The Determinants of Food Prices:
A Case Study of Pakistan

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C O N T E N T S

ABSTRACT

Controlling prices is one of the major tasks for the macroeconomic policy-makers. The recent oil price hike that shifted the policy towards biofuels and some natural calamities increased food prices around the world. This paper analyses the demand- and supply-side factors that affect food prices in Pakistan. Long-run relationship is analysed using the Autoregressive Distributed Lag Model (ARDL) for the period 1970 to 2008. The result indicates that supply-side factors (subsidies and world food prices) have a significant impact on food prices, whereas demand-side factors, such as money supply, are the main cause of the increase in food prices in the short as well as the long run. The error correction is statistically significant and shows that market forces play an active role to restore the long-run equilibrium.

Keywords: Food Prices, ARDL Approach, Pakistan

INTRODUCTION

Controlling food prices is one of the biggest tasks for the macroeconomic policymakers. This task is difficult as they need to consider a number of external, structural, and demand factors that are involved in manoeuvring food prices, including international food prices, subsidies, and the quantity of food crops in that particular year as well as in the past years.

According to Trostle (2008), the world market prices of major food items such as vegetable oil and food grain, which are the two main essential items used in every household, have increased sharply by more than 60 percent in just two years around the world. Thus the rise in food prices is a greater concern for the policy-makers as it directly affects the poor and below average families with a significant proportion of their income being spent on food.

An increase in food prices creates several problems for the poors, especially on account of allocation of budgets on non-food items including health and schooling. According to UN (2008) in Pakistan the poorest households now need to spend 70 percent or more of their income on food and their ability to meet most essential expenditures for health and education is severely compromised. This will lead to more dropouts from schools and one implication would be lower chances of achieving the Millennium Development Goals (MDG) targets of 100 percent primary completion. Similarly, the malnourishment target will also be difficult to achieve.

Food inflation was very low in the first four years of the decade of 2000 but it doubled after 2005-06 (see Table 1). The severity of the problem rose when it went up to the 26.6 percent in 2008-09, which is the highest in 23 years. An increase in food prices in Pakistan is generally associated with the decline in wheat production, increase in international food prices, political economy factors, mismanagement, etc.

Food prices are affected by demand factors as well as supply factors. Moreover, they are also determined by structural and cyclical factors, as well as domestic and world markets. In this paper our focus is on identifying the determinants of food prices in Pakistan. This paper is organised as follows: Section I reviews the determinants of food prices; Section II presents methodology; Section II explains data and variables; Section IV provides a descriptive analysis; Section V describes the analytical framework; Section VI interprets the empirical findings and results; Section VII performs a stability test on the residuals variance; Section VIII draws the main conclusions of the study.

Table 1

Food Inflation in Pakistan

Years	Food Inflation	Years	Food Inflation
1971-72	3.39	1990-91	12.91
1972-73	10.59	1991-92	9.94
1973-74	34.79	1992-93	11.89
1974-75	27.80	1993-94	11.34
1975-76	10.98	1994-95	16.49
1976-77	12.15	1995-96	10.13
1977-78	7.82	1996-97	11.90
1978-79	6.09	1997-98	7.65
1979-80	8.50	1998-99	6.46
1980-81	13.08	1999-00	1.68
1981-82	13.56	2000-01	3.56
1982-83	2.75	2001-02	2.50
1983-84	7.90	2002-03	2.83
1984-85	5.91	2003-04	6.02
1985-86	2.58	2004-05	12.48
1986-87	3.97	2005-06	6.92
1987-88	8.02	2006-07	10.28
1988-89	14.15	2007-08	14.36
1989-90	4.47	2008-09	26.61
		2009-10	11.84

Source: Pakistan Economic Survey (Various Issues).

I. DETERMINANTS OF FOOD PRICES:
LITERATURE REVIEW

Several studies have been carried out on the determinants of food prices, especially after the recent increase in food prices. The first major food price hike was observed in 1973. Eckstein and Heien (1978) analysed the relevant factors find the food inflation levels in the United States in 1973 and they found that the monetary policy and actions taken by the US as well as foreign governments, the Soviet grain deal, world economic conditions, devaluation of the dollar, and the rapid growth of income as the US economy moved out from the recession were the key factors for the rise in food inflation. Lamm and Westcott (1981) found that an increase in factor prices affected the food prices. Moreover, the increase in farm level prices and substantial increases in non-farm resource prices appear to explain why food prices were affected more than non-food prices in the 1970s.

Laap (1990) results showed that variations in the growth rate of money supply, whether it is anticipated or unanticipated, did not affect the average level of prices received by farmers relative to the other prices in the economy during

the period of 1951–85. The positive impact of unexpected money growth on the relative price of agricultural commodity was significant for a short period. His findings show that the estimated effect is quantitatively small and, economically, there is no significant variation in the relative prices of agricultural commodities.

Khan and Qasim (1996) found food inflation to be driven by money supply, value added in manufacturing wheat support price, and the price of utility. Non-food inflation is determined by money supply, real GDP, import prices, and electricity prices. It is not surprising that changes in the wheat support price affect the food price index, given that wheat products account for 14 percent of the index.

Khan and Gill (2007) analysed the impact of money on food and general price indices by using the OLS technique during the period of 1975–2007. Their results shows that CPI food, CPI general, WPI general, GDP deflator, and SPI are negatively related with M1 and M2 supply of money, whereas CPI food, CPI general, WPI general, GDP deflator, and SPI are positively related with M3 supply of money. It is concluded that M1 supply of money affects the CPI general more than CPI food.

The Asian Development Bank (ADB) (2008) addresses three sets of factors that are the main cause high food prices in developing countries of Asia. First is the distinction between supply and demand; second is the distinction between structural and cyclical factors; and third is the relationship between international and domestic markets.

The structural factor identifies is falling production growth below consumption growth for several years. Rice and wheat stocks have ebbed and now are about 200 million metric tons, compared with 350 million metric tons in 2000, a decline of about 43 percent [United States Department of Agriculture [USDA (2008)]. The annual growth rate of the production of aggregate grains and oilseeds has slowed down. Between 1970 and 1990, production rose to an average of 2.2 percent per annum. Since 1990, the growth rate has declined to about 1.3 percent per annum USDA's 10-year agricultural projections for the US and world agriculture saw a declining rate of 1.2 percent per annum between 2009 and 2017.

One of the two most important demand factors which influences food prices is the change in dietary habits of the people of emerging market countries due to an increase in their income. The people, who are enjoying a higher income now, have shifted to meat and dairy products, which require a large amount of grain feed for the livestock, and hence a decline in the production of grain for human beings. The other major policy factor which affects food prices is the competitive use of food grain for the production of ethanol as a substitute for oil. Thus, biofuel demand is rising and is leading to the diversion of grain, soybeans, sugar, and vegetable oil from their use as food or feed [ADB (2008)].

Capehart and Richardson (2008) argue that higher commodity and energy cost are the leading factors behind higher food prices in USA. Moreover, they address the rapidly changing consumption pattern, i.e., a higher demand for processed food and meat in countries such as China and India, which in turn requires more feed grains and edible oil. At the world level, the stocks of corn, wheat, and soybean are reducing, with the world stock for wheat at a 30-year low, which in turn raises the food prices.

Some important supply side determinants are urbanisation and the competitive demand for land for commercial as opposed to agricultural purposes (Ibid). Moreover, the neglect of investment in agricultural technology, infrastructure, and extension programmes are also to blame for the rapid growth in the supply of rice [International Rice Research Institute (IRRI) (2008)].

Gomez (2008) found that the inflation rates and exchange rates of China and India is the key in explaining important food inflation in Colombia. However, they argue that the recent increase in food inflation in Colombia in 2007 was due to drought and an expansionary monetary policy. They further argue that this effect is only short-term. The change in consumption habit due to a rise in the per capita income increases the demand of meat relative to the demand of cereals, which in turn causes food inflation. Food inflation can be reduced by increasing agricultural growth, which can be beneficial for poor countries.

Naim (2008) argues that the causes for inflation are increasing energy prices, non-food hedging policy against the drought years, speculation in food commodity markets, and the US corn ethanol policy.

Trostle (2008) examines the factors for the rise in world market prices of food commodities. He concludes that some factors reflect the slower growth in production and the rapid increase in demand that increase the food prices. Food prices are also affected by the global demand of biofuels feed stocks and adverse weather conditions in 2006 an 2007. Food inflation is also affected by the decline in the value of the US dollar, rising energy prices, increasing agriculture cost of production, growing foreign exchange holdings by major food-importing countries and policies adopted recently by some exporting and importing countries can be cause of food price inflation.

Increase in Global food inflation leads to an increase in the prices of products in the home country especially, if the country is an importer of a specific product. For Instance, Pakistan imported 2.5 million tons of wheat at higher prices in 2008, thus inviting inflation in the country as it was not subsidised by the government. However, if it was subsidised, then fiscal deficit would increase and in any case financing through bank borrowing would increase the inflation in the long run as well as the interest rates.

In Pakistan, political economy, like other economic determinants, plays an important role in food inflation. Smuggling of wheat across the border,

especially due to governance problem, hoarding of wheat and other commodities by the stockists when their prices are increasing remain the main issues, while anti-protectionist policymakers always believe that there is no hurdle the system. However, restricting the export of wheat, especially would be effective in combating the problem of increase in food prices.

II. METHODOLOGY

In this section, we formulate a framework of analysis to determine the various factors which could potentially affect the food inflation in Pakistan. We know that inflation is always a monetary phenomenon in the long run [See, for example, Haque and Abdul Qayyum (2006) and Kemal (2006)]. According to [Khan and Qasim (1996)], money supply is also the major causes of food inflation in case of Pakistan. Similarly, there are many other demand and supply factors that play a crucial role in explaining the increase in food prices as explained in the previous section. We shall analyse some of these factors that have a strong influence on food inflation.

Demand side factors which raise the quantity demand of food items are:

$$Q_d^F = \alpha_0 + \alpha_1 FP + \alpha_2 PCI + \alpha_3 MS + u_d \qquad \ldots \qquad \ldots \qquad \ldots \qquad (1)$$

Where FP represents prices of food items, which affect demand negatively. PCI represents the per capita income, which is positively associated with food demand, and MS represents money supply used as a proxy to money demand with an equality constraint (i.e., MS=MD). It is positively associated with the demand for food, and u_d represents error term.

Supply side factors which affect the quantity supply of food items :

$$Q_s^F = \beta_0 + \beta_1 FP + \beta_2 SUB + B_3 BI + \beta_4 Y + u_s \qquad \ldots \qquad \ldots \qquad \ldots \qquad (2)$$

A positive association is expected to exist between quantity supply and food prices (FP), SUB represents subsidy on agriculture, which is positively associated with the supply of food, Y is the output of food items per year in the country, which is positively associated with the supply of food, BI is bureaucracy index. With more efficiency of the bureaucracy, the quantity supply increase so it has a positive relationship with quantity supply and u_s represents error term.

The prices of food items are determined at the equilibrium when the quantity demand of food items is equal to the quantity supply of food items, hence

$$Q_d^F = Q_s^F \qquad \Rightarrow$$
$$\alpha_0 + \alpha_1 FP + \alpha_2 PCI + \alpha_3 MS + u_d = \beta_0 + \beta_1 FP + \beta_2 SUB + \beta_4 BI + \beta_5 Y + u_s$$

After re-arranging:

$$FP = \gamma_0 + \gamma_1 PCI + \gamma_2 MS + \gamma_4 SUB + \gamma_5 Y + \gamma_6 BI + v \qquad \dots \qquad \dots \qquad (3)$$

Equation (3) represents the demand and supply equation with a structural and cyclical parameter Y, which shows the current production and overtime increase or decrease in food production. However, what still missing, is the international food prices. The following Equation (4) represents our final equation including the world food prices and all the variables that are in log form.

$$\log(FP) = \gamma_0 + \gamma_1 \log(PCI) + \gamma_2 \log(MS) + \gamma_4 \log(SUB) + \gamma_5 \log(Y) + \\ \gamma_6 \log(BI) + \gamma_7 \log(WFP) + v \qquad \dots \qquad (4)$$

III. DATA AND VARIABLES

Data on food CPI, per capita income in rupees, population in millions, and money supply in millions are taken from various issues of the *Pakistan Economic Survey*. Data on agricultural subsidy in millions are taken from *Budget in Briefs*, data on food crop in tons are taken from the *Agriculture Statistics of Pakistan*, data on bureaucratic efficiency are taken from the *International Country Risk Guide*, and data on world food prices are taken from the *International Financial Statistics*. The annual data for all the variables are taken from 1970–2010, which gives us enough leverage to apply the cointegration analysis. However, the data of world food prices are available till 2008. All of the variables used in log form give direct elasticities.

Since a review of the literature section gives us little insight, we are using the explanatory variables in Equation (4) but to understand it more explicitly let us look at the expected signs of the explanatory variables on the dependant variable, food prices.

Per Capita Income (PCI)

We include *PCI* as a demand side determinant of food price inflation. It is used as a proxy of dietary habits of the nation. A higher *PCI* leads to a higher consumption of food as well as a change in the dietary habits, i.e., increased consumption of meat and dairy products rather than that of cereals. This requires a large amount of grain feed for the livestock and hence a decline in the production of grain for human beings. An increase in the food prices follows as grain for human beings is now more valuable. Thus per capita income is expected to be positively associated with food prices.

Agricultural Subsidy (SUB)

Agriculture subsidy is another supply side determinant of food prices. Subsidies help to reduce the cost of production and hence decrease the food prices. Thus agriculture subsidy is negatively associated with food prices.

Money Supply (MS) Unit

Money Supply is the proxy to money demand through the equality constraint (i.e., MS=MD) because people demand more money to spend on the consumption of food. More demand for money leads to an increase in prices. When more money is demanded for the consumption of food, then food prices go up. The higher the money demand the higher would be the money supply and the higher food prices. Therefore, money supply is positively associated with food prices.

Bureaucracy Index (BI)

Bureaucracy efficiency index has been calculated using data from the *International Country Risk Guide (ICRG)*. The index is composed of corruption index, bureaucracy quality, democratic accountability, and military in politics (For details, see Appendix). Bureaucracy index is a supply-side determinant. A simple and effective bureaucratic system smoothes the process and decreases the transaction costs, which in turn decrease the prices. An effective and efficient bureaucracy would ensure price management of food, and steps about smuggling, corruption prohibition, etc.

Agriculture Output (Y)

Food crops are taken as an agricultural output, which is a structural and cyclical variable in the long run representing the output of food items. This variable represents changes overtime in the production and cyclical movement, as shown in Graph 1.
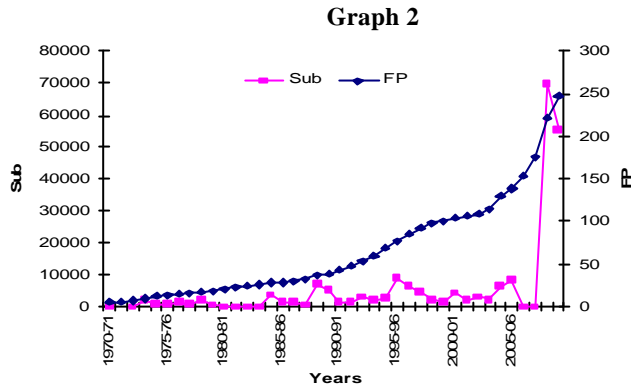
Graph 1
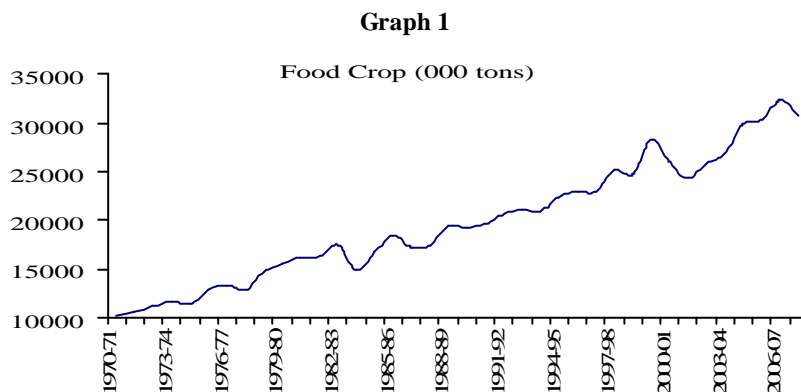
World Food Prices (WFP)

World Food Prices is the third type of determinant of food prices as discussed in ADB (2008). It shows the interlinkages between domestic and international markets.

However, if we do not have to import food items , and international prices go up in the international market, it affects the domestic market as well. Thus world food prices are positively associated with domestic food prices.

IV. DATA DESCRIPTIVE ANALYSIS

Graph 2 shows the relationship between subsidies and annual food prices. It has a negative association in one period (1990-1995) and a positive association in another period (1998–2007). Overall, in the long run, their association seems to be ambiguous.

Graph 2

Graph 3 shows a significant positive long-term association between per capita income and food prices. However, while carefully looking at the graph, we observe that apart from the period between 1995 and 2003, food prices grow at an increasing rate, while the per capita income increases at a decreasing rate till early 2000, and then it increases at a constant rate. The correlation between the two variables is very high, i.e., 93.35 percent, which shows a significant association among the two variables.
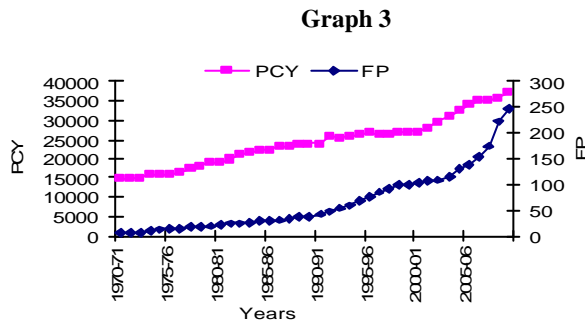
Graph 3

Graph 4 shows that that there is positive and strong relationship betwe en money supply and food prices which implies that the association between the two variables is significantly strong in the long run.

Graph 4
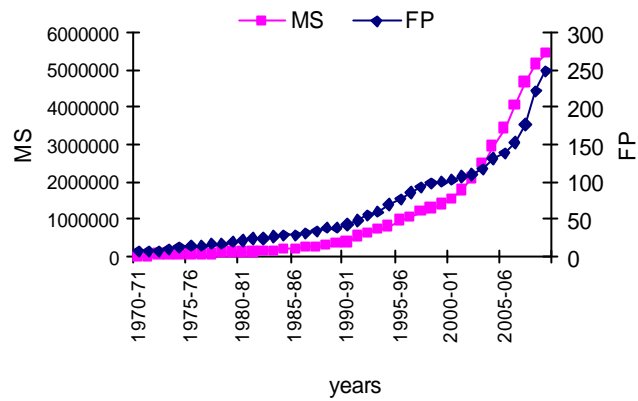
Output which shows structural and cyclical variations of food crops over time is negatively related to the annual food prices as depicted in Graph 5. Initially, it shows a lag behaviour. From 1995-2003, it shows a negative association, and in the end it shows some positive association.

Graph 5
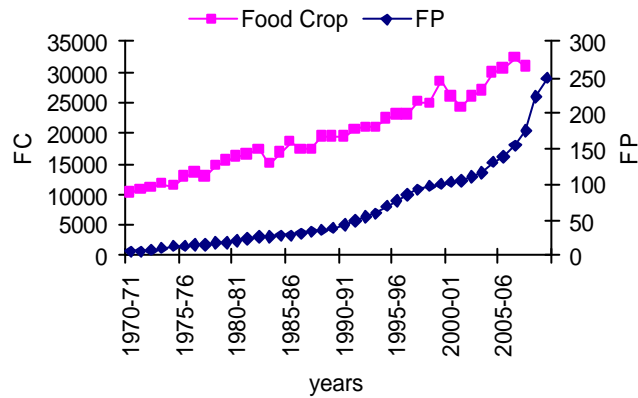
Graph 6 depicts some ambiguous results between food prices and World Food Prices, but since 1989-99, both the series have the same trend and a significant long run association over time.

Graph 6
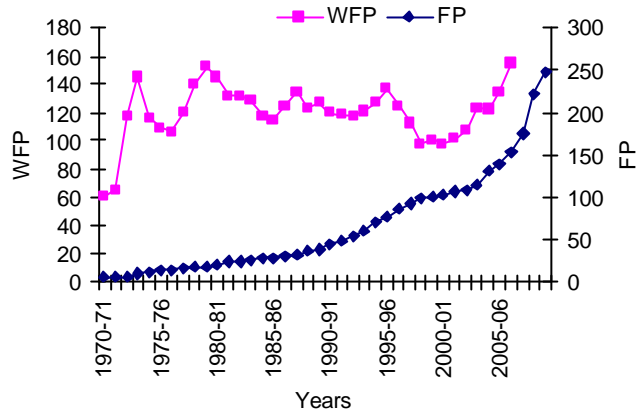
Graph 7
Bureaucracy Index
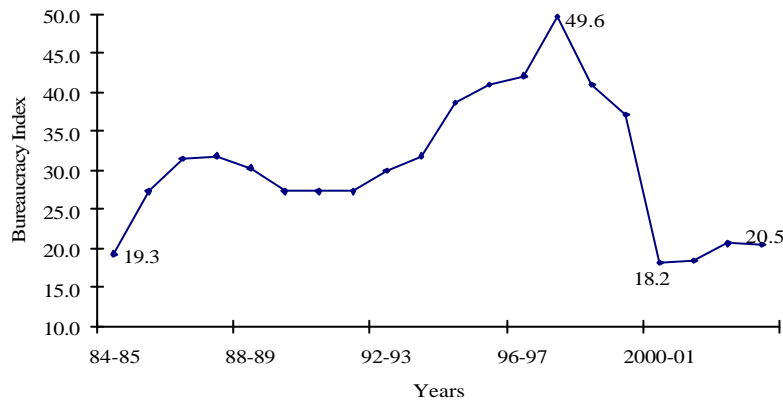
Pakistan has not as yet seen a sustainable and appropriate price control policy implementation. Prices of different consumer goods especially food items have been on the rise and the government has not as yet been successful in curbing the price hike. World oil price has seen dramatic changes. Oil prices have been well above $100 a barrel. With this price, the economy has suffered, and it has also been a drag on the producers and consumers. But as the world

faces a financial recession there has been a significant reduction in oil prices—to the value of $42 per barrel. But, so far, the government has so far not been able to transfer the benefits of low oil prices to the producers and consumers in the country. Pakistan has reduced the import duty on the raw material and it is also imported it from China on competitive prices, but the benefits of reduction in import duties and the price of the raw material has not yet been passed on to the consumer.

Hoarding and smuggling further aggravated the situation. Food items especially wheat, have been hoarded as well as smuggled to neighbouring countries, especially Afghanistan. The failure of the authorities to prevent hoarding and smuggling has made the food prices more volatile. The recent urea crunch also portrays a failure on the part of the bureaucracy to curb hoarding and smuggling. Although the government is providing a huge subsidy on urea, the farmers cannot find this fertiliser in the market. It is smuggled to Afghanistan as it is sold at a higher price there. This shortage of urea will damage, among other crops, the wheat crop in particular. With high production costs, less water, the energy crisis, and now this fertiliser crunch, Pakistan is not expected to achieve the targetted output of 25 million tons of wheat in 2008-09. Pakistani government has spent billions of rupees to mobilise farmers to cultivate more and more wheat, but now it is not taking any actions to check black marketing and shortage of urea. If timely and appropriate measures are not taken, the expected outcome of all this is again a price hike, and shortage of wheat. Inefficiency of the bureaucracy and the lack of accountability of the service providers will lead to a price shock. A high price of sugar due to hoarding is another example of the failure of the bureaucracy to control the food price hike. Data on the components of the bureaucratic efficiency index are available for 1984-2004 only. So it has not been used in the regression.

V. ANALYTICAL FRAMEWORK

Since we are interested in examining the determinants of food prices in the long run as well as in the short run, we have used a cointegration analysis. There are a few techniques available for such analysis, such as the Johansen Approach, the Engle Granger Approach, and the ARDL approach. However, the basic start for each approach is almost the same, i.e. if the variables are integrated of the same order and their linear combination is integrated of the order less than the order of the variables, implies that there exists cointegration among the variables. However, more recent approaches are also used for those variables that are integrated of different orders.

Unit Root Test

The Augmented Dickey Fuller (ADF) test, using both constant and trend, on log of all the variables is used to check the unit root of the series. If the series

has a unit root (not stationary at levels), then it implies that the series is non-stationary. If the series is stationary of the same order, say 1,[1] and their linear combination is integrated of the order less than the order of the variables, then it implies that there may exist a long-run relation among the variables. Lagged differences are an essential part of the ADF test to avoid the problem of serial correlation. Optimal levels of lags are chosen by using minimum Akaike Information Criterion (AIC). Specifications of the ADF tests are:

$$\log(y_t) = \rho \log(y_{t-i}) + \gamma \sum_{i=1}^{n} \Delta \log(y_{t-i}) \qquad \dots \qquad \dots \qquad \dots \quad (5)$$

$$\log(y_t) = \alpha + \rho \log(y_{t-i}) + \gamma \sum_{i=1}^{n} \Delta \log(y_{t-i}) \qquad \dots \qquad \dots \qquad \dots \quad (6)$$

$$\log(y_t) = \alpha + \beta t + \rho \log(y_{t-i}) + \gamma \sum_{i=1}^{n} \Delta \log(y_{t-i}) \qquad \dots \qquad \dots \quad (7)$$

Where y is any variable, t is the trend variable, ρ is the autocorrelation coefficient, α and β are parameters, ε is the error term, and the subscript t shows the time periods.

Thus the stationarity test is applied on any three auto-regressive processes of the following orders; one with no intercept or trend, one with intercept but no trend, and one with both intercept and trend. Lag differences are checked using minimum AIC or SBC. Our one-tailed null hypothesis is:

$$H_o = \rho \geq 1$$
$$H_A = \rho < 1$$

If H_0 is rejected, the series has no unit root and it is therefore stationary. On the other hand, if H_0 is not rejected, we conclude that there is a unit root in the series and it is non-stationary. The test is first applied on the levels, and if the level is non-stationary, then the test is applied on the first difference. If the first difference is also non-stationary, the test is then applied on the second difference and so on.

The other approaches to check the unit root in the data are the Philip-Perron test and the KPSS test. We have used both the ADF and KPSS tests to validate the conclusions of either unit root or no unit root in the series. The Philip-Perron test is also used if both the tests are giving us opposite results. Unlike the ADF test, the null hypothesis in the KPSS test is "there is no unit root in the series". Thus if null hypothesis is accepted, then the series is called

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[1]Known as integrated of order one, I(1).

stationary. On the other hand, the Philip-Perron test is a test of stationarity in the presence of structural breaks in the data. The null hypothesis of the Philip-Perron test is the same as the ADF test, i.e., there is a unit root in the series.

Cointegration

Various methods of cointegration are available; the most popular among them are Engle-Granger single equation two-step cointegration approach, multiple equation Johansen cointegration approach, and the ARDL single equation approach. In this paper, we need to check the long-run determinants of food prices, thus we do not need to apply the Johansen approach, which is a better technique when we have multiple cointegrating vectors. The Engle-Granger approach has certain shortcomings which are mostly overcome by a technique given by Pesaran and Shin (1997),[2] known as the ARDL approach of cointegration [For further details, see Khan, Qayyum, and Sheikh (2005)]. The ARDL approach yields consistent estimates of the long-run coefficients irrespective of the order of integration of variables, i.e., whether they are integrated of order one, I(1), or zero, I(0) [Pesaran and Shin (1997)].

The long-run equations are estimated by using the following Equation (8) and by checking the significance of the variables in lag level forms jointly using F-statistic, i.e., H_0 is $\beta_1 = \beta_2 = 0$. If the F-statistic is significant, we may say that there may exist a long-run relationship between the variables.

ARDL Representation (for the Two-variables Case)

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta y_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta x_{t-i} + \varepsilon_t \qquad \dots \qquad (8)$$

The number of lagged differences is determined by using AIC or SBC. It can be checked by using the general to specific methodology, i.e., checking the significance of all the differenced variables jointly at each lag. For example, if we regress the equation including 4 lags (lagged differences) of each variable and check all the terms of lag 4 jointly using F-statistic, and if it is insignificant, then we have to regress again using 3 lags and continue this process until it shows statistically significant results.

After the final estimation, we check the joint significance of the lagged variables. In this equation it will be $\beta_1 = \beta_2 = 0$. If it is significantly different from zero, then it shows that there exists a long-run relationship among the variables. After this step we can move onto the error correction equation.

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[2]The first version of this study came out in 1995.

VI. EMPIRICAL FINDINGS AND RESULTS

The results of the unit root tests in Table 2. We've used two other tests for better conformity of the results of the unit root in the series. We have only explained the ADF unit root test in the methodology section. The Phillip-Perron (PP) test is a structural break test of the unit root. It is used when there are structural breaks in the series, which are very common in the economic policy variables such as subsidies, if the subsidies are not consistent each year. Another unity root test which we used is the KPSS (1992) (Kwiatkowski-Phillips-Schmidt-Shin) test. The null hypothesis of this test is the opposite of the ADF and the PP test. The null hypothesis of this test is that the series is stationary. This is a LM test, which assumes that random walk has zero variance.

Table 2

Results of Stationarity

Variables	ADF		KPSS	PP
	Constant + Trend	Constant		
Ln(Food Prices)	–4.61*	–1.16	–2.13	0.12**
D Ln(Food Prices)	–4.55*	–4.53*	–4.03*	0.10
Ln(Money Supply)	–3.90**	–2.23	–2.05	0.14**
D Ln(Money Supply)	–5.63*	–5.56*	–5.61*	0.06
Ln(PCI)	–2.69	–0.01	–1.63	0.15**
D Ln(PCI)	–5.45*	–5.53*	–5.46*	0.12
Ln(Food Crops)	–3.511*	–1.144	–0.871	0.734*
D Ln(Food Crops)	–6.727*	–6.810*	–9.385*	0.050
Ln(Subsidy)	–8.85*	–8.40*	–15.20*	0.06
Ln(World Food Prices)	–6.40*	–6.43*	–3.99*	0.14**

Note: *, ** represent at one and five percents level of significance.

The results show a case of trend of stationary economic variables but otherwise integrated of order one. Starting with food prices and money supply, they are integrated of order one, as confirmed by all the tests. Both are trend stationary. Per Capita income is integrated of order one, as confirmed by all the three tests. Similarly, food crop is integrated of order one. Subsidy and World Food prices are integrated of order zero, which shows that both the variables are stationary.

Equation 4 represents the log linear form of the equation. However, apart from the Bureaucracy index, we have used all the variables and the estimated Equation (8) which represents the ARDL approach of cointegration.

$$\Delta fp_t = \beta_0 + \beta_1 fp_{t-1} + \beta_2 SUB_{t-1} + \beta_3 PCI_{t-1} + \beta_4 Y_{t-1} + \beta_5 ms_{t-1} + \beta_6 wfp_{t-1}$$

$$+ \sum_{i=1}^{n} \beta_7 \Delta fp_{t-i} + \sum_{i=1}^{n} \beta_8 \Delta SUB_{t-i} + \sum_{i=1}^{n} \beta_9 \Delta PCI_{t-i} + \sum_{i=1}^{n} \beta_{10} \Delta Y_{t-i}$$

$$+ \sum_{i=1}^{n} \beta_{11} \Delta ms_{t-i} + \sum_{i=1}^{n} \beta_{12} \Delta wfp_{t-i} + \varepsilon_{lt} \qquad \dots \qquad \dots \qquad \dots \qquad (9)$$

Equations (9) represent the ARDL model of the estimated equation. All the variables are in log form. FP represents log of food prices, SUB represents subsidy taken in log form, PCI represent log of real per capita income, FC represents log of food crop, MS represents log of money supply, WFP represents log of world food prices, and e_{lt} is the error term of the Equation (9). The subscript t represents time period, bs are the coefficients of each variable, and n represents the number of lags.

Lagged differences are chosen using minimum AIC. Moreover, this equation gives the maximum power to explain the dependant variable with the minimum sum of squared residuals. However, some variables are insignificant which affects the significance of other variables. The model allows us to estimate the general model first and then the specific model, which is known as GTS (general-to-specific) model. The results of the specific ARDL model are given in Table 3.

Table 3

Results of ARDL Equation

Variable	Coefficient	t-Statistic	Prob.
D(SUB(-1))	0.015	2.13**	0.0478
D(PCI(-2))	–0.934	–3.22*	0.0050
D(FP(-3))	0.602	5.45*	0.0000
D(SUB(-3))	–0.008	–2.67**	0.0162
FP(-1)	–0.514	–3.65*	0.0020
MS(-1)	0.378	4.24*	0.0006
SUB(-1)	–0.024	–2.38**	0.0293
FC(-1)	–0.104	–1.15	0.2641
WFP(-1)	0.273	5.46*	0.0000
PCI(-1)	–0.295	–2.20**	0.0416

$R^2 = 0.83,$ $\quad \overline{R}^2 = 0.75,$

$\sum \varepsilon_t^2 = 0.0062,$ $\quad AIC = -4.80,$ $\quad SBC = -4.32$

Diagnostic Tests:	Heteroscedasticity: F = 0.94 [0.52]
	Serial Correlation: F = 0.24 [0.79]

Note: *represents five percent levels of significance, value in parentheses are the p-value.

The diagnostic tests for the ARDL model indicate no problem of serial correlation (LM test) and hetroscedasticity (Breusch-Pagan-Godfrey). The null hypotheses of both tests show that there is no serial correlation and no problem of heteroscedasticity among the residuals.

The redundant variable test (Table 4) ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$) rejects the null hypothesis that the variables have no power. Thus they are significantly different from zero, which implies that there may exist a long-run relationship among the variables.

Table 4

Redundant Variable

Redundant Variables: FP(-1) SUB(-1) PCI(-1) TP(-1) M2(-1) LWF(-1)			
F-statistic	22.71938	Probability	0.000000*
Log likelihood ratio	59.38082	Probability	0.000000*

Note: *represents five percent level of significance.

Table 5 shows normalised cointegrating vectors (long-run coefficients). We normalised the coefficients of lagged level variables by dividing with the coefficient of *FP* (assuming all the other coefficients are equals to zero) and hence obtained the long-run elasticities. The results show that agriculture subsidies are negatively associated with food prices. However, its coefficient is too small to explain the significant day role in the long run as a one-percent increase in subsidies reduces the food prices by only 0.047 percent. Surprisingly, per capita income is negatively associated with food prices. The coefficient shows that a one-percent increase in per capita income leads to a decline in food prices by 0.57 percent. Output is a very important variable to determine food prices. So increasing the agriculture output by improving the supply situation can help to reduce the food prices. In our result, the negative sign of food crops shows an overall structural effect of increase in the production leads to a decline in prices or otherwise. However, in our model it does not significantly contribute to the change in domestic food prices in the presence of other variables. Money supply came out to be the most significant variable in the case of Pakistan to determine the variation in food prices. It is positively associated with food prices. Its coefficient implies that a one-percent increase in money supply leads to an increase in food prices by 0.73 percent. World food price, which is the only international variable in our analysis, is positively associated with food prices. Its coefficient implies that a one-percent increase in world food prices leads to a 0.53 percent increase in domestic food prices in the long run.

Table 5

Normalised Cointegrating Vectors

Variables	Coefficients	t-values
FP	1.00	−3.65181*
SUB	−0.047342	−2.37958*
PCI	−0.573796	−2.20398*
FC	−0.202252	−1.15487*
MS	0.73533	4.238589*
WFP	0.53204	5.463012*

Note: * represents five percent level of significance.

The F statistics of the Redundant Test shows that there is a long-run relationship among the variables. The following Error Correction Model (ECM) is estimated for the short-run dynamics.

$$\Delta fp_t = \beta_0 + \sum_{i=1}^{n} \beta_8 \Delta SUB_{t-i} + \sum_{i=1}^{n} \beta_9 \Delta PCI_{t-i} + \sum_{i=1}^{n} \beta_{10} \Delta Y_{t-i}$$

$$+ \sum_{i=1}^{n} \beta_{11} \Delta ms_{t-i} + \sum_{i=1}^{n} \beta_{12} \Delta wfp_{t-i} + \lambda EC_{t-1} + \varepsilon_{2t}$$

Where λ represent the speed of adjustment and *EC* is the residual term obtained from the ARDL Model.

Table 6 shows the results of the ECM. In the ECM we use one lag less than used in the ARDL approach [see the example in Khan and Khan (2007)]. So we use two lag differences. The general to specific methodology has been used to get better results.

The overall result shows a significant presence of an error correction in the equation and its negative sign implies that whenever there is disequilibrium food prices adjust towards equilibrium to be restored as market forces are in operation. The estimated value of EC_{t-1} is 0.376, indicating the speed of adjustment to long-run equilibrium in response to disequilibrium which is due to short-run shocks of the previous period. Since we have annual data, it takes almost 3 years to restore complete equilibrium Money supply has a positive sign and plays an important role in increasing the food prices in the short-run. Per capita income has a negative impact on food prices in the short-run. Subsidies are effective and play a negative role in the second period to determine the prices which show that subsidies help in reducing the food prices.

Table 6

Short-run Dynamics (ECM) Results

Coefficient	Coefficient	t-Statistic	Prob.
EC(-1)	−0.37611	−10.2484	0.0000[*]
D(MS(-1))	0.173448	3.293961	0.0033*
D(PCI(-1))	−0.74493	−4.79743	0.0001*
D(FP(-2))	0.509757	9.253716	0.0000*
D(SUB(-2))	−0.00618	−2.75019	0.0117*
D(PCI(-2))	−0.33375	−2.31598	0.0303*
D(FC(-2))	0.065018	1.597895	0.1243

$R^2 = 0.876944, \quad \overline{R}^2 = 0.843383,$

$\sum \varepsilon_t^2 = 0.004699, \quad AIC = -5.407054, \quad SBC = -5.077017$

VII. STABILITY TEST

In this section we shall perform some stability tests to the ARDL estimation. These tests include (i) CUSUM and (ii) CUSUM of Squares Test.

(i) The CUSUM test is based on the cumulative sum of the recursive residuals. This test measures the parameter instability within a range of 5 percent. If it goes outside the range, then the estimation is not stable, than it is stable otherwise. Results of the CUSUM measure is given in Graph 8. This shows that the estimation is stable.

Graph 8
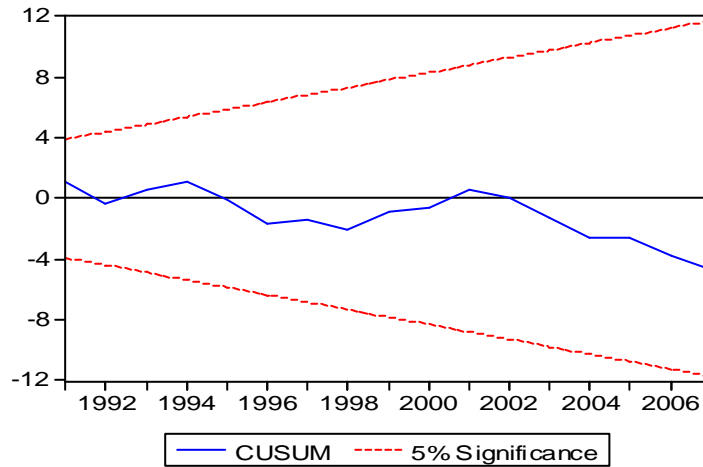
(ii) The CUSUM test of squares is performed on the squares of the residuals. Similar to the CUSUM, if this test measures the parameter instability within the range, then the residuals variance is stable, otherwise it is not. Graph 9 below shows that the cumulative sum of squares is within the range. Thus it passes the second stability test.

This finding indicates that food price must be stable and should be controlled by market forces.

Graph 9

This finding indicates that food price must be stable and should be controlled by market forces.
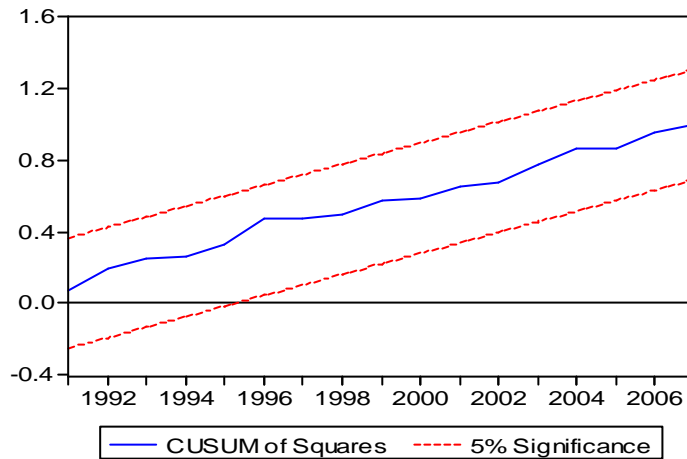
VIII. CONCLUSIONS

The problem of food prices in the Pakistan, and in fact all over the world has been severe in the last few years. The problem is not very new and the world has witnessed this type of problem since the early 1970s. While there could be different reasons for the recent increase in prices, in this paper we have followed a relatively basic economic approach discussed in ADB (2008). Based on the model we have developed in this paper, per capita income, agriculture output, agricultural subsidies, money supply, and world food prices are identified as the key determinants of food prices in Pakistan.

An important conclusion of the paper is that the most significant variable which affects food prices in the long run as well as in the short run is money supply. It is also concluded that subsidies help in reducing food prices in the long run but the impact of subsidy is very small. The negative association of per capita income with food prices implies the Engle Aggregation, that the percentage of expenditure on food items declines with an increase in income. The immediate effect of food crops on prices is not found in this study, which implies that the movement in food prices is more significant than the current production of domestic food crops. There is a possibility that the type and level

of production of food crops follow the price of food crops and some other factors in the previous years. Whether or not it is the other way round may be checked in another study. The long-run association between the two variables is found to be insignificant. One of the important variables affecting food prices in the long run is the international price, which raises the domestic price in a country. Another conclusion of the study is that food prices restore the equilibrium when the system is in disequilibrium.

Our paper does not touch on the political economy side of the increase in price, which includes smuggling, untimely exports, and then imports at higher prices. Also, the model can be improved to get better results.

REFERENCES

Asian Development Bank (2008) Food Prices and Inflation in Developing Asia: Is Poverty Reduction Coming to an End? Economic and Research Department. Accessible at: http://www.adb.org/Documents/reports/food-prices-inflation/food-prices-inflation.pdf

Capehart, Richardson (2008) Food Price Inflation: Causes and Impacts. *Congressional Research Service Report for Congress.* Washington, DC.

Eckstein, Heien (1978) The 1973 Food Price Inflation. *American Journal of Agriculture Economics* 60:2, 186–196.

Gomez, P. (2008) Emerging Asia and International Food Inflation: The Case of Colombia. *Latin America EconoMonitor,* No. 512.

Haque, N. and A. Qayyum (2006) Inflation Every Where is a Monetary Phenomenon: An Introductory Note. *The Pakistan Development Review* 45:2, 179–183.

IMF (2008) *International Financial Statistics.* Washington, DC: International Monetary Fund.

International Country Risk Guide. Political Risk Services. www.prsgroup.com/prsgroup_shoppingcart/pc-39-7-international-country-risk-guide-icrg.aspx

IRRI (2008) The Rice Crisis: What Needs to be Done? International Rice Research Institute, Los Banos. Available: http://www. irri. org.

Kemal, M. A. (2006) Is Inflation in Pakistan is a Monetary Phenomenon. *The Pakistan Development Review* 45:2, 213–220.

Khan, Ashfaque H. and Muhammad Ali Qasim (1996) Inflation in Pakistan Revisited. *The Pakistan Development Review* 35:4,. 747–757.

Khan, E. A. and A. R. Gill (2007) Impact of Supply of Money on Food and General Price Indices: A Case of Pakistan. *IUB Journal of Social Sciences and Humanities* 5: 2, 125–143.

Khan, M. A., A. Qayyum, and S. A. Sheikh (2005) Financial Development and Economic Growth: *The Pakistan Development Review* 44:4, 819–837.

Khan, Sajawal and Muhammad Arshad Khan (2007) What Determines Private Investment? The Case of Pakistan. (PIDE Working Papers No. 36).

Kwiatkowski, D. P., C. B. Phillips, P. Schmidt, and Y. Shin (1992) Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root. *Journal of Econometrics* 54, 159–178.

Laap, S. (1990) Relative Agricultural Prices and Monetary Policy. *American Journal of Agriculture Economics* 72:3, 622–630.

Lamm. R. and C. Westcott. (1981) The Effect of Changing Input Cost of Food Prices. *American Journal of Agriculture Economics* 63:2, 187–196.

Naim, M. (2008) Missing Links: The Global Food Fight. Foreign Policy Magazine. http://www.foreignpolicy.com/story/cms.php?story_id=4347.

Pakistan, Government of (Various Issues) *Budget in Brief*. Islamabad: Ministry of Finance.

Pakistan, Government of (Various Issue) *Economic Survey*. Islamabad: Economic Adviser's Wing, Ministry of Finance.

Pakistan, Government of (Various Issues) *Agricultural Statistics of Pakistan.* Islamabad: Ministry of Food, Agriculture Livestock.

Pesaran, M. H. and Y. Shin (1997) An Autoregressive Distributed Lag Modelling Approach of Cointegration Analysis. This paper is a revised version of what was presented at the *Symposium at the Centennial of Regular Frish*. The Norwegian Academy of Science and Letters, Oslo (3–5 March, 1995). http://www.econ.cam.ac.uk/faculty/pesaran/ardl.pdf

Trostle, R. (2008) Global Agriculture Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices. A Report from the Economic Research Service. http://www.ers.usda.gov/Publications/WRS0801/WRS0801.pdf.

United Nations (2008) High Food Prices in Pakistan: Impact Assessment and the Way Forward. UN Inter Agency Assessment Mission. Prepared for Ministry of Food, Agriculture and Livestock, Government of Pakistan, Islamabad.

USDA (2008) *Production, Supply and Distribution*. US Department of Agriculture. http://www.fas.usda.gov/psdonline.