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Can Unprocessed Food Prices Really Be One of the Main Responsible Causes for not Achieving Inflation Targets in Turkey?

Abstract. Parallel to international conjecture, as of 2006 food prices, particularly those of unprocessed foods, have displayed high levels of fluctuation and it is know that these fluctuations have increased in more recent years. In the explanations and reports issued by economic circles and fiscal authorities, it is frequently emphasized that fluctuations seen in food prices result in negative influences on inflation and particularly the fluctuations observed in unprocessed foods create serious uncertainties by making inflation forecasting quite difficult. In the current study, whether there is some kind of interaction between 2006:01-2016:03 inflation realizations in Turkey and food prices, processed and unprocessed food prices and uncertainties obtained by using GARCH-type volatility forecasting models was analyzed through VAR Granger causality tests.The findings obtained in the current study support the explanations of economic circles to a great extent.

Keywords: unprocessed food price index, processed food price index, food price index, GARCH-type volatility forecasting models, VAR Granger causality/block exogeneity wald tests, inflation targeting, Turkey

Introduction

Since 2002 when an inflation targeting regime was adopted in Turkey, with the exceptions of 2002-2005 and 2010, the targets have not been achieved. In some years, more than a hundred percent deviations were observed. Globally, on the other hand, as of the second half of 2000, commodity prices have greatly increased and volatility in food prices has also increased, mainly as a result of: increases in energy prices, changing climate conditions, fluctuations in exchange rates, increases in the utilization of agricultural products for the production of bio-fuel, income growth, low and uncertain stock levels, and changing demand structures of developing countries due to their wealth and population growth (FAO, 2010, 2011, 2012; FAO et al., 2011; OECD-FAO, 2011, USDA, 2011).

The negative effects of this conjecture on Turkey became more remarkable in 2008 and 2011 when serious crises were experienced in the world. On the other side, food prices started to fall after 2011 in the world and in February 2016 food prices dropped by 14.5% and came to the lowest value of the last six years (FAO, February 2016). However, in Turkey, food prices continue to increase by significantly deviating from their historical trends and international food prices. In addition, especially unprocessed food prices exhibited important volatility and this volatility has been increasing more in recent years.

In this regard, particularly as of 2006, the main focus of many basic policy articles has been the rapid increases in food prices that are outside the control of the Central Bank, remarkable increases in inflation due to adjustments made on products whose prices are administered and unforeseen fluctuations. It is stated that especially excessive volatility

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experienced in the prices of unprocessed foods leads inflation to follow a volatile path in monthly frequency. Accordingly, the basic driving force of the rise in inflation is pointed out to be unprocessed foods, especially fresh fruit and vegetables, and a high level of fluctuations in the annual inflation of unprocessed food prices is claimed to be resulting in a considerable prediction uncertainty (CBRT, 2006a-2016a; CBRT; 2012b-2016b).

In this respect, in the current study, whether there were any interactions between inflation realizations in Turkey in the period of 2006:01-2016:03 and food prices, processed and unprocessed food prices and the uncertainties determined by using GARCH-type volatility forecasting models such as symmetric ARCH Engle (1982), GARCH (Bollerslev, 1986) and asymmetric EGARCH Nelson (1991) and TGARCH/GJR-GRARCH Glosten, Jagannathan and Runkle (1993) and Zakoinan (1994) were analyzed by means of VAR Granger Causality/Block Exogeneity Wald Tests.When the test results were examined, the existence of one-way causality from the uncertainty of unprocessed food prices to food prices; one-way causality from both of them to annual inflation and one-way causality from annual inflation to food prices could not be refuted. The obtained findings support the statements of CBRT to a great extent. Uncertainties occurring in unprocessed food prices were revealed to be both a direct cause of annual inflation and an indirect cause of it over food price fluctuations.

Inflation Targeting and Inflation Realizations in 2002-2015

The Turkish economy, experiencing a serious inflation problem as of the 1970’s, became very fragile up to 2000, particularly as a result of the consecutive economic crises occurring in the 1980’s. In addition to this, the financial crises experienced in 2000-2001 symbolized a turning point in Turkey and then macro-level economic measures were considered to realize a series of fiscal, economic and legal amendments. At the same time, the Central Bank of the Republic of Turkey (CBRT) declared implicit inflation targeting in 2002-2005 following the crises and as of 2006, explicit inflation targeting was adopted (CBRT, 2005; 2006c). The inflation targets and their realizations during the period when the implicit inflation targeting was adopted are given in Table 1.

Table 1. Annual CPI Percentage Changes and Targeted Inflation Values in 2002-2005

Years	2002	2003	2004	2005
Realization	29.7	18.4	9.35	7.72
Target	35	20	12	8

Source: Cenrtal Bank of Republic of Turkey (CBRT).

As can be seen in Table 1, the Central Bank mainly focused on price stability as of 2002 and the inflation that descended to single digit level after long years came under the targets. On the other hand, price stability involves not only achieving low inflation levels but also sustaining this price stability and settings where low inflation levels can be sustained are regarded as the settings where price stability is attained. That is, when inflation level descends to the level ranging from 1% and 3% and then increases to the level higher than 10%, it means that price stability could not be achieved (Serdengeçti, 2002; CBRT, 2006c, 2013c).

In a similar manner, middle-term price stability is defined by the European Central Bank as the increase of HICP (Harmonized Index of Consumer Prices) less than 2% when compared to the previous year (Duisenberg, 2001). Accordingly, though the annual inflation started to be realized at single digits, it can be seen that it is still highly over the inflation rates of developed countries in Table 2.

Table 2. The Targeted, Realized Inflation Rates and Deviation Status in Period 2006-2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Mean
Target	5	4	4	7.5	6.5	5.5	5	5	5	5	5.3
Uncertainty Band	3.0-7.0	2.0-6.0	2.0-6.0	5.5-9.5	4.5-8.5	3.5-7.5	3.0-7.0	3.0-7.0	3.0-7.0	3.0-7.0	3.3-7.3
Realization	9.7	8.4	10.1	6.5	6.4	10.4	6.2	7.4	8.2	8.8	8.2
Deviation[(1)] (%)	94	110	152	-13.3	-1.5	89	24	48	64	76	56.4

[(1)] Deviations were calculated

Source: Central Bank of Republic of Turkey (CBRT).

The inflation levels realized during the implicit inflation targeting period could not be attained as of 2006 when explicit inflation targeting was adopted by CBRT. In this regard, it has been emphasized by both CBRT and economic circles that the reason behind the inflation rates' being higher than the expected and limiting the speed of inflation decrease is the negative trend in food prices. At the same time, such developments delay the improvement in the inflation outlook and thus force inflation to move upwards; as a result, in terms of the realization of inflation target, increases seen in food prices play an important role (Başçı, 2014a, 2014b, 2014c). As in every type of price fluctuation, it is known that fluctuations in food prices make it difficult for the Central Bank to produce short-term and middle-term inflation forecasting and underestimate the informative value of estimations and thus negatively affects the management of expectations (Başkaya, Güngör and Öğünç, 2008). Moreover, it is stated that food group is one of the sub-groups making the greatest contribution to the upward movement of inflation and that deviations result from the jumps in the administered prices that are out of control of fiscal policy and in unprocessed food prices (CBRT, 2006a-2016a).

As is known well, climate changes, decrease in the stocks of agricultural products, increases in the costs of energy and other inputs, population growth, increasing amount of agricultural products used for different purposes such as the production of bio-fuels, resulted in excessive increases in food prices in the world and price fluctuations in the second half of 2000. Particularly in developing countries, depending on population and welfare growth, demand for agricultural products has been increasing and thus food prices have been kept staying high (Ministry of Development, 2013).

The increasing prices of fresh fruit and vegetables, rapid changes in climate conditions and differentiations of the seasonal structures of prices and structural elements and estimation-related elements; all of these can impose some pressure on the inflation outlook. These factors lead to larger uncertainty intervals determined for the inflation target in Turkey when compared to many other countries implementing inflation targeting regimes (Atuk and Sevinç, 2010).

It is widely believed that the high increases observed in the prices of international agricultural raw materials since mid-2005 have led to increases in inflation rates in many developing countries, including Turkey where food purchases constitute a large part of gross consumer spending (Başkaya et al., 2008).

As in other developing countries, food products have a relatively greater share in the consumer basket. On the other hand, in developed countries, high-technology products have a greater share. As a result, high efficiency increases in technology-intense products have positive reflections on the inflation rates of developed countries. However, the increase in the prices of world food products can be accelerated by factors such as fast transition from agriculture sector to industry and service sectors in developing countries, low productivity in agriculture and increasing share of developing countries in the global demand. When all these developments are combined with the relatively larger share of food products in the consumer basket, then higher inflation rates are witnessed in developing countries (CBRT, 2006a-2013a). As food products have a large share in consumer price index in Turkey, it has been frequently stated that fluctuations in food prices are an important source of uncertainty in the analysis and prediction of consumer inflation and complicate the process of expectation management (Orman, Öğünç, Saygılı and Yılmaz, 2010).

In this connection, since the period when inflation targeting was adopted in Turkey, compared to other developing countries keeping the uncertainty interval for their information target as 2 percent in both directions of the target, Turkey has relativelylarger uncertainty intervals and the main reason for this is the impact of fruit and vegetable prices on inflation forecasting (Atuk and Sevinç, 2010).

Therefore, close monitoring of these prices and thus detecting the factors increasing the fluctuation and taking the required measures to prevent these fluctuations are of great importance in terms of establishing middle-term price stability. In our study, the following graphs were drawn to evaluate whether it would be correct to deal with food prices as the main culprit of the price fluctuations seen in Turkey and to see the trends of food prices in the world and in Turkey.

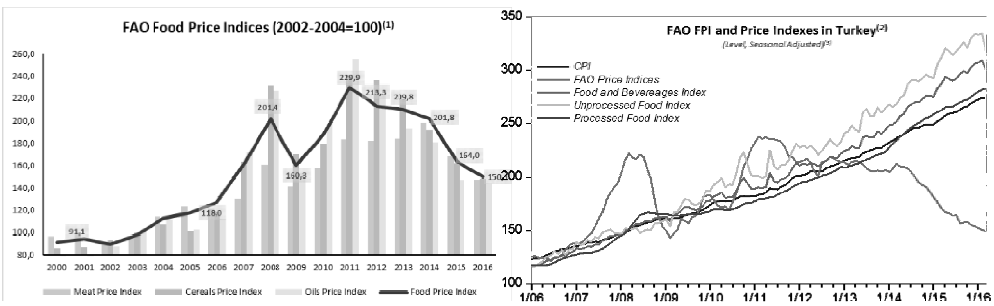

Fig. 1. Trends of Food Prices in the World and in Turkey

Source : (1) Food And Agriculturel Organization of the United Nations, World Food Situation FAO Nominal Food Price Index (February value just for 2016). It indicates the annual average values. http://www.fao.org/worldfoodsituation/foodpricesindex/en/

(2) Price Indexes in Turkey are obtained from the offical website of Turkish Statistical Institude (TSI)

(3) Indexes are seasonally adjusted using Census X-13 method.

While FAO food price index entered a trend of increase as of 2006, particularly between 2008 and 2011 serious jumps were observed, since 2012 there has been a relative decrease in these prices in that in February 2016 food prices dropped by 14.5% and came to the lowest value of the last six years (FAO, February 2016). On the other hand, it can be clearly seen from

Figure 3 that as a result of fast increases seen in domestic food prices in recent years, they deviated from both their historical trends and from international food prices. When Turkey's food indexes were drawn together, taking 2011 as the starting point when FAO attained its highest value, this deviation from international prices can be more clearly seen.

Empirical Framework

Preliminary Analysis of Data

Data set is composed of Consumer Price Index (CPI), Food and Non-Alcholic Beverages (FPI), Unprocessed Food Index (UFI) and Processed Food Index (PFI). All data is taken from The Turkish Statistical Institute (TSI) and Central Bank of Republic of Turkey (CBRT) covers the time period from 2006:01 to 2016:03, with the base year of 2003.The descriptive statistics and stationarity conditions of the investigated variables are given in Table 3.

Table 3. Descriptive Statistics and Stationarity Conditions of The Investigated Variables

Statistics	Price Indexes				Cyclic Component of Price Indexes			
	CPI	FPI	UFI	PFI	Annual Inflation	FPICYC**	UFICYC**	PFICCYC**
Mean	190.8758	200.2546	211.9326	188.4054	8.313943	-1.73E-11	-2.81E-11	-3.53E-11
Median	183.9300	192.2200	208.2403	179.5570	8.280488	-0.326613	-1.367969	-0.548976
Maximum	274.4400	315.2200	347.5136	283.9699	12.06461	16.28675	27.72780	11.86836
Minimum	123.5700	117.6100	118.6834	116.3651	3.986038	-9.985823	-18.85494	-6.774389
Std. Dev.	43.52085	54.68397	63.09850	46.66904	1.736061	5.413422	10.00429	3.744414
Skewness	0.263258	0.385802	0.362511	0.371321	-0.196276	0.358718	0.321324	1.031996
Kurtosis	1.923145	2.125302	2.060917	2.193891	2.722704	2.771590	2.578675	4.529353
Prob. (J-B)	0.025175	0.030617	0.027138	0.046033	0.553269	0.233952	0.220207	0.000000
Stationarity*	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	I(0)

* For the determination of the integration degree of the series, Philips-Perron (1988) PP and Kwiatkowski-Phillips-Schmidt-Shin (1992) KPSS stationarity tests were employed, constant and trend variables were included in the models.

** While administering Serilere Hodrick-Prescott (1980) filtering method to the series, adjustment parameter (lambda=14400) was used.

Source: own research.

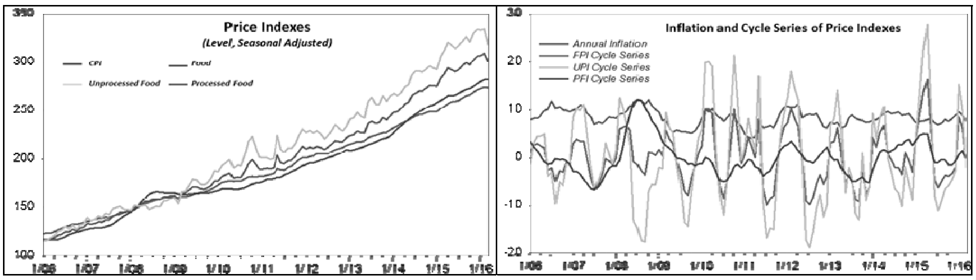

Fig. 2. Cycle Series of Price Indices and Annual Inflation and Price Indices Isolated from the Trends

Source: own research.

Price indices' continuous tendency to increase over time indicates trend effect and positivity of the means support this. Moreover, the differences between the minimum and maximum values of the series offer some preliminary information. This difference is most notable in food and unprocessed food indices. Another sign of volatility, standard deviation values give the same variables and this indicates that these variables might be under the volatility. Median values lower than means indicate that volatility mostly concentrates on price fluctuations taking place over the mean. At the same time, though positive price fluctuations are more than negative price fluctuations, it can be seen from skewness and kurtosis values that most of the index realizations occur around the mean at similar frequencies.

As known, for the models to be set in research to support their hypotheses, the series must be stable. Though it is possible to stabilize variables by taking the difference of unstable series in time series, this operation leads to loss of both data and information; first elements that can disturb the stability (structural break, trend etc.) should be handled. In this regard, as can be seen in Table 3, price indices were found to be not stable and on the basis of the idea that what disturbs the stability is trend effect, Hodrick-Prescott (1980) filtering method was administered to the series. As is known well, this method is widely used in separation of long-term tendency in such a way as to obtain a cycle in macro-economic time series.

Under the inflation targeting regime, year-end inflation rates calculated as the 12-month change in the CPI are set as the target variable in Turkey. In the current study, annual inflation rates were considered as inflation series and it was observed that when CPI was converted into annual inflation, it became stationary. At the same time, cycle series obtained as a result of filtering administered to the other series were observed to become stationary. Similar to the price indices, the indices where volatility effect became the most notable in cycle series are food and unprocessed food prices.

Investigating the Causal Relationship of Price Indices in Turkey

Knowing the direction of long-term relationships between the variables is of great importance for policy makers and as known, this information is related to determination of causality between variables. In this regard, in order to elicit the interactions between the variables addressed in the current study, uncertainty series of the variables under investigation were obtained by using symmetric and asymmetric GARCH-type volatility forecasting models whose details are given in Table 4.

While determining the GARCH model best representing ARCH impact in error from among the models, in addition to the biggest log-possibility, significance of the coefficients at the level of 5% were taken into consideration (Demetriades et al., 2006). GARCH-type models satisfying all of these characteristics at the same time are given in Table 5.

As can be seen in Table 5, as annual inflation realizations and ARCH effect on processed food prices could not be determined, only uncertainties for unprocessed food prices (UNUFICYC) EGARCH(0.4) and food price index (UNFPICYC) ARCH(1) could be obtained.

At the second stage of the analysis, causality tests will be utilized in order to determine the direction of the long-term relationships between the variables. Methodologically, the causality relationship between series started to be tested with "Granger Causality Test" developed by Clive W.J. Granger (1969). This test was originally developed to determine whether a variable is necessary for the prediction of another variable. It is an easy-to-calculate test; therefore, it is one of the most commonly preferred methods in causality analysis.

Table 4. Symmetric and Asymmetric GARCH-type Volatility Models and Coefficient Restrictions

Models	ARCH(q)	GARCH(p,q)	EGARCH(p,q)	GJR/TGARCH(p,q)
	$Y_t\|I_{t-1} \sim N(X_t\beta, h_t)$ $\varepsilon_t\|I_{t-1} \sim N(0, h_t)$ $E(\varepsilon_t\|I_{t-1}) = 0,$ $V(\varepsilon_t\|I_{t-1}) = h_t z_t \sim N(0,1)$ $\varepsilon_t = z_t\sqrt{h_t}$ $h_t = \sigma_t^2 = V(\varepsilon_t^2\|I_{t-1}) = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2$	$y_t\|I_{t-1} \sim N(x_t\beta, h_t)$ $\varepsilon_t / I_{t-1} \sim N(0, h_t)$ $\varepsilon_t = y_t - x_t\beta$ $h_t = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j}$	$logh_t = w + \sum_{j=1}^{p} \beta_j \, logh_{t-j} + \sum_{i=1}^{q} \alpha_i \left\| \frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}} \right\| + \sum_{k=1}^{r} \gamma_k \frac{\varepsilon_{t-k}}{\sqrt{h_{t-k}}}$	$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \gamma_i S_{t-i} \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_i \sigma_{t-j}^2$ $S_{t-i} = \begin{Bmatrix} 1 & \varepsilon_{t-i} < 0 \\ 0 & \varepsilon_{t-i} \geq 0 \end{Bmatrix}$
Coefficient Restrictions				
Non Negativity	$w > 0, \alpha_i \geq 0$ $i = 1,2,3, \ldots, q,$	$p \geq 0, \;\; q > 0, \;\; w > 0,$ $\alpha_i \geq 0 \;\; i = 1,2,3, \ldots, q,$ $\beta_j \geq 0 \;\; j = 1,2,3, \ldots, p$		$\omega > 0, \alpha_i \geq 0,$ $i = 1, \ldots, q (\alpha_i + \gamma_i)/2 \geq 0$ $\beta_j \geq 0 i = 1, \ldots, p$
Cov.Stationarity/ Stability	$\sum \alpha_i < 1$	$\sum \alpha_i + \sum \beta_j < 1$		$\left[\frac{\sum_{i=1}^{q} (\alpha_i + \gamma_i)}{2} + \sum_{j=1}^{p} \beta_j < 1 \right]$
Mean Reverting Level	$\frac{\omega}{(1 - \sum \alpha_i)}$	$\frac{\omega}{1 - \sum \alpha_i - \sum \beta_j}$		

Source: own research.

In this connection, the causality between the variables handled in the current study will be tested by using VAR Granger Causality/Block Exogeneity Wald Tests on a standard VAR model constructed independent of which variables are exogenous and which are endogenous.

Prior to the investigation of causality relationship, stationarity tests of the series should be conducted because the method to be used to conduct causality analysis varies depending on whether the stationarity of the series has been attained or not. If all series are not stationary with a lag order of 1 and are not co-integrated, we should implement VAR in the first difference. If all series are not stationary with a lag order of 1 and co-integrated, we should implement VAR in levels (Enders, 2003). In addition to this, as the variables are stationary in the study, by using level values of the series and considering seasonal effects, six-variable unrestricted VAR(p) model (Pesaran and Shin, 1998);

$$y_t = a_0 + a_t + \sum_{j=1}^{p} \phi_j y_{t-j} + b x_j + \varepsilon_t$$

was constructed. Here, y represents (Annual Inflation, FPICYC, UNFPICYC, UFICYC, UNUFICYC, PFICYC) variables, a_0 ve a_t6x1 represent coefficient vector; $\phi_j j = 1, \ldots, p$ represent coefficient matrix in lag order, b represents exogenous (seasonal dummy variables) variable matrix and t shows the trend. The time lag length of the model was determined with AIC (Akaike’s Information Criterion), FPE (Final Prediction Error), SC (Schwarz criterion), and HQ (the Hannan & Quinn (1979) criterion) information criteria, whether there is an autocorrelation in the errors of the determined VAR model was tested with VAR residual serial correlation LM test and assumption of normality (residual normality) was tested with normality test and then whether no AR roots lies outside the unit circle - stability condition was met or not was tested (Lutkepohl, 2005).

Table 5. Symmetric and Asymmetric GARCH-type Volatility Forecasting Models and Coefficient Restrictions

Coefficient	Annual Inflation	FPICYC	UFICYC	PFICYC
Mean Equation				
c	1.393238 (0.0478)			
θ_1	1.040311 (0.0000)	0.650623 (0.0000)	0.647012 (0.0000)	1.512139 0.0000)
θ_2	-0.225915 (0.0180)	-0.230793 (0.0119)	-0.216794 (0.0209)	-0.589999 (0.0000)
θ_3	0.165181 (0.0845)		0.187278 (0.0392)	-0.184245 (0.0565)
θ_4	-0.143740 (0.0956)		-0.227625 (0.0170)	0.274737(0.0228)
θ_5	-0.516285 (0.0000)			-0.148558 (0.0045)
θ_6	0.507971 (0.0000)			
SD(1)		3.953961 (0.0001)	8.192966 (0.0000)	
SD(2)		3.016719 (0.0039)	7.142064 (0.0008)	0.437734 (0.1306)
SD(3)		2.996741 (0.0024)	8.050277 (0.0001)	
SD(4)		2.628527(0.0123)	5.542603 (0.0091)	
SD(5)				-0.615318 (0.0402)
SD(6)		3.953961 (0.0003)	-8.012256 (0.0003)	
SD(7)		3.016719 (0.0176)	-7.159618 (0.0016)	
SD(8)		2.996741 (0.0025)	-5.462040 (0.0076)	
SD(9)		2.628527 (0.0441)	-4.309851 (0.0363)	
SD(10)				
SD(11)		-1.723727 (0.0895)	-3.994410 (0.0445)	
Adj.R-squared	0.834334	0.730085	0.716625	0.948891
B-G Serial Corr LM	0.175711[1] (0.6751)	0.110801[1] (0.7392)	0.000000 (1.0000)	0.002729 (0.9583)
ARCH Heteros. Test	0.451194 [1] (0.7980)	11.74257 [1] (0.0006)	17.03310 (0.0002)	0.300210 [1] (0.5838)
Norm. of Residuals	0.147641 (0.928838)	2.691658 (0.260324)	3.591050 (0.166040)	0.610227 (0.737040)
Variance Equation				
ω		2.943713 (0.0000)	12.50715 (0.0067)	
α			0.637247 (0.0275)	
γ		0.378154 (0.0038)		
β_1		0.751234 (0.0000)		
β_2		-1.166719(0.0000)		
β_3		0.590219(0.0056)		
β_4		-0.753431(0.0000)		
Log likelihood		-286.0324	-337.9167	
ARCH-LM Test		0.108450 [1] (0.7419)	0.164955 [2] (0.6846)	

* The values within the square brackets show the most suitable time lag length and the values in the brackets show p-values.

** Mean equation $\pi_t = w + \sum_i^p \pi_{t-i} + u_t$ was modeled as autoregressive. Moreover, while establishing the model, autoregressive lags of the variable best explaining the model were selected and if there was seasonality effect, significant seasonality dummy variables were included in the model.

Source: own research.

In order to know the causality between those six time series, we should apply the Granger causality/ Block exogeneity Wald test (Enders, 2003). This test detects whether the lags of one variable can Granger-cause any other variables in the VAR system. The null hypothesis is that all lags of one variable can be excluded from each equation in the VAR system. For example, this test helps to answer whether or not all lags of FPI can be excluded from the equation of AI or not. Rejection of the null hypothesis means that if all lags of FPI cannot be excluded from the AI equation, then AI is an endogenous variable and there is causality of FPI on AI.

In the VAR system established on the basis of these explanations, the equation for annual inflation is given below. In the system, as shown in equation 2, each variable is made a dependent variable in turn and whether the coefficients belonging to the lags of endogenous variables altogether equal to zero was estimated with Wald test. Thus, the hypothesis that whether the dependent variable of each of the endogenous variables is Ganger-cause or not was tested. The results related to VAR Granger Causality/Block Exogeneity Wald Tests conducted over VAR satisfying the system assumptions (App.1) by following the given procedure are presented and the obtained relationship structure is shown in Figure 3.

$$AI_t = a_0 + \sum_{j=1}^{10} \phi_j AI_{t-j} + \sum_{j=1}^{10} \phi_j FPICYC_{t-j} + \sum_{j=1}^{10} \phi_j UNFPICYC_{t-j} + \sum_{j=1}^{10} \phi_j UFICYC_{t-j} + \sum_{j=1}^{10} \phi_j UNUFICYC_{t-j} + \sum_{j=1}^{10} \phi_j PFICYC_{t-j} + b_1 SD(1) + b_2 SD(5) + b_3 SD(6) + b_4 SD(7) + b_5 SD(8) + b_6 SD(9) + b_7 SD(10) + b_8 SD(11) + b_9 SD(12) + \varepsilon_t$$

When the test results were examined, it was seen that the variables outside the annual inflation, food prices and unprocessed food prices uncertainties are exogenous.At the same time, the existence of one-way causality from the uncertainty of unprocessed food prices to food prices; one-way causality from both of them to annual inflation and one-way causality from annual inflation to food prices could not be refuted.

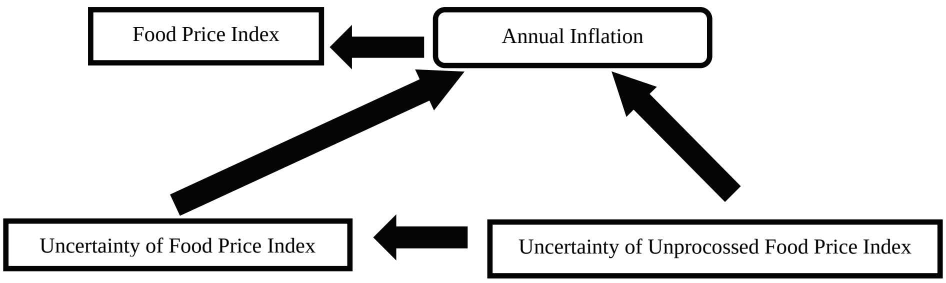

Fig. 3. Representation of VAR Granger Causality/Block Exogeneity Wald Tests' Results

Source: own research.

The obtained findings support the explanations made by CBRT to a great extent. Uncertainties occurring in unprocessed food prices were revealed to be both a direct cause of annual inflation and indirect cause of it over food price fluctuations.

Results and Discussion

Explicit commitment made by fiscal authorities to keep the inflation at the target level puts them under the responsibility for accountability. In this regard, when a deviation occurs from the declared target, the reasons for this deviation need to be explained and the measures to be taken for the target to be achieved should be defined. In the inflation targeting regime, central banks shape their policies depending on the future inflation expectations rather than the realized inflation.

In the inflation targeting in Turkey, as the target, variable end-of-year inflation ratios calculated on the basis of 12-month changes of CPI are taken and inflation targets are determined as point targets. However, target value is determined to be relatively higher when compared to developed countries and uncertainty interval is kept to be wider when compared to many countries implementing inflation targeting regime with 2 percent possible deviation from the target at both sides. Yet, Turkey has made great strides in terms of price stability, stated to be the main objective since 2002 when inflation targeting was adopted. On the other side, parallel to the developments in the world, important increases in food prices were observed after 2006. In the same period, problems were experienced in achieving the inflation targets and there were some years when more than a hundred percent deviation from the target was seen.

In this regard, it is emphasized by CBRT and economic circles that the cause of inflation rates being realized higher than the predicted rates and the one limiting the decreasing speed of inflation is the negative trend of food prices. In many of the explanations and reports issued, it is stated that uncertainties experienced in food prices and particularly in unprocessed food prices are one of the basic negative elements putting pressure on inflation outlook and that this makes it difficult to achieve the end-of-year inflation targets.

Considering the above-given information, the current study investigated the interactions between consumer price level (CPI), food price index and processed and unprocessed food indices and fluctuations, if there are any. As is known well, prior to the investigation of causality relationship, stationarity tests of the series should be conducted because the method to be used to conduct causality analysis varies depending on whether the stationarity of the series has been attained or not. On the basis of the idea that what disturbs the stability in the variables found to be not stationary as a result of the stationarity tests is trend effect, Hodrick-Prescott (1980) filtering method was administered to the series and it was observed that the obtained cycle series became stationary. Previously, annual inflation rates were investigated as inflation series and it was observed that when CPI was converted into annual inflation, it became stationary; thus, it was exposed to filtering. For the uncertainty of the series, some symmetric ARCH (Engle, 1982), GARCH (Bollerslev, 1986) and asymmetric EGARCH (Nelson, 1991) and TGARCH/GJR-GRARCH (Glosten, Jagannathan and Runkle, 1993; Zakoinan, 1994) GARCH-type volatility forecasting models were drawn on. As the annual inflation realizations and ARCH effect on processed food prices could not be determined, uncertainties were obtained only for unprocessed food prices (UNUFICYC) EGARCH (0,4) and food price index (UNFPICYC) ARCH(1).

At the second stage of the analysis, in order to determine the direction of long-term relationships between the variables, VAR Granger Causality/Block Exogeneity Wald Tests were administered.The test results revealed that there might be one-way causality from the uncertainty of unprocessed food prices to food prices; one-way causality from both of them to annual inflation and one-way causality from annual inflation to food prices.

The findings of the current study seem to support the explanations coming from economic circles and CBRT but also reveal some other remarkable results. First, no uncertainty was detected in the annual inflation realizations within the framework of the utilized volatility forecasting models. As known well, volatility of a variable is defined as this variable's excessive rise or fall around the mean value. In this case, inflation volatility encompasses changes and instabilities experienced at varying degrees in inflation and here rather than the variance of all the changes taking place in inflation, the variance of the ones of these changes that are not expected (Ball and Cecchetti, 1990) correspond to the uncertainty. Moreover, what is meant by unpredictability in inflation uncertainty defined as subjective unpredictability of the price level is forecasting uncertainty (Tsyplakov, 2010). In light of these definitions, it can be argued that during the period of 2006:M01-2016:M03 there was no unexpected change in the inflation realizations or unpredictability that might lead to forecasting uncertainty.

Due to the fact that there is no volatility in inflation, the proposition that unprocessed food and food prices volatility creates estimation uncertainty in inflation may not be true. In this context, the related volatilities may be effective in the realizatons of high and low inflation rates. However there is no sign to reach the conclusion that the volatilities from food and unprocessed food prices lead the inflation uncertainty interval to above realization.

In this case even if the inflation values are high it may not be true to express that they are unexpected. As it is known when CBRT determines the inflation targets, just in case, not only they tend to present relatively high inflation taking the inflation dynamics of Turkey into consideration but also they determine a wide range of uncertainty interval to reduce possible fluctuations such as in exchange rates, production and employment effected by the instability of energy and food prices that are out of monetary policy control.

Moreover, as it stated in the Law on the Central Bank of the Republic of Turkey, in the case of a remarkable violation of the inflation target, the CBRT is in charge for reporting to the Government and announcing to the public the reasons behind the failure to meeting the inflation target and the necessary measures to be taken.

In this context, the transition to inflation targeting regime in Turkey since 2006, 17 open letters stating that the inflation target has been outside the determined uncertainty range except only the years 2011 and 2013 have been published. Generally, the increase in food prices, developments in energy prices, drought and financial crisis, the effect of transition to exchange rates are expressed as key elements in overcoming the inflation target (CBRT, 2006d-2016d). Hence, the explanations made have raised the opinion that due to the developments outside the domain of monetary policy the inflation targets have led to failing to meeting the required level. At the same time, examining all these years it is remarkable to notice that Central Bank keeps determining the inflation target as 5% when the inflation rate has never been observed under 6.2% obtained in 2012.

There is some research looking at the reasons for the increases in food prices in Turkey while regressions were seen in food prices in the world. For example, Orman et al., (2010) reported that remarkable fluctuations seen in unprocessed food prices are one of the main factors increasing the fluctuation in inflation. They also explained the structural reasons such as high degree of climate-dependence in production, insufficiencies in agricultural know-how, high number of intermediaries in the supply chain, uncertainties surrounding agricultural subsidies, weaknesses in the regulatory, supervisory and monitoring framework, concentration of production in certain geographic areas and fluctuations in external demand for the fluctuations in food prices especially unprocessed food prices in Turkey. Meanwhile, Öğünç (2010) revealed that it would not be very accurate to explain price changes in the food sector on the basis of climate changes in Turkey, because low levels of fluctuations in unprocessed food prices were observed in other Mediterranean countries that are also the producers of these food items. For instance, in his study revealed that in 2004-2009; though Turkey was in the position of a producer, monthly food prices fluctuations were four times higher than the fluctuations in 27 European Union countries and unprocessed food price fluctuations were six times higher than the fluctuations in these countries. One of the sub-groups of unprocessed foods, meat prices were found to have ten times higher fluctuations and fruit and vegetable prices exhibited a similar trend of fluctuation in the same period. In addition to the structural factors, Atuk and Sevinç (2010) compared variable and fixed weight approaches in the CPI calculation and showed that inflation rates of fresh fruit and vegetables calculated by the fixed weighting method display lower volatility. Furthermore, in Balkan, Kal and Tümen (2015)'s study have been stated that the fuel-price increases have a potential to lead to more-than-one-for-one increases in the wholesale prices of fresh produce.

Conclusion

In Turkey, inflation targets do not meet the required level to a large extent. though the size of the inflation is unknown, the volatilities arising from elements such as social, structural, food and especially unprocessed food prices can have effect on the appearance of the inflation indeed. However, this effect is not creating uncertainty in the mid term inflation outlook, emerging with actual inflation.

As a result; to be successful in inflation targeting regime, it is thought that appropriate policies beyond the elements of monetary policy control which are minimizing the effect of structural measures must be implemented in time. As it is known, one of the main features of that regime has the chance to be updated quickly when there is a requirement in policy change. Therefore, insisting on keeping the targeting unchanged is in fact inconsistent with the inflation targeting itself. Moreover the consequences from a loss of credibility arising from conservativeness of the regime may be more severe due to the loss of arising changing objectives.

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Appendix 1

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2006M01 2016M03
Included observations: 103

Dependent variable: YEARINFPER

Excluded	Chi-sq	df	Prob.
FOODCYC	9.843978	10	0.4543
FOOEGARCH04	19.89937	10	0.0302
PROCCYC	8.130608	10	0.6161
UNPROCCYC	10.24030	10	0.4197
UNPROCARCH01	21.42892	10	0.0183
All	71.53148	50	0.0245

Dependent variable: FOODCYC

Excluded	Chi-sq	df	Prob.
YEARINFPER	18.31130	10	0.0499
FOOEGARCH04	9.066812	10	0.5258
PROCCYC	12.22760	10	0.2701
UNPROCCYC	14.69132	10	0.1437
UNPROCARCH01	12.15976	10	0.2745
All	49.12858	50	0.5083

Dependent variable: FOOEGARCH04

Excluded	Chi-sq	df	Prob.
YEARINFPER	11.25151	10	0.3383
FOODCYC	8.245198	10	0.6049
PROCCYC	8.757738	10	0.5552
UNPROCCYC	10.01716	10	0.4390
UNPROCARCH01	33.03934	10	0.0003
All	182.0861	50	0.0000

Dependent variable: PROCCYC

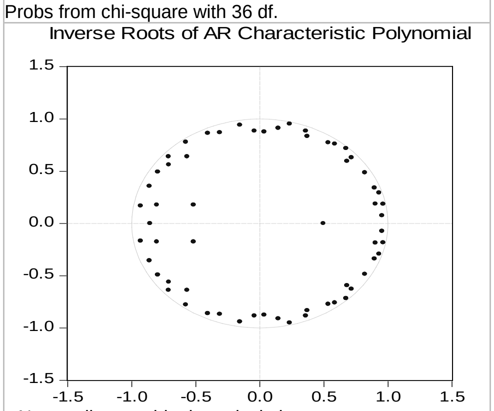
Excluded	Chi-sq	df	Prob.
YEARINFPER	16.43406	10	0.0879
FOODCYC	16.91350	10	0.0763
FOOEGARCH04	13.87453	10	0.1788
UNPROCCYC	15.57537	10	0.1125
UNPROCARCH01	14.49087	10	0.1518
All	53.32359	50	0.3477

Dependent variable: UNPROCCYC

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Sample: 2006M01 2016M03
Included observations: 103

Lags	LM-Stat	Prob
1	49.32813	0.0685
2	28.77987	0.7983
3	36.97517	0.4237
4	23.26979	0.9500
5	42.00369	0.2268
6	41.15644	0.2551
7	33.55780	0.5853
8	39.37375	0.3214
9	28.47258	0.8099
10	38.36234	0.3629
11	32.35822	0.6425
12	26.52885	0.8753

Probs from chi-square with 36 df.



No root lies outside the unit circle.
VAR satisfies the stability condition.

Excluded	Chi-sq	df	Prob.
YEARINFPER	17.66976	10	0.0608
FOODCYC	12.95371	10	0.2263
FOOEGARCH04	8.172315	10	0.6120
PROCCYC	10.35656	10	0.4098
UNPROCARCH01	11.79982	10	0.2987
All	47.07670	50	0.5914

Dependent variable: UNPROCARCH01

Excluded	Chi-sq	df	Prob.
YEARINFPER	17.80225	10	0.0584
FOODCYC	11.01440	10	0.3564
FOOEGARCH04	5.389214	10	0.8637
PROCCYC	10.72546	10	0.3793
UNPROCCYC	10.87971	10	0.3670
All	68.31993	50	0.0435

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Sample: 2006M01 2016M03
Included observations: 103

	Component	Chi-sq	df	Prob
Joint	Skewness	4.766383	6	0.5741
	Kurtosis	0.990540	6	0.9860
	Jarque-Bera		df	Prob.
	5.756923		12	0.9278