

AN EMPIRICAL INVESTIGATION OF DOMESTIC AND EXTERNAL DETERMINANTS OF INFLATION IN PAKISTAN

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Abstract. In this study ARDL approach is applied for estimating the long-run and short-run relationship among the variables using annual data for the period 1972-2010. The results show that in the long-run money supply growth, lagged inflation, foreign inflation and dummy variable for global financial crises 2008 have positive and significant impact on inflation in Pakistan. Further, except money supply all the variables affect inflation in the short-run. The significant and negative coefficient of lagged error correction term is an indication of the convergence towards long-run equilibrium. The study recommends that in rapidly globalizing world, serious considerations need to be given by policy makers to external shocks like foreign inflation and global crises for formulating policies which help in controlling inflation in Pakistan.

Keywords: Inflation, Nominal effective exchange rate, Financial crisis

JEL classification: E31, F49, G01

I. INTRODUCTION

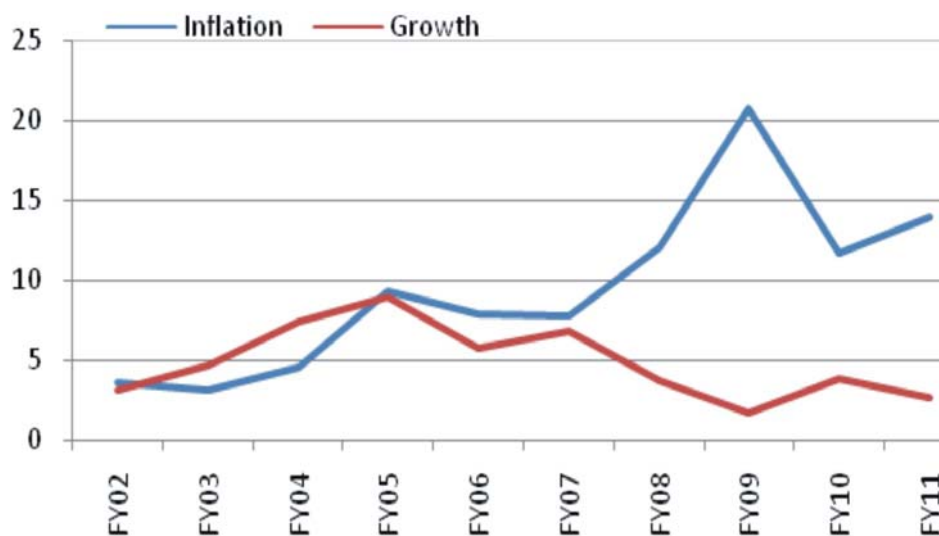
Low rate of inflation along with high and sustainable economic growth is considered to be one of the major goals of macroeconomic policy formulation in developing economies. Inflation has important implications

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for the economic management and life style in an economy. It adversely affects the overall growth, the financial sector development and the vulnerable poor segment of the population (Qayyum, 2006). Moderate level of inflation is considered to be good for growing economies, whereas high rate of inflation adversely affects economic performance and living standard in the economy. Pakistan economy is facing on average double digit CPI inflation in last seven years since FY2005 whereas average real GDP growth rate of more than 7 percent during FY2004-07 has declined to less than 3 percent on average during FY2008-11 (see Figure 1).

FIGURE 1

Real GDP Growth and CPI Inflation in Pakistan Since FY2002 (in %)



The recent increase in the rate of inflation in Pakistan has once again originated a debate on the determinants of Inflation. Major determinants of inflation in Pakistan along with output gap include external factors and policy coordination problems as frequently highlighted by State Bank of Pakistan in its monetary policy statements (MPS).

Pass-through of external shocks to macroeconomic goal variables like inflation in small open economies like Pakistan is major area of concern for both academia and policy makers. Recent literature related to Pakistan has focused on the impact of exchange rate, foreign inflation, foreign direct investment, workers' remittances, foreign debt and other macroeconomic variables on inflation (Choudhri and Hakura, 2001; Bhundia, 2002). The pass-through of external shock on inflation in Pakistan has critical

implications for effectiveness of monetary policy to control inflation in Pakistan. According to Edwards (2006), “if the inflationary effects of exchange rate change are large, the authorities will have to implement monetary and fiscal policies that offset the inflationary consequences of exchange rate changes.” In rapidly globalizing world, effectiveness of demand management policies in controlling inflation depends on limiting pass-through of external shocks into local inflation. Recent literature suggests that evidence of low pass-through supports the adoption of an inflation targeting regime in Pakistan (Jaffri, 2010).

The current study investigates the impact of external shocks along with domestic determinants of inflation in Pakistan by using annual data from 1972 to 2010. The study incorporates nominal effective exchange rate, foreign inflation and DUM2008 (proxy for global financial crisis) as explanatory variables along with output gap and money supply to check the effect of external shocks on domestic inflation in Pakistan.

II. LITERATURE REVIEW

The role of external shocks in determining inflation and other macroeconomic variables in small open economies like Pakistan is very frequently addressed question in recent empirical research. As Krznar and Kunovac (2010) reported that changes in external factors like change in world prices produced significant spillover effects on producer and consumer price indices in domestic economy of Croatia. The study employed the seasonally adjusted quarterly data from 2000Q2 to 2010Q1. The variance decomposition analysis by applying Vector Autoregressive (VAR) model revealed that external shocks must be taken into account in theoretical modeling of domestic prices and economic activity.

Gerlach-Kristen (2006) distinguished some key domestic and external factors that are mainly responsible for swings in output in economy of Hong Kong. The paper estimated a structural model by utilizing data for the period 1990 to 2002. Using general to specific approach the results of VAR model are compatible with the New Keynesian Phillips Curve. Furthermore, the import prices in domestic currency showed rising trend in the long-run in domestic economy if the foreign prices rise. It was mainly concluded that CPI inflation showed strong reaction against the internal and external shocks in the time period under analysis.

The cost caused by the financial crisis 2008 is also a major factor in shaping the pattern of inflation in emerging economies. An exploratory study by te Velde (2008) identified some worrying signs triggered by the financial

crisis to world economies. The substantial slow down in developed economies can turn the course of economic activity in developing world. The combination of higher food and oil prices lead to the double-digit inflation in several economies. Such serious implications alert the policy makers in developing countries to reduce the magnitude of this shock through the appropriate policy response.

Kemal (2006) investigates whether in the long-run an increase in money supply results high rate of inflation. Study applies cointegration technique on quarterly data from 1975:1 to 2003-4. Results provide support for the quantity theory of money and also suggest that the money supply works in the short run period in less than a year. Similarly, Qayyum (2006) also found a strong correlation between money growth and inflation. Excess money supply growth has been the central contributor to the rise in inflation in Pakistan in the corresponding period.

Akbari and Rankaduwa (2006) have investigated the important determinants of the general price level in case of Pakistan by using time series data for the period 1982-2004. The results indicate that the foreign price level of imports, money supply, and domestic output level are most important determinants of the general price level.

Khan *et al.* (2009) checked the determinants of inflation in Pakistan by using data from 1972-73 to 2005-06 by applying Ordinary Least Square (OLS). The study incorporates all important demand side and supply side policy variables while modeling inflation dynamics. Their quantitative analysis reveals that the most significant factor in explaining inflation in 2005-06 were inflation expectations, private sector credit and rising import prices, whereas fiscal policy's contribution to inflation was very low. Adaptive expectations become very dominant at that time when people started expecting higher prices in future as the land prices, house rents and food prices rise.

Khan *et al.* (2009) explained the major descriptive causes for recent inflation trends in Pakistan, by using time series data from 1972 to 2005. By using OLS method the analysis reveals that government sector borrowing, real demand, private sector borrowing, import prices, exchange rate, government taxes, previous year consumer price index and wheat support prices are directly influencing consumer price index of Pakistan.

Abdullah and Kalim (2009) found the main determinants of food price inflation in Pakistan. Johansen co-integration technique has been employed on time series data for the period 1972 to 2008 to estimate long-run results.

The study demonstrates that the money supply, per capita GDP, agriculture support price, food exports and food imports are dominantly affecting food inflation in Pakistan.

Jaffri (2010) investigated the impact of real exchange rate misalignment on CPI inflation in Pakistan by using monthly data from 1993-7 to 2010-3. The study found that foreign inflation significantly affects inflation in Pakistan. Misalignment was found insignificant for the overall period, however, under managed exchange rate regime overvaluation reduces inflation significantly in contrast to flexible exchange rate regime in Pakistan.

Bashir *et al.* (2011) investigated the determinants of inflation in Pakistan using Johansen’s co-integration approach for the data period 1972-2010. The study investigated the demand side and supply side determinants of inflation and causal relationship among some macroeconomic variables in Pakistan. Study found that money supply, gross domestic product, imports and government expenditures are positively affecting consumer price index.

Above literature review highlights various determinants of inflation in Pakistan incorporated in recent studies on determinants of inflation. No previous study has incorporated impact of recent financial crisis on inflation in Pakistan. This study investigates the domestic and foreign determinants of inflation in Pakistan by incorporating a dummy variable for financial crisis of 2008.

III. METHODOLOGY AND RESULTS

For model specification, current study uses augmented Phillips curve models used by Korkmaz (2010) and Genberg and Pauwels (2005).

$$\Delta\text{LCPI} = f(\underset{(+)}{\text{YGAP}}, \underset{(+)}{\Delta\text{LM0}}, \underset{(+)}{\text{INF}(-1)}, \underset{(-)}{\Delta\text{LNEER}}, \underset{(+)}{\text{DUSINF}}, \underset{(+)}{\text{DUM2008}}) \quad (1)$$

The variables incorporated in this study are: Inflation (DLCPI) as a dependent variable and output gap (YGAP), growth in reserve money (ΔLM0), expected future inflation proxied by lagged inflation $\{\text{INF}(-1)\}$, growth in nominal effective exchange rate (ΔLNEER), US inflation as a proxy of foreign inflation (USINF) and DUM2008 in order to capture the effect of financial crises. The signs in the parenthesis reflect the direction of relationship between inflation and explanatory variables as discussed in the literature:

- There exists positive relationship between YGAP and INF. If the output gap is positive through time, means that the actual output is greater than potential level of output, then inflation will start rising in response to demand pressures in the markets. And if the actual output is lower than the potential then it will cause decrease in inflation in the economy.
- Money supply (M0) has apparent positive relationship with inflation (INF). Whenever, the excess money grows as compared to growth rate of economy it causes inflation.
- USINF is taken as a proxy of foreign inflation; positive sign of foreign inflation variable reflects when the prices of imported commodities increase cost of production of the domestic firms rise. In order to cover the cost of production, producers increase the prices of goods and services; this ultimately brings inflation in the economy.
- Inflation expectations are positively correlated with inflation rate. As inflation rate increases into the economy, people's expectation about future inflation also goes up.
- A dummy variable is used in the model in order to capture the effect of unusual price hike of FY2008 during global financial crisis. And positive sign represents that due to financial crises of FY2008, inflation rate is expected to rise significantly in corresponding year.
- Nominal effective exchange rate is expected to negatively affect inflation rate. An increase in the NEER represents appreciation of rupees in effective terms. Appreciation causes decrease in domestic currency prices of imported finished goods and raw material leading to decrease in overall domestic price level.
- The study uses annual time series data from 1972-2010 and sources are International Financial Statistics (IFS), IMF and Annual reports of State Bank of Pakistan (SBP).

To investigate the stationarity of the data, Dickey and Fuller (1979) proposed a test based on following equations for the presence of unit root commonly known as the Dickey Fuller (DF) test.

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \quad (2a)$$

$$\Delta y_t = \beta_1 + \delta y_{t-1} + \varepsilon_t \quad (2b)$$

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \varepsilon_t \quad (2c)$$

Where y_t is the relevant time series and ε_t is the residual term while t is the time trend. The distribution of DF tests is tabulated under the null hypothesis that $\delta = 0$ (*i.e.* unit root) and hence y_t is non-stationary while the alternative hypothesis is $\delta < 0$ (*i.e.* no unit root) and hence y_t is stationary. However, assumption behind DF test was that error term for Equation 2 was serially uncorrelated. In case of violation of this assumption Dickey and Fuller (1981) proposed Augmented Dickey Fuller (ADF) test, an augmented form of Dickey Fuller test with same null and alternate hypothesis.

$$\Delta y_t = \delta y_{t-1} + \sum \beta_i \Delta y_{t-i} + \varepsilon_t \tag{3a}$$

$$\Delta y_t = \beta_1 + \delta y_{t-1} + \sum \beta_i \Delta y_{t-i} + \varepsilon_t \tag{3b}$$

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum \beta_i \Delta y_{t-i} + \varepsilon_t \tag{3c}$$

TABLE 1
Unit Root Test

At Level			At First Difference		
Series	With intercept	With trend and intercept	Series	With intercept	With trend and intercept
LCPI	0.1030 (1)	-3.244 (4)	DLCPI	-3.6291(4)**	-3.4589(4)*
YGAP	-3.006 (0)**	-3.0284(0)**		—	—
LMO	-1.77 (0)	-2.886 (0)	DLMo	-7.0212(0)***	-7.516 (0)***
LNEER	0.69 (0)	-2.895 (1)	DLNEER	-5.3644(0)	-5.9665 (0)***
USINF	-2.1535(0)	-2.6973(0)	DUSINF	-5.2007(0)***	-5.1202 (0)***

***, **, * denote the significance of test statistics at 1 percent, 5 percent and 10 percent level of significance respectively against the null hypothesis of unit root. Figures in the parenthesis represent the lag selection based on Schwarz Information Criterion (SIC). The critical values for ADF test were taken from Mackinnon (1991).

Table 1 shows the results of ADF test indicating that all the variables except YGAP are nonstationary at level, however, stationary at first difference. The order of integration of the variables in the model is not suitable to apply the conventional Johansen’ cointegration techniques as results do not fulfill its prerequisite requiring same order of integration. In such situation, Pesaran *et al.* (2001) suggest an approach for testing the existence of long-run relationship among variables in levels which is applicable irrespective of whether the underlying regressors are purely I(0),

purely I(1) or mutually cointegrated. However, one of the condition of ARDL is that any variable should not be I(2), because Bounds test for cointegration is only applicable to I(0) and I(1) variables.

In Bounds test, the number of regressions estimated by ARDL is equal to $(p + 1)^k = (3 + 1)^5 = 1024$ where $p = 3$ is the maximum number of lags selected based on lag selection criterion (Akaike Information Criterion) and $k = 5$ is the number of variables in the regression.

TABLE 2

Lag Selection Criteria based on Vector Autoregressive Model

Lag Order	Log Likelihood	Akaike Information Criterion	Schwarz Criterion
0	-208.0263	11.83480	12.05473
1	-3.476049	1.859781	3.179380*
2	37.50107	0.972163	3.391428
3	73.92496	0.337502*	3.856433

*Schwarz criterion selects 1 optimal lag whereas Akaike Information Criterion selects 3 lags from maximum 3 lags as allowed in annual data by ARDL method.

Once lag selection has been made on the basis of any lag selection criterion, the next step is to apply Wald Test (F-Statistic) by imposing restrictions on the estimated long-run coefficients in equation (4) to check the existence of long-run relation.

$$\Delta LCPI = \gamma_0 + \gamma_1 \sum_{i=1}^p \Delta LCPI_{t-i} + \gamma_2 \sum_{i=1}^p \Delta YGAP_{t-i} + \gamma_3 \sum_{i=1}^p \Delta LM_{t-i} + \gamma_4 \sum_{i=1}^p \Delta NNEER_{t-i} + \gamma_5 \sum_{i=1}^p \Delta USINF_{t-i} + \gamma_6 LCPI_{t-1} + \gamma_7 YGAP_{t-1} + \gamma_8 LM_{t-1} + \gamma_9 NNEER_{t-1} + \gamma_{10} USINF_{t-1} + \varepsilon_t \quad (4)$$

$H_0: \gamma_6 = \gamma_7 = \gamma_8 = \gamma_9 = \gamma_{10} = 0$ (No evidence of long-run relationships)

$H_1: \gamma_6 \neq \gamma_7 \neq \gamma_8 \neq \gamma_9 \neq \gamma_{10} \neq 0$ (Existence of long-run relationships)

According to Bounds test forwarded by Pesaran *et al.* (2001) if F_{cal} is greater than upper critical value then we can reject null hypothesis of no co integration in favor of existence of long-run relationship. Otherwise, if F_{cal} is lower than lower critical value then it indicates existence of no co integration and if F_{cal} is between two critical values then Bounds test is considered inconclusive in detecting co integration. $F_{cal} = 5.43$ is greater than lower and

upper bounds (3.23 – 4.35) observed from table with unrestricted intercept and no trend at 5 percent level of significance thus indicating existence of long-run relationship. In the next step long-run relationship has been found by applying Ordinary Least Square (OLS) method and results are given in Table 3.

TABLE 3
Long-run Relationship Among Variables

Variables	Coefficients	<i>t</i> -values	Probability
C	-0.4448	-2.5058	0.0181
YGAP	-0.0002	-0.2439	0.8090
LM0	0.0965	4.1608	0.0003
LNEER	-0.0148	-0.8909	0.3803
USINF	0.0051	2.4438	0.0209
LCPI(-1)	1.4601	12.8433	0.0000
LCPI(-2)	-0.6265	-6.2442	0.0000
DUM2008	0.0897	3.8841	0.0005
Adj. $R^2 = 0.99$		DW Stat = 2.27	
Jarque-Bera $\text{Chi}^2(2) = 0.3763(0.8284)$			
Breusch-Godfrey LM $\text{Chi}^2(1) = 2.3131(0.3146)$			
Engle's ARCH LM $\text{Chi}^2(1) = 0.9173 (0.3382)$			
Ramsey's RESET Test = $\text{Chi}^2(1) = 0.2116 (0.641)$			

Source: Estimations of Study

Table 3 shows that in the long-run money supply, foreign inflation, past inflation and DUM2008 positively and significantly affect inflation in Pakistan. However, LNEER and YGAP insignificantly affect inflation, whereas, LNEER has expected sign of coefficient. Table 3 also provides diagnostic tests to ensure existence of no serial correlation, ARCH effect, non-normality of residuals and model specification problem. From this long-run estimated relationship among variables, equilibrium error has been calculated to use it in error correction model in lagged form in Equation (5).

$$\begin{aligned}
\Delta LCPI = & \gamma_0 + \gamma_1 \sum_{i=1}^3 \Delta LCPI_{t-i} + \gamma_2 \sum_{i=1}^3 \Delta YGAP_{t-i} + \gamma_3 \sum_{i=1}^3 \Delta LM_{t-i} + \gamma_4 \sum_{i=1}^3 \Delta LNEER_{t-i} \\
& + \gamma_5 \sum_{i=1}^3 \Delta USINF_{t-i} + \gamma_6 LCPI_{t-1} + \gamma_7 YGAP_{t-1} + \gamma_8 LM_{t-1} + \gamma_9 NEER_{t-1} \\
& + \gamma_{10} USINF_{t-1} + \eta ECM_{t-1} + \varepsilon_t
\end{aligned} \tag{5}$$

TABLE 4

Error Correction Representation for the Selected ARDL-model (2, 1, 1, 1, 1)

Variables	Coefficients	t-values	Probability
C	0.0143	1.2113	0.2363
ECM(-1)	-0.6007	-2.6687	0.0127
$\Delta LCPI(-1)$	0.7157	7.3244	0.0000
$\Delta YGAP$	0.0007	1.0656	0.2960
$\Delta LM0$	0.03543	0.6681	0.5097
$\Delta LNEER$	-0.0382	-1.1810	0.2479
$\Delta USINF$	0.0044	2.1805	0.0381
DUM2008	0.0987	4.2053	0.0003
Adj. $R^2 = 0.7349$		DW Stat = 1.60	
SE of Regression = 0.0196		F-statistic = 13.12	
Prob (F-statistic) = 0.0000		Akaike Info Criterion = -4.8116	
Schwarz Criterion = -4.4157		Jarque-Bera $\text{Chi}^2(2) = 4.006 (0.135)$	
Breusch-Godfrey LM $\text{Chi}^2(1) = 3.56(0.166)$			
Engle's ARCH LM $\text{Chi}^2(1) = 1.2157 (0.2702)$			
Ramsey's RESET Test = $\text{Chi}^2(1) = 0.07 (0.7917)$			

Source: Estimations of Study

Table 4 shows the short run dynamics of inflation (DL CPI) in Pakistan based on ARDL model (2, 1, 1, 1, 1). The results show that inflation is positively affected by change in output gap ($\Delta YGAP$), growth in money supply ($\Delta LM0$), change in foreign inflation ($\Delta USINF$), and by lagged inflation ($\Delta LCPI(-1)$), whereas, it is negatively affected by growth in nominal effective exchange rate ($\Delta LNEER$). Further, inflation is

significantly and positively affected by DUM2008 reflecting inflationary impact of 2008 global financial crisis. Signs of all coefficients in the regression are correct and according to the expectations. The significance of coefficient of lagged error correction term with negative sign confirms convergence towards long-run equilibrium. The value of coefficient of $ECM(-1)$ is -0.6007 showing that 60 percent convergence is achieved in a period of one year.

Adjusted $R^2 = 0.7349$ shows that 73% variation in the dependent variable is being explained by independent variables incorporated in the model. Further, $F\text{-stat} = 10.75$ (0.000005) indicates that at 1% level of significance null hypothesis that independent variables jointly do not affect dependent variable is rejected.

Durbin Watson stat = 1.60 is not close to 2 reflecting presence of autocorrelation, however, in presence of lagged dependent variable as a regressor in the model, DW stat is not applicable. For this purpose, Breusch Godfrey Serial correlation LM test has been applied for first, second and third order serial correlation which shows presence of no serial correlation.

Normality of residuals has been checked by applying Jarque-Bera test. $JB = 1.3981$ (0.4970) does not reject the null hypothesis of normality in residuals of regression.

To check the presence of Autoregressive Heteroskedasticity (ARCH) effect, the study uses ARCH LM test, $\text{Chi}^2(1) = 2.23$ (0.135) shows that null hypothesis of presence of no ARCH effect is not rejected as probability of Chi^2 is 0.135.

Finally, Ramsey Reset Test has been applied to check the stability of the model. $\text{Chi}^2(1) = 1.28$ (0.2580) shows that null hypothesis of stable model cannot be rejected as the probability of Chi^2 is 0.258.

IV. CONCLUSION AND POLICY IMPLICATIONS

The present study estimates impact of domestic and external variables on inflation in Pakistan by applying ARDL method for the annual data from 1972 to 2010. As traditional Phillips curve covers only demand side of the economy, its open economy version also takes into account external sector which realizes the importance of supply side factors in explaining inflation. The results of the study show that money supply significantly increases inflation in Pakistan in the long-run. Although, appreciation in nominal effective exchange rate affects inflation negatively in the long-run and short-run, its coefficients are statistically insignificant. But pass-through of foreign

shocks is clear from significant and positive coefficients of foreign inflation and DUM2008. Foreign inflation proxied by US inflation affects domestic inflation both in the long-run and short-run. Further, DUM2008 significantly and positively affects inflation in Pakistan thus providing empirical evidence of pass-through of external shocks to domestic macroeconomic goal variables. Based on its empirical findings, the study concludes that external shocks need to be seriously considered while making monetary and fiscal policies to control inflation. In rapidly globalizing world, effectiveness of demand management policies in controlling inflation depends on limiting pass-through of external shocks into local inflation.

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