International Journal of Contemporary Issues in Social Sciences
Volume 2, Issue 4, 2023 ISSN(P):2959-3808 | 2959-2461

AN INTERMEDIATE TARGET FOR THE SBP: HEADLINE OR CORE INFLATION?

Fatima Khaliq

Fatima.Khaliq@sbp.org.pk

Received: 20 October, 2023 **Revised:** 30 November, 2023 **Accepted:** 15 December **Published:** 28 December, 2023

ABSTRACT

The choice of inflation measure to target (headline vs. core) has always been an important policy question for inflation targeting central banks amid the potential second round effects from food and energy prices. This paper investigates the same for Pakistan using SVAR and identifying the exogenous shocks to the food, and energy prices and the transmission of these shocks to the rest of the economy. The paper finds evidence of strong transmission from food price shocks to the headline inflation and inflation expectations in Pakistan over the sample of 2009 – 2022 suggesting to target headline inflation over the medium term.

Keywords: inflation, core inflation, food prices, inflation expectations, second-round effect
JEL Classification Numbers: E31, E52

1.INTRODUCTION

The State Bank of Pakistan (SBP) has been delegated with the obligation to articulate and conduct monetary policy in a way that is compatible with both the targets of economic growth and inflation set by the government. Since the inception of the SBP Act in 1956, numerous changes have been made to it, from time to time, in order to clarify the objectives and improve the bank's functional and institutional autonomy.

With the most recent amendments in the Act in 2022, the prime objective of the SBP has been re-defined: to accomplish and maintain domestic "price stability – the maintenance of low and stable inflation, guided by the government's medium-term inflation target, along with secondary objective of financial stability" (**Appendix A**). In addition to operational, technical, and legal aspects to accommodate the recently revised objective of the SBP, other important questions like the inflation target and its band, specific and targeted escape clauses are needed to be addressed. [1,2] What inflation measure to target is one of the most important questions that needs to be addressed and the question of choosing headline inflation or core inflation as the "explicit nominal anchor" is still under discussion.

With the adoption of Inflation Targeting (IT) regime by many central banks in 1990's, the debate of choosing core versus headline inflation had gained much attention. Although both measures have some strengths and weaknesses, central banks gradually opted for headline inflation targeting regime. Among various reasons to do so, concerns over the existence of strong second round effects of food and energy price shocks on core inflation and formation of inflation expectations over these shocks predominantly caught attention. Currently, almost all IT countries are targeting headline CPI, some IT countries had initially shunned the practice of targeting the headline inflation in favor of core inflation (**Appendix B**).

It is often argued that the SBP should target core instead of headline inflation in line with the idea that

[1] Creation of an independent Monetary Policy Committee (MPC) in 2015 and amendments in the clauses pertaining to its functions, continuous improvements in the monetary policy communication strategies in 2022 and significant changes in the exchange rate regime, are some of the key milestones achieved so far.

[2] Government's current medium-term inflation target is set at 5-7 percent.

monetary policy is most effective in the face of demand shocks. This debate has been mainly steered by the impression that inflation is result of money expansion (a monetary phenomenon) i.e., that excessive money growth will lead to high prices if the output is not increased with the same ratio (Friedman, 1977). Consequently, core inflation that excludes volatile items from headline, is the most suitable inflation measure, since variations in food and fuel prices signify shocks emanating from supply-side (Wynne, 2008, Hanif, 2012). On the other side, food and energy constitutes a large component of CPI basket in Pakistan which suggest that targeting core inflation might ignore very important component of household consumption.

Though the SBP has mentioned informally that targeting headline inflation is the appropriate stance and the same has been established by the best international practices, the technical aspect supporting the stance specific to country's dynamics is still missing.

With this background, this study aims to explore the argument based on technical grounds to understand tradeoffs in targeting headline inflation vis-a-vis core inflation. More specifically, the paper first shows that there are potential "links" in reduced form sense between the food and energy prices and the headline inflation, and inflation expectations. The paper then uses a structural vector autoregression to identify the idiosyncratic shocks to food, and energy prices to trace out the dynamic effects of these shocks on Pakistan's economy. Results have shown the presence of second-round effects of the shocks i.e., shocks to food and energy prices can lead to increase in the core inflation along with output loss and the fact that inflation expectations change with the shocks to food and energy prices in the short-run.

The analysis makes a significant contribution to the existing literature with respect to second-round effects in Pakistan's economy suggesting that the SBP may continue using headline inflation as an intermediate target. This can be linked to the low credibility of central bank's policy response. Therefore, headline targeting might be a suitable policy option until enhanced level of credibility is achieved.

The rest of the paper is structured as follows: First section introduces the rationale and motivation of the study. Second section will discuss the empirical literature on the subject in terms of choosing headline versus core inflation. In third section, data, methodology and results will be discussed for Pakistan's economy followed by concluding remarks in section four.

2. LITERATURE REVIEW

This section aims to address the cons and pros of choosing either core inflation targeting regime (CITR) or headline inflation targeting regime (HITR) in the light of literature available.

2.1 Targeting Core Inflation

Less volatile in nature: Core inflation (excluding food, energy, and other volatile components from headline CPI) has been viewed as the most suitable measure of inflation for conducting monetary policy as fluctuations in food and energy prices represent supply shocks and are non-monetary in nature. Moreover, since these shocks are transitory, highly volatile, and do not reflect changes in the underlying rate of inflation, they should not be a part of the targeted price index (Mishkin, 2007, 2008). On the flipside, since it excludes major items from the basket especially with reference to developing economies, it is not considered to be representative of actual cost of living.

Welfare maximization under complete markets: Using a New Keynesian model, Aoki (2001) establishes that targeting inflation in the sticky price sector leads to macroeconomic stability and welfare maximization. Targeting core inflation is equivalent to stabilizing the aggregate output gap as output and inflation move in the same direction under complete markets. Mankiw and Reis (2003) show that, in order to improve the stability of economic activity, the targeted "stability" price index should put more weight on sectors that have sluggish price adjustment, are more procyclical, and have a smaller weight in the consumer price index. The result from the prior literature generally depends on the assumption that markets are complete (allowing households to fully insure against idiosyncratic risks).

Credibility Notion: Literature identifies using core inflation target with enhanced central bank credibility. With enhanced credibility of the central

bank, inflation will become less responsive to shocks, and the impact of food and oil price shocks on wages and inflation will be diminished soon (Baba and Lee, 2022).

2.2 Targeting Headline Inflation

Welfare maximization under incomplete markets: In developing economies, a large part of society is unable to follow their consumption patterns according to the notion of permanent income hypothesis (Anand et al., 2015). Also, developing economies differs from advanced economies in terms of household consumption expenditure.[3] Therefore, stabilizing core inflation is no longer correspondent to stabilizing outputs as was indicated by Aoki (2001) and Mankiw and Reis (2003) under the assumption of complete markets. The reason is that credit-controlled families cannot insure their future income against risks with the existence of financial frictions; hence, their demand for goods and services is not contingent to the policy rates but does mainly contingent upon their contemporary real wages. Therefore, the employment of HITR may be the better policy option.

Easy communication: Using measures other than the CPI raises communication problems, especially if the discrepancy with headline inflation is large (Upper, 2016). Some central banks, therefore, limit their communication relating to core measures and focus instead on headline inflation. Others, for instance, the Bank of Thailand, are rather comfortable to refer to different measures while communicating their objective and monetary policy stance.

Effective in achieving monetary policy objectives: According to the study conducted by Upper (2016), none of the Emerging Market Economies (EMEs) central banks that participated in the survey for his work, targets an index other than the CPI. This overwhelming preference for targeting the headline CPI suggests that central banks do not see the shortcomings such as the high share of regulated, volatile, or administered prices in EMEs, as hindrances in the achievement of their monetary policy objectives. Moreover, since it is available at a relatively high frequency and is not subject to many revisions, it enhances its transparency and use in monetary policy (Moreno, 2009).

No judgmental calculation: The headline CPI is relatively easy to understand and is familiar to a large segment of the population. It does not involve judgmental calculations like core inflation. Since many practices are involved in calculating core index, for example, some authorities exclude only food, some exclude administered prices while some exclude mortgage charges etc. (Wynne, 2008), it makes it difficult to be understood easily.

Covers long-term policy horizon: Inflation targeters have started focusing on medium-term to long-term policy horizon, i.e., beyond one year (**Appendix C**). There has been continuing discussion on the convergence between headline and core inflation and its possible impact on future path of monetary policy (Goyal and Parab, 2019). Core and headline inflation is likely to converge over the longer horizon which means that the significance between two loses its implication from the communication perspective (Roger and Stone, 2005; Cockerell, 1999). For instance, if core inflation remains low and stable despite shock to food and energy prices, then headline inflation will converge towards core inflation over time. On the other hand, if significant variation in headline inflation on account of shocks to food and fuel price persists for a longer horizon, it would build into the higher long-term inflation expectations, causing second-round effects. In this case, core inflation would relapse to headline inflation.

Incorporates second-round effects of food inflation: In 1970's, it was generally believed that price indices rise because of temporary noise (food/fuel prices), and then are reverted after a short interval (Cecchetti and Moessner, 2008). Therefore, monetary policy should not respond to it. However, research in recent years has indicated that in low-income countries where food comprises a major portion of the consumption basket, food prices have become more persistent (**Appendix D**). Similar problems were apparent even in developed countries

[3] In developing countries, expenditure on food constitutes around 40 to 50 percent of household expenditures. On the contrary, advanced economies constitute around 10 to15 percent for the same.

following the rise in food prices during 2003-2007. In terms of transmission channel, food inflation shocks may transmit to core inflation through different sources like rise in cost of labor, substitution effects of relatively higher food price, and the real income effect of food producers (Gregorio, 2012). Persistent increase in food prices induces laborers to demand higher wages, which in turn raises the cost of production and translates into higher prices of non-food items. On the other side, rise in food prices raises real income of food producers and hence their demand for non-food products (Anand and Prasad, 2010). Thus, use of HITR is preferred as it encompasses all-round inflationary impacts.

Inflation Expectations based on overall inflation: Inflation expectations are assumed to capture forces and underlying assumptions important to the determination of actual inflation outcome. Most of the central banks carefully monitor inflation expectations and view keeping these expectations 'anchored' as a crucial factor in achieving their objectives. For instance, Meng (2016) proved that inflation expectations have statistically distinct role in driving Singapore's overall inflation outcomes. According to Anand and Prasad (2010), food price inflation feeds into inflation expectations through the channel of wages i.e., expectations of the second-round impacts discussed earlier.

3. DATA, METHODOLOGY AND RESULTS

3.1 Inflation Trends in Pakistan

In recent years, high and volatile inflation has re-emerged as a central macroeconomic policy concern in most of the countries and Pakistan is no exception. Over the past 15 years, double-digit inflation has been observed on three occasions.

For instance, during 2010-11, year-on-year headline inflation remained in double digits in Pakistan where the spike in inflation mainly emanated from food inflation amid floods that caused considerable damages to crops, livestock and infrastructure which resulted in sharp acceleration in the domestic commodity price. After keeping a persistent low trend for more than eight years, domestic inflation jumped again in August 2019. Data shows that food inflation was the main driving force in dragging the headline inflation up during both episodes of high inflation. With food accounting for around 45 percent of the consumption basket in Pakistan, movements in food prices have significant influence on overall inflation. Third episode was observed in August 2022 where inflation spiked to historical high levels. Hike in energy prices along with rise in food inflation, primarily attributed to an increase in the prices of both perishable and non-perishable food items on account of floods as well as imported inflation contributed to surge in overall inflation in August 2022 and onwards.

Figure 1 presents year-on-year headline inflation and its components from July 2009 to December 2022. It can be seen that overall inflation and food inflation tracked one another closely, while core and non-food inflation appeared less correlated with food inflation, especially during the episodes of high inflation. The food inflation had been more volatile relative to other components. Also, it was much higher than core and non-food inflation during 2009-11 as well as September 2019 onward. In terms of contribution to the overall CPI, food remained the dominant component over the years (**Figure 2**).

Though the increase in food prices on a global level has influenced inflation around the world, the impact of food prices on inflation can be diverse in different countries. Since the share of income spent on food is higher in emerging market economies compared to developed economies, therefore, food price changes have comparatively larger influence on CPI inflation in these economies. In addition, food inflation can have social consequences as well, as the lowest segment of the society suffers more than proportionate due to higher food prices (Mold, 2011).

3.2 Empirical Evidence under Different Scenarios and Methodologies

In view of the available literature, the following two approaches have been used in this study to test the hypothesis.

1. ***Second-round effects under the assumption of convergence of headline and core in the medium-term:*** In case of Pakistan, literature analyzing second round impact of food inflation is scant. Hanif (2012) estimated food inflation persistence in Pakistan economy. The study applies autoregressive model and sum of autoregressive coefficients (SARCs) as measure

of inflation persistence. It uses monthly data from 1959 to 2011 and indicates absence of food inflation persistence in Pakistan. Furthermore, it also suggests that increase in food inflation is less likely to impact wages. However, this study does not directly test for second round impact by applying suitable methodology. Therefore, it is important to identify whether changes in food and energy prices in Pakistan are momentary or have permanent influence on overall inflation through its second-round impact. The same can be gauged employing time series analysis such as (a) Gap model by Cecchetti and Moessner (2008) to evaluate the second-round impact of food and energy inflation, and (b) employing Structural Vector Autoregressive (SVAR) analysis to analyze the path of output with respect to shocks to food and energy inflation.

2. ***Role of inflation expectations****:* Since inflation expectations refer to the anticipated rate at which individuals anticipate prices to increase in the future, these hold importance because they influence the actual inflation outcomes. To estimate which type of inflation expectations (non-food-non-energy and headline) are being influenced by which type of shocks (food price shock, energy price shock or both), two approaches have been employed using time series data. The approaches are: (a) gap analysis-deviation of shock component from core inflation and (b) SVAR-recognizing that price shocks (food and energy) that enter the consumer basket matters for the determination of household inflation expectations because of its salience (Binder, 2018; Kilian and Zhou, 2022).

3.2.1 Data Sources and Description:

With respect to the required resources for the model estimation, the following variables have been used.

- **Inflation:** Disaggregated data of inflation for Pakistan since 2009 on monthly basis. Data has been taken from Pakistan Bureau of Statistics (PBS) website. Since the inflation data was re-based in 2015-16, time series used in this paper has been converted to 2009 base using splicing techniques.[4]
- **Food and Energy Inflation:** PBS publishes food index and energy index separately. In addition to the use of individual indices, *food and energy* index was constructed combining the two separate indexes.

- **Inflation expectations:** Inflation expectations data since 2012 on monthly basis. Data has been taken from Consumer Confidence Survey (CSS) available on the SBP website. By conducting this survey since 2012 in collaboration with Institute of Business Administration (IBA), primarily through
telephone interviews during the first week of every odd-numbered month, it establishes a consistent and direct means of gathering primary data from households.

- **Output Gap:** Data on the output gap is also available for the same time horizon on quarterly basis. Staff estimates has been used for output gap.

- **Wage Inflation:** Monthly data is available since 2001 and has been taken from PBS website. It is important to mention that the PBS calculates the wage index for construction-related occupations such as wages for painter, mason, unskilled labor, plumber, and electrician. However, for the analysis, a broader wage index has been constructed including wages for cleaning and laundering services, garbage collection, household servants, tailoring, mechanics, and personal grooming services (barber, beautician etc.) in addition to the construction wages (**Table 1**).

- **Global Food Index:** International food price inflation is calculated using food index (includes cereal, vegetable oils, meat, seafood, sugar, and other food) from International Monetary Fund (IMF) monthly data.

[4] Splicing inflation data on one base refers to the process of aligning inflation data from different time periods onto a single base year. This process allows for the comparison of inflation rates across different periods using a consistent reference point.

- **Global Energy Index:** International energy price inflation is calculated using energy index (includes crude oil (petroleum), natural gas, coal, and propane) from IMF monthly data.

3.2.2 (a) Evaluation of Second-round Impact

1- Gap-Model:

In this section, the approach used by Cecchetti and Moessner (2008) to evaluate the second-round impact of food inflation has been followed.[5] The approach, referred as gap-model in literature, assesses the dynamics of headline inflation with respect to core inflation. According to this approach, the existence of second round impact or otherwise depends on speed with which the headline inflation reverts to core inflation. If headline inflation reverts quickly to core inflation, then the impact of food and energy price shocks is considered as temporary and may not lead to persistently increasing headline inflation. Therefore, policy makers may not need to respond to temporary spikes in the headline inflation. Otherwise, the food and energy inflation might have permanent impact on the headline inflation which may calls for close attention of policymakers to keep inflation in the desired range.

To test the same for Pakistan, equation (1) is estimated using monthly data for the period July 2009 - December 2022.

$$\pi_t^h - \pi_{t-i}^h = \alpha + \beta\left(\pi_{t-i}^h - \pi_{t-i}^c\right) + \varepsilon_t \qquad (1)$$

In equation (1), *h* is headline inflation and *c* is core inflation. The sign and magnitude of coefficient β will determine whether headline inflation reverts to core inflation or not. Negative value of β suggests that

headline inflation reverts to core inflation and if value is close or equal to -1, this implies full reversion within *i* months period (in our case it is 12 months).

According to the estimation results in **Table 2**, the coefficient is negative. However, it is statistically insignificant and magnitude is immaterial compared to the proposed estimate of 1. Therefore, it can be implied that headline doesn't revert to core inflation indicating the persistence of food and energy price shocks which doesn't allow reversion of headline to core.

Meanwhile, there is a possibility that core inflation may reverts to headline inflation over the period. In this case, it will be of a great policy concern as the shocks to headline inflation caused by food and energy price spikes, will translate into higher inflation expectations and core inflation will increase ultimately. Therefore, it is also important to assess whether core inflation reverts to headline inflation or not (Gelos and Ustyugova, 2012). To evaluate the impact, equation (2) has been estimated:

$$\pi_t^c - \pi_{t-i}^c = \sigma + \delta\left(\pi_{t-i}^c - \pi_{t-i}^h\right) + \varepsilon_t \qquad (2)$$

For equation (2), if coefficient δ is equal to 0, it indicates that core does not revert to headline inflation. Whereas, coefficient of -1 implies full reversion within a period of *i* months (in our case it is 12 months).

According to the estimation results in **Table 2**, the coefficient is negative and statistically significant as well although the magnitude is still on the lower side. Therefore, it can be implied that core inflation reverts to headline inflation partially. These results indicate that food and energy inflation in Pakistan did exert second round impacts on headline inflation during the period under review.

2- Structural Vector Auto-regressive (SVAR) Approach

This section estimates SVAR(p)[6] model to identify the shocks to food, and energy prices and then to trace out the dynamic effects of those through the impulse-response functions (IRFs). The identification is achieved through Cholesky decomposition.

Three different SVARs are estimated where one shock is identified in every single one of them: food, energy and combined food and energy prices. In each of these SVARs, the food price, energy price and the combined food and energy price shocks are identified with the Cholesky decomposition. The additional

[5] Gelos & Ustyugova (2012), Ruch & Bester (2012), Rangasamy (2011), Janak & Sangita (2011), Lafleche & Armour (2006), McCauley (2006), Rich & Steindel (2007), Cogley (2002), Clark (2001) and Macklem (2001).

[6] p is the number of lags determined by Akaike Information Criterion (AIC).

endogenous variables included in the models are wages, core inflation, headline inflation and output gap for Pakistan's economy.

The main identification assumption in these SVARs is that the food, energy and the combined food and energy prices are the most exogenous and are ordered the first. This assumption can be attributed to the following two reasons. Let's start with the SVAR that identifies the food price shocks. First, domestic food prices are highly influenced by international food prices. Pakistan is net importer of food for many decades, however, the import of wheat (major staple food having highest share in the food basket) and cooking oil, for the last few years, have particularly influenced the domestic food prices significantly. Second, domestic crops of perishable food items have been adversely affected by the extreme weather conditions for the past few years. The significance of this matter is evident by the fact that Pakistan has been ranked at the 8th place worldwide in terms of climate risk index. Thus, the above stated reasons make the food price shock to be determined completely outside of the model.

In addition to food prices, energy component of the basket (comprising of fuel, electricity and LNG) has been added as a second source of external shock. Since Pakistan is also net importer of fuel and LNG, global prices drive the domestic inflation of energy component, making it a plausible case for the Cholesky identification. Furthermore, international food prices and crude oil prices shock will also be analyzed separately for the same set of variables mentioned above. All variables have been tested for stationarity (**Annexure E**). Since the paper identifies a single shock only, the ordering of the other variables that are listed below the food, and energy prices do not matter. As a robustness, the food, and energy prices are also ordered last. The results are qualitatively very similar.

Domestic Food and Energy Price Shocks:

The ordering of the variables has a causal chain of effects: Shock to all variables do not contemporaneously affect food inflation. In that sense, it is considered completely exogenous within the months. While it contemporaneously affects wage inflation, wage inflation is a component of core inflation, it will directly impact the core inflation as well. Headline inflation will be impacted by the core inflation as core being the major chunk of headline inflation. Output gap is affected contemporaneously by variables in the current SVAR framework. However, as we discussed above, the ordering of the other variables does not affect the identification of the main shock we are interested in. Under these restrictions, a structural VAR model with A and B matrices for food shock can be stated as below:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a21 & 1 & 0 & 0 & 0 \\ a31 & a32 & 1 & 0 & 0 \\ a41 & a42 & a43 & 1 & 0 \\ a51 & a52 & a53 & a54 & 1 \end{pmatrix} \begin{pmatrix} efood \\ ewage \\ ecore \\ eheadline \\ eoutputgap \end{pmatrix} = \begin{pmatrix} b11 & 0 & 0 & 0 & 0 \\ 0 & b22 & 0 & 0 & 0 \\ 0 & 0 & b33 & 0 & 0 \\ 0 & 0 & 0 & b44 & 0 \\ 0 & 0 & 0 & 0 & b55 \end{pmatrix} \begin{pmatrix} ufood \\ uwage \\ ucore \\ uheadline \\ uoutputgap \end{pmatrix}$$

In a similar fashion, the IRF mechanism can be explained for the energy inflation shock as well as combined food and energy shock where the first term in the matrix will be replaced by energy and food and energy combined shock.

The lags of the SVAR model for each case are determined by using Akaike Information Criteria (AIC). In IRF, one standard deviation shock is introduced in domestic food inflation, energy inflation and both food and energy inflation and the responses of domestic variables are presented in the **Figure 3**.

Food inflation shock depicts that it effects the contemporaneous variable as well as wages, core inflation, headline inflation and output gap significantly in time t. Positive shock raises the food inflation, wages, core and headline inflation in the same time whereas it effects the output gap

negatively. [7] This implies that due to inelastic demand of food items, household are forced to cut down on other expenses in order to maintain the same level of consumption for food items.

For energy shock, dynamics similar to food inflation shock are observed, however, with the relative passive intensity. This can be attributed to the fact that energy component doesn't comprises a big part of consumption basket. Also, people switch to alternatives such as using public transport, opting for carpooling services in order to absorb the price shock. However, for food, developing countries cannot negotiate on the already compromised dietary standards. Dynamic behavior, in all three types of shocks, show that wage inflation witnesses significant rise, however, with food inflation shock and combined food and energy shock, it remained persistent up to a longer horizon before dying down as compared to energy inflation shock. Similar response has been observed for core inflation, whereas for headline inflation, the food inflation shock remained significantly persistent. The output gap plummets in response to all three shocks. However, the shock remained to be persistent for a longer horizon in case of food inflation shock. This implies that the food prices shock caused reduced demand for the other goods for a longer horizon as demand for food is normally inelastic, keeping the output gap in the negative zone up to four quarters before it declines. This might have not only caused unemployment but also have initiated recession due to upward pressure on wages, increased cost of production triggering supply side shock.

Forecast Error Variance Decomposition (FEVD), measuring the contribution of each shock (food and energy in this case) in an outcome variable across different horizons show that in one year's period, around 13 percent of the forecast error variance in core inflation, around 4 percent in wage inflation, around 2 percent in headline inflation is due to food price shock. For 2- and 3-year's horizon, the impact is same for core and headline, however, for wages, the contribution increased to 8 percent and 9 percent. Thus, food shock has significant influence for core inflation.

Energy shock, on the other hand, is contributing small variation in core inflation (around 2 percent), however, its contribution is significant for wage inflation (7 percent) and headline inflation (8 percent) over 1-year, 2-year and 3-year's horizon (**Annexure F**).

International Food and Crude Price Shocks:

In this section, pass-through from international food and energy inflation to domestic wages, core inflation, headline inflation and output gap is documented by using IRFs. The argument for orthogonality is that the demand for food and oil by small-open economy does not affect the international price for food and oil.

The identifying restrictions under the two shock scenarios are described as follows:

In case 1, food being the most exogenous factor, a structural VAR model (Cholesky Decomposition) with A and B matrices for international food shock can be stated as below:

[7] Difference between the actual output and the potential output. A negative output gap shows that actual economic output is below the economy's full capacity while a positive output means an economy is outperforming.

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a21 & 1 & 0 & 0 & 0 \\ a31 & a32 & 1 & 0 & 0 \\ a41 & a42 & a43 & 1 & 0 \\ a51 & a52 & a53 & a54 & 1 \end{pmatrix} \begin{pmatrix} eintfood \\ ewage \\ ecore \\ eheadline \\ eoutputgap \end{pmatrix} = \begin{pmatrix} b11 & 0 & 0 & 0 & 0 \\ 0 & b22 & 0 & 0 & 0 \\ 0 & 0 & b33 & 0 & 0 \\ 0 & 0 & 0 & b44 & 0 \\ 0 & 0 & 0 & 0 & b55 \end{pmatrix} \begin{pmatrix} uintfood \\ uwage \\ ucore \\ uheadline \\ uoutputgap \end{pmatrix}$$

Similarly, for case 2, the most exogenous variable will be replaced by international energy inflation. Implications for higher global food and energy prices for Pakistan have been shown in **Figure 4**. Global food inflation shock positively affects the core inflation and output gap in period t whereas, it decreases the wage inflation and headline inflation in period t. For core inflation, the impact remains persistent up to three quarters and starts declining afterwards. For output gap, it closes to zero after four quarters. For wage and headline inflation, it peaks in the third quarter and dies down gradually. Positive shock to output gap reinforces the empirical finding by Killian (2009) that global commodity shock is mainly driven by enhanced global demand phenomenon. Also, the gradual decline can be attributed to the slower pass-through impact of international price changes to domestic prices on account of government interventions by subsidizing fuel sometimes to absorb the international commodity shocks. Therefore, global commodity price shocks did not cause immediate recession in Pakistan's economy.

3.2.3 (b) Inflation Expectations and Inflation

1- Gap Analysis:

To perform empirical assessment of the relationship between realized inflation and inflation expectations in Pakistan, month-on-month inflation (headline, food, and core) and inflation expectations (measured from the Consumer Confidence Survey (CSS), at the six-month ahead horizon) has been modelled from equation (3) to equation (6) in **Table 3**. Since the inflation expectations data is available from January 2012, ten years' data has been used in this section.

In equation (3), *e(nfne)* refers to inflation expectations of non-food-non-energy component (percentage change in period t over period t-1 which is one month in this case). In equation (5), *e(headline)* refers to overall inflation expectations. $\alpha > 0$ indicates that positive deviation of food and core inflation (food inflation is higher than core inflation) is causing non-food-non-energy inflation expectations to increase indicating that economic agents expect second-round impact of food inflation shock by the channels mentioned earlier.

According to the estimation results of equation (3) in **Table 4**, the coefficient is positive and statistically significant at 5 percent level of significance. In view of the coefficient sign, it can be implied that NFNE inflation expectations are formed over higher food inflation as one basis point increase in the difference in the growth rates will increase the lagged differential growth in the NFNE inflations expectations index by almost half basis points.

Results of equation (4) show that NFNE inflation expectations are also responding over higher food and energy inflation (statistically significant positive coefficient). Similarly, results of equation (5) and equation (6) show that overall inflation expectations are formed over higher food inflation as well as higher food and energy inflation.

In addition to the inflation expectations data taken from survey, growth in wages have been analyzed as a function of difference between the

food and core inflation as wages are considered to be impacted through expectation channel incorporating second-round impact (equation 7).

$$\pi_t^{wages} - \pi_{t-1}^{wages} = \sigma + \alpha\left(\pi_t^{food} - \pi_t^{core}\right) + \varepsilon_t \quad (7)$$

Results of equation (7) show that wages are increasing reacting to higher food inflation and the relationship is statistically significant as well, however, the magnitude is small.

In order to see the direction of wage growth in response to inflation expectations, equation (8) has been estimated.

$$\pi_t^{wages} = \sigma + \alpha(foodinfexp_{t-1}) + \beta(coreinfexp_{t-1}) + \Upsilon(overallinfexp_{t-1})\varepsilon_t \quad (8)$$

Results of equation (8) show that wages are positively responding to all inflation expectations, though statistically insignificant amid multicollinearity. Lag has been used assuming wages might be affected with lag.

Thus, static regression model suggests the evidence of change in the inflation expectations over changes in the food and energy inflation. It shows that how variation of food and energy inflation from core inflation have discernible role in driving inflation expectations.

2. SVAR Approach

In the earlier section, the analysis is based on estimates of static reduced-form regressions. Unlike static regression models, structural VAR models allow us to quantify the cumulative effects of food and energy price shocks on inflation expectations at each point in time without imposing strong restrictions on the dynamics of the relationship between inflation expectations and the price of food and energy. Therefore, this section estimates SVAR(p) model to identify the shocks to food and energy prices and then to trace out the dynamic effects of those through the impulse-response functions (IRFs) to analyze the inflation expectations behavior (Binder, 2018; Kilian and Zhou, 2022).

Let's define $yt = [\Delta x, \pi txexp, \pi tcoreexp, \pi tinfexp]'$, where Δx denotes the growth rate of domestic and international food and energy (being exogenous shocks), and πt infexp, πt xexp, πt coreexp are the SBP Survey of Consumers' measure of household expectation of inflation over the next six months for overall, x (food, energy) and core, respectively. All variables have been tested for stationarity (**Annexure G**).

Domestic Food and Energy Price Shocks:

This section uses the impulse response functions using the short-run assumptions applying the Cholesky decomposition and is particularly suited to assess the dynamic response of inflation expectations to shocks. Two different shocks such as domestic food and energy prices will be analyzed separately over variables like food inflation expectations, core inflation expectations and overall inflation expectations.

The identifying restrictions under domestic food inflation shock can be described as follows: Shock to all variables do not contemporaneously affect food inflation. While it contemporaneously affects expectations of food inflation, this being component of core inflation, it will directly impact the expectations of core inflation as well. Overall inflation expectations will be impacted by contemporaneously by all the other variables' shocks as being considered the most exogenous factor in the current SVAR framework. Under these restrictions, a structural VAR model with A and B matrices for food shock can be stated as below:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a21 & 1 & 0 & 0 & 0 \\ a31 & a32 & 1 & 0 & 0 \\ a41 & a42 & a43 & 1 & 0 \\ a51 & a52 & a53 & a54 & 1 \end{pmatrix} \begin{pmatrix} eintfood \\ ewage \\ ecore \\ eheadline \\ eoutputgap \end{pmatrix} = \begin{pmatrix} b11 & 0 & 0 & 0 & 0 \\ 0 & b22 & 0 & 0 & 0 \\ 0 & 0 & b33 & 0 & 0 \\ 0 & 0 & 0 & b44 & 0 \\ 0 & 0 & 0 & 0 & b55 \end{pmatrix} \begin{pmatrix} uintfood \\ uwage \\ ucore \\ uheadline \\ uoutputgap \end{pmatrix}$$

Similarly, the IRF mechanism can be explained for the energy inflation shock where the first term in the matrix will be replaced accordingly. A positive food inflation shock causes increase in the food inflation contemporaneously, however, the impact dies after four months. It causes significant increase in food inflation expectations that quickly dies out after second month. Similarly, it impacts non-food-non-energy (underlying) inflation expectations, but the impact gets weaker immediately after second month. Thus, food inflation shock creates significant, though temporary change in the inflation expectations, however, there is no evidence that food inflation shock permanently affects six-months inflation expectations. For energy inflation shock, the immediate effect on the expectations is significant, however, it dies down after second month (**Figure 5**).

FEVD in response to food and energy shocks show that core inflation expectations are significantly being explained by food price shock (around 9 percent) over 1-year, 2-year and 3-years' time period whereas, the same has not been significantly explained by energy price shock (**Annexure H**).

International Food and Crude Price Shocks:

This section analyses the global commodity shocks (food and energy). Structural VAR model with A and B matrices for international food shock can be stated as below:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a21 & 1 & 0 & 0 & 0 \\ a31 & a32 & 1 & 0 & 0 \\ a41 & a42 & a43 & 1 & 0 \\ a51 & a52 & a53 & a54 & 1 \end{pmatrix} \begin{pmatrix} efood \\ ewage \\ ecore \\ eheadline \\ eoutputgap \end{pmatrix} = \begin{pmatrix} b11 & 0 & 0 & 0 & 0 \\ 0 & b22 & 0 & 0 & 0 \\ 0 & 0 & b33 & 0 & 0 \\ 0 & 0 & 0 & b44 & 0 \\ 0 & 0 & 0 & 0 & b55 \end{pmatrix} \begin{pmatrix} ufood \\ uwage \\ ucore \\ uheadline \\ uoutputgap \end{pmatrix}$$

Also, the IRF mechanism can be explained for the international energy inflation shock where the first term in the matrix will be replaced accordingly. IRF under global food inflation shock demonstrates that expectations at time t reported small decline with a positive global food shock. This is in line with the positive output gap explanation i.e., rise in global food prices depict more of demand side dynamics. Thus, inflation expectations are well anchored. However, inflation expectations rise with lag and die down quickly (**Figure 5**). This can also be attributed to the fact that share of imported food is relatively less in the domestic food basket. On the other hand, IRF under global fuel shock reveals that the initial impact is significantly positive, however, it dies down after three months on average. The rationale for initial significant impact can be attributed to the fact that Pakistan relies heavily on imported fuel. With the vulnerabilities on external front, government cannot absorb the price pressures which ultimately feed into the domestic prices and influences the expectations accordingly. Thus, the short-run effect of the shocks to the inflation expectations are sizable, but the evidence of moving the inflation expectations over longer horizon and them being persistent are weak in line with the literature (Killian and Zhou, 2022).

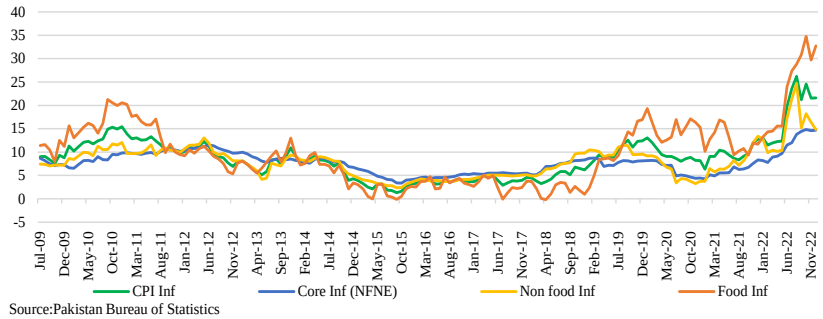
4. CONCLUDING REMARKS

Policymakers are always cautious about the presence and extent of second-round effects to effectively utilize monetary policy while targeting the appropriate anchor (whether headline inflation or core inflation) in inflation targeting regime. In Pakistan, the impact of food and energy price shocks on wage-setters and inflation expectations is deeply ingrained in analysts' discussions. Nevertheless, the evidence supporting this phenomenon largely consists of anecdotal accounts. To measure these effects, two approaches have been employed. In first approach, second-round impact has been estimated using gap model and structural VAR model with Cholesky decomposition. It tested whether food and energy price shocks, both domestic and global, contribute to rise in core and headline inflation or not and whether the shocks are transitory or persistent. Results confirm presence of second-round effects as well as their persistence over the longer horizon in line with the literature available for developing economies especially for food price shock. In the second approach, inflation expectation channel was studied using gap analysis as well as structural VAR with Cholesky decomposition. It tested whether food and energy price shocks, both domestic and global, contribute to rise in inflation expectations or not. Results confirm that external shocks indeed contribute to six-months household inflation expectations, but not as much as commonly believed.

The presence of second-round effects changes the approach how a central bank needs to respond to relative price shocks. This might even come with a significant output cost as was evident in the case of domestic food and energy shocks under Structural VAR framework. Generally, when these second-round effects do not exist, a central bank can look through shocks to food and energy prices being temporary in nature. However, when second-round effects are present, the central bank has to respond accordingly to ensure that inflation expectations remain anchored around the target as an inappropriate response in the face of food and energy shocks would worsen the inflation outcome and might end up with the consequences of output loss and credibility. In view of the second-round effects of food and energy inflation on core inflation as well as anchoring inflation expectations of the economic agents in the economy, it is appropriate for the SBP to continue with the current practice of using headline inflation as an immediate target until enhanced credibility is achieved

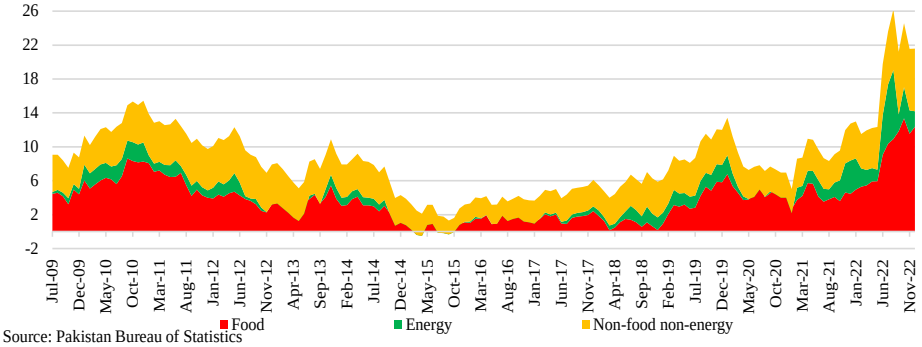
FIGURES

Figure 1: Headline Inflation and Components



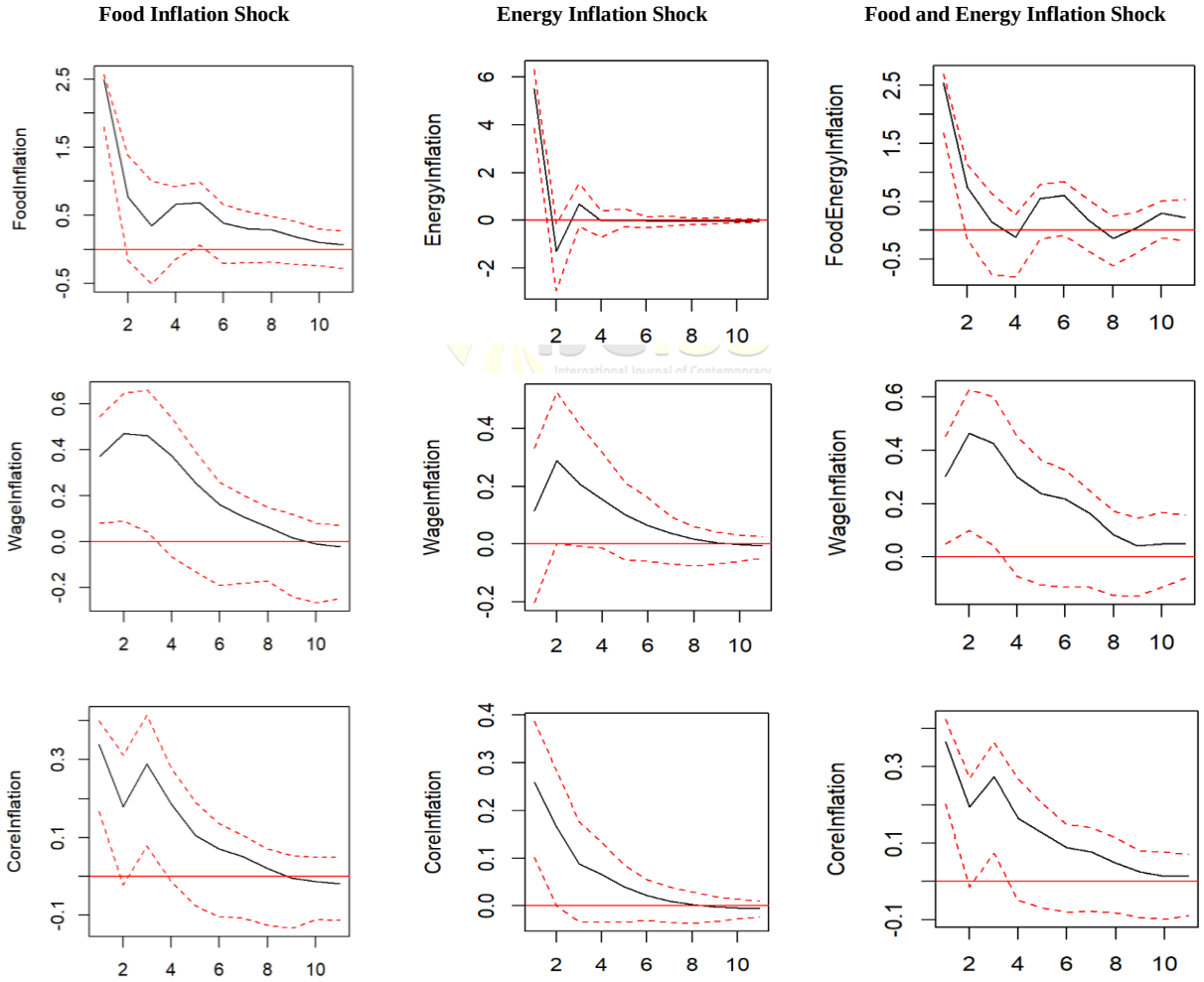
Source:Pakistan Bureau of Statistics

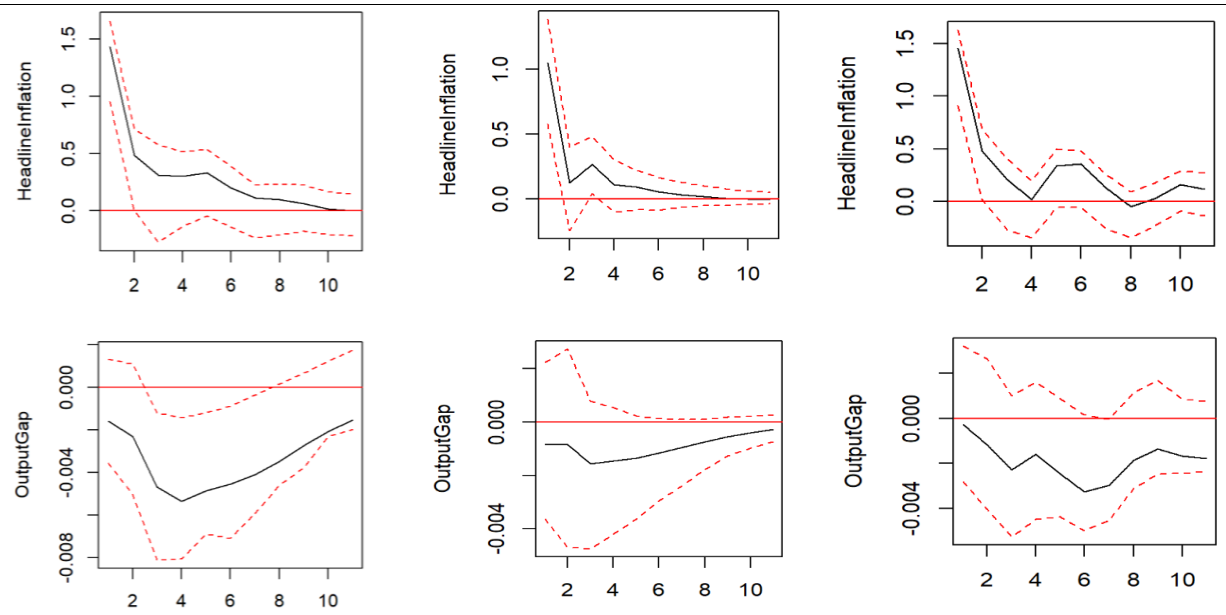
Figure 2: Inflation Contribution (% points)



Source: Pakistan Bureau of Statistics

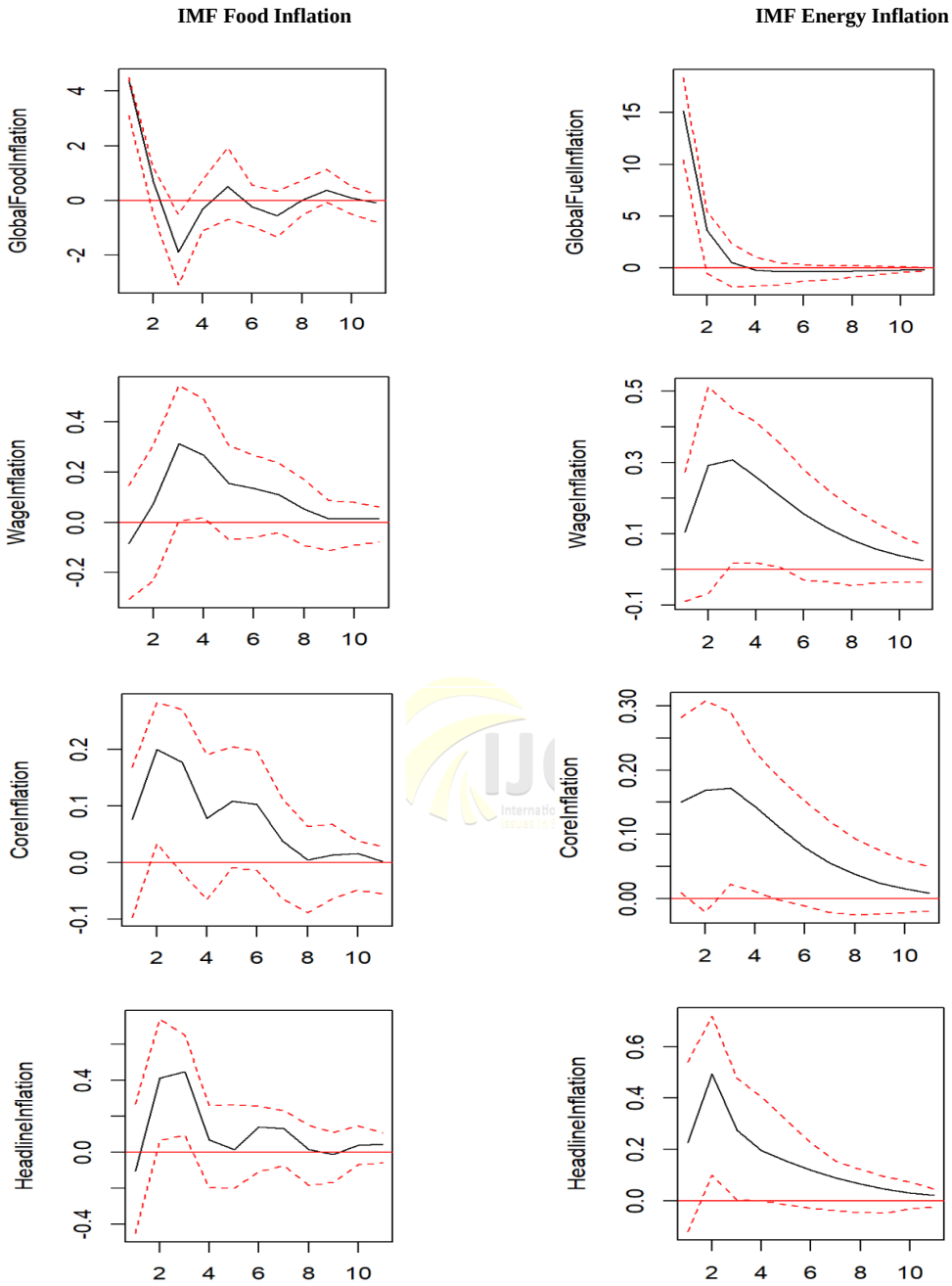
Figure 3: Impulse Response Functions-Domestic Shocks

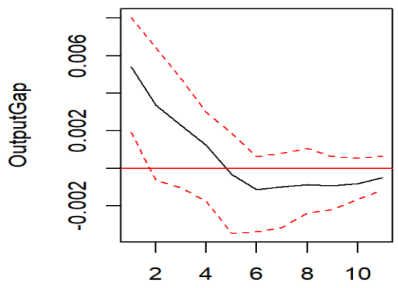


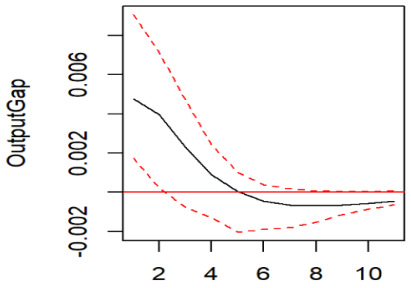


The period is in quarters. The shock occurs at time t.

Figure 4: Impulse Response Functions-International Shocks







The period is in quarters. The shock occurs at time t.

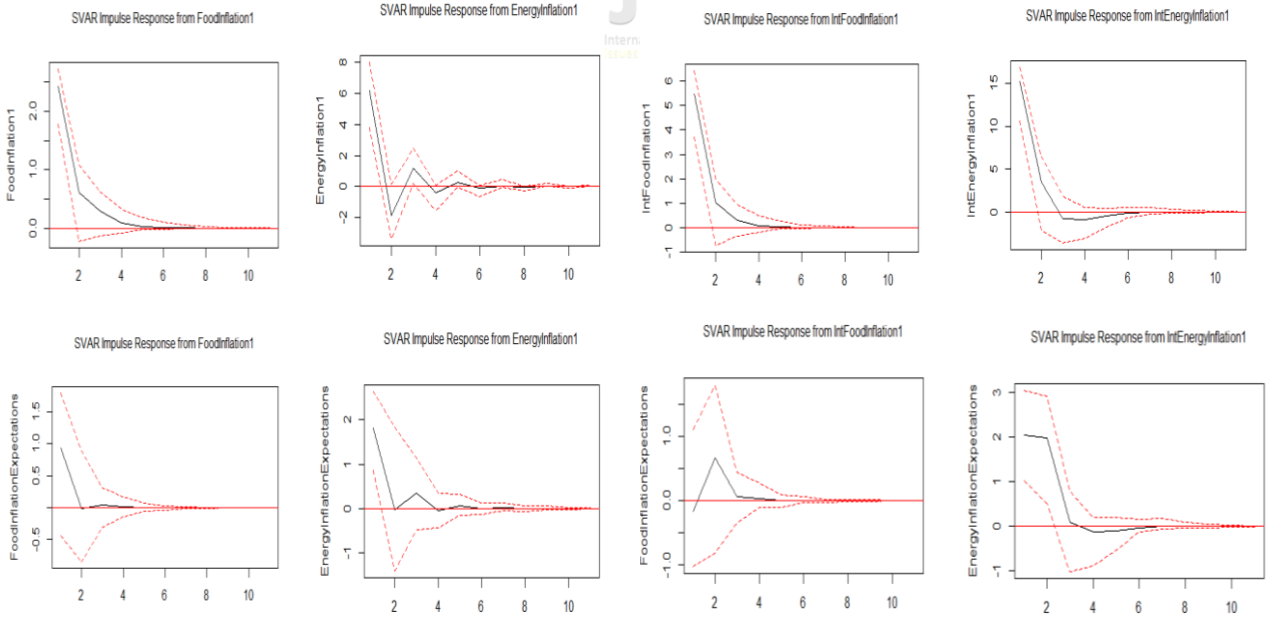
Figure 5: Impulse Response Functions-Domestic and International Price Shocks

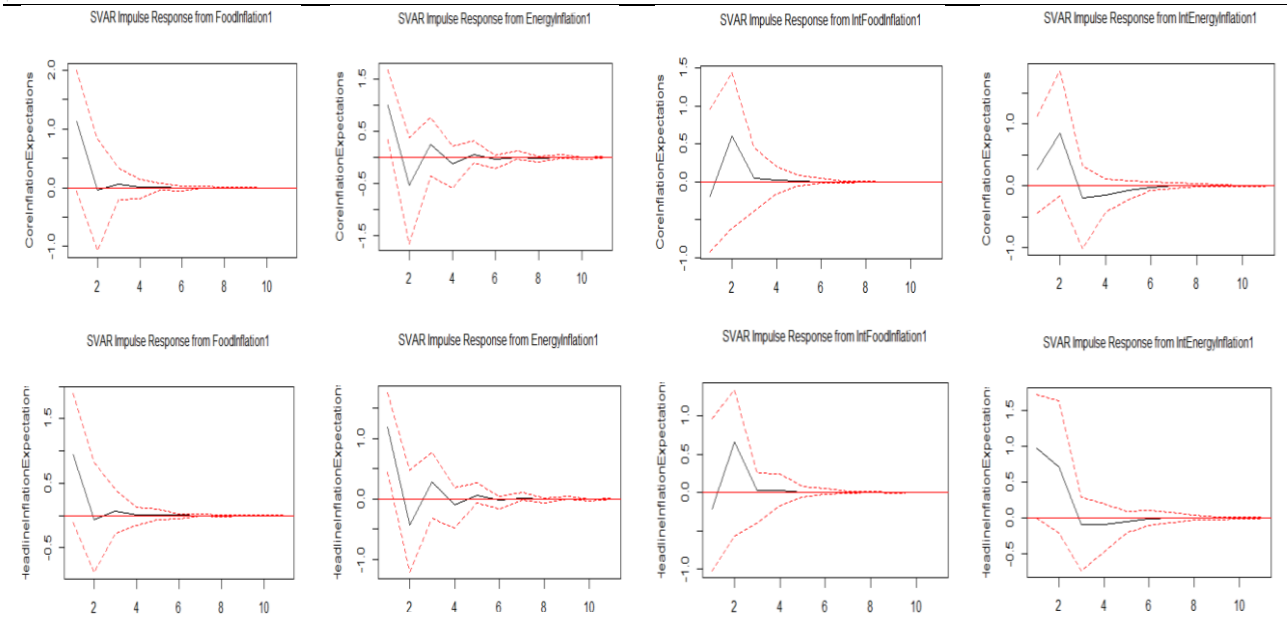
Domestic Food Inflation Shock

Domestic Energy Inflation Shock

Global Food Inflation Shock

Global Energy Inflation Shock





The period is in months. The shock occurs at time t.

TABLES

Table 1: Inflation Data Description

	Index	Items	Weights	
			Urban	Rural
1	CPI	All Items	100	100
2	Food	Perishable food items and non-perishable food items	36.8	45.9
3	Non-food	CPI-excl. all food items	63.2	54.1
4	Energy	Fuel, electricity, LNG, and gas	9.5	11.4
5	Food and Energy	Perishable, non-perishable food, fuel, electricity, gas	46.3	57.4
6	Core	Non-food and non-energy	53.7	42.6
7	Wages	Construction, cleaning, tailoring, grooming, servants	3.5	3.5
8	Administered*	Wheat, fuel, electricity, gas, LNG, postal, MV Tax	9.7	10.4

*Prices generally controlled by the Government of Pakistan (GoP).
Data source: Pakistan Bureau of Statistics, Staff Calculations

Table 2: Equation Results

Equation 1				
Variable	**Estimate**	**Std. Error**	**t-value**	**P-value**
Intercept	0.7650	0.3247	2.3562	0.0198
β (hc)	-0.1913	0.1291	-1.4822	0.1404
Equation 2				
Intercept	0.1668	0.1801	0.9264	0.3558
δ (ch)	-0.2785	0.0794	-3.5040	0.0006

Table 3: Inflation Expectation Equations

Description	Equation Specification
NFNE inflation expectations over food and core inflation differential	$\pi_t^{e(nfne)} - \pi_{t-1}^{e(nfne)} = \sigma + \alpha\left(\pi_t^{food} - \pi_t^{core}\right) + \varepsilon_t$ (3)
NFNE inflation expectations over food and energy (combined) and core inflation differential	$\pi_t^{e(nfne)} - \pi_{t-1}^{e(nfne)} = \sigma + \alpha\left(\pi_t^{food\,\&\,energy} - \pi_t^{core}\right) + \varepsilon_t$ (4)
Overall inflation expectations over food and core inflation differential	$\pi_t^{e(headline)} - \pi_{t-1}^{e(headline)} = \sigma + \alpha\left(\pi_t^{food} - \pi_t^{core}\right) + \varepsilon_t$ (5)
Overall inflation expectations over food and energy (combined) and core inflation differential	$\pi_t^{e(headline)} - \pi_{t-1}^{e(headline)} = \sigma + \alpha\left(\pi_t^{food\,\&\,energy} - \pi_t^{core}\right) + \varepsilon_t$ (6)

Table 4: Equation Results

Variable	Estimate	Std. Error	t-value	P-value
Equation 3				
Intercept	-0.0314	0.2639	-0.1190	0.9050
food -core	0.4618	0.1812	2.5490	0.012
Equation 4				
Intercept	-0.0278	0.2624	-0.1060	0.9157
food & energy -core	0.4372	0.1564	2.795	0.0059
Equation 5				
Intercept	-0.0268	0.2489	-0.1080	0.9144
food -core	0.3550	0.1709	2.0780	0.0397
Equation 6				
Intercept	-0.0256	0.2474	-0.1040	0.9176
food & energy -core	0.3485	0.1475	2.363	0.0196
Equation 7				
Intercept	-0.0141	0.0497	-0.285	0.7760
food -core	0.0341	0.0341	1.9990	0.0440
Equation 8				
Intercept	0.6926	0.0447	15.4810	0.0000
FE_{t-1}	0.0068	0.0644	0.1070	0.9150
$NFNE_{t-1}$	0.0168	0.0598	0.2810	0.7790
IE_{t-1}	0.0031	0.0533	0.0590	0.9530

APPENDIX

A: SBP Act 1956

Date	Preamble
Since 1956	"*WHEREAS it is necessary to provide for the constitution of a State Bank to regulate the monetary and credit system of Pakistan and to foster its growth in the best national interest with a view to securing monetary stability and fuller utilization of the country's productive resources*"
January, 2022	"W*HEREAS it is necessary to provide for the constitution of* ***State Bank to achieve domestic price stability*** *by way of regulating the monetary and credit system of Pakistan and, without prejudice to said primary objective, contribute to the stability of the financial system of Pakistan and supporting the general economic policies of the Federal Government to foster development and fuller utilization of the country's productive resources*"

Source: SBP Act 1956 (amended up to January 2022)

B: Countries' Transition in Choosing Measure of Inflation Target: Experiences and Rationales

Currently, almost all Inflation Targeting (IT) countries are targeting a measure of inflation based on the CPI. Most of them use the headline inflation rate because central banks have found it hard to define a core measure that is readily understood and accepted by the public. For this reason, several central banks-including the Czech National Bank (CNB), the Bank of Korea (BOK), Reserve Bank of Australia (RBA), and the Bank of Thailand (BOT), among others-have chosen to change their target measure from an underlying index to the headline CPI (**Table B**).

Initially, some IT countries have shunned targeting the rate of change in headline CPI in favor of targeting a measure of underlying or core CPI. To varying degrees, these countries recognized that targeting headline CPI inflation may not be appropriate. In part, this reflects the realization that monetary policy should not be held responsible for non-monetary factors that interrupt prices. Top amongst these factors is supply shocks and changes in tax rates. From a practical point of view, prices that are most subject to supply shocks typically tend to be the most volatile and consequently it may not be feasible to target a price index that includes them. For the same reasons, Thailand had been targeting core inflation till 2015 since the adoption of inflation targeting regime. It is considered the last country to use core inflation as a policy target since all other countries had already changed to headline IT framework (Peerawattanachart, 2015).

***Case Study of Korea*:** In the initial phase of inflation targeting in Korea, i.e., from 1998 to 1999, the headline CPI was selected as a target index due to its awareness to the economic agents. However, in 2000, core CPI was adopted as the target index. The core CPI was used as the target index under the annual targeting regime of 2001 to 2003, when an unofficial medium-term target was also operated. The items excluded from CPI consist of certain non-grain agricultural and petroleum products. In totality, 49 items were stripped out from the 516 items comprising the CPI. However, the authorities decided to switch back to headline target 2004 onwards.

As stated in the Bank of Korea's publication titled "Monetary Policy in Korea 2008", "*Core inflation is less subject than consumer price inflation to short-term volatility and it reacts sensitively to the adjustment of the policy rate. It does, however, suffer from the weakness of being estranged from the day to-day life of the general public in that it excludes the prices of agricultural products and petroleum-based fuels that constitute major items in the cost of living. In addition, most countries that have adopted inflation targeting employ the consumer price index as their target indicator. If the Bank of Korea were to persist with core inflation despite the government's use of the CPI as its price indicator in planning the management of the economy, this also could lead to popular confusion in judging price levels."*

It was against this backdrop that the Bank of Korea has eventually opted for annualized average headline CPI as the index for the current medium-term targeting period of 2007.

***Case Study of Czech Republic*:** In deciding what measure of inflation to target, the CNB faced a trade-off between transparency and the ability to control inflation. For the purpose of inflation targeting, it introduced a new concept, called net inflation. Net inflation measures change in the consumer price index (CPI), excluding the movement in regulated prices and is further adjusted for the impact on the remaining items of changes in indirect taxes or subsidy elimination. Unlike many other inflation-targeting countries, the CNB did not exclude from net inflation changes in prices of energy and agriculture products. Such an exclusion would have narrowed the targeted price index too much and would make it too detached from the headline inflation. At the end of 1997, CPI consisted of 754 items, 91 items had regulated price, and net inflation measured movements of 663 items.

However, in April 2001, the main reasons for favoring net inflation targeting rather than headline inflation targeting had disappeared, and CNB decided that from 2002 onwards, it would target headline inflation measured by the consumer price index. The CNB explained that headline inflation covers more comprehensively price developments in the economy, and that it is more relevant for decisions of economic agents. As stated in Czech National Bank's publication titled "Ten Years of Inflation Targeting (1998-2007)", "*The experience gained by the CNB, combined with a decrease in the uncertainty about regulated prices going forward and an effort to enhance the transparency and clarity of its inflation targets, led the CNB to abandon net inflation targets*".

Table B: Transition to Choosing headline CPI as Inflation Target

	Country	Started With	Changed to
1	Czech Republic	Net Inflation*-1998	CPI-2003
2	South Africa	CPI-excl. mortgage interest- 2000	CPI-2008
3	Australia	CPI-excl. interest charges-1993	CPI-1999
4	New Zealand	CPI-excl. mortgage interest and section prices-1998	CPI-
5	UK	RPIX-excl. mortgage payments-1992	CPI-2004
6	Iceland	CPI-excl. mortgage interest-2001	CPI-
7	Sweden	CPI-excl. mortgage interest and indirect taxes-1993	CPIF**-2017
8	Korea	Core-2000	CPI-2007
9	Norway	Core-2001 (CPIATE)	CPI-
10	Thailand	Core-2000	CPI-2015

*Measures changes in the consumer price index, excluding the movement in regulated prices and is adjusted for the impact on the remaining items of changes in indirect taxes or subsidy elimination, **Fixed Interest Rate
Data source: Websites of Central banks, documents of central banks, IMF Working Paper 02/184

***Case Study of Thailand*:** Core inflation target which had been adopted by Bank of Thailand (BOT) since the introduction of the inflation targeting framework in 2000, was replaced with headline inflation in 2015. Despite the success of the inflation targeting framework with core inflation as a policy target in achieving price stability, some deficiencies with respect to the use of core inflation reduced its effectiveness. After bank's decision to switch to headline inflation target following communication was made.

"Compared to core inflation, headline inflation was better in reflecting changes in the cost of living since it captured changes in prices of all goods and services in the consumption basket, including raw food and energy prices which account for 27 percent of the basket. Therefore, headline inflation was more in tune with the public's understanding of what constitute the cost of living and was used as a reference for consumption and saving decisions by households and for investment and price setting decisions by businesses. In addition, in recent years, core inflation has somewhat lost its ability to track overall inflationary pressure as it has diverged from headline inflation for much longer time period, compared to the past. This was likely because changes in raw food and energy prices had a larger influence on inflation dynamics. Therefore, adopting headline inflation as a policy target would facilitate the central bank's communication with the public regarding monetary policy decisions and also strengthen monetary policy effectiveness in anchoring long-term inflation expectations. Lastly, every country that adopted the inflation targeting framework currently used headline inflation as a policy target."

Case Study of Australia: Since 1993, monetary policy in Australia has been conducted under an inflation-targeting framework and had specified the target for inflation in terms of underlying or core inflation. The main reason for this was that the inclusion of interest charges in the headline CPI from 1986 represented a serious impediment to the use of the headline index for the assessment of monetary policy. A secondary deliberation was that core measures of inflation were subject to less short-run volatility than the headline measure. However, changes to the CPI by the Australian Statistician had meant the removal of interest charges from the index from the September quarter 1998 onwards, thus removing the main obstacle to its use as the policy target. The Reserve Bank and the Federal Treasurer agreed in the light of this change that specifying the target in terms of the headline CPI is consistent with the intent of the original statement on monetary policy.

The primary argument for shifting to the headline rate was that it represents a more widely accepted and understood measure of inflation. Its use is, therefore, likely to promote accountability, as well as public understanding and acceptance of the targeting framework. As stated in Reserve Bank of Australia's research paper titled "Measures of Inflation and Inflation Targeting in Australia 1999", "*The adjustment to the policy target reflected a judgement that the advantages of using the CPI, in terms of public recognition, outweighed the disadvantages in terms of its greater volatility".* One concern in making this change was that the headline rate of inflation still includes changes in prices which are unrepresentative of general inflation and correspondingly tends to be a noisier measure of general price inflation. For this reason, core measures will remain a source of information about the general direction of price inflation.

C: Target Horizon

Table C: Target Horizon of Inflation Target Countries

Country	Target Horizon	Country	Target Horizon
Armenia	Medium term	Mexico	Medium term
Australia	Medium term	New Zealand	Medium term
Brazil	Yearly target	Norway	Medium term
Canada	Six-eight quarters	Peru	At all times
Chile	Around two years	Philippines	Medium term (from 2012–2014)
Colombia	Medium term	Poland	Medium term
Czech Republic	Medium term, 12–18 months	Romania	Medium-term target from 2013
Ghana	18-24 months	Serbia	Medium term
Guatemala	End of year	South Africa	On a continuous basis
Hungary	Medium term	South Korea	Three years
Iceland	On average	Sweden	Normally two years

Indonesia	Medium term	Thailand	Eight quarters
Israel	Within two years	Turkey	Multiyear (Three years)

Data source: State of the art inflation targeting (2012)

D: Studies on Impact of Food and Energy Prices

Table D: Impact of food inflation and energy prices on core and overall inflation for both advanced and emerging economies

Country	Title and Authors	Results
India-2019	Impact of Food Inflation on Headline Inflation in India-Anuradha Patnaik	The results of empirical analysis show significant causality running from headline inflation to core inflation in India and as a result, the prevalence of the second-round effects.
Bangladesh-2016	Food Inflation and Inflation Dynamics in Bangladesh-Rahman, A.K.M. A. and Zeba, S	The study examines the direct and indirect impact of food inflation on overall inflation in Bangladesh using data from 1996 to 2012. It finds the evidence of transmission of food inflation shock to non-food inflation by applying Granger casualty test.
Kenya-2015	Second Round Effects and Pass-Through of Food Prices to Inflation in Kenya-Roseline Nyakerario Misati & Olive Munene	While estimations of the Phillips curve suggest a domestic food price pass-through of 0.49 to overall inflation and 0.38 to non-food non-fuel inflation. Thus, this paper recommends usage of headline inflation to estimate trend inflation, enhanced communication to mitigate second round effects.
Republic of Moldova-2013	How Core Inflation Reacts to The Second Round Effects-Simion Mija, Dorin Slobozian, Radu Cuhal and Alexandru Stratan	The analysis confirms the existence of second round effects on core inflation due to the changes in fuel and food prices.
India-2011	Measures of core inflation in India: an empirical evaluation-Janak Raj and Sangita Misra	The author attempted to analyze seven exclusion-based measures of core inflation for India with regard to volatility, persistence and predictive power for headline inflation, using time-series techniques. The study indicated that there were the second-round effects in six out of the seven measures of core inflation considered. It was, therefore, concluded that headline inflation, not core inflation, should be the focus of monetary policy in countries such as India where food and fuel comprise a major portion of the consumer basket.
Developing Economies-2011	Reconsidering the Role of Food Prices in Inflation-James P. Walsh	The author finds that food price impact on inflation is significant especially in lower income countries and that the policy focus on core inflation may be misleading.
India-2014	Food Inflation in India: The Role for Monetary Policy-Rahul Anand, Ding Ding and Volodymyr Tulin	It estimates the second-round effects of food inflation in India using reduced-form general equilibrium model and find that it is relatively high due to high share of food expenditures in household incomes and since food inflation influences inflationary expectations and future wage settings.

E: Stationarity Check

To check the stationarity of the variables used for SVAR analysis both under domestic and global shock scenario, an important condition for generating meaningful IRFs, unit-root tests named Phillips–Perron (PP, 1988) was performed.

Table F: Unit Root Tests- July 2009-December 2022

	Quarterly Growth-Global Oil Index	Quarterly Growth-Global Food Index	Quarterly Growth-Urban Energy Index	Quarterly Growth-Urban Food Index	Quarterly Growth-Urban Food & Energy Index	Quarterly Growth-Urban CPI Index	Quarterly Growth-Urban Core Index	Quarterly Growth-Urban Wage Index	Quarterly Growth-Output Gap

Phillip-Perron (PP) - Null Hypothesis: The variable has a unit root

Z (alpha)	-40.56	-43.26	-69.22	-35.71	-39.97	-33.56	-18.11	-15.22	-19.14
p-value	0.01	0.01	0.01	0.01	0.01	0.01	0.07*	0.09*	0.05

By default, Truncation lag parameter was taken as 3.

*10 percent level of significance

According to the PP unit-root tests (**Table F**), the results for nine variables were obtained at a 5% significance level. The unit-root test results show that the integrated order for all data series except wages and output is zero at a 5% level. On the other hand, the integrated order for output and wages is zero at 10% significance. These results show that all series are stationary in the level at 10% significant level.

F: FEVD

```
$FoodInflation
      FoodInflation WageInflation CoreInflation HeadlineInflation    OutputGap
 [1,]     1.0000000    0.00000000    0.00000000        0.000000000 0.000000000
 [2,]     0.8810677    0.01684658    0.09079006        0.009578435 0.001717269
 [3,]     0.8243846    0.02067703    0.12414663        0.018064147 0.012727572
 [4,]     0.8147911    0.03709090    0.11561594        0.019834941 0.012667107
 [5,]     0.7902378    0.06239143    0.11131669        0.021290602 0.014763491
 [6,]     0.7678964    0.07389102    0.11921370        0.024235148 0.014763762
 [7,]     0.7599106    0.07990405    0.11983289        0.023708927 0.016643502
 [8,]     0.7517186    0.08510208    0.11980814        0.023716192 0.019654998
 [9,]     0.7450319    0.08825446    0.12109352        0.024235804 0.021384341
[10,]     0.7417649    0.08957882    0.12168290        0.024155338 0.022818066
[11,]     0.7397082    0.09018789    0.12191771        0.024143512 0.024042659
[12,]     0.7385113    0.09044313    0.12208451        0.024189102 0.024771930
[13,]     0.7379964    0.09048723    0.12213475        0.024179340 0.025202273
[14,]     0.7377766    0.09046832    0.12213556        0.024173078 0.025446475
[15,]     0.7377058    0.09045096    0.12211895        0.024169490 0.025554769
[16,]     0.7376889    0.09045173    0.12209848        0.024166112 0.025594763
[17,]     0.7376795    0.09047039    0.12208280        0.024163793 0.025603517
[18,]     0.7376654    0.09049899    0.12207308        0.024161735 0.025600821
[19,]     0.7376420    0.09052948    0.12206989        0.024161216 0.025597457
[20,]     0.7376154    0.09055661    0.12207019        0.024161043 0.025596774
[21,]     0.7375902    0.09057798    0.12207189        0.024160864 0.025599099
[22,]     0.7375683    0.09059314    0.12207440        0.024160999 0.025603136
[23,]     0.7375517    0.09060286    0.12207670        0.024161127 0.025607628
[24,]     0.7375401    0.09060851    0.12207837        0.024161181 0.025611808

$EnergyInflation
      EnergyInflation WageInflation CoreInflation HeadlineInflation  OutputGap
 [1,]       1.0000000    0.00000000   0.000000000        0.00000000 0.00000000
 [2,]       0.7822160    0.06725870   0.001146173        0.07818954 0.07118963
 [3,]       0.7700613    0.06527246   0.011962372        0.08123531 0.07146853
 [4,]       0.7611648    0.06780022   0.012034576        0.08036565 0.07863476
 [5,]       0.7579781    0.06793155   0.011984080        0.08003394 0.08207237
 [6,]       0.7563471    0.06783248   0.011986418        0.07986966 0.08396430
 [7,]       0.7555284    0.06776015   0.012021765        0.07978896 0.08490070
 [8,]       0.7551066    0.06776576   0.012066976        0.07974783 0.08531287
 [9,]       0.7548764    0.06782323   0.012108388        0.07972509 0.08546686
[10,]       0.7547417    0.06789775   0.012140214        0.07971130 0.08550904
[11,]       0.7546578    0.06796644   0.012161892        0.07970235 0.08551147
[12,]       0.7546038    0.06801955   0.012175292        0.07969637 0.08550500
[13,]       0.7545687    0.06805594   0.012182874        0.07969239 0.08550008
[14,]       0.7545463    0.06807858   0.012186800        0.07968981 0.08549855
[15,]       0.7545323    0.06809148   0.012188638        0.07968820 0.08549941
[16,]       0.7545239    0.06809821   0.012189396        0.07968724 0.08550130
[17,]       0.7545190    0.06810140   0.012189654        0.07968668 0.08550329
[18,]       0.7545162    0.06810274   0.012189712        0.07968638 0.08550493
[19,]       0.7545148    0.06810321   0.012189709        0.07968622 0.08550609
[20,]       0.7545140    0.06810333   0.012189697        0.07968614 0.08550683
[21,]       0.7545136    0.06810333   0.012189692        0.07968610 0.08550726
[22,]       0.7545134    0.06810332   0.012189695        0.07968608 0.08550749
[23,]       0.7545133    0.06810331   0.012189701        0.07968607 0.08550760
[24,]       0.7545133    0.06810331   0.012189707        0.07968606 0.08550765
```

G: Stationarity Check

Unit-root tests (PP, 1988) was performed to test the variables for stationarity both under domestic and global shock scenario. The results for eight variables were obtained at a 5% significance level. The unit-root test results show that the integrated order for all data series is zero at a 5% level (**Table G**). Thus, all series are stationary in the level at 5% significant level.

Table G: Unit Root Tests- January 2012-December 2022*

	Global Oil Index	Global Food Index	Urban Energy Index	Urban Food Index	Inflation Expectations	Food Inflation Expectations	Energy Inflation Expectations	Core Inflation Expectations
Phillip-Perron (PP) - Null Hypothesis: The variable has a unit root								
Z (alpha)	-4.8	-4.9	-56.9	-30.3	-7.4	-7.4	-6.3	-8.3
p-value	.01	.01	.01	.01	.01	.01	.01	.01

By default, Truncation lag parameter was taken as 3.

*Quarterly growth of the variables has been taken

H: FEVD

$FoodInflation1

	FoodInflation1	FoodInflationExpectations	CoreInflationExpectations	EnergyInflationExpectations	HeadlineInflationExpectations
[1,]	1.0000000	0.000000000	0.00000000	0.000000e+00	0.00000000
[2,]	0.8496136	0.007043029	0.08606641	2.692718e-05	0.05651000
[3,]	0.8313896	0.025211919	0.08498244	4.589465e-03	0.05382660
[4,]	0.8208541	0.030820757	0.08379062	1.200202e-02	0.05253249
[5,]	0.8099369	0.030248561	0.08793967	2.025856e-02	0.05161634
[6,]	0.8081914	0.030441258	0.08867448	2.084353e-02	0.05184930
[7,]	0.8068999	0.030685732	0.08916880	2.144669e-02	0.05179885
[8,]	0.8064929	0.030674878	0.08912401	2.191540e-02	0.05179285
[9,]	0.8062430	0.030711045	0.08919008	2.196702e-02	0.05185886
[10,]	0.8061722	0.030719627	0.08918619	2.206799e-02	0.05185396
[11,]	0.8061481	0.030722511	0.08919181	2.207336e-02	0.05186425
[12,]	0.8061377	0.030724417	0.08919081	2.208119e-02	0.05186593
[13,]	0.8061363	0.030724430	0.08919096	2.208144e-02	0.05186687
[14,]	0.8061347	0.030724573	0.08919079	2.208250e-02	0.05186741
[15,]	0.8061346	0.030724567	0.08919086	2.208257e-02	0.05186742
[16,]	0.8061344	0.030724569	0.08919084	2.208269e-02	0.05186748
[17,]	0.8061344	0.030724570	0.08919086	2.208270e-02	0.05186747
[18,]	0.8061344	0.030724570	0.08919086	2.208272e-02	0.05186748
[19,]	0.8061344	0.030724571	0.08919086	2.208272e-02	0.05186748
[20,]	0.8061344	0.030724571	0.08919086	2.208273e-02	0.05186748
[21,]	0.8061344	0.030724571	0.08919086	2.208273e-02	0.05186748
[22,]	0.8061344	0.030724571	0.08919087	2.208273e-02	0.05186748
[23,]	0.8061344	0.030724571	0.08919087	2.208273e-02	0.05186748
[24,]	0.8061344	0.030724571	0.08919087	2.208273e-02	0.05186748

$EnergyInflation1

	EnergyInflation1	FoodInflationExpectations	CoreInflationExpectations	EnergyInflationExpectations	HeadlineInflationExpectations
[1,]	1.0000000	0.0000000000	0.00000000	0.00000000	0.000000000
[2,]	0.9506338	0.0002197429	0.00303402	0.04213849	0.003973945
[3,]	0.9289204	0.0080596683	0.01209120	0.04069539	0.010233372
[4,]	0.8902858	0.0129320702	0.00891333	0.06033854	0.027530221
[5,]	0.8848766	0.0131249047	0.00876061	0.06480423	0.028433690
[6,]	0.8645099	0.0246273644	0.00849406	0.06236865	0.040000027
[7,]	0.8581293	0.0212150347	0.00883705	0.05787105	0.053947602
[8,]	0.8512679	0.0214147609	0.00844659	0.06681398	0.052058731
[9,]	0.8424389	0.0226496786	0.00903831	0.06687811	0.058995025
[10,]	0.8363900	0.0238944191	0.00874404	0.06432669	0.066644805
[11,]	0.8338848	0.0231568936	0.00857020	0.06907986	0.065308282
[12,]	0.8256549	0.0264835805	0.00876048	0.07009461	0.069006383
[13,]	0.8216411	0.0264232883	0.00903120	0.06852462	0.074379785
[14,]	0.8212604	0.0257550304	0.00878373	0.07076649	0.073434392
[15,]	0.8173015	0.0268232019	0.00885451	0.07208921	0.074931556
[16,]	0.8143226	0.0272520249	0.00893159	0.07073878	0.078754989
[17,]	0.8139412	0.0266764305	0.00882723	0.07220415	0.078350975
[18,]	0.8116630	0.0273041084	0.00884674	0.07343797	0.078748175
[19,]	0.8094686	0.0278052528	0.00893749	0.07263708	0.081151565
[20,]	0.8095718	0.0273837337	0.00886478	0.07300294	0.081176754
[21,]	0.8083635	0.0276669906	0.00884087	0.07410710	0.081021521
[22,]	0.8067200	0.0280782712	0.00892631	0.07368232	0.082593123
[23,]	0.8066112	0.0278251534	0.00889138	0.07375872	0.082913510
[24,]	0.8061014	0.0278777873	0.00885944	0.07455615	0.082605209

ACKNOWLEDGEMENT

I am extremely thankful to my supervisor Ozer Karagedikli. I also benefited from comments by Hans Genberg, Anella Munro, Ikuo Takei and Triwit Ariyathugun. In addition, I am grateful to Dr. Waqas Ahmed and Dr. Abdullah for providing me quarterly data on output gap for Pakistan. The views in this paper are solely the responsibility of the author.

REFERENCES

Anand, R., Ding, D., and Tulin, V. (2014). Food Inflation in India: The Role for Monetary Policy, *IMF Working Paper*, No.178.

Anand, R., Prasad, E. and Zhang, B. (2015). What Measure of Inflation Should a Developing Country Central Bank Target? *Journal of Monetary Economics*, 74.

Anand, R. and Prasad, E. (2010). Optimal Price Indices for Targeting Inflation Under Incomplete Markets, *National Bureau of Economic Research Working Paper Series*, No. 16290.

Aoki, K. (2001). Optimal Monetary Policy Response to Relative Price Changes, *Journal of Monetary Economics*, 48: 55-80.

Baba, C and Lee, J. (2022), Second-Round Effects of Oil Price Shocks – Implications for Europe's Inflation Outlook, IMF Working Paper, 173.

Binder, C.C. (2018), Inflation Expectations and the Price at the Pump, Journal of Macroeconomics, Vol.58.

Cecchetti, S. and Moessner, R. (2008). Commodity prices and inflation dynamics, *Bank for International Settlements Quarterly Review* :55-66.

Cockerell, L. (1999). Measures of Inflation and Inflation Targeting in Australia, RBA, manuscript.

Clark, T. (2001). Comparing measures of core inflation, *Economic Review, Federal Reserve Bank of Kansas*, 86 (2).

Cogley, T. (2002). A simple adaptive measure of core inflation, *Journal of Money, Credit and Banking*, 34 (1).

Friedman, M. (1977). Nobel Lecture: Inflation and Unemployment. Journal of Political Economy, 85(3).

Gregorio, D. J. (2012). Commodity Prices, Monetary Policy and Inflation, *IMF Economic Review*, 60(4).

Gelos, G. and Ustyugova, Y. (2012). Inflation Responses to Commodity Price Shocks–How and Why Do Countries Differ? *IMF Working Paper*, No. 225.

Goyal, A. and Parab, P. (2019). Inflation convergence and anchoring of expectations in India, *Indira Gandhi Institute of Development Research, Mumbai Working Papers*, 2019-023.

Hanif, M. N., Malik M. J. and Iqbal, J. (2012). Intrinsic Inflation Persistence in a Developing Country, *SBP Working Paper* No. 52.

Janak, R., Sangita, M. (2011). Measure of core inflation in India-An empirical evaluation, *RBI WP Series*, No.16.

Kilian, L. and Zhou, X. (2022), The impact of rising oil prices on U.S. inflation and inflation expectations in 2020–23, *Energy Economics*, Vol. 113

Kilian, L. (2013). Structural vector autoregressions. In N. Hashimzade & M. Thornton (Eds.), *Handbook of research methods and applications in empirical macroeconomics.* Edward Elgar

Köse, N., & Ünal, E. (2021). The effects of the oil price and oil price volatility on inflation in Turkey. *Energy*, *226*, 120392.

Lafleche, T. & Armour, J. (2006). Evaluating measures of core inflation, *Bank of Canada Review*, 2006: 19-29.

Mankiw, N. G. and Reis, R. (2003). What Measure of Inflation Should a Central Bank Target?, *Journal of the European Economic Association*, Volume 1, Issue 5, Pages 1058–1086.

Macklem, T. (2001). A new measure of core inflation, *Bank of Canada Review*, 2001(1): 3-12.

McCauley, R. (2006), Core verses headline inflation targeting in Thailand, Paper for presentation at a conference on 'Challenges of Inflation Targeting in Emerging Countries, *Bangkok, Bank of Thailand.*

Misati, R.N. (2015). Second Round Effects and Pass-through of Food Prices to Inflation in Kenya, *International Journal of Food and Agricultural Economics*, 3 (3): 75-87.

Mold, A. (2011). Shifting Wealth and the Consequences of Rising Food Prices on Social Cohesion, OECD Development Centre.

Mija, S., Slobozian, D., Cuhal, R. and Stratan, A. (2013), How Core Inflation Reacts to the Second Round Effects, *Journal for Economic Forecasting*, (1), 98-118

Mishkin, Frederic S. (2007). Inflation Dynamics, Speech at the Annual Macro Conference, Federal Reserve Bank of San Francisco, San Francisco.

Mishkin, Frederic S. (2008). Does Stabilizing Inflation Contribute to Stabilizing Economic Activity, Speech at East Carolina University's Beta Gamma Sigma Distinguished Lecture Series, Greenville, North Carolina.

Meng, C. K. (2016). The inflation process and expectations in Singapore, *BIS Papers chapters in: Bank for International Settlements (ed.)*, Inflation mechanisms, expectations and monetary policy, vol. 89, 335-343.

Moreno, R. (2009). Some issues in measuring and tracking prices in emerging market economies, *BIS Working papers*, No. 49

Peerawattanachart, K. (2015). Administered price and inflation targeting in Thailand.

Patnaik, A. (2019). Impact of food inflation on headline inflation in India, *Asia-Pacific Sustainable Development Journal*, 26, (1), 85-111

Rahman, A.K.M.A. and Zeba, S. (2016). Food Inflation and Inflation Dynamics in Bangladesh, *International Review of Business Research Papers*, 12(2):152 – 165.

Rangasamy, L. (2011). Food inflation in South Africa: Some implications for economic policy, *South African Journal of Economics*, 79(2): 184-201.

Rich, R.W. and Steindel, C. (2007). A Comparison of Measures of Core Inflation, *FRBNY Economic Policy Review*, 13(3):19-38.

Ruch, F. and Bester, D. (2012). Towards a measure of core inflation using singular spectrum analysis, *SARB Working Paper*, No.07.

Roger, S. and Stone, M. (2005). On Target? the International Experience with Achieving Inflation Targets, *IMF Working Papers*, No 2005/163.

Sims, C. A. (1986). Are forecasting models usable for policy Analysis? *Minneapolis Federal Reserve Bank Quarterly Review*, 10, 2–16

Stock, J. H., & Watson, M. W. (2001). Vector Autoregressions. *Journal of Economic Perspectives*, 15(4).

Upper, C. (2016). Inflation mechanisms, expectations and monetary policy, BIS Working papers, No. 89

Walsh, J. P. (2011). Reconsidering the Role of Food Prices in Inflation, *IMF Working Papers*, 2011/071, International Monetary Fund.

Wynne, M. A. (2008). Core inflation: a review of some conceptual issues, *Review*, 90, issue May, p. 205-228