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An Estimation of the Consumption Function Under the Permanent Income Hypothesis: The Case of D-8 Countries

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This study examines the consumption function formed on the permanent income hypothesis. It covers eight countries that are member to the Organization of Islamic Cooperation (D-8) based on the annual data from 1980 to 2010. The model employed in this study takes into consideration both the adaptive expectations model and a combination of the partial adjustment model and the adaptive expectations model. The techniques used in time series analysis have been utilized as econometric models. Empirical results include evidences supporting the consumption function formed in accordance with the permanent income hypothesis and the adaptive expectations model.

1. Introduction

Consumption expenditures constitute an important part of national income. Marginal propensity to consume determines the size of multiplier and the dynamic effects of economic shocks. The higher the multiplier is, the more economic fluctuations there are. While the multiplier and the marginal propensity to consume have high values as per the Keynesian absolute income hypothesis, they are expected to have lower values in the theories based on inter-temporal utility maximization such as the permanent income hypothesis (Friedman, 1957) and the life-cycle income hypothesis (Modigliani and Brumberg, 1954). In addition, the validity of Ricardian equivalence theorem depends on the validity of the permanent income hypothesis and the life-cycle income hypothesis. Although the permanent income hypothesis and the life-cycle income hypothesis bear a similar optimization model and results, mostly the permanent income hypothesis is used in empirical studies.

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Developed by Milton Friedman in 1957, the Permanent Income Hypothesis argues that the most important factor determining consumption expenditures is permanent income. As per the permanent income hypothesis, people determine permanent income within the framework of the adaptive expectations hypothesis. According to Friedman, current consumption expenditures in a particular period (C_t) consist of two elements: permanent consumption expenditures (C_t^P), and temporary consumption expenditure s (C_t^T).

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

In a similar way, current income (Y_t) also consists of two parts: permanent income (Y_t^P) and temporary income (Y_t^P)

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

Based on this fact, it is assumed that permanent income determines permanent consumption expenditures. It is possible to write this functional relationship considering related parameters as follows:

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

α and β in the equation numbered (3) are the parameters to be estimated.

The purpose of this study is to estimate the consumption function for D-8 countries formed based on the equation numbered (3) according to the permanent income hypothesis. The demonstration of whether the income elasticity of demand varies among D-8 countries can be guiding for future studies.

2. Method and Data Set

Following the works of Katsouli (2006), the equation numbered (3) can be estimated by combining the partial adjustment model and the adaptive expectations model. The permanent income in the permanent income hypothesis is not an empirically observable size contrary to measured income. The combination of the above-mentioned models makes it possible to convert non-observable variables of permanent

consumption expenditures (C_t^p) and permanent income (Y_t^p) into observable variables. The model indicated below has been obtained based on the models proposed in Manitsaris (2006) and Seddighi et al. (2000).

$$C_t^p = \alpha + \beta Y_t^p \quad (4)$$

$$C_t - C_{t-1} = \gamma\left(C_t^p - C_{t-1}\right) + \varepsilon_t\,,\ 0 < \gamma \leq 1 \quad (5)$$

$$Y_t^p - Y_{t-1}^p = \theta\left(Y_t - Y_{t-1}^p\right),\ 0 < \theta \leq 1 \quad (6)$$

Here, γ is partial adjustment coefficient, and θ is adaptive expectations coefficient. The following equation is obtained when the equation systems numbered (4), (5), and (6) are solved (Manitsaris, 2006):

$$C_t = \alpha\gamma\theta + \beta\gamma\theta Y_t + [(1-\theta) + (1-\gamma)]C_{t-1} - (1-\theta)(1-\gamma) + C_{t-2} + [\varepsilon_t - (1-\theta)\varepsilon_{t-1}] \quad (7)$$

On the other hand, the following equation is obtained when the equation numbered (1) is inserted into its place in the equation numbered (3):

$$C_t = \alpha + \beta Y_t^P + C_t^T \quad (8)$$

It is possible to write this equation through econometric terms by taking into account the error term:

$$C_t = \alpha + \beta Y_t^P + u_t \ \text{ Where } \ u_t = \varepsilon_t + C_t^T \quad (9)$$

The following solution can be obtained based on the equations numbered (6) and (8):

$$C_t = \alpha\theta + \beta\theta Y_t + (1-\theta)C_{t-1} + [u_t - (1-\theta)u_{t-1}] \quad (10)$$

In this way, it becomes possible to estimate the equations numbered (7) and (10) based on actual values (not observable values). This study covers the period between 1980 and 2010. Necessary data related to D-8 countries have been taken from the database of the World Bank. The definitions about the said variables are given below:

Y_t = Disposable Income (US$, as per the prices in 2000)

C_t = Private Final Consumption Expenditures (US$, as per the prices in 2000)

3. Empirical Findings

If it is argued that there is a statistically significant relationship between two time series, it is needed to determine the orders of stationarity of the series by means of a unit root test in order to realize whether the said relationship is real or spurious. If both series have the same order of stationary (integration), the said relationship is real, which means a real regression. Thus, these series are called co-integrated series. In other words, series need to be co-integrated series (series having the same order of stationary) in order for the regression to be considered real. If the mean, variance, and autocovariance of a time series are time-independent and finite, such time series is considered covariance stationary. If a time series becomes stationary after difference is removed d times, it is deemed to become integrated at d order and is expressed as I(d).

In order to test the unit root in time series, Augmented Dickey Fuller (ADF) Test is the most common method in literature. The equation which has lagged values in the dependent variable can be formulated with an intercept and time trend as follows:

$$\Delta y_t = \mu + \beta t + \delta y_{t-1} + \sum_{j=1}^{k} \alpha_j \Delta y_{t-j} + \varepsilon_t \qquad (12)$$

Δ is the difference operator, t is the time trend, ε is the error term, y_t is the series investigated and k is the lag number. ADF assumes that the error term is statistically independently distributed and it has a constant variance. Besides, it is important to select the lag numbers correctly for the power of the test and significance level of the parameters (Said and Dickey, 1984). ADF test depends on the estimation of the parameter δ. If δ is different from zero and statistically significant, then the hypothesis which shows the series has a non stationary process is rejected. Philips-Perron test (1988) has been developed to control the high frequency correlation and it does not give way to the limitation of

the assumptions. Therefore Philips-Perron test (1984) is a complementary unit root test for the ADF test. PP test does not include enough lag values of the dependent variable in the model, so Newey-West estimator is performed to remove the autocorrelation problem in the model. As the absolute value of τ in ADF test is greater than the absolute value of Mac-Kinnon critical values, the series has a non-stationary process. Table 1 presents the ADF, PP, KPSS and DF test results for each series:

Table 1: Unit root test results for D-8 member states

D-8 member state	Log(Y_t)				Log (C_t)			
	ADF	**PP**	**KPSS**	**DF**	**ADF**	**PP**	**KPSS**	**DF**
Iran	-3.91(0)**	-1.59(3)	0.08(3)*	-2.69(0)	-3.76(0)	-4.43(2)*	0.12(3)**	-3.18(0)
Pakistan	-1.40(0)	-1.60(1)	0.21(3)	-1.80(0)	-1.45(0)	-1.36(4)	0.21(0)**	-1.69(0)
Bangladesh	-0.70(0)	-0.71(0)	0.19(4)	-0.86(0)	-2.00(0)	-2.00(0)	0.19(3)	-2.07(0)
Indonesia	-2.35(0)	-2.27(3)	0.18(4)	-2.08(0)	-1.66(0)	-1.76(2)	0.23(4)**	-1.75(0)
Egypt	-4.32(3)*	-4.20(3)**	0.21(4)**	-3.08(3)	-3.64(3)	-4.52(4)**	0.10(4)*	-3.01(3)
Malaysia	-2.14(0)	-2.14(0)	0.20(3)	-2.08(0)	-2.21(0)	-2.24(4)	0.20(3)	-2.25(0)
Turkey	1.41(1)	4.43(3)	0.19(3)	-0.26(1)	-0.83(1)	-2.17(2)	0.18(4)	-1.18(1)
D-8 Members	-2.04(0)	-2.05(1)	0.22(4)	-1.65(0)	-1.34(0)	-1.52(2)	0.26(4)	-1.43(0)
McKinnon (1996) Critical Values								
Significant Level								
1 %	-4.30	-4.30	0.22	-3.77	-4.30	-4.30	0.22	-3.77
5 %	-3.57	-3.57	0.15	-3.19	-3.57	-3.57	0.15	-3.19
10 %	-3.22	-3.22	0.12	-2.89	-3.22	-3.22	0.12	-2.89

Table 1 (Continued): Unit root test results for D-8 member states

D-8 member state	ΔLog(Yt)				ΔLog (Ct)			
	ADF	**PP**	**KPSS**	**DF**	**ADF**	**PP**	**KPSS**	**DF**
Iran	---	---	---	---	---	---	---	---
Pakistan	-5.00(0)*	-4.99(3)*	0.20(2)*	-4.66(0)*	-4.49(0)*	-4.41(6)*	0.22(4)*	-4.36(0)*
Bangladesh	-4.08(0)*	-4.09(2)*	0.37(3)*	-3.91(0)*	-4.63(0)*	-4.62(2)*	0.06(1)*	-4.54(0)*
Indonesia	-6.03(0)*	-6.02(1)*	0.20(2)*	-6.08(0)*	-4.90(0)*	-4.91(1)*	0.10(1)*	-4.78(0)*
Egypt	---	---	---	---	---	---	---	---
Malaysia	-4.69(0)*	-4.66(2)*	0.08(1)*	-4.77(0)*	-4.39(1)*	-4.02(7)*	0.09(5)*	-4.28(1)*
Turkey	-10.65(0)*	-10.5(1)*	0.50(4)*	-0.74(1)*	-7.36(0)*	-7.51(2)*	0.11(5)*	-7.07(0)*
D-8 Members	-4.56(0)*	-4.56(1)*	0.22(2)*	-4.65(0)*	-4.35(0)*	-4.32(2)*	0.13(2)*	-4.24(0)*
McKinnon (1996) Critical Values								
Significant Level								
1 %	-3.68	-3.68	0.74	-2.65	-3.68	-3.68	0.74	-3.77
5 %	-2.97	-2.97	0.46	-3.19	-2.97	-1.95	0.46	-3.19
10 %	-2.62	-2.62	0.35	-2.89	-2.62	-1.61	0.35	-2.89

All variables expressed in logarithms. Δ shows the first-difference operator. Figures in the parentheses from the unit root test results are the lag values which show there is not an autocorrelation according to SIC. But for the PP test, the numbers in the parenthesis are the optimal Newey-West lag values. * and **, *** denote the rejection of the null hypothesis at 1%, 5% and %10 level, respectively.

Based on the analysis results presented in the table 1, since the absolute values of ADF, PP, and DF test statistics are lower than the absolute values of Mac-Kinnon critical values for level values of all series in all countries except for Iran and Egypt, H_0 hypothesis, which states that series involve unit root, thus are not stationary, has been accepted. These results demonstrate that not all series are stationary at their levels. All series have been determined to be stationary when their differences have been removed. Differently from other tests, KPSS (1992) test indicates that the series is stationary under null hypothesis. KPSS test results show that not all levels are stationary at level value at the significance level of 5%, but they are difference stationary.

The ARDL bound test approach has been considered appropriate for the calculation of the income elasticity of consumption for Iran and Egypt. Two-stage Engle-Granger co-integration test has been implemented for other D-8 countries. Nigeria has been excluded from analysis since are not necessary data for that country. Table 2 shows the results of co-integration test for the countries other than Iran and Egypt:

Table 2: Regression results for Equation (10):
Dependent variable log(Ct)

	Turkey	**Iran***	**Pakistan**	**Bangladesh**	**Indonesia**	**Egypt***	**Malaysia**	**D-8 M.**
Constant	0.897	0.839	-0.291	0.049	0.169	-0.137	0.837	-0.055
	[0.009]	[0.000]	[0.039]	[0.974]	[0.813]	[0.285]	[0.042]	[0.833]
Log(Y_t)	0.365	0.409	0.669	0.153	0.595	0.757	0.656	0.624
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Log (C_{t-1})	0.442	0.562	0.324	0.839	0.393	0.240	0.293	0.369
	[0.000]	[0.011]	[0.000]	[0.000]	[0.033]	[0.001]	[0.002]	[0.019]
AR (1)	-	-	-	-	0.643	-	-	-
					[0.015]			
MA (1)	-	-	0.180	0.099	0.275	-	0.652	0.509
			[0.320]	[0.693]	[0.013]		[0.000]	[0.001]
Trend	-0.009		-	-	-	-	-	-
	[0.061]							
Adj. R^2	0.843	0.999	0.999	0.968	0.998	0.999	0.998	0.998
DW	2.087	1.967	1.851	1.528	2.265	2.706	1.807	2.104
LM (1)	0.179	0.970	0.093	0.193	0.911	0.048	0.443	0.097
JB	0.492	0.989	0.768	0.053	0.984	0.914	0.102	0.787
WH	0.539	0.777	0.306	0.184	0.063	0.605	0.184	0.184
ARCH(1)	0.703	-	0.717	0.833	0.991	-	0.906	0.319

Notes: Test statistics in the table have been obtained from ARDL bound test approach for Iran and Egypt. Values in parentheses are p-values. DW = Durbin – Watson statistic for autocorrelation. LM(1) = Lagrange multiplier statistic of order one for autocorrelation. JB = Jarque–Bera statistic for normality. WH = White heteroskedasticity statistic. ARCH(1) = Autoregressive conditional heteroskedasticity statistic of order one.

At the second stage of Engle-Granger two-stage cointegration test, error terms have been drawn from the regression equation for each country, thus the stationary of error terms series has been searched. Since τ-statistic (ADF test statistic) obtained at the end of the ADF is higher than the table value in terms of absolute value, that is to say e_t error

term is I(0), there is a relationship between two time series in the long term. The table 3 presents the results of unit root test pertaining to the error term:

Table 3: Results of Cointegration test for D-8 member states

D-8 member state	**ADF**	**P-value**
Pakistan	-4.27(0)	0.0001
Bangladesh	-4.90(0)	0.0000
Indonesia	-5.04(1)	0.0000
Malaysia	-4.85(0)	0.0000
Turkey	-5.57(1)	0.0000
D-8 Members	-5.27 (0)	0.0000
McKinnon (1996) Critical Values		
Significant Level		
1 %	-2.65	
5 %	-1.95	
10 %	-1.61	

Notes: Values in parentheses indicate the optimal length of the lag. The optimum lag length (p) selection is based on minimizing Akaike Information Criterion (AIC).

Test results show that the error terms obtained from the cointegration regressions pertaining to countries are stationary at level value. Since the absolute value of the ADF test statistic estimated for all regression equations is higher than the absolute values of Mac-Kinnon critical values, it is concluded that there is not unit root and the error term is stationary, thus there is a long-term relationship between the variables.

When some of the series are stationary at level and some of them are stationary at first difference level I(1), we can not apply on the traditional cointegration test. This problem can be removed by the Autoregressive Distributed Lag (ARDL) model and the bound test approach which is developed by Paseran, Shin and Smith (2001) to observe the long run relationship between the variables. The cointegration method used here, the ARDL method allows testing for a long-run relationship between variables of mixed order of integration (Paseran et al., 2001). There are many advantages of using ARDL model for testing the private investment model on Turkey. The main advantage of this method is that ARDL avoid the pre-testing problems in data. Bound test approach can be applied to studies that have a small

size while Engle and Granger (1987) and Johansen (1988, 1995) methods of cointegration are not reliable for small sample sizes (Enders, 1995; Banerjee vd., 1993).

The results of ARDL test calculated for Iran and Egypt are given in the table below:

Table 4: Results of Cointegration Test

Iran				
Lag structure :	ARDL (1 , 0)			
F – statistics :	**5.749**			
k :	1			
Significant level	**Critical values for the bounds test (Narayan, 2004)**			
	Restricted intercept and no trend		**Restricted intercept and trend**	
	I(0)	I(1)	I(0)	I(1)
1 %	6.027	6.760	8.170	9.285
5 %	**4.090**	**4.663**	**5.390**	**6.350**
10 %	3.303	3.797	4.290	5.080
Egypt				
Lag structure :	ARDL (1 , 0)			
F – statistics :	**6.481**			
k :	1			
Significant level	**Critical values for the bounds test (Narayan, 2004)**			
	Restricted intercept and no trend		**Restricted intercept and trend**	
	I(0)	I(1)	I(0)	I(1)
1 %	6.027	6.760	8.170	9.285
5 %	**4.090**	**4.663**	**5.395**	**6.350**
10 %	3.303	3.797	4.290	5.080

Note: The critical value is reported in the same table which based on critical value suggested by Narayan (2004) using small sample size between 30 and 80. Lag orders of the lags in the ARDL model are selected by either the AIC or SBC. For annual data, Paseran and Shin (2001) recommended choosing a maximum of 2 lags.

The calculated F-statistics (F-statistic = 5.749) is higher than the upper bound critical value at 5 per cent level of significance (4.663) for Iran, using restricted intercept and no trend. But the F-statistic is only higher than the upper bound critical value at 10 per cent level of significance (5.080), using restricted intercept and trend. The calculated F statistic (F-statistic = 6.481) is higher than the upper bound critical value at 5 per cent for Egypt, restricted using intercept and trend or restricted intercept and no trend. This implies that the null hypothesis of no

cointegration cannot be accepted at 5 per cent and 10 per cent level and therefore, there is cointegration relationship among the variables. The values about ARDL long-term coefficients obtained for Iran and Egypt are given in the table 2 so as not to disrupt the integrity.

Table 5 presents the income elasticity values obtained based on the coefficients related to variables by means of the equations numbered 6 and 10.

Table 5: Short-run and Long-run Elasticities of Consumption With Respect to Income and Adjustment Coefficients

D-8 member tate	Elasticity of consumption with respect to actual income	Adaptive expectations adjustment coefficient (δ) (Eq. 6)	Elasticity of consumption with respect to permanent income (β) (Eq. 10)
Iran	0.409	0.438	0.934
Pakistan	0.669	0.676	0.989
Bangladesh	0.153	0.161	0.950
Indonesia	0.595	0.607	0.980
Egypt	0.757	0.760	0.996
Malaysia	0.656	0.707	0.927
Turkey	0.365	0.558	0.654
D-8 Members	0.624	0.631	0.989

4. Conclusion

The table 2 presents the consumption elasticity values based on current income for D-8 countries obtained from the equation numbered 10. By using these elasticity values, the adaptive expectations adjustment coefficients and consumption elasticity values based on permanent income have been calculated for each country based on the equations numbered 6 and 10 respectively. These values are given in the table 5. For instance, the consumption elasticity value based on current income included in the first column of the table has been found to be 0.624 for all D-8 countries. This elasticity value shows that an increase of 1% that can occur in the current income (ceteris paribus) will increase current consumption by 0.624%. However, if this increase in income continues, consumption elasticity obtained based on permanent income

will become 0.989. This result means that an increase of 1% in permanent income will increase current consumption by 0.989%. When both consumption elasticity values are compared (short-term elasticity value= 0.624 and long-term elasticity value= 0.989), it is possible to say that consumers will realize approximately two thirds of their expectations in any period because the adaptive expectations coefficient has been estimated to be 0.631. However, these results should be cautiously evaluated by considering the criticisms in the literature about calculation or estimation methods used at every stage of our study.

Test results considerably support the consumption function formed based on the permanent income hypothesis and the adaptive expectation model. The determination of whether the consumption elasticity based on permanent income is different between D-8 countries may be guiding for generating macroeconomic policies. D-8 countries are grouped based on the adaptive expectations adjustment coefficient, current income, and consumption elasticity based on permanent income (respectively) as follows:

The categorization of D-8 members by adaptive expectations adjustment coefficient:

Low: Bangladesh

Medium: Iran, Italy

High: Pakistan, Indonesia, Egypt, Malaysia

The categorization of D-8 members by current income consumption elasticity:

Low: Bangladesh, Turkey

Medium: Iran, Indonesia

High: Pakistan, Malaysia, Egypt

The categorization of D-8 members by permanent income consumption elasticity values:

Low: Turkey

Medium: Malaysia, Iran, Bangladesh

High: Indonesia, Egypt, Pakistan

As can be seen in the categorizations above, consumption elasticity based on permanent income varies between different D-8 countries. Thus, any economic policy that can affect income may have different impacts on D-8 countries. However, these estimation results, which have been obtained based on econometric analyses, should be cautiously evaluated. This is because; the estimation procedure taken as basis in this study does not follow any instrumental variable method, and estimation coefficients may deprive of internal consistencies. On the other hand, this study conducted on D-8 members may contribute to future studies, and have a contributory impact on the generation of macroeconomic policies, though partly.

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