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An Empirical Investigation of Second Round Effect and Persistence of Food Inflation in Pakistan

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ABSTRACT

This study empirically investigated the persistence of food inflation and its Second Round Effect (SRE) in Pakistan. The study has used consistent time series monthly data from 2008M7 to 2018M6 to estimate persistence of inflation and SRE of food inflation on headline inflation. The study has applied backward linkage approach for estimating persistence of inflation and Ordinary Least Square (OLS) method to estimate SRE. The empirical analysis revealed that food inflation is relatively more persistent than non-food, headline, and core inflation in Pakistan. The results also indicated that SRE of food inflation exists in Pakistan as headline inflation catches up core inflation and gap between them reduces over the period. Findings of this study are consistent with recent empirical evidence found for other similar countries. The study recommended that in

the presence of the SRE, for effective control on inflation the monetary policy should be formulated on headline inflation instead of core inflation and coordinated with fiscal policy.

Keywords: Second Round Effect, Monetary Policy, Food Inflation, Pakistan
JEL CLASSIFICATION: F31, E31, F41

INTRODUCTION

The concept of Second Round Effect (SRE) of food and fuel inflation drove from the ability of the price setting firms to increase the prices and wage setting labor to increase the wages in response to the relative price shocks of other goods and services (Baumeister et al., 2010). The importance of the core inflation increased due to the historical fact that the effect of food & fuel inflation dies in very short period of time. So the core inflation becomes best measure for the monetary policy. As a result the headline inflation congregates the core inflation and the monetary policy does not respond due to volatile factors of inflation due to food & fuel inflation (Clerk, 2001).

There are two channels of SRE, through cost and expectations. The cost channel is also called direct channel and refers to the impact of marginal cost due to increase in input cost. In direct channel, the impact of food & energy prices have direct impact on CPI inflation according to its weight in CPI. The expectations channel is also called indirect channel and it runs via expectations of inflation, rise in wages and prices of other commodities. For example, if labor assumed that shock is permanent, and they have better bargaining power to raise wages, then it will raise the inflation expectations and ultimately increases the CPI.

The recent literature showed that in developing economies where food share in the basket of CPI is high, there is more chance of existence of SRE of food inflation and rise in food prices also transmitted in core inflation through rise in wages, inflationary expectations and rise of other commodities however, where food share in CPI is low, the SRE is not existed (Walsh, 2010). The food and fuel share in the consumption baskets is on average 41% in developing and emerging economies and almost 10% in developed economies[1].

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Initially the SRE was estimated by Aoki, (2001) by using dynamic stochastic general equilibrium (DSGE) model. The study used two sectors of economy, flexible and sticky price sectors. The flexible price goods are traded and used as inputs in productions and also consumed by households like food and energy. On the other hand, the sticky price goods are traded in monopolistic environment. This model is used to understand the transmission mechanism of relative price shocks on inflation. But latter on Bodenstein et al. (2008) modified the DSGE model and included the energy sector and found the energy supply shocks on optimal monetary policy. The model is used to find the transmission from core inflation to headline inflation. Then the DSGE model of Aoki, (2001) further expanded by Anand and Prasad (2010) by including financial frictions to limit the credit constraints of consumer to access the financial market. The size and existence of SRE of food inflation was 1st found by Hledik and Banka (2003) by using small dynamic rational expectation open economy model. The model was further elaborated and more accurately estimated SRE by Cecchetti and Moessner (2008) in quantifying manner. The study modifies the New Kynesian Philips Curve (NKPC) approach to estimate the SRE. The ERPT in food inflation raises the question of SRE of food inflation on headline inflation. The analysis of SRE used the NKPC and captured the effects of inflation expectation, lagged inflation, and output gap on current inflation in small open economy. Anand et al. (2014) modified the model of ERPT and estimated the affects of foreign inflation on overall inflation and estimated the existence of SRE of food inflation. The food inflation effect the headline inflation directly according to its weight in the first round and indirectly through rising wage of other commodities, expectations and rise in the price of other commodities.

The persistence of inflation is defined in the literature as the ability of the shock to push the inflation rate away from its steady state for a long period (Roache 2014). The persistence of the inflation is important for both policy makers as it raise the output cost of the goods even after declining the inflation which is described in literature as “sacrifice ratio”. So if the inflation is less persistent it means that policy maker have more space to absorb the temporary price shocks. The countries where food inflation is more persistent than core inflation and headline inflation should be considered food inflation while adjusting macroeconomic policies (Rhee & Lee, 2013).

Table 1: Decade Wise Analysis of Average Inflation Rate in Pakistan

	1980's	1990's	2000's	2010's
Headline Inflation	7.33	8.88	8.90	6.18
Food Inflation	7.5	9.16	11.28	5.27
Non Food Inflation	7.28	8.61	7.31	6.82
Core Inflation	7.4	7.86	6.52	7.28

Source: Pakistan Bureau of Statistics

The table 1 showed that food inflation was always above than headline inflation and core inflation during last four decades of Pakistan.

Further the research paper provides literature review in the next section, and the there is specified section on methodology for estimating SRE. The section on empirical findings is before the last section for conclusion.

LITERATURE REVIEW

Empirical analyses of the role food prices play in overall inflation and the implications for monetary policy also exist in the literature, Zhang & Law (2010) estimated the SRE by using monthly time series data for the period January 1995 to December 2008. The study applied backward looking approach and found that food inflation is main driver of inflation in China. The study found that SRE is not existed during the data period in China and food inflation is more volatile than headline inflation. The study concluded that high demand of food items increased the food inflation, which causes to rise the headline inflation. Therefore monetary authorities formulate policy on the basis of headline inflation for effective control.

Rangasamy (2010) used the annual time series data for the period 1972-2009 and estimated the SRE and persistence of food inflation. The study found that food inflation is more persistent than headline and core inflation and food inflation is major cause of inflationary pressure in the country. Moreover, the headline inflation is affected by supply shocks, domestic demand and international factors. The study found that SRE of food inflation existed and increased the impact of ERPT on headline inflation.

Jalil & Zea (2011) estimated the pass through of global food prices on CPI inflation and existence of SRE in five Latin American economies. The study used the VAR model and concluded that pass through of global food price on domestic food inflation was high. The global food prices also affect the overall inflation of the countries. However, the pass through of global food prices to domestic food prices was high than in core inflation. Further, the domestic core inflation was not affected by food inflation, which showed the existence of SRE due to global food prices.

World Economic Outlook (2011) estimated the occurrence of SRE in major economies of the world and found that SRE is stronger and long lasting in those economies where food share in CPI basket of goods is high and having less inflation expectations. The report concluded that the economies where food share is high basket of good of CPI should formulate monetary economies on the basis of headline inflation instead of core inflation and economies where food share in CPI basket is low should formulate monetary policy on the basis of core inflation. The study also concluded that food inflation is more volatile in less developed economies where food share in CPI basket is high and challenged the policy makers. As high food inflation created the two round of inflation.

Mija et al. (2013) used vector autoregressive (VAR) model to estimate the SRE for the period 2002 to 2012. The study estimated the impact of ERPT and global commodity price on CPI inflation and food inflation. The study estimated the SRE of food inflation on overall inflation and found that although the ERPT in food inflation is low but due to existence of SRE the impact of ERPT increased on the headline inflation. Finally concluded that the monetary policy based on core inflation is misleading the situation in those countries where food share is high in basket of CPI. The policy makers should considered the headline inflation in formulation of monetary policy.

Anand et al. (2014) estimated the size SRE in India for the period 1996- 2013 by using estimated reduced form general equilibrium model on monthly time series data. The study found that the gap between headline and core inflation reduced to three fourth within a year due to existence of SRE in India. Furthermore, the size of SRE is large due to high food share in CPI basket, inflation expectations and rise in wages. The study concluded that monetary policy becomes

ineffective in the presence of SRE, the monetary policy is formulated on core inflation. The study suggested that monetary authorities should considered the food inflation in formulation of monetary police.

Furceri et al. (2016) used the monthly time series data of 84 countries of the world for the period of 2000 to 2013 to estimate the impact of global food inflation on the domestic inflation and then the existence of SRE in these economies by using VAR model. The study found that in advance economies the 10% increase in the global commodity prices increases the domestic food inflation 0.5 percentage point and the impact is less persistent and dies within a year mean SRE not existed. However, the impact of global commodity prices on food inflation in emerging and developing economies is stronger and persistent. Finally the study concluded that food inflation is more anchored in developed economies than emerging economies.

Ruch & Plessis (2018) estimated the ERPT in prices and then SRE of food inflation on overall inflation by using quarterly data for the period 2000 to 2014 for South Africa. The study used the SBVAR model to estimate the importance of SRE of food inflation with short run and long run as well as sign Restriction. The study estimated the both channels of SRE i-e expectations channel (rising wages and salaries) and cost channel (core inflation) and found that SRE in South Africa with a one per cent shock to relative food, petrol and energy prices leading to a 0.4 per cent increase in unit labour cost after four quarters and 0.2 per cent increase in core inflation after three quarters. The study concluded that high core inflation is normally due to high expectations of wages.

Patnaik (2019) estimated the SRE in India by using time series data for the period January 2012 to June 2019. The study used the granger causality to estimate the SRE in India. The study found that significant causality moves from overall inflation to core inflation and as a result SRE occur in India. The study also found that food inflation is not volatile and it increased the inflationary expectations, feeds into wages and price of other commodities ultimately created SRE. The study concluded that the main reason of failure of monetary policy to control inflation in India is that monetary authorities ignore the existence of SRE and formulate monetary policy on core inflation, therefore the monetary policy unable to control inflation in India. The study suggested that for effective monetary policy the monetary authorities should consider the food inflation in formulation of monetary policy.

In case of Pakistan, only a few studies were conducted to estimate persistence of inflation and SRE of food inflation on headline inflation. However, enough attention was not given to the issue of SRE of food inflation in Pakistan. Hanif et al. (2017) used the monthly time series data of Pakistan for the period 1992-2015 and estimated the pass through of global food inflation to domestic food inflation. The study concluded in Pakistan, the global inflation of metal and cotton quickly pass through to headline inflation and food inflation than core inflation.

Khan & Schimmelpfennig (2006) used the time series data of Pakistan for 1998 to 2005 and forecast the inflation and explained the main determinants of inflation. The study found that high inflation is harmful for the growth of the country and determine the main determinants of inflation. The study concluded that the share of food inflation in CPI is high; therefore the monetary authorities should formulate the monetary policy on headline inflation, rather, on core inflation. The study also concluded that targeting headline inflation would increase the effectiveness of the monetary policy.

METHODOLOGY AND RESULTS

The study followed the Thamae & Letsoela (2014) to estimate the persistence of headline inflation, food inflation, nonfood inflation and core inflation. The persistence is estimated by assuming inflation results from univariate autoregressive (AR) process. The basic equation of the model is as follows

$$I_t = \alpha + \sum_{i=1}^{n} \beta_i I_{t-i} + \mu_i \qquad (1)$$

Where I_t is the inflation rate, α and β_i are the parameters, μ_i is the white noise error term and n is the optimal lag length based on information criteria. The AR model represents random process it means that it represents the certain time varying process. The AR models explains that independent variables depends on its own previous value and on the stochastic term. Therefore, the model is in difference equation.

So, Adrew and Chen (1994) estimated the persistence by sum of AR coefficients from the above equation.

$$\pi = \sum_{i=1}^{n} \beta_i \qquad (2)$$

The above said method is best measure for calculating the persistence. The value of the π will explains the effect of the price shock it means that if the value of π is closer to zero it means that price shock is temporary and it will die with same period however if the value of π closer to unity or exceeds, it means that price shock is more persistent and long lasting.

The month on month data of headline Inflation ,food inflation, non-food inflation, and core inflation obtained from Pakistan Bureau of Statistics (PBS) from July 2008 to June 2018 with the base year of 2008-09. PBS releases the data of inflation indicators on monthly, quarterly and annual basis.

Table 2: Persistence of Headline Inflation, Food Inflation, Nonfood Inflation and Core Inflation for the Period July 2008 to June 2018.

Model	Lag length Criteria	π
Core Inflation	AIC	0.83
Headline inflation	AIC	0.93
Non- Food inflation	AIC	0.94
Food Inflation	AIC	0.97

Table 2 showed the results of the persistence of core inflation, headline inflation, non-food inflation and food inflation. AIC criteria has been used for lag selection for estimating the persistence. The optimal lags by using AIC criteria for food inflation is 01, and 04 for headline inflation, non-food inflation and core inflation. The value of π for food inflation is 0.97, for non food inflation is 0.94, for headline inflation is 0.93, and for core inflation is 0.83 it means that food inflation is more persistent than headline inflation, core inflation and non- food inflation. The results are consistent with the results of the other similar economies where food share is high in CPI basket of goods [Rangasamy (2011), Roache (2014), and Thamae & Letsoela (2014)].

The study followed the Anand et al. (2014) to check the existence of SRE of food inflation in Pakistan. The model consisted of two equations. In equation-1 we checked, weather headline inflation reverts to core inflation and in equation-II we checked, weather core inflation reverts to headline inflation.

1) $\text{INF}_t^{headline} - INF_{t-12}^{headline} = \alpha + \beta(INF_{t-12}^{headline} - INF_{t-12}^{core}) + \varepsilon_t$.....(3)

If the headline inflation reverts quickly to core inflation, it means that food and fuel price shock in temporary and SRE is limited. On the other hand, if headline inflation is not reverting quickly to core inflation it means that food and fuel price shock is not temporary and SRE is large due to higher inflation expectations and accelerating wages.

2) $INF_t^{core} - INF_{t-12}^{core} = \alpha + \beta(INF_{t-12}^{core} - INF_{t-12}^{headlin\ e}) + \varepsilon_t$.....(4)

On the other hand, head line inflation hold implications in the second round.

Does Headline Inflation Revert to Core Inflation.?

To address the above stated questions, model 3.15 and 3.16 have been estimated using data of month on month CPI inflation and core inflation

$$\Pi_t^{headline} - \Pi_{t-12}^{headline} = \alpha + \beta(\Pi_{t-12}^{headline} - \Pi_{t-12}^{core}) + \varepsilon_t$$

Table 3: The Results of Model-I of SRE

Dependent Variable $\Pi_t^{headline} - \Pi_{t-12}^{headline}$

	β	**Std. Error**	**t-Statistic**	**Prob.**
$(\Pi_{t-12}^{headline} - \Pi_{t-12}^{core})$	-0.66***	0.088991	-7.425606	0.0000
Constant	-0.0008	0.000607	-1.381053	0.1700

Note:- *** showed that coefficients are significant at 1%. The value of β is -0.66 and value of probability is 0.0000.

Table 2 showed that the value of β is -0.66 and highly significant, and wald test confirmed null hypothesis β=-1 and α =0 is not rejected**.** It means that headline inflation is not fully reverted to core inflation and shock is persistent and SRE of food inflation on headline inflation is large. The results showed that SRE is large in Pakistan and persistent and having long lasting effect.

Diagnostics tests for model-I of SRE

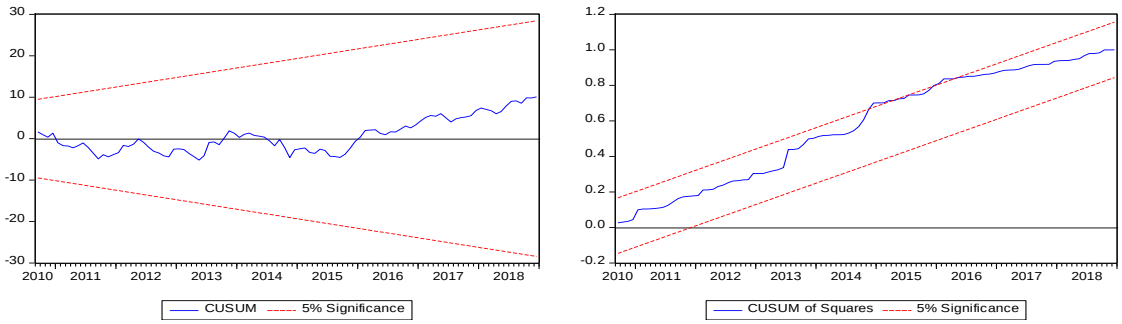
Diagnostic test of BG serial correlation LM test, Jarque Bera test of normality of residuals, Ramsey Reset test of stability and Breusch Pagan Godfrey test for heteroskedasticity are applied on model-1 and the results are shown in table 4

Table 4: Diagnostic tests for model-1

Serial Correlation LM Test			
F-statistic	1.9644	Prob.	0.1457
Chi-Square	3.9315	Prob. Chi-Square	0.1400
Heteroskedasticity			
F-statistic	3.2650	Prob.	0.0738
Chi-Square	3.2246	Prob. Chi-Square	0.0725
JB Test of Normality			
Jarque-Bera	0.1346	Prob.	0.9349
Ramsey RESET Test			
t-statistic	0.3672	Prob.	0.7142
F-statistic	0.1348	Prob.	0.7142

Table 3 showed the results of diagnostic test applied on the model-1 of SRE. The results of diagnostic tests showed that the probability of BG serial correlation LM test is 0.1457, probability of Breusch Pagan Godfrey test of heteroskedasticity is 0.0738, and probability of Jarque Bera test for normality of residuals is 0.9349. The probability of all above tests statistically are greater than 0.05 confirming that null hypothesis is not rejected and there is no serial correlation, no heteroskedasticity and residuals are normally distributed. Furthermore the stability of the coefficients is confirmed by test of CUSUM and CUSUM squares tests. The figures showed that the lines of CUSUM and CUSUM square are within the limit of 0.05 level of significance.

Figure 1: Stability Tests for Model-I of SRE



Whether Core Inflation Revert to Headline Inflation. ?

In model-II, we will investigate that whether core inflation reverts to headline inflation.? If core inflation reverts to headline inflation it means that SRE of food inflation existed. This issue is investigated by using the following equation.

$$\Pi_t^{core} - \Pi_{t-12}^{core} = \Upsilon + \delta\left(\Pi_{t-12}^{core} - \Pi_{t-12}^{headline}\right) + \varepsilon_t$$

Table 5: Non-Core Inflation Pass Through-Model-II of SRE

Dependent Variable	$\Pi_t^{core} - \Pi_{t-12}^{core}$			
	δ	**Std. Error**	**t-Statistic**	**Prob.**
$(\Pi_{t-12}^{core} - \Pi_{t-12}^{headline})$	-0.11**	0.049	-2.21	0.0292
Constant	-0.0002	0.0003	-0.57	0.5691

Note:- ** showed that coefficients are significant at 5%. The value of β is -0.11 and value of probability is 0.0292.

Table 4 showed that the value of δ is -0.11 and the probability is 0.0292, which confirms that δ is significant at 5% level of significance. It means that core inflation reverts to headline inflation and SRE of food inflation on headline inflation is existed in Pakistan during the data period.

Diagnostics Tests for Model-II of SRE

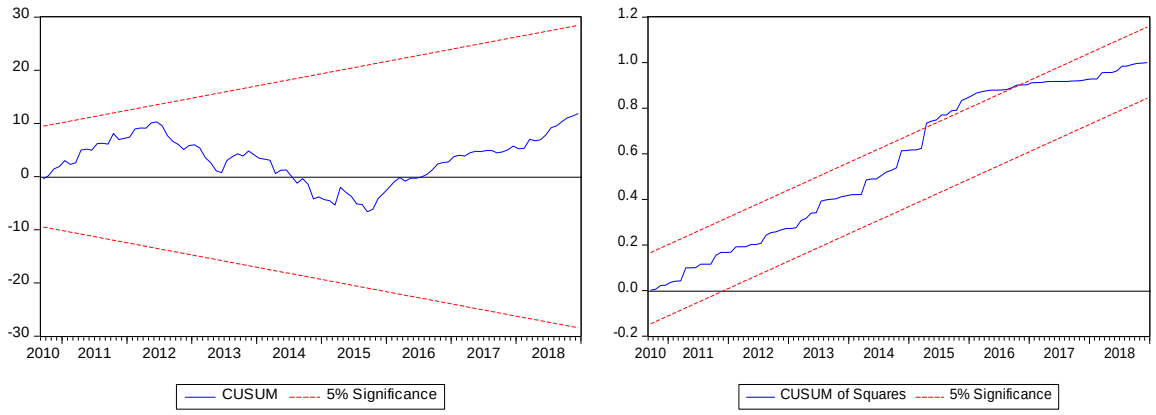
Diagnostic test of BG serial correlation LM test, Jarque Bera test for normality of residual, Ramsey Reset test of stability and Breusch Pagan Godfrey test for heteroskedasticity are applied on model-II of SRE and the results are shown in table 6.

Table.6: Diagnostic tests for model-II of SRE

Serial Correlation LM Test			
F-statistic	1.3535	Prob.	0.2631
Chi-Square	2.7419	Prob. Chi-Square	0.2539
Heteroskedasticity			
F-statistic	0.2835	Prob.	0.5956
Chi-Square	0.2884	Prob. Chi-Square	0.5912
JB Test of Normality			
Jarque-Bera	3.1037	Prob.	0.2118

Table 5 showed the results of diagnostic test applied on the model-II of SRE. The findings from diagnostic tests suggested that there is no hetero, serial correlation, non-normality problem. The figures showed that the lines of CUSUM and CUSUM square are within the limit of 0.05 level of significance. The stability of the models can be seen the following figures which indicates that the models are over the period of the time shown stable results.

Figure 2: Stability Tests for Model-II of SRE



CONCLUSION

This unique study for Pakistan has empirically estimated the persistence of the headline inflation, food inflation, non-food inflation and core inflation and, second round effect of food inflation on headline inflation and Anand et al. (2014) have addressed two questions. First, whether the headline inflation (HINF) reverts to Core Inflation (CINF)? Second, whether CINF reverts to HINF. In developing countries, the share of food in overall basket of CPI is very high. Therefore, the importance of food inflation in developing economies increases more than developed economies. The food inflation affects the headline inflation in two rounds. In first round, the food inflation affects the headline inflation according to weight in CPI basket of commodities. However, in second round, it affects the headline inflation indirectly through rise in wages and inflationary expectations. The study of SRE along with ERPT increases its importance. As the ERPT in food inflation is low but it affects more harmfully in the second round.

The results showed food inflation is more persistent than headline inflation, non-food inflation and core inflation. Furthermore, the study estimated the existence of SRE of food inflation and found that in Pakistan SRE of food inflation on headline inflation existed. It means that food inflation affects the headline inflation in two rounds. In the first round, the food inflation leading to increase in headline inflation as per weightage in CPI. The existence of SRE of food inflation showed that even small change in food inflation harms the economy more strongly in the second round in case of Pakistan. The empirical results of the study recommended that the even if food inflation is low, but the existence of SRE increased its impact. Therefore, the monetary authorities should remain vigilant control the food inflation in Pakistan. Furthermore, in the presence of SRE of food inflation, monetary Policy remains ineffective on the core inflation. Therefore, the monetary authorities should revisit and formulate monetary policy by considering headline inflation instead of core inflation in Pakistan.

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