arising from this same innovation. The PIH was found not to hold for Ghana. The magnitude of the revision in consumption arising from realization of income innovation was found to be consistently smaller than the magnitude of the revision in permanent income. This implies the consumption response to changes in income in Ghana is smaller than what is predicted by the PIH. This condition is known in the literature as excess smoothness.

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Appendices

Appendix A

Table 3. Information criterion from ARMA models of the stationary income process

Dependent variable: change in Current Income (ΔY_t)			
ARMA(p, q)	AIC	BIC	HQC
(1, 0)	541.20	546.69	543.26
(0, 1)	541.17	546.66	543.22
(1, 1)	541.80	549.11	544.54
(1, 2)	543.63	552.77	547.05
(2, 1)	543.49	552.64	546.92
(2, 2)	543.26	554.22	547.37
(0, 2)	542.09	549.40	544.83
(2, 0)	542.37	549.68	545.11

Appendix B

Table 4. Results of residual diagnostics tests.

Normality test (JB)	Autocorrelation test	$\text{corr}(\psi, \xi)$
H_0 : Normality of ξ H_1 : Non-normality of ξ p-value = 0.548 AR(1)p-value (LM) = 0.602	H_0 : No autocorrelation H_1 : Autocorrelation DW = 2.077	$\text{corr}(\psi, \xi) = 0.00$

Column one in Table 4 reports the result of Jarque-Bera normality test for the disturbance in the model. The p-value of 0.548 shows the null hypothesis of normality of the residuals cannot be rejected at 5% or 10% significance level as it is greater than 0.05 and 0.1. Results in column two shows there is no autocorrelation in the residuals of the model. The Durbin-Watson test gives a DW value very close to 2 which hints at no autocorrelation. A more general test of autocorrelation, the Lagrange multiplier (LM) test gives a p value of 0.602. The null hypothesis of no autocorrelation cannot be rejected at 5% or 10% significance level as 0.602 is greater than 0.05 and 0.1. These shows the residuals are not serially correlated. Also, the last column in Table 4 reports the correlation between the residuals and the explanatory variable taken from the correlation matrix of these variables. From this it can be seen that these variables are uncorrelated. The table does not report heteroskedasticity test results because the model uses heteroskedasticity-corrected standard errors as the residuals were not homoskedastic. Heteroskedasticity poses a problem in that it makes the standard errors of the coefficients unreliable. Using the heteroskedasticity-corrected standard errors mitigates this problem.

Appendix C

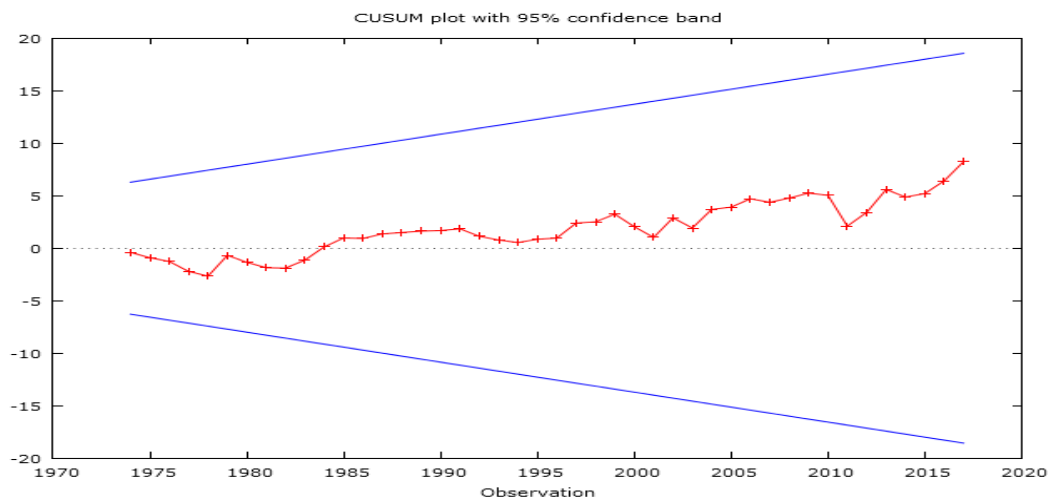


Figure 1. CUSUM Graph of coefficient stability.

Figure 1 shows graph of the change in the coefficients of the consumption model. It shows the coefficients are stable over time as it stays within the bounds. The p-value from Harvey-Collier test of whether or not the coefficients change over time is 0.221. At 0.05 or 0.1 the null hypothesis of no change in parameters cannot be rejected implying the coefficients of the model are stable.

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