Drivers of Food Prices: New Evidence from Turkey

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Abstract

This study intends to determine the drivers of high food prices in Turkey by employing the Structural Vector Auto Regression (SVAR) model for the January 2011 and March 2021 periods. The study has used external and domestic factors such as oil prices, world food prices, interest rate, exchange rate, money supply growth rate, producer price in agricultural goods. The findings indicate that all determinants show a significant positive contribution to the explanation of food prices except oil prices. The most substantial explanatory factor of food price is the price inertia shock in food prices. Domestic factors such as producer prices, interest rate, money supply, and exchange rate have also contributed to high food prices, while oil prices and world food prices have not played any substantial role. The results are robust compared to a different SVAR model identified by Cholesky decomposition. It is inferred that both exchange rate and monetary expansion have been quite effective in variations of food price in recent years. Overall, the findings indicate that controlling the food price movements is critical to ensuring overall price stability in the Turkish economy.

Keywords

Food prices, monetary policy, Turkey, SVAR

JEL code

C32, E52, Q18

INTRODUCTION

In recent years, the increase in food prices has become one of the key problems of many developing countries like Turkey. This upswing exerts pressure over any country's social and economic conditions since food is an important part of mandatory consumption of households, especially on the impoverished ones who spend significant money on food (Abdullahi, 2015; Eştürk and Albayrak, 2018). On the other hand, since food prices widely determine headline inflation, the rapid increases and volatility in food prices hamper inflation targeting, which most central banks officially announced (Chadwick and Bastan, 2017; Iddrisu and Alagidede, 2021). Increases in food prices in many developing countries distort inflation forecasting, which may have a detrimental impact on inflationary perceptions and public morale (i.e., the Central Bank's credibility), all of which are critical for the effectiveness of inflation targeting. When food prices rise due to exogenous shocks, overall inflation eventually follows, and citizens' quality of life suffers (Bhattacharya and Gupta, 2018; Wu and Wu, 2021).

Food price increases might affect headline inflation in direct and indirect ways (Rangasamy, 2011). The weight of food in the consumer basket determines the direct effect of rising food prices on overall inflation. When the food price rises are higher than those of the other items in the basket, food inflation contributes more to the overall inflation than the food weight in the consumer basket. This is more

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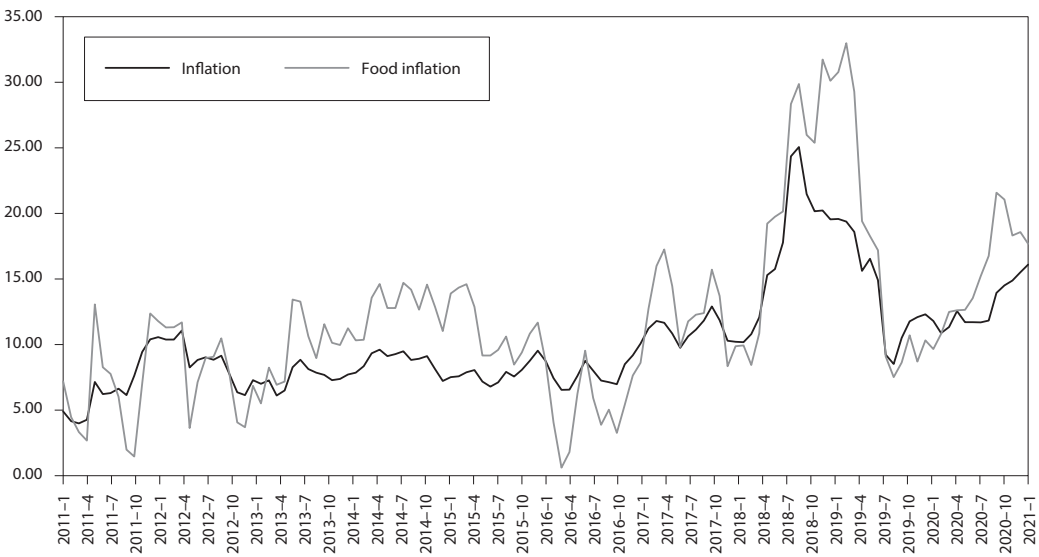
appropriate for low-income and developing countries that usually have a higher weight in their Consumer Price Index (CPI) for food products (Iddrisu and Alagidede, 2021). The effect of food prices on headline inflation may also be "indirect" to influence inflationary expectations, incomes, and prices in the CPI. Indirect effects are generally called 'second round' inflation effects in empirical research (Rangasamy, 2011).

Food consumption constitutes a significant share of household spending in low-income and developing economies. Hence, changes in food prices lead to significant fluctuations in these leading inflation-targeting countries. As a major developing economy, the share of food consumption in Turkey has a significant impact on household spending. According to the Household Budget Survey of 2019, it is reported that the proportion of the household's total expenditures on food and non-alcoholic beverages increased from 20.3% in 2018 to 20.8% in 2019, which is the highest share in recent ten years. It is also revealed that the weight in the food and non-alcoholic beverages reached 25.94% in the CPI basket in 2021, which is the highest weight after 26.22% in 2012.

Turkey has faced a long time of high inflation, primarily determined by continuing high food inflation during the past decade. Figure 1 shows the tendency in food inflation[2] and overall inflation in Turkey over the 2011–2021 period. Two features worth mentioning are shown in Figure 1. Firstly, the food inflation was mostly higher than the CPI inflation over the 2011–2021 period. The average inflation is 10.36%, while the food prices inflation average is 12.08% over the 2011–2021 period. Therefore, annual food price inflation is approximately four percentage points above inflation both in 2014 and 2019. Second, there exists a strong correlation between food prices and headline inflation. Though correlation does not involve causality, the view that food inflation can be a significant cause of inflationary pressures in Turkey appears to be an intuitive support. Increases in food prices put pressure on inflation and make it impossible to achieve inflation targets, set as 5% per year since 2012. Ganioglu (2017) reveals that the main reason for the deviation in headline inflation from core inflation was the increasing food prices in Turkey. Accordingly, higher food prices also make it difficult to anchor consumer inflation expectations.

Figure 1 Food and overall inflation in Turkey

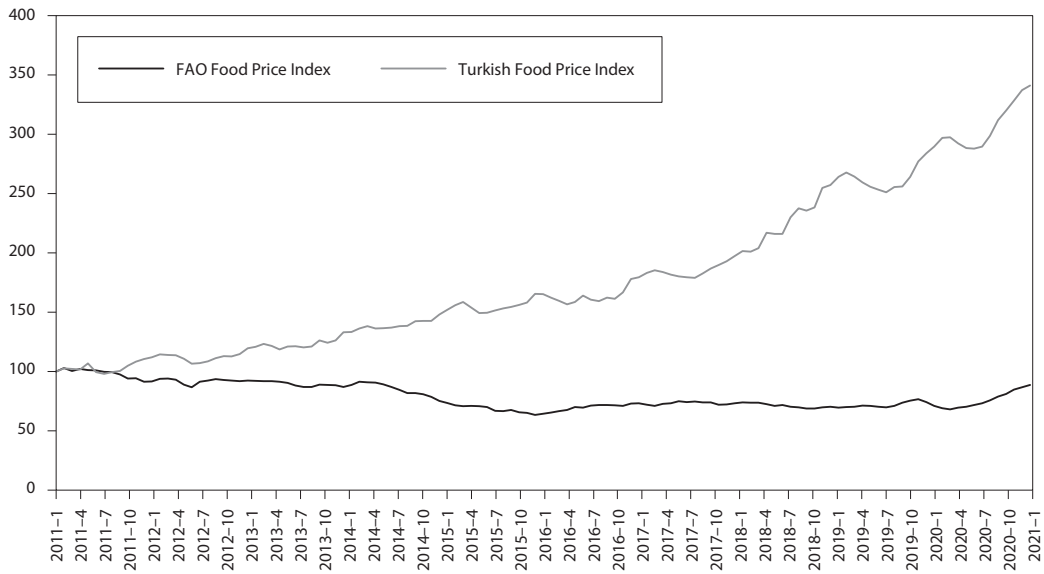


Source: Author's compilation

[2] Food inflation displays the boost in the food part of the Consumer Price Index.

As well as the difference between the food price inflation and CPI inflation, the food price index in Turkey and the world food price index have been seen to diverge further. Figure 2 shows that a co-movement existed between the world food prices and food prices in Turkey until 2012. Since then, there has been a divergence between these two price indexes. However, while world food prices decreased after 2012, food prices in Turkey continued to increase and became one of the main determinants of inflation. Akçelik and Yücel (2016) indicate that food prices in Turkey in the period after 2010 are higher than those of other developing countries in terms of both levels of food price and level of food price volatility. Işık and Özbuğday (2021) report that the food price inflation was 18% and 19.5% in Turkey while these were 1.9% and 2% in the European Union countries in 2018 and 2019.

Figure 2 Turkey Food Price Index and World Food Price Index



Source: Author's compilation

Accordingly, it is vital and useful for policymakers and households to spend a considerable amount of money on food in their budget to consider the external and domestic driving factors in explaining the food price increase. In this respect, analyzing the factors that cause huge food price increases could ensure a fruitful understanding of food price inflation and developing food policies. Nonetheless, studies on the driving factors of food price increases in Turkey are still scarce. Hence, this study investigates the external and domestic variables that reveal the increases in food prices in Turkey. The variables that are fundamental for food price inflation are the oil price, the world food prices, monetary factors, the exchange rate, production prices in the agricultural sector.

This study examines the following questions: (1) which type of external and domestic shocks give a superior interpretation of food price inflation? (2) what are the other factors that specify food inflation in Turkey in addition to those factors? (3) to what extent does the expansionary monetary policy, which is implemented after 2015, impact food prices? (4) which types of policies can be proposed? So, this study provides answers to these questions using a Structural Vector Autoregression (SVAR) model, allowing for the dynamic interlinkages among these variables. This study adds to the existing literature by empirically

examined role of external and domestic factors in explaining food prices by utilizing monthly data from January 2011 to March 2021.

The rest part of the study is formulated as follows. Section 1 shortly reports the empirical studies that explain the important factors driving the food price inflation in different countries. Section 2 introduces the empirical methodology to gauge the contribution of several factors to food prices and the data used. Results of the estimation are reported in Section 3. Last section provides a summary of the findings and conclusion of the study.

1 LITERATURE REVIEW

Considerable studies have investigated the factors influencing food prices in different economies, especially with recent sharp upswings in food prices globally. Since the proportion of food in the consumption spending is higher in developing countries, the number of studies for these countries in the literature is relatively big. In one of the previous studies from African countries, Kargbo (2000) examines the role of monetary and macroeconomic aspects in explaining significant increases in food prices in Eastern and Southern Africa countries such as Ethiopia, Tanzania, Sudan, Malawi, Kenya, South Africa, Zambia by using cointegration method over the 1960–1996 period. The findings indicate that food production, income, trade policy restrictions, real exchange rate, and monetary policies are mainly responsible for driving food prices. A similar study by Kargbo (2005) employed the VECM model to examine the monetary and macroeconomic factors' impact on food prices in some West African countries such as Senegal, Ghana, Nigeria, Cote d'Ivoire. The study indicates that trade policy, real exchange rates, and monetary policy innovations substantially affect food prices.

Recently, a couple of studies that examine the relationship between monetary policy, interest rates, exchange rate, and food prices have increased by considering both advanced and developing countries' experience. However, in the existing studies based on the literature in both countries, diverse findings are obtained with different techniques utilized by the researchers. Akram (2009) indicates that shocks to interest rate and real exchange rate positively affect explaining substantial shares of fluctuations in commodity prices by employing the Structural VAR approach for the US. In a similar vein, Hammoudeh et al. (2015) examine the role of interest rate shock on commodity prices in the United States by employing the SVAR model. The study shows that a positive interest rate innovation causes a positive and insistent increase in the variation of food prices. In contrasting evidence, Abdullah and Kalim (2012) reveal that monetary shock does not contribute to food prices in Pakistan, while supply-side factors have a dominant role in explaining the food prices. Ahsan et al. (2012) examine the macroeconomic determinants that trigger the food prices in Pakistan by using the ARDL cointegration method. Their finding points to the importance of the money supply in explaining food inflation in both the long and short term. The study also indicates that agricultural subsidies have a slight impact on reducing food prices. In another study, Awan and Imran (2015) investigate the cost-push and demand-pull factors that affect food inflation in Pakistan. Their result shows that per capita GDP, fertilizer prices, money supply, fuel prices, and foreign aid have a positive impact on food prices, while the exchange rate is negatively associated with food prices. Concerning studies in Nigeria, Abdullahi (2015) examines the driving factors in food price inflation in Nigeria by employing the cointegration test and the VECM model. The study finds that GDP and energy price plays a significant role in food price inflation, whereas money supply and exchange rate lower food price in the long-term period. In a related study, Egwuma et al. (2017) investigate the link between food inflation and different macroeconomic indicators such as output, food import, and crude oil price for Nigeria by using the cointegration method and realize that all these factors are positively related to food price inflation. Recently, Bhattacharya and Jain (2020) investigated whether monetary policy is an effective policy tool to control the food price inflation in developed and developing economies for the 2006–2016 period. They found that monetary policy shocks created a positive and important

impact on food prices in both countries. Iddrisu and Alagidede (2020) examine the drivers of food prices in South Africa by applying a quantile regression approach. The study shows that monetary policy has a positive and substantial effect on food prices. In addition, they reveal that exchange rate fluctuations, transport cost, and world food prices are significant determinants of food prices in South Africa, while GDP does not have a significant effect. Iddrisu and Alagidede (2021) investigate the nexus between monetary policy and food price using the quantile regression approach in Ghana, where the proportion of food consumption is 43.9% in the CPI basket. The study shows that a contractionary monetary policy to control the increase in general inflation destabilizes food prices. They also demonstrate that output and transportation cost contributed significantly to the explanation of food inflation while fluctuations in world food prices and exchange rate do not play an important role. Fasanya and Olawepo (2018) show the effect of lending rate, oil price, and exchange rate shocks on Nigeria's variation of food prices by using multivariate GARCH models.

Previous studies investigating international oil and world food prices impact on domestic food prices have been somehow mixed in different countries. Holtemöller and Mallick (2016) reveal that inflationary supply shocks arising from global food prices play a substantial role in food prices in India. Norazman et al. (2018) reveal that real effective exchange rate and world food commodity prices are the most important factors that clarify the food price fluctuations in Malaysia. On the other hand, Baltzer (2013) indicates that international prices do not play a significant role in domestic food price fluctuations in China and India. Similarly, Bhattacharya and Gupta (2018) study the explaining factors of rising food prices in India in the recent decade by considering SVAR and SVECM approaches. The study reveals that agricultural wage inflation is largely responsible for the rapid food price increase. However, international prices play a limited role in food price inflation even if they have a significant pass-through impact on, especially tradable goods. El-Karimi and El-Ghini (2020) study the pass-through of world commodity prices to food prices in Morocco across different commodities by employing the SVAR method. The study reveals that world food prices' effect on domestic food inflation is positive, and there is a powerful imported component in the food consumption basket.

There are also studies in which variables related to the agricultural sector, especially agricultural production, are used. Rangasamy (2011) explores the determinants of food price fluctuations in South Africa using the VAR model. The study reveals the dominating role of domestic factors such as nominal exchange rate, household expenditures on food, and food production price in explaining food price inflation. Irz et al. (2013) investigate both short and long-term food price dynamics by estimating a vector error-correction (VEC) model in a cointegration framework for Finland. Their findings point out that agricultural commodities, labor, and energy substantially affect the food price inflation. Joiya and Shahzad (2013) investigate the driving factors of food price increases in Pakistan by employing the ARDL model. The study reveals that GDP and food export play a positive role in food prices while food imports and credit to the agriculture sector reduce food prices. Their finding also highlights agricultural loans as an effective tool to control the increase in food prices. Ismaya and Anugrah (2018) examine the driving factor of food inflation in Indonesia by applying GMM estimation. The study points out that agriculture sector output, food import, food production, infrastructure, demand level, agriculture sector credit play an important role in explaining food prices. In one of the most recent studies that examine the determinants of food price, Wu and Xu (2021) investigate the impacts of shocks in agricultural output, production material price, and production price on food price for 26 provinces in China by applying a heterogeneous panel structural vector autoregressive (SVAR) approach. According to the findings of the study, price inertia shock (food price shock) is the main responsible for the driving force of food price.

Bayramoğlu and Yurtkur (2015) investigate the determinants of food prices in Turkey by employing the VAR model over the 1999–2014 period. Their findings indicate that the US dollar and Euro exchange rates play an important role in determining short-term innovations in food prices. The study reveals that

there has been limited contribution of oil prices, agricultural producer prices, and world food prices to the variation of food prices. Altıntaş (2016) examines the impact of oil prices on food prices by employing an asymmetric framework over the 2000–2013 period. The study indicates that a rise of 1% in oil prices brings about 0.47% increases in food prices, whereas a 1% decline in oil prices leads to a 0.19% lessen in food prices. It is inferred that the positive oil price shock has a more significant effect on food prices than negative oil price innovations in Turkey. Işık and Özbuğday (2021) utilize the cointegration approach to consider the role of agricultural input prices in explaining the recent rapid increases in food prices in Turkey and confirm the existence of positive contribution of agricultural input prices on food prices. Ertugrul and Seven (2021) explore the differences between world food prices and Turkish food prices. Their findings indicate that the exchange rate plays an important role in the increasing differences between both, whereas oil prices contribute to lessening those differentiations.

2 METHODOLOGY AND DATA

This section introduces the methodology, identification framework, variables in the model, and the data. The SVAR model allows one to investigate the response of food prices to unanticipated shocks by considering the dynamic relationship between food prices and macroeconomic variables.

2.1 The SVAR methodology

The SVAR model gives a facility to identify restrictions in harmony with economic reasoning and preceding expertise. The structural identification of a VAR model is given as the following:

$$Ay_t = C(L)y_t + Bu_t, \tag{1}$$

where A is the matrix of contemporaneous interactions between variables, y_t is an (n × 1) vector of the endogenous macroeconomic variables, C(L) is an (n × n) matrix of lag operator L, representing impulse-response functions of the shocks to the elements of y_t, B is an (n × n) matrix which captures the linear relations between structural shocks and those in the reduced form; finally, u_t presents an (n × 1) vector of structural shocks which are uncorrelated and identically distributed in a normal manner.

Unfortunately, Formula (1) cannot be estimated directly because of identification problems; the reduced form is determined by multiplying Formula (1) by an inverse matrix A^{-1} to estimate the SVAR model:

$$y_t = D(L)y_t + u_t, \tag{2}$$

where $(L) = A^{-1}\, C(L)y_t$, $u_t = A^{-1}\, Bu_t$. u_t is an $(nx1)$ vector of shocks in a reduced form that are uncorrelated and normally distributed yet contemporaneously correlated with each other. The relation between structural shocks and reduced-form shocks is the following:

$$Au_t = B\varepsilon_t. \tag{3}$$

Formula (3) is also known as the short run AB model. To obtain the SVAR parameters in Formula (1), one can easily impose a constraint on matrix A and B. To identify structural parameters given a $(kx1)$ dimensional VAR, one would require general $k^2 + \frac{k(k-1)}{2}$ restrictions in the short run AB model on the SVAR (see Amisano and Giannini, 2012). The identifying restrictions are assumed on the structural parameters as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & 0 & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} u^{oil} \\ u^{wfp} \\ u^{interest} \\ u^{money} \\ u^{exch} \\ u^{ppi} \\ u^{fprice} \end{bmatrix} = \begin{bmatrix} \beta_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \beta_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{77} \end{bmatrix} \begin{bmatrix} \varepsilon^{oil} \\ \varepsilon^{wfp} \\ \varepsilon^{interest} \\ \varepsilon^{money} \\ \varepsilon^{exch} \\ \varepsilon^{ppi} \\ \varepsilon^{fprice} \end{bmatrix},$$

where a_{ij}s are the coefficients to be estimated. u^{oil}, u^{wfp}, $u^{interest}$, u^{money}, u^{exch}, u^{ppi}, u^{fprice} are structural shocks, while ε^{oil}, ε^{wfp}, $\varepsilon^{interest}$, ε^{money}, ε^{exch}, ε^{ppi}, ε^{fprice} are the reduced form residuals.

In monetary policy literature, the oil price is a widely used indicator and represents the inflationary and negative supply shock (Kim and Roubini, 2000). According to the structural identification above, since the oil price (*oil*) is considered as the external factor for Turkey, it does not react simultaneously to shocks caused by other endogenous model variables. World food price (*wfp*) does not react simultaneously to macroeconomic factors in Turkey, while it is contemporaneously impressed by the oil price shock. The interest rate (*interest*) is a factor that affects food price (*fprice*) but is not simultaneously influenced by other variables' shocks. It starts to react only one period after a financial or exchange rate shock. The money supply (*money*) only responds contemporaneously to interest rate shock but is not contemporaneously influenced by other variables' shocks. The exchange rate (*exch*) is contemporaneously affected by oil price, interest rate, and money supply. The producer price in agriculture (*ppi*) is affected contemporaneously by all other variables' shocks. Finally, the food price is permitted to respond simultaneously to all other variables.

2.2 Data

This study uses monthly frequency data ranging from January 2011 to March 2021 to examine the effect of driving factors on food prices in a SVAR approach. The variables selected for investigating the food price dynamics are consistent with the current literature:[3] oil prices, world food prices, interest rate, money supply growth rate, exchange rate, producer prices of agriculture products, and food price. Since Turkey is situated between Europe and Asia, it mainly relies on countries closer to Europe to maintain its economic ties. For the purpose of this study the oil price for Brent (Europe) is chosen based on US dollars per gallon. The world food price variable reflects the international pressure on food prices. A new monetary policy framework in CBRT has been created to monitor financial stability as well as price stability since the end of 2010. Within this framework, the CBRT has started to use more than one interest rate as a policy tool, such as the BIST overnight repo rate, policy rate, and overnight borrowing/lending rate. Since the new monetary policy framework consists of a combination of various policy instruments, the Weighted Average Funding Cost (WAFC) data is chosen as the interest rate variable in the study to reflects the new monetary policy stance. However, recent studies use the WAFC as an interest rate variable in the Turkish economy (Bastav, 2020; Tümtürk, 2020). Monetary policy is represented by the WAFC and measured in percentage. The WAFC is the official monetary policy tool in Turkey after 2011. The growth rate of M2 is utilized to reflect the level of economic activity and aggregate demand (Kargbo, 2005). Since the Turkish economy trades with many different countries, mainly European Union countries, it is used the mixed basket of US dollar and Euro currency. A basket of 0.5 USD + 0.5 EUR representing the nominal exchange rate is used as the nominal exchange rate. The CPI for food represents the food price inflation in Turkey, as in several studies (Irz et al., 2013; Abdullahi, 2015; Bhattacharya and Jain, 2020). The producer price index of agricultural products reflects the cost effect on overall

[3] See the studies of Rangasamy (2011), Bhattacharya and Jain (2020), Iddrisu and Alagidede (2021).

inflation and food prices. Table 1 presents the definition of variables and data sources. All variables are converted into logarithm form and are seasonally adjusted except the interest rate.

Table 1 Definition of variables

Variable	Definition	Source
oil	Europe Brent Spot Price	Central Bank of Republic of Turkey
wfp	World food price index	Food and Agriculture Organization (FAO
interest	Weighted Average Cost of Funding	Central Bank of Republic of Turkey
money	M2 money supply	Central Bank of Republic of Turkey
ppi	Producer Price Index of Agricultural Products	Turkish Statistical Institute
exch	Basket of USD Dollar and Euro	Central Bank of Republic of Turkey
fprices	Food Price Index	Central Bank of Republic of Turkey

Source: Author's compilation

The findings of the summary statistics of the selected macroeconomic variables and food prices are presented in Table 2. The food price index averaged 344.06 over the period, ranging from 189.91 in July 2011 to 658.96 in March 2021. The oil price index ranged from 14.85 to 126.59 with an average of 75.336 and a standard deviation of 28.64. The average world food price index is 106.41 over the period with a standard deviation of 14.41. Monetary policy rated averaged 10.84% during the period, from a minimum of 4.52% in May 2013 to a maximum of 25.5% in March 2019. The growth rate of the money supply showed considerable fluctuations over the period, dropping to as low as 5.6% in August 2012 and rising to as high as 44.69% in October 2020. The exchange rate of Turkish Lira to the mixed basket of US Dollar and Euro ranged between 1.813 and 8.730. The average of producer price index is 113.815 during the period investigated.

Table 2 Descriptive statistics (level series)

Statistics/variables	*oil*	*wfp*	*interest*	*money*	*exch*	*ppi*	*fprice*
Mean	75.336	106.413	10.840	19.482	3.856	113.815	344.068
Max.	126.59	137.612	25.500	44.693	8.730	216.380	658.960
Min.	14.850	84.866	4.520	5.681	1.813	71.440	189.910
Std. Dev.	28.647	14.419	5.254	8.201	1.950	36.933	126.724
Skewness	0.183	0.515	1.387	1.083	0.954	0.989	0.779
Kurtosis	1.679	1.875	4.017	4.436	2.686	2.930	2.467
Jarque-Bera	9.627	11.924	44.792	34.668	19.166	20.086	13.909
Obs.	123	123	123	123	123	123	123

Source: Author's compilation

3 EMPIRICAL ANALYSIS

3.1 Unit Root Tests

This part performs the stationary properties of the variables via the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests. Table 3 summarizes the results of both tests for the investigated variables. All the variables have a unit root in their levels, except the interest rate for the ADF test, and become

stationary when they are first differenced at the 1% level. Since all the series are non-stationary in their differences, the model is estimated in the first differences.

Table 3 ADF and PP test results

	ADF Test		PP Test	
Variable	**Level**	**First difference**	**Level**	**First difference**
oil	–2.703 (0.237)	–9.136 (0.000) ***	–2.772 (0.210)	–11.329 (0.000) ***
wfp	–0.014 (0.995)	–9.136 (0.000) ***	0.257 (0.998)	–9.141 (0.000) ***
interest	–3.528 (0.040) **	–3.565 (0.037) **	–2.512 (0.321)	–9.034 (0.000) ***
money	–2.825 (0.191)	–10.098 (0.000) ***	–2.825 (0.191)	–10.081 (0.000) ***
exch	–1.932 (0.631)	–8.762 (0.000) ***	–2.132 (0.522)	–7.418 (0.000) ***
ppi	–1.309 (0.880)	–9.457 (0.000) ***	–0.882 (0.953)	–13.665 (0.000) ***
fprice	–1.564 (0.801)	–9.942 (0.000) ***	–1.432 (0.846)	–10.940 (0.000) ***

Notes: ***, ** and * present the significance at 1%, 5%, and 10% levels, respectively. All tests are conducted for the trend and intercept models. The Schwarz Information Criterion for the selection of lag length is determined when employing the ADF test. The estimate of PP test is based on the Bartlett-Kernel with the aid of the Newer-West bandwidth.
Source: Author's compilation

When the estimate is carried out, the information criteria for optimal lag length selection are determined. The order of the unrestricted VAR has been selected as one according to the Akaike information criterion (AIC), Hannan-Quinn information criteria (HQ), and Schwarz information criteria (SBC), and the stability condition is satisfied.[4] Before obtaining the structural shocks of the SVAR model, it is also necessary to verify the stability of the underlying VAR structure. It is estimated a VAR model and found out that all the eigenvalues lie within the unit circle (see Table A2). This means that the VAR meets the stabilization criterion, and it is safe to proceed with the structural model's Impulse Response Function analysis. Since the SVAR model is over-identified, according to the contemporaneous relation matrix defined in the previous part, it is desirable to control the over-identifying restriction test to prove the validity of the identifying restrictions imposed in the model. The likelihood ratio (LR) test is 5.18 [0.3941], which is higher than 0.05, showing that over-identification is valid. Diagnostic tests of the underlying VAR process is conducted. The LM test provides (see Table A3) the absence of serial correlation in residuals from the VAR model.

3.2 Impulse Response Functions

This section indicates the findings obtained from the impulse response functions (IRFs) to reveal the variables affecting food prices. The IRFs demonstrate the impact of a one standard deviation shock to each of the variables in the model in a certain period. Since the primary interest is to figure out the effect of macroeconomic variables shocks on food prices, Figure 3 only represents the response of food prices to oil price, world food price, interest rate, money supply growth, exchange rate, and producer price shocks. The IRFs illustrate the dynamic path of adjustment to shocks on endogenous variables up to 10 months.

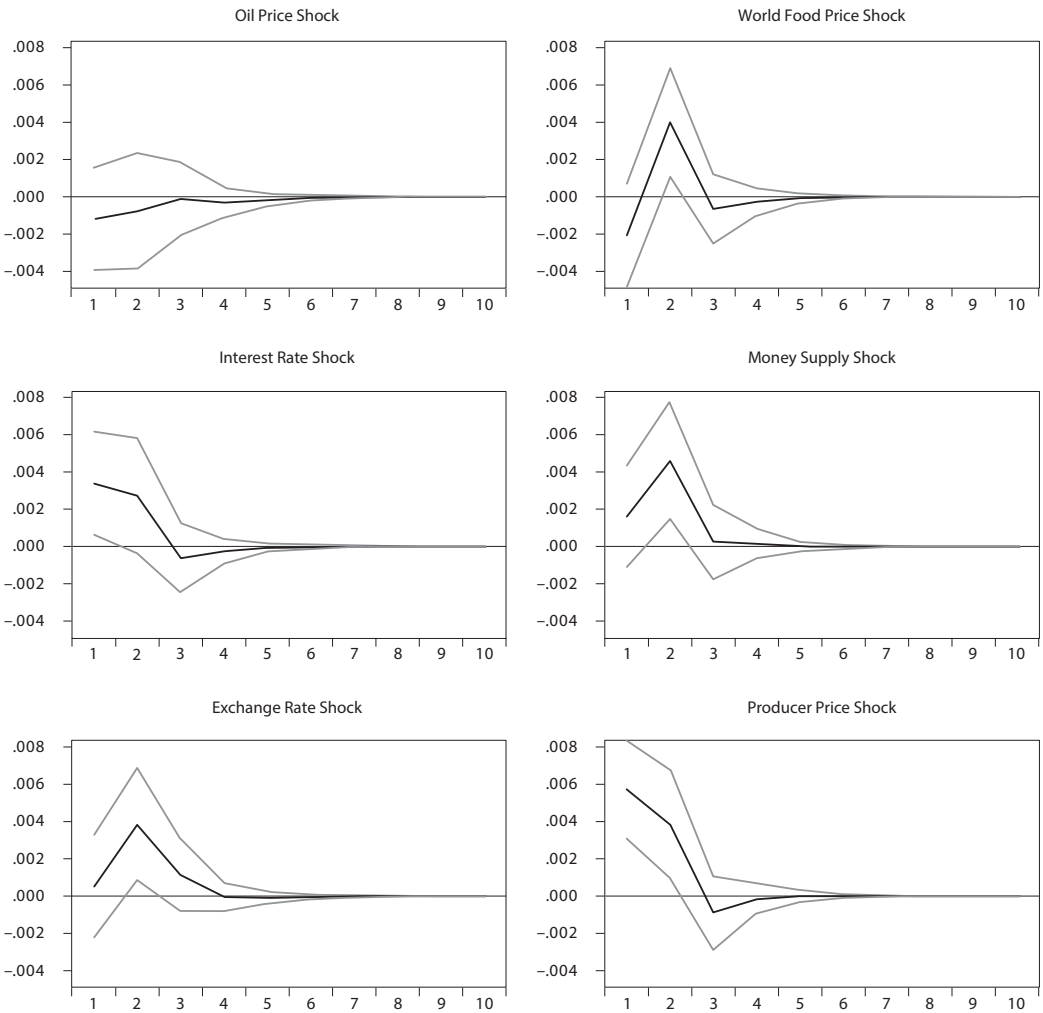
Figure 3 indicates that all the shocks that affect the dynamics of food prices have small and short effects. The response of food prices to oil prices is not statistically significant and does not change over the months. This finding is in line with the study of Ahsan (2012) for Pakistan. Following an unexpected

[4] The lag selection criteria are presented in Table A1. According to AIC and FPE selection criteria, a one lag vector autoregressive model is estimated.

world food price shock, food prices react positively after an initial downturn. An increase in world food prices, on the other hand, has a temporal contribution to food prices. It increases food prices after two months of the shock, but the effect lasts insignificantly after that. This finding is in line with the El-Karimi and El-Ghini (2020) for Morocco.

Similarly, the response of food prices to interest rate shock is positive and significant. Rising the interest rate reflects contractionary monetary policy in Turkey. A rise in monetary policy tightening instantaneously increases food inflation, but the effect lasts for two months and then dies out. The contribution of monetary policy to food prices is in line with the previous findings in the literature Hammoudeh et al. (2015), Bhattacharya and Jain (2020), and Iddrisu and Alagidede (2021). The contractionary monetary policy gives rise to an increase in interest rates that is borrowed for using capital in production.

Figure 3 Response of food prices to other variables, sample: 2011M1–2021M3



Source: Author's compilation

Hence, production becomes expensive, and the rising production costs cause upswings in food prices. The positive money supply shock shows a statistically significant but short-term contribution to food prices. An increase in the growth rate of the M2 money supply reflects an easing of the monetary policy, which turns to an increase in the amount of credit. When more money is demanded for food consumption, the food prices go up, which shows a demand-driven inflationary pressure. The finding is compatible with the results of Awan and Imran (2015) for Pakistan. As may be expected, the effect of the exchange rate shock on food price is positive and continues for nearly four months, but insignificant after the third month. This finding is in line with Başkaya et al. (2008) regarding the short-term effect on food prices. The depreciation of the Turkish Lira against foreign currency (Dollar and Euro) brings about a rising food price inflation in the short period. Food prices are very sensitive to depreciation in the exchange rate. Food prices respond immediately to producer prices in agriculture shocks. A positive shock to the producer price index in agriculture brings about an expected rise in food prices. The impact of this shock on food prices appears to completely disappear in the third month. This result is supported by Irz et al. (2013) for Finland.

3.3 Variance decomposition analysis

The variance decomposition presented in Table 4 demonstrates the information about the relative importance of each random innovation to variables in the model. Using variance decomposition, it can be seen how much of the shocks occurring in the variables are accounted for by the own shock and the shocks of other variables. The variance decomposition of variables in the model is reported by considering the 1, 5, 10, and 20 months prediction horizons for food prices. In the first month, two important dynamics explain the variation in food prices: producer price (13.49%) and interest rate (4.74%). The effects of oil prices (0.58%), world food prices (1.82%), money supply growth (1.07%), and exchange rate (0.14%) shocks are barely apparent in the first month. The main part (78%) explaining the variance in food prices is accounted for by its shocks in the first month. After 20 months, around 15% of the variation in food price is accounted for by producer prices in the agriculture sector, followed by the growth of money supply (7.28%), world food price (6.34%), interest rate (5.89%), and exchange rate (5.04%) respectively. A tiny part of the forecast error variance of food prices can be related to shocks in oil prices (0.66%). The variable for food price has more than 60% of its variance accounted for by own-innovations for the entire forecasting horizon in Turkey. This finding shows that the food price has an important impact on itself, and the current high food price generates expectations of future high food price inflation (i.e., food price inertia). The second highest contribution to the variation of food price is producer price shocks.

The variance decomposition analysis suggests that supply-side variables play a role in explaining a moderate proportion of the variation in food prices in Turkey over the investigated period. Furthermore, even though external shocks play some role, food price variation in Turkey is explained mainly by domestic

Table 4 Forecast error variance decomposition analysis, sample: 2011M1–2021M3

Horizon	Oil price	World food price	Interest rate	Money growth	Exchange rate	Producer price	Food price
1	0.582	1.823	4.745	1.074	0.143	13.490	78.096
5	0.652	6.340	5.898	7.286	5.043	14.746	60.191
10	0.660	6.340	5.898	7.286	5.044	14.745	60.188
20	0.660	6.340	5.898	7.286	5.044	14.745	60.188

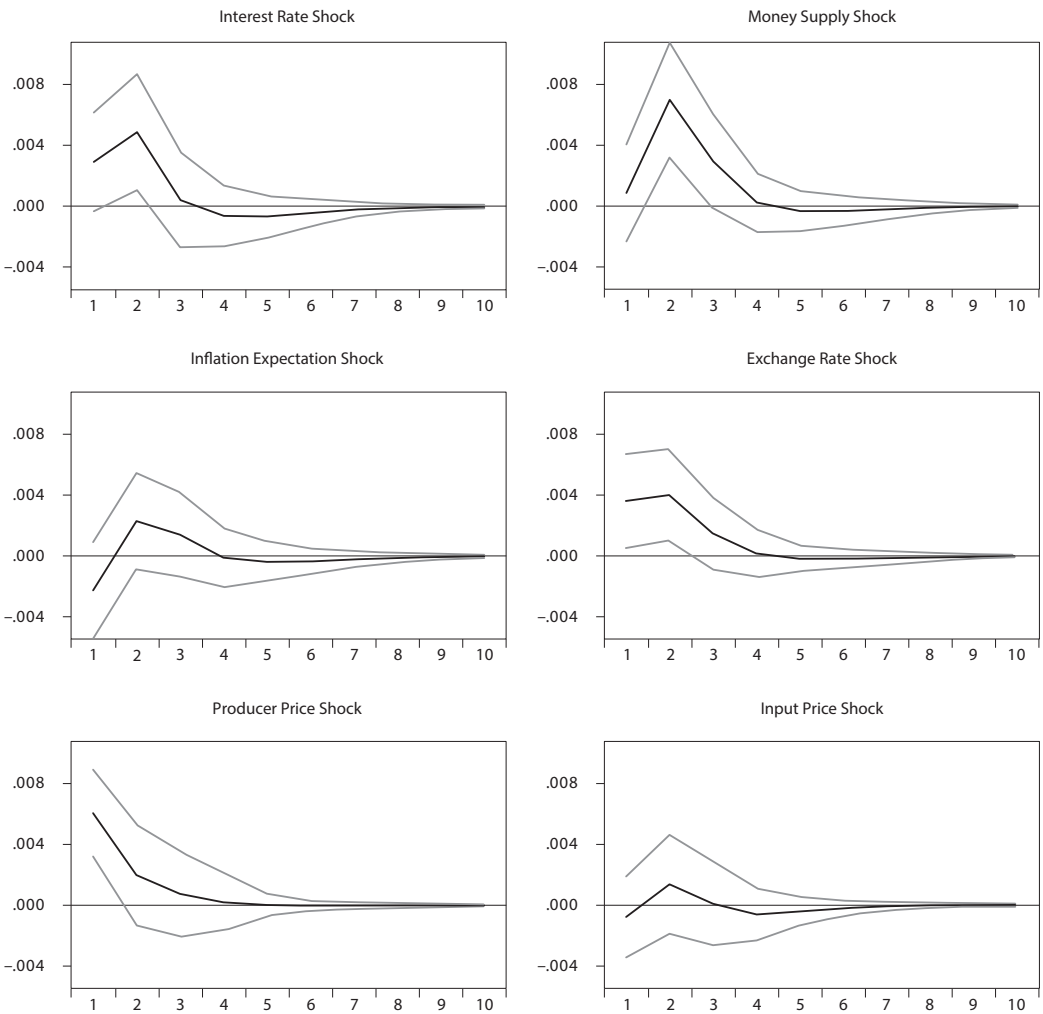
Source: Author's compilation

factors. These results are supported by the existing studies such as Rangasamy (2011), and Bhattacharya and Gupta (2018). The estimated findings are consistent with the impulse response function analysis.

3.4 Robustness checks and further evidence

This section provides a robustness check and re-estimates the SVAR model by varying identification, selecting variables, and the sample period. Instead of structural identification, it is considered the traditional Cholesky identification with all the domestic macroeconomic variables. Following the empirical literature, the variables in Cholesky specification are ordered as follows: interest rate → money supply growth rate → inflation expectation → exchange rate → producer price → agricultural input price → food prices. The variables in the Cholesky scheme are ordered from the most external to the most internal, affecting

Figure 4 Impulse response for food price, sample: 2015M1–2021M2



Source: Author's compilation

each other in one direction most time. In this direction, it is shown that in period T, the top variable is not simultaneously affected by any variable, yet it influences all other variables in the model. The second variable that comes after it reacts only to the first variable before it and affects all other variables, and the process continues in the same way. It is also considered a different sample that begins from January 2015 to February 2021. The choice of a new sample relies on incorporating two possible factors of food prices and other variables examined above. These are inflation expectation (revealed in 2013) and agricultural input price index (released in 2015). Inflation expectation data are represented by the expectation of 12 months ahead annual CPI in percentage and modified mean and obtained from CBRT. The agricultural input price index, which is released by TurkStat, monitors the variability of the inputs purchased by the producers or farmers both in the current production year and for investment purposes as a cost factor.

The empirical findings obtained both IRFs and FEVDs are like previous findings, and the signs of the responses of food prices to different shocks are close, which indicates the robustness of the link between food price and driving factors (see Figure 4).[5] However, the contribution of both inflation expectation and input prices in agriculture to food prices are in line with economic expectations but are not statistically significant.

Comparing the FEVD findings for the post-2015 period with that for the whole sample indicates that some variables in explaining food prices have strengthened in the post-2015 period. The effect of money supply on food prices has doubled after 2015. After 20 months, the money supply explains approximately 18% variation in food price, compared to 7.3% in the full-sample analysis. Once more, it confirms the perception that expansionary monetary policy has led to boost food prices because of the monetary policies implemented by CBRT in Turkey. Similarly, after 20 months of a shock, more than 13% variation in the food prices is accounted for by interest rate shocks. Thus, the contribution of interest rate changes doubles in the post-2015 period. In the post-2015 period, there is no substantial change in producer prices on food prices. After 20 months of a shock, 13.68% of the variation in food price is accounted for by producer price shock. The 8.19% variation in food prices is attributed to exchange rate shocks, which is slightly higher than the entire sample period. Furthermore, the contribution of inflation expectation (3.48%) and agricultural input price (2.42%) shocks in explaining food price volatility remain with a negligible amount after 2015. Finally, Table 5 shows that the variation in food prices comes mainly from its own shocks (50.9%) rather than from the shocks of the other variables at the end of 20 months. It indicates that the food price inertia shock continues to one of the powerful determinants for food prices, which explains approximately 50.9–71.5% in variation in food prices. Overall, these findings reveal that monetary policy shocks have a strong effect on food prices in Turkey.

Based on the above findings that are obtained by two different identification methods (i.e., structural, and recursive) and samples, it is clear that the effect of monetary policy, exchange rate, and producer

Table 5 Variance decomposition of food prices, sample: 2015M1–2021M2

Horizon	Interest rate	Money supply	Inflation expectation	Exchange rate	Producer price	Agricultural input price	Food price
1	7.324	0.020	3.250	4.042	21.605	0.230	71.504
5	13.016	17.835	3.467	8.189	13.694	2.420	51.094
10	13.022	17.839	3.482	8.190	13.686	2.420	50.972
20	13.022	17.839	3.482	8.190	13.686	2.420	50.972

Source: Author's compilation

[5] It has not been interpreted in detail due to space constraints.

prices have a substantial role in determining the food prices in Turkey. The findings related to exchange rate and producer prices are consistent with those reported for Turkey by Bayramoğlu and Yurtkur (2015), Ulusoy and Şahingöz (2020), and Ertuğrul and Seven (2021).

CONCLUSION AND POLICY IMPLICATIONS

The findings presented in this study are analyzed from the SVAR approach that investigates the driving external and domestic factors in determining the food prices in Turkey by employing monthly data ranging between January 2011 and March 2021. The external determinants include the oil price and world food prices, while the domestic variables consist of interest rate, money supply growth rate, exchange rate, producer prices in agriculture. Also, to consider the recent dynamics of the Turkish economy that is characterized under expansionary monetary policy and exchange rate depreciation, a different SVAR model that is included only domestic variables by employing for January 2015 and 2021 February. In that model, there are added two new variables, such as inflation expectation and agricultural input prices, to capture the current macroeconomic environment in Turkey.

The impacts of the variables on food price are analyzed by impulse response function (IRF) and forecast error variance decomposition (FEVD). The IRFs and FEVDs analysis reveal that the response of food price to different macroeconomic variables shocks is close to the empirical predictability exhibited in developing countries. Also, the response of food prices to all shocks in the model is short-lived. The study indicates that domestic components are more significant drivers than external factors in determining food prices. According to both IRFs and FEVDs findings for the entire sample period, all variables except oil prices have a significant effect on food prices. The impact of oil prices on food prices in Turkey is not as strong as expected. However, when both oil prices and world food prices are considered, it is found that there is a limited role of international prices on food prices. Furthermore, together with the effect of the exchange rate, there are significant pass-through effects that cause a rise in domestic food prices. The most important factor that largely explains food prices is the producer price in the agricultural sector in that period. Secondly, the contributions of interest rate and money supply growth rate also impact the food price fluctuations to some extent.

Overall, the findings remain robust to the alternate SVAR model that consists of both different identification schemes (i.e., Cholesky identification) and a shorter different sample (January 2015 to February 2021). The food prices in Turkey are greatly affected by the monetary policy shocks (both interest rate and money supply growth rate). This finding suggests that the food price level tends to increase rapidly while the economy is overheating. However, the food prices respond quickly to the easing of the monetary policy. The producer prices continue to create a considerable positive influence on food prices in the new period. Moreover, the role of the exchange rate in determining food prices has increased significantly. The result implies that a pass-through of depreciation from exchange rate to food price inflation. Ertuğrul and Seven (2021) point that massive depreciation in the exchange rate and increases in import share of agricultural food reinforced with the easing of monetary policy has led to high and volatile food prices after 2013. Since the food industry depends mainly on foreign raw materials, the fluctuations in exchange rates affect the food prices in Turkey. Surprisingly, inflation expectation and agricultural input prices do not substantially explain food prices in the near past.

The findings of this study indicate that controlling food price movements is critical to ensuring overall price stability in the Turkish economy. As a result, the adverse outcome of monetary policy shocks on food prices is an additional significant reason to focus on policies capable of mitigating their impact. Monetary policy can stabilize food inflation by controlling aggregate demand in the economy. Furthermore, as food prices are economically and socially important and the share of food spending for the impoverished is high, it is crucial to monitor food prices and agricultural product markets. In addition, the implementation

of policies that will stabilize the exchange rate fluctuations will reduce the exchange rate pass-through effect, and the increase in food prices will be partially controlled.

Some additional issues remain open for further research. It is possible to investigate the food price dynamics according to the different sub-sectors in Turkey. As a result, the disaggregation of the analysis across different food sectors will offer further insights. Additionally, a comparative study of driving factors in food prices in different major developing countries would provide general conclusions regarding the effectiveness of economic policies.

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APPENDIX

Table A1 Optimal lag length selection criteria

Lag	Log likelihood	LR	FPE	AIC	SIC	HQ
0	1338.618	NA	1.68e–16	–16.45488	–16.18693	–16.34608
1	1502.263	308.9951	4.06e–17*	–17.87905*	–16.67328*	–17.38946*
2	1540.330	68.56769*	4.67e–17	–17.74323	–15.59965	–16.87285
3	1572.894	55.82412	5.77e–17	–17.53906	–14.45765	–16.28788
4	1599.099	42.64308	7.80e–17	–17.25588	–13.23666	–15.62391
5	1626.422	42.08805	1.05e–16	–16.98661	–12.02956	–14.97385
6	1664.616	55.51198	1.25e–16	–16.85237	–10.95751	–14.45882
7	1702.684	52.01806	1.52e–16	–16.71657	–9.883889	–13.94222
8	1732.203	37.76998	2.09e–16	–16.47457	–8.704073	–13.31943

Source: Author's compilation

Table A2 SVAR model stability condition check

Root	Modulus
0.345211	0.345211
0.163059 – 0.211560i	0.267106
0.163059 + 0.211560i	0.267106
–0.096922	0.096922
0.038205	0.038205

Source: Author's compilation

Table A3 VAR residual serial correlation LM test

Lags	LM-Stat	Prob
1	66.67531	0.1418
2	61.01115	0.1169
3	49.90338	0.4379
4	50.96735	0.3968
5	44.26877	0.6656

Source: Author's compilation