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Factors Affecting Food Prices in Pakistan

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The purpose of the study is to identify the factors affecting food prices in Pakistan. The findings reveal that there is a negative and significant impact of the real effective exchange rate on wheat prices in the long run. Similarly, the real interest rate affects wheat and rice prices indirectly, while it has a direct impact on tea prices. There is a positive and significant impact of international crude oil prices and international food prices on most food commodities. Moreover, the study explains that in the long run, the increase in local production significantly reduces the prices of food commodities. It is also found that the government policy of adjusting (increasing) wheat support prices also has a positive and significant impact on wheat prices.

JEL Classification: L66, E4, G18

Keywords: Food Prices, Real Effective Exchange Rate, Real Interest Rate, International Crude Oil Prices, International Food Prices, Government Policy

1. INTRODUCTION

Globalisation has increased the economic integration of the world integrated economically, and the interdependency of developed and developing nations on various commodities has also increased. It is evident that during the past two decades, commodity prices exhibited increasing and volatile behaviour globally. International food prices almost doubled in the year 2007-08, which is evident from the Food and Agriculture Organisation (FAO) Index—the food price increased up to 27 percent. Like other developing countries, Pakistan was also affected by the international food price crisis. In 2008-09, food inflation broke the record for the last 23 years as it increased by 23.13 percent compared to 17.65 percent in 2007. Between 2005 and 2008, the wheat price increased by 106 percent, whereas, the variation in the price of other staple food commodities remained in the range of 20 to 120 percent. Besides high global food prices, there were also some domestic reasons behind the inflated wheat price, for instance, regional smuggling and hoarding of wheat were important reasons. To combat the hoarding and smuggling of wheat, Pakistan Government increased the wheat procurement price. According to the Ministry of Finance 2008-09, due to this act, the

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local wheat price was increased more than the international price of wheat. These elevated wheat prices also accelerated the prices of vegetables, meat, oil and milk (Awan, et al. 2015). Khan and Qasim (1996), Sherani (2005) and Schimmelpfennig and Khan (2006) stated that wheat procurement prices increased inflation in Pakistan.

The literature has identified different factors that can cause changes in food prices. For instance, Frankel (2006), Calvo (2008), and Roache (2010) explained that agricultural commodity prices are affected by small changes in interest rates. It is identified that interest rate affect food prices both positively and negatively. As it is the cost of borrowing that a farmer pays on a loan, a high interest rate discourages agricultural investment which increases food prices. On the other hand, the interest rate is used as a policy tool to tackle the rising general price level. Ismail, et al. (2017) identified both positive and negative impacts of interest rates on some food commodities. Furthermore, according to Landerretche, et al. (2007); Abbot, et al., (2009); Nakamura & Zerom (2010), exchange rate has a leading role in the transmission of international goods prices to the national. There are two ways in which the exchange rate affects food prices. First, as the currency depreciates, it increases the prices of inputs or raw materials, for instance, seeds, pesticides, and fertilisers. It also increases the prices of final food commodities that are imported, such as pulses. Second, a depreciation in the exchange rate also increases the import price of crude oil which further raises the transportation cost of agricultural commodities exerting inflationary pressure on food prices. Therefore, a depreciation of the exchange rate causes an increase in food prices. Furthermore, a depreciation in the exchange rate or a decline in the REER (depreciation in the value of the rupee) is an indication that the country's exports have become cheaper and imports more expensive In other words, the country gains trade competitiveness but also causes inflationary pressure (Hayes,[1] et al. 2021). Moreover, Herrmann (2009); Baffes (2007); Ghani, et al. (2018) have found a significant effect of crude oil or diesel on agricultural commodities. Oil price shock influence domestic food prices in several ways through the food supply chain. For instance, it not only affects the production of the commodity by increasing the cost of production but also influences the processing and local and international distribution of the commodity. It amplifies the retail price and farm gate price, as it is used to transport the commodity from the producers to buyers. The literature suggests that an increase in agricultural input prices, namely fertiliser and crude oil, increases the expenditures of producers, which ultimately raises the prices of agricultural outputs.

Furthermore, Tadesse, et al. (2016) explained that various government policies, for instance, discretionary trade policy, export bans, aggressive imports, delays in the decision to import, etc., have a direct impact on the variability in food prices. It is considered that political condition is an endogenous variable that amplifies the spikes in food prices.

Moreover, Salman, et al. (2013); Awan & Imran (2015) highlighted that input prices, money supply, foreign aid, exchange rate and transportation cost played an adverse role in increasing food prices in Pakistan. Realising the importance of the issue, the current study is planned to investigate the impact of various exogenous and endogenous covariates on prices of fifteen major food commodities; beef, chicken, rice,

[1]See https://www.investopedia.com/terms/r/reer.asp

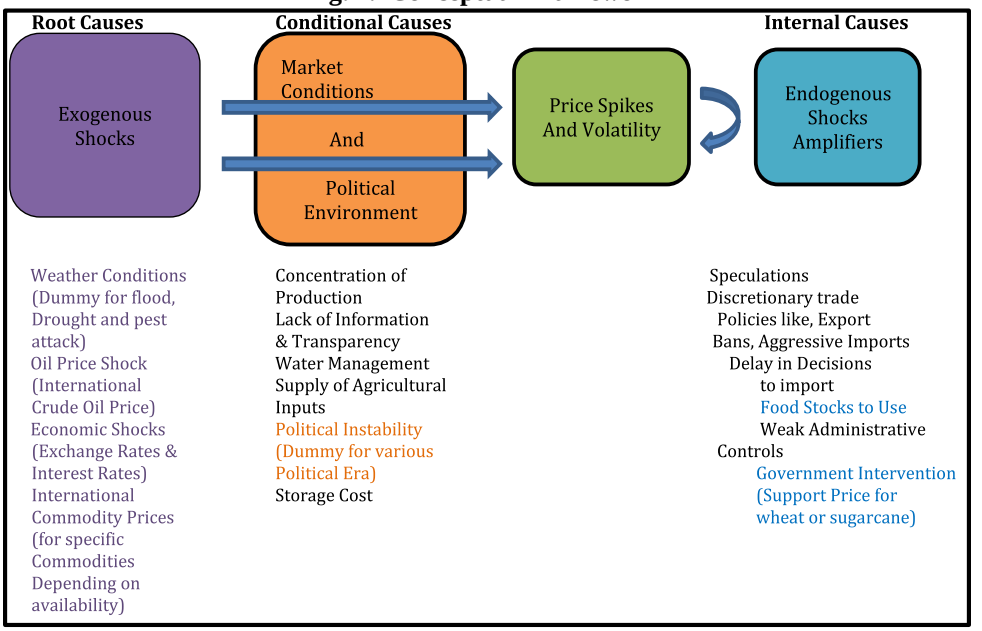
wheat, mash, mung, masur, tomato, potato, garlic, onion, sugar, tea, milk, and eggs over the years. The study clears the role of each factor (used in the study) in food price changes. The study will help the policymakers to design policies to control the variation and increase in food prices. The proposed study will lengthen the literature by investigating the main drivers of food prices for the given period.

Following the introduction in Section 1, the paper is organised as follows. Section 2 explains the conceptual framework of the study. Section 3 details data sources and methodology. Section 4 gives results and discussion. Section 5 provides the conclusions and the policy recommendations.

2. CONCEPTUAL FRAMEWORK

To determine the main drivers of food prices the study adopts the concept proposed by Tadesse, et al. (2016) with a small modification.

Fig. 1. Conceptual Framework



Source: Tadesse, et al. 2016.

According to the framework given in Figure 1, the determinants of food prices are divided into three groups, i.e., exogenous shocks, market conditions and political environment, and endogenous shocks. It is postulated that exogenous factors are the root cause of price fluctuation. These include extreme weather shocks (heavy rains and floods), economic shocks (changes in the interest rate and exchange rate), international commodity price shocks, and oil price shocks. These exogenous shocks are expected to be responsible for generating variability in food prices, while the extent of their influences or the saturation of their effect on the native economy partly depends on the market conditions and political situation of the country. Hence, the second group of factors is associated with political and market conditions that can reduce or aggravate

exogenous shocks. The majority of these factors, such as the lack of transparency in water management and commodity markets, are time-invariant and quite hard to measure. Consequently, these factors are not taken into account in the empirical analysis. Factors included in the third group are endogenous shocks. These include unrestricted trade policies, speculative activities determined by price expectations, weak administrative controls, etc. Some of the other country-specific endogenous factors, such as the role of the middleman, hoarding, etc., are also important factors. These factors amplify the effect of other factors present in the first and second groups. However, similar to the second group of factors, most of the endogenous factors are qualitative in nature and, hence, difficult to include in the modelling of the framework. Although the present study mainly emphasises exogenous shocks as they may cause other factors to emerge, some country-related political, economic, and other endogenous factors are also included in the empirical analysis.

2. DATA SOURCES AND METHODOLOGY

This section provides the data sources and describes the methodological approach that is adopted for accomplishing the objective of the study.

2.1. Data Sources

The study employs monthly data of food prices for fifteen food commodities that are a part of the CPI basket, namely, beef, chicken, pulses (mash, mung, masur), rice (IRRI), wheat, tomato, potato, onion, garlic, milk, egg, sugar, and tea for 14 large cities of Pakistan. Cities included in this analysis are Bahawalpur, Faisalabad, Hyderabad, Islamabad, Karachi, Khuzdar, Lahore, Multan, Peshawar, Quetta, Rawalpindi, Sargodha, Sialkot, and Sukkur. Cities are selected based on the definition of a big city by the Pakistan Bureau of Statistics. Monthly data is gathered from July 2002 to July 2021, from various issues of the Monthly Statistical Bulletin published by the Pakistan Bureau of Statistics. Furthermore, the monthly data of real effective exchange rate, interest rate, international crude oil prices[2], and international prices of food commodities (tomato, beef, chicken, milk, wheat, rice, sugar and tea) in Pak Rupees is collected from the IMF and State bank of Pakistan from July 2002 to April 2021. The yearly data of the total production of food commodities (except garlic and tea) and wheat support price is collected from the Ministry of Agriculture Pakistan and PBS respectively. Moreover, the dummy variable is used for a political era.

2.3. Methodology

The study employed Autoregressive distributed lag (ARDL) model to identify the factors responsible for the change in food prices**.** The empirical time series model that shows the association among the prices of food commodities and their associated factors is as follows:

$$LP_t = \beta_0 + \beta_1 LREER_t + \beta_2 LRIR_t + \beta_3 LOP_t + \beta_3 LIP_t + \beta_3 LPD_t + \beta_3 LSP_t + \varepsilon_t \qquad (1)$$

[2]Brent Crude Oil $/(Barrel)/159L.

Where, LP_t is the log of price series of a particular food commodity at time t. LREER, LRIR, LOP, LIP, LPD and LSP are logs of the real effective exchange rate, the real interest rate, input prices (crude oil prices), international prices, production and support prices respectively. The above independent variables are almost the same for each commodity. The study uses the ARDL bound test developed by Pesaran (2001). The model identifies a long-run and short-run association among the covariates and prices of each commodity. There are different cointegration approaches, for instance, Engle-Granger (1987); Johansen & Juselius (1990), and Johansen (1991). The ARDL is the most suitable model as it is applicable for the series with different integrating orders, e.g., I(0) or I(1) (Pesaran, et al. 2001) unlike other models. The ARDL model is given by the following equation:

$$\begin{aligned}\Delta LP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i}\Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{2i}\Delta LREER_{t-i} + \sum_{i=0}^{p} \alpha_{3i}\Delta LRIR_{t-i} + \\ \sum_{i=0}^{p} \alpha_{4i}\Delta LOP_{t-i} + \sum_{i=0}^{p} \alpha_{5i}\Delta LIP_{t-i} + \sum_{i=0}^{p} \alpha_{6i}\Delta LPD_{t-i} + \\ \sum_{i=0}^{p} \alpha_{7i}\Delta LSP_{t-i} + \alpha_8 LP_{t-1} + \alpha_9 LREER_{t-1} + \\ \alpha_{10} LRIR_{t-1} + \alpha_{11} LOP_{t-1} + \alpha_{12} LIP_{t-1} + \alpha_{13} LPD_{t-1} + \alpha_{14} LSP_{t-1} + \varepsilon_t \quad (2)\end{aligned}$$

Where, Δ and i are the difference operator and lag length, respectively. The long-run relationship between the covariates (variables) is identified by the F-test of the joint significance of the coefficient of lagged variables. The null hypothesis of the model is $\alpha_8=\alpha_9=\alpha_{10} = \alpha_{11}=\alpha_{12}=\alpha_{13} =\alpha_{14}= 0$, showing the absence of a long-run relationship.

In this test, the variables are cointegrated if the F-statistic (calculated) is greater than the upper critical bound (UCB), while if it is less than the lower critical bound (LCB), the series are not cointegrated. The result is inconclusive if the F-statistic (calculated) is between the UCB and the LCB. These critical bounds are given by Pesaran (1997). To estimate the short-run association, the following equation presents the error correction model separately for each commodity price.

$$\begin{aligned}\Delta LP_t = \gamma_0 + \sum_{i=0}^{p} \gamma_{1i}\Delta LREER_{t-i} + \sum_{i=0}^{p} \gamma_{2i}\Delta LRIR_{t-i} + \sum_{i=0}^{p} \gamma_{3i}\Delta LOP_{t-i} + \\ \sum_{i=0}^{p} \gamma_{4i}\Delta LIP_{t-i} + \sum_{i=0}^{p} \gamma_{5i}\Delta LPD_{t-i} + \sum_{i=0}^{p} \gamma_{6i}\Delta LSP_{t-i} + \phi ECT_{t-1} + \varepsilon_t \quad (3)\end{aligned}$$

The negative and significant value of the coefficient of $ECT_{t-1}(\phi)$ means that the dependent variable monotonically converge to long-run equilibrium as a result of a change in its determinants.

3. RESULTS AND DISCUSSION

In this section, the ARDL results are discussed. In the ARDL model, most of the policy macroeconomic variables, such as real effective exchange rate, real interest rate, and crude oil prices, are included for all food commodities to capture the intensity of exogenous shocks in determining the prices of food commodities. However, some other regressors, for instance, international prices of the same commodities and local production of commodities are included in the model depending on the availability of time series data. Another important group of factors identified by the literature are the political and market conditions. However, such factors, for example, transparency and political stability are difficult to quantify.

Therefore, to gauge the impact of political instability, three dummies for different political eras are included in the model. Support prices are announced only for wheat by the Government of Pakistan each year. Therefore, only the wheat support price is included in the model. This variable signifies the role of the government in determining the prices of wheat. Table A-1 in the Appendix shows the group unit root test results. A group unit root test is performed for the first difference to ensure that all the series are integrated at I(1) or I(0). It has been argued that higher-order integrated variables can exhibit spurious regression results in Autoregressive Distributed Lag Models (ARDLs). Therefore, for examining the cointegration of variables using ARDL bound testing, the stationarity of the series was checked, as a precondition, suggested by Dickey and Fuller (1979). The group unit root test for the first difference confirmed that the order of integration for each variable of each model was either I(0) or I(1). Therefore, ARDL bound testing was performed to determine the long-run as well as short-run impacts of various factors on the prices of food commodities. The order of lags for each model was selected based on the AIC. According to Pesaran & Shin (1999), precise adjustment of orders of the ARDL model is necessary to remove serial correlation in the residual and resolve the endogenous variable issue. Hence, the lags' maximum values are decided for each of the fifteen models based on the AIC criterion. The results are given in Figure A-1 (Appendix). Table 1, shows the F-statistics for the ARDL long run form and bounds test along with the corresponding lower bounds, i.e., I(0) and upper bounds, i.e., I(1) at a 5 percent level of significance. Results confirm the presence of a long-run cointegrating association between the variables for most of the models. With log prices of various food commodities, for instance, onion, tomato, potato, beef, chicken egg, milk, wheat, pulse mash, sugar, and tea, as dependent variables, the null hypothesis of no level relationship was rejected as the F-statistics exceeded upper bound critical values.

Table 1 provides evidence of a long-run relationship between log prices of onion, tomato, potato, beef, chicken egg, milk, wheat, pulse mash, sugar, and tea and their determinants. Table 2 describes the partial long-term impact of various factors on the log prices of these food commodities. Table 2 shows that the log of the real effective exchange rate (REER) significantly influenced the log prices of wheat. A 1 percent point decrease in the REER increased the wheat prices by 0.64 percent. The model with log wheat price confirms the negative association of prices with the REER, which is supported by literature as well. For instance, it is well documented that the exchange rate transmits international goods prices to local markets (Zerom & Nakamura, 2010; Abbot, et al. 2009; Landerretche, et al. 2007). Ismail, et al. (2017) also found the same results for Pakistan. The results show that there is a negative relationship between the prices of wheat and rice and interest and a positive relationship between the price of tea and interest rate. These results mean that a 1 percent decline in interest rate caused the prices of wheat and rice to increase by 0.11 and 0.57 percent, respectively. On the other hand, a 1 percent increase in interest rate increased the price of tea by about 0.72 percent respectively. Ismail, et al. (2017) also found mixed results regarding the impact of the interest rate on the prices of various food commodities.

Table 1

ARDL Bound Test Results

Dependent Variables	F-Statistics	Lower bound at 5%	Upper Bound at 5%	k	Remarks
Vegetable Group					
log (Onion price)	8.29	2.56	3.49	4	Present
log (tomato price)	8.10	2.39	3.38	5	Present
log (garlic price)	0.90	2.79	3.67	3	Absent
log (potato price)	8.29	2.56	3.49	4	Present
Meat Group					
log (beef price)	4.54	2.39	3.38	5	Present
log (chicken price)	5.93	2.39	3.38	5	Present
Dairy Group					
log (egg price)	9.99	2.56	3.49	4	Present
log (milk price)	9.79	2.39	3.38	5	Present
Cereal & Pulses Group					
log (wheat price)	9.66	2.27	3.28	6	Present
log (rice price)	2.13	2.39	3.38	5	Absent
log (Pulse moong price)	3.03	2.56	3.49	4	Absent
log (pulse mash price)	3.4	2.56	3.49	4	Present
log (pulse masoor price)	2.32	2.56	3.49	4	Absent
Other Group					
log (sugar price)	3.38	2.39	3.38	5	Present
log (tea price)	14.94	2.56	3.49	4	Present

Source: Authors' calculations.

Table 2

Long-run Coefficients

Dependent (prices) \ Independent Variables	Exchange Rate	Interest Rate	International Oil Price	International Price	International Production	Support Price	c
Vegetable Group							
log (Onion price)	0.24	0.02	0.27**		0.67	–	–3.50
log (tomato price)	0.57	–0.53	0.40**	–0.56	–1.02**	–	–1.88
log (garlic price)	1.01	3.43	-0.99	–	–	-	-2.83
log (potato price)	0.48	–0.05	0.53***	–	–0.27	–-	1.84
Meat Group							
log (beef price)	0.40	–0.19	0.05	0.58***	0.25	–	-1.07
log (chicken price)	-0.16	–0.03	0.15***	0.45***	0.18	–	1.37
Dairy Group							
log (egg price)	–0.54	–0.18	0.25***	–	–1.53***	–	–8.55***
log (milk price)	–1.18	0.48	0.90	0.12	1.26	–	–8.19
Cereal & Pulses Group							
log (wheat price)	–0.64***	–0.11***	0.05*	0.10***	–0.17	0.74***	5.52***
log (rice price)	0.12	–0.57***	0.48***	0.92***	–0.61	–	3.93
log (Pulse moong price)	–8.09	1.32	0.16	–	–2.02	–	49.95
log (pulse mash price)	–0.25	0.40	–0.14	–	–1.55***	–	20.17*
log (pulse masoor price)	–4.76	–0.27	0.06	–	–1.60***	–	30.05
Other Group							
log (sugar price)	0.07	–0.25	0.21***	0.56***	–1.20***	–	14.65
log (tea price)	0.08	0.72***	0.04	0.22**	–	–	–0.01

Source: Authors' calculations. ***, **, and * show 1 percent, 5 percent, and 10 percent level of significance, respectively.

The other most important exogenous factor is the crude oil price. Table 2 shows a significant and positive impact of oil prices on almost all commodities. The largest impact of oil prices was found on vegetable prices. Results reveal that a 1 percent increase in crude oil price led to 0.53 percent, 0.40 percent, and 0.27 percent increase in the prices of potatoes, tomatoes, and onions, respectively. Similarly, chicken and egg prices were also affected by increases in oil prices. A 1 percent increase in oil price raised the prices of chicken and eggs by 0.15 percent and 0.25 percent, respectively. Wheat prices were also affected by oil prices but the impact was minimal. The sugar price model, however, exhibited a significant and positive impact of a rise in oil prices on sugar prices. These findings are consistent with the earlier findings. For instance, Herrmann (2009), Ismail et al. (2017), and several other researchers showed that, among other variables, the crude oil price was the foremost factor in the case of Pakistan that caused fluctuation in the commodity prices. Table 2 confirms the proposition that international prices of commodities affect the local prices even in the absence of trading activities (Ahsan et al., 2011 and ADB, 2008). The present study also found a positive impact of international food prices on the prices of staple food commodities, such as beef, chicken, wheat, rice, sugar, and tea. A 1 percent increase in international food prices increased the local prices of beef, chicken, wheat, rice, sugar, and tea by 0.58, 0.45, 0.1, 0.92, 0.56, and 0.22 percent, respectively. Another factor that plays a major role in reducing domestic prices is total local production (TLP), which has an inverse relationship with local prices (Tadesse, et al. 2016). TLP is included in the model only for those commodities that are produced locally. Table 2 shows the impact of TLP on the production of various commodities on their prices. According to the results, a 1 percent increase in the local production of mash, masoor, sugarcane, tomato, and egg led to a decrease in decline their prices by 1.55, 1.6, 1.2, 1.0, and 1.5 percent, respectively. The literature also supports these findings. For example, Ahsan, et al. (2011) found that a decline in the production of wheat and rice increases food prices in Pakistan. The wheat support price is the foremost policy tool to regulate the price of wheat. There are a few studies that look at the relationship between the wheat support price and inflation. For example, Khan and Qasim (1996) and Sherani (2005), Schimmelpfennig, and Khan (2006) found a positive and significant link between the wheat support price and food inflation in Pakistan. However, no study looks at the relationship between the wheat support price and the market price of wheat. Therefore, to fill this gap, the present study includes the wheat support price in the empirical analysis. The results, given in Table 2, show a positive and highly significant impact of the wheat support price on wheat prices. These findings suggest that a higher support price encourages farmers to increase wheat production, not only by increasing yield per acre but also by bringing more area under wheat cultivation.

Table 3 shows the coefficients of ECTt-1 for each model which is given by Equation 3. The ECTt-1 coefficients show the short-run adjustment. It is worth mentioning here that an ECT coefficient between -1 to 0 implies that the correction in commodity prices in period t is a proportion of the error in the previous period, i.e., t-1. This means that the food commodity prices would converge monotonically to a long-run equilibrium as a result of changes in their determinants. On the other hand, a positive or

lower than -2 ECT coefficient, implies that the food commodity prices would diverge. Moreover, a value between –2 and –1 implies a dampening oscillation in the food commodity prices around their equilibrium trail.

Table 3

Short-run Coefficient

Dependent Variables (Prices)	ECT_{t-1}
Vegetable Group	
△log (Onion price)	–0.35***
△log (tomato price)	–0.41***
△log (garlic price)	–
△log (potato price)	–0.24***
Meat Group	
△log (beef price)	–0.12***
△log (chicken price)	–0.49***
Dairy Group	
△log (egg price)	–0.37***
△log (milk price)	–0.009***
Cereal & Pulses Group	
△log (wheat price)	–0.33***
△log (rice price)	–
△log (Pulse moong price)	–
△log (pulse mash price)	–0.04
△log (pulse masoor price)	–
Other Group	
△log (sugar price)	–0.13***
△log (tea price)	–0.24***

Source: Authors' calculations. ***, **, and * show 1 percent, 5 percent, and 10 percent level of significance, respectively.

Table 3, however, shows that the coefficients of ECTt-1 are between -1 and 0 for each model. It must be noted that the long-run bound test, discussed above, indicated the presence of long-run cointegration among the food commodity prices and their determinants. The coefficients of all the models are statistically highly significant at the 1 percent level. This indicates that the error correction method monotonically converges to the equilibrium. The coefficient of ECTt-1 of the prices of onions, tomatoes, potatoes, chicken, eggs, wheat, and tea reveals a higher pace of correction each month and implies that the divergence from the equilibrium level of prices in the current period was corrected by 35, 41, 24, 49, 37, 33, and 24 percent, respectively, in the following month. However, the pace of adjustment was relatively slower for other commodities such as beef, milk, mash, and sugar. Residual diagnostic tests separately for each model were also run to check their robustness. Table A-2 (Appendix) shows the results of tests for F-statistics, serial correlation, homoscedasticity, and lag selection criteria. Figure A-2 (Appendix) shows the graphs of the CUSUM stability test for each model. The test for serial correlation confirmed

the Gauss-Markov assumption of no serial correlation. Although the problem of heteroscedasticity was detected in some of the models, these models were reestimated by employing the robust standard error process. The literature suggests that for large sample sizes, robust standard errors overcome the problem of heteroscedasticity and provide unbiased standard errors of slope coefficients. F^2 shows the overall significance of the models, which confirms the model's accuracy. Figure A-2 (Appendix) shows that CUSUM lines are within the 5 percent level of significance critical bounds. This shows the precision of the long-run and short-run parameters of the models. This also proves that models are correctly specified.

4. CONCLUSIONS AND POLICY IMPLICATIONS

The study is an attempt to identify the main factors related to food prices. For this purpose, monthly data from July 2002 to July 2021 was collected from the monthly statistical bulletin for 14 large cities of Pakistan for 15 important food commodities. The ARDL bound test shows that there was a negative and significant impact of the REER on wheat prices in the long run. The real interest rate had a mixed effect on food prices in the long run. It inversely affected wheat and rice prices but directly affected tea prices. An increase in international crude oil prices significantly increased the prices of vegetables except for garlic. It also increased the prices of chicken, eggs, wheat, rice, and sugar in the long run. The study finds support for international food price transmission to domestic prices in the long run. The results revealed that an increase in international prices of beef, chicken, wheat, rice, sugar, and tea significantly increased their domestic prices. On the other hand, in the long run, an increase in local production of tomatoes, eggs, mash, masoor, and sugar significantly reduced their prices. Regarding the government's wheat support price policy, it was observed that an increase in the wheat support price had a positive and significant impact on wheat prices. The results also indicate that the log prices of onions, tomatoes, potatoes, chicken, eggs, wheat, and tea monotonically converged to equilibrium. It implies that the divergence from the equilibrium level of prices in the current period would be corrected by 35, 41, 24, 49, 37, 33, and 24 percent, respectively in the next month. However, the pace of adjustment was relatively slower for other commodities, such as beef, milk, mash, and sugar. The results of this study show that the wheat support price increases the price of wheat. This increase in wheat prices will decrease the production of other agricultural commodities and, ultimately, hurt the consumers. Thus, there is a need to increase the per acre yield of wheat instead. To encourage investment in crop production by local farmers, it is important to provide loans at a low interest rate. The results reveal that the high crude oil prices increase the prices of most of the food commodities. Even though international crude oil prices are out of the government's control, the government may consider the provision of crude oil at subsidised rates to the producers to reduce the input cost. Furthermore, there is a need to construct a proper transportation system from farms (villages) to the city markets to reduce transportation costs.

APPENDIX

Table A-1

Group Unit Root Test (First Difference)

Variables	Lags	P-Values
	Vegetable Group	
	(a) Onion	
Method	Statistic	Probabilities
ADF - Fisher Chi-square	592.357	0.0000
ADF - Choi Z-stat	-23.5522	0.0000
Domestic Price	0	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
	(b) Tomato	
Method	Statistic	Probabilities
ADF - Fisher Chi-square	543.860	0.0000
ADF - Choi Z-stat	-22.3832	0.0000
Domestic Price	6	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
International Price	9	0.0000
	(c) Garlic	
Method	Statistic	Probabilities
ADF - Fisher Chi-square	443.085	0.0000
ADF - Choi Z-stat	-20.3277	0.0000
Domestic Price	0	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
	(d) Potato	
Method	Statistic	Probabilities
ADF - Fisher Chi-square	549.063	0.0000
ADF - Choi Z-stat	-22.5697	0.0000
Domestic Price	6	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
	Meat Group	
	(a) Beef	
Method	Statistic	Probabilities
ADF - Fisher Chi-square	727.967	0.0000
ADF - Choi Z-stat	-26.0537	0.0000
Domestic Price	0	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
International Price	0	0.0000

Continued—

Table A-1—(*Continued*)

(b) Chicken		
Method	Statistic	Probabilities
ADF - Fisher Chi-square	592.152	0.0000
ADF - Choi Z-stat	-21.9616	0.0000
Domestic Price	2	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	11	0.0857
International Price	0	0.0000
Dairy		
(c) Egg		
Method	Statistic	Probabilities
ADF - Fisher Chi-square	428.660	0.0000
ADF - Choi Z-stat	-18.0830	0.0000
Domestic Price	9	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	11	0.0000
(d) Milk		
Method	Statistic	Probabilities
ADF - Fisher Chi-square	612.330	0.0000
ADF - Choi Z-stat	-23.3152	0.0000
Domestic Price	2	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
International Price	1	0.0000
Cereal & Pulses Group		
(a) Wheat		
Method	Statistics	Probabilities
ADF - Fisher Chi-square	615.707	0.0000
ADF - Choi Z-stat	-22.5829	0.0000
Domestic Price	0	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	11	0.0000
International Price	0	0.0000
Wheat Support Prices	11	
(b) Rice		
Method	Statistics	Probabilities
ADF - Fisher Chi-square	628.433	0.0000
ADF - Choi Z-stat	-24.0702	0.0000
Domestic Price	0	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0857
International Price	0	0.0000

Continued—

Table A-1—(*Continued*)

	(c) Pulse Moong	
Method	Statistics	Probabilities
ADF - Fisher Chi-square	517.882	0.0000
ADF - Choi Z-stat	-21.6735	0.0000
Domestic Price	1	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
	(d) Pulse Mash	
Method	Statistics	Probabilities
ADF - Fisher Chi-square	617.970	0.0000
ADF - Choi Z-stat	-24.0504	0.0000
Domestic Price	0	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
	(e) Pulse Masoor	
Method	Statistics	Probabilities
ADF - Fisher Chi-square	427.919	0.0000
ADF - Choi Z-stat	-19.2625	0.0000
Domestic Price	2	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
	Others Group	
	(a) Sugar	
Method	Statistics	Probabilities
ADF - Fisher Chi-square	639.151	0.0000
ADF - Choi Z-stat	-24.3413	0.0000
Domestic Price	1	0.0000
Exchange Rate	0	0.0000
Interest Rate	1	0.0000
Oil Price	0	0.0000
Production	0	0.0000
International Price	0	0.0000
	(b) Tea	
Method	Statistics	Probabilities
ADF - Fisher Chi-square	488.457	0.0000
ADF - Choi Z-stat	-21.2557	0.0000
Domestic Price	1	0.0000
Exchange Rate	0	0.0000
Interest Rate	0	0.0000
Oil Price	0	0.0000
International Price	1	0.0000

Source: Authors' calculations.

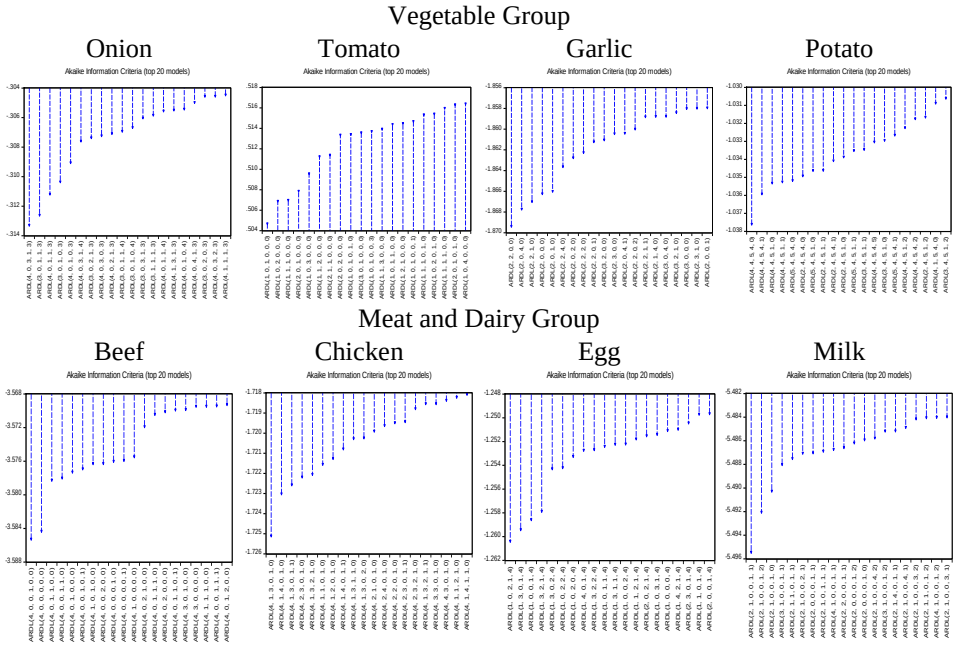
Table A-2

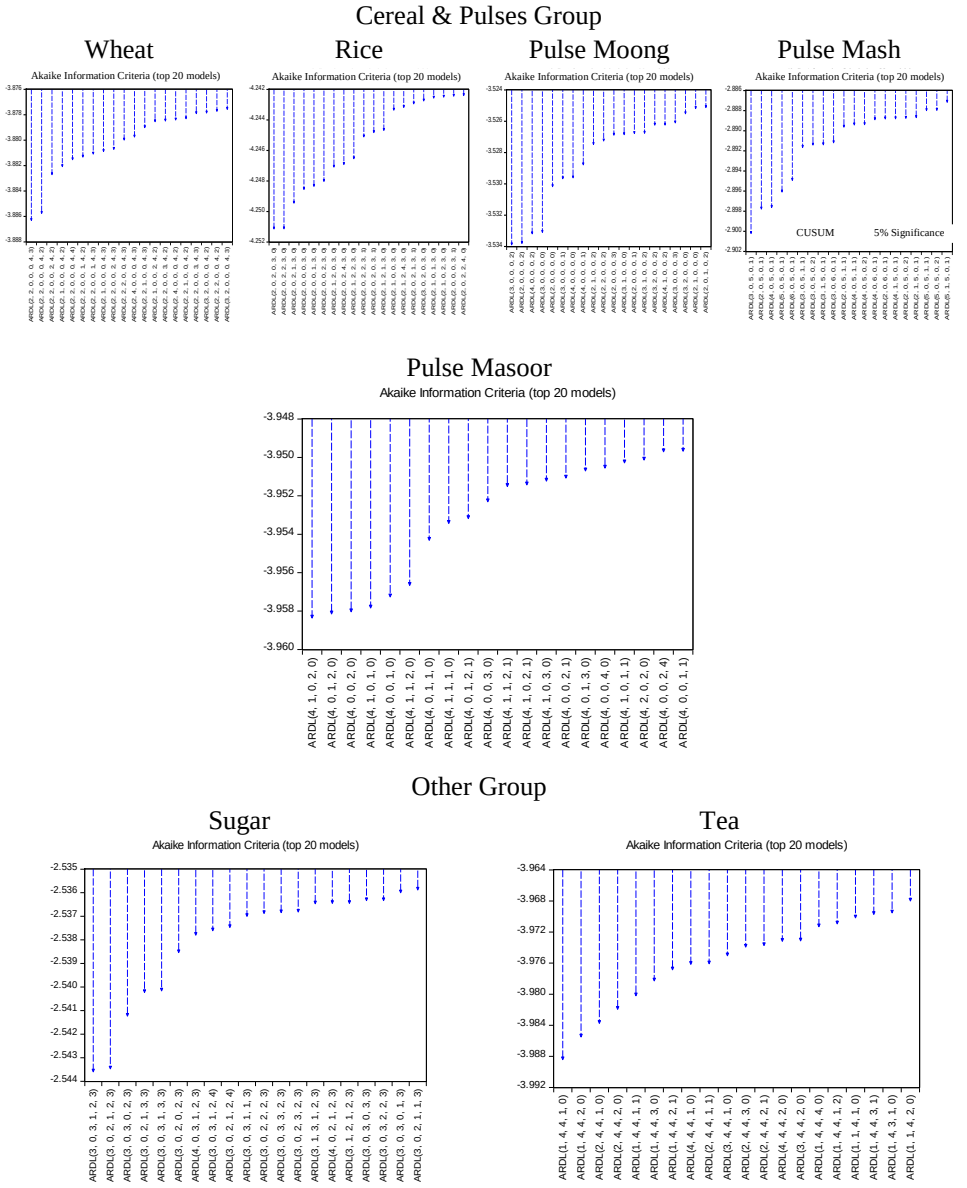
Residual Diagnostic Test/ Model Robustness

Dependent Variables	F^2Stat	R^2	$\chi^2_{Serialcorrelation}$	χ^2_{hetero}	AIC lag selection
Vegetable Group					
log (Onion price)	101.7606***	0.90	0.89	Robust SE (HAC)	(4, 0, 3, 1, 3)
log (tomato price)	49.08887***	0.71	0.80	Robust SE (HAC)	(1, 0, 1, 0, 0, 0)
log (garlic price)	1832.16***	0.98	0.86	Robust SE (HAC)	(2, 2, 0, 0)
log (potato price)	131.8729***	0.94	0.93	Robust SE (HAC)	(4, 4, 5, 4, 0)
		Meat Group			
log (beef price)	3840.197***	0.99	0.11	0.93	(4, 0, 0, 1, 0, 0)
log (chicken price)	229.9765***	0.95	0.20	Robust SE (HAC)	(4, 1, 3, 0, 1, 0)
Dairy Group					
log (egg price)	260.0035***	0.94	0.30	0.24	(1, 0, 2, 1, 4)
log (milk price)	31401.96***	0.99	0.81	Robust SE (HAC)	(2, 1, 0, 0, 1, 1)
Cereal & Pulses Group					
log (wheat price)	2575.58***	0.99	0.435	Robust SE (HAC)	(2, 2, 0, 0, 0, 4, 3)
log (rice price)	7057.850***	0.99	0.65	Robust SE (HAC)	(2, 0, 2, 0, 3, 0)
log (Pulse moong price)	4970.500	0.99	0.17	0.13	(3, 0, 0, 0, 2)
log (pulse mash price)	2181.496***	0.99	0.59	Robust SE (HAC)	(3, 0, 5, 0, 1)
log (pulse masoor price)	3847.106***	0.99	0.72	Robust SE (HAC)	(4, 1, 0, 2, 0)
Other Group					
log (sugar price)	552.98***	0.98	0.31	Robust SE (HAC)	(3, 0, 3, 1, 2, 3)
log (tea price)	2804.805***	0.99	0.41	Robust SE (HAC)	(1, 4, 4, 1, 0)

Source: Authors' calculations.

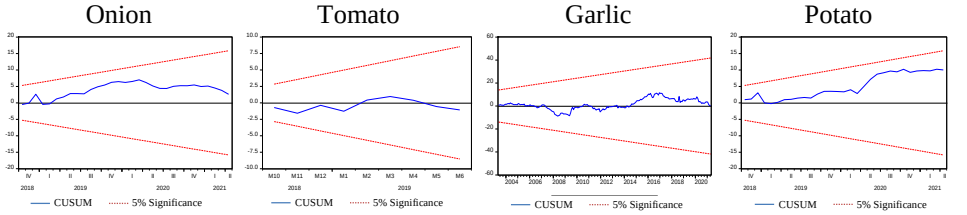
Figure A-1. Akaike Information Criteria

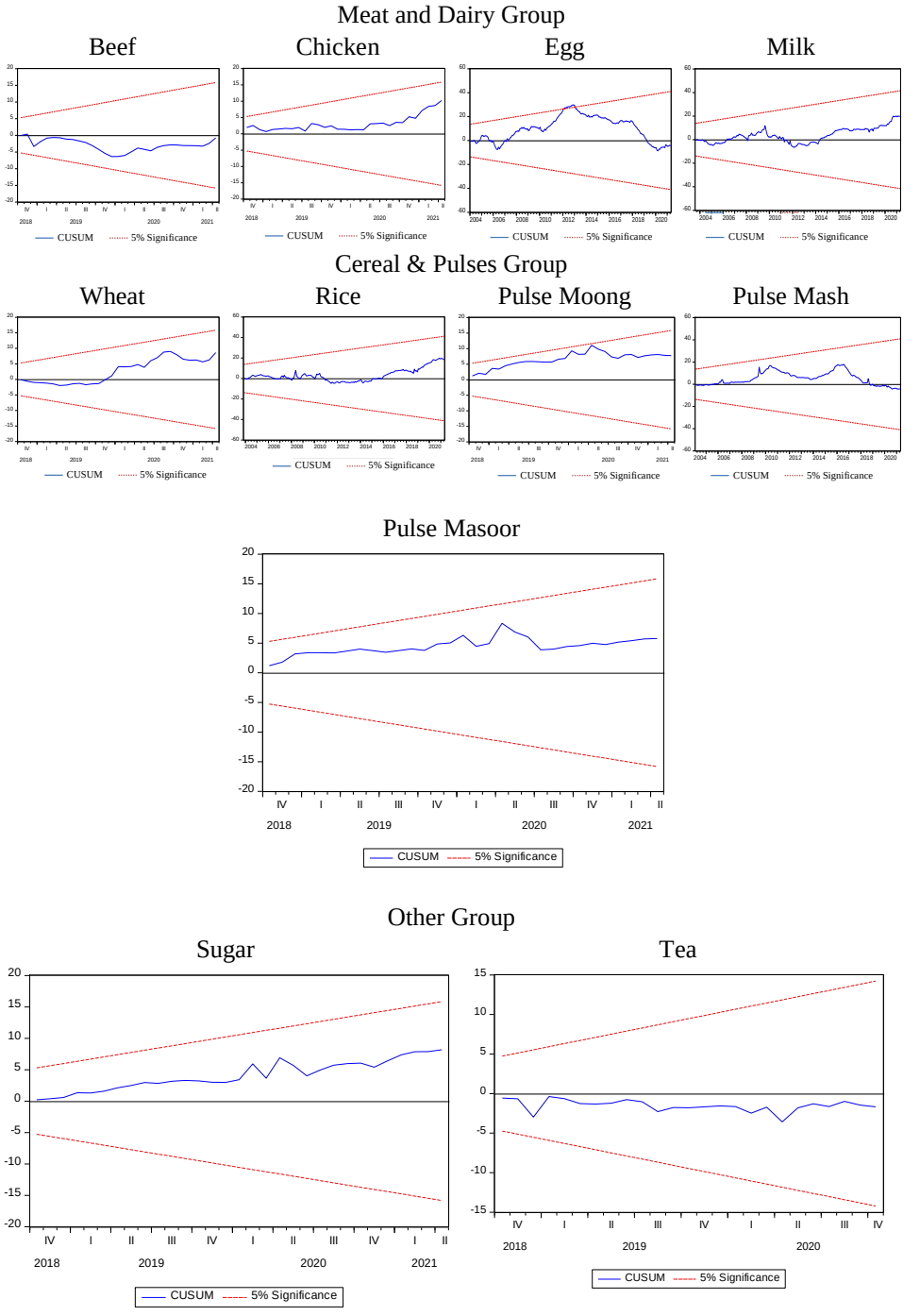




Source: Author's illustration.

Fig. A-2. CUSUM Stability Test





Source: Authors' illustration.

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