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Qazi Muhammad Adnan Hye and Asghar Ali

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Money Supply, Food Prices and Manufactured Product Prices: A Causality Analysis for Pakistan Economy.

Qazi Muhammad Adnan Hye
&
Asghar Ali

Abstract

This pioneer research for Pakistan uses monthly time series data for the period of 1997-1 to 2008-4 to determine the causal relationship between the money supply, food prices and manufactured product prices in developing country like Pakistan. Empirical analysis is performed by using the ARDL and Toda Yamamoto causality test. The results show that the bidirectional causality between the food prices and money supply and unidirectional causality from money supply to manufactured product prices. On the other hand there is no causal relationship between the food prices and manufactured product prices. The important finding of this study is that food prices response faster then the manufactured product prices to a change in money supply in the Pakistan.

Keywords: Food prices, Manufactured Product prices, Money supply

JEL Classifications: E_3, E_{51}

1-Introduction

A steady inflation in Pakistan has greater impact on the living standard of the poor and fixed income people of the society. Recently, Pakistan has seen strong upward pressure on food prices. High food prices, has hurting the poor and fixed income groups of the society. The CPI based inflation in during the July-April 2007-08 averaged 10.3% and 7.9% in the same period last year. The single larges component of the CPI is the food group, which makes up 40.34% of the CPI, and it showed an increase of 15.0%.This was higher than the 10.2% observed over the same period in the last year. The non food prices increase at a lower pace compared to the last year. Non food inflation averaged 6.8% during July-April 2007-08 while it stood at 6.2% in the corresponding period last year[1].Thus this study aims to use the Autoregressive Distributed Lag (ARDL) and Toda Yamamoto approaches to Cointegration to determine whether there is evidence of causal relationship between the money supply (MS), food prices (FP) and manufactured product prices (MP), in the long run with regard of Pakistan data.

The plan of the remaining paper as follows. Section 2 briefly reviews of reveling literature. Section 3 will discuss the empirical data used and econometric methodology. Section 4 presents the result and the final section concludes this study.

2. Literature Review

In the revelent literature number of study argued that the macroeconomics, predominantly monetary and financial sector impact on the agricultural output prices and manufacturing producted prices .Tweeten (1980) found that the monetary shocks little effect on the agricultural prices. David A. Bessler (1982) empirically finds out that causality from money supply to agricultural prices in Brazilian data. Devadoss and Meyers (1987)

[1]See, Pakistan Economic Survey 2007-08.

support the hypothesis that agricultural prices faster repose than manufacturing product prices to a change in money supply in the U.S.A. Saghaian, Reed and Marchant (2002) empirically prove that the in the long run money neutrality does not hold in the determination of agricultural prices. Xuehua peng et.al (2004) investigate that the monetary variables impacts on the food prices in China.

Most of the empirical research analyses regarding macroeconomic variables impact on the agricultural prices were conducted on the well developed market economics. Compared with these markets, Pakistan's agricultural commodity markets not well developed. But due to the financial reforms in Pakistan, it is anticipated that the monetary policy plays a more vigorous role in affecting food prices and manufactured product prices in Pakistan. Hence, it is important to verify the monetary impacts on Pakistan food prices and manufacturing prices through quantitative methods so that the relative prices changes can be understandable.

3. Data and Econometric Methodology

This pioneer research for Pakistan use monthly time series data for the period 1997-1 to 2008-4. Data of all variable Food prices (food wholesale prices index), Broad money supply and Manufacture product prices (wholesale manufactured product price index) take from the monthly bulletin of State Bank of Pakistan. All data series transformed in natural logarithms form for econometric analysis.

Table-1 Descriptive Statistic and Correlation Matrix

Descriptive Statistic			
	Ln(MS)	**Ln(FP)**	**Ln(MP)**
Mean	14.48	4.72	4.65
Median	14.39	4.65	4.62
Maximum	15.29	5.21	5.24
Minimum	13.80	4.44	4.47
Std. Dev.	0.447	0.18	0.11
Skewness	0.29	0.79	0.94
Kurtosis	1.75	2.66	5.53
Correlation Matrix			
Ln(MS)	1.00		
Ln(FP)	0.97	1.00	
Ln(MP)	0.93	0.90	1.00

Econometric Methodology

Unit Root Test

In the case of time series analysis, unit root tests are important. Unit root tests help to identify the stationarity and non-stationarity of time series data used for the study. A stationary time series has three basic properties. First, it has a finite mean. This means that a stationary series fluctuates around a constant long run mean. Second, a stationary time series has a finite variance. This means that variance is time invariant and third, a stationary time series has a finite (auto) covariance. This reflects that theoretical autocorrelation decay fast as lag length increases. Regressions run on non-stationary time Series produce a spurious relationship. Hence, to avoid a spurious relationship, there is a need to perform a unit root test on variables. This paper uses Augmented Dickey–Fuller (ADF) and Phillips-Perron tests for performing unit root tests.

Augmented Dickey-fuller (ADF) Test

Augmented Dickey-fuller (ADF) test is a standard unit root test, it analyze order of integration of the data series. ADF test to check the stationary of the series is based on the following regression model.

$$\Delta X_t = \beta_0 + \beta_1 T + \alpha X_{t-1} + \sum_{j=1}^{k} d_j \Delta X_{t-j} + \varepsilon_t \text{ - - - - - } (1)$$

ε_t is pure white noise error term.

Where X_t is a time series, T is a linear time trend, Δ is the first difference operator, β_0 is a constant, k is the optimum number of lags on the dependent variable, and ε_t is random error term. The null hypothesis for testing non-stationary is H_0: $\alpha = 0$ meaning economic series are non-stationary. That is X_t is a random walk and it has a unit root. If the t-Statistic associated with estimated coefficient, where α, is less than the critical value for the test, the null hypothesis of non-stationary cannot be rejected at 1 or 5 or 10 % level of Significance.

Causality Tests

This study aims to use the two types of causality tests

- Autoregressive distributed lag (ARDL) based causality test.
- Toda and Yamamoto (1995) modified granger causality test.

Autoregressive distributed lag (ARDL) based causality test

This paper use the ARDL based causality test for determining the direction of causality among money supply (MS), food prices (FP) and manufacturing prices .ARDL method has certain econometric advantages in comparison to other single co-integration

producers. Firstly, endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated simultaneously. Secondly, it is apply irrespective the variables included in the model are purely I(0),I(1) or mutually co-integrated. Thirdly, a dynamic error correction model can be deriving through a simple linear transformation. Fourthly, all variables are assumed to be endogenous.

$$\Delta Ln(FP)_t = \lambda_0 + \sum_{i=0}^{n} \lambda_i \Delta Ln(FP)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta Ln(MS)_{t-i} + \alpha_1 Ln(FP)_{t-1} + \alpha_2 Ln(MS)_{t-1} + \nu_{1t} \text{-----} (2)$$

$$\Delta Ln(MS)_t = \gamma_0 + \sum_{i=0}^{n} \lambda_i \Delta Ln(MS)_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta Ln(FP)_{t-i} + \beta_1 Ln(MS)_{t-1} + \beta_2 Ln(FP)_{t-1} + \nu_{2t} \text{-----} (3)$$

$$\Delta Ln(MP)_t = \lambda_1 + \sum_{i=0}^{n} \lambda_i \Delta Ln(MP)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta Ln(MS)_{t-i} + \alpha_2 Ln(MP)_{t-1} + \alpha_2 Ln(MS)_{t-1} + \nu_{3t} \text{-----} (4)$$

$$\Delta Ln(MS)_t = \gamma_1 + \sum_{i=0}^{n} \lambda_i \Delta Ln(MS)_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta Ln(MP)_{t-i} + \beta_2 Ln(MS)_{t-1} + \beta_3 Ln(MP)_{t-1} + \nu_{4t} \text{-----} (5)$$

$$\Delta Ln(FP)_t = \lambda_2 + \sum_{i=0}^{n} \lambda_i \Delta Ln(FP)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta Ln(MP)_{t-i} + \alpha_3 Ln(FP)_{t-1} + \alpha_3 Ln(MP)_{t-1} + \nu_{5t} \text{-----} (6)$$

$$\Delta Ln(MP)_t = \gamma_2 + \sum_{i=0}^{n} \gamma_i \Delta Ln(MP)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta Ln(FP)_{t-i} + \beta_3 Ln(FP)_{t-1} + \beta_3 Ln(FP)_{t-1} + \nu_{6t} \text{-----} (7)$$

The F-tests are used for testing the existence of long-run relationships. The Pesaran *et al*. approach compute two sets of critical values for a given significance level. One set assumes that all variables are *I*(0) and the other set assumes they are all *I*(1). If the computed F-statistic exceeds the upper critical bounds value, then the H_0 (null hypothesis) is rejected. If the F-statistic falls into the bounds, then the test becomes inconclusive. Lastly, if the F-statistic is below the lower critical bounds value, it implies no co-integration. When long-run relationship exists, the F-test indicates which variable should be normalized. The null hypothesis of equation (2) is $\langle H_0 = \alpha_1 = \alpha_2 = 0 \rangle$. This is denoted as $F_{FP} \langle FP \mid MS \rangle$, in equation (3), the null hypothesis is $\langle H_0 = \beta_1 = \beta_2 = 0 \rangle$ this is represented by $F_{MS} \langle MS \mid FP \rangle$.The null hypothesis of equation (4) is $\langle H_0 = \alpha_3 = \alpha_4 = 0 \rangle$ this is represent by $F_{MU} \langle MP \mid MS \rangle$, the null hypothesis of equation (5) is $\langle H_0 = \beta_3 = \beta_4 = 0 \rangle$ this is represent by $F_{MS} \langle MS \mid MP \rangle$. The null hypothesis of equation (6) is $\langle H_0 = \alpha_5 = \alpha_6 = 0 \rangle$ this represent by $F_{FP} \langle FP \mid MP \rangle$, and in equation (7) the null hypothesis is $\langle H_0 = \beta_5 = \beta_6 = 0 \rangle$ this is represent by $F_{MU} \langle MP \mid FP \rangle$.

Toda and Yamamoto (1995) Modified Granger Causality Test

In order to establish a causal relationship between monetary expansion, food prices and industrial prices, we also employed a modified version of the Granger Causality test, which is robust for the Cointegration features of the process. This procedure was suggested by Toda and Yamamoto (1995) with the objective to overcome the problem of invalid asymptotic critical values when causality test are performed in the presence of non- stationary series. The Toda and Yamamoto (1995) procedure essentially suggests the determination of the d-max, i.e., the maximal order of integration of the series in the

model, and to intentionally over fit the causality test underlying model with additional d-max lags-so that the VAR order is now $\rho = k + d$, where k is the optimal lag order.

The Toda Yamamoto (1995) augmented Granger causality test has been obtained in the present study by estimating a two-equation system using the seemingly unrelated regressions (SUR) techniques. Therefore the model can be specified as follows

$$Ln(FP) = \sum_{i=1}^{k+d} \alpha_{1i} Ln(FP)_{t-i} + \sum_{i=1}^{k+d} \beta_{1i} Ln(MS)_{t-i} + \mu_{1t} \text{ -----} (8)$$

$$Ln(MS) = \sum_{i=1}^{k+d} \alpha_{21i} Ln(MS)_{t-i} + \sum_{i=1}^{k+d} \beta_{2i} Ln(FP)_{t-i} + \mu_{2t} \text{ -----} (9)$$

$$Ln(MP) = \sum_{i=1}^{k+d} \alpha_{3i} Ln(MP)_{t-i} + \sum_{i=1}^{k+d} \beta_{3i} Ln(MS)_{t-i} + \mu_{3t} \text{ -----} (10)$$

$$Ln(MS) = \sum_{i=1}^{k+d} \alpha_{4i} Ln(MS)_{t-i} + \sum_{i=1}^{k+d} \beta_{4i} Ln(MP)_{t-i} + \mu_{4t} \text{ -----} (11)$$

$$Ln(FP) = \sum_{i=1}^{k+d} \alpha_{5i} Ln(FP)_{t-i} + \sum_{i=1}^{k+d} \beta_{5i} Ln(MP)_{t-i} + \mu_{5t} \text{ -----} (12)$$

$$Ln(MP) = \sum_{i=1}^{k+d} \alpha_{6i} Ln(MP)_{t-i} + \sum_{i=1}^{k+d} \beta_{6i} Ln(FP)_{t-i} + \mu_{6t} \text{ -----} (13)$$

Where Ln(MS), Ln(FP) and Ln(MP) are respectively the logarithms of money supply, food prices and manufacturing producted prices, k is the optimal lag order, d is the maximal order of integration of the series in the system and $\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$ and μ_6 are error terms that are assumed to be white noise. Conventional Wald tests were then applied to the first k coefficient matrices using the standard χ^2-statistics. The main hypothesis set can be drawn as follows: in equation (8), money supply "Granger-causes" food prices if it is not true that $\beta_{1i} = 0 \forall i \leq k$; in equation (9), food prices "Granger-

causes" money supply if it is no true that $\beta_{2i} = 0 \forall i \leq k$; in equation (10) money supply "Granger-causes" manufacturing prices if it is not true that $\beta_{3i} = 0 \forall i \leq k$; in equation (11) manufacturing prices "Granger-causes" money supply if it is no true that $\beta_{4i} = 0 \forall i \leq k$; in equation (12) food prices "Granger-causes" manufacturing prices if it is not true that $\beta_{5i} = 0 \forall i \leq k$; and in equation(13), manufacturing prices "Granger-causes" food prices if it is no true that $\beta_{6i} = 0 \forall i \leq k$.

As pointed out by Yamada and Toda (1995), the lag selection procedure is a crucial step for the augmented Granger causality test. This study uses the AIC, to choose the optimal lag length (k).

In addition, we adopt an innovation accounting by simulating variance decompositions (VDC) technique for further inferences.VDC serve as a tool for evaluating the dynamic interactions and strength of causal relationship among the variables in the system. The VDC indicate the percentages of a variable's forecast error variance attributable to its own innovations and innovations in other variable. Thus, from the VDC, we can measure the relative importance of money supply fluctuations in accounting for fluctuation in food prices and manufacturing prices.

4. Empirical Results

The unit root null was test using the Augmented Dickey-Fuller (ADF) test for all the variables .The result in table-1 show that the all the variables are I(1).

Table-1 Unit Root Test

Variable	**ADF Unit root test**	
	Level	**First difference**
Ln(FP)	1.16	-6.98*
Ln(MS)	-1.09	-8.30*
Ln(MP)	-2.62	-4.75*

* Significant at 1% level

Table-2 shows the result of ARDL based causality test. The results indicate that the bi-direction causality between the food prices and money supply and unidirectional causality between the money supply to manufactured product prices. There is no causal relationship in either direction between the food prices and manufactured product prices.

Table-2 ARDL based Causality Test Result

Dependent variable	**Explanatory Variables**		
	Ln(MS)	**Ln(FP)**	**Ln(MP)**
Ln(MS)	-	9.04***	3.21
Ln(FP)	3.66*	-	0.12
Ln(MP)	4.64**	1.17	-
Bound Value Determine by M.H. Pesaran			
		I(0)	**I(1)**
***:10% Significant Level**		**2.63**	**3.35**
****:5% Significant Level**		**3.10**	**3.87**
*****:1% Significant Level**		**4.13**	**5.00**

Table-3 shows the results of Toda and Yamamoto Causality test. The result support the ARDL based causality test.

Table-3 Toda and Yamamoto Causality Test Result

Dependent variable	**Explanatory Variables**		
	Ln(MS)	**Ln(FP)**	**Ln(MP)**
Ln(MS)	-	16.77**	6.77
Ln(FP)	16.03**	-	5.25
Ln(MP)	23.71***	5.81	-

Results of Variance Decomposition

Variance decomposition gives information about the proportion of the movements in the dependent variables that are due to their own shocks, versus shocks to the other variables. A shock to any variable, for example a shock to money supply , will directly affect that variable (money supply), but this shock will also be transmitted to all of the other

variables in the system (food prices and manufactured product prices) through the dynamic structure of the Vector Autoregressive (VAR).

Table-4 Variance Decompositions of Ln(MS)

MS - FP,MU			
Period	**Ln(MS)**	**Ln(FP)**	**Ln(MP)**
1	100.00	0.00	0.00
3	94.21	4.72	1.05
5	90.80	8.28	0.91
7	77.15	20.74	2.10
9	65.70	31.53	2.76
11	52.61	44.84	2.54
13	41.64	54.29	4.06
15	32.01	64.39	3.58
17	25.03	72.01	2.95
19	19.03	78.68	2.28
21	14.62	83.61	1.75
23	11.21	87.28	1.49
25	8.59	90.20	1.19

Table-5 Variance Decomposition

% of Forecast Variance Explained by innovations in						
Period	**(I)Ln(MS)-Ln(MP)**		**(II) Ln(MS)-Ln(FP)**		**(III)Ln(FP)-Ln(MS)**	
	Ln(MS)	**Ln(MU)**	**Ln(MS)**	**Ln(FP)**	**Ln(FP)**	**Ln(MS)**
1	100.00	0.00	100.00	0.00	99.99	0.01
3	97.92	2.07	97.18	2.81	98.51	1.48
5	96.03	3.96	96.41	3.58	96.42	3.57
7	89.48	10.51	87.56	12.43	96.21	3.78
9	84.36	15.63	79.77	20.22	94.89	5.10
11	80.05	19.94	67.89	32.10	91.60	8.39
13	75.24	24.75	56.73	43.26	90.10	9.89
15	73.24	26.75	46.63	53.36	89.46	10.53
17	71.37	28.62	39.48	60.51	88.69	11.30
19	69.10	30.89	32.22	67.77	88.60	11.39
21	67.77	32.22	26.30	73.69	88.37	11.62
23	66.76	33.23	21.17	78.82	87.33	12.66
25	65.90	34.09	17.03	82.96	87.01	12.98

The table-4 shows the variance decomposition of money supply. In the first round, the entire change in money supply is explained only by a shock to the money supply

innovation. This shock also causes an immediate change in food prices and manufacture product prices, but the resulting changes in these variables have no effect on the money supply at this time, since food prices and manufactured product prices have no effect on money supply. In round three, food prices accounts for 4.723% of the change in money supply, however, manufactured product prices for 1.057 of the change in money supply.

As the time period increases the food prices explain the more response than the manufactured product prices. When the 25- month period is taken into account, the response of food prices, following the initial shock to the money supply innovation, is 90.203% but the response of manufactured product prices is 1.198% after the 25-month .

Table-5 (I) shows the response manufactured product price at the shock in the money supply. As the time period increases the response of MP, following the initial shock to the money innovation, is increases. When the 25-month period take into account, response of MP 34.094%. Part-II shows the response FP to MS. As time period increases the response of FP, following the initial shock to the MS innovation, is increases. When the 25-month period take into account, response of FP 82.968%.Part-III

Show the response FP to MS. As time period increases the response of MS, following the initial shock to the FP innovation, is increases but low pace. When the 25-month period take into account, response of MS 12.987%.

5. Conclusion

This research uses recently advance technique autoregressive distributed lag (ARDL) and Toda Yamamoto (1995) based causality tests, for determine the causal relationship between the money supply, food prices and manufactured producted prices. The result of both tests reveals that there is bidirectional causality between the food prices and money supply and unidirectional causality from money supply to manufactured product prices. On the other hand there is no causal relationship between the food prices and manufactured product prices. The important finding of this study derive from impulse response analysis food prices response faster then the manufactured product prices to change in money supply but the feedback response from food prices to money supply is very low in the Pakistan. Thus the GOVT of Pakistan use monetary policy instrument to control inflation in general and fluctuation in food prices or manufactured product prices. The Pakistan GOVT should give great care and attention to macroeconomic policy adjustment because the fluctuation in food prices effect on the consumer living standard and there consumption expenditure.

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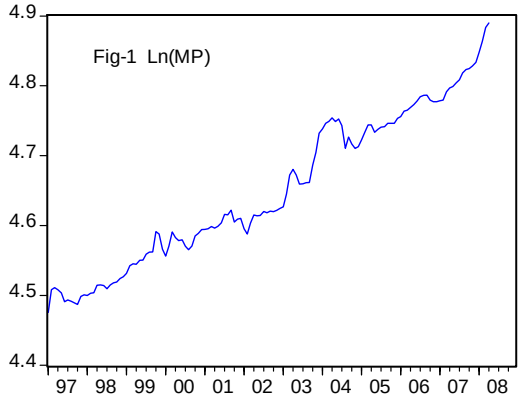
Apendex: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4.7
4.6
4.5
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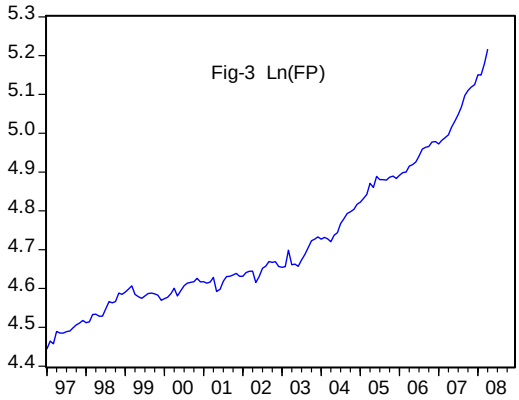
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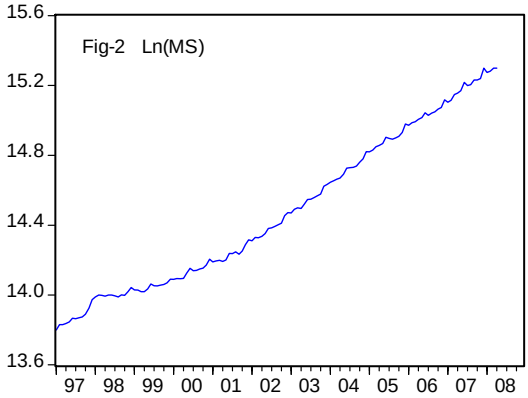
Fig-2 Ln(MS)
15.6
15.2
14.8
14.4
14.0
13.6
97 98 99 00 01 02 03 04 05 06 07 08

Variance Decomposition of M:			
Period	M	F	MU
1	100.0000	0.000000	0.000000
3	98.83304	0.642716	0.524248
5	98.82720	0.763253	0.409550
7	94.93123	4.397148	0.671619
9	90.00549	9.013984	0.980526
11	84.49891	14.50059	1.000494
13	74.59408	21.91134	3.494584
15	65.40714	31.53262	3.060243
17	58.34341	39.09213	2.564462
19	49.90150	47.94494	2.153555
20	46.21781	51.78779	1.994399
Variance Decomposition of F:			
1	1.153357	98.84664	0.000000
3	0.542966	99.42387	0.033160
5	1.528314	97.64418	0.827510
7	1.214827	97.17204	1.613135
9	2.029536	93.64177	4.328697
11	4.993793	88.51580	6.490409
13	6.106236	86.61300	7.280763
15	5.757521	86.29883	7.943645
17	5.497258	85.60607	8.896673
19	4.883939	85.57527	9.540795
20	4.583057	85.37081	10.04613
Variance Decomposition of MU:			
1	1.239457	2.482715	96.27783
3	3.146538	3.856473	92.99699
5	3.173047	4.781954	92.04500
7	5.197347	4.895548	89.90710
9	5.338719	5.065405	89.59588
11	5.322286	5.987063	88.69065
13	5.428734	6.484832	88.08643

15	6.702696	7.027489	86.26981
17	7.785343	7.257478	84.95718
19	8.101079	8.168503	83.73042
20	8.507591	8.532745	82.95966