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Second-round effects of food prices on core inflation in Turkey

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Abstract

Turkey has recently experienced persistently high food inflation, among the highest in emerging markets, with food accounting for a significant proportion of consumer expenditures. This study investigates the second-round effects of food price shocks on core inflation using monthly data from January 2013 to June 2024 through a Bayesian Structural Vector Autoregressive (SBVAR) model. Incorporating domestic and international macroeconomic variables, the model identifies second-round effects by imposing theory-based constraints and leveraging Bayesian methods. Results reveal that core inflation reacts strongly to food price shocks, with rising food prices worsening inflation expectations and amplifying second-round effects on overall inflation. Historical decomposition reveals a more persistent impact of food price shocks on core inflation and expectations post-COVID-19. These findings underscore the importance of closely monitoring food price dynamics to safeguard price stability in Turkey, highlighting their critical role in shaping inflationary pressures.

Keywords

- food prices
- core inflation
- second-round effects
- Bayesian Structural VAR

JEL codes: C32, E31, E50, Q10

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Introduction

What drives inflation has always been a challenging question for both academics and policymakers, but as seen in many ways in the period after 2020, commodity price increases and fluctuations are among the major factors that destabilise countries' general price levels. In particular, the increase in food prices since the mid-2000s has been of particular importance due to the welfare impact of food and has put great pressure on the inflation rate and living standards of developing countries with fragile economies (Bhat et al., 2018; Durevall et al., 2013; Mishra & Kumar, 2021). Rising food prices not only have an impact on inflation, but also create uncertainty and lead to a surge in inflation expectations. This situation generates difficulties with regard to forecasting headline inflation and achieving inflation targets.

Commodity prices shocks giving rise to a hike in inflation expectations can have an impact on price and wage-setting behaviour and can create what is known in the economics literature as second-round price effects (Galesi & Lombardi, 2009; Rangasamy & Nel, 2014; Ruch, 2016). In other ways, second-round effects may be defined as the responses of wage and price determinants to the first-round effects caused by a price shock. The attempts of economic agents to satisfy the loss of real income brought about by past inflation shocks may have an impact on inflation expectations and the behaviour of price and wage setters. As a result, a temporary price shock can become entrenched and more costly to overcome. To illustrate this point, labour, whose purchasing power has been eroded by rising oil and food prices, may be able to leverage this in wage negotiations. Consequently, wage growth can result in elevated production costs and inflationary pressures (Cavallo, 2008).

The influence of food inflation on core inflation can be attributed to the interplay between elevated inflation expectations and labour demands for wage increases (Ianchovichina et al., 2014). The rise in food prices may lead to an increase in inflationary pressures and present a challenge to macroeconomic decision-making. The propagation of food price shocks to other sectors of the economy through various channels may lead to an increase in inflation expectations. Given the high proportion of food in the consumption basket in many countries and the potential for second-round effects, domestic food inflation may exert a prolonged influence on core inflation, particularly in countries with less resilient inflation expectations. Also, workers may seek higher wage increases to offset the decline in purchasing power resulting from elevated inflation expectations, thereby intensifying the inflationary pressure on the economy (Behera & Ranjan, 2024). In general, imbalances arising from food price shocks lead to imbalances that affect macroeconomic stability over the cost, expectations, and wage-price spiral channels. As long as these instabilities do not cause a second-round effect on core inflation in the economy,

they are not eliminated by central banks through monetary policy. However, the persistence of such shocks makes it inevitable for central banks to contain inflationary expectations and costs.

For many years, policymakers have debated the strength of monetary policy in moderating food price pressures in developed and developing markets, where rising food prices are known to have a significant direct inflationary impact (De Brauw, 2011; Galesi & Lombardi, 2009; Kidane & Woldemichael, 2020). Since the design of monetary policy is primarily concerned with addressing demand-side shocks to the economy, supply-side shocks often require the use of instruments that are not available to central banks. Studies, especially in advanced economies, have generally revealed that shocks arising from food and energy prices tend to be short-lived and do not distort inflation expectations (Simbanegavi & Palazzi, 2023). However, monetary policy can help minimise the second-round effects of food and energy prices in emerging market economies (EMEs). Inflation expectations that are well anchored through monetary policy reduce fluctuations in wage/cost adjustments and thus help to break wage-price spirals (Gelos & Ustyugova, 2017; Pattanaik et al., 2020).

Several factors, including market cyclicality, determine the likelihood of second-round effects from a commodity shock. These are economic, commodity, and labour market flexibility, inflation expectations, and, above all, central bank credibility (Alp et al., 2023; Apergis, 2024; Baba & Lee, 2022; Iliyasu & Sanusi, 2024). Specifically, central bank credibility helps to reduce volatility in price / wage adjustments by preventing speculation on inflation expectations. Countries with a higher degree of central bank independence and a higher governance score seem to be in a better position to lessen the effect of these shocks (Gelos & Ustyugova, 2017). Therefore, the determination of the second-round effects takes the part of a major role in terms of ensuring the success of the monetary policy and maintaining its credibility. It is possible that failing to consider the impact of a food price shock on future inflation may result in inflation diverging from the central bank's target, thereby undermining the effectiveness of central bank monetary policy (Ginn & Pourroy, 2020).

Given all these developments, the spillover outcomes of food price increases on overall price stability, which is of great importance for macroeconomic stability, are a valuable issue for analysis. This paper contributes to the related literature by investigating the dynamics and magnitude of the second-round effect of the transition from food prices to core inflation using the Bayesian Structural VAR (SBVAR) model, which considers domestic and external shocks on core inflation, using the period from January 2013 to June 2024 of Turkish monthly data. Although many papers have analysed the link between food prices and various macroeconomic variables, this study eliminates the lack of papers examining the second-round effect of food prices on core inflation

in Turkey by employing the Bayesian techniques. It also studies the effect of food prices on overall prices through core inflation and inflation expectations. Turkey is an interesting case in point, especially given the chronic nature of high food inflation, which has registered one of the highest inflation rates in emerging economies in recent years.[3] Thus, understanding the impact of food prices is important for the success of monetary policy, macroeconomic stability, and controlling the overall level of prices.

The rest of this study is organised in the following way. Section 1 gives the literature review about the second-round effect of food prices. Section 2 introduces data and methodology. Section 3 presents the findings of the Bayesian Structural VAR estimates and robustness check results. Finally, the last Section closes the study by including policy conclusions.

1. Literature review

The impact that price increases in commodities, particularly food and energy, have on core inflation and the wider economy has been the subject of extensive research, employing a range of methodologies and focusing on diverse geographical contexts. This study divides the literature into studies based on developed countries and in developing / underdeveloped countries. Nevertheless, the findings suggest that second-round effects are more prevalent in developing / underdeveloped countries than in developed countries, although the data and methods used differ.

The increasing weight of food prices in the consumption basket in developing and less developed countries has led to the emergence of an important area of research analysing the second-round effects of food price shocks, which have recently increased in these regions. For example, Anand et al. (2014), Holtemöller and Mallick (2016), Bhattacharya and Gupta (2018), Patnaik (2019), and Behera and Ranjan (2024) all show that food prices have a second-round effect on core inflation and headline inflation in India using different models. In their studies on South Africa, Rangasamy and Nel (2014), Ruch and Du Plessis (2015), and Simbanegavi and Palazzi (2023) demonstrate that food prices exert a second-round effect on core inflation, whereby both expectations and costs are implicated. Iliyasu and Sanusi (2024) demonstrate that increases in energy and food prices have a positive and persistent effect on core inflation in Nigeria. Demeke and Tenaw (2021) establish evidence of

[3] In the report prepared by the World Bank's Food Security, Turkey ranks fourth among the 10 countries with the highest food price inflation in the May-September period of 2023, after Venezuela, Lebanon, and Argentina.

second-round effects between food and non-food prices in Ethiopia, as well as the strong and persistent impact of food prices on inflation. Nachega et al. (2024) reveal that global and domestic food prices indicate the existence of second-round effects of food prices in Gambia. To assess the second-round effects on core inflation in the Moldovan economy, Mija et al. (2013) analyse how core inflation responds to developments in oil and food prices in international markets by employing the VAR model. These findings support the idea that oil and food price movements have second-round effects on core inflation. Similarly, Ginn and Pourroy (2020) show that an international food price shock lead to second-round effects on non-food inflation in Chile.

For developed countries, Lee (2009) shows that food prices in the US have a significant impact on current core inflation and help predict future core inflation. The study also shows that there is a second-round effect stemming from the food and energy prices. Peersman and Van Robays (2009) and Peersman (2022) reveals the existence of a second-round effect of food price commodity shocks in the euro area by raising wages and inflation expectations. Studies of the period of high inflation in advanced economies after COVID-19 point to the increasing existence of a second-round effect stemming from commodity prices. Baba and Lee (2022) show that oil shocks in Europe have a strong impact on wages and core inflation. Alp et al. (2023) show that oil price increases give rise to small but non-trivial second-round effects on inflation through pass-through to food and core prices in Canada, the United Kingdom, and the euro area. The study also forecasts that second-round effects will continue to play a role in the dynamics of inflation in the coming years as well. Anderl and Caporale (2024) show that for the country groups of the US, the UK, the euro area, Canada, Japan, South Korea, Mexico and Denmark, shocks stemming from global food price averages and volatilities have a persistent second-round effect on core inflation.

Nonetheless, some studies have indicated that the second-round effect of food and energy price increases on core inflation in advanced economies is either negligible or relatively weak. Wong (2015) investigates whether oil price shocks have a second-round effect in understanding inflation dynamics by using the inflation expectations of the Michigan Survey in the US. The findings show that the second-round effect of real oil price shocks on inflation is not very strong and disappeared after the 1990s. Šoškić (2015) reveals that in Serbia the initial food price shock has no meaningful second-round effects on headline inflation. Likewise, Castro et al. (2017) show that the increase in oil price has no significant effect on non-energy price in eurozone, Germany, France, Spain and Italy. Similarly, Enders and Enders (2017) analysed the existence of a second-round effect caused by oil prices for the euro area and Germany through the wage response. Their results show no strong evidence for second-round effects due to oil prices in the euro area or even in Germany. Similarly, Conflitti and Luciani (2019) show that oil price shock has a trivial ef-

fect on core prices in both the eurozone and the USA. However, even though the relatively limited influence of oil prices in the USA, the pass-through effect was observed to be persistent, with a duration exceeding four years.

Given the impact of food price shocks on the pricing behaviour of the economy, it is also important to examine the response of monetary policy management to these shocks separately. Ginn and Pourroy (2020), on central bank attitudes to food inflation in developing countries, show that food price inflation becomes an important factor in the formulation of monetary policy in Chile. The Chilean central bank adjusts monetary policy to mitigate the second-round effects of food price shocks on non-food inflation and raises the policy rate in response to food price shocks. Ginn and Pourroy (2022) also reveal that the Reserve Bank of India does not ignore food price inflation and that the share of food price inflation in the Taylor rule is nearly equal to the share of food price inflation in the CPI.

In conclusion, the literature reviewed reveals that the likelihood of second-round effects is higher in developing countries. However, Turkey is an appropriate case study for examining second-round effects because of the high share of food in the consumption basket in developing countries and the fact that Turkey is a country that has experienced high food and overall inflation in recent years.

2. Model, data and methodology

The vector autoregression (VAR) methodology is the usual approach employed in empirical macroeconomic studies for investigating simple linear, causal, and dynamic simultaneous relationships between time series variables and forecasts (Rooj & Kaushik, 2023; Sims, 1980). In this study, we analyse the dynamic link between food prices and core inflation in determining the second-round effect of food prices in Turkey through the inclusion of several control variables, such as an external price shock and domestic macroeconomic variables. Thus, the reaction mechanism between the endogenous variables in the model can be captured using the VAR framework.

Firstly, the benchmark reduced-form VAR model estimate is as follows:

$$Y_t = c + \sum_{i=1}^{n} b_i Y_{t-i} + e_t \qquad \text{where} \qquad t = 1, 2, \ldots, T \tag{1}$$

where c represents intercepts vector, Y_t shows the endogenous variables vector, b_i denotes the autoregressive coefficients matrix of the lagged values of Y_t, i demonstrates the number of lags in the model and e_t shows the residual

vectors. To determine whether the second-round effect of food price occurs, the reduced VAR model is converted to the structural model:

$$A_0 Y_t = B_0 + \sum_{i=1}^{n} B_i Y_{t-i} + u_i \quad (2)$$

where A_0 shows the structural matrix of contemporaneous impact, B_i's represents the structural coefficient matrices of the lagged values of Y_t, and u_t, refer to the structural shocks that are uncorrelated with each other:

$$e_t = A_0^{-1} u_t \quad (3)$$

In small sample sizes, the rich parameterisation of VARs can overfit the data, potentially resulting in inaccurate conclusions and predictions. The Bayesian estimation method is useful for avoiding such overfitting and it makes use of prior information to reduce the parameters of the model down to a parsimonious benchmark, which may lead to higher accurate estimates. While too much reduction will not allow the data to 'speak', too little shrinkage will not prevent over-fitting problems (Hanck & Prüser, 2020). The basic principle of Bayesian econometrics is to treat model coefficients as conditional probabilities, not fixed parameters with 'true' values. In this approach, each parameter is considered as a random variable with a probability distribution on which it is based. Bayesian analysis involves combining the economist's prior knowledge about the distribution of the variables (i.e. the prior) including the knowledge derived empirically from the data (i.e. likelihood) to produce the revised distribution (i.e. the posterior) (Dieppe et al., 2016). The over-parameterisation problem is solved by combining the likelihood and prior to obtaining the posterior distribution for the parameters. However, to avoid misspecification that may affect the posterior distribution, the choice of prior distributions must be made carefully (Rooj & Kaushik, 2023).

2.1. Data

This study estimates a SVAR model to detect the second-round effect of food prices on core inflation in Turkey. This study is based on a monthly data set covering the period from January 2013 to June 2024. The choice of starting year depends on the availability of data. The data used in the econometric analysis are as follows: Food and Agricultural Organisation's real food price index (*fao*), Real Effective Exchange Rate (*reer*), Food Price Inflation (*foodinf*) Core Inflation C[4] (*corecinf*), Weighted Average Cost of the CBRT Funding as in-

[4] There are six different consumer price index indicators for the CPIs with specified coverage produced by Turkstat. This study prefers to use CPI_C as the core inflation indicator, as it excludes energy, food and non-alcoholic beverages, alcoholic beverages, tobacco and gold.

terest rate and Expectation of 12 Months Ahead Annual CPI[5] (%) (*expect*). The FAO food price index is collected from the Food and Agricultural Organisation of the United Nations. The remaining data are obtained from the Electronic Data Documentary System (EDDS) of the Central Bank of the Republic of Turkey (CBRT). All series except for the interest rate are transformed into their natural logarithms. Furthermore, all variables are also seasonally adjusted in accordance with the X12 CENSUS multiplicative method.

Over the past decades, Turkey has experienced a period of high inflation, one of the causes of which is the high level of food prices. The direct outcome of food prices in determining the level of inflation is an issue that should be considered for the Turkish economy. The rise in food prices in Turkey complicates inflation forecasting and may hurt inflation expectations and public confidence in the central bank, all of which are crucial for the success of inflation targeting.

Figure 1 represents the major trends in food inflation, core inflation, and headline inflation in Turkey from January 2011 to June 2024. The food inflation rate was higher and more volatile than the headline inflation rate, especially after 2018. In the November of 2022, Core_C inflation, Headline inflation, and Food inflation reached 68.91%, 84.39%, and 102.04%, respectively, the highest levels in the last 15 years. The sharp increase in food prices is also linked to factors such as the depreciation of the Turkish Lira, the ongoing increases in international agricultural commodities and food prices, and the

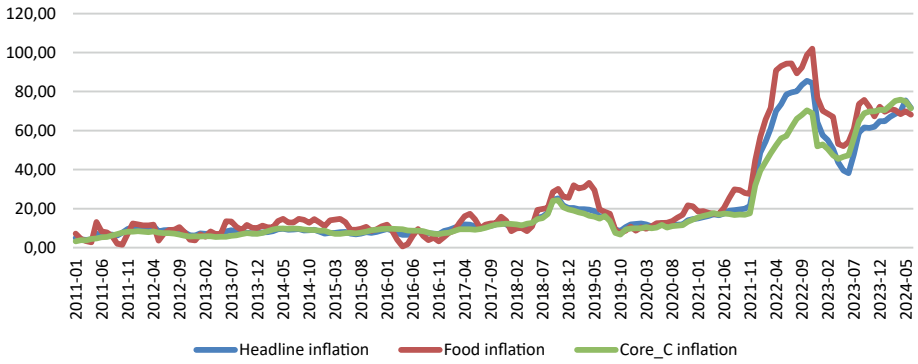

Figure 1. Monthly inflation trends in Turkey

Source: based on: (Central Bank of the Republic of Turkey, 2024).

[5] The CBRT provides the market participants survey-based data on expected inflation for Turkey, obtained from the Expectation Survey (ES) to monitor the expectations of decision makers and experts in the financial and real sectors regarding various macroeconomic variables. It is used as the 12-month ahead inflation expectation in CPI (%), in line with the studies of the Turkish economy, Bulut (2018), Alkan (2019), Gulsen and Kara (2020), and Koç et al. (2021).

agricultural drought (İnal et al., 2023). Price movements accelerated because of the COVID-19 pandemic, which caused disruptions in the supply chain and increased the cost and complexity of global food distribution.

The threat of global warming and climate change, as well as geopolitical risks, are considered among the driving forces behind the rise in food prices (Karagöl, 2023). Furthermore, the conflict between Ukraine and Russia, who are important food suppliers in the region, has brought reasonable humanitarian tragedy and political uncertainty to the global economy. As a neighbour and key regional actor, Turkey is vulnerable to market shocks due to its strong cooperation Ukraine and Russia, and its high dependence on agricultural imports from both (Ozturk & Faizi, 2023). It is worth noting the various causes responsible for food price inflation in Turkey, although the marked rise in food prices in 2022 can largely be attributed to the Russia–Ukraine conflict.[6] There is a noticeable decline in early 2023, but food prices begin to rise again in the final months of 2023. Although core inflation, headline inflation, and food price inflation have shown a significant increase recently, the rise in food prices is observed to put pressure on inflation. One reason for this is that the share of households' expenditures on food and non-alcoholic beverages in the consumption basket increased from 21.7% in 2017 to 25.4% in 2023. Hence, the price movement in this item of products has a dominant influence on the fluctuations in the general price level.

2.2. Identification of structural shocks

Structural shocks are defined using the Cholesky decomposition of the covariance matrix of the errors. The Cholesky decomposition is widely used by macroeconomic researchers, due to its simplicity and clear interpretation (Bańbura et al., 2015; Rooj & Kaushik, 2023; Urlichs, 2018). Using triangular factorisation, a recursive ordering is used to describe structural shocks. With regard to the ordering of the variables in the VAR, the general principle is that most exogenous (endogenous) variables are set first (last), and the ordering also takes into account whether the variable is fast responding or not (Doojav et al., 2024).

The model estimated is constructed to reveal a causality from food prices to core inflation, in order to show the existence of second-round effects of food prices on core inflation in Turkey. The sequence of structural shocks, and hence their impact on the other endogenous variables, can be determined from the initial order of variables in the model. This means that *fao* comes

[6] For more studies on the determinants of food prices, see Yıldırım (2021), Kutlu (2021), Orkun-Oral et al. (2023), and Inal et al. (2023).

first, followed by *reer*, *interest*, *foodinf*, *lnexpect* and *corecinf*. According to the Cholesky definition, external food price is not simultaneously influenced by any domestic variable shocks by assuming that food prices in the global economy are less influenced by how the Turkish economy and commodity markets perform. Consistent with the existing literature, i.e. Al-Shawarby and Selim (2013), Rangasamy and Nel (2014), Holtemöller and Mallick (2016), and Iliyasu and Sanusi (2024), the effect of food price shocks on core inflation is examined to evaluate whether there are long-lasting second-round effects of the initial shocks. The real effective exchange rate (*reer*) responds simultaneously only to global food prices. The interest rate (*interest*) is simultaneously affected by FAO food prices and the real effective exchange rate. Domestic food prices (*foodinf*) respond simultaneously to all variables except inflation expectation and core inflation. Inflation expectation (*expect*) responds simultaneously to all variables in the model except the core inflation. Finally, core inflation (*corecinf*) responds simultaneously to all variables in the model. The results are an illustration of the effect of a food price disturbance on core inflation and whether the second-round effect is realised. Moreover, it allows the second-round effects of food prices through the inflation expectations channel in Turkey to be analysed. The following constraints are implied by the order of the variables in the above formation:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} u^{fao} \\ u^{reer} \\ u^{interest} \\ u^{foodinf} \\ u^{expect} \\ u^{corecinf} \end{bmatrix} \begin{bmatrix} \beta_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & \beta_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{66} \end{bmatrix} \begin{bmatrix} \varepsilon^{fao} \\ \varepsilon^{reer} \\ \varepsilon^{interest} \\ \varepsilon^{foodinf} \\ \varepsilon^{expect} \\ \varepsilon^{corecinf} \end{bmatrix}$$

In this study, the lag length of the VAR model estimate is determined using the Deviance Information Criterion (DIC). The DIC is a popular model selection criterion in Bayesian estimation because it resembles the Akaike Information Criterion (AIC), widely used in frequentist inference (Andres-Escayola et al., 2023). DIC is also an indicator that incorporates the fit and complexity of fitted Bayesian models to optimize the behaviour of the residual error term.

2.3. Prior selection and hyperparameters

Another important step in Bayesian VAR analysis is prior selection. Estimating in small sample Bayesian models is very responsive to the prior

distribution. For this reason, this study selects the common hyperparameters of the prior distributions to overcome the problems. Since there is no previous study analysing the economic outcomes of food price shocks in Turkey using the Bayesian method, there are no existing priors to be used in this study. Therefore, in the SBVAR model estimated in this study, multiple priors are selected according to the Minnesota, Normal-Normal-Wishart, and Independent Normal-Wishart methods. However, the results obtained do not show a significant difference.

The model is estimated by means of the BEAR (Bayesian Estimation, Analysis and Regression) tool in MATLAB, prepared by Dieppe et al. (2016), with a 2 lag. The default values for the hyperparameters in the BEAR Toolbox are the common values from the Turkish studies for the calculation of the mean and the variance of the prior distribution for the VAR coefficients (Çelik & Oğuş-Binatlı, 2022). The autoregressive coefficient (δ_i) is 0.8, overall tightness (λ_1) is 0.1, cross-variable weighting (λ_2) is 0.5, lag decay (λ_3) is 2, and exogenous variable tightness (λ_4) has the value 100. The total number of Gibbs sampling iterations is set to 10,000, with 5,000 discarded as burn-in iterations to obtain impulse response functions.

3. Empirical findings

3.1. Impulse response functions

This study seeks to identify the consequences of food price shocks on core inflation and inflation expectations through impulse response functions (IRFs) analysis. The study principally investigates how core inflation and inflation expectations respond to food price shocks. To this end, Figure 2 displays the impulse responses from the Bayesian SVAR estimation. The regular blue solid line demonstrates the median responses of the relevant variables to the shocking events in the model, and the corresponding shaded area shows the 68% credible interval of the response. The credibility intervals are only meant to summarize the distribution of impulse responses to a given shock (Büyükbaşaran et al., 2020). The horizontal axis shows the time or period after the first effect of the shocks, while the vertical axis demonstrates the size of the reaction to the explained shocks.

The IRFs in the sixth row of Figure 2 show the response of core inflation to the other variables in the model. There is a significant and long-lasting response of core inflation to a positive FAO food price shock. The impact of higher external food prices is transmitted to stronger inflation by means of the supply-side channel. Also, the rise in the prices of international commod-

ity goods such as food and oil prices contribute to the rise in core inflation by increasing inflation expectations. This is consistent with the findings of Khan and Ahmed (2014), Holtemöller and Mallick (2016), Köse and Ünal (2021), and Alp et al. (2023), who claimed that core inflations are mostly very sensitive to developments in commodity prices. These findings seem to be consistent for the Turkish economy, given the country's dependence on external commodities and derivative products used as an important component of manufacturing and service industries.

A shock in domestic food prices gives rise to a positive and statistically significant impact on core inflation, which lasts approximately five months. These findings indicate that external and domestic food price shocks confirm the existence of second-round effects on core inflation in Turkey. These findings are similar to those of Mija et al. (2013) for Moldova, Ruch and Du Plessis (2015) for South Africa, Bawa et al. (2020), Iliyasu and Sanusi (2024) for Nigeria, and Anderl and Caporale (2024) for most developed countries. To put it another way, food inflation plays an important role in the main inflationary pressures in the economy. This may occur when foods become inputs for producing other goods. In addition, many foods are intermediate inputs in the production of other goods whose prices are included in core inflation, such as starch used in biodegradable plastics or natural fibres

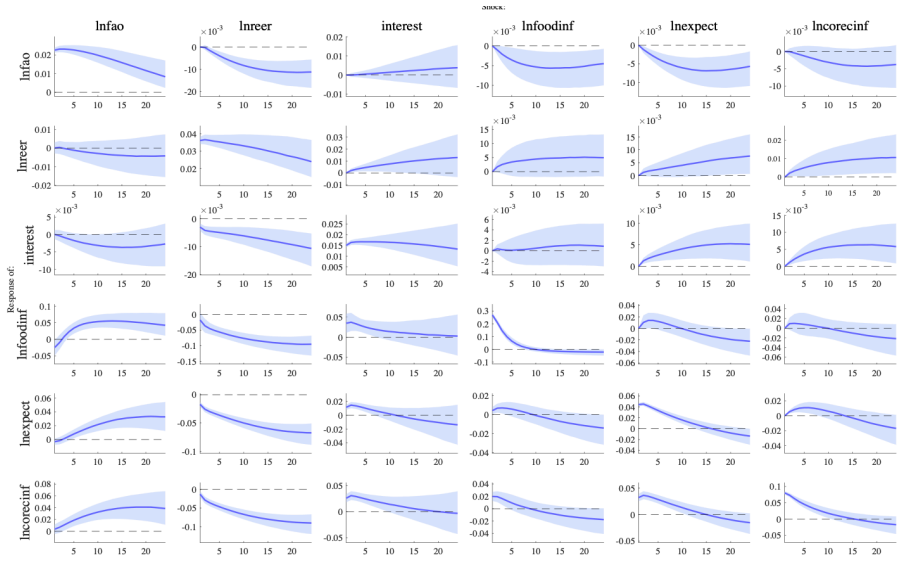

Figure 2. The impulse response functions of shocks to variables

Note: The *y*-axis represents the percentage change by cause of a one standard deviation shock in the variable, since the model variables are defined in terms of natural logs, except for interest rate. The BVAR is estimated with a normal-Wishart prior.

Source: own work.

used in textiles and construction; these lead to a rise in the overall production costs for companies, which are then reflected on to consumers prices (Anderl & Caporale, 2024).

A food inflation shock gives rise to a positive and statistically significant impact on inflation expectations. This shows that the second-round effect on the economy is realized through the expectations channel. Food prices exert a broad impact on the economy through their effect on intermediate input prices and inflation expectations. Food inflation, leading to higher inflation expectations, influences price-setting behaviour and second-round price effects. Second-round effects are observed in developing countries due to food constituting a large part of household expenditures, less stabilized expectations, and persistent supply shocks.

The IRFs also show that the of inflation expectation shock on core inflation is positive and lasts 10 months. According to Wong (2015), for the second-round effect to occur, it is not enough for an oil price shock to raise inflation expectations: this increase should also be reflected in inflation. The formation of high inflation expectations is reflected in core inflation through the realisation of price setting and wage bargaining in the presence of second-round effects. The consensus among economists is that inflation expectations create inflationary pressures as businesses and consumers incorporate them into their forward-looking pricing behaviour (United Nations, 2023). Such increases in inflation expectations could also lead to persistently higher inflation via second-round effects. Furthermore, the second-round effect pertains to the increase in inflation through labour force demands for higher wages to maintain the existing standards (Bhat et al., 2018). Because of the non-negligible division of food in consumption expenditures, food price inflation is the primary determinant of headline inflation. It forms the basis not only for prevailing inflation but also for future inflation and wage negotiations via expectations. This is confirmed by the following studies: Ferrucci et al. (2010), Walsh (2011), De Gregorio (2012), Mija et al. (2013), Rangasamy and Nel (2014), Misati and Munene (2015), Bhat et al. (2018), Patnaik (2019), Shahzad et al. (2022), Anderl and Caporale (2024), and Iliyasu and Salusi (2024).

Normally, the emergence of second-round effects is expected to follow a time lag. However, in economies with heightened inflation expectations and disrupted pricing behaviour, such as Turkey, these effects can manifest contemporaneously. In such high-inflation contexts, where inflation expectations and pricing mechanisms are severely distorted, core inflation may respond immediately to surges in food prices (Kara & Sarıkaya, 2024). This phenomenon can be explained by two primary channels. Firstly, the Expectations Channel: In a country where food prices constitute a significant portion of consumer expenditures (Turkey is a suitable country with approximately 25% food expenditure in the CPI), an increase in food prices can

swiftly impact inflation expectations. Businesses and consumers, sensitive to these expectations, often adjust non-food prices concurrently, eliminating the usual lag and generating a contemporaneous second-round effect. Secondly, the Cost Pass-Through Channel: The transmission of increased input costs to broader consumer prices can occur almost instantly, especially when supply chains are tightly interconnected, as observed in the post-COVID-19 period (Aktug & Akarsu, 2024; Algieri et al., 2024). These rapid adjustments collectively lead to a simultaneity in the responses of food and core inflation, suggesting that under these conditions, a contemporaneous second-round effect is plausible.

The influence of the real effective exchange rate on core inflation is positive and statistically significant in the long run. The stabilization or reduced depreciation of the national currency helps curb inflationary pressures in Turkey. On the contrary, the depreciation of the national currency causes inflation to spiral out of control. The findings present a strong exchange rate pass-through effect (EPRE) mechanism of domestic currency depreciation directly to the core inflation rate. This EPRE mechanism has been approved through many recent papers in the Turkish economy (Gayaker et al., 2021; Karaoğlu & Demirel, 2021; Tetik & Yıldırım, 2021; Ulug et al., 2023).

An increase in the policy rate causes all interest rates in the market to move upwards. Accordingly, in the short term this leads to an increase in the cost of borrowing and a rise in core inflation. Some of the recent studies on Turkey show that a rise in interest rates has an impact on inflation. Tayyar (2019), Sümer (2020), Şeker and Demirel (2022) and Akça (2023) show that a hike in nominal interest rates increases inflation. This result implies that long-term high interest rates in Turkey have inflationary effects by increasing inflation expectations.

3.2. Forecast error variance decomposition (FEVD)

The IRFs do not demonstrate the effect of these shocks in the variation of core inflation, although they do provide information on the effect of food price shocks on core inflation. In contrast, the FEVDs for the identified shocks in the model show how much variation is described by each shock. The FEVDs represent the importance of the intended shock on the variables. For the variance decomposition of the variables in the model, 1-, 6-, 12-, and 24-month forecast horizons are considered.

Table 1 reports the share of the variance for the core inflation shock (*lncorecinf*) explained by FAO food price shock (*lnfao*), real effective exchange rate shock (*lnreer*), interest rate shock (*interest*), food price inflation shock (*lnfoodinf*), inflation expectation shock (*lnexpect*) and its own shocks. Two impor-

tant shocks explain the variation in core inflation in the first month: inflation expectation (11.48%) and interest rate (7.57%). In the short 6-month period, shocks to the real exchange rate (20%), inflation expectations (13.23%) and interest rates (9.90%) are the source of variance in core inflation. The analysis findings demonstrate that looking at the one-year period, after the real exchange rate shock (40.99%), the global food price shock (9.36%), the inflation expectation shock (8.72%) and the interest rate shock (7.38%) explain the changes in core inflation. In the long run (24 months), real exchange rate and FAO food price shocks explain 57.39% and 13.32% of the variation in changes in core inflation, respectively. Then, 14.90% of changes in core inflation are explained by its own shocks.

Table 1. FEVD analysis of core inflation

Period	*lnfao*	*lnreer*	*interest*	*lnfoodinf*	*lnexpect*	*lncorecinf*
1	1.16	1.30	7.57	4.40	11.48	74.06
6	3.07	20.01	9.90	3.57	13.23	50.18
12	9.36	40.99	7.38	3.06	8.72	30.46
24	13.32	57.39	5.92	3.33	5.11	14.90

Source: own estimates.

In our empirical findings, it is crucial to differentiate between the roles of Forecast Error Variance Decomposition (FEVD) and Impulse Response Function (IRF) analyses, as both contribute unique insights to the relationship between food prices and core inflation. The FEVD analysis quantifies the extent to which variations in core inflation can be attributed to shocks in food prices over different time horizons. While the results show that food inflation explains only a modest share of the overall variation in core inflation, this reflects the multifaceted nature of core inflation, which is influenced by a variety of macroeconomic factors beyond food prices alone. Conversely, the IRF analysis is designed to illustrate the dynamic response of core inflation to an initial shock in food prices. This approach captures the immediate and potentially sustained impact of such shocks, emphasizing how they can create significant second-round effects through channels like inflation expectations and cost pass-through. Thus, while the FEVD provides an overview of the proportional influence of food price shocks, the IRF analysis reveals the mechanism and timing of their impact, highlighting the meaningful role food price fluctuations play in the formation of core inflation.

3.3. Historical decomposition

Figure 3 shows the historical decomposition of core inflation, indicating the relative contribution of other structural shocks over the estimation period from January 2013 to June 2024. From a different perspective, historical decomposition graphs can be used to examine which periods of food price shocks provide more explanation of the behaviour of core inflation. After the pandemic, core inflation increased by a higher rate than can be explained by the identified shocks, which confirms the abnormal nature of this episode. However, it can be inferred that historical decompositions of core inflation confirm the findings of the baseline model. As explained in the previous section, food price shocks and exchange rate shocks are also an important source of fluctuations in core inflation.

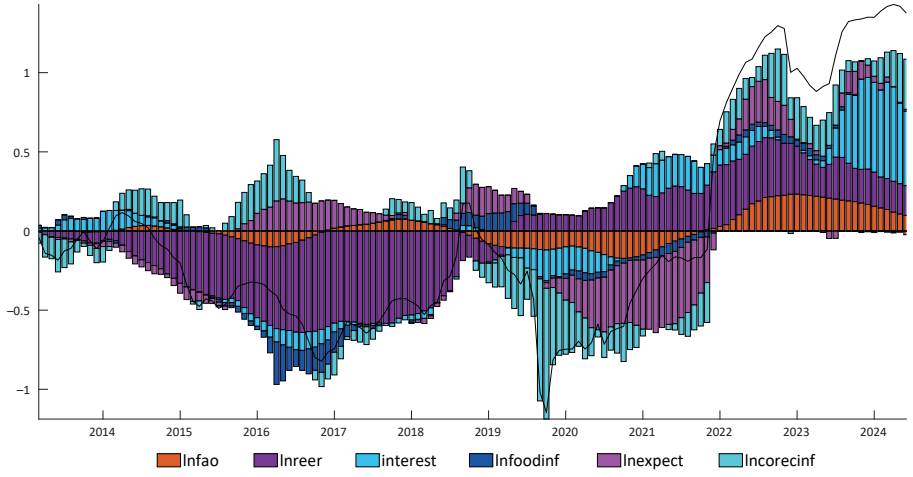

Figure 3. Historical decomposition of core inflation

Source: own work.

Furthermore, the impact of commodity price fluctuations, such as those of oil and food prices, on inflation is more pronounced when there is a lack of credibility in the monetary policy framework. It is therefore evident that if the central bank has established credibility in consistently achieving inflation targets, the size of the second-round effects from food prices will be more moderate (Baba & Lee, 2022; Behera & Ranjan, 2024). Central bank credibility fosters the formation of stable expectations among economic agents, thereby reducing the probability of excessive reactions to policy adjustments. A central bank with greater credibility will result in less sensitivity to shocks, as well as weaker second-round effects of commodity shocks on wages and inflation

(Bems et al., 2018). The credibility of the CBRT, which has been the subject of recent discussion, reinforces the direct (exchange rate pass-through, EPRT) and indirect effects of commodity prices on the overall economy (Gayaker et al., 2021).

3.4. Robustness checks

This section briefly provides robustness checks of the results by estimating the baseline model with the addition of various variables and with the use of different priors. Following Anderl and Caporale (2024) and Iliyasu and Sanusi (2024), the nominal FAO food prices, nominal exchange rates and real money supply are first replaced as new variables in the model. Secondly, the baseline model is estimated using different prior parameters, such as Independent Normal Wishart.

The IRF findings are reported in Figure A1 and A2, respectively, in the Appendix of the study. The results under different specifications, alternative variables and priors are consistent with the baseline results. No significant change in the results was observed after the robustness checks. According to the findings of robustness estimation, there is a second-round effect of food prices shocks on core inflation in Turkey

Conclusions and policy recommendation

This study explores the existence of the second-round effect of food prices on core inflation by using the SBVAR model for the Turkish economy throughout January 2013 and June 2024. The model is analysed using impulse responses, variance decompositions, and historical decomposition tools to reveal the presence of the second-round effect on core inflation.

Historically, food inflation has been a significant determinant of inflation expectations. This is due to its relatively lower volatility compared to energy inflation, as well as its substantial impact on household expenditures. Given that Turkey is among the countries with the highest inflation and food price inflation worldwide, an examination of the influence of food prices on core inflation via the inflation expectations channel represents a significant motivation for this study.

The results from the IRFs reveal that core inflation responds positively and strongly to domestic and external food price shocks. Furthermore, the impact of food price shocks on inflation expectations also appears to be signif-

icant and persistent. When these two effects are considered together, it can be seen that the second-round effect of food prices emerges and the inflationary pressure from the food price shock is transmitted to core inflation via the inflation expectations channel. Historical decomposition findings reveal that the effects of food price shocks on core inflation have been more persistent since the COVID-19 period. These findings indicate that food prices have become a much more important component of overall inflation over recent years through inflation expectation channel. The development of food prices has been an important factor in generating inflationary episodes in Turkey and in the rise in inflation expectations.

These findings have important implications for policymakers. The results of this paper show that it is essential to keep food price movements under control to maintain price stability in Turkey. Hence, monetary policy needs to follow food prices closely. Ignorance of food price movements may lead to a misleading picture of underlying inflationary pressures and an inappropriate monetary policy response. Second-round effects may become persistent through two potential channels: higher inflation expectations or price / wage increases by firms / labour. Both of these scenarios are crucial for central banks to ensure price stability. By establishing a robust anchor for inflation expectations, monetary policy can assist in preventing a wage-price spiral and mitigating the second-round effects of supply shocks. This would help to circumvent an unfavourable macroeconomic outlook of lower growth and higher inflation. This calls for a renewed and vital role for the Central Bank of the Republic of Turkey in anchoring households' inflation expectations through effective communication and transparency. Finally, in the management of a central bank such as the Central Bank of the Republic of Turkey, which has failed for years to achieve its inflation target and to manage expectations, the emergence of strong and persistent second-round effects in commodity prices may be an important universal lesson for failed monetary policy implementations.

Appendix

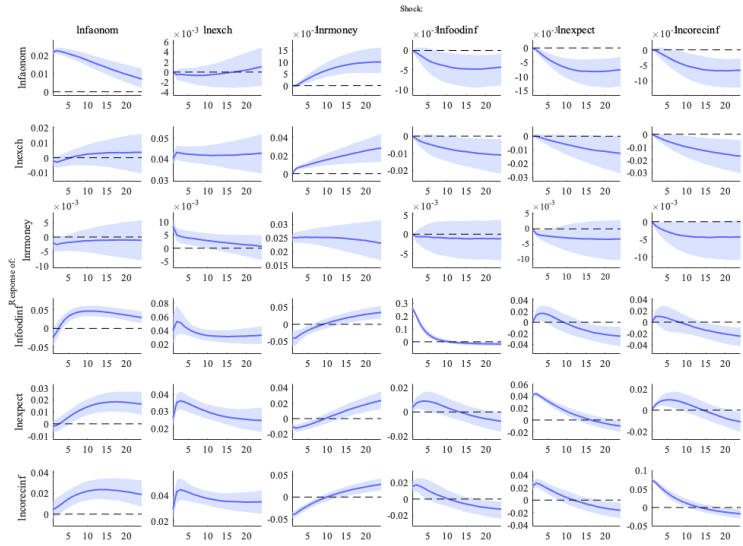

Figure A1. Robustness checks-1: IRFs to alternative VAR model

Source: own work.

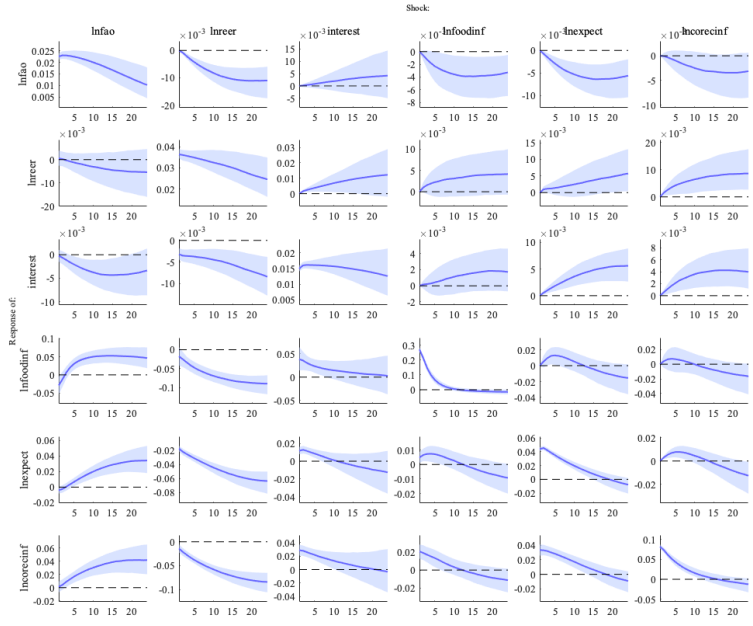

Figure A2. Robustness checks-2: IRFs to alternative prior (Independent Normal Wishart)

Source: own work.

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