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Cointegration and Error-Correction Modelling of Wheat Consumption in Pakistan

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This paper provides an empirical analysis of wheat consumption in Pakistan for the period 1975 to 2006 using cointegration analysis and error correction model. The estimated long and short-run elasticities suggest that income is the most significant determinant of wheat consumption in the long run while price of wheat is the major affecting factor of wheat consumption only in the short run. The less elastic nature of wheat demand both in the short and the long run suggests that under the likely Doha Round agricultural trade liberalization, wheat price rise will harm the poor consumers

1. Introduction

Pakistan is a low-income, food-deficit country (LIFDC) with a gross national product per capita of US $950. Agriculture is a major economic activity in Pakistan. Although its share in the economy is declining and has come down to 20.9 percent of GDP, it is still the backbone of the economy. It is a dominant sector in terms of employment (43.4 percent), directly sustains 66 percent of population and claims a high share in the total trade (Pakistan, 2006).

Crops are the most important sub-sector of Agriculture sector of Pakistan. Among the major food crops wheat is the main staple diet of the country's population. It contributes 74 percent of the overall production of food grains. Wheat area constitutes 36 percent of the total cropped area and its production accounts for 30 percent of the value added by major crops (APCOM, 2004, Pakistan, 2006). Pakistan is one

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of the major producers of wheat in the world. Yet the domestic wheat production remains insufficient for the needs of population, which is at present growing at about 1.9 percent per annum. Hence to ensure food security, the country has to supplement the local production with imports. It is estimated that imports cover from 10-20 percent of national consumption needs.

Because of the strategic importance of wheat as a major staple food commodity, government used to intervene not only to guarantee affordable supplies to consumers but also to provide market support to producers. The present wheat policy is based on a system of official wheat procurement and releases of wheat at officially regulated procurement and release prices. It involves a significant cost to the public exchequer on account of marketing and storage of wheat by the public sector. In addition, the government of Pakistan has tried to keep the price of wheat below the international level in order to subsidize domestic consumers.

Due to high population growth in Pakistan, the food situation has always been fragile. Per capita net availability has declined in recent years, because of sub-par harvests that were not completely offset by increased government imports and draw down of stocks. From 1990-91 to 2001-02, per capita wheat consumption averaged 131 kgs/year. For the five years period, 2002-03—2006-07, however, per capita wheat availability (consumption) fell by nearly 11 percent to 117 kgs/year. As a result of the reduced availability, real prices of wheat and wheat flour rose by 26 and 31 percent, respectively, from 2001-02 to 2006-07.

The objective of this paper is to investigate long and short run relationships that exist in the demand for wheat in Pakistan, and provide insights regarding the functioning of the market and the potential impacts from the relevant policy reform(s). The rest of the paper is organized as follows. Section 2 provides literature review. Analytical framework is presented in section 3. Data description and empirical findings are given in section 4. The final section concludes the study.

2. Literature Review

Development policy for a country's agri-food sector requires a comprehensive approach, which requires information on both demand

and supply. Agricultural policies in developing countries, in general, tend to focus on the supply side and not the demand side. The challenge is to balance the food and nutrition needs along with the development requirements of the agricultural sector. On the demand side food policy decisions, therefore, require knowledge about price and income elasticities. This information is needed to measure the impacts of various price and related policies on food consumption. Reliable demand parameters facilitate policy analysis for meeting the basic food needs of the population. A major reason for the uncertainty about food requirements is due to the imperfect knowledge of these parameters.

Various studies have been conducted to examine the issues of food consumption in different countries. In accordance with the developments in econometric theory and methods, the cointegrating demand systems are estimated in various ways. Some examples are Balcombe and Davis (1996), Attfield (1997), Song et al. (1997), Karagiannis et al. (2000), Tzouvelekas et al (2001), Dufly (2002, 2003), and Karagiannis and Mergoos (2002).

Wheat, being the staple food of Pakistanis, carries immense importance. It shares about 80 percent in consumption of food grains and about 50 percent of the calories and proteins intake in Pakistan. Consequently, overall dietary well being of our people is largely dependent on the performance of wheat economy. Given the importance of this issue, there has been surprisingly little research on the demand for wheat in Pakistan. We have not come across any study that has been conducted with the sole objective of estimating wheat consumption in the country. However, we do find a few studies that have partially touched this issue in the frame work of trade liberalization and subsidy elimination.For example, Ghani (1998) evaluates the impact on wheat production, consumption and trade of changing the input subsidy and output price subsidy policies. The results of the study indicate that there will be a greater decline in wheat production if the government eliminates the input subsidies at once than if there is a gradual phasing out of these. There will be a slight decline in the consumption of wheat due to an increase in the consumer price of wheat. However, the low-income household with the higher number of family members will be affected more with the increase in the price of staple wheat. Imports of wheat are greater if the subsidies are eliminated at once, as compared to phase them out gradually. . Akhtar (1999) estimates the impact of trade liberalization on wheat, rice (both Basmati and non-Basmati rice) and maize by using simple welfare analysis for these commodities. The estimated wheat demand function is of the inelastic nature and there will be net welfare loss under the trade liberalization scenario.

Therefore, there is a lot of scope for estimating wheat consumption in Pakistan and the present study is advancement to this end. With the application of cointegration analysis and error correction technique, we will be in a position to compare the long run and the short run demand elasticities.

3. Method of Analysis

3.1 Theoretical model

The representative consumer maximizes utility, given a fixed income. The demand schedule is derived by maximizing utility. This study assumes that the per capita demand for wheat is a linear function of its own price, prices of substitutes and complementary goods and per capita income i.e.

$$PQ_d = f\,(P_m, P_s, I). \tag{1}$$

Where PQ_d is per capita quantity demanded of wheat, P_m is domestic market (wholesale) price of wheat, P_s is price of other (substitute) commodity and I is Per capita income.

3.2 Empirical model

3.2.1 Unit Root Test

Since macroeconomic time-series data are usually non-stationary (Nelson and Plosser, 1982) and thus conducive to spurious regression, we test for stationarity of a time series at the outset of cointegration analysis. For this purpose, we conduct an augmented Dickey-Fuller (ADF) test by carrying out a unit root test based on the structure in (2):

$$\Delta X_t = \kappa + \phi_t + \Theta_i X_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-i} + \varepsilon_t. \tag{2}$$

Where X is the variable under consideration, Δ is the first difference operator, t captures any time trend, ε_t is a random error, and n is the maximum lag length. The optimal lag length is identified so as to ensure that the error term is white noise. While κ, ϕ, Θ $and \varphi$ are the parameters to be estimated. If we cannot reject the null hypothesis $\Theta = 0$, then we conclude that the series under consideration has a unit root and is therefore non-stationary.

3.2.2 Cointegration Test

The concept of cointegration was first introduced by Granger (1981) and elaborated further by Engle and Granger (1987), Phillips and Ouliaris (1990), Stock and Watson (1998), Johansen (1988,1992) and Johansen and Juselius (1990), among others. The econometric framework used for analyzing the paper is the Johansen-Juselius (Maximum-Likelihood) cointegration technique, which tests both the existence and the number of cointegration vectors. The multivariate cointegration test by Johansen (1988) can be expressed as:

$$Z_t = K_o + K_1 \Delta Z_{t-1} + K_2 \Delta Z_{t-2} + ... + K_{p-1} \Delta Z_{t-p} + \Pi Z_{t-p} + \nu_t . \qquad (3)$$

Where,

$$Z_t = (PCCW, WPW, WPB, WPNB, WPM, PCI)$$

$Z_t =$ a 6 x 1 vector of variables that are integrated of order one [i.e. I (1)]

$K =$ a 6 x 6 matrix of coefficients

$\Pi =$ 6 x 6 matrix of parameters and

$\nu_t =$ a vector of normally and independently distributed error term.

The presence of r cointegrating vectors between the elements of Z, implies that Π is of the rank $r(0 < r < 5)$ and hence Π can be decomposed, according to Odhiambo (2005), as:

$$\Pi = \alpha \beta'$$

where

$\alpha =$ the matrix of cointegrating vectors

$\beta =$ the adjustment matrix,

α and $\beta = 5r$ matrices.

The above equation can now be written as:

$$Z_t = K_o + K_1\Delta Z_{t-1} + K_2\Delta Z_{t-2} + ...+ K_{p-1}\Delta Z_{t-p} + \alpha(\beta' Z_{t-p}) + v_t \quad .(4)$$

The rows of β are interpreted as distinct cointegrating vectors such that $\beta' Z_t$ form linear stationary process and $\alpha's$ are the vector correction coefficients (Odhiambo, 2005). The problem with the $\beta's$ presented in equation (4) is that they are unrestricted and hence, this system cannot identify typical long-run economic relationships. Each vector therefore requires at least r restrictions. One of which is the normalization restriction. These normalization restrictions must be motivated by economic theory so that the identified cointegrating vectors can be interpreted as long-run economic relationships.

Trace and Maximum Eigenvalue Tests

The Johansen and Juselius method uses two tests to determine the number of cointegrating vectors, namely the "Likelihood Ratio Trace Test-LRT" and the "Maximum Eigenvalue Test-ME".

The likelihood trace statistics can be expressed as:

$$LRT = -\sum_{i-i+1}^{n} \ln(1-\mu_i) \quad . \qquad (5)$$

The null hypothesis in this case is that the number of cointegrating vectors is less than or equal to r, where r is 0,1 or 2, …, etc. In each case, the null hypothesis is tested against the general hypothesis. That is full rank $r = n$.

The maximum eigenvalue test, on the other hand, is expressed as:

$$ME = -T \ln(1-\mu_r). \qquad (6)$$

In this case, the null hypothesis of the existence of r cointegrating vector is tested against the alternative of $r+1$cointegrating vectors. If there is any divergence of results between the trace test and the maximum eigenvalue test, it is advisable to rely on the evidence based on the maximum eigenvalue test, because the latter is more reliable in small samples (see Odhiambo, 2005; Dutta and Ahmed, 1997; Banerjee et al. 1993). The results of cointegrating test using Johansen and Juselius maximum likelihood procedure is presented in Section 4.

3.2.3 Error Correction Model (ECM)

In order to capture the short run deviations that might have occurred in estimating the long-run cointegration equation, a dynamic error-correction model is formulated. The paper specified unrestricted over parameterized equation with an inclusion of one-lag error correction term. The cointegrating equation (1) is respecified as an ECM using Engle-Granger two-step method (lagged residual as error correction term). The economic model (1) is transformed into an econometric model under ECM framework in the following equation:

$$\Delta(PCCW)_t = \omega_0 + \omega_{1i}\sum_{i=0}^{1}\Delta PCCW_{t-1} + \omega_{2i}\sum_{i=0}^{1}\Delta WPW_{t-1} + \omega_{3i}\sum_{i=0}^{1}\Delta WPBR_{t-1} + \omega_{4i}\sum_{i=0}^{1}\Delta WPNBR_{t-1}$$

$$+ \omega_{5i}\sum_{i=0}^{1}\Delta WPM_{t-1} + \omega_{6i}\sum_{i=0}^{1}\Delta PCI_{t-1} + \lambda EC_{t-1} + \xi_t. \qquad (7)$$

Where EC_{t-1} is the error correction term lagged one period and Δ stands for first difference. All the variables (second order first differenced) in the equation are stationary and therefore OLS method gives consistent and valid estimates (Enders, 1995). The model is estimated by OLS method and the residual is tested for autocorrelation error. The model makes use of quarterly time series data and has lagged dependent variable as explanatory variable. Stability and residual tests are conducted to evaluate the predictive accuracy of the model.

4. Data, Estimation and Interpretation of Results

The study uses annually observations for the period 1975 to 2006. The main focus of this paper is on per capita consumption (demand) of wheat (PCCW), wholesale (market) prices of wheat (WPW), basmati rice (WPBR), non-basmati rice (WNBR), maize (WPM) and per capita income (PCI). Ideally data should be from a single source to maintain consistency. However, there is no single source that can provide all the relevant data. Therefore, different secondary sources have been used to take the required data. The data, expressed in nominal terms, have been obtained from Agricultural Statistics of Pakistan (various issues) , Economic Survey of Pakistan (various issues) and Federal Bureau of Statistics, Islamabad, Pakistan. All the variables are in logarithms.

The first step in cointegration analysis is to test the unit roots in each variable.[1] To this end we apply Augmented Dickey-Fuller (ADF) stationary tests on logarithmic form of PCCW, WPW, WPBR, WPNBR, WPM and PCI. Table 1 reports the results of the ADF tests for the level as well as for the first-difference of the relevant variables. The results show that unit root tests applied to the variables at levels fail to reject the null hypothesis of non-stationarity of all the variables used. It implies that all the variables are non-stationary at levels. The null hypothesis is accepted when the series are first-differenced i.e. all variables are first-differenced stationary. This implies that all the series are integrated of order one [i.e. $I(1)$].

Table 1. Augmented Dickey Fuller (ADF) Unit Root Tests

Variables	Level	First Difference	Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root			Decision	Order of Integration
			1 %	5 %	10 %		
LPCCW	-0.65	-4.76	-2.58	-1.94	-1.62	Nonstationary at level but stationary at first difference	I (1)
LWPW	6.05	-3.95	-2.58	-1.94	-1.62	Nonstationary at level but stationary at first difference	I (1)
LWPBR	2.51	-6.47	-2.58	-1.94	-1.62	Nonstationary at level but stationary at first difference	I (1)
LWPNBR	3.42	-4.77	-2.58	-1.94	-1.62	Nonstationary at level but stationary at first difference	I (1)
LWPM	4.01	-3.97	-2.58	-1.94	-1.62	Nonstationary at level but stationary at first difference	I (1)
LPCI	8.42	-5.56	-2.58	-1.94	-1.62	Nonstationary at level but stationary at first difference	I (1)

[1] Since the cointegration methodology involves finding a stationary linear combination of a set of variables, which are themselves non-stationary, therefore, a precondition for cointegration to be held is that all variables should be non-stationary.

In the next step, we have determined the optimal lag length because Johansen method is known to be sensitive to the lag length. Cheung and Lai (1993) find that the Johansen's cointegration tests are rather sensitive to under-parameterization in the lag length, though not so to over-parameterization. Their results point to the importance of proper lag specifications in estimating cointegrated systems. As for as our study is concerned, the Schwarz Bayesian Criteria (SBC) has suggested a lag length of 1 as optimal that is not surprising for annual data. The cointegration test is carried out assuming an intercept in the cointegrating equation.

Cointegration relationship among LPCCW, LWPW, LWPBR, LWPNBR, LWPM and LPCI has been investigated using the Johansen technique. Its ability to apprehend the properties of the time series, to produce estimates of all plausible cointegrating vectors, and to provide test statistics for the number of cointegrating vectors are among other reasons for choosing this technique. Johansen (1988,1992) and Johansen and Juselius (1990) suggest two likelihood ratio tests for examining the cointegration relationships when there are more than two variables. One is the trace test, which tests the null hypothesis that there are at most r cointegrating vectors, where $0 \leq r < n$, and where n is the number of variables. The second is the maximum eigenvalue test, which tests the null hypothesis that there are r cointegrating vectors against the alternative of $r+1$cointegrating vectors. In both the cases, if the statistic is greater than critical value, the null hypothesis is rejected. Thus the first row tests $H_0 : r = 0$ against $H_1 : r = 1$, if this H_0 is rejected only, then the next row is considered and so on. Table 2 reports our cointegration test results based on Johansen's maximum likelihood method. Both trace statistics (λ_{trace}) and maximum eigenvalue (λ_{max}) statistics indicate that there is at least one cointegrating vector among LPCCW, LWPW, LWPBR, LWPNBR, LWPM and LPCI. So, we can reject the null hypothesis of no cointegrating vector in favour of one cointegrating vector in both test statistics at 5 percent level of significance. We cannot reject the null hypothesis of at most one cointegrating vector against the alternative hypothesis of two cointegrating vectors, for both the Trace and max-eigenvalue test statistics. Therefore, there is a long-run equilibrium relationship among per capita consumption of wheat, wholesale prices of wheat, basmati rice, non-basmati rice, maize and per capita income.

The cointegrating equation, which is given at the bottom of the Table 2, has been normalized for LPCCW just to get meanings from the coefficients. Parameter estimates are all statistically significant except for LWPBR. LPCI is the most important factor influencing LPCCW in the long run followed by LWPW.If we are willing to accept all the parameter estimates as long run elasticities, then these results shows that own price elasticity, cross price elasticities and income elasticity of wheat demand are small. The low value of own price elasticity demonstrates the inelastic nature of wheat demand while smaller values of cross elasticities show that both types of rice and maize are remote substitutes of wheat. Similarly, low value of income elasticity represents that wheat is a necessity good in Pakistan.

Parameter estimates of the dynamic short-run demand for wheat have been reported in the table 3. λ is the error correction term derived from the long-run cointegrating relationship lagged one period. The coefficient of the error-correction term carries the correct sign and it is statistically significant at 5 percent, with the speed of convergence to equilibrium of 10 percent Short-run price elasticities (-0.16,0.12,0.04 and 0.11 for LWPW, LWPBR, LWPNBR and LWPM respectively) are considerably smaller in magnitude than the relevant long-run estimates. Same is the case with income elasticity of demand. However, consistent with *a priori* expectations, income elasticity is significantly smaller than unity (0.13), indicating again that wheat is a necessity good for Pakistani consumers.

Table 2. Cointegration Tests

Null Hypothesis	Alternative Hypothesis			Critical Values	
				95 %	P-values[oo]
λ_{trace} rank tests		Eigenvalues	λ_{trace} rank value		
$H_0 : r = 0$	$H_1 : r = 1$	0.3806	95.5286[o]	88.8038	0.0312
$H_0 : r = 1$	$H_1 : r = 2$	0.2174	49.5759	69.81889	0.1319
$H_0 : r = 2$	$H_1 : r = 3$	0.1084	27.1559	47.85613	0.3268
$H_0 : r = 3$	$H_1 : r = 4$	0.0857	20.3658	29.79707	0.3502
$H_0 : r = 4$	$H_1 : r = 5$	0.0653	12.8975	15.49471	0.391
$H_0 : r = 5$	$H_1 : r = 6$	0.0268	2.1457	3.841466	0.5446
$\lambda_{\max}$ rank tests			$\lambda_{\max}$ rank value		
$H_0 : r = 0$	$H_1 : r > 0$	0.3806	48.1211[o]	40.9568	0.0046
$H_0 : r \leq 1$	$H_1 : r > 1$	0.2174	20.4200	24.8058	0.1839
$H_0 : r \leq 2$	$H_1 : r > 2$	0.1084	10.1559	17.8671	0.2668
$H_0 : r \leq 3$	$H_1 : r > 3$	0.0857	6.3251	15.8921	0.3457
$H_0 : r \leq 4$	$H_1 : r > 4$	0.0653	4.0122	6.6691	0.4985
$H_0 : r \leq 5$	$H_1 : r > 5$	0.0268	2.1457	3.8414	0.5446

Normalized Cointegrating Coefficients:

LPCCW= -3.77 –0.25*LWPW –0.08*LWPBR + 0.16*LWPNBR +0.13*LWM + 0.53*LPCI
(-6.29)* (-7.25)* (-0.05) (3.48)* (2.28)* (4.67)*

Trace test indicates 1 cointegrating equation(s) at 5 percent significance level.
Max-eigenvalue test indicates 1 cointegrating equation(s) at 5 percent significance level.

[o] denotes rejection of the null hypothesis at 5 percent significance level.
[oo] MacKinnon-Haug-Michelis (1999) p-values.
* t-values given in parenthesis indicate significance at 5 percent probability level .

Pakistan joined World Trade Organization (WTO) in 1994. Being a signatory of WTO; Pakistan has accepted both the opportunity and the challenge of trade liberalization. The likely impact of agricultural trade liberalization under Doha Round of WTO on wheat has been predicted more than for most other grains due in part to the greater degree of subsidization of wheat in the past. Any successful conclusion of issues relating to agricultural trade liberalization under Doha Round means reduction of the government subsidies to wheat farmers in the major wheat net exporter countries like the United States and Canada. These two countries are major sources of wheat imports in Pakistan. Since they are major supplier of wheat in the world too, they are the price leaders. The elimination of subsidies on wheat by these countries would result in higher prices of Pakistan's wheat imports. As the demand elasticity is found less elastic both in the short and the long run, which shows that along with increase in its price, there will be very small decrease in the demand of wheat. Moreover, it is evident that with the increase in wheat price, there will be increase in the import bill of wheat on one hand and on the other hand further burden on the poor people who purchase food grains from the market.

Table 3. VEC Model

Dependent Variable: Δ(LPCCW)

Regressor	Coefficient	t-Statistic
Constant	-0.66	(-3.21)*
Δ(LPCCW (-1))	0.19	(1.20)
Δ(LWPW (-1))	-0.16	(-3.12)*
Δ(LWPBR (-1))	0.12	(3.64)*
Δ(LWPNBR (-1))	0.04	(0.17)
Δ(LWPM (-1))	0.11	(3.45)*
Δ(LPCI (-1))	0.13	(3.04)*
λ	0.10	(3.07)*
R-squared	0.65	
Adj.R-squared	0.61	
F-statistic	13.39 (0.00)	

Note: * indicates significance at 5 percent level

5. Conclusion

Agriculture is a key sector in Pakistan because of its major share (around one-fourth in GDP) in the economy in terms of its contribution to national income and employment. Crops are the most important sub-sector of Agriculture sector of Pakistan. Among the major food crops, wheat is the main staple food of the country's population and it occupies more land under agriculture than all other crops. Because of the importance of wheat, successive governments of Pakistan since Independence have intervened heavily in wheat markets, procuring wheat at administratively set prices to support farmer incomes and subsidizing wheat sales to flour mills or directly to consumers with the objective of stabilizing prices at levels affordable to consumers.

This paper examines the demand characteristics of the Pakistani market for the period 1975 to 2006. The existence of a long-run equilibrium relationship among per capita consumption, the prices of wheat, basmati rice, non-basmati rice, maize and per capita income has been verified using cointegration methodology. Short and long-run dynamics of the demand for wheat have been determined through the estimation of an error correction model. Income is the most important determinant of wheat consumption in the long run while own price is determined to be the most significant influencing factor of the demand for wheat in the short run. Low values for cross elasticities estimates indicate that both types of rice and maize are remote substitutes of wheat in Pakistan. The income elasticity of demand is significantly lower than unity, underlining the importance of wheat in the Pakistani diet both in the short and the long run.

Because of agricultural trade liberalization under Doha Round of WTO, it is expected that domestic price of wheat will rise in future and as a result will harm the poor consumers. In order to protect the consumers from high or sudden rise in price and to ensure food security, following essential conditions are recommended:

(a) Food security objectives should not be compromised in any case and major reliance will have to be placed on government stocks for price stability and availability of staple food to entire population.
(b) Along with public sector, efforts should be made to encourage the investment by the private sector in marketing and procurement of wheat. But the issue of food security cannot be left entirely at the mercy of private sector and the government should always be there to play a supervisory and dominant role.
(c) Targeted consumer subsidies should be provided to the low-income groups and people below the poverty line who are expected to be adversely affected by increase in food prices.

References

Akhtar, M. R. (1999), "Effects of Trade Liberalization on Agriculture in Pakistan: Commodity Aspects ". *Working Paper No. 44*, United Nations ESCAP CGPRT Center, Bogor, Indonesia.

APCOM. (2004), *Support Price Policy for Wheat, 2004-05 Crop,* Agricultural Price Commission Series No.212, Islamabad.

Attfleld,C.L.F. (1997), "Estimating a cointegrating Demand System", *European Economic Review*,41:61-73.

Balcombe,K.G., and J.Davis (1996), "An Application of Cointegration Theory in the Estimation of the Almost Ideal Demand System for Food Consumption in Bulgaria", *Agricultural Economics*,15:47-60.

Banerjee, A., Jdolado, J.W.Galbraith and D.Hendry (1993), *Cointegration, Error Correction and the Econometric Analysis of Non-Stationary Data*, Oxford University Press

Cheung, Y.W., & Lai, K. S. (1993), " Finite-Sample Sizes of Johansen's Likelihood Ratio Tests for Cointegration", *Oxford Bulletin of Economics and Statistics*, 55(3), 313–25.

Dufly. (2002), "On the Estimation of an Advertising-Augmented Cointegrating Demand System", *Economic Modelling*,20:181-206.

Dufly. (2003), "Advertising and Food, Drink and Tobacco Consumption in the United Kingdom: A Dynamic Demand System", *Agricultural Economics*, 28:51-70.

Dutta, D. and N.Ahmed (1997), *An Aggregate Import Demand Function for Bangladesh: A Cointegration Approach*, Working Paper in Economics, University of Sydney

Enders, W. (1995), *Applied Econometric Time Series*, New York: John Wiley.

Engle, R. F. and C. W. J. Granger (1987), "Cointegration and Error Correction Representation, Estimation and Testing", *Econometrica,* 55: 251-76.

Granger, C. W. J. (1981), "Some Properties of Time Series Data and Their Use in Econometric Model Specification", *Journal of Econometrics,* 16: 121-30

Ghani, Ejaz (1998), "The Wheat Pricing Policies in Pakistan: Some Alternative Options", *The Pakistan Development Review,* 37 (2): 149-166.

Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors", *Journal of Economics Dynamics and Control,* 12: 231-54.

Johansen, S. (1992), "Determination of Cointegration Rank in the Presence of a Linear Trend", *Oxford Bulletin of Economics and Statistics,* 54:383-97.

Johansen, S. and K.Juselius (1990), "The Maximum Likelihood Estimation and Inference on Cointegration-with Application to Demand for Money", *Oxford Bulletin of Economics and Statistics*, 52:169-210

Nelson, C. and C. Plosser (1982), "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," *Journal of Monetary Economics,* 10: 130-62

Karagiannis, G., S. Katranidis and K. Velentzas (2000), "An Error Correction Almost Ideal Demand System for Meat in Greece", *Agricultural Economics,*22(1):29-35.

Karagiannis, G., and G.J. Mergoos (2002), "Estimating Theoretically Consistent Demand Systems using Cointegration Techniques with Application to Greek Food Data", *Economics Letters,* 74:137-43.

Odhiambo, N.M. (2005), "Financial Liberalization and Financial Deepening: Evidence from Three Sub-Saharan African Countries", *African Review of Money, Finance and Banking* (Savings and Development Supplement, 2005), 5-23

Pakistan, Government of (2006-07),"Economic Survey" Finance Division, Islamabad.

Phillips, P. C. B. and S. Ouliaris (1990), "Asymptotic Properties of Residual Based Tests for Cointegration", *Econometrica,* 58: 165-93

Song, H.,Xiaming L. and Peter R. (1997), "A Comparative Study of Modelling the Demand for Food in the United States and the Netherlands", *Journal of Applied Econometrics*,12(5): 593-608.

Stock, J. and M.Watson (1988), "Testing for Common Trends", *Journal of the American Statistical Association,* 83:1097-1107

Tzouvelekas, V. et al. (2001), "Cointegration and Error-Correction Modelling of Olive Oil Consumption in Greece", *Applied Economics Letters,* 8:539-43.