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Empirical Analysis of Food Price Inflation in Pakistan

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Abstract: This study focuses on the identification of main determinants of food price inflation in Pakistan. Using the data from 1972 to 2008, Johansen's co-integration technique is utilized to find out the long run relationships among food price inflation and its determinants like inflation expectations, money supply, per capita GDP, support prices, food imports and food exports. Empirical findings prove the long run relationships among food price inflation and its determinants. All the determinants affect food price inflation positively and significantly except money supply which is insignificant with correct positive sign. In the short run, only inflation expectations, support prices and food exports affect the food price inflation. The results reveal that both demand and supply side factors are the determinants food price inflation in Pakistan. However, our study supports the structulists' point of view of inflation as money supply shows insignificant results.

Key words: Food Price Inflation · Inflation Expectations · Food Exports · Food Imports · Support Prices · Money Supply

INTRODUCTION

In the recent years, food price inflation has risen very sharply at global level. According to [1], the overall and food inflation rates at global level stand at 16.5 and 30.2 percent respectively by November 06, 2007. Reduced level of poverty, increase in per capita income and urbanization are main reasons of sharp increase in demand and prices of some basic food items. For example, in China per capita consumption of meat at 20 Kg in 1985 increased to 50 Kg in 2007 [2]. There is 17 per cent boost in grain consumption from 2000 to 2005 among the oil producing and exporting countries (OPEC) because of their huge export earnings [3]. Demand for bio fuels in rich countries is also an important contributor towards higher prices of some basic food items. There seems a link between food and energy prices as since 2000, prices of oil and wheat have become triple and prices of corn and rice are double now [4].

Because of higher food inflation, households have to make reductions in some areas of food consumption leading to malnutrition. Malnutrition results in productivity losses of up to 10 percent of lifetime earnings and GDP losses of 2-3 percent in the worst affected countries [5]. High inflation erodes the benefits of growth and leaves the poor worse off [6]. It hurts the poor more, since more than half of the budget of low wage earners goes toward food. It redistributes income from fixed income groups to the owners of assets and businessmen and increases the gap between rich and poor [7].

Pakistan has also experienced high food inflation of 17.5 percent and 26.6 percent in 2007-08 and 2008-09 respectively. Moreover, food inflation remained more than 10 percent on average from 1972 to 2009, in the whole history of (West) Pakistan. To determine the factors behind this persistent food inflation is a matter of great interest and concern for the academics and policy makers. But very little research work has been done separately to find the determinants of food price inflation with respect to Pakistan. This paper will try to find both demand and supply side factors of food price inflation in Pakistan. Its findings may provide some important guide lines for policy makers to control the recent inflationary trends of food prices in the country.

Literature Review: The economic literature reveals that demand-side factors and supply-side factors are two major sources of inflation. These factors are discussed under two schools of thoughts, the monetarist and the structuralist.

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The monetarist model has its theoretical foundations on the quantity theory of money which is part of the classical economic theory. It was presented by [8] and [9] tested it empirically.

The structuralist models of inflation emerged in the 1950s. These were supported by [10] and [11]. According to these models, supply-side factors like food prices, administered prices, wages and import prices are the determinants of inflation.

[12] Applied structuralist approach through error correction specification for modeling inflation in India. He concluded that labor and raw material costs were significant determinants of inflation in industrial sector. In agriculture sector, prices of food grains were determined by per capita output, per capita income in agriculture sector and government procurement of food grains.

[13] Studied general inflation and food price inflation separately. They found that inflation is co-integrated with money supply (M2), import price and real GDP. According to their findings, food inflation has also long run relationship with money supply, value added in agriculture and wheat support prices.

[14] Estimated the disaggregated inflation model with respect to different sectors (of Wholesale Price Index) according to their weights in aggregated inflation model. They concluded that supply shocks (production of agricultural goods) have negative impact on food price inflation. Impacts of support prices of wheat and expectations about future inflation were positive and highly significant on food price inflation. Money supply or monetary policy showed an insignificant impact on agriculture food prices.

[15] Found that monetary factors determined the inflation in Pakistan. Broad money growth and private sector credit growth were the key variables of inflation. They included money supply and credit to private sector as standard monetary variables, exchange rate and wheat support prices as supply side factors. Support prices influenced inflation only in short run.

[16] Argued that the monetary shocks had little effect on the agricultural prices. [17] were of the view that agricultural prices had faster response, as compared to the prices of manufacturing products, to a change in money supply in the U.S.A.

[18] Claimed money neutrality did not hold in the determination of agricultural prices in U.S.A. [19] rejected the non neutrality of money supply in the determination of food prices.

[20] Concluded that there is only a weak evidence of the existence of long run co integration between domestic prices, international prices and support prices for key agricultural goods in Pakistan. Only in the case of wheat, the evidence is strong.

According to [21], there are different structural and cyclical factors determining the food prices in developing Asian countries. Production growth has fallen below the consumption growth for several years. There is 43% decline in rice and wheat stocks if we compare 2000 and 2007.

[22] Found that international food commodity prices and producer prices determine the domestic food and non-food prices in Ethopia. Inflation expectations (inertia) affected food price inflation more as compared to non-food inflation. In the short and medium run, agriculture supply shocks and inertia affect the inflation in the country.

Methodology and Data Sources: We have applied Augmented Dickey-Fuller (ADF) test proposed by [23] and [24] to investigate the stationarity and order of integration of time series data used in this study.

Co-integration is a popular econometric technique which is used to find long run relationship between variables. In this study Johansen co-integration method is used to investigate long-run relationship among the concerned variables. [25] is a better technique than[26]. [26] method finds out only one co-integrating vector through two step estimation approach. While on the other hand, number of vectors can be found using maximum likelihood testing procedure suggested by [25] in the Vector Autoregressive (VAR) representation.

The general form of VAR can be written as following:

$$\Upsilon_t = \delta + B_j \Upsilon_{t-1} + \ldots\ldots + B_k \Upsilon_{t-k} + \varepsilon_t$$

$$= \delta + \sum_{j=1}^{k} B_j \Upsilon_{t-j} + \varepsilon_t \quad (1)$$

Where Υ_t represents (n×1) column vector of k variables whose order of integration is same, δ is a (n×1) vector of constants, B_t .... B_{t-k} are representing parameters and ε_t is an error term which is independently and identically distributed.

The above equation (6) of general VAR model can also be rewritten in the following alternative way to represent the Vector Error Correction Model (VECM).

$$\Delta\Upsilon_t = \delta + \sum_{j=1}^{k-1} \Pi_i \Delta\Upsilon_{t-j} + \Pi\Upsilon_{t-1} + \varepsilon_t \quad (2)$$

Where Υ_t is a (n×1) column vector of k variables, δ and ε_t are (n×1) vector of constants and usual error term respectively. Δ is difference operator. Π and Π_t are representing coefficient matrices. The coefficient matrix Π_t is also called an impact matrix which tells about the long run relationship. The other coefficient matrix Π captures the short run impact.

The following VECM representation of concerned variables is specified for this study to determine short run relationships.

$$\Delta FPI_t = \alpha_0 + \sum_{j=1}^{n} \alpha_{1j} \Delta FPI_{(t-1)} + \sum_{j=1}^{n} \alpha_{2j} \Delta M2G_t + \sum_{j=1}^{n} \alpha_{3j} \Delta PGDP_t + \sum_{j=1}^{n} \alpha_{4j} \Delta ASP_t + \sum_{j=1}^{n} \alpha_{5j} \Delta FX_t + \sum_{j=1}^{n} \alpha_{6j} \Delta FM_t + \lambda ECT_{t-1} + \varepsilon_t \quad (3)$$

If the coefficient (λ) of ECT_{t-1} is significant, it means that short run relationship exists among the variables. The value of coefficient (λ) explains the speed of adjustment towards the long run equilibrium. Its negative sign explains convergence to the long run equilibrium and positive sign indicates divergence from the long run equilibrium. According to [27] and [28]. (1998), significance of ECT_{t-1} with a negative coefficient is another proof and efficient way for establishing co-integration relationship.

Annual data from 1972 to 2008 of concerned variables has been used in this study. CPI food has been used as a proxy of food price inflation (FPI). Data of CPI food has been collected from various issues of Pakistan Economic Survey. Data of wheat support price as proxy agricultural support prices (ASP) has also been collected from various issues of Pakistan Economic Survey [29] and [30]. Data of per capita gross domestic product (PGDP), growth rate of money supply (M2G), food exports (FX) and food imports (FM) have been taken from World Development Indicators (WDI) online database [31].

Empirical Results: In this study, ADF unit root test has been used to check the stationarity and order of integration of time series data of the variables of our interest. Schwarz Information Criterion has been used for maximum lag selection for applying ADF unit root test. The results of ADF test are presented in Table 1.

The results displayed in Table 1 indicate that all variables are integrated of order one I(1) as they are stationary at first difference and non-stationary at level.

Lag selection criterions like sequential modified likelihood ratio (LR), Final prediction error (FPE), Aikaike information criterion (AIK), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) suggest an optimal lag length of one which has been used in our analysis. Results of these criterions are reported in Table 2.

As the variables have same order of integration, therefore Johansen co-integration can be applied to find the long-run relationship of food price inflation, growth of money supply, per capita GDP, agricultural support prices, food exports and food imports.The results of Johansen's co-integration test have been reported in Table 3.

Both the Maximum Eigen Statistics λ_{max} and Trace Statistics λ_{trace} confirm the existence of co-integration and same number (two) of co-integrating vectors. The Trace-test Statistics is 141.98, which is greater than the critical value of 95.75 at 5 percent significance level. Therefore, null hypothesis $r \leq 0$ is rejected against the alternative hypothesis r=1. The null hypothesis of $r \leq 1$ is also rejected in favor of alternative hypothesis of r = 2 because trace statistics 82.89 is greater than the critical value of 69.82 at 5 percent level of significance. The Max Eigen-test Statistics is 59.08, which is greater than the critical value of 40.08 at 5 percent significance level. Therefore, null hypothesis $r \leq 0$ is rejected against the alternative hypothesis r= 1. We also reject the null hypothesis of $r \leq 1$ against alternative hypothesis of r=2 because Maximum Eigen Statistics 37.82 is greater than the critical value of 33.88 at 5 percent level of significance.

After confirming the long run relationship among food price inflation, growth of money supply, per capita GDP, agricultural support prices, food imports and food exports, the long run coefficients are reported in Table 4.

The results reported in Table 4 show that impact of all dependent variables, except money supply growth, on food price inflation is positive and statistically significant. According to results, on average one unit change in FPI_{t-1}, which represents inflation expectations or inertia, will increase CPI food by 0.7 units. Although money supply growth is not impacting food price inflation significantly but its coefficient bears the correct positive sign. One unit (one rupee) average increase in per capita GDP increases food price inflation by 0.0017 units. Wheat support price also has inflationary and significant impact on food price inflation. One unit (one rupee) average increase in wheat

Table 1: Augmented Dickey-Fuller (ADF) Test for Unit Root

	At Level		At 1st Difference	
Variables	t-statistics of ADF	Prob.Values	t-statistics of ADF	Prob.Values
FPI_t	1.9729	1.000	-4.0928*	0.0156
$M2G_t$	-2.2862	0.4262	-7.8567**	0.0000
$PGDP_t$	-2.9655	0.1601	-3.4095*	0.0173
ASP_t	1.2472	0.9999	-3.7743*	0.0302
FX_t	-2.6561	0.2597	-8.2416**	0.0000
FM_t	-3.1421	0.1127	-6.0840**	0.0000

Note: * represents significant level at 1%.
** represent significant level at 5%.

Table 2: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-932.2801	NA	7.77e+15	53.61601	53.88264	53.70805
1	-733.2516	318.4457*	7.22e+11*	44.30009*	46.16651*	44.94438*
2	-700.1105	41.66312	1.03e+12	44.46346	47.92966	45.65999

* Indicates lag order selected by the criterion
LR: sequential modified likelihood ratio test statistic (each test at 5percent level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 3: Unrestricted Co-integration Rank Test (Trace and Maximum Eigen value)

Unrestricted Co-integration Rank Test (Trace)				
H_0	H_1	Trace Statistics	0.05 Critical Value	Prob.[a]
r = 0*	r = 1	141.9786	95.75366	0.0000
r = 1*	r = 2	82.89489	69.81889	0.0032
r = 2	r = 3	45.08015	47.85613	0.0891
r = 3	r = 4	18.41380	29.79707	0.5356
Unrestricted Co-integration Rank Test (Maximum Eigen value)				
H_0	H_1	Max-Eigen Statistics	0.05 Critical Value	Prob.[a]
r = 0*	r = 1	59.08367	40.07757	0.0001
r = 1*	r = 2	37.81475	33.87687	0.0161
r = 2	r = 3	26.66635	27.58434	0.0652
r = 3	r = 4	12.69969	21.13162	0.4803

[a]MacKinnon-Haug-Michelis (1999) p-values
* Denotes rejection of the null hypothesis at the 0.05 level

Table 4: Long Run Relationships

Dependent Variable = FPI_t			
Variable	Coefficient	T-Statistic	Prob-Value
Constant	-44.90991	-4.941833	0.0000
FPI_{t-1}	0.735522	15.78609	0.0000
$M2G_t$	0.073152	1.499076	0.1447
$PGDP_t$	0.001740	5.343473	0.0000
ASP_t	0.055197	4.131034	0.0003
FX_t	0.479935	3.675908	0.0010
FM_t	0.272316	2.384839	0.0238

R^2= 0.9986
Adj-R^2 = 0.9984
F-Statistic= 3656.589
Prob(F-statistic)= 0.0000
Durbin-Watson = 2.1329

Table 5: Short Run Relationships

Dependent Variable = ΔFPI_t			
Variable	Coefficient	T-Statistic	Prob-Value
Constant	-0.163500	-0.219200	0.8284
ΔFPI_{t-1}	0.800563	3.808210	0.0009
$\Delta M2G_t$	0.059029	1.530154	0.1396
$\Delta PGDP_t$	0.001114	1.477726	0.1530
$\Delta PGDP_{t-1}$	0.000463	0.536597	0.5967
ΔASP_t	0.058287	4.446252	0.0002
ΔASP_{t-1}	-0.006688	-0.219333	0.8283
ΔFX_t	0.354770	2.831904	0.0094
ΔFX_{t-1}	0.134124	1.919740	0.0674
ΔFM_t	0.275443	1.794954	0.0858
ΔFM_{t-1}	0.009114	0.071144	0.9439
ECT_{t-1}	-0.991143	-3.614136	0.0015

R^2= 0.915113
Adj-R^2 = 0.874
F-Statistic= 22.54085
Prob(F-statistic)= 0.000
Durbin-Watson = 2.092

support price results in 0.05 unit increase in food CPI. One percentage point increase in food exports and food imports cause 0.48 and 0.27 unit increase in food CPI respectively.

VECM has been used to find out the short run dynamics. The results of short run dynamics of the variables are reported in Table 5. According to these results only three variables inflation expectations (ΔFPI_{-t-1}), agricultural support prices (ΔASP_t) and food exports (ΔFX_t) are showing statistically significant effect on food price inflation. All other variables are statistically insignificant in short run.

The error correction term of our short run model is also statistically significant with a negative sign. It is another proof that long run relationship exists among the variables we used in this study. The negative value of coefficient of ECT_{t-1}, which is (-0.9), indicates the very high speed of convergence towards equilibrium. It may be justified because food price inflation, even more than general inflation, is very sensitive to policy shocks like administered prices (support prices), trade policy (export of food) and inertia (inflation expectations).

CONCLUSION

In the recent years, food price inflation has risen very sharply at global level. It has increased the living cost of households especially in developing countries like Pakistan which results in malnutrition and, therefore, productivity losses. It hurts the poor more because they spend more than half of their budget on food.

Time series data from 1972 to 2008 of relevant variables was used for empirical analysis. All variables were integrated of order one I(1) as they became stationary at their first differences at 5% level of significance. As the variables had same order of integration, therefore Johansen co-integration was applied to find the long-run relationships. Maximum Eigen Statistics λ_{max} and Trace Statistics λ_{trace} were used. Both statistics confirmed the existence of co-integration and same number (two) of co-integrating vectors. The impact of all dependent variables on food price inflation was positive and statistically significant except money supply growth. All the coefficients had expected positive signs.

The results revealed that both demand and supply side factors determined food price inflation in Pakistan. However, on the basis of empirical results we may conclude that food price inflation is not a monetary phenomenon in Pakistan (money supply growth is statistically insignificant). While the supply side factor or structural factors have dominant role in determining the food prices.

Vector Error Correction Model (VECM) had been used for the analysis of short run dynamics. In the short run, only inflation expectations, support prices and food exports affected the food price inflation. The negative value of coefficient of ECT_{t-1}, which is (-0.9), indicated the very high speed of convergence towards equilibrium.

Policy Implications: Findings of the study show that 'inflation expectations' has dominant role in determining food price inflation both in long run and short run in

Pakistan. Therefore, there should be continuity and consistency in government's economic policies so that people may rely on these polices and do not expect inflationary trends in the future.

Support prices are the second major source of food price inflation in Pakistan. Government should pursue a moderate policy in raising support prices. Government should also encourage and support farmers to adopt modern technology for higher production with lower production cost.

Economic growth (increase in per capita GDP) is also contributing towards food price inflation according to this study. It is because the percentage share of services and manufacturing sectors to GDP is growing rapidly as compared to agricultural sector in Pakistan. Government should formulate proper policy for agriculture sector to fill the output gap. Sufficient credit facilities should be provided through formal and informal channel. Government should also take measures to improve infrastructure, agriculture markets and land ownership system.

According to our analysis, imports of food items are also inflationary because of higher prices of food item at global level and exchange rate depreciation. As a policy measure, we need to exploit our unrealized yield potential in production of food items as God has gifted us with all necessary resources.

This study reveals that food exports affect food price inflation positively not only in the long run but also in the short run. Government should ban the exports of food items until they are over and above the domestic needs. For price stability in the country, buffer stocks of essential food items like wheat, sugar and pulses should be maintained. There should be maximum control on smuggling of wheat, rice and live stock to neighboring countries.

Empirical results of this study prove that growth in money supply or expansionary monetary policy does not affect food price inflation significantly in Pakistan. In this situation it is suggested that government should encourage the expansion in private sector credit, especially towards the agricultural and its related sectors. Increase in public expenditures on the provision of infrastructure for rural areas will also be helpful for optimal utilization of the potential of agriculture sector.

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