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Whether there is an Impact of Money Supply and Exchange Rate on Agricultural Prices in Pakistan

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Abstract: This study analyzed the long-run neutrality of money supply and exchange rate on the agricultural prices of Pakistan by using the Least Square Estimator (LSE) and Johansen & Jusileius from 1975 to 2016. The result shows that the neutrality of exchange rate does not hold in the long-run while the coefficient of money supply is insignificant in the long run emphasized the neutrality of money. There are some unobservable factors such as demand and supply empirically include in the model shows those prices of agricultural influenced by other factors in the short and long run. Therefore, result suggests that the monetary authorities can control the exchange rate through proper policies to overcome the overshoot problem of agricultural prices in Pakistan.

Keywords: Money Supply, Exchange Rate, Agricultural Prices, Error Correction, Pakistan

1: Introduction

Agriculture, since independence, has been one of the major productive sectors in Pakistan. Even though there have been decades of efforts to reforms and shift towards a higher value industry and service-centric production, agriculture still holds a huge impact on our economy. One cannot shy away from the significance of the agriculture sector because it contributes a sizeable 20 percent to our Gross Domestic Product (GDP) and employs 43.7 percent of the total labor force. Major chunk of that labor force, about 90 percent, hails from the low -income and fixed income households of the rural areas of Pakistan whereas 62 percent of the whole population is dependent upon this sector for their livelihood. [Government of Pakistan, 2014]

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Standard theory dictates that prices are the lubricant that keeps the economic wheel moving. For the purpose of this study, we are focused exclusively on the agricultural sector and are primarily interested in agricultural prices and their dynamics. To put the problem in perspective we argue that since a significant portion of the population attached to this sector is middle to low income households [GoP, 2014], any change (instability) in prices whether direct or indirect can have significant impacts of their standard of living as well as the rest of the population. Therefore, it is of reasonable interest to find what are the major macroeconomic factors that impact agriculture prices and develop reasonable predictability for future periods.

There is a good amount of literature investigating into the instability of agricultural prices due to changing exchange rate and monetary policy. Pakistan also trades agricultural products internationally so it is reasonable to believe that domestic agricultural prices are affected by any changes in its exchange rate, especially for an economy operating under the floating ER system because at times it is possible for the nominal exchange rate to overshoot out of bounds and cause severe distress on prices and subsequently the domestic purchasing power of the households. The relationship between relative long-term agricultural prices and exchange rate has been empirically examined for other countries.

The overshooting model argues that monetary policy changes carry short run effects that are real on agricultural prices also that money in the short run is non-neutral because it can change relative prices. Without the intervention of government policies, the prices of agricultural commodities are flexible as they are determined in competitive circumstances. While the prices of manufacturing goods are mostly sticky as there is presence of some sort of monopoly power [Barnet, *et al*. (1983)]. Since monetary policy does carry effects for agricultural sectors in both short and long run, it becomes very important from a perspective of analysis because the income of farmers is susceptible to changes in market prices. Even if the money supply is neutral in the long run having no long-term effects on income of farmers still in the short run it has tremendous impact on the farmer’s income. Any change in the prices of agricultural commodities is a concern to the public and policy makers because fluctuations in prices affects productivity of agricultural sector. Fluctuations in prices increase uncertainty related to farmers and effects the business of agriculture. Before 2007, agricultural prices were comparatively low but after 2007, there was a pickup in prices of crops in Pakistan. Several internal and external factors are responsible for this factor. In Pakistan, the agricultural policy mainly focuses on increasing farmer's income along with providing cheap food items for urban consumers, and availability of raw materials on low prices for industrial sector. Saghian, *et al.* (2002) and Siftain, *et al*. (2016) suggested that expansionary monetary policy can boost up the agriculture prices which leads to an increase in income, uplifting the farmer's living standard and increasing their investment capacity.

To support the urban population and to decrease domestic inflation, a rather tight monetary policy can be drafted to keep agricultural prices in check. Support price is used for controlling the prices of major commodities. Thus, the agriculture pricing policy plays a pivotal role in boosting crop production and farmer's income. It is also important to understand the supply response price mechanism [Nerlove & Bachman (1960)].

Ejaz (2007) and Hye (2009) conducted the study in Pakistan about the monetary impacts of agricultural sector. In these studies, exchange rate is not incorporated. As Pakistan is a small open economy, therefore, it would be better to include exchange rate. Siftain, *et al.* (2016) incorporated the monetary variables with exchange rate to investigate the impacts of monetary policy on food prices in long and short run by using Saghaian, *et al.* (2002) model.

However, Siftain, *et al.* (2016) did not focus on the long-run neutrality of exchange rate on the movement of relative agricultural prices in Pakistan and showed the only long-run relationship. In this study, we have tried to find out the impact of monetary policy and exchange rate on the relative prices of agriculture sector in Pakistan and to find out the long-run neutrality of these on the movement of relative agricultural prices.

There is also an additional long-run relationship that would not be ignored and that is the relationship of agricultural prices or food prices with overall because the long-run relationships could be explained by unobservable

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relative movements of factors. First time Friedman (1975) notes that expansionary monetary policy affects the overall prices of the economy and demand and supply of the commodities determined the relative prices of the products. This shows that in the long run agricultural prices move differently than the overall price level even if the money supply does not change.

The factors that influence the prices of agriculture are important to study for a developing country like Pakistan. In the historical context, relative prices are mostly determined by real demand and supply factors. Nominal money factors have lesser role to play in determining relative prices as it affects only the general price level. The money supply and demand only determine the general price level and have less concern about relative prices. Schuh (1974) was the first who suggested that the exchange rate significantly affects the agricultural prices. Later, the interest is developed to find out implication of several other nominal variables e.g. money supply and discount rate with agricultural prices. Studies of different areas show that there is ambiguity about the relationship among agricultural prices and monetary variables. Lapp (1990) shows that money supply does not significantly affect food prices. However, the later studies such as [Saghain, *et al.* (2002); Asfaha & Jooste (2007), and Ejaz, *et al*. (2007)] investigated that monetary policy has significant impact and strong implications for agriculture sector. Agricultural and food prices are significantly impacted by several macroeconomic variables and money. Policies and changes in relative prices have impact on investment decision of the farmer, farm's productivity and farmer's income. Now the need is to understand which factors affects agricultural prices because it is important to sustain productivity in this sector as well as the whole economy also.

1.1: Objectives:

The current study will achieve the following objectives:

i. To ascertain whether there is any short run impact of money supply and exchange rate on agricultural prices.

ii. To find out whether in the long-run money supply and exchange rate are neutral in determination of the relative agricultural prices.

iii. To find out the relationship of overall prices with the agricultural prices.

2: Data & Methodology

In this section, we will discuss the theoretical foundation of our proposed empirical model. The chapter also includes the econometric specification of the model and data sources and variables information.

2.1 *Theoretical Framework*

Since Schuh's (1974) seminal work on the issue related to the agricultural sector and its relationship between monetary and other macroeconomic variables. This issue is important because impact of monetary directly affects the prices of agriculture and that prices influence the living standard of every person. Our main problem is to check whether agricultural and nonagricultural prices respond to monetary changes in long run or not. Further, we want to check the hypotheses of money neutrality for the short run. Observational data suggest that agricultural prices are more competitive in nature than any other sector so the prices are less sticky. Consequently, expansionary monetary policy favors the agriculture sector while contractionary monetary policy has reverse effect. Ferto I. & Bakucs L. Z. (2005). Many studies conducted in this regard showed that prices of agriculture adjust faster than the non-agriculture sector to changes in monetary policy in short-run but money neutrality does not hold in the long run [Saghaian, *et al.* (2002); Jooste A. & Asfaha T. (2007)]. We will test whether this holds for Pakistan or not.

Referring to Dornbusch's (1976) model above mentioned studies explain the linkage among exchange rate, money supply, and prices. According to the Saghaian, *et al.* (2002) model which is an extended version of Dornbusch's model with incorporation of international trade, nominal exchange rate deviation may be possible in the short run when prices are sticky. So, this overshooting may cause the short-run variation of real exchange rate even if it in the long run.

Prices of agriculture and exchange rate are assumed flexible as they have their own separate and different adjustment paths and adjust quickly to shocks in monetary policy. In contrast, prices of non-agriculture sector

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assumed to be sticky. They assumed the economy to be a small open economy, the study asserted that with monetary shocks the prices of agricultural and services sector are far from their long-run equilibrium. Study concludes that when the monetary shocks occur the burden of adjustment of the sector where prices are sticky is also shared by the flexible prices sector. The economy which has floating exchange rate system is less prone to agricultural price hike due to monetary shocks.

2.2 Model Specification

The goal is to test for money neutrality in the long run and for that, we follow in the footsteps of [Zanias (1998); Grennes & Lapp (1986); Saghaian *et al.* (2002) and Robertson & Orden (1990)]. We set up the equations for nominal prices of food and agriculture, money stock, real exchange rate, and aggregate price level as

$$\ln P_t^A = \alpha_0 + \alpha_1 lnM_t + \alpha_2 lnR_t + \varepsilon_t \quad (2.1)$$

$$lnP_t = \beta_0 + \beta_1 lnM_t + \beta_2 lnR_t + v_t \quad (2.2)$$

Where;

$\ln P_t^A$ denotes the log of agricultural food/product prices
lnM_t denotes the log of the money supply
lnR_t denotes the real exchange rate in log form
lnP_t denotes the log of manufacturing products prices

If one percent increase in the money supply generates the same percentage increase in the general price level as well as agricultural prices this would be indicative of long-run neutrality of money. In older studies $\alpha_1 = \beta_1$ has been taken as a condition to test this hypothesis. However, if percentage increase in money supply translates into a higher average price level, also argued by Friedman (1975), then it becomes imperative that relative prices between commodities, in the long run, be determined by the changing in the existing supply-demand conditions. Through Friedman's argument it is, therefore, possible for agricultural prices do not always move in coherence with the general prices regardless how stock of money changes. Conversely, if stock of money changes, where agricultural and general prices are moving disproportionately, its impact on both will be quite different. As per our hypothesis, the impact of money supply on agricultural would be different as compared to the overall prices and in this case α_1

should be smaller than β_1. This empirical model is not proper to test the money neutrality.

Another relationship of significant importance is among prices for food and agriculture and prices in general. Now, there is unobservable relative movement of factors to explain long-run relationships, as noted by Kliesen & Poole (2000) in favor of elasticity of demand and income, however, it is not possible to include all such structural variables in the analysis. We have incorporated the relationship between prices for agriculture and food and prices, in general, using the rational expectation approach. The approach suggests that in the long run, relative movements of demand and supply over time is realized in variation of relative prices.

Assuming the given below long-run association between General and agricultural prices, which is determined by the real factors.

$$lnP_t^A = \gamma_0 + \gamma_1 lnP_t + \eta_t \quad (2.3)$$

Multiply equation (2.2) by -γ_1 and add equation (2.1) & (2.2) for following long-run relationship:

$$lnP_t^A - \gamma_1 lnP_t = \alpha_0 - \gamma_1\beta_0 + (\alpha_1 - \gamma_1\beta_1)lnM_t + (\alpha_2 - \gamma_1\beta_2)lnR_t + (\varepsilon_t - \gamma_1 v_t) \quad (2.4)$$

Or, equivalently

$$lnP_t^A = \delta_0 + \gamma_1 lnP_t + \delta_1 lnM_t + \delta_2 lnR_t + \xi_t \quad (2.5)$$

If agricultural prices reacted more than overall prices in the reaction of change in money supply, $\delta_1 > 0$ and $\alpha_1 > \gamma_1\beta_1$; $\delta_1 < 0$ and $\alpha_1 < \gamma_1\beta_1, otherwise.$ If agricultural price respond more sensitively in response to real exchange rate $\delta_2 < 0$ and $\alpha_2 < \gamma_1\beta_2$; $\delta_2 > 0$ and $\alpha_2 > \gamma_1\beta_2$, otherwise. If we take money and exchange rate to be neutral i.e., δ_1 and δ_2 equal to zero then $\alpha_1 = \gamma_1\beta_1$ and $\alpha_2 = \gamma_1\beta_2$.

The model (2.5) contains three possible cases. Formally, expressed below;

Case-1: if the long-run relationships signified in equation (2.1), (2.2) and (2.5) holds and also if exchange rate and money are neutral in the long run,

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then the estimated coefficients δ_1 and δ_2 in model (2.5) should be zero. Under given innovations, ξ_t should be a stationary process implies that the coefficient γ_1 should be a cointegration vector.

Case-2: If true long-run relationships hold in (2.1), (2.2), and (2.3), but without holding long-run neutrality either in money or in the real exchange rate, the coefficients δ_1 and $\delta_2$should be zero. However, the coefficients in model (2.5) represent a long-run co-integration vector under hypothesis of given inventions.

Case-3: If residual ξ_t is a non-stationary process means that the coefficients of model (2.5) are not a co-integration vector. Hence, either there should be no true long-run relationships existed in estimated equations (2.1), (2.2), and (2.3) or, it might be that we are not able to detect the relationship, with the variables. Since here could be features that are unobservable causing cyclical variations in long-run equilibrium path of prices for food and agriculture.

Note that the δ_2 coefficient indicates how much food and agricultural prices are sensitive to respond against movements in real exchange rates and aggregate prices relatively. Simply we can say that even when δ_2 is zero, it does not imply exclusion of any real effect of real exchange rate either on exports related to agricultural and food or on domestic agricultural or food prices. Instead, real exchange rate variability cause food and agricultural prices as well as aggregate price level in long run.

We followed a proper econometric procedure to get our estimates. We started with a very basic model OLS, which definitely gives us an insight into the econometric problems like endogeneity, autocorrelation as expected. The further procedure incorporates the tests to cater these problems. Augmented Dicky Fuller test used for the purpose of unit root analysis. Secondly, we used co-integration based on unit root analysis for long-run relationship. For checking the long-run relationship, we have used Least Square Estimator [Engle & Granger (1987)]. LSE is good for its consistency property in estimating long-run relationship. For comparison, we have used another technique known Johanson and Juselious (JJ) (1990) cointegration technique.

2.3 Data and Variables

This study used the real exchange rate, money supply, agricultural prices, and overall prices. CPI of food is used as a proxy for agricultural prices and index of all commodities for overall prices. Money stock (M1) data is used for Money variable and real effective exchange rate data is used for exchange rate. All variables are transformed into logarithm form. Annual Time series data is used from 1977 to 2018. Data of money supply is used from data source of SBP. IFS database is used to collect exchange rate data. Index of food and overall price are collected from the data source of Pakistan Bureau of Statistics.

2.4 Estimation Method

For the purpose of our analysis, of relationships amongst the series, in the long run, we use the most successful technique i.e., the "Engle & Granger Two-Step Estimation Method" as used by [Engle & Granger (1987)]. Error Correction Model is castoff to check the short-run relationship of the variables. This method, however, is not asymptotically efficient because of non-existent dynamic short-run adjustments and is only consistent under a few regularity conditions for estimating long-run co-integrating vectors. JJ technique also allows us to test the hypothesis on the cointegrating relationship themselves, which "Engle and Granger" doesn't [Brooks (2008)]. "Engle and Granger" also cannot find the cointegrating vectors if there are more than one cointegrating vectors so JJ method is applied to find if there are more than one cointegrating vectors.

We start the discussion with the explanation on the least square method. Let Z_t be a $n \times 1$ vector of a variable that is both random and stationary at first difference (ΔZ_t denotes stationary). Under the condition, where there is a non-zero vector of real number $\boldsymbol{a}$ such that $a'Z_t$ is stationary, then it is consider to be associated with a co-integrating vector $\boldsymbol{a}$. normalizing one element with one is expedient most of the time. Assuming the first component of $\boldsymbol{a}$ is zero, then partition Z_t by $Z_t = (y_t\ , X_t')$ and stabilize $\boldsymbol{a}$ by $\boldsymbol{a} = (\mathbf{1}, -\boldsymbol{c})$. Now, y_t is a stationary process, X_t is a vector difference stationary process, and $\boldsymbol{c}$ is a stabilized associating vector.

The cointegration system (2.5) can be written as

$$y_t = X_t'c + \varepsilon_t \tag{2.6}$$

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$$\Delta X_t' = v_t \quad (2.7)$$

Here $y_t = lnP_t^A, X_t' = [1,\ lnP_t, lnM_t, lnR_t], and\ c' = [\delta_0, \gamma_1, \delta_1, \delta_2]$ are in our case. The $y_t\ and\ X_t$ are stationary at first difference. While $\varepsilon_t\ and\ v_t$ are stationary and their mean is zero.

Now

$$Wt\ =\ (\varepsilon t, Vt)' \quad (2.8)$$

Let $\Phi(i) = E(w_t w_{t-i}'), \sum = \Phi(0)$, $\Gamma = \sum_{i=0}^{\infty} \Phi(i),$ and $\Omega = \sum_{0=-\infty}^{\infty} \Phi(i)$. In detail, the $\boldsymbol{\Omega}$ is the long-run variance matrix of $\boldsymbol{w_t}$**.** Further $\boldsymbol{\Omega}$ is explained in matrix form as

$$\Omega = \begin{bmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{1221} & \Omega_{22} \end{bmatrix} \quad (2.9)$$

Whereas Ω_{11} is a scalar, and where Ω_{22} is $(n-1) \times (n-1)$ matrix, and partition likewise.

Defining,

$$\Omega_{11.2} = \Omega_{11} - \ \Omega_{12}\Omega_{22}^{-1}\Omega_{21} \quad (2.10)$$

$$and\ \Gamma_2 =\ (\Gamma_{12}'\ , \Gamma_{22}'\ )'.$$

The LSE is used to correct the short-run movements and error term in the model, the example of this correction technique is maximum likelihood estimation presented by [Johnson (1988)]. As we are more interested in a long run association of variables in the model rather than short-run estimates, therefore, “Johanson and Juselious (1990)” cointegration technique is also used in this study. The “Johanson and Juselious (1990)” method follows the “Maximum Likelihood” (ML) method and finds the cointegrating equation in a non-stationary time series “Vector Autoregressive (VAR)” with restrictions imposed, known as a “Vector Error Correction Model” (VECM). This is measured as one of the efficient technique for estimation. For more brief understanding, take into account following equations:

$$y_t^* = y_t + \Pi_y' w_t \quad (2.11)$$

$$X_t^* = X_t + \Pi_x' w_t \quad (2.12)$$

As w_t is stationary, y_t^* and X_t^* are cointegrated of the same order. When y_t^* is regressed on X_t^*. The matrices for the purpose are

$$\Pi_y = \Sigma^{-1}\Gamma_2 c + (0, \Omega_{12}\Omega_{22}^{-1})' \quad (2.13)$$

$$\Pi_x = \Sigma^{-1}\Gamma_2 \quad (2.14)$$

Practically, through these equations, long-run covariance parameters can be estimated, and then these Π_y and Π_x transformed in to y_t and X_t.

3: Results and Discussion

This section presents the estimation results and detailed discussion on these results. Ongoing part of study is separated into different segments. Section 4.1 provides descriptive statistics and whereas section 4.2 gives results of unit root test. The long-run analysis discussed in later sections of this chapter.

3.1 Unit Root Test

"Augmented Dicky Fuller" (ADF) and "Dicky Fuller" (DF) test have been widely used to check the existence of unit root in data set. DF captures only AR (1) process whereas the ADF test captures higher-order process also. ADF is an improved version of DF and three different forms of DF test was used to amend the ADF test. The Null hypotheses $\delta = 0$ is used in ADF against the alternative hypotheses $\delta < 0$. If critical value is greater than the alternative value, alternative hypotheses are accepted $\delta < 0$ whereas the null hypotheses is rejected $\delta = 0$ so, the series is stationery and unit root does not occur.

We also applied the ADF test to check the stationarity of the series. The results are presented below in tables.

Table 3.1: Unit Root Test at Level

Variable	1% critical	5% critical	10% critical	t-Statistic	Prob.*
ln Food Prices	-3.606	-2.934	-2.607	-0.082	0.945
ln General Prices	-3.606	-2.937	-2.607	-0.210	0.929
ln M1	-3.600	-2.935	-2.606	0.343	0.978
ln Real Effective ER	-3.601	-2.935	-2.606	-1.946	0.309

The above Table 3.1 presents the unit root results at the level. According to the probability value of all variables, we cannot discard the null hypothesis and concluded that all of the variables are not stationary at level. Therefore,

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we are checking the unit root again after taking first difference and the results are described in below table.

Table 3.2: Unit Root Test of Variables at 1st Difference

Variable	1% critical	5% critical	10% critical	t-Statistic	Prob.*
ln Food Prices	-4.212	-3.531	-3.196	-4.281	0.0084
ln General Prices	-3.610	-2.934	-2.608	-3.669	0.0080
ln M1	-3.610	-2.934	-2.608	-5.624	0.0000
ln Real Effective ER	-3.610	-2.934	-2.608	-4.741	0.0004

Graphical representation of the series suggests that the log of food prices has time trend so we apply the ADF test accordingly. From the above table, it can be seen that the ADF test rejects the null hypotheses that Food price variable has a unit root. Probability value clearly specifies that after taking first difference, the variable is stationary.

In case of the General Prices and M1, ADF test rejects both of the null hypotheses that $\delta = 0$ which means both variables are stationary at first difference. The last Unit Root test was applied to check the presence of stationarity at the Real Effective Exchange Rate. The ADF test rejects the null hypothesis and indicates that the series is stationary. Thus, the conclusion can be drawn from the above results that all are the variables are stationary after taking first difference.

3.2 Engle-Granger Results

Two-step Engle-Granger Cointegration approach has been applied to analyze the relationship among the series suggested by [Engle & Granger (1987)]. Long Run Results are specified below in 3.3 Table.

The value of the coefficient for the 'general price' comes out to be 0.870 which is also significant which can be interpreted as one percent growth in general prices will raise the food prices by 0.870 percent which is close but still lower than a one-to-one increase. The difference, however, is significant enough to prove the disproportionate movement in general prices and food prices. The reason why this happens is explained extensively in Kliesen & Poole (2000) on why food prices have a descending movement. The proposed reasons are comparatively lower-income elasticity (Engel's Law) and inelastic Demand & Supply Functions of food products. Engel's law points that due to increase in income, food and agricultural products consumption will increase but less proportionately than income. The lower-income elasticity and inelastic demand for consumption of food are the reasons for disproportionate increasing movement in food prices.

Table 3.3: Least Square Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.995	0.176	-5.657	0.000
Ln General Price	0.870	0.033	26.049	0.000
Ln M1	0.009	0.0136	0.674	0.504
Ln Real Effective Exchange Rate	0.103	0.038	2.694	0.010
R^2	0.993	**Adjusted R^2**	0.992	

The coefficient Ln M1 estimated value is 0.009 and it is statistically insignificant which explains the long-run money neutrality of the said variable. The money supply coefficient indicates a one percent increase in money supply causes a 0.009 percent increase in food prices although it has no impact on our model. Money supply growth rate is positive during the sample period.

Real Effective Exchange Rate coefficient is 0.103 in our results and explains that a 1 percent appreciation of the currency leads to a 0.103 percent increase in the food prices. The variable is explaining that the real effective exchange rate movements are not neutral in terms of explaining the overshooting the food prices in the long run.

Adjusted R^2 has a value 0.992, shows the goodness of fit, through this value we can explain that 99 percent variation in explanatory variables is explained by this regression.

Table 3.4: Augmented Dicky Fuller Test of Co-integration

Variable	**1% critical**	**5% critical**	**10% critical**	**t-Statistic**	**Prob.***
Residuals	-3.616	-2.941	-2.609	-3.013	0.0426

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Augmented Dicky Fuller (ADF) test has been utilized to analyze the presence of co-integration. The given stats indicate the rejection of null hypothesis of at 5 percent level.

3.3 Error Correction Model (ECM)

We know that the benefit of using ECM method to find the presence of long-run association is that it takes care of the spurious regression. Table 3.5 offers sufficient evidence on the long-run association between the said series. The value of probability is 0.043 which specifies the denial of the null hypothesis. This condition has formed a foundation to regress ECM. The results are presented in below given table 3.5.

Table 3.5: Error Correction Model Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLGP	1.451	0.074	19.702	0.000
DM1	0.004	0.013	0.330	0.744
DRER	0.089	0.037	2.356	0.024
U (-1)	-0.365	0.084	-4.351	0.000
C	-0.030	0.007	-4.617	0.000
R^2	0.929	**Durbin-Watson stat**		1.825

According to the Durbin Watson and R-squared values, the ECM regression is not a spurious regression. The co-efficient DLGP represents the short-run equilibrium coefficients and has a positive sign, which indicates a positive association among general price level and food prices. This coefficient is also statistically significant at 1% level. Both DM1 and DLRER are also the short-run coefficients and have positive relationship with food prices but money supply variable is statistically insignificant in our model whereas the real effective exchange rate has a positive and significant role in our study. The coefficients U (-1) is the coefficient of error correction which is as well as known as long-run coefficients and it has negative sign as required. The value of U (-1) coefficient is -0.36 which explains that the shock in previous period will adjust in this period by 36%. This variable has the probability value is 0.0001 which confirms the significance and the long-run relationship.

3.4 Diagnostic Test

In order to diagnose the above regression, we further applied test for autocorrelation and normality test. Both tests results are specified below in Tables.

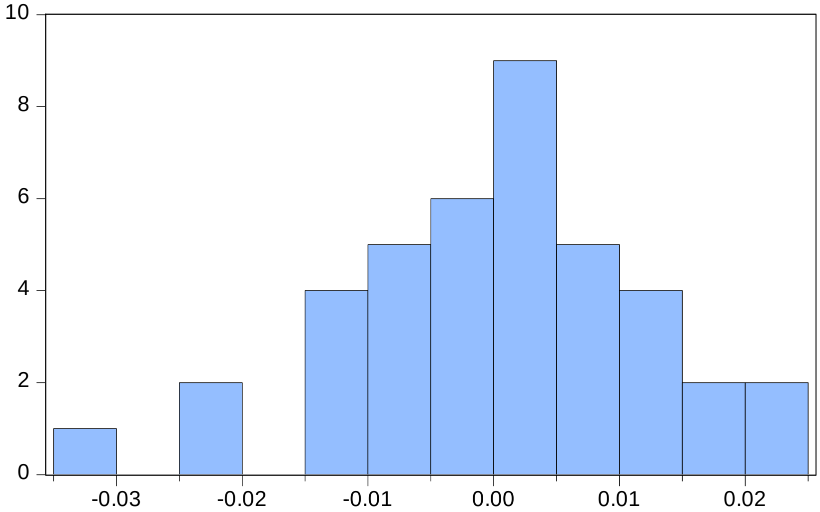
Table 3.6: LM Test for Serial Correlation

F-stat	1.064	**Probability F (2,33)**	0.357
Observation * R-squared	2.424	**Probability Chi-Square (2)**	0.298

"Breusch-Godfrey serial correlation LM test" has been applied to detect the auto-correlation. Table 3.6 shows the results which highlighted not presence of autocorrelation in our model. The Chi-Square value is 0.298 that rejects the null hypothesis and confirms the no autocorrelation in our regressed model.

Further, we applied the Histogram Normality test to check the distribution of errors. The graph and the statistics of the normality test are provided below in figure 3.1.

Figure 3.1: Normality Test



The above graph shows a normal distribution of error terms further we can also check the statistics provided in the above graph. The Jarque-Bera value is 0.466 so this study does not negate the null hypothesis. The Null Hypothesis of the above test is that the errors are normally distributed.

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3.5 Johanson and Juselious Co-Integration

There are some testing method to implement the Johansen's Cointegration technique like the time series data must be I (1). ADF test is utilized to find the presence of unit root in data and we found that all of our series are first difference stationary. ADF results are specified above in table 3.1 and 3.2.
The JJ method tells us the cointegrating equations by following the "Maximum Likelihood" method in a series which have unit root "Vector Autoregressive" (VAR) with limits levied, also recognized as a "Vector Error Correction Model" (VECM).
To obtain the optimal lag length for JJ procedure, we prefer the "Akaike Information Criteria" (AIC) over the "Schwarz Bayesian Information Criteria" (SBIC) because the AIC gives the efficient results [Brooks (2008)]. Lag length criteria results are given in table 3.7.

Table 3.7: Lag Length Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	38.472	NA	1.91e-06	-1.814	-1.642	-1.753
1	287.087	431.804*	9.29e-12*	-14.057*	-13.195*	-13.751*
2	299.352	18.721	1.17e-11	-13.861	-12.309	-13.309
3	316.763	22.909	1.17e-11	-13.935	-11.693	-13.138
4	329.057	13.588	1.66e-11	-13.740	-10.809	-12.697

Johansen (1991) proposed the tests to check the cointegration that are: the "Maximum Eigenvalue Test" and the "Trace Test". The trace test follows the alternative hypothesis that is no cointegration. The "Maximum Eigenvalue" test check the hypothesis that the number of cointegrating vectors are $r + 1$ or equals to r [Brooks (2008)].
After checking the unit root, we applied the JJ cointegration method to find out the association between variables in the long-run. As per the result of trace test, this study negates the null hypothesis of no cointegration equation because the value is lesser than 0.05. The next hypothesis is at most one cointegrating equation and according to the probability value, we are unable to negate the null hypothesis. Trace and maximum eigenvalue tests are giving the same results. We conclude that in VECM one cointegrated vector (long-run equilibria) will be added with one lag.

Table 3.8: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

None *	0.692	74.038	47.856	0.000
At most 1	0.360	29.254	29.797	0.057
At most 2	0.221	12.266	15.495	0.144
At most 3	0.069	2.732	3.841	0.098

Table 3.9: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	Prob.**
None *	0.692	44.784	27.584	0.000
At most 1	0.360	16.988	21.132	0.173
At most 2	0.221	9.534	14.264	0.244
At most 3	0.069	2.732	3.841	0.098

3.6 VECM Results

After the detection of a number of cointegrating equation, we proceed for the "Vector Error Correction Model" (VECM). Table 3.10 illustrates the VECM results. From table 3.10 given below, the long-run speed of adjustment back to its equilibrium is denoted by c(1) which is also recognized as the adjustment factor. The VECM coefficient is -0.464 and it is also statistically significant which implies that the system will come back to its equilibrium by 46% in the long run.

Table 3.10: Results of VECM

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	Prob.
C(1)	-0.464	0.216	-2.149	**0.038**
C(2)	0.441	0.605	0.728	**0.471**
C(3)	1.924	0.860	2.237	**0.031**
C(4)	0.086	0.057	1.491	**0.145**
C(5)	-0.272	0.228	-1.192	**0.241**
C(6)	-0.146	0.041	-3.498	**0.001**
Adjusted R-squared	0.4793	**F-statistic**	**2.636**	
Durbin Watson stat	1.973	**Prob (F-statistic)**	**0.040**	

The results are obtained after estimating the VECM, we also applied different test for diagnostics to figure out how fit is our mode. If our

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estimated model clears all of the diagnostics then we can conclude that the obtained results are efficient.

3.6.1 Wald Test

We conducted a test named WALD to check the combined influence of the variables and the results show that all of the variables are jointly influence our dependent variables. The hypothesis of test is that the selected variables are equal to zero but we rejected the null hypothesis because the probability value is 0.0126 which is less than 0.05.

Table 3.11: Wald Test

Test Statistic	**Value**	**df**	**Probability**
F-statistic	3.187056	(4, 34)	0.0251
Chi-square	12.74823	4	0.0126

3.6.2. Serial Correlation LM Test

Lagrange-Multiplier test which is commonly known as the LM test is utilized to capture the autocorrelation and the below tables 3.12 shows no autocorrelation.

Table 3.12: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.024	Prob. F(2,32)	0.976
Obs*R-squared	0.060	Prob. Chi-Square(2)	0.970

4. Conclusion & Policy Implication

4.1 Conclusion

Instability is a severe issue in the agriculture sector of the economy and long-term volatile prices are the most vital variable in the contribution of this instability. Agriculture economists found severe instability issue after unexpected dollar variation while Bretton wood era, the association between exchange rate, relative food, and agricultural prices has been ignored in the long-run due to stringent impact of the monetary economic review of flexible exchange rate system.

In this study, long term neutrality of the local money and the exchange rate on the long run variations with relative prices of agriculture in Pakistan is tested. A simple derivation of new empirical model to examine the long-term neutrality of supply of money and exchange rate has been conducted. We have used the Johansen and Juselious method and we used Least Square Estimator (LSE) to check our results.

We observed the association among food prices and other variables that are described above by using the annual data from 1975-2016. In this study, we estimate the short-run coefficients and find the long-run equilibrium relation. We also find the evidence that increase in general price level cause increase in food prices. However, we find that the money neutrality holds in our study. The real effective exchange rate also grounds a rise in food prices.

On the other side of results, it is being argued by certain economists that only stable monetary policy is not enough to avoid the problem of volatility in the future as money supply plays a neutral role as it is insignificant. Since misalignment of the exchange rate is the reason up to some extent in the market of foreign exchange.

4.2 Policy Recommendations

Instability in any sector of the economy is the major problem for any country. The money supply does not the main factor to create disturbance in the prices of the agricultural sector as we see it plays a neutral role in the long run because the money supply variable found insignificant. However, the exchange rate overshoot causes changes in the prices of agricultural sector. Therefore, the monetary authorities can control the exchange rate through proper policies to overcome the overshoot problem. There are some other unobservable factors exists which cause the problem such as demand and supply problems. These problems can be overcome through crop support prices. Only the wheat support prices are given by the government to control the illegal export of the wheat. However, the support prices will provide the stability of prices of agricultural sector.

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