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Determinant of Inflation in Pakistan: An Econometrics Analysis, Using Johansen Co Integration Approach

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ABSTRACT

The main object behind the study is to explore the long run and short run dynamics of inflation in case of Pakistan. For this purpose study used annual data 1971 to 2012. Johansen co integration approach is used to check long run equilibrium while ECM (Error Correction Model) is used to check short run dynamics. The result highlighted GDP, M2, energy crises, import and current government expenditure, output gap and adaptive expectation create inflation while development expenditure negatively corrected with inflation. The study concluded that in Pakistan demand side and supply side inflation persist.
Key Word: Inflation, Long run and Short run

INTRODUCTION

Inflation is defined as continuous rise in general price level of the country or economy, another way of defining inflation is that inflation is a process in which general price index is increasing in persistently and value of money decline. The issue of rising inflation is general phenomena in most of economy. In case Pakistan inflation is primary issues among all other issues. From economic and business perspective, inflation rate is mostly influence by the stock of qusai money, exchange rate, domestic output level, interest rate, fiscal deficit, energy crises, law and order condition etc.

Inflation is major problem in Pakistan as well as most of developing and developed countries. Due higher inflation level people need more amount of money to make daily transaction and people has demanding more money and value of money decline. Inflation also negative effects on saving rate in society and people substitute their saving towards consumption due to high price level. In Pakistan most of demand side and supply side factor are found. Inflation can be a result of shocks to the supply of certain food items and world oil price increases. Recent rise in oil prices pretense of increases in prices of almost all other commodities of the consumer basket. This supply side effect cannot be countered with the help of demand management policy. However, government of Pakistan still designs policies which back demand side inflation.

The demand side pressures were often considered as an outcomes of 9/11 incidence and combination of expansionary fiscal and monetary policies. Domestic demand increase due to high inflows of remittances from abroad, liberal demand management causes increases output gap and upward trend in price level. This gap is filling by sharp increase by imports and increase trade deficit.

Ease in fiscal policy in last few year in Pakistan also create inflationary pressure and further widen the current account deficit. It's widening the saving investment gap, which finance through external sources. Moreover, fiscal deficit finance through money creation also creates inflation in case of Pakistan. Another reason behind high level of general price level is expansionary monetary policy. Easiness in credit policy was also believed to be contributing to high inflation.

Rising import prices and faster deprecation in Pak rupees also considered as an important factor in creating inflation. Similarly, some researcher (Khan and Qasim 1996) argued that indirect taxes are the main cause of inflation in Pakistan.

The question now arises as to what was the most significant explanatory factor for inflation in Pakistan? This study investigates this question. The paper first presents review of literature and discuss different theories of inflation, then present theoretical model and econometrics methodology and empirical evidence and finally conclusion by giving some policy recommendations.

LITERATURE REVIEW

Different school of economist presents different aspects of inflation. Most of the familiar theory is quantity theory of money which provides equation of money supply and provides the dynamics of inflation of excess money supply and quality theory of money which focus the purchasing power of buyer. In Keynesian era where believed to be caused by either an increase in aggregate demand or decrease aggregate supply. During Keynesian era, fiscal policy was considered an important tool in controlling inflation.

A.W Philips (1950) investigates the relationship between inflation and unemployment, this investigation on the basis of rapid falling in money wages. . this model was further investigate by Lipsey (1960), Samuelson and Robert Solow (1960). In 1995 Barro investigate the link between inflation and economic growth.

Kuijs (1998) has investigated the determinants of three variables: inflation, exchange rate and output. The study found that first lag of price, third lag of price, first lag of money supply and first lag of output gap are positively correlated with inflation in case of Nigeria.

Lim and Papi (1997) highlighted on the key determinant of inflation in case of Turkey. For this purpose they used time series data from the period of 1970 to 1995. They used Johansen Co integration to find out long run equilibrium relation between money, wages price of export and import have positive influence on domestic price level where as exchange rate relate inversely on domestic price of turkey.

Abdullah and Khalim (2009) examined the main determinants of food inflation in Pakistan. They used time series data for the period of 1972 to 2008. They used Johansen co integration method to explore the equilibrium relation. The result shows that money supply, per capita GDP, support price of agriculture product and food export and import price are positively associated with food inflation in case of Pakistan.

THEORETICAL MODELING, VARIABLES & DATA SOURCES

In this study we focus on demand and supply side determinants of inflation in case of Pakistan. The equation of inflation is written as follows.

$$LCPI_t = \alpha + \beta_1 LM2_t + \beta_2 LGDP_t + \beta_3 LM_t + \beta_4 LX_t + \beta_5 Output\_gap_t + \beta_6 LCG_t + \beta_7 LDG_t + \beta_8 Energy\_crises_t + \beta_9 LagCPI_t + \varepsilon_t$$

LCPI= Log of Consumer Price Index

LM2= Log of Monetary Aggregate M2

LGDP= Log of Gross Domestic Production

LX= Log price of export goods

LM=Log price of import goods

Output_gap= Real demand relative to real supply

Energy Crises= difference between energy demand and energy supply

LCG= log of government current expenditure

LDG= log of government development expenditure

Lag LCPI= log of lag CPI

ε = stochastic error term.

The study used annual data from the period of 1970 to 2012. The data has been taken from WDI (World development Indicator) issue by World Bank various issues. The study also used Pakistan Statistical Year Book 2012 published by Pakistan Bauru of Statistics.

ECONOMETRICS METHODOLOGY

Most of the macroeconomics time series data are found non stationary, so OLS (ordinary least square) method in appropriate and lead to spurious results. When data series is non stationary we used Johansen co integration technique to find long run equilibrium relation. When time series data is stationary, its means that its mean value, variance value and co variance value are constant over the period of time (Gujarati 1995), thus before going to check long run determinant of inflation in this study first we analysis presence of stationary in macroeconomics data series. To evaluate the any presence stationary in data we used Augmented Dicky Fuller (ADF) test, which equation is written as follow.

$$\Delta Y_t = \alpha_1 + \beta_1(\phi_1 - 1)Y_{t-1} + \sum_{i=1}^{k} \delta \Delta Y_{t-i} + \mu_t$$

Where Y is the series of data under consideration and μ is white noise error term, which mean is zero and variance is constant. The ADF test analysis that the null hypothesis is unit root against the alternative hypothesis of stationary time series data (Dickey and Fuller, 1981)

The concept of co integration first time introduced by Granger in 1981 and empirically analysis it's by Engle and Granger in 1987. In Econometrics literature there are two method to test the existence of co integration in model. (1) Residual Based Augmented Dickey Fuller technique designed by Granger and Engle in 1987 (2) Johansen's full information maximum likelihood approach proposed by Johansen and Juselius in 1990. After analysis the long run equilibrium relation among the variables Engle and Granger provided ECM (Error Correction Mechanisum) to obtain information on the speed of adjustment towards long run. The weakness of Engle and Granger approach is that it include low power and finite sample bias. It is not helpful when we used more than two variables. (Dolado, Jenkinson, & Sosvilla-Rivero, 1991; Charemza & Deadman, 1992), making Johansen's technique more appropriate. The following VAR (Vector Auto Regressive) model used to check multivariate co integration among the variables.

$$Z_t = A_1 Z_{t-1} + ... + A_k Z_{t-k} + \mu$$

Each equation in above VAR model can estimate with the help of OLS because each variable in Z is regressed on lagged values of its own and all other variables in the system of equations. Since it is assed that Z is non stationary, so it can be written on above VAR model on first difference or error correction form as follow (Cuthbertson, Hall, & Taylor, 1992)

$$\Delta Z_t = \Gamma_i \Delta Z_{t-1} + ... + \Gamma_{k-1} \Delta Z_{t-k+1} \Pi Z_{t-k} + \mu_t$$

Where

$$\Gamma = -(I - A_1 - A_2 - ..... - A_i), (i = 1.....K - 1)$$
$$\Pi = -(I - A_1 - A_2 - ..... - A_i)$$

The above model provide the information of the short run and long run adjustments to the changes in Z by estimating Γ and Π. The term ΠZ_{t-k} gives information on the long run equilibrium association among the variables while information about the number of co integration relations among the variables in Z is given by the rank of the matrix Π. If the rank of matrix is Π is 0<r<n, there are r linear combination in the VAR model.

In above model the parameters of Π is break into two component, α and β, where α provided the information of error correction and there component shows the speed of adjustment in ΔZ_t and β shows the number of vectors which are co integrated between non stationary variables

Johansen and Juselius used two likelihood methods one is trace value and another one is maximum eigen value test, which determine the co integration rank and estimated the long run cofficent in the matrix. The equation of trace value test written as follow.

$$\lambda_{trace} = -2\ln Q = -T\sum_{i=r+1}^{p}\ln(1-\lambda_i)$$

the null hypothesis in above Johansen co integration test is that the number of distinct co integration vectors is less than or to r against the alternative hypothesis that r>0. The maximum eigenvalue test, used to detect the presence of a single co integration vector is based on the following equation.

$$\lambda_{\max} = -2\ln(Q: r/r+1) = -T\ln(1-\lambda_{r+1})$$

Max eigenvalue tests the null hypothesis that the number of co integration vector is r, against the specific alternative of (r+1) co integration vectors

RESULT AND DISCUSSION

In this study we conduct analysis in three step, first, the ADF test was conducted to test the unit root in the time series variables. Next, Johansen full information maximum likelihood test to check the long run relation among variables and last ECM was used to obtain the short run dynamics in the model.

Table no.1 ADF (Augmented Dickey Fuller) Test

Variables	Level	First Difference
LCPI	-1.66	-5.64*
Lag LCPI	-2.51	-4.47*
LEC	-1.24	-8.77*
LGDP	-1.47	-6.33*
LX	-2.02	-9.87*
LM	-2.11	-7.45*
LGDP	-0.98	-3.14*
Output Gap	-2.87	-12.36*
LDG	-1.44	-4.14
LCG	-0.98	-4.51*

*significant at 5%

Johansen co integration method requires that all the variables are integrated order i.e I(1). Above table no. 1 shows that the results of ADF unit root test and confirm that all the variables are integrated at order one.

At second step, the research try to found number of co-integrated equation in the model by using maximum eigenvalue and trace statistics value. Null hypothesis is set that there are no co-integrated vectors against the alternative hypothesis that there is at most 1 co-integrated vector and so on. In our results it's found that there are at most 4 co-integrated vectors which show long run association among the variables. The result Johansen co integration likelihood test given below in table no. 2 and 3

Table No.1 and 2: Unrestricted Co-integration Rank test (trace) and Unrestricted Co-integration Maximum eigenvalue test.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.247735	571.3188	239.2354	0.0000
At most 1 *	0.195752	428.1316	197.3709	0.0000
At most 2 *	0.142388	318.5542	159.5297	0.0000
At most 3 *	0.127791	241.2917	125.6154	0.0000
At most 4 *	0.099674	172.5183	95.75366	0.0000
At most 5 *	0.089937	119.7039	69.81889	0.0000
At most 6 *	0.065202	72.30045	47.85613	0.0001
At most 7 *	0.040848	38.38571	29.79707	0.0040
At most 8 *	0.029266	17.40778	15.49471	0.0255
At most 9	0.004893	2.467044	3.841466	0.1163

*significant 5 % level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.247735	143.1872	64.50472	0.0000
At most 1 *	0.195752	109.5774	58.43354	0.0000
At most 2 *	0.142388	77.26244	52.36261	0.0000
At most 3 *	0.127791	68.77345	46.23142	0.0001
At most 4 *	0.099674	52.81442	40.07757	0.0011
At most 5 *	0.089937	47.40341	33.87687	0.0007
At most 6 *	0.065202	33.91473	27.58434	0.0067
At most 7	0.040848	20.97793	21.13162	0.0525
At most 8 *	0.029266	14.94074	14.26460	0.0390
At most 9	0.004893	2.467044	3.841466	0.1163

*significant 5 % level

At second step, the study has found number of co integrated equation in vector with the help trace statistics and maximum eigenvlaue statistics. Table no. 2 and 3 shows that null hypothesis that there is no co integrated vector, there is at most one co integrated vector, there is at most 2 co integrated vector, there is 3 co integrated vectors, there is 4 co integrated vectors, there is 5 co integrated vectors, there is 6 co integrated vectors, there is 7 co integrated vectors and also there is 8 co integrated vectors. It means that there is 8 co integrated vectors in long run equilibrium. The result support that there is elevated relationship among the variables.

Table No. 3: Long run Equation: Normalized Co-integration coefficients: Dependent Variable CPI

Variables	Coefficients	t-value
LM2	0.692*	7.21
LGDP	0.457*	5.33
LM	0.401*	2.54
LX	0.651	1.47
L_Output Gap	1.742*	4.17
LCG	1.247*	2.14
LDG	-1.143*	-4.23
L_Energy Crises	0.847*	3.64
L_lag CPI	0.411*	6.19

*significant at 5%

The long run coefficients of CPI model are shown in table no. 4. The results show that money is positively correlated with inflation in case of Pakistan. The coefficient of LM2 shows that 1 percent increase in money supply causes 0.69 percent increase in price level or CPI on average in long run or other words we says that price elasticity with respect to broad money is0.61. the result is according classical quantity theory of money. This is demand side inflation, because higher money supply create more aggregate demand. The coefficient of gross domestic product is positive and significant, 1 percent change in GDP cause to increase in 0.457 price level. The justification behind is that higher income causes to higher aggregate demand and increase price, this is also demand side inflation.

The coefficient of import of goods and services are positive, the coefficient shows that if 1 percent increase in import goods and services price increases by 0.401. The positive sign of import of goods and services shows that most of Pakistan import are consumer goods, if Pakistan import capital goods its causes increase in production in domestic level and price level decline. The another reason the positive sign of coefficient of import goods and services more imports of goods causes to decline domestic income and investment, which cause decline in production of goods and services and causes supply side inflation.

The coefficient of exports of goods and services is negative but the t value of exports shows insignificant. The negative sign of export goods and services shows that higher export of goods and services causes trade revenue increases causes more investment and finally increases aggregate supply. Higher export also increases domestic production which leads the firm to achieve economies of scale and cost of production decline. Export also effects demand side inflation because country demand increase due to foreign demand.

The coefficient of demand relative to supply pressures, represent the output gap. The coefficient of demand relative to supply is greater than one, it is shows an upward pressure on price level. The coefficient of output gap is positive and significant. 1 percent increase in output gap causes to increase in 1.74 percent in price level.

The coefficient of current government expenditure and development expenditure are positive and negative respectively. Both coefficients are significant statistically. Current government expenditure coefficient shows that as government current expenditure increases by 1 percent causes to increase inflation by 1.28 percent because current government expenditure stimulate aggregate demand. Development government expenditure coefficient shows that as development government expenditure increases by 1 percent inflation is decreases by 1.14 percent because higher development expenditure stimulate aggregate supply and encourage domestic and foreign investment.

Recently, energy crises is key issue of Pakistan economy and main cause of inflation in Pakistan last decade adversely effects all sector of economy specially industrial sector. The coefficient of energy crises which is based on energy demand over energy supply is positive and highly significant. Coefficient shows that as energy crises increases by 1 percent inflation is increases by 0.84 percent in case of Pakistan.

Rising prices create expectations for future inflation. Future expectation play vital role in determined future price level. People expect higher salaries due to higher future prices, speculation in security and financial assets, credit for manufacturing sector, estate shocks, profit seekers etc. expect higher prices in future. This

phenomenon is capture trough lag CPI in the model. The sign of lag CPI is positive which shows and significant, so uncertainty also effect inflation in case of Pakistan.

Table no. 5: Error Correction Model: Short run dynamics (Dependent Variable D(LCPI))

Variables	Coefficients	t-statistics
Speed of Adjustment / Error correction term	-0.301*	2.33
D(LCPI(-1))	0.231*	2.14
D(LCPI(-2))	0.478	0.21
D(LM2(-1))	-0.245	1.47
D(LM2(-2))	0.423	1.98
D(LX(-1))	0.987	0.85
D(LX(-2))	0.145*	3.66
D(LM(-1))	-0.214*	2.11
D(LM(-2))	0.419	1.78
D(LCG(-1))	0.932	0.22
D(LCG(-2))	0.147*	4.55
D(LDG(-1))	0.654*	4.97
D(L output gap(-1))	-0.217*	8.21
D(L output gap(-2))	0.347	0.66
D(L energy crises(-1))	0.222*	7.22
D(L energy crises(-2))	0.132*	5.01
Adjusted R square	0.491	
F statistics	3.77	

*significant at 5% level

In table no. 5 study shows the mechanism of short run dynamics. The coefficient of speed of adjustment shows that how much time would be taken by the economy to restore long run equilibrium. Negative sign of speed of adjustment shows that over estimate of inflation in short run or other words we say overshooting of inflation in case of Pakistan. It is adjusted 30 percent annually according to this study short run dynamics coefficient.

CONCLUSION

The aim of the study is to found out long run as well as short run dynamics of inflation in case of Pakistan. The result shows that money supply, current government expenditure, imports, energy crises, output gap and gross domestic production positive contribution in case of Pakistan. The study also proves that there is no effect of exports in inflation. The result of error correction shows that overshooting of inflation which is adjust 30 percent annually or required almost 3.5 years to adjust. So it is concluded that in case of Pakistan, both supply side inflation as well as demand side inflation prevail.

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