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# AGGREGATE CONSUMPTION IN PAKISTAN: Revisiting the Permanent-Income Hypothesis under Adaptive Expectation Model

**Syed AMMAD* and Qazi Masood AHMED****


## Abstract

This study is an empirical investigation of aggregate consumption function under the permanent-income hypothesis for Pakistan based on Cagan (1956) and Gujarati and Porter (2009) methodologies. The study employs the annual time series data of real per-capita aggregate consumption and real per-capita income during 1973 to 2015. Results of the study reveal that in short-run a unit increase in per-capita income will increase the per-capita consumption by Rs.0.74 which is the short-run MPC, while the long-run MPC out of income is 0.78. The coefficient of adaptive-expectation term is positive, but insignificant; indicating that previous consumption has no significant impact on current consumption or there is no significant role of past consumption on the present consumption decisions. The insignificance of adaptive-expectation term rejects the existence of permanent-income hypothesis under adaptive-expectation. Contrary to this, the significant positive effect of per-capita income supports the absolute-income hypothesis in Pakistan.


*Key words:* Aggregate Consumption, Permanent-Income Hypothesis, Adaptive-expectation, Pakistan.
*JEL Classification:* D12; E12, C22, C5.

## I. Introduction

The understanding of consumer behavior is crucial for macroeconomic stabilization and development. In general, vast majority of the research work is evolved in search of prime determinants of consumption or more specifically it is related to the consumption function, which exclusively defines the relationship between consumption and income. The objective of this research is to find relevance of permanent-income hypothesis for Pakistan; under the assumptions of adaptive-expectations model. In order to accomplish this, the study follows Friedman (1957), and Gujarati and Porter (2009) who applied the methodology of adaptive-expectation, devised by Cagan (1956). The study employs the real per-capita gross-national-product (GNP) and real per-capita aggregate consumption during 1973 to 2015.

* Lecturer/Staff Economist, Applied Economics Research Centre, University of Karachi,

** Director, Centre for Business and Economics Research, Institute of Business Administration, Karachi, Pakistan.
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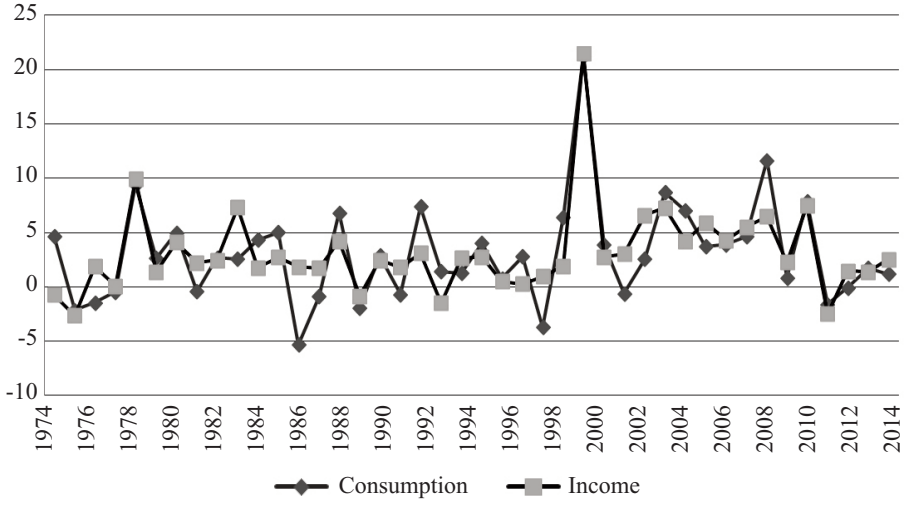
The growth trend of income and consumption shows (Figure-1) that both of them follow each other; however, these trends lie in a constant band. The co-movement of these two variables show close association and dependency of both variables.




*Source*: Authors' estimation.

**Figure 1**

Growth of Real Per-capita Consumption and Income

The present study is an addition to the pool of existing research stock related to permanent-income hypothesis in general and specific to Pakistan; as the study examine the permanent-income hypothesis under the adaptive-expectation model based on Cagan (1956) and Gujarati and Porter (2009) methodologies. However, in case of Pakistan Khalid (1994), and Khan and Nishat (2011) previously examined the permanent-income under the rationale-income by following Flavin (1981) and Campbell and Mankiw (1990) methodologies, respectively.

The rest of the study is organized as follows: Section II consist of the review of literature. Section III is based on analytical framework and Section IV constitute on the empirical specification and the issues. Section V provides the explanation of the data sources and estimation technique, while Section VI comprises of empirical results. Finally, conclusion and recommendations are given in Section VII.

## II. Review of Literature

The existing literature has variety of empirical research which deals with the permanent-income hypothesis under different assertions. Its relevance under the adaptive expectation model is relatively less examined, among the existing stock. Osei-Fosu,

et al. (2014) estimated the consumption patterns in Ghana under the permanent-income hypothesis (PIH). The study, based on adaptive expectation model where the annual time series data of real GDP, real household aggregate consumption, and real interest rate were used from 1970 to 2010, and concluded the existence of permanent-income hypothesis for Ghana. Similarly, in case of Nigeria and South-fria; Alimi (2015) estimated the consumption function under permanent-income and examined the relationship between consumption and income under adaptive-expectation theory where real interest rate, real household final consumption and real GDP of both countries were taken during 1980 to 2013. The study employed a modified unit-root test advanced by Elliot, et al. (1996), which is Dicky-Fuller GLS (DF-GLS) de-trending test, and shows that except the real-interest rate, aggregate consumption and GDP are first difference stationary for both countries. Further, results of cointegration found the long-run relationship in case of South-Africa only. The estimated OLS results showed that in both countries, consumer is forward-looking and permanent-income holds for both countries. Goud (2016) examined the relevance of permanent-income theory for India. The study was based on aggregate annual time series data of real GDP and the real aggregate final consumption from 1975 to 2007. The estimated least-square results showed low MPCs in short-run and long-run, as 0.22 and 0.6, respectively. However, the estimation technique was not robust and, even the study did not address the stationarity issue of the variables.

Sadeq (1996), empirically verified the Hall's (1978) hypothesis that the rate of change of consumption depend on the innovation in income for USA, Hong king, South Korea, Singapore, France, Japan, and the Germany. The study employed the annual real consumption and GDP during 1950 to 1992. In the first step, the predicted value of income was estimated by regressing the log of income to its first lag and in the second step, difference of log of income to its predicted values which were used as an explanatory variable to measure the impact of innovation or surprise change on consumption growth for all the four countries. The estimated OLS results showed that in all these countries cases the coefficient of surprise change was highly significant and positive with MPC, not less than 0.59.

Many other studies examined the permanent-income hypothesis by following the Campbell and Mankiw (1990), Zeldes (1989), and Runkle (1991) methodology where they also examined the two plausible reasons of the rejection of permanent-income hypothesis, i.e., due to liquidity constraint and myopia. As in the case of US and China, Gao, et al. (2013) performed a rigorous two fold examination of permanent income hypothesis under the assumption of random walk. The study employed the annual time series data of rural China from 1978 to 2009 of real per capita disposable income and consumption in logarithmic forms; while for US, quarterly data from 1952: Q1 to 2011: Q4 was used. Following the methodology of Campbell and Mankiw (1990) the study applied Generalized Method of Moments (GMM) at the first stage, and then Vector autoregressive (VAR) model was estimated for both countries. The estimated results of

GMM where different iteration were applied after changing the instruments, such as lag of income and consumption, which shows that each model reject the permanent income hypothesis for both countries. The VAR model estimates show that approximately 50 per cent change in consumption is due to shock in income for rural China; however, the income shock explained only 25 per cent change in consumption in case of US.

Gomes and Paz (2010) estimated the life-cycle permanent income hypothesis for four South American economies (Brazil, Peru, Venezuela and Colombia). The study followed the methodology of Shea (1995) and Sarantis and Stewart (2003). The data set comprises on the logarithm of real aggregate consumption, including durable and non-durable goods, and logarithm of real income in per capita terms. Real interest rate was used to estimate the hypothesis for each country. The estimation is based on 2SLS regression, using 6 models for each economy by changing the instrumental variables, where lag values of all three variables were used as instruments. The first estimated model checked the significance of income coefficient while the second model was used to check liquidity constraint and myopic behavior. To check the liquidity constraint and myopia issues the study applied two dummy variables; the first dummy contain one if growth rate of income is greater than zero while the other contain one when the growth rate is less than zero. Under the myopic behavior, both coefficients of dummies must be equal and significantly greater than zero; while for liquidity constraint positive growth years' dummy, the first dummy must be positive and statistically significant. The study rejected the life-cycle PIH for all countries. The results of second model showed that in Colombia and Brazil there was a liquidity constraint, while in Peru the hypothesis test showed the evidence of perverse asymmetry. However in Venezuela both hypothesis were rejected. Furthermore, for robustness, the study employed Hansen-Sargan specification test and Shea's Partial R-square for measuring predictive power of the instruments.

Khan and Nishat (2011) estimated the PIH based on Hall (1978) random walk in case of Pakistan. The study followed the Shea (1995) methodology for which growth of consumption was regressed on growth of income in the first model. The second model added the real interest rate as an additional explanatory variable. However, in both models the validity of PIH is tested through significance of income growth coefficient. Furthermore, to check liquidity constraint and myopia issues the study applied two dummy variables; the first dummy contain one if growth rate of income is greater than zero while the other contain one when growth rate is less than zero. Under the myopic behavior, both coefficients of dummies must be equal and significantly greater than zero, while for liquidity constraint positive growth years' dummy, the first dummy must be positive and statistically significant. Furthermore it should be greater than negative growth years' dummy which is the second dummy. The study employed aggregate data from 1971 to 2010 in real terms while the estimate was based on OLS and IV regression, where 6 different models were used by changing the lag variable, as an instrument. The estimated results of both models

rejected the PIH and so, to find the plausible reason of myopia or liquidity constraints the study estimated a third model, with the help of OLS and 2SLS methodology. Results of the third model rejected the myopia, however there was liquidity constraint problem.

Rao (2005) estimated the relevance of PIH in case of Fiji by adopting the methodology of Campbell and Mankiw (1989) which was based on the assumption that the set of population can be divided into two segments: one which consumes on the basis of their permanent income, and is forward looking, while the remaining segments' consumption depend on the current income. The estimation was based on OLS and IV regression models where growth rate of consumption was used as dependent variable, while the growth rate of predicted value of income, interest rate and a dummy variable are used as explanatory variables. The data series consist of annual observation from 1974 to 2002 for IV regression different lags values which were used as instruments. The overwhelming majority of the results rejects the PIH and endorse that current income is the main determinant of current consumption and that, interestingly the credit availability has positive significant impact on consumption.

## III. Analytical Framework and Modeling

### *1. A Simple Theoretical Model*

The publication of the seminal work of Friedman (1957) is the permanent-income hypothesis which received widespread acceptance among the researchers. According to this hypothesis income has two components: the permanent $Y^p$ and the transitory income $Y^T$.

$$Y_t = Y_t^p + Y_t^T \tag{1}$$

The same classification is true for consumption which is the combination of permanent consumption Cp and the transitory consumption CT.

$$C_t = C_t^p + C_t^T \tag{2}$$

It is further assumed that permanent consumption is determined by permanent income; and forms

$$C_t^p = \alpha + \beta Y_t^p \tag{3}$$

which is the generalized form of permanent-income hypothesis, where $\alpha$ and $\beta$ are the parameters.

## IV. Empirical Specifications and Data Issues

The generalized Equation (3) defines permanent-consumption, depends on permanent-income which is directly unobservable. In order to estimate this equation the study follows Friedman (1957), and Gujarati and Porter (2009) who applied the methodology of adaptive-expectation, sometime also called progressive expectation, devised by Cagan (1956).

The ideology of adaptive-expectation is based on the theme that individuals adjust their current expectations on basis of their past experience and follow the error leering which they learned from their past mistakes.[1] Following this theme an adaptive-expectation model can be defined as:

$$Y_t^p - Y_{t-1}^p = \theta(Y_t - Y_{t-1}^p) \tag{4}$$

where $\theta$ lies in between 0 to 1, which is also called the coefficient-of-expectation. Equation (4) also indicate that change in permanent-income is equal to the $\theta$ time (the difference between actual and permanent). These expectations are rectified each year by $\theta$ time (the difference between actual and expected).

Equation (4) can be simplified as:

$$Y_t^p = \theta(Y_t - Y_{t-1}^P) + Y_{t-1}^P \tag{5}$$

and

$$Y_t^p = \theta Y_t + (1 - \theta) Y_{t-1}^P \tag{6}$$

Equation (6) indicates that unobservable component, i.e., permanent income, is equal to the weighted average to actual income and the lag value of permanent income. This equation further indicates that if θ is one then the permanent and actual income will both be equal, while if θ is zero then permanent income will be equal to its lag value, which imply that expectations are constant and future values are identified through the current values.[2]

In order to find the relation of consumption and permanent-income substitute, the value of $C^p$, in Equation (2) which implies that,

$$C_t = \alpha + \beta Y_t^p + C_t^T \tag{7}$$

The econometrical formation of Equation (7) begets

$$C_t = \alpha + \beta Y_t^p + \mu_t \tag{8}$$

[1, 2] G. K. Shaw, Rational Expectations: An Elementary Exposition, St. Martin's Press, New York, 1984, pp. 25, 20, respectively.

and the one year lag model of Equation (8) is

$$C_{t-1} = \alpha + \beta Y^{P}_{t-1} + \mu_{t-1} \quad (9)$$

For estimating Equation (8) substitute the values of Yp from Equation (6), which implies that,

$$C_t = \alpha + \beta [\theta Y_t + (1-\theta) Y^{P}_{t-1}] + \mu_t \quad (10)$$

Multiply Equation (9) by (1-θ) and subtracting the resultant from Equation (10), the yield is

$$C_t - (1-\theta) C_{t-1} = \alpha - (1-\theta) \alpha + \beta\theta Y_t + \beta(1-\theta)Y^{p}_{t-1} - \beta(1-\theta)Y^{p}_{t-1} + \mu_t - (1-\theta) \mu_{t-1} \quad (11)$$

After cancelling the terms $\beta(1-\theta) Y^{P}_{t-1}$ the rearranging implies,

$$C_t = \theta\alpha + \beta\theta Y_t + (1-\theta) C_{t-1} + \mu_t - (1-\theta) \mu_{t-1} \quad (12)$$

$$C_t = \gamma_0 + \gamma_1 Y_t + \gamma_2 C_{t-1} + \varepsilon_t \quad (13)$$

The final Equation (13) is the short-run consumption function under the permanent-income hypothesis, based on the adaptive-expectations. The advantage of this model is obvious as now all variables are known.

where,

Y is the real per-capita national income (GNP),

C is the real per-capita aggregate private consumption,

$\gamma_0 = \theta\alpha$ which is the autonomous consumption in short-run, while the long-run counter part of this term can be generated as $(\gamma_0/\theta) = \alpha$,

$\gamma_1 = \beta\theta$ is the short-run marginal-propensity of consumption, long-run counter part of this term can be generated as $(\gamma_1/\beta) = \theta$,

$\gamma_2 = (1-\theta)$, this coefficient will generate the adjustment coefficient θ which is equal to $\theta = (1 - \gamma_2)$, and

$\varepsilon = \mu_t - (1-\theta) \mu_{t-1}$, which is the standard residual term.

## V. Data Sources and Estimation Techniques

The present study is based on time-series data from 1973 to 2015. All data series were taken from the State Bank of Pakistan's Annual Reports; 50 years of Pakistan Economy, and various issues of the Economic Survey of Pakistan. The study used the real per-capita income (per-capita GNP) and the per-capita aggregate consumption which were converted into real by using the GDP deflator for 2005-06; the common base of 2005-06 deflator series is generated through the standard splicing technique.

In order to estimate the stationarity of variables the Augmented Dickey-Fuller,[3] and PP[4] test are used to check the order of integration. The existence of long-run relationship can be confirmed through several methods including Engle and Granger (1987) single equation method and through maximum likelihood procedure [Johansen (1991), (1992)]. However, this study employed the Engle and Granger (1987) cointegration approach. The reason for using Engle-Granger approach is based on findings of Gonzalo and Lee (1998), and Gonzalo and Pitarakis (1999) who mentioned that Johansen approach has small sample bias for cointegration when it does not exist. Finally, due to presence of high multi-collinearity in the OLS results, the study employed the AR(1), ARMA Generalized Least-Square (GLS) estimation techniques to find dynamic relationship between consumption and permanent-income.

## VI. Empirical Results and Discussion

### *1. Univariate Analysis*

In order to investigate the order of integration of the study variables, two major test are applied [Phillips Perron (1988) and Augmented Dickey-Fuller (1979)]. The results of unit root test are presented in Table 1 which shows that per-capita consumption (PCONS) and income (PGNI), both are non-stationary with constant and constant plus trend, at level. However, both tests results show that these variables are stationary at first difference. Hence, they are integrated of order 1.

### *2. Cointegration Analysis*

The study variables real per-capita consumption and the real per-capita income, both are stationary at first difference, i.e., their order of integrated is I(1). Hence, in order to estimate the coefficient and MPC out of income through regression, it is necessary that series must be cointegrated; while in the absence of cointegration the regression estimated would be spurious. Therefore, the existence of cointegration is fundamental. The cointegration relationship is estimated through the Engle and Granger (1987) cointegration test, the results of which are mentioned in Appendix (Table A-1) which shows that these two variables are cointegrated.

[3] Dickey and Fuller(1979).

[4] Phillips and Perron (1988).

**TABLE 1**

Results of Unit Root Test

| | Augmented Dickey-Fuller Unit Root Test | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Level | | | | First Difference | | | |
| | Constant | | Constant, Linear Trend | | Constant | | Constant, Linear Trend | |
| | t-Statistic | Prob.* | t-Statistic | Prob.* | t-Statistic | Prob.* | t-Statistic | Prob.* |
| PCONS | 1.729983 | 0.9995 | -1.14242 | 0.9092 | -5.57* | 0 | -6.26* | 0 |
| PGNI | 2.317813 | 0.9999 | -1.07011 | 0.9222 | -5.49* | 0 | -6.41* | 0 |
| | Phillips-Perron Unit Root Test | | | | | | | |
| | Level | | | | First Difference | | | |
| | Constant | | Constant, Linear Trend | | Constant | | Constant, Linear Trend | |
| | t-Statistic | Prob.* | t-Statistic | Prob.* | t-Statistic | Prob.* | t-Statistic | Prob.* |
| PCONS | 1.837206 | 0.9997 | -1.10625 | 0.9159 | -5.57* | 0 | -6.27* | 0 |
| PGNI | 2.090563 | 0.9999 | -1.11476 | 0.9144 | -5.59* | 0 | -6.42* | 0 |

### *3. The Marginal Propensity of Consumption*

The estimated results of Equation (13) are mentioned in Table 2 which shows that marginal-propensity of consumption out of income is positive and significant. The estimated coefficient show that in short-run unit increase in per-capita income will increase per-capita consumption by 0.74 units, which is the short-run MPC. The coefficient of adaptive-expectation term is positive, but insignificant; indicating that the previous consumption has no significant impact on current consumption or there is no significant role of past consumption on the current consumption decisions. With the help of these short-run estimates, the long-run estimates can easily be retrieved at the first stage θ which is the adjustment coefficient and is equal to one minus coefficient of the lag of consumption (0.049), 0.95. The long-run MPC out of income is 0.785 which indicates that one unit increase in income will raise the consumption by Rs.0.785.

The lower panel of Table 2 shows the diagnostic test where R-square is 0.99 and F-statistics shows the overall significance of the model, which is also highly significant. In order to check the serial correlation, LM test is applied which indicate no-serial correlation as probability value of the test statistics (0.85). The functional form of test is checked through Ramsey's test which confirms that there is no specification biased. Jarque-Bera test is applied to ensure the normality condition and the probability value 0.9 indicates that the model follows normality assumption. Finally, Breusch-Pagan-Godfrey test is applied to check the heteroskedasticity and the estimated probability coefficient indicates that there is no heteroskedasticity in the model.

**TABLE 2**

GLS Based Estimated Coefficients

| Dependent Real Per-Capita Consumption (C) | | | |
|---|---|---|---|
| Regressors | Coefficient | Standard Error | T-Ratio[Prob] |
| Real Per-Capita Income (Y) | 0.747 | 0.062 | 11.87[0.00] |
| Lag of Real Per-Capita Consumption [C(-1)] | 0.049 | 0.082 | 0.59[0.55] |
| C | 479.67 | 483.14 | 0.99[0.32] |
| Diagnostic Test | | | |
| R-Squared | 0.9974 | R-Bar-Squared | 0.9971 |
| Prob(F-statistic) | | 0.0000 | |
| A : Serial Correlation Prob. F(4,34) | | 0.85 | |
| B : Functional Form Probability | | 0.2433 | |
| C : Normality Probability | | 0.973 | |
| D : Heteroscedasticity Prob. F(2,39) | | 0.128 | |

*Note*:
A : Breusch-Godfrey Serial Correlation LM Test.
B : Ramsey's RESET test using the Square of the Fitted Values.
C : Based on normality Jarque-Bera Probability.
D : Based on Breusch-Pagan-Godfrey Heteroskedasticity Test.

### *4. Sensitivity Analysis*

In order to check the robustness of estimated results; a sensitivity analysis was performed by re-estimating the model after reducing the sample size. The sensitivity results are mentioned in the Appendix (TableA-2) where three different models, in terms of number of observations, are estimated. The results of all models endorse the main model's finding as coefficient of the adaptive-expectation term is insignificant in all the models.

## VII. Conclusion

The knowledge of consumption function is very important for policy making and gauging the expected multiplier effect of a change in any policy variable. The objective of this research is to find relevance of permanent-income hypothesis for Pakistan; under the assumptions of adaptive-expectations model. In order to accomplish this, the study follows Friedman (1957), and Gujarati and Porter (2009) who applied the methodology of adaptive-expectation, devised by Cagan (1956). The study employed the real per-capita gross national product (GNP) and the real per-capita aggregate consumption during 1973 to 2015.

Results of the study reveal that in short-run a unit increase in per-capita income will increase per-capita consumption by Rs.0.74, which is the short-run MPC; while the long-run MPC (out of income) is 0.78. The coefficient of adaptive-expectation term is positive but insignificant indicating that previous consumption has no significant impact on current consumption or there is no significant role of past consumption on the current consumption decisions. The insignificance of adaptive-expectation term rejects the existence of permanent-income hypothesis in case of Pakistan. Contrary to this the significant positive effect of per-capita income supports the absolute-income hypothesis.

The rejection of permanent income hypothesis through adaptive-expectation model invites further research work by using other consumption hypothesis and functions, which represent the consumption pattern of our economy. One more limitation of the present work is that in case of Pakistan we do not have series of disposable income; and the results may vary due to the procedure adopted to compute disposable income series.

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## APPENDIX

**TABLE A-1**

Engle Granger Cointegration Results

Series: PCONS PGNI.
Sample: 1973 2015.
Included observations: 43.
Null hypothesis: Series are not cointegrated.
Cointegrating equation deterministics: C.
Automatic lags specification based on Schwarz criterion (max. lag = 9).

| Dependent | tau-statistic | Prob.* | z-statistic | Prob.* |
|---|---|---|---|---|
| PCONS | -3.399644 | 0.06 | -18.48534 | 0.0431 |
| PGNI | -3.389054 | 0.0614 | -18.41864 | 0.0439 |

*MacKinnon (1996) p-values.

*Intermediate Results:*

| | PCONS | PGNI |
|---|---|---|
| Rho – 1 | -0.440127 | -0.438539 |
| Rho S.E. | 0.129463 | 0.129399 |
| Residual variance | 329900.9 | 530621.6 |
| Long-run residual variance | 329900.9 | 530621.6 |
| Number of lags | 0 | 0 |
| Number of observations | 42 | 42 |
| Number of stochastic trends** | 2 | 2 |

**Number of stochastic trends in asymptotic distribution.

**TABLE A-2**

Results of Sensitivity Analysis

| Dependent Real Per-Capita Consumption | | | |
|---|---|---|---|
| Sample Period | Real Per-Capita Income (Y) | Lag of Real Per-Capita Consumption [C(-1)] | C |
| 1974-1990 | 0.59 (0.003)* | -0.0226 (0.98) | 4651.618 (0.014)** |
| 1980-2000 | 0.85 (0.000)* | -0.139058 (0.47) | 1442.588 (0.56) |
| 1985-2010 | 0.77 (0.000)* | 0.025443 (0.85) | -206.3296 (0.78) |

*, ** significant at 1% and 5%, respectively,
P-values are mentioned in parenthesis,