Internal Determinants of Consumer Price Index in Pakistan: A Cointegration and Stability Analysis

Masood Javed

Parvez Azim

Sami Ullah[*]

Abstract

This study investigates the relation between consumer price index and its determinants i.e. producer price index adaptive expectations, public capital stock (gross fixed capital formation) domestic credit to private sector and interest rate. Different time series econometric techniques are applied for short run and long run dynamics. In doing so, Johansson approach is used to find out co-integration among variables and ECM (error correction method) to unearth short run dynamics. The estimated results reveal that adaptive expectations play their main role to increase the consumer price index in long and short run periods. The high producer price index is linked positively and significantly with consumer price index and is the second dominant force, which increases CPI in the country. Finally, the coefficient of interest rate shows that interest rate raises CPI in both the periods.

Keywords: CPI, Co-integration, Stability,
JEL Classification: E31, E52,

1. INTRODUCTION

Inflation is one of the most important macroeconomic indicator and is the concern of policy makers. The country is exposed to tangible economic pressures and social challenges. Macroeconomic balances have been on the regressive side over the past few years. Such as, inflation has risen to the record levels. The sharp rise in oil prices in international market during the past few years has not been fully passed on to the final consumers and some basic food items especially wheat is being subsidized, even then prices kept on rising. The roots of inflation since 2004 may have been monetary in character but now it has acquired a structural nature. Pakistan is the country which is still caught in double digit inflation and this increase in prices witnessed during the start of 2008 pushed the CPI on 25 percent in august 08 and still remain-

ing above 20 percent until February 09. So this sudden and steep rise in domestic price level badly effects on consumers, especially on low and fixed income groups, this condition is also severe for macroeconomic stability of Pakistan.

Several internal determinants are responsible for the rapid increase in the local prices. Internal factors include adaptive expectations, producer price index, domestic credit to private sectors, public capital stock and interest rate. The coefficients of independent factors were used to assess the relevant significance of these main determinants of inflation shown in the model. The coefficient of lagged inflation is the highest among all other determinants. Inflationary expectations have generated extraordinary pressure on price level, especially with regard to consumption. Therefore stronger policy action is now required to counter these expectations. The higher inflation is mainly geared by adaptive expectations, food and energy prices, even though full domestic adjustments to higher international prices have not yet been made. When people initiated to expect the sustainability of higher prices of basic necessities in future, the role of adaptive expectations became distinct.

Expansionary monetary policy led to a precipitous fall in the interest rate which caused a high growth of consumer financing. It has been seen that expansionary monetary policy and consumer financing put the economy on a high inflation road. During July-May 2008-09, currency in circulation increased to Rs.199.9 billion as compared to Rs.186.1 billion during the same period last year. The currency in circulation consists of 24.1 percent of the money supply (M2) against 23.2 percent during the corresponding period last year.

Inflation is required to be curtailed for durable development and macroeconomic solidarity in the under-developed country like Pakistan. Macroeconomic stability is not an objective in itself. It should create and support the conditions for sustained high growth and help to check the rapid increase in prices. Relevant economic literature demonstrates that there exists bond between price level and production. Very high and very low levels of inflation both are destructive for the economy. Both extremes in prices incur economic troubles and retard productive capacity of the economy. Soaring prices adversely affect both the poor and the wage earning (fixed income) class and exert burden on the

---
[*] The authors are, respectively, Assistant Professor of Economics, Government College Sheikhupura, Dean Faculty of Arts and Social Sciences, GC University Faisalabad and Lecturer in Economics, University of Gujrat, Gujrat.

poor more than that of rich. The former both groups of population are unable to save themselves from the cost related to inflationary pressures.

This paper investigates some internal factors those put a strong pressure on CPI in Pakistan in the last few years. In spite of tight monetary policy in the presence of all other government activities, consumer price index reached at alarming level. All the price indices (CPI, WPI, SPI and GDP Deflator) showed upward trend. Price distortions along with poor structure of supply are responsible for price hike in Pakistan. The high rate of inflation raises the cost of living and leads to economic sufferings, social tensions and political upheaval. The continuous and rapid increase in prices in Pakistan is the outcome of number of causes. In this perspective it is very complicated, tedious and multidimensional task to keep inflation at lower single digit. With multi-causal inflation, no single policy measure will be sufficient to control it, hence to maintain inflation at stable rate is a major challenge for the government.

2. LITERATURE REVIEW

Jaumotte and Morsy (2012), examines the determinants of inflation differentials in the euro area, with emphasis on the role of country specific labor and product market institutions. The analysis uses a traditional backward looking Phillips curve equation and augments it to explore the role of collective bargaining systems, union density, employment protection, and product market regulation. The model is estimated over a panel dataset of 10 euro area countries over the period 1983-2007. Results show that high employment protection, intermediate coordination of collective bargaining, and high union density increase the persistence of inflation. Oil and raw materials price shocks are also more likely to be accommodated by wage increases when the degree of coordination in collective bargaining is intermediate.

Bashir, et al (2011), examined the demand side and supply side determinants of inflation in Pakistan on economic and econometric criterion and also to investigate causal relationships among some macroeconomic variables. For that purpose, study has undertaken time series data for the period from 1972 to 2010. Long run and short run estimates have been investigated using Johansen Co-integration and Vector Error Correction approached. The findings of the study reveal that in the long run consumer price index has found to be positively influenced by money supply, gross domestic product, imports and government expenditures on the other side government revenue is reducing overall price level in Pakistan. Long run elasticities of Price level with respect to money

supply, gross domestic product, government expenditures, government revenue and imports are 0.61, 0.73, 0.32, -1.37 and 0.41 respectively. On the basis of empirical analysis, it is suggested that there should be optimal level for all of them so that price level should be stable

Andersson, et al (2009), analyzed the determinants of inflation differentials and price levels across the euro area countries. Dynamic panel estimations for the period 1999-2006 show that inflation differentials are primarily determined by cyclical positions and inflation persistence. The persistence in inflation differentials appears to be partly explained by administered prices and to some extent by product market regulations. In a cointegrating framework we find that the price level of each euro area country is governed by the levels of GDP per capita.

Munir and Choudhary (2007) provided a detailed analysis of the effects of exchange rate on output and the price level in Pakistan for the period of (1975-2005) using VEC model. The empirical findings showed that devaluation of the currency has the positive link with output, but it negatively effect the price level. However import prices and interest rate have inverse link with output but have positive bond with price level. Moreover expansionary monetary policy put upward pressure on both output and the price level.

Khan and Shahbaz (2007) investigated the role of different factors of recent inflation trends in Pakistan. In this study annual data is used from 1972-73 to 2005-06 and incorporated all the possible demand side and supply side variables. All independent variables are taken in log form and OLS method is used for estimation. The result showed that the most significant factors were adaptive expectations, domestic credit to private sector and imported inflation, while the quantitative findings about fiscal policy provide little support for the proposition that the impact of fiscal policy on inflation was significant.

Agha and Khan (2006) conducted a study "An empirical analysis of fiscal imbalances and inflation in Pakistan". He found that, there exist a long run bond between fiscal sector and inflation. In this study he incorporated Johansen co integration technique by using the annual data from (1973-2003). This study alludes that inflation is effected by the total bank borrowing as well as fiscal deficit. General Price level is mainly influenced by unsustainable fiscal deficit, financing of fiscal deficit through banking system, printing of new money and creating interest bearing money.

An empirical study by Kia (2003) showed the main determinants which exert influence on the inflation rate in the economy of Iran, are internal rather than external. Anyhow in short run the constituents of

price hike are internal and external. Government deficit, debt financing, monetary policy and structural changes are used as internal variables, while terms of trade, foreign interest rate and attitude of the rest of the world are taken as external variables. Dwyer (2000) provided a detailed analysis changes in the determinants of inflation in Australia. They found that interaction of micro and macro elements exert the pressure on prices. They also investigated that monetary policy has a significant role to overcome price expectations while some variation in inflation is inevitable in the face of shocks.

Durevall (1996) conducted a study and explored the dynamics of inflation in Kenya. In this study incorporating the Johansen cointegration and Error correction model using the annual data from (1974-1996), alludes that exchange rate only have short run effect in Tanzania.

3. METHODOLOGY AND DATA ANALYSIS

The model is estimated for Pakistan over 1990Q3-2008Q4 time span with 74 observations. The data on consumer price index, producer price index and internal factors has been obtained from International Financial Statistics, Handbook of Statistics on Pakistan Economy (2005) and Economic Survey of Pakistan.

All the variables are converted in logarithmic form to get rid of variations in time series data except interest rate. It is claimed in literature that log-linear specification provides more favorable and reliable empirical results than linear regression model. Furthermore, Bowers and Pierce (1975); Ehrlich (1975); Ehrlich (1977) and Layson (1983) suggested that log specification of regression model is superior to the simple specification of model. Estimation equation of the model can be described in functional form as given below:

For estimation purpose, algebraic model for empirical evidence is being converted as following:

$$LCPI = \alpha_{\circ} + \alpha_{CPI} LCPI_{t-1}$$
$$+ \alpha_{PPI} LPPI + \alpha_{PSC} LPSC$$
$$+ \alpha_{PCS} LPCS + \alpha_{IR} IR + \mu_i$$

where CPI = consumer price index, PPI = producer price index, PSC = domestic credit to private sector, PCS = public capital stock proxy by gross fixed capital formation, IR = interest rate proxy by Treasury bill rate, Δ Is differenced term and λ is estimate of error term and L = stands for logarithm.

3.1. Unit Root Test

Various studies used different types of unit root tests to examine unit root problem in time series data. In present study, Augmented Dickey Fuller (ADF) unit root test is used to guess either unit root problem exists or not. ADF unit root test is used for the stationary purpose that is based on the following equation:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \alpha_i \sum_{t=1}^{m} \Delta y_{t-1} + \varepsilon_t$$

where ε_t is a pure white noise error term and $\Delta y_{t-1} = (y_{t-1} - y_{t-2})$, $\Delta y_{t-2} = (y_{t-2} - y_{t-3})$
so on and so forth.

These test authenticate either the coefficient of δ are equal to zero or not. ADF test statistics are based on collective distribution by Dickey and Fuller (1979), if the calculate-ratio (value) of the coefficient δ is lower than τ critical value from Fuller table, then it is said that y do not have unit root problem.[1]

3.2. Johansan Cointegration Approach

The innermost idea for cointegration test is relevant to the functional forms of model. This comprises of the long run relationship of one variable with other variables. Simply, it is documented that cointegration describes the occurrence of long run stable association between running factors. The variables can be cointegrated when they have one or more linear alignments among themselves which are cointegrated. Furthermore, there is long run association between variables if they are stationary at same order of integration i.e. cointegrated at I(1).

The cointegration approach was first commenced by Engel and Granger (1987). Latter on, it was further advanced and changed by Stock and Watson (1988), Johansen (1988, 1991, 1992, 1995) and Johansen and Juselius (1990). In this study, Johansen maximum likelihood (ML) approach is applied to examine the cointegration among variables. The main reason is that Johansen cointegration is the most consistent one. It is better for small sample data set as in present study. In addition to it, another improvement of this approach is that it estimates numerous co integration relations among the variables at the same time. Two statistics i.e.trace (Tr) test and the maximum eigenvalue (λmax) test are being used for checking cointegration.

3.3. Error Correction Model

The concept of an error correction model dates back and the present popularity of ECM linked with the work of Hendry. ECMs are formulated in terms of first differences, which typically removed trends from the variables and solved the problem of spurious regressions. Furthermore it is a suitable model measuring the correction from disequilibria of the previous period which has a very good eco-

---

[1] 't' ratio of coefficient δ is always with negative sings.

nomic implication. Briefly, the error correction model is a short run dynamic model, consisting of difference variables except the error correction term.

To capture the short run impact of CPI_{t-1}, PPI, PSC, PCS and IR on CPI, ECM version of ordinary least squared is being finalized as given below:

$$\Delta LCPI = \beta_{\circ} + \sum_{j=0}^{n} \beta_{CPI} \Delta LCPI_{t-j}$$

$$+ \sum_{j=0}^{n} \beta_{PPI} \Delta LPPI_{t-j} + \sum_{j=0}^{n} \beta_{PSC} \Delta LPSC_{t-j}$$

$$+ \sum_{j=0}^{n} \beta_{PCSC} \Delta LPCS_{t-j}$$

$$+ \sum_{j=0}^{n} \beta_{IR} \Delta IR_{t-j} + \lambda \eta_{t-1} + \mu_{i}$$

4. DATA ANALYSIS

While dealing with time series data it is necessary to address the stationarity problem of the variables to establish their order of integration. Stationarity is important because if series is non stationary then the results of classical regression model are not valid, meaningless and spurious. In doing so, Augmented Dickey Fuller (ADF)[2] test is used. The key insight of this test is that non stationary and unit root problem are equivalent. If the ADF statistical value is greater than the critical bound then hypothesis of unit root problem may be rejected. This seems to conclude that series has a stationary process. The empirical evidence in Table 1 reveals that all the variables are not cointegrated at I(0). However variables do not have unit root problem at I(1). It may be documented that variables are stationary at their 1st differenced form. ADF test takes account of the additional lagged terms of variables to avoid the problem of autocorrelation and multicolinearity. Because the data is non stationary at level to make it stationary we take the first difference and the series is integrated at order *I(1)*.

INSERT TABLE-I HERE

It shows that all variables have no unit root problem at their 1st differenced form. The same level of integrating order of variables tends to apply for cointegration approach. In doing so, Johansan test is applied. This method of Cointegration requires the lag length. To avoid over- parameterization of time series data, suitable lag length is necessary. The lag length selection is based on the minimum value of AIC and FPE.

INSERT TABLE-II HERE

The results of chronological tailored likelihood ratio test, final prediction error correction and Akiake's information criterion are shown in Table

2. The lag 4 is selected on the basis of FPE and AIC criteria as shown by (*) in Table 2.

Now in next step, we determine the number of cointegrating vectors. In general for n variables we have n-1 cointegrating vector. To establish the number of cointegrating relationships, Johansan has advanced the likelihood ratio statistics. Trace and maximum Eigen statistics are utilized to show the subsistence of cointegration among the running variables.

INSERT TABLE-III HERE

Table 3 presents the summary of results for cointegration analysis between consumer price index and its determinants.[3] The results reveal that maximum Eigen value and trace-test value investigate the validity of the null supposition of no cointegration against the alternative one. This exercise tends us to explain the null premise of no cointegration (R =0) among the running variables. The value of trace-test is 103.7495. This value is greater than tabulated value 1 percent probability level while critical value is 65.81(probability value has also been displayed in the Table 3). It may be concluded that null hypothesis R ≤ 0 may be rejected against alternative supposition i.e. R = 1. Moreover, it is evidenced in Table 3, the alternative premise of R = 2 may be accented and favor the existence cointegrating vector against null hypothesis of R ≤ 1. The main reason is the high Trace test calculated value (63.0270) against critical value that is 44.4935 at 1 percent probability level. The same case is with the third cointegrating vector but at 5 percent probability level. This seems to designate that three cointegrating vectors are existed amongst the running variables in model. Hence it is found that existence of numerous cointegrating vectors supports the empirical resulting of estimated model inferable, meaningful and substantial. Therefore over quarterly data (1990Q3-2008Q4) favor the view point that in Pakistan there is a long run relation among consumer price index (CPI), Producer price index (PPI), Public capital stock (PCS), domestic credit to private sector, interest rate (IR).

The next step is to describe the establishment of cointegration through maximum Eigen value approach. The results reveal that the null theory of non cointegration (R = 0) may be discarded at 1 percent level of probability in the favor of other one that is R = 1. The calculated value of Eigen value

---

[2] ADF includes both intercept and trend.

[3] The distribution of test statistic is sensitive to the order of lag used. If the lag order is used less than true lag, then the regression estimates will be biased and residual term will be serially correlated. If the order of lag used exceeds the true order, the power of the test is to be reduced.

approach is (40.7224) greater than critical value (31.2392) at 1 percent probability level. The test also seems to reject the null hypothesis of R = 1 in the favor of the alternative R = 2. This critical value of Eigen value approach (25.1240) is less than calculated value (32.9475) at 1 percent probability level. Similarly, there is also existence of third cointegrating vector and level of probability is 10 percent. This concludes that three cointegrating relationship are existed among the five variables that are stationary at *I(1)* integrating order. Finally, it is documented that quarterly data from 1990 to 2008 establishes relationship among consumer price index (CPI), Producer price index (PPI), Public capital stock (PCS), domestic credit to private sector, interest rate (IR) for long span of time.

4.1. Empirical Interpretation of Internal Determinants of CPI

$$LCPI = 0.0432 Cons\tan t$$
$$+ 0.8040 LPCI_{t-1} + 0.1027 LPPI$$
$$- 0.0296 LPCS + 0.0445 LPSC$$
$$+ 0.0010 IR + \mu$$

The impacts of independent variables on dependent variable are shown in above equation. The estimated results are showing theoretical correct signs of coefficients of concerned variables. The estimated elasticity with respect to mentioned variables is significant. The lag of dependent variables is incorporated to check the effect of Adaptive expectations of individuals. The impact of adaptive expectations is dominant with greater probability. This indicates that more than 80 % consumer prices are increased in current period on account of adaptive expectations. The general understanding in Pakistan is that adaptive expectations about CPI are indicating the phenomena of hoarding, and assets price hike. Exogenous changes in energy and food prices exert pressure on price level with a lag. Empirical literature also shows that past inflation affects current inflation, Kozo Ueda (2009).

The producer price index also positively affects the consumer price index. The estimated coefficient of producer price index shows that 1 percent increase in producer price index causes consumer price index to rise by 0.1027 percent. This empirical evidence supports the causal association to supply-side. The supply-side indicates production timing and producers add value in existing production after a lag period. It is explained in open macro economy model that producer or retail sector seems to use primary goods in running domestic production as inputs. In such way, consumer prices generally depend upon producer prices of goods, imported goods prices, exchange rate, rate of indirect taxes implementation, marginal cost of retail

production. This phenomenon gives support to the producer price analysis that has been developed by Cushing and McGarvey (1990). As in the production of final goods, primary goods are used with lagged period. So the turbulence in primary goods market influences prices. The production of final goods in each period utilizes primary goods produced in lagged period as inputs that indicates the supply-side turbulence in primary goods market influences producer and consumer prices in upcoming period. Cushing and McGarvey (1990) conclude that primary goods are used as inputs with lag period in production process of consumption goods, that's why producer prices will lead consumer prices independently (Shahbaz, *et al.*,, 2009).

The impact of public capital stock is checked by the inclusion of gross fixed capital formation. The sign of PCS shows that it leaves negative impact on consumer price index with high probability i.e.1 percent level of significance. The public capital stock affects the economy in two ways. First, it shows that high public capital stock increases the potential of an economy to produce more output. Secondly, increased public capital stock enhances the aggregate demand that may push the value of consumer price index. If the proportional impact of output is greater than the proportional impact of aggregate demand then public capital stock tends to lower the value of consumer price index.

The consumer price index is positively affected by an increase in domestic credit to private sector at 1 percent level of probability. It may be concluded that 1 percent increase in domestic credit to private sector enhances the consumer price index by 0.0445 percent. This indicates that consumer's liquidity increases, consequently expenditure level on housing and consumer durable items rise up (Ahmad and Aamir, 2009). The rise in interest rate is also linked positively with consumer price index at 10 percent level of probability but its impact is minimal and according to theory. It is said in literature that rise in interest rate simply enhances the price of borrowing and makes investment more expensive for investors. Higher interest rate is having bad impact on investment especially on real production activities. Furthermore, the high cost of borrowing compels the investor to increase price of final goods which they produce. In turn, prices of consumer items are increased.

4.2. Short Run Estimation

$$\Delta LCPI = 0.0019 Cons\tan t$$
$$+ 0.8383 \Delta LPCI_{t-1} + 0.1751 \Delta LPPI$$
$$- 0.0853 \Delta LPPI_{t-1} - 0.0316 \Delta LPCS$$
$$- 0.0180 \Delta LPCS_{t-1}$$
$$+ 0.0046 \Delta LPSC + 0.0018 \Delta IR$$
$$- 0.8285 ecm_{t-1} + \mu$$

In the above equation the estimated ecm_{t-1} lagged term indicates the rate of convergence to equilibrium level. It should have negative coefficient with greater probability. It assures that long run stable relation can be found from ECM approach. Kremers *et al.* (1992); and Bannerjee *et al.* (1993) claim that high value of ecm_{t-1} with negative sign proves that established link is stable for long span of time. It is claimed that this is an effective way to establish cointegration through carrying negative coefficient of error term. The estimate of ecm_{t-1} is equal to (-0.8285) for short run model. It tends to imply that deviation from the long-term consumer price index is precise by (82.85) percent over the each quarter at 1 percent level of probability for consumer prices.

In short span of time, the coefficient of adaptive expectations is the largest among all other variables and most significant as in the long run model. The effect of producer price index is positive and high, 1 percent increase in values of producer prices causes an increase in consumer prices by 0.1751 percent. Differenced and lag of differenced term of public capital stock or gross fixed capital formation seems to affect consumer prices inversely. This shows that PCS lower down the price level in both of the periods short run and long run. Domestic credit to private sector affects consumer prices positively but it is statistically insignificant in short run. Finally, interest rate is positively linked with consumer prices but the impact is minimal with weak probability i.e.10 percent level of significance.

4.3. Stability Analysis

The strength of long run and short run estimations may be examined by the application of CUSUM (cumulative sum) and CUSUMsq (cumulative sum of squares). Pesaran *et al.,* (2001) have documented that strength of the estimates of the ECM model can be econometrically scrutinized by the application of said method. That's why graphs of CUSUM and CUSUMsq are inserted in Figures 1 and 2. Following the conclusion of Bahmani-Oskooee and Nasir (2004) that the null premise that is "the regression equation is correctly specified" may be accepted if the plots of these statistics are between critical bounds at the 5% level of probability.

INSERT FIGURE-I HERE
The straight lines represent critical bounds at 5% probability level.
INSERT FIGURE-II HERE
The straight lines represent critical bounds at 5% probability level.
The plots of both the CUSUM and the CUSUMsq are between the limits at 5 percent level of probability, and these plots strengthen the impact of under consideration variables, on consumer price index in Pakistan on quarter basis. It is noted that model is suitable and there is no specification problem. The main reason is that CUSUM and CUSUMsq test statistics do not cross critical bounds at the 5 percent level of probability (Figures 1 and 2).

5. CONCLUSION

In this study we explore the relation between consumer price index and its determinants i.e. producer price index adaptive expectations, public capital stock (gross fixed capital formation) domestic credit to private sector and interest rate. In doing so, Johansan approach is used to find out cointegration among said variables and ECM (error correction method) to unearth short run dynamics. Before co integration test, ADF test has been conducted for stationarity properties of macroeconomic variables. The estimated results reveal that adaptive expectations play their main role to increase the consumer price index in long and short run periods. The high producer price index is linked positively and significantly with consumer price index and is the second dominant force, which increases CPI in the country. The public capital stock seems to lower the consumer prices in long span of time and in short run also, lag of differenced term is also negative and statistically insignificant. Finally, the coefficient of interest rate shows that interest rate raises CPI in both the periods.

On the basis of empirical findings of this study, it is recommended that adaptive expectations are playing very important role in inflation upheavals, followed by interest rate. It is also found that inflation of previous time period is also badly impacting current inflation and same was shown with private sector. So, government has to rationalize economic policies for the control of inflation in Pakistan.

REFERENCES

Adedeji, O. S. and O. Liu 2003. "Determinants of Inflation in the Islamic Republic of Iran: A Macroeconomic Analysis" IMF Working Paper 00/127.

Agha, A. I. and M. S. Khan 2006. "An Empirical Analysis of Fiscal Imbalances and Inflation in Pakistan" *SBP Research Bulletin* 2(2): 343-363.

Andersson, M., Klaus Masuch and Marc Schiffbauer, 2009, "Determinants of Inflation and Price Level Differentials across the Euro Area Countries", European Central Bank, Working Paper Series no 1129.

Bahmani-Oskooee, M. and A. B. M. Nasir 2004. "ARDL Approach to Test the Productivity Bias hypothesis" *Review of Development Economics Journal* 8(3): 483-488.

Banerjee, A. and Newman, A. 1993. "Occupational Choice and the Process of Development" *Journal of Political Economy* 101(2):274-298.

Bowers, W. and G. Pierce 1975. "The Illusion of Deterrence in Isaac Ehrlich's Work on the Deterrent Effect of Capital Punishment" *Yale Law Journal* 85(1): 187-208.

Cushing, M. J. and M. Gravey 1990. "Feedback Between Wholesale and Consumer Inflation: A Re-examination of the Evidence" *Southern Economic Journal* 56(4): 1059-1072.

Dickey, D. O. and W. A. Fuller 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association* 74(366): 427 – 431

Durevall, D. 1999. "A Dynamic Model of Inflation for Kenya, 1974-1996" IMF Working Paper, WP No. 99/97

Dwyer, Jacqueline and Kenneth leong 2000. "Changes in the Determinants of Inflation in Australia" BIS paper number 3.

Ehrlich, I. 1975. "The Deterrent Effect of Capital Punishment – A Question of Life and Death" *American Economic Review* 65(3): 397-417.

Ehrlich, I. 1977. "The Deterrent Effect of Capital Punishment Reply", *American Economic Review* 67(3): 452-58.

Engle, R. and C. W. J. Granger 1987. "Cointegration and Error Correction Representation: Estimation and Testing" *Econometrica* 55(2): 251–76.

Furrukh Bashir, Shahbaz Nawaz, Kalsoom Yasin, Usman Khursheed, Jahanzeb Khan, Muhammad Junaid Qureshi, 2011, "Determinants of Inflation in Pakistan: An Econometric Analysis Using Johansen Co-Integration Approach", Australian Journal of Business and Management Research, Vol.1 No.5, pp 71-82

Government of Pakistan, Pakistan Economic Survey (Various Issues), Ministry of Finance, Islamabad.

Government of Pakistan. 2005. Handbook pf Pakistan Economy, Federal Bureau of Statistics, Islamabad.

Jaumotte, Florence and Hanan Morsy, 2012, "Determinants of Inflation in the Euro Area: The Role of Labor and Product Market Institutions", IMF Working Paper No 12/37.

Johansen, S. 1988. "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control* 12(2-3): 231-254.

Johansen, S. 1991. "Estimation and Hypothesis Testing of Co-integrating Vectors in Gaussian Vector Autoregressive Models" *Econometrica* 59(6): 1551–80.

Johansen, S. 1992. "Co-integration in Partial Systems and the Efficiency of Single-Equation Analysis" *Journal of Econometrics* 52(3): 389–402.

Johansen, S. 1995. *Likelihood-based Inference in Cointegrated Vector Autoregressive Models.* Oxford University Press: Oxford.

Johansen, S. and K. Juselius 1990. "Maximum Likelihood Estimation and Inference on Cointegration- with Applications to the Demand for Money" *Oxford Bulletin of Economics and Statistics* 52(2): 169-210.

Khan, A. and M. Shahbaz. 2007. "Openness-Inflation Puzzle for Pakistan: Under Two Alternative Approaches" *European Journal of Economics, Finance and Administrative Sciences* 8(7): 39-50.

Kia, A. 2003. "Deficit, Debt Financing, Monetary Policy and Inflation in developing countries: Internal or external factors: evidence from Iran" Carleton Economic Papers.

Kozo, Ueda. 2009. "Determinants of Household, Inflation Expectation" IMSE Discussion paper# 8.

Kremers, J. J. M., N. E. Ericsson, J. J. Dolado 1992. "The Power of Co-integration Tests" *Oxford Bulletin of Economics and Statistics* 54(8): 325-48.

Layson, S. 1983. "Homicide and Deterrence: Another View of the Canadian Time Series Evidence" *Canadian Journal of Economics* 16(4): 52-73.

Munir, C. and M. A. Choudhary 2007. "Effects of the Exchange Rate on Output and Prices: A Case Study Pakistan Economy" *Lahore Journal of Economics* 12(1): 49-77.

Pesaran. M. H., Y, Shin and R. J. Smith 2001. "Bounds Testing Approaches to the Analysis of Level Relationships" *Journal Applied Econometrics* 16(3): 289–326.

Shahbaz, M. and N. Aamir 2009. "Determinants of Workers' Remittances: Implications for Poor People of Pakistan" *European Journal of Scientific Research* 25(1): 130-144.

Shahbaz, M., U. R. Awan and M. N. Nasir 2009. "Producer & Consumer Prices Nexus: ARDL Bounds Testing Approach" *International Journal of Marketing Studies* 1(2): 78-86.

Stock, J. and M. Watson 1988. "Testing for Common Trends" *Journal of the American Statistical Association* 83(404): 1097-1107.

Thomas J. S. 1973. "Rational Expectations, the Real Rate of Interest, and the Natural Rate of Unemployment" Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution 4(3): 429-480.

Internal Determinants of Consumer Price Index in Pakistan: A Cointegration and Stability Analysis

Table 1: Unit Root Estimation

Variables	ADF Test at Level		
	T-value	Prob-value	Lags
LCPI	-1.8159	0.6868	1
LPPI	-1.8712	0.6591	1
LPCS	-0.0121	0.9954	2
LPSC	-0.7273	0.9668	3
IR	-2.0674	0.5544	3
ADF Test at 1st Difference			
LCPI	-4.6861	0.0017	2
LPPI	-3.4860	0.0487	2
LPCS	-4.3493	0.0048	4
LPSC	-6.5572	0.0000	2
IR	-4.4872	0.0031	2

Table 2: Lag Order Selection

VAR Lag Order Selection Criteria				
Lag	LogL	LR	FPE	AIC
0	13.31601	NA	5.43e-07	-0.2376
1	504.3437	897.8793	8.97e-13	-13.5526
2	553.1760	82.3172	4.59e-13	-14.2336
3	570.7370	27.0940	5.84e-13	-14.0210
4	612.1549	57.9851	3.85e-13*	-14.4901*

* indicates lag order selected by the criterion

FPE: Final Prediction Error

AIC: Akaike Information Criterion

Table 3: Johansen Maximum Likelihood Test for Co integration

Null Hypothesis	Trace–test Statistics	1 % critical value	Prob. value**	Hypotheses	Max-Eigen Statistic	1 % critical value	Prob-value
R = 0	103.7495	65.8197	0.0000	R = 0	40.7224	31.2392	0.0065
R ≤ 1	63.0270	44.4935	0.0010	R= 1	32.9475	25.1240	0.0093
R ≤ 2	30.0794	27.0669	0.0464	R = 2	19.9970	18.8928	0.0714
R ≤ 3	10.0824	13.4287	0.2744	R = 3	9.6535	12.2965	0.2357
R ≤ 4	0.4288	2.70554	0.5125	R = 4	0.4288	2.7055	0.5125

**MacKinnon-Haug-Michelis (1999) p-values
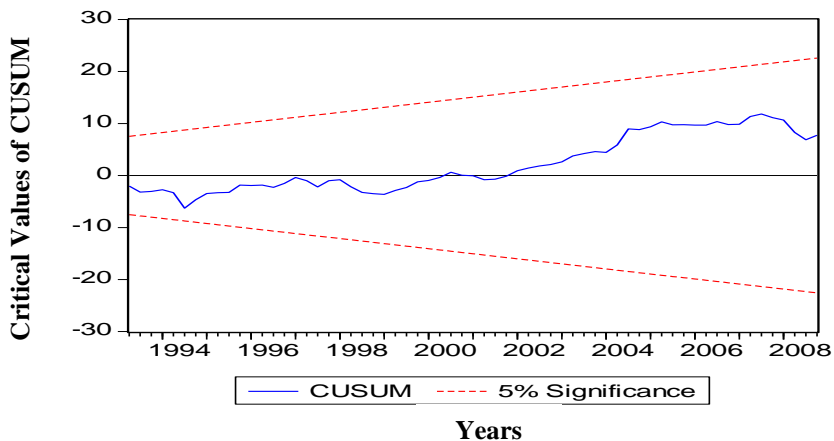
Figure 1: Cumulative Sum of Recursive Residuals

Figure 2: Cumulative Sum of Squares of Recursive Residuals

Years