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Food Prices and Monetary Policy: Evidence from Türkiye

Gıda Fiyatları ve Para Politikası: Türkiye'den Bulgular

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ABSTRACT

This study investigates the relationship between monetary policy and food prices over the period of 2011:M1-2024:M9 in the case of a small economy, Türkiye. We perform a Structural Vector Autoregression (SVAR) to capture the dynamic relationship between monetary policy and food prices. Our non-recursive identification scheme is formed based on the small-open economy characteristics which are in line with economic theory. Our empirical results showed that expansionary monetary policy is associated with a fall in food prices. As food prices move in the same direction with the decreasing interest rate, an expansionary monetary policy shock generates price puzzle and stabilizes food prices. Similar to food prices consideration, expansionary monetary policy also generates price puzzle in overall economy. The relative weakness of the demand channel allows us to recommend unconventional expansionary monetary policy practice in fighting against food and consumer inflation. We also performed several robustness checks and found that our results are robust.

MAKALE BİLGİSİ

Makale Türü
Araştırma Makalesi

Anahtar Kelimeler
Para Politikası
Gıda Fiyatları
Yapısal VAR

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ÖZ

Bu çalışma, para politikası ve gıda fiyatları arasındaki ilişkiyi küçük ülke örneği Türkiye özelinde araştırmaktadır. Gıda fiyatları ve para politikası arasındaki dinamik ilişki Yapısal VAR yöntemiyle analiz edilmiştir. Yinelemesiz tanımlama varsayımları, ekonomik teoriyle uyumlu olarak küçük-açık ekonomi karakteristik özelliklerine dayanılarak oluşturulmuştur. Ampirik sonuçlar, genişletici para politikasının gıda fiyatlarını düşürdüğünü göstermektedir. Gıda fiyatları düşen faiz oranları ile aynı yönde hareket ettiğinden, genişletici para politikası fiyat bulmacası yaratmakta ve gıda fiyatları üzerinde istikrar sağlamaktadır. Gıda fiyatlarına benzer olarak, genişletici para politikası genel fiyatlar üzerinde de fiyat bulmacası yaratmaktadır. Talep kanalının göreceli zayıflığı, gıda ve tüketici enflasyonuyla mücadelede geleneksel olmayan genişletici para politikası uygulamalarının önerilmesine olanak tanımaktadır. Ayrıca, uygulanan dirençlilik testleri elde edilen sonuçların dirençli olduğunu göstermektedir.

1. Introduction

Food prices may have a significant impact on consumer inflation dynamics in low and middle-income countries as they share a significant portion of consumer inflation basket. Figure 1 reports the share of main expenditure groups in Turkish inflation basket. The weight of the food and non-alcoholic beverages category is around 25% while the other expenditure groups in the basket share the remaining 75%. In addition, Figure 2 shows that food inflation rates are mostly above consumer inflation rates. The mean food and consumer inflation rates in a fourteen-year period between 2011 and 2024 are 1.8% and 1.6%, respectively. The fact that food prices are one of the main drivers of overall inflation necessitates Central Bank of the Republic of Türkiye (CBRT) to closely monitor the food price dynamics. Among the main expenditure groups, food prices should receive the most attention mainly for two reasons. First, an increase in food prices may naturally endanger the price stability objective of CBRT, which has adopted inflating targeting regime since 2006. Second, an increase in food prices significantly reduces the real disposable income of low and middle-income

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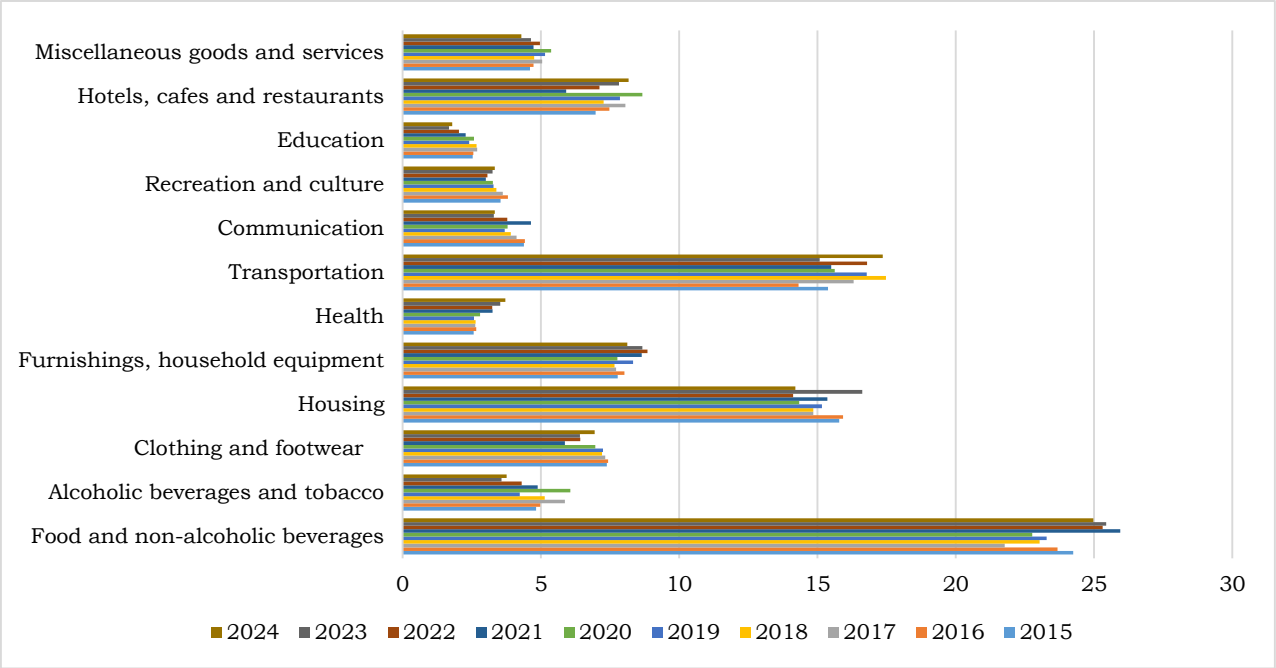
households which constitute a significant part of the population since food expenditures easily dominate their consumption expenditures.

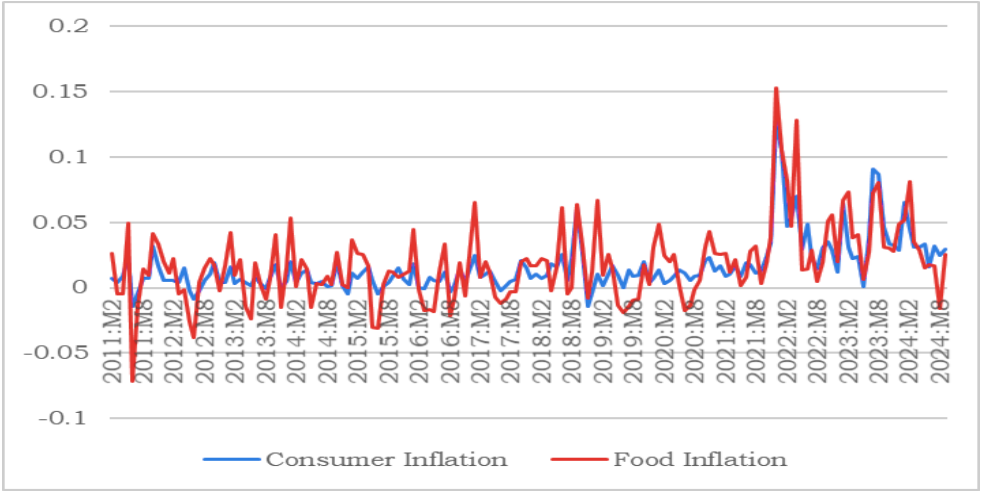
Figure 1: The Share of Main Consumption Goods and Services in the Inflation Basket



Source: Turkish Statistical Institute (TSI)

In conventional theoretical literature, monetary policies can stabilize food prices through aggregated demand channel. Accordingly, when a food price shock hits an economy, a contractionary monetary policy tends to stabilize food prices as it reduces output and income. Therefore, central banks raise interest rates and activate demand channel of monetary transmission mechanism to benefit from the negative relationship between monetary policy rate and food prices. However, as the aggregated demand channel is not the single valid channel in the monetary policy transmission process, there is not a general empirical consensus that food prices will certainly decline in response to a contractionary monetary policy. An increase in policy rate may also trigger the "*production cost channel*" of monetary transmission mechanism (Sims 1992; Barth and Ramey, 2001; Chowdhury et al., 2006; Gaiotti and Secchi, 2006) and raise food prices.

Figure 2: Consumer and Food Inflation, Monthly



Source: Electronic Data Delivery System of CBRT

According to the cost channel that delivers positive price impacts following a contractionary monetary policy, an increase in interest rate first raises capital cost in capital intensive non-food sectors and then leads to a rise in their output prices. Due to the increasing cost of capital, the firms in capital-intensive non-food sectors tend to substitute labor with relatively expensive capital. Since the substitution of capital with labor leads to a rise in labor wages in the overall economy, production costs and hence output prices of labor-intensive food sector also increase. As a result, price increases in both capital-intensive non-food sectors and labor-intensive food sector generate inflationary pressures in whole economy (Bhattacharya and Jain, 2020). This suggests that relative strength of the monetary transmission mechanism determines the stabilizing role of conducted monetary policies. On the other hand, the fact that prices and nominal interest rates both move in the same direction following a monetary policy shock exhibits a well-known phenomenon "*price puzzle"* which has been a long-documented puzzle in monetary policy literature (Bernanke and Blinder, 1992; Eichenbaum, 1992; Barth and Ramey, 2001; Hanson, 2004; Taş, 2011). Empirical literature has offered various solutions to eliminate price puzzles. Sims (1992) recommended to use commodity prices in econometric models to capture the impact of future price expectations while School and Uhlig (2008) introduced constraints on impulse response function to solve price puzzle. Estrella (2015) included the structural lag in the effect of monetary policy on prices and concluded that price puzzle disappears. Finally, Carlstrom et al. (2009) indicated that the orthogonal Cholesky identification restriction which imposes that monetary policy shock does not affect macroeconomic variables contemporaneously is responsible for price puzzles.

While the empirical food price literature mainly focuses on the drivers of food prices such as exchange rate (Harri et al., 2009; Baek and Koo, 2010; Reboredo and Ugando, 2014; Bhattacharya and Jain, 2020), world food prices (Bhattacharya and Gupta, 2018; Iddrisu and Alagidede, 2020; Bhattacharya and Jain, 2020), energy prices (Zhang and Qu, 2015; Salisu et al., 2017; Pal and Mitra, 2019; Kırıkkaleli and Darbaz, 2021), and etc., the empirical question of whether monetary policy stabilizes food inflation is very limited in terms of the volumes of research. Most of the related empirical literature devoted to the assessment of the relationship between monetary policy and commodity prices and tended to find stabilizing role of monetary policy (Christiano et al., 2005; Frankel, 2008; Sousa, 2010; Miranda-Pinto et al., 2023). However, only a limited number of studies have gone beyond the commodity price index and analyzed the impacts of monetary policy on subcomponents of commodity prices such as food and agricultural commodities. Frankel (2008), Akram (2009), and Scrimgeour (2014) provided evidence that monetary policy can stabilize agricultural commodity prices. On the other hand, Hammoudeh et al. (2015), Bhattacharya and Jain (2020), Iddrisu and Alagidede (2020) found destabilizing role of monetary policy on food prices. They concluded that monetary policy destabilizes food prices due to relative strength of cost channel.

Unfortunately, whether the conducted monetary policies in Türkiye have ability to stabilize food prices have not been sufficiently discussed empirically. The empirical efforts regarding food prices have largely skewed to the context of drivers of food inflation rather than exploring the relationship from CBRT monetary policies to food prices. Specificially, these studies concluded that food price dynamics are mostly driven by world food prices, money supply, exchange rates, oil prices, consumer credit interest rate, economic uncertainty, and etc. (Çıplak and Yücel, 2004; Bayramoğlu and Yurtkur, 2015; Altıntaş, 2016; Alper, 2018; Işık and Özbuğday, 2021; Algan et al., 2021; Yıldırım, 2021; Kartal and Depren, 2023; Daşdemir, 2023; Karagöl, 2023; Demirağ and Sağır, 2024; Özçelik and Uslu, 2024; Bozkurt and Mutlu Çamoğlu, 2025).

This study, on the other hand, explores the effects of the monetary policies conducted in Türkiye on food prices over the monthly period of 2011:M1-2024:M9. We perform a SVAR analysis which is the most widely employed empirical methodology when investigating the monetary policy transmission mechanism. Our estimation method has the ability to capture the dynamic mutual interdependency between the monetary policy rate and macroeconomic fundamentals such as

domestic prices, exchange rates, and output. Therefore, the mutual interdependencies among the variables allow us to analyze not only monetary policy-food prices relationship but also monetary policy-consumer prices relationship in Türkiye. This study presents a number of contributions to empirical literature. Due to the lack of empirical consensus on the monetary policy-food prices nexus, the role of monetary policy on food prices can only be determined by country specific studies. We attempt to fill this gap for Türkiye as our study is one of the earliest empirical efforts which systematically investigates the relationship between the CBRT monetary policies and food prices. Second, while the past empirical literature mainly provides insights in the context of U.S. and advanced countries, the present study explores the monetary policy-food inflation relationship in the case of an emerging country example. Therefore, our structural identification assumptions significantly differ from the traditional large open economy literature and are designed by the small open economy characteristics. Third, this study differs from the past studies that propose contractionary monetary policies to generate a fall in food and consumer prices. Unlike the conventional monetary policy literature, our study suggests that CBRT should conduct the expansionary monetary policies to stabilize food prices. Failure of the aggregated demand channel of monetary transmission mechanism over the study period can explain the stabilizing role of expansionary monetary policies in Türkiye.

The rest of the study is organized as follows. Section 2 presents details of selected empirical methodology and non-recursive identification assumptions on VAR innovations. Section 3 reports estimation results while Section 4 performs several robustness checks. Finally, Section 5 discusses the results and Section 6 concludes.

2. Empirical Methodology and Data

To identify the impact of the monetary policy on food prices, we estimate the following m^{th} order VAR(m) model:

$$Z_t = A_0 + A_1 Z_{t-1} + A_2 Z_{t-2} + \cdots + A_m Z_{t-m} + DX_t + u_t \quad (1)$$

where Z_t is a vector of endogenous variables, and X_t is a vector of exogenous variables. A_0 is a vector of constants. m indicates the selected number of lags while A_i and D are coefficient matrices. The innovations $u_t \sim N(0, \Sigma)$ can be represented by a linear transformation of mutually uncorrelated structural shocks ε_t such that:

$$u_t = G\varepsilon_t \text{ where } E(u_t u_t^T) = \Sigma = GG^T \quad (2)$$

We can write Equation (1) as the following structural form based on structural shocks:

$$A(Z_t - A_0 - A_1 Z_{t-1} - A_2 Z_{t-2} - \cdots - A_m Z_{t-m} - DX_t) = Au_t = B\varepsilon_t \text{ where } G = A^{-1}B \quad (3)$$

Our baseline VAR model includes seven variables. The vector of endogenous variables, Z_t=(OUT FOOD CPI IR REER)^T includes industrial production index (OUT), food prices (FOOD), consumer prices (CPI), interest rate (IR), and real exchange rate (REER) while world food prices (WFOOD) and U.S. monetary policy rate (USFFR) are our exogenous variables.[1] Industrial production index, real exchange rate, world food prices, and Federal Funds rate data are obtained from Federal Reserve Economic Data (FRED) while domestic prices and interest rate data are downloaded from Electronic Data Delivery System (EDDS) of CBRT. A decrease in the real exchange rate represents a depreciation of the national currency.

Before introducing identification assumptions on VAR innovations, one of the issues that needs to be considered is to decide which interest rate reflects CBRT's monetary policy stance over the period of 2011:M1-2024:M9. CBRT started to conduct a rather untraditional monetary policy

[1] For similar use of endogenous and exogenous variables, please see Eichenbaum and Evans (1995), Grilli and Roubini (1995), Cushman and Zha (1997), Christiano et al., (2005), Kim and Roubini (2000), Peersman and Smets (2001), Bjørnland, (2009), Hammoudeh et al. (2015) Bhattacharya and Jain (2020), Iddrisu and Alagidede (2020).

framework at the beginning of 2011. Accordingly, the bank has started to release "*Weighted Average Funding Cost (WAFC)*". The WAFC rate is simply designed by a weighted combination of BIST interbank overnight repo rate, weekly repo rate, overnight lending and borrowing rates, etc. However, the presence of several policy instruments in the new monetary policy scheme generated confusion in the financial markets. With the aim of reattaching global conventional monetary policies, the bank has simplified the monetary policy framework and started to use weekly repo rate since June, 2018. That is, the monetary policy stance of CBRT is reflected by WAFC rate between 2011:M1-2018:M6 while the one-week repo rate has been announced as the policy rate in 2018:M6 and thereafter. Since the WAFC rate prevails most of our study period, we employ the WAFC rate to represent the monetary policy rate of the bank.[2] Our study covers the period of 2011:M1-2024:M9 as the CBRT has released WAFC data starting from 2011:M1.

All domestic and exogenous variables except for the domestic and US interest rates are expressed in logarithms. The order of integration of the variables are determined based on Phillips-Perron unit-root test suggested by Phillips and Perron (1988).[3] Since all variables are stationary in first differences, our VAR model (1) is estimated by first-differences. To carry out the impulse-response analysis, the optimal VAR specification must be determined. We first set the max lag length twelve. The most often selected by the three information criteria, AIC (Akaike Information Criterion), SIC (Schwarz Information Criterion) and HQIC (Hannan-Quinn Information Criterion) was m=1. Due to the detected autocorrelation at m=1, we then elevated the number of lags to m=2 so that VAR innovations in Equation (1) are free from autocorrelation. Our VAR specification does not violate the eigenvalue stability condition.[4] This suggests transitionary impacts of the exogenous shocks in the VAR system.

2.1. Identification Assumptions

Our identification scheme contains the following assumptions based on the relevant economic theory:

i. We follow standard VAR literature and place industrial production above the FOOD, CPI and financial variables (IR and REER) due to the long-lasting adjustment process of output in relative to the prices and financial variables. Following a price or a financial shock, the real sector naturally requires more time to adapt its output level to the current economic environment. The adjustment process of output is imposed by lagged responses of the real sector to the shocks in prices and financial sector.

ii. Reaction function of CBRT is reflected by interest rate equation and placed under the domestic variables (OUT, FOOD and CPI). Kim and Roubini (2000), Sims and Zha (2006) imposed "*zero*" restrictions on domestic variables at the interest rate equation based on the "informational delays". These restrictions indicate that the monetary authority responds contemporaneously to the changes in REER; however, does not react contemporaneously to the changes in OUT, FOOD and CPI.

The fact that CBRT does not reach to the production statistics in monthly manner due to quarterly released GDP data makes the informational assumption on OUT reasonable. Since our study contains monthly data, we also follow the same zero restriction on output. On the other hand, the informational assumption on prices can be considered as somewhat controversial. Even though immediate reaction of CBRT to the change in prices is possible due to monthly access to domestic prices, the informational assumption on prices can still be reasonable if the bank does not convene regularly on a monthly basis and changes the monetary policy at some specific points in time. In Türkiye, monetary policy is conducted by the Monetary Policy Committee (MPC) at pre-scheduled

[2] Later, we also employ one-week repo rate in the VAR model and compare the estimation results of two interest rates.
[3] Phillips-Perron (1988) unit-root test results are available upon request.
[4] Eigenvalue stability condition is available upon request

monthly meetings. Therefore, we slightly change the informational assumption and put zero restriction only on output.[5] To put it shortly, the monetary policy rule is adjusted by the current value of prices and exchange rates while interest rate equation is restricted from the current impact of output. Our interest rate rule differs from the traditional Cholesky orthogonal assumption which indicates that the domestic variables, OUT, FOOD, and CPI do not react to current changes in monetary policy variable while the monetary policy variable exhibits immediate change in response to price and output shocks (Christiano et al., 2005; Mojon and Peersman 2001; Peersman and Smets, 2001; Bjørnland, 2009).

iii. Exchange rate is subject to all structural shocks contemporaneously and hence ordered last. We impose two main assumptions on the exchange rate. First, the well-known pass-through process of exchange rate requires sluggish reaction of domestic variables to the exogenous real exchange rate shocks as suggested by Kim and Roubini (2000), Bjørnland (2009), Hammoudeh (2015). Second, as mentioned above, the monetary policy rule does not exhibit informational delays when a real exchange rate shock emerges.

iv. Our identification scheme also introduces the assumption that the financial variables, REER and IR exhibit contemporaneous mutual dynamic relationships. Faust and Rogers (2003) suggested that interest rate shocks in open economy VAR models should be identified by contemporaneous interaction of financial variables. Similarly, Bjørnland (2009) explained that neglecting the simultaneous reactions between IR and REER may produce biased estimations. Therefore, exchange rate and interest rate variables are allowed to generate simultaneous responses to exogenous IR and REER shocks.

v. We also consider two exogenous variables.[6] First, we include the impact of world food prices (WFOOD) in parallel with Pourroy et al. (2016), Bhattacharya and Gupta (2018), Iddrisu and Alagidede (2020). Second, we follow Peersman and Smets (2001), Mojon and Peersman (2001) and control the impacts of U.S. monetary policy changes (Federal Funds Rate-FFR) on CBRT's monetary policy decisions. Since Türkiye is a small open economy, we differ from the open large economy characteristics and restrict contemporaneous or lagged impacts of domestic shocks on the exogenous variables. With this set-up, we ensure that there is no feedback from domestic variables to exogenous variables.

Based on the identification assumptions above, we can introduce the following non-recursive restrictions:

$$\begin{pmatrix} u_{OUT_t} \\ u_{FOOD_t} \\ u_{CPI_t} \\ u_{WAFC_t} \\ u_{REER_t} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ G_{21} & 1 & 0 & 0 & 0 \\ G_{31} & G_{32} & 1 & 0 & 0 \\ 0 & G_{42} & G_{43} & 1 & G_{45} \\ G_{51} & G_{52} & G_{53} & G_{54} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_{OUT_t} \\ \varepsilon_{FOOD_t} \\ \varepsilon_{CPI_t} \\ \varepsilon_{WAFC_t} \\ \varepsilon_{REER_t} \end{pmatrix} \quad (4)$$

3. Empirical Results

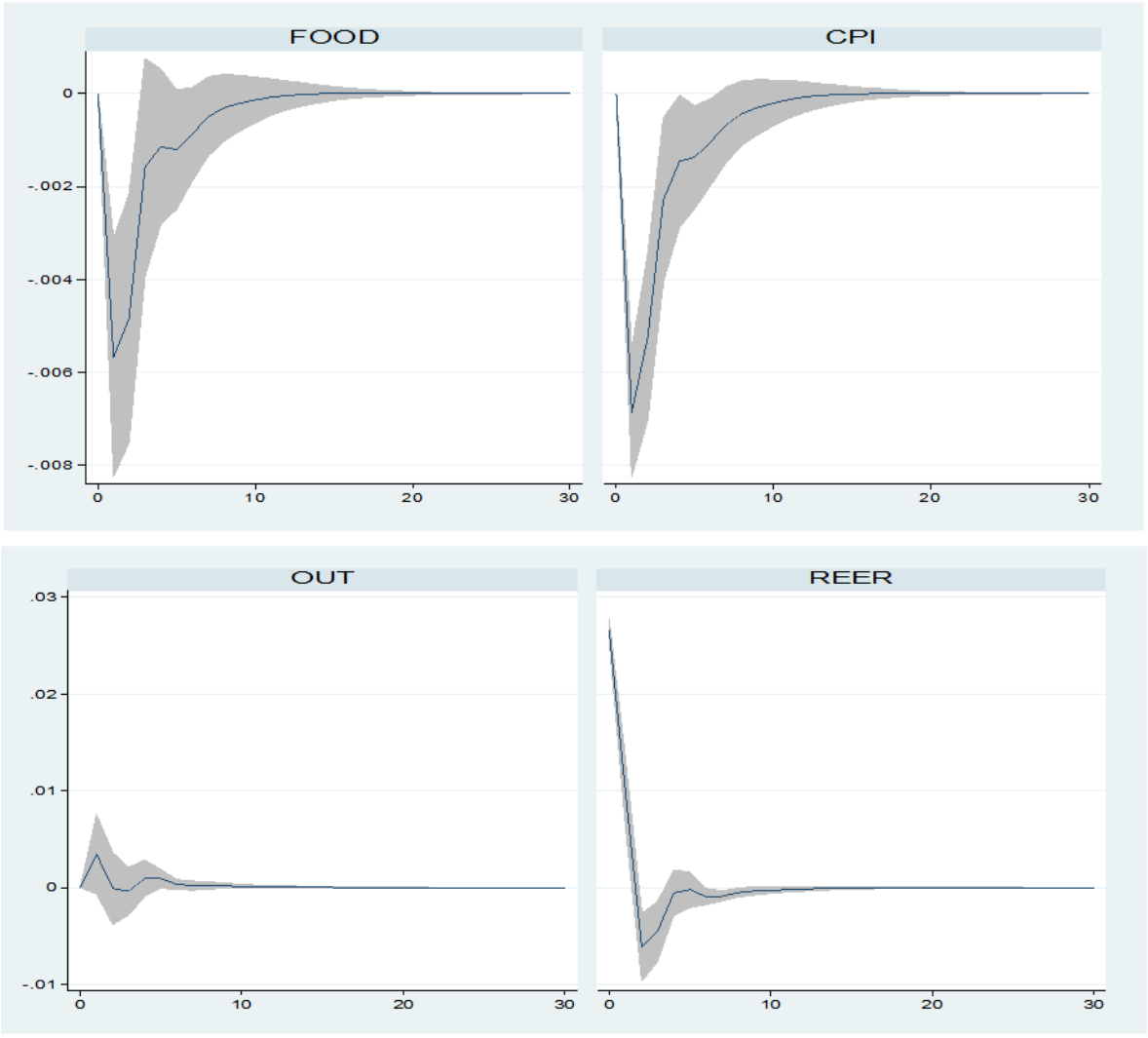
Figure 3 depicts the structural impulse-response functions (SIRF) of the food prices and other variables in endogenous vector in response to an exogenous monetary policy shock. The grey areas around thr baseline SIRF paths represent the 90% confidence interval bands. Following an exogenous monetary policy shock, the interest rate significantly falls (i.e. expansionary monetary policy). The impact thereafter gradually weakens and disappears roughly in 20 months. An expansionary monetary policy leads to a significant fall in food prices, but the response emerges with a lag. The fact that the monetary policy rate and food prices move in the same direction (positive

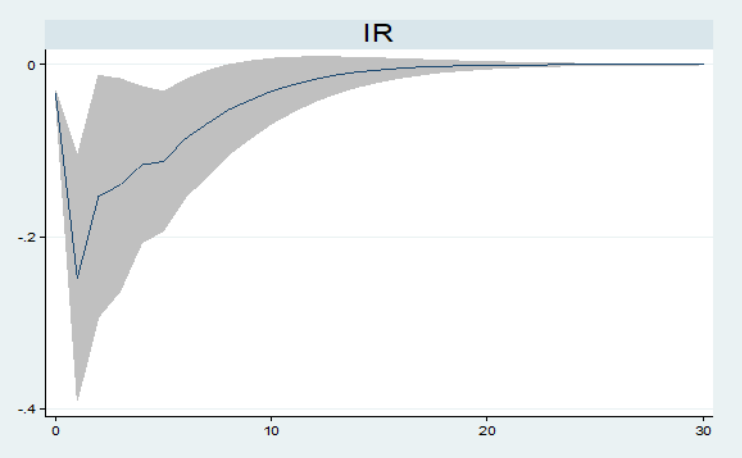
[5] Later, we also impose zero restrictions on food and consumer prices for robustness checks.
[6] Later, we also use different exogenous variables for robustness checks.

impact) indicates the presence of price puzzle in food prices. Following the initial fall, the food price gradually returns to its baseline as the impact of expansionary policy erodes. Similarly, consumer prices are also found to decrease following an expansionary monetary policy shock. That expansionary monetary policy is followed by a decline in consumer prices also reveals price puzzle in consumer prices. As both prices return their baselines in parallel with the interest rate, the negative impacts of expansionary monetary policy on food and consumer prices are transitory. To put it shortly, nature of the monetary policy transmission process delivers a greater positive impact on prices than the negative impacts through the demand channel after an expansionary shock.

Price puzzle on food prices can be explained by production cost channel. On the one hand, a negative shock in the CBRT policy rate reduces the cost of capital in the capital-intensive non-food sectors, and hence decreases their output prices. On the other hand, as a result of relatively cheap capital, the firms in capital-intensive non-food sectors tend to substitute labor with capital. The substitution of labor with cheap capital reduces labor wages and production cost in labor-intensive food sector. Therefore, the firms in the labor-intensive food sector also lower their own output prices. Finally, a decline in both food and non-food sector prices leads to a fall in overall prices.

Figure 3: Responses of the Endogenous Variables to an Exogenous Monetary Policy Shock, Baseline Specification





"*Fiscal channel*" can present another perspective to explain price puzzles appeared in Figure 3. Sargent and Wallace (1981) argued that fiscal dominance on domestic economy policies may be responsible for puzzling results. Accordingly, when fiscal policies dominate the economic policies, and public debts are mostly financed by bonds, an expansionary monetary policy naturally reduces the debt burden of the country. The fall in public debt levels eventually lowers future budget deficits, and hence future price expectations. Therefore, an expansionary monetary policy itself may be a main source of decreases in domestic prices. Blanchard (2004), Favero and Giavazzi (2004) also highlighted the prominence of fiscal channel when explaining the dynamics behind the price puzzles. The mean share of the interest payments in total government expenditures over the study period is 11% for Türkiye (CBRT EDDS, 2024). However, the same rate is 4.55% for OECD countries, 5.97% for whole world, 4.60% for Euro area, 8.11% for Western and Central Africa, 7.05% for Sub-Saharan Africa (World Bank, 2024). Due to the relatively high interest payments in Türkiye, expansionary monetary policies help to reduce debt burden of the economy and may activate the fiscal channel.

Price puzzle documented in Turkish data may also be explained by "information asymmetry" between central banks and the public (Hanson, 2004; Taş, 2011). According to the information asymmetry channel, central banks naturally have more information than the public about future prices, and hence they are able to provide a more accurate economic analysis for the relevant fundamentals. When the bank announced to conduct an expansionary monetary policy, economic agents may consider this announcement as a signal of negative future price shocks. The information asymmetry and fiscal channels provide additional contributions on production cost channel when explaining a fall in prices in response to an expansionary policy shock. This also explains why the aggregated demand channel does not dominate the monetary transmission mechanism and domestic prices tend to decline when expansionary monetary policy shock occurs. Finally, our results are in line with empirical literature (see Chowdhury et al., 2006; Bhattacharya and Jain, 2020; Iddrisu and Alagidede, 2020; Hammoudeh et al., 2015 for food prices-monetary policy nexus, and see Bernanke and Blinder, 1992; Eichenbaum, 1992; Barth and Ramey, 2001 for consumer prices-monetary policy nexus).[7]

As seen in Figure 3, negative innovations in the monetary policy lead to a moderate positive impact on output. However, the positive responses of output following an exogenous expansionary monetary policy shock are not statistically different from zero. Our findings on output can be explained by the low level of financial market depth, small size of financial sector, low degree of financial integration, and institutional deficiencies in finance sector including the central banking system (Cecchetti, 1999; Mihov, 2001; Norris and Floerkemeir, 2006; Bhattacharya and Jain, 2020).

[7] See Tümtürk (2020), Civcir and Akçağlayan (2010) for empirical studies documenting price puzzle in general price level in the case of Türkiye.

Long-lasting debates on whether CBRT is independent of elected governments and serious market concerns about the bank's credibility may provide additional support for financial market failures. This result is also consistent with Keynesian view. Accordingly, lower capital cost as a result of an expansionary monetary policy may not ensure economic agents to increase their investment expenditures if increasing political and economic uncertainties feed pessimistic expectations of future state of the economy. Coup attempt in 2016, severely increasing political tension due to transition to the Turkish Presidential system in 2018, 2018 financial crisis, Covid-19 pandemic, 2022 War in Ukraine, 2020 and 2023 earthquakes, military and political conflicts with neighboring countries, frequently held elections and related political and social stress, Syrian civil war, terrorist attacks and etc. explain why Türkiye have suffered from increasing economic and politic uncertainties.

Finally, following an expansionary monetary policy shock, the real exchange rate initially appreciates and reaches its maximum level. The impact thereafter decays, and the real exchange rate returns to its uncovered interest parity level-UIP in five months. The initial appreciation of real exchange rate in response to a negative interest rate shock generates "exchange rate puzzle" which has been another long-documented puzzle in exchange rate literature. Unlike Dornbusch's (1976) well-known overshooting hypothesis, our results are consistent with Sims (1992) and Grilli and Roubini (1995) who concluded that expansionary monetary policy shocks may lead to impact appreciation of exchange rate rather than depreciation.[8,9] Sims (1992) and Barth and Ramey (2001) indicated that production cost channel of monetary policy can explain the presence of exchange rate puzzle: a decrease in cost of capital lowers consumer prices and leads to initial appreciation of home currency. As a result, we can conclude that the documented price puzzle in consumer prices also explains the exchange rate puzzle appeared in our data.

Table 1: Forecast Error Variance Decomposition Analysis

	Forecast Horizon	OUT	FOOD	CPI	REER	IR
FOOD	1	0.003423	0.996577	0	0	0
	4	0.005101	0.647221	0.347612	0.000033	0.000034
	8	0.004841	0.61942	0.375674	0.000033	0.000032
	12	0.004831	0.618393	0.376711	0.000032	0.000033
CPI	1	0.000058	0.1276	0.872342	0	0
	4	0.001327	0.100678	0.897911	0.000045	0.000039
	8	0.001337	0.101931	0.896591	0.000043	0.000039
	12	0.001333	0.102034	0.896556	0.000043	0.000039
OUT	1	1	0	0	0	0
	4	0.842624	0.036615	0.120742	0	0
	8	0.825449	0.037028	0.137501	0. 000011	0. 000011
	12	0.824377	0.037117	0.138515	0. 000011	0. 000011
REER	1	0.03389	0.000247	0.95493	0.006713	0.004213
	4	0.012272	0.045134	0.940759	0.00112	0.000716
	8	0.012746	0.049446	0.935825	0.001083	0.00069
	12	0.012702	0.049931	0.935605	0.001076	0.000686
IR	1	0.266461	0.174273	0.469098	0.090108	0.00006
	4	0.071148	0.160667	0.764837	0.002678	0.000135
	8	0.048004	0.132819	0.817002	0.002065	0.000111
	12	0.045125	0.131251	0.821584	0.001932	0.000108

[8] For a more detailed literature for exchange rate puzzles, see Kim and Roubini (2000), Sarno (2005), Scholl and Uhlig (2008), Engel and Zhu (2019)

[9] See Civcir and Akçağlayan (2010), Tümtürk (2020), Yıldırım (2021) for empirical studies documenting exchange rate puzzle in the case of Türkiye.

The forecast error variance decomposition (FEVD) results in Table 1 report how much of the variability in endogenous variables is attributable to each structural shock in the system over the horizon of 12 months. At different forecast horizons, the most important sources of the variations in domestic prices are CPI and FOOD. Innovations to food prices are the second important source of variation in consumer prices. This result is not surprising since the food prices share a significant portion of the inflation basket. Similarly, innovations to consumer prices are also the second important source of variation in food prices. This implies that agents in the food sector observe consumer prices carefully when making their pricing decisions. More importantly, the monetary policy stance of CBRT is mainly driven by consumer prices and food prices, respectively. This is again not surprising since price stability is the main policy focus of CBRT, which has already conducted inflation targeting regime. Additionally, CBRT closely monitors changes in food prices to achieve its price stability objective. Apart from the price consideration, the third important source of the variation in monetary policy rate is driven by output, which implies that the bank also scrutinizes the real sector. This result may raise suspicions on the bank's policies and operations and question the validity of its independence. Next section contains several robustness checks.

4. Robustness Analyses

4.1. Different Exogenous Variables

This section differs from the baseline specification in respect to selected exogenous variables. We remain the 5-variable endogenous vector and associated identifying assumptions same and introduce additional exogenous factors: world commodity prices (WCOMPI), world energy prices (WEPI) and U.S. industrial production index (USOUT). All three exogenous variables are obtained from FRED.

World Commodity prices: We include world commodity prices into baseline specification mainly for two reasons. First, as the central banks naturally have more resources than markets, they have the ability to collect superior information about future inflation. However, Sims (1992) argued that simple VAR models may fail capturing the signals for future prices. He concluded that including commodity prices in the VAR models may solve price puzzles since commodity prices naturally contain information for future prices. Following Sims (1992), many authors traditionally employed commodity prices in their VAR models as a proxy of future prices (Christiano et al., 1996; Kim, 1999; Barth and Ramey, 2001). Second, we also aim to control the impacts of inflationary supply shocks on endogenous variables.

World Energy Prices: Türkiye has recently had the fastest growing energy demand among the OECD countries, and energy supply is heavily dependent on imports. We control the impact of world energy prices (WEPI) as world energy prices are expected to change production, marketing and distribution costs of food sector, and hence food prices.

World Demand Conditions: A change in world demand conditions is expected to generate domestic food price changes. Therefore, U.S. industrial production index is included to represent world demand changes.

Based on the introduced exogenous variables above, we first form 8-variables VAR models and run alternative Specifications 1, 2, and 3, respectively. Finally, we form another 7-variable VAR model (Specification 4) and report the results for comparison. Our new specifications with different sets of exogenous vectors can be represented as follows:

Specification 1: $Z=(OUT\ \ FOOD\ \ CPI\ WAFC\ \ REER)^T$ $\quad X=(WFOOD\ \ FFR\ \ WCOMPI)^T$

Specification 2: $Z=(OUT\ \ FOOD\ \ CPI\ WAFC\ \ REER)^T$ $\quad X=(WFOOD\ \ FFR\ \ WEPI)^T$

Specification 3: $Z=(OUT\ \ FOOD\ \ CPI\ WAFC\ \ REER)^T$ $\quad X=(WFOOD\ \ FFR\ \ USOUT)^T$

Specification 4: $Z=(OUT\ \ FOOD\ \ CPI\ WAFC\ \ REER)^T$ $\quad X=(WFOOD\ \ WEPI)^T$

Figure 4: Responses of the Endogenous Variables to a Negative Monetary Policy Shock, Different Exogenous Variables

Figure 4 shows the structural impulse-response functions of the endogenous variables in the alternative VAR specifications with respect to an expansionary monetary policy shock. As seen in Figure 4, the alternative and baseline specifications generate very similar SIRF paths. In addition, including the commodity prices in the VAR model does not solve the price puzzles. This result is in line with Hanson (2004), who analyzed the impacts of several inflation forecasting indicators including commodity prices. Hanson (2004) expressed that there is a weak correlation between an ability to forecast prices and an ability to solve the price puzzle.

4.2. The Role of Money

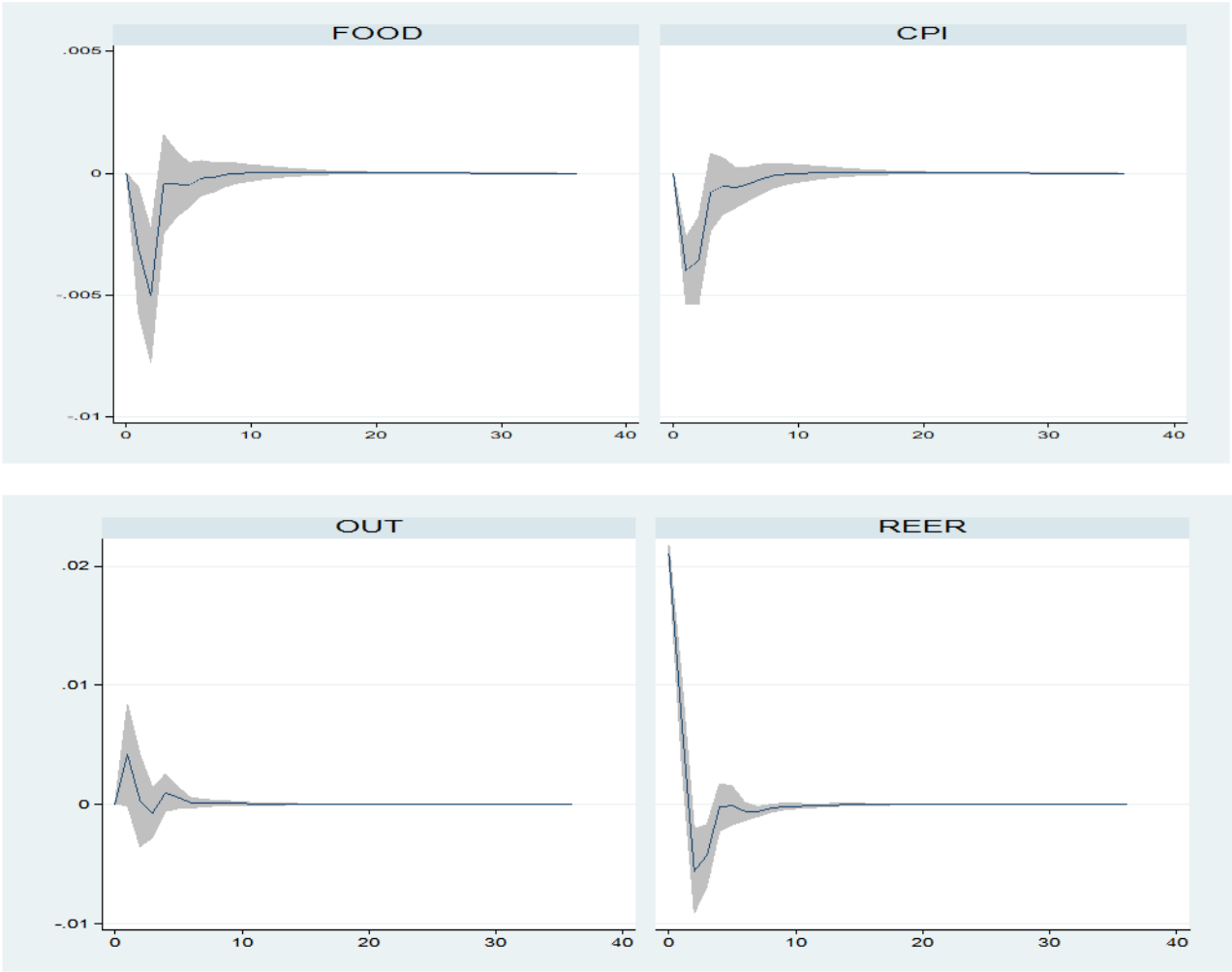
The baseline specification identifies the monetary policy shocks without money. The monetary aggregates have disappeared in most widely used VAR models since the relationship from monetary aggregates to economic activity and prices is mostly considered ambiguous due to unstable and unpredictable velocity of money. On the other hand, there has not been empirically a general consensus on the triviality of money. Many authors have still included monetary aggregates in their models such as Eichenbaum (1992), Christiano et al. (1996), Kim and Roubini (2000), Dedola and Lippi (2005), Hammoudeh et al. (2015). Friedman (1968) and monetarist economists severely recommended to use monetary aggregates as the interest rate changes are believed not to reflect true nature of the conducted monetary policies (contractionary or expansionary). They admitted that an increase in money supply temporarily generates a fall in interest rate. However, when the output level elevates in response to an expansion in the money supply, interest rates move in the opposite direction and increase as a result of expanded demand and prices. Therefore, a fall in interest rate may not necessarily be an indicator of the expansionary monetary policy.

In this section, we introduce M1 monetary aggregate into the baseline specification and analyze the structural impulse-responses of an expansionary shock in monetary policy rate. M1 money data is obtained from EDDS. In the new identification scheme, the money equation is considered as the traditional money demand equation and responds contemporaneously to exogenous shocks in monetary policy rate, domestic food and consumer prices, and output. The new identification scheme with money can be represented as follows:

$$\begin{pmatrix} u_{OUT_t} \\ u_{FOOD_t} \\ u_{CPI_t} \\ u_{WAFC_t} \\ u_{M_t} \\ u_{REER_t} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ G_{21} & 1 & 0 & 0 & 0 & 0 \\ G_{31} & G_{32} & 1 & 0 & 0 & 0 \\ 0 & G_{42} & G_{43} & 1 & G_{45} & G_{46} \\ G_{51} & G_{52} & G_{53} & G_{54} & 1 & 0 \\ G_{61} & G_{62} & G_{63} & G_{64} & G_{65} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_{OUT_t} \\ \varepsilon_{FOOD_t} \\ \varepsilon_{CPI_t} \\ \varepsilon_{WAFC} \\ \varepsilon_{M_t} \\ \varepsilon_{REER_t} \end{pmatrix} \quad (5)$$

Figure 5 shows the structural impulse-response functions of the endogenous variables under the presence of money in response to a negative policy shock while the grey area around the SIRF paths are 90% confidence interval bands. As seen in Figure 5, the inclusion of money is trivial as the impulse-response functions of endogenous variables with and without money exhibit similar statistical and economic inferences.

Figure 5: Responses of the Endogenous Variables to a Negative Monetary Policy Shock, Existence of Money

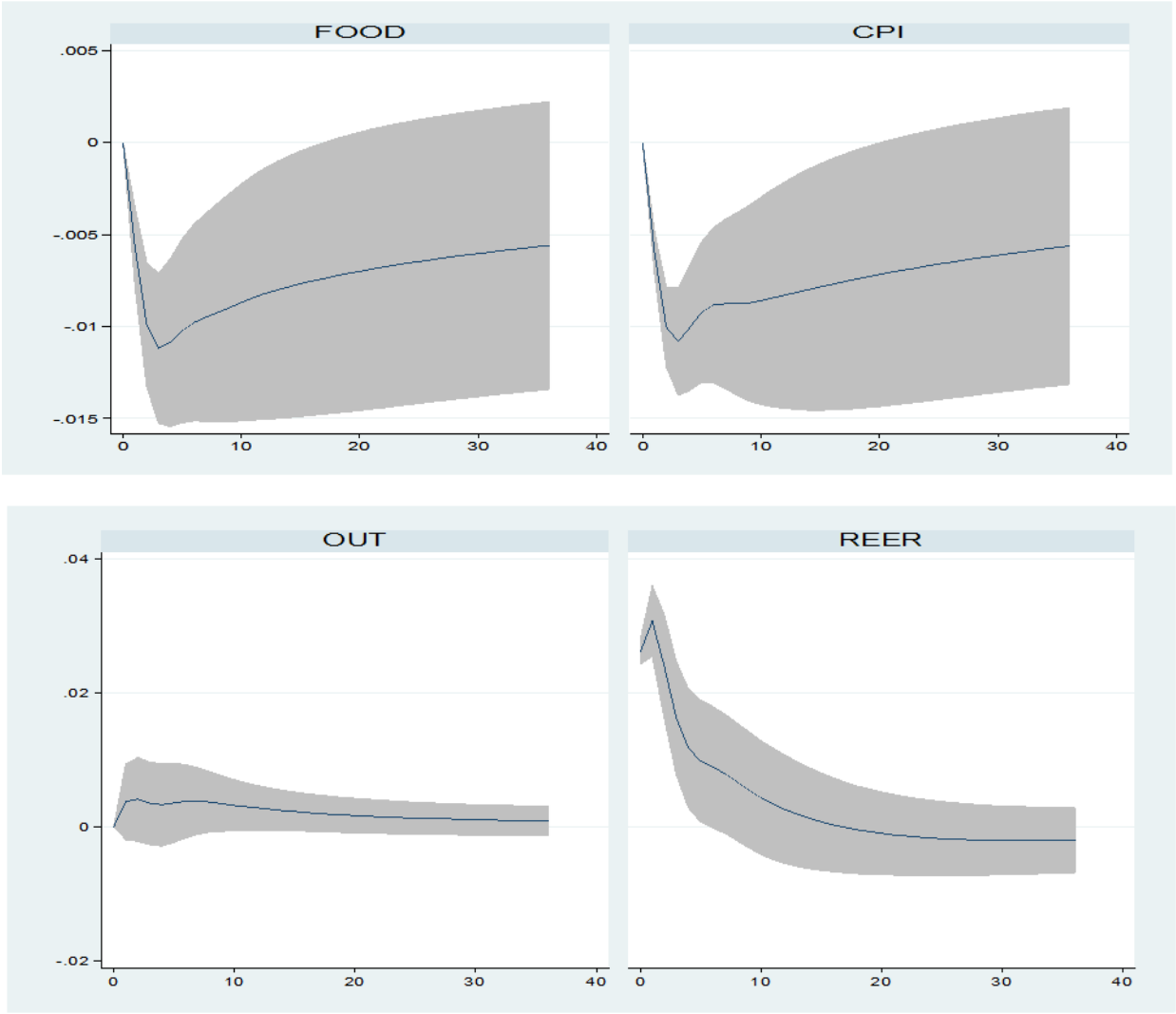


4.3. Estimating the VAR Model in Levels

Our baseline specification is estimated with first-differenced stationary data. In this section, we follow Christiano et al. (2005), Kim and Roubini (2000), Mojon and Peersman (2001), Scholl and

Uhlig (2008), Sousa (2010), Cover and Mallick (2012), Hammoudeh et al. (2015), and estimated the baseline specification with the variables in their levels. Figure 6 reports the impulse-response functions of the endogenous variables in levels in response to an expansionary monetary policy shock. The grey areas around the SIRFs are their 90% confidence intervals. Even though the impulse-responses require substantially more time to disappear than in the baseline specification, our statistical and economical inferences remained same.

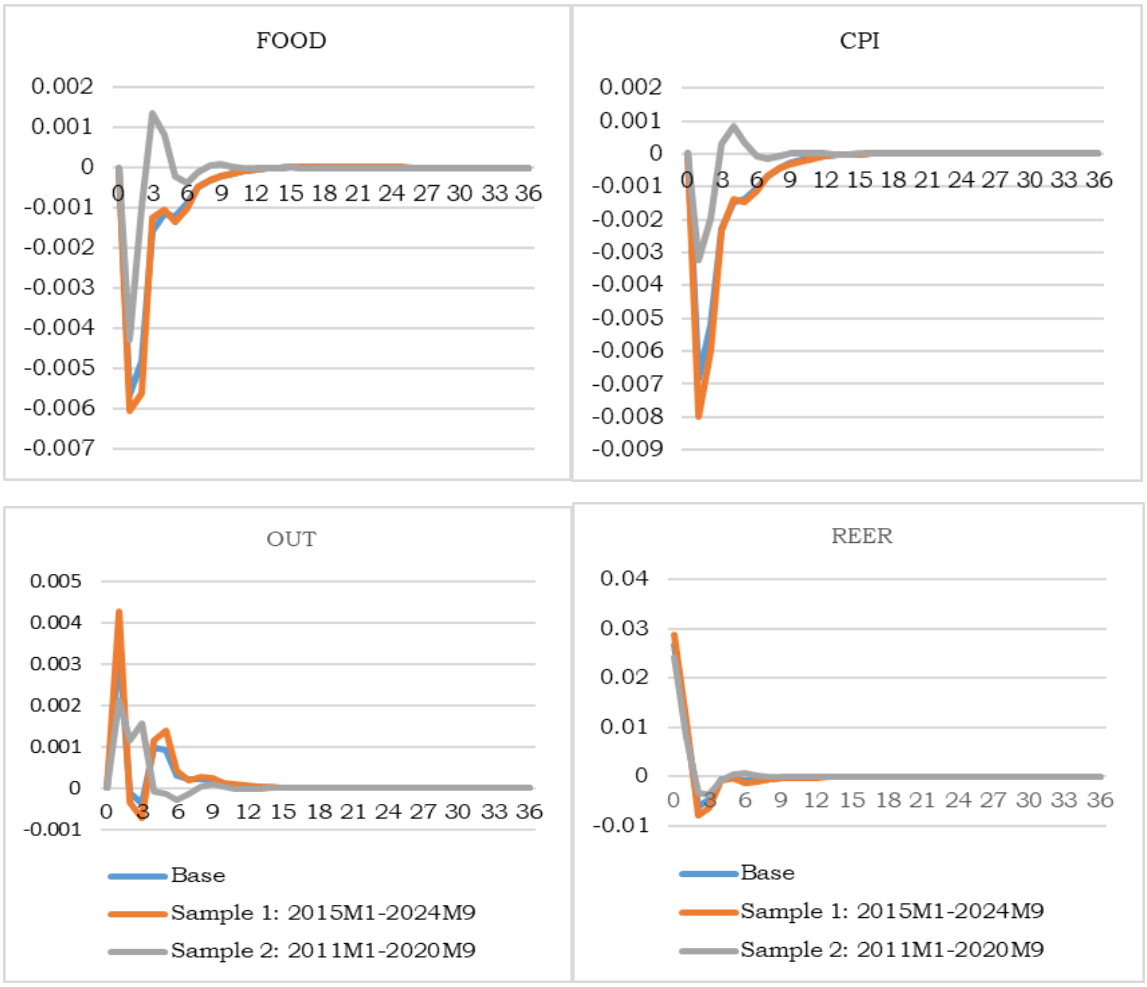
Figure 6: Responses of the Endogenous Variables to a Negative Monetary Policy Shock, Variables in Their Levels



4.4. Impulse-Responses Across Different Subsamples

This section controls the baseline results with respect to the use of alternative subsamples. We reduce the number of sample points by four years and generate additional two subsamples. First, we moved the starting point of the original data set four years ahead and reproduced impulse-responses over the subperiod of 2015:M1-2024:M9. Second, we also removed the last four years in the original data set, and generated impulse-responses for another subperiod, 2011:M1-2020:M9. The structural impulse-response functions of the endogenous variables across different sample periods are shown in Figure 7. Statistical and economical inferences obtained from both subsamples are in line with the baseline specification.

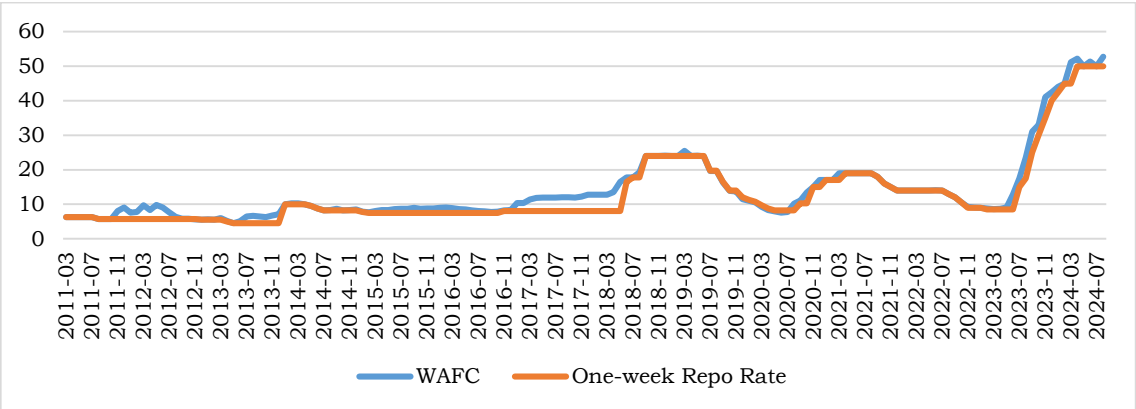
Figure 7: Responses of the Endogenous Variables to a Negative Monetary Policy Shock, Different Subsamples



4.5. Monetary Policy Indicator: WAFC or Repo Rate?

This section employs one-week repo rate and controls the results obtained by WAFC rate which represents the monetary policy changes in the baseline specification. Figure 8 plots how WAFC and one-week repo rates have evolved over time. As the single policy rate has reflected the bank's monetary policy stance since 2018M6, they have naturally shared the same time path afterwards. However, both indicators started to differ before 2018M6. Now, we perform robustness check with respect to use of different measurement of monetary policy, one-week repo rate.

Figure 8: The WAFC and One-week Repo Rate, Monthly



Source: Electronic Data Delivery System of CBRT

Figure 9: Responses of the Endogenous Variables to a Negative Monetary Policy Shock, Different Policy Indicators

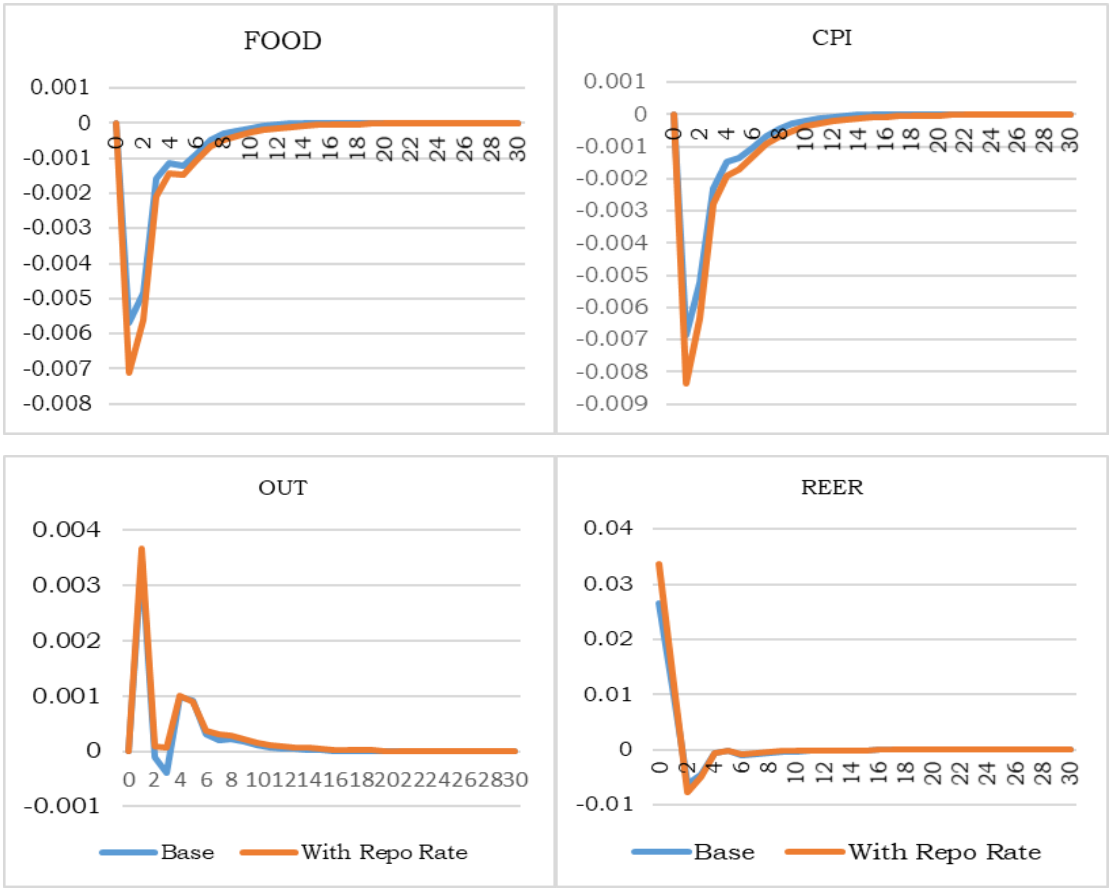


Figure 9 shows the structural impulse-response functions of the endogenous variables in response to a one week-repo rate and a WAFC shock. As shown in Figure 9, the impulse-response functions with respect to negative repo rate shock are quite similar to what was found in the baseline model with WAFC rate. Therefore, our results are robust to use of one-week repo rate.

4.6. Additional Robustness Checks

This section introduces additional robustness checks. First, we impose zero restrictions on domestic prices based on informational delays and set G42=G43=0 in Equation (4). Even though the MPC announced to meet on a pre-announced monthly basis, the past schedule of MPC meetings reveals that there are some exceptions (CBRT, 2024). As the committee did not meet at each month in 2019, 2018, and 2017, zero restrictions on food and consumer prices may be reasonable. With this set-up, it is assumed that monetary policy is also not adjusted by current value of prices. Second, we replace the real exchange rate variable in the baseline model and employ nominal effective exchange rate (NEER). NEER data is obtained from FRED and calculated as geometric weighted means of bilateral exchange rates. A decrease in NEER represents the depreciation of the home currency. Finally, we slightly changed the order of the price variables in the baseline specification without any change in identifying assumptions. Accordingly, FOOD variable is placed below CPI and rearrange the order by following endogenous vector, Z=(OUT CPI FOOD WAFC REER). The results remained the same.[10]

[10] The related structural impulse-responses are not reported for space consideration. However, they are available upon request.

5. Discussion of Results

Food prices are one of the main factors of consumer price increases in low or middle-income countries where food prices traditionally share a significant portion of the inflation basket. In theoretical literature, the stabilizing role of monetary policy on food prices is generally accepted through the demand channel of the monetary transmission mechanism. When a positive price shock occurs (contractionary monetary policy), monetary authorities increase the interest rate to activate demand channel and aim to offset price increases. On the other hand, price puzzle emerges if a contractionary monetary policy is associated with an increase in food prices. This indicates that the negative impacts of the contractionary monetary policy on food prices through the demand channel do not dominate the monetary transmission mechanism.

Our result that monetary policy destabilizes food prices is in line with Hammoudeh et al. (2015), Bhattacharya and Jain (2020), Iddrisu and Alagidede (2020). However, these studies conclude that a contractionary policy may turn out to be destabilizing for the food prices. Our result, on the other hand, is symmetrical counterparts of a contractionary monetary policy. We empirically showed that the documented price puzzle in Turkish data in response to an expansionary policy shock contributes to stabilizing food prices. That is, the stabilizing role of monetary policy on food prices requires a fall in interest rate rather than an increase. Accordingly, a decrease in interest rate stabilizes the food prices as the monetary policy transmission mechanism that delivers a positive relationship between the monetary policy and food prices through the cost channel outweighs the negative relationship through the demand channel. The information asymmetry and fiscal channels also provide additional support to the production cost channel of monetary transmission mechanism and strengthen the stabilizing role of the expansionary policies on food prices. This result also presents a policy puzzle in respect of inflation targeting. Türkiye has experienced severe food and consumer inflation hikes in the 2020s (see Figure 2). As seen in Figure 8, the bank has rapidly increased the policy rate from 8.5% to 50% in 2024 to activate demand channel and stabilize prices. However, this policy is not expected to stabilize food prices mainly for two reasons. First, the demand channel of monetary policy transmission mechanism is not as effective as the bank considers. Second, as suggested by our results, a fall in food prices requires an expansionary monetary policy. Consequently, this paper proposes a rather unconventional monetary policy practice which benefits from the positive relationship between an expansionary monetary policy and domestic prices in fighting against food and consumer price rises.

According to TSI survey results in 2023 which refer the 2022 income reference year, the share of the 20% of the population with the highest income takes 49% of the total income, while the remaining 80% of the population receives 51% of the total income. Gini coefficient was estimated 0.488 when excluding all social transfers (TSI, 2024). Finally, TSI poverty and living condition statistics referring to the year 2022 report that the poverty rate according to the poverty threshold set at 60% median equivalised household disposable income was 21.3% (TSI, 2024). Given income inequality levels in Türkiye, the recent jump in the monetary policy rate toward 50% has unfortunately presented challenging real income dynamics on middle and low-income groups which constitute a significant part of the population. As these groups must allocate a large proportion of their budgets to finance their food consumption, a restriction in monetary policies poses a severe livelihood concern that emanates from increasing food prices. Finally, a fall in the savings of a large group of the population due to increasing share of food consumption will reduce domestic savings, which in turn leads to a deterioration of foreign trade balance.

Before closing this section, the relative weakness of the aggregated demand channel needs to be clarified. This can be explained by the inadequate price stability performance of the bank and confusion in the financial markets generated by the bank policies and operations. For instance, the CBRT Law introduced in April 2001 (Article 4) states that the primary objective of CBRT is to achieve and maintain price stability. However, the Turkish government introduced “Chinese Growth Model”

as a new economic plan in December 2021. As seen in Figure 8, CBRT, which previously conducted contractionary monetary policies, loosened its monetary policy stance to decrease the value of the home currency and stimulate exports in tandem with the new plan. This monetary policy practice raised concerns in financial markets about what the bank's main objective is and whether CBRT is independent of elected governments. That the FEVD analysis results revealing that the bank also monitors real sector presents empirical evidence in favor of the market concerns. In addition, recent debates related to bank's credibility, CBRT policy realizations and consistently missed target inflation rates, frequent changes of the bank governors (eight change over the period of 2011-2024), etc. may have generated a confusion in the market about the main role of the bank. Consequently, all of these reasons may explain why economic agents in Türkiye make their expenditure decisions independently of CBRT policy changes, and why the demand channel of the monetary transmission mechanism has been disrupted.

6. Conclusion

This study explores the impacts of the monetary policy changes on food prices in Türkiye. We follow structural identification scheme and impose non-recursive identification assumptions based on the current economic theory. We empirically showed that expansionary monetary policy is associated with a fall in food prices. As food prices move in the same direction with the decreasing interest rate, an expansionary monetary policy shock generates price puzzle and stabilizes food prices. Our results can be summarized as follows:

i. Following an expansionary monetary policy shock, the monetary transmission mechanism that delivers a fall in food prices outweighs the aggregated demand channel that delivers a rise in food prices. This result can be explained by relative strength of production cost channel of monetary transmission mechanism. Additionally, the fiscal and information asymmetry channels also strengthen the stabilizing role of the expansionary policies on food prices. In addition, the recently conducted contractionary monetary policy cannot help to stabilize food prices since demand channel does not dominate the monetary transmission mechanism in Türkiye. On the contrary, these policies are expected to destabilize current and future food prices. Given income inequality levels in Türkiye, the recent jump in the monetary policy rate toward 50% is unfortunately expected to present challenging real income dynamics on middle and low-income groups and raises livelihood concerns that arise from increasing food prices.

ii. At different forecast horizons, innovations to food prices are the second important source of variation in consumer prices. The significant role of food prices on overall inflation requires CBRT to scrutinize the food prices dynamics. That the monetary policy stance of CBRT is mainly driven by consumer and food prices, respectively suggests that CBRT monitors the change in food prices to achieve its price stability objective.

iii. Similar to food prices consideration, a decrease in monetary policy rate reveals a fall in consumer prices. That is, an expansionary monetary policy also generates price puzzle in overall economy. Accordingly, when a negative monetary policy shock occurs, the monetary transmission mechanism that delivers a fall in consumer prices outweighs the aggregate demand channel that delivers a rise in consumer prices. This result is interesting since the price stability objective of CBRT requires insufficient price impacts arising from the demand channel. In addition, the relative weakness of the demand channel allows us to recommend unconventional expansionary monetary policy practice in fighting against food and consumer inflation. Finally, as the major source of variation in monetary policy rate is explained by domestic prices, price stability emerges as the main policy focus of CBRT, which is in line with the inflation targeting monetary policy.

iv. The expansionary monetary policy shock exhibits moderate output increases. However, the positive output responses are not statistically different from zero. Our empirical findings on output in response the monetary policy changes can be explained by financial market deficiencies including

the central banking system in Türkiye. In addition, increasing uncertainties over the study period may also explain why lower production cost does not necessarily drive output significantly.

v. Unlike Dornbusch's (1976) overshooting hypothesis, the expansionary monetary policy shocks generate initial appreciation in home currency before depreciating back to its UIP level. This suggests another long-lasting puzzle in exchange rate literature. The presence of price puzzle on consumption goods may also explain the puzzling exchange rate results in our data. Accordingly, the expansionary monetary policy shock that leads to decreases in overall prices may explain the initial appreciation of home currency.

vi. We performed several robustness checks and confirmed that our results are robust.

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