Analysing the Relationship between Food Inflation and Exchange Rate in Turkey

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Abstract: In recent years, food inflation and exchange rates in Turkey have emerged as significant interrelated factors. Particularly, since the second half of 2018, the depreciation of the Turkish lira has led to a rapid increase in food prices. Examining the relationship between food inflation and exchange rates is great importance, particularly in terms of trade balance, import dependency, and consumer welfare. This study aims to investigate the dynamic relationships between exchange rates and food inflation. The VAR model has been utilized to analyse the relationship between exchange rates and food inflation. The results of the model reveal that food inflation is largely influenced by its own variability. According to the variance decomposition, food inflation is affected 77% by its own variability and 23% by the exchange rate.

Key Words: food inflation, US dollar, VAR analysis, variance decomposition

1. INTRODUCTION

Food inflation and exchange rate are two important parameters for economic stability and sustainable development. Food inflation refers to price increases, which have a direct impact on the living standards of households, especially in developing countries, while the exchange rate is an important factor determining the value of a country's currency against other currencies. The relationship between these two economic indicators is closely followed by economists and policy makers and can be influenced by many factors.

Analysing the relationship between food inflation and exchange rates is of great importance, especially in terms of trade balance, import dependency and external debt burden. Exchange rate fluctuations may directly affect the cost of imported food products, thereby increasing local prices and triggering food inflation. While this situation has significant effects on the consumer price index, it also weakens the purchasing power of the public. On the other hand, the impact of exchange rate changes on economic growth and production costs plays an important role in determining food prices. Especially in countries with high exchange rate parity, increases in the prices of imported raw materials and energy used in food production trigger inflation.

In this context, understanding the relationship between food inflation and the exchange rate is critical for ensuring price stability, ensuring food security and formulating fiscal policies in times of economic crisis. This study aims to analyze the dynamic relationship between exchange rate and food inflation. The VAR (Vector Auto Regressive) model was used to analyse the relationship between exchange rate and food inflation and variance decomposition method was used to interpret the model results.

In the literature, it is possible to find studies examining the relationship between inflation and exchange rate. While Sarı (2021), Güngör and Erer (2022), Daşdemir (2023) examined the relationship between food inflation and exchange rate in their studies, Sever and Mızrak (2007), Türk (2016), Celkan (2023), Aytekin et al. (2023) examined the relationship between inflation and exchange rate. In this study, the relationship between food inflation and exchange rate between 2000 and 2023 will be analysed.

2. MATERIAL AND METHODS

The data used in the study are time series for the years 2000-2023. Turkey's food price inflation is obtained from the Food and Agriculture Organization (FAO, 2024), while the exchange rate (United States Dollar) is obtained from the World Bank (World Bank, 2024). The exchange rate variable is realized with the 2010-based consumer price index.

In this study, the VAR (Vector Auto Regressive) model is used to analyse the dynamic relationships between food price inflation and exchange rate in Turkey and to reveal the time propagation of the reciprocal effects of changes in these variables.

VAR, which is a special case of simultaneous equation systems, was developed by Sims (1980) to overcome the problem that the selection of endogenous and exogenous variables in structural econometric models is subject to subjective decisions.

The method is simple and objective; it is not necessary to determine which variable is endogenous and which variable is exogenous in an unconstrained VAR model. All variables are endogenous. In order to construct the model, it is sufficient to determine the variables that are considered to be interrelated and the maximum number of lags to be taken (Pindyck and Rubinfeld, 1998). The model is easy to estimate: The least squares method can be applied to each equation separately. Forecasts with unconstrained VAR models are better than those of much more comprehensive simultaneous models (Greene, 2000).

Although the VAR approach has been criticised as being inconsistent with the theory (Cooley and Leroy, 1985; Darnel and Evans, 1990), due to these advantages, it has been used for forecasting and policy analysis in many areas (Darnell and Evans, 1990). In particular, VAR is widely used in research on economic relationships.

The VAR model is generally as follows (Sims, 1980):

$$Y = \alpha + \sum_{j=1}^{n} \beta i Y_{t-j} + \sum_{j=1}^{n} \gamma i X_{t-j} + u_{1t} \quad (1)$$

$$X = \alpha' + \sum_{j=1}^{n} \theta i Y_{t-j} + \sum_{j=1}^{n} \lambda i X_{t-j} + u_{2t} \quad (2)$$

The variables in the VAR model should be stationary. Augmented Dickey-Fuller (ADF) unit-root test was used for the stationarity test of the variables. Unit root tests are a method used to determine whether a time series is stationary or not, and if a time series contains a unit root, it means that the series is not stationary. Since non-stationary series have a longer memory than stationary series, the effects on stationary series disappear over time, while the effects on non-stationary series change the structure of that series. In order to ensure stationarity, the method of taking the differences of the series is used and if a non-stationary series becomes stationary after taking 'd' differences, it is defined as I(d) integrated of the dth degree. A non-stationary Yt Series expresses a stationary process in the form of Δ dYt after being differenced d times (Gujarati, 1995). The following equation is applied for the ADF test (Gujarati, 1995);

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \sum_{i=1}^{n} \Delta Y_{t-1} + \varepsilon \quad (3)$$

Information criteria such as Schwarz Bayesion Criteria (SBC), Akaike Information Criterion (AIC), Hannan-Quinn (HQ) were used to decide how many period lags of the dependent variable should be on the right side of the regression equation.

Variance decomposition is used to measure the contribution of verticalised shocks of changes in the system on the forecast error of the dependent variable. In this case, the variance decompositions of the dependent variables provide information about the economic importance of the variables in the system (Direkçi, 2006).

Variance decompositions obtained from the moving averages section of the VAR express the sources of shocks occurring in the variables themselves and in other variables as a percentage. It shows what percentage of a change in one of the variables in the system is caused by itself and what percentage is caused by other variables. If most of the changes in a variable are caused by shocks in itself, this indicates that the variable in question moves exogenously. In addition, variance decompositions also provide information about the degree of causality relations between variables (Enders, 1995).

3. RESULTS AND DISCUSSION

Since the variables used in the model have time series characteristics, it is firstly investigated whether the variables are stationary or not. Improved Dickey-Fuller (ADF) test was applied to test the stationarity of the variables. Table 1 shows the stationarity tests of the variables to be used in the model. For a series to be stationary, the ADF coefficient must be greater than the absolute value of the Mac-Kinnon critical value. According to the ADF test, while the real exchange rate variable is stationary at the level, the food inflation variable is stationary when differenced at the first order.

Table 1: ADF test Results

	Level		First differences	
	ADF Coefficient	Critical value*	ADF Coefficient	Critical value*
Food Inflation	-0.504504	-3.0114	-3.333900	-3.0199
Exchange rate	-3.373104	-3.0038		

*Significant at 0.05

As it is known, the lag length should be determined in the VAR model. LR (Log Likelihood), FPE (Final Prediction Error), AIC (Akaike Information Criterion), SC (Schwarz Information Criterion) and HQ (Hannan-Quinn Information Criterion) test results were used to determine the appropriate lag length. These test results are given in Table 2. Since the most appropriate lag length was determined as 4 according to all test types, the VAR model was estimated with 4 lags.

Table 2. Var Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-79.44539	NA	29.19399	9.049488	9.148418	9.063129
1	-58.10859	35.56133	4.278921	7.123177	7.419968	7.164101
2	-53.44764	6.732496	4.071297	7.049737	7.544388	7.117943
3	-49.21965	5.167539	4.199884	7.024405	7.716917	7.119893
4	-39.56911	9.650534*	2.504374*	6.396568*	7.286940*	6.519339*

* indicates lag order selected by the criterion

Food inflation (FPINF) and real exchange rate (RER) are used as endogenous variables in the VAR model. There are no exogenous variables in the model. The results of the VAR model with a lag length of four are given in Table 3.

Rather than interpreting the parameters of the VAR model, it is more appropriate to make an interpretation using variance decomposition. According to the variance decomposition results, while food price inflation is completely affected by its own variability in the first period, this effect decreases to 95.55% in the second period (Table 4). In the second period, the change is explained by the exchange rate by 4.45%. In the tenth period, the change in food inflation is affected by its own variability with 73.98%, while 26% is explained by the exchange rate. When the average of the ten-year period is taken into account, the change in food inflation is affected by its own variability by 77% on average, while 23% is affected by the exchange rate.

According to the variance decomposition results of the exchange rate, it is seen in Table 5 that the source of variability in the first period is itself with 82.37% and it is affected by the food inflation variable with 17.62%. In the following 10-year period, the effect of exchange rate on its own variability increases up to about 96 per cent and decreases to 88.59 per cent in the tenth year. During this period, the effect of food inflation on exchange rate variability decreased to 4.08 per cent and increased to 11.40 per cent in the tenth year. When examining the variability of the exchange rate, 91.41% of the average of the ten-year period is due to its own variability, while 8.59% is affected by food inflation.

Table 3. Result of VAR Model

	DINF	RER
D(FPINF(-1))	-0.200112	-0.007789
	(0.28187)	(0.00522)
	[-0.70995]	[-1.49295]
D(FPINF(-2))	-0.720863	-0.003935
	(0.27268)	(0.00505)
	[-2.64362]	[-0.77971]
D(FPINF(-3))	-0.357571	-0.011339
	(0.34098)	(0.00631)
	[-1.04867]	[-1.79670]
D(FPINF(-4))	0.465025	0.000176
	(0.21047)	(0.00390)
	[2.20947]	[0.04509]
RER(-1)	-13.42493	0.826566
	(15.0742)	(0.27901)
	[-0.89059]	[2.96255]
RER(-2)	49.94810	0.379791
	(21.6983)	(0.40161)
	[2.30193]	[0.94567]
RER(-3)	-14.84306	0.549251
	(26.0174)	(0.48155)
	[-0.57050]	[1.14059]
RER(-4)	2.864746	-0.709026
	(15.6808)	(0.29023)
	[0.18269]	[-2.44296]

C	-40.17005	0.019012
	(13.4178)	(0.24835)
	[-2.99378]	[0.07655]
R-squared	0.742496	0.958908
Adj. R-squared	0.513604	0.922382
Sum sq. resids	565.2266	0.193633
S.E. equation	7.924832	0.146679
F-statistic	3.243866	26.25258
Log likelihood	-56.56259	15.24859
Akaike AIC	7.284732	-0.694287
Schwarz SC	7.729918	-0.249102
Mean dependent	3.727473	2.034235
S.D. dependent	11.36305	0.526485

Table 4. Variance Decompozition of DINF

Period	S.E.	DINF	EXR
1	7.924	100.00	0.0000
2	8.474	95.552	4.4476
3	10.31	68.267	31.732
4	10.66	68.021	31.978
5	12.93	78.254	21.745
6	13.19	76.945	23.054
7	15.27	68.389	31.610
8	15.65	68.244	31.755
9	17.21	73.725	26.275
10	17.30	73.980	26.019
Average		77.130	22.862

Table 5. Variance Decompozition of EXR

Period	S.E.	DINF	EXR
1	0.146	17.624	82.375
2	0.183	11.58	88.415
3	0.240	6.757	93.242
4	0.319	4.924	95.075
5	0.368	4.081	95.918
6	0.407	4.769	95.230
7	0.448	5.706	94.293
8	0.471	9.129	90.870
9	0.478	9.921	90.078
10	0.482	11.406	88.593
Average		8.590	91.4093

4. CONCLUSION

The study reveals that food price inflation is largely affected by its own variability. In the early periods, all of the change in food inflation is due to its own internal dynamics, while in the later periods, the effect of the exchange rate becomes more pronounced. Especially in the tenth period, 26 per cent of the change in food inflation is affected by the exchange rate. On average, while 77 per cent of food inflation is affected by its own variability, 23 per cent is affected by the exchange rate. In the early periods, 82.37 per cent of the exchange rate variability is due to its own internal dynamics. However, the effect of exchange rate on its own variability increases over time, and in the ten-year period, on average, exchange rate is affected by its own dynamics by 91.41%.

The fact that food inflation is affected by exchange rate fluctuations necessitates taking into account the effects of exchange rate policies on food prices. Especially considering that the interaction between the exchange rate and food inflation has increased over time, ensuring exchange rate stability may limit excessive fluctuations in food prices.

Considering that food prices are largely affected by domestic dynamics, encouraging agricultural production will reduce external dependency. Policies to increase productivity in agriculture and technological investments will be effective in stabilising food prices. Eliminating the shortcomings of existing support policies and making them more effective will alleviate the cost pressures faced by producers. Increasing agricultural subsidies, especially for items that affect production costs such as fertilisers, pesticides and irrigation, will enable farmers to be more efficient in production processes. Such supports are expected to create long-term stabilising effects on food prices.

For sustainable growth of the agricultural sector, long-term strategic planning is important. Training programmes for farmers should be encouraged to learn modern agricultural techniques and make the most efficient use of local resources. Transparent and continuous updating of practices and policies for agricultural development will contribute to the competitiveness and stability of the sector.

Considering the relationship between food inflation and the exchange rate, strategies to control food prices should be developed together with exchange rate policies in the fight against inflation. In periods of high food inflation, short-term interventions may be considered to reduce pressures on the exchange rate. The changing dynamics of the relationship between the exchange rate and food inflation over time emphasise the importance of long-term economic planning. Economic policies need to be made more resilient to future fluctuations by continuously monitoring the interaction between exchange rates and food prices.

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