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IMPACT OF ANOMALIES ON FOOD PRICES IN TÜRKİYE

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ABSTRACT

Interest on building an early warning indicator to detect abnormal growth in prices in consumer markets has increased after the global food crisis of 2007/2008 and 2011. The indicator of food price anomalies (IFPA) identifies abnormally high or low prices that occur for a food commodity price series over a given period of time. This paper aims to present IFPA for selected products in Türkiye for the last ten years (2012-2021) in order to detect the anomalies in food prices through the quarterly and annual Compound Growth Rates (CGR), of the monthly price level. CGR is modified in order to account seasonality in this method. According to the results, abnormally high prices were measured in the years of 2013 and 2021 at most in Türkiye. And, no abnormally high prices were measured in the years of 2017 and 2019. Bread, veal, sunflower oil, milk, tea, wheat flour, fresh fish and olive were the food items abnormally high prices were measured more than one. Chicken meat, sunflower oil, milk, yoghurt and fresh fish were the food items abnormally high prices were measured in 2021. And, moderately high prices were measured for veal, egg and wheat flour in 2021. When the last three year situations of food items with abnormally high food prices were examined, it was observed that the abnormally high prices were intensively observed after COVID-19 pandemic started.

Keywords: Food Prices, Price Anomalies, Sustainable Development Goals, Türkiye

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INTRODUCTION

The causes for increases in the price indexes of food items relative to the consumer price index (CPI) can be summarized as: the imbalance between demand and supply mainly due to climate change, increase in transportation and production cost, increasing demand for feed because of rising demand for meat over the years, population growth, speculation, panic or hoarding, government trade and inventory policies (Shankar, 1995; Capehart and Richardson, 2008; Timmer, 2008; Chand, 2010; Yavuz, 2021).

Some characteristics of agricultural product markets; the seasonality of production, the derived nature of their demand, and generally price-inelastic demand and supply functions, tend to make agricultural product prices more volatile than are the prices of most nonfarm goods and services (Schnepf, 2006). Interest on building an early warning indicator to detect abnormal growth in prices in consumer markets has increased after the global food crisis of 2007/2008 and 2011 (Baquedano, 2015). The monitoring of prices after taking into account seasonality and inflation is an ideal way to use as the basis of an early warning indicator (Araujo *et al* 2012, Dawe and Doroudian, 2012; WFP, 2014; Baquedano, 2015). Indicator of food price anomalies (IFPA), which is one of international indicator directly evaluates growth in ~~prices over a particu~~lar month over many years, ensures that. IFPA, which relies on a weighted compound growth rate that accounts for both within year and across year price growth, for selected food products in Türkiye was measured in this study. IFPA has been used recently in the literature to detect food price anomalies (Baquedano, 2015; Traore and Diop, 2021; UN,2022a).

One of the important goals in Sustainable Development Goals (SDG) is SDG 2 defined as *"End hunger, achieve food security and improved nutrition and promote sustainable agriculture*". Target 2.c defined as *"Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility"* is classified in this goal. Indicator 2.c.1: *"Indicator of food price anomalies (IFPA)"* of Target 2.c identifies markets prices that are abnormally high. The IFPA measures the number of "Price Anomalies" that occur on a given food commodity price series over a given period of time.

Food inflation is higher than other goods and services inflation level and total inflation in Türkiye (Akcelik and Yucel, 2016). Also food prices way in Türkiye differs from international way, thus food prices in Türkiye show parallelism with world food prices up to 2010, however after 2010 they follow an opposite course in such a way that the volatility of food inflation and its level is significantly higher compared to other countries

[1]The opinions and contents of the article remains the responsibility of the author, not of the Turkish Statistical Institute.

(Akcelik and Yucel, 2016; Ulusoy and Sahingoz, 2020). Main reason of that food prices in Türkiye followed the opposite course than the world food prices was the high level of foreign dependency in agricultural inputs in Türkiye (Bayramoglu and Yurtkur, 2015). The depreciation of the Turkish lira against the dollar and the euro caused the increase in the prices of energy, fertilizer and feeding stuff. Accordingly, high increase in food prices was observed**.** These events have caused for concern among policy makers, and the efforts on monitoring and preventing the increasing of food prices have gathered speed in recent years.

Presently, there is a lack of research on the food price anomalies by food commodities both in Türkiye and in other countries. The results presented in this paper are the first estimations for Türkiye known to date. There are some IFPA estimations for some other countries only for wheat, maize, rice, millet and sorghum (UN, 2022a). The objective of this paper is to detect food price anomalies for selected products in Türkiye for the last ten years (2012-2021) through the quarterly and annual Compound Growth Rates (CGR), of the monthly price level.

MATERIALS AND METHODS

The food items with high weights (50 % of the group of food and non-alcoholic beverages) in consumer price index for 2021 were selected for measurements. These food items are bread, veal, lamb, chicken meat, tomato, white cheese, egg, milk, yoghurt, tea, sun-flower oil, potato, olive, and fresh fish. The data on food prices was gathered from the outlets in whole Türkiye by Turkish Statistical Institute (TurkStat) interviewers once a week or twice a month. The real price values, which have been deflated using CPI (2003=100), were used in this study.

In this study, food price anomalies for selected products in Türkiye for the period 2012-2021 are measured through the quarterly and annual Compound Growth Rates (CGR), of the monthly price level. A CGR is a geometric mean that assumes that a random variable grows at a steady rate, compounded over a specific period of time (Baquendo, 2015; Anson *et al*., 2011). The calculation of IFPA indicator requires an uninterrupted monthly price series of at least 5 years (UN, 2022b). In this study, the ten years after the 2007/2008 and 2011 food crises were taken as a basis to reveal the changes in food prices in the last decade. The assumption of a steady rate of growth ensures the smoothness of the effect of volatility of price changes (periodic price movements). The CGR is the growth in any random variable from time period t_0 to t_N, raised to the power of one over the length of the period of time being considered (Eq. 1) (Baquendo, 2015).

$$C\quad_{t} = \left(\frac{P_{t_n}}{P_{t_0}}\right)^{\frac{1}{t_n - t_0}} \qquad [1]$$

Where P_{t_0} is the price at the beginning of the period, P_{t_n} is the price at the end of the period, and $t_n - t_0$ is the time in months between t_0 and t_n.

Seasonality is an important phenomenon in agricultural markets that causes agricultural commodity prices vary periodically (Gilbert *et al*. 2017). So, CGR is modified in this method in order to account for seasonality by defining two CGR's, a Quarterly Compound Growth Rate (CQGR) and an Annual Compound Growth Rate (CAGR). CQGR and CAGR are calculated as a moving average over the immediately preceding 3-month or 12-month period of month t, respectively. Then, the threshold that identifies abnormal growth in prices is defined as abnormal price growth, an absolute positive change in the CGR, either annual or quarterly, that is at least one standard deviation of the mean CGR over a specific month. Where $C\quad_{y}$ is either the quarterly or annual compound growth rate in month t for year y, $\overline{C\quad_{t}}$ is the average of either the quarterly or annual compound growth rate for month t across years y, $\hat{o}\ X\quad_{t}$ is standard deviation of either the quarterly or annual compound growth rate for month t over years y, and $X\_I\quad_{t}^{Z}$ is either the quarterly or annual indicator of price anomaly (watch/alert/normal) (Eq. 2) (Baquendo, 2015).

$$\left(\frac{C\quad_{y} - \overline{C\quad_{t}}}{\hat{o}\ X\quad_{t}}\right) =$$

$$X\_I\quad_{t}^{Z} \begin{cases} 0.5 \le X\_I\quad_{t}^{Z} < 1 & P\quad W\quad h\,(X\_I\quad_{t}^{W}) \\ X\_I\quad_{t}^{Z} \ge 1 & P\quad A\quad (X\_I\quad_{t}^{A}) \\ o.w. & A\quad (X\_I\quad_{t}^{N}) \end{cases} \qquad [2]$$

The indicator of price anomalies ($I\quad_{t}$) for month t is then obtained by the following weighted sum (Eq. 3):

$$I\quad_{t} = \gamma * Q\_I\quad_{t}^{Z} + (1-\gamma) * A\_I\quad_{t}^{Z} \quad [3]$$

The value of γ is the weight of the deviations of the quarterly or annual compounded growth rates. Finally, annual indicator of food price anomaly (IFPA) for a certain year was estimated as the average weight of all months of the year.

RESULTS

Reel price trends over the last decade were examined by combing different food items with high weights in consumer price index for 2021 into particular groups. The trends in real prices are given in Figure 1.

With regard to the group of cereal products, bread real prices, which decreased throughout 2012, fluctuated and followed an increasing trend until 2015, and decreased again until 2017. Bread real prices, which increased slightly between 2017 and 2021, entered a downward trend after this year. Wheat flour real prices

slightly fluctuated between 2012 and mid-2018, and sharply increased at the end of 2018 and in 2021 (Figure 1(a)).

When we examined real prices of meat items, we observed a lot of fluctuations for all meat types over the years. Veal real prices fluctuated and slightly decreased between 2012 and mid-2014, and increased almost steadily until August of 2015. After this year, it decreased almost steadily until 2019 then fluctuated until end of 2021. Chicken meat real prices fluctuated until March of 2019 then sharply increased until mid-2019. It increased almost steadily between October of 2020 and end of 2021. Lamb meat real prices decreased until 2013 then fluctuated and slightly increased until 2017. There were two sharply increases in lamb real prices throughout first half of 2017 and 2018. Fresh fish real prices fluctuated over years and slightly increased (Figure 1(b)).

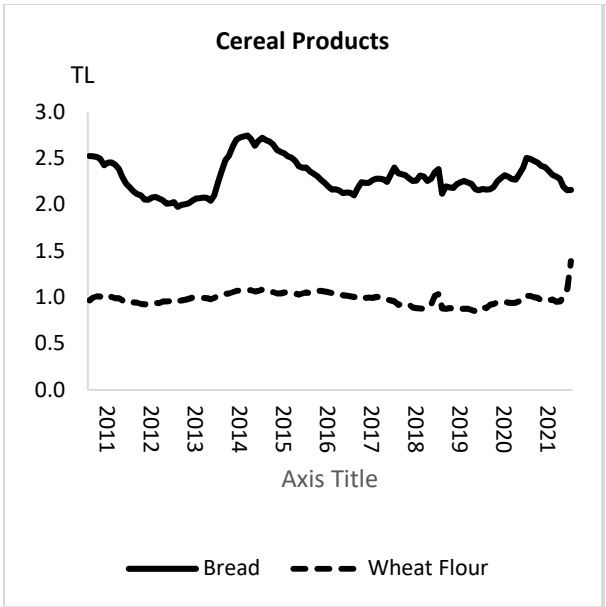
The real prices of milk, yoghurt and wheat cheese fluctuated similarly over the years except for at the end of 2020. Their prices did not change much until the beginning of 2015. After this year, the prices decreased almost steadily until mid-2017 then increased until the beginning of 2018. Then, it fluctuated and increased until the end of 2020. At the end of 2020, white cheese real price decreased while the real prices of milk and yoghurt increased. After that their prices highly fluctuated and increased (Figure 1(c)).

Regarding breakfast foods, egg real price highly fluctuated over years and increased sharply at the end of 2016, then fluctuated over years and increased until the end of 2021. Olive real price fluctuated until mid-2015 and increased until end of 2016. Its price did not change much until mid-2018, then decreased in following years. Tea real price decreased until 2014, and increased until end of 2017. Then, it fluctuated and decreased until end of 2021. (Figure 1(d)).

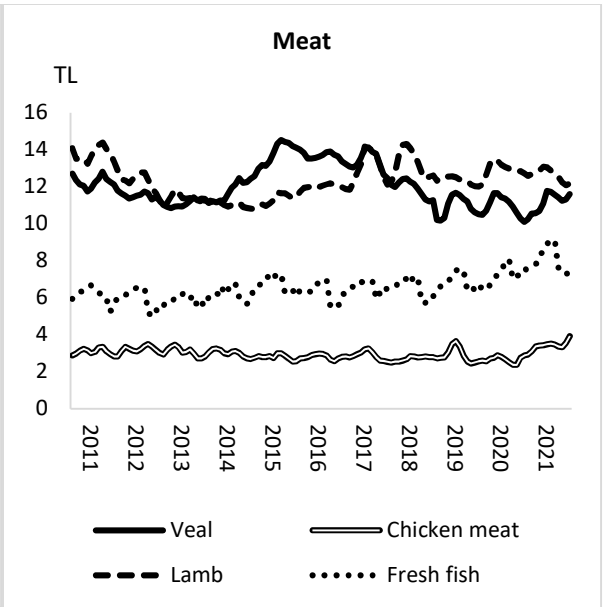
Sunflower oil real price fluctuated but did not change so much until 2020. On the other hand, it sharply increased in 2020 and 2021. Significant fluctuations were observed in tomato reel prices over years (Figure 1(e-f)).

According to the results of IFPA, abnormally high prices were measured in the years of 2013 and 2021 at most. And, no abnormally high prices were measured in the years of 2017 and 2019. No abnormally high prices were measured for egg among ten years. And, bread, veal, sunflower oil, milk, tea, wheat flour, fish and olive were the food items abnormally high prices were measured more than one (Table 1).

When the last three year situations of food items with abnormally high food prices were examined, there was no price anomalies in 2019. On the other hand, price anomalies were observed for sunflower oil and wheat flour in 2020. Chicken meat, sunflower oil, milk, yoghurt and fresh fish were the food items abnormally high prices were measured in 2021. And, moderately high prices were measured for veal, egg and wheat flour in 2021 (Table 1). Monthly fluctuations of IFPA values and the reel prices of these food items were given in Figure 2.



(a)



(b)

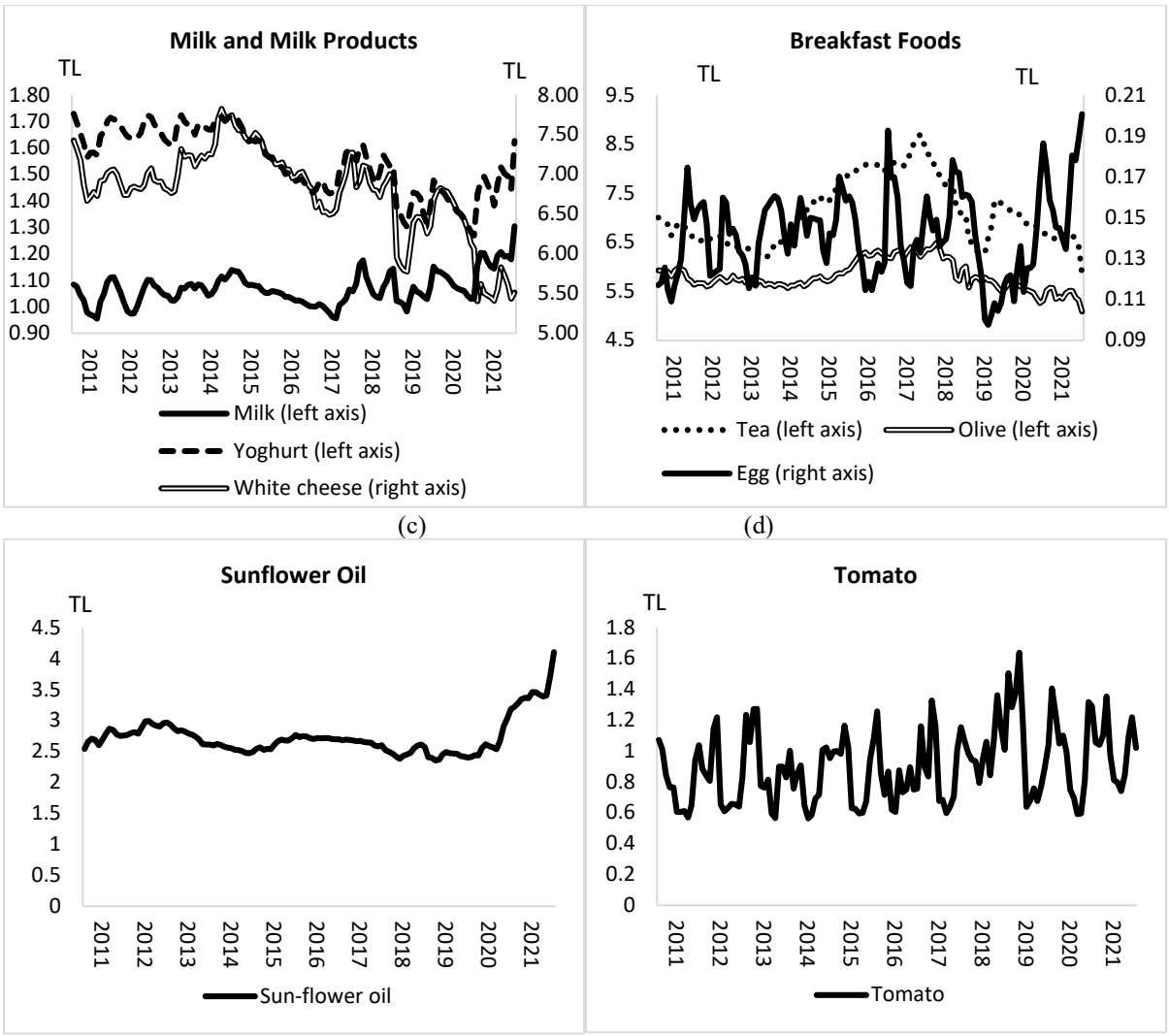


Figure 1. Reel price trends of food items over the last decade in Türkiye

Table 1. Annual indicator of food price anomalies (IFPA) for selected products in Türkiye.

Food item	Annual Indicator of Food Price Anomalies (IFPA)										
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Bread	0,0	-1,2	**2,5**	**1,7**	-0,7	-0,8	0,5	0,2	-0,4	0,6	-0,3
Veal	0,0	0,0	**1,0**	**1,1**	**2,0**	-0,5	-0,8	-1,3	-0,5	0,2	0,6
Chicken meat	0,0	0,6	-1,2	0,0	-0,7	0,6	0,6	-0,3	0,5	-0,2	**2,3**
Lamb	0,0	-0,6	-0,2	0,2	1,0	**1,1**	0,8	0,0	-0,7	0,5	-0,4
Egg	0,0	-0,4	-0,8	-0,1	-0,1	-1,1	0,4	0,5	-1,5	0,7	0,8
White cheese	0,0	0,9	**2,2**	0,7	-0,6	-1,0	-0,3	0,1	-1,5	0,4	-1,4
Tomato	0,0	0,3	**2,2**	-0,1	0,1	-0,1	0,3	0,5	-0,2	0,0	0,0
Sunflower oil	0,0	0,3	-2,0	-0,5	0,6	0,3	-0,4	-0,5	-0,3	**1,9**	**2,8**
Milk	0,0	-0,3	**1,9**	0,6	-0,5	-0,9	0,1	**1,7**	-0,6	0,1	**1,4**
Tea	0,0	-0,6	-2,3	**1,9**	**1,5**	0,2	0,0	-2,4	-1,4	0,0	-0,5
Yoghurt	0,0	0,3	0,4	0,5	-0,9	-1,3	1,0	0,4	-1,4	0,0	**1,4**
Wheat flour	0,0	**3,0**	**1,1**	0,5	-1,0	-0,9	-1,1	-0,7	-0,9	**1,3**	0,8
Fresh fish	0,0	-0,6	-1,1	0,3	**1,1**	-1,3	0,3	-0,2	0,6	0,7	**1,1**
Olive	0,0	0,2	-0,6	0,1	**1,8**	**1,8**	-0,3	-1,6	-1,9	-0,4	-0,1

If < 0.5: No ; 0.5 ≤ If < 1: Moderate high; If ≥ 1: Acute high

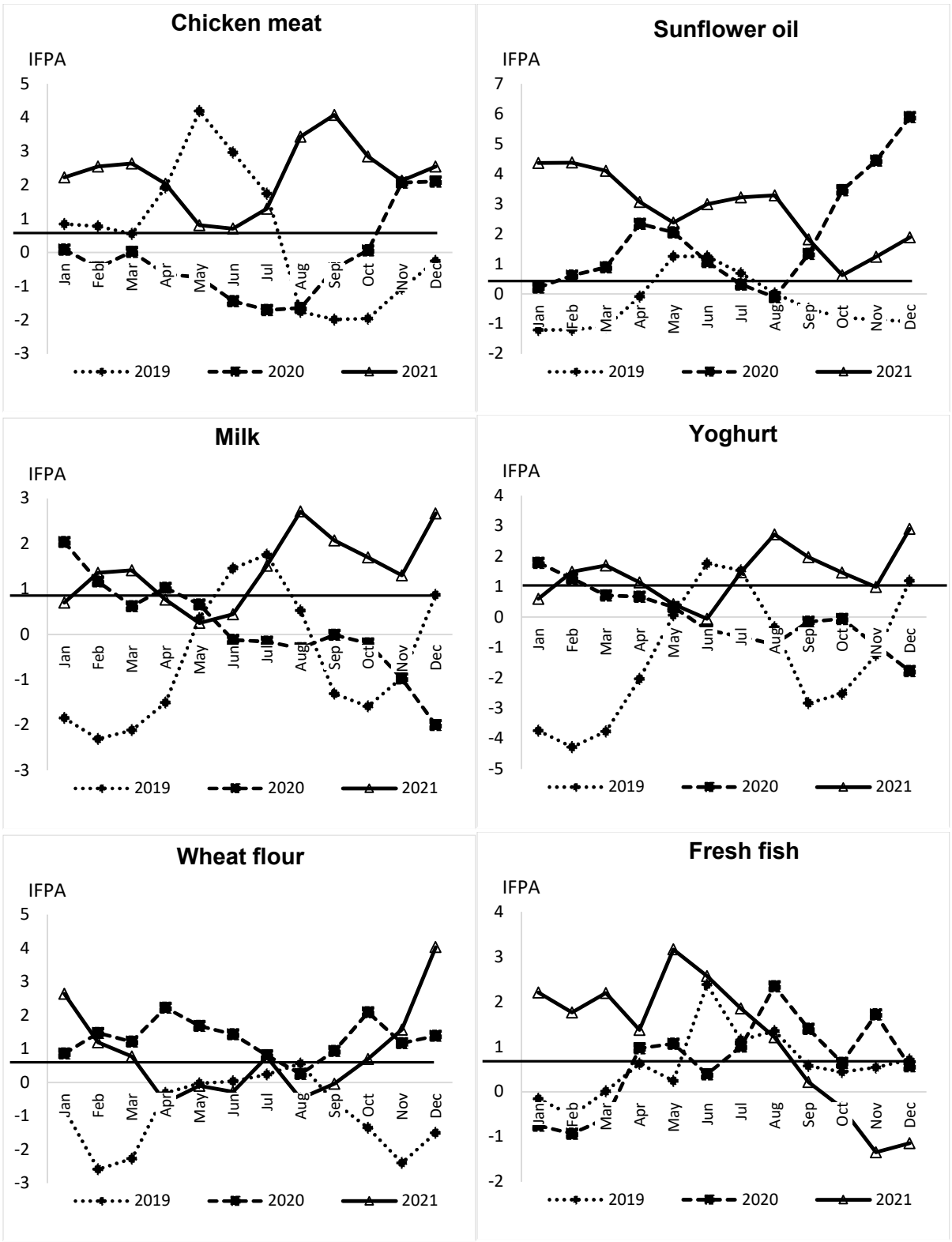


Figure 2. Indicator of food price anomalies (IFPA) of food items with abnormally high food prices in 2020 and 2021 in Türkiye

DISCUSSION

The results were discussed in two parts: (i) before 2019 and (ii) from 2019 in order to analyze better the impact of COVID-19 pandemic, which started in the beginning of December of 2019 in the world and in March of 2020 in Türkiye, on food prices.

Food price anomalies before 2019: The price of bread, which has the highest weight in consumer price index in Türkiye, was defined by Turkish Government. And the governments tend to keep stable bread price as much as possible due to the its high effect in food inflation. Bread real price decreased throughout 2012 because of the fact that nominal bread price was almost the same while CPI increased by 6,2% in 2012. Food price anomalies were observed for bread in 2013 and in the first half of 2014 because of decrease in durum wheat production in 2013 both in Türkiye and in the world (Emen, 2020). This also caused price anomaly in wheat flour for the year of 2013.

Abnormally high prices were measured in the second half of 2013, in 2014 and in 2015 for veal. Main reason of this was the depreciation of the Turkish lira against the foreign currency, that caused the increase in the prices of agricultural inputs with the high foreign dependency used in meat production particularly in the price of feeding stuff. Veal-feed parity, which is an important criterion in terms of cost and profitability in cattle breeding (Aral etc. 2020), increased sharply in these years and exceeded ideal parity (ESK, 2022). After 2015, the veal prices decreased due to increasing in the number of imported cattle for slaughtering. Abnormally high prices were observed for lamp in 2015, the second half of 2016, mid-2017 and the first half part of 2018. Main reasons for rising of lamb prices in these periods were the increases in the prices of feeding stuff and in the demand for the consumption of lamb meat (Ozdemir etc. 2020). Fish prices anomalies were observed in the beginning of 2015 due to bad weather conditions during this period.

Abnormally high prices were observed in 2013, at the end of 2017 and in 2018 for milk. In Türkiye, reference milk price excluding subsidy is identified by Turkish National Dairy Council. The Council announced the recommended raw milk price as 1,70 Turkish Lira (TL) at the end of 2017 and 2,30 TL at the end of 2018. This caused price anomalies for milk in 2018. The price anomaly for milk in 2013 was mainly caused by price anomaly in May 2013. The reason for this was abnormally high price was observed in May 2013 compared to the same month of last years.

Egg prices abnormally rose at the end of 2016 and in the beginning of 2017 as the foreign exchange rate increased, which directly affects the price of imported animal feed, one of the most important inputs in the egg production, and other countries exported eggs from Türkiye due to the bird flu disease seen in neighboring countries. The reason for anomalies in 2018 was also the rise in foreign exchange rate.

Food price anomalies were observed for tea in 2014 and 2015 because of decrease in tea production due to the drought both in Türkiye and in other countries (Sri Lanka and Malesia) with high tea production. Olive production decreased in 2015 because of bad weather condition in the winter and olive tree diseases (Kıvrak, 2016). Total supply of olive was also low in Türkiye in 2016. This caused price anomalies for olive in 2015 and 2016.

The reasons for tomato price anomaly in 2013 were high marketing margins, and off season prices of tomato, of which were the highest in 2013 between 2011 and 2017 (Yavuz, 2021).

Food price anomalies from 2019: When the last three year situations of food items with abnormally high food prices in these years were examined, it was observed that the abnormally high prices were intensively observed after COVID-19 pandemic started (2020) (Figure 2). This result is consistent with Yavuz (2021), which mentioned that after 2019 the food prices in Türkiye increased faster than before.

Abnormally high prices were measured in 2020 for wheat flour in almost all months except for January, July, August and September. Only in August 2020, the price fluctuation was normal. And, prices were moderately high in other three months. Wheat flour prices increased abnormally in 2020 because of increase in demand as a reason of COVID-19 pandemic although wheat supply increased in 2020 compared to 2019 in Türkiye. High level of wheat import is also an effect on abnormally high prices in wheat flour.

High price anomaly was observed for wheat flour after September in 2021 because of price increases in agricultural inputs depend on increase in foreign exchange rate, which affected directly the cost of agricultural inputs. Another important reason for anomaly was decrease in domestic supply because of drought that wheat production decreased 13,9% in Türkiye in 2021 compared to previous year (TurkStat, 2022).

In 2019, recommended raw milk price was between 1,70 and 2,30 TL, and it was constant in whole year of 2020 as of 2,30 TL. So, price anomalies for milk were barely observed in these years. However, it fluctuated between 2,80 and 4,70 TL in 2021. This caused price anomalies for milk in 2021. Almost the same situation with milk was observed for yoghurt.

Sunflower oil prices were abnormally high in all months after August 2020 except for October 2021. They were also abnormally high in 2020 in April, May and June. However, in 2019 there were no price anomalies except for May and June. Sunflower seed production in the world decreased 10,3% in 2020 compared to previous

year. It also decreased in Russia and Ukraine, the countries have a great importance in sunflower seed production of world (52,6% of total production), 13,4% and 14,1% respectively (FAOSTAT, 2022) because of drought during pre-bloom (MoAF, 2022a). The reduce in the production caused increase in sunflower seed price in 2020. Also, it was affected by that Russia and Ukraine tended to export sunflower oil instead of sunflower seed to gain higher income. In 2020, foreign sunflower seed price increased 42,9% from September to December. Türkiye imported 1,145 million tonnes sunflower seed, almost 55,4% of domestic production. This caused to observe abnormally high prices (MoAF, 2022a).

The decrease in sunflower seed production in Türkiye in 2020 also affected the prices in 2021. With increase in production after harvest started in 2021, price anomaly also decreased after August 2021. However, it increased again after October because of increase in foreign exchange rate, this caused rise in production and transportation cost. But, the anomalies after October were relatively low because of increase in sunflower seed production in Türkiye in 2021, this rise was 16,8% compared to previous year (TurkStat, 2022). Another reason for the anomalies of sunflower oil prices in 2020 and 2021 was the increase in demand as a reason of COVID-19 pandemic.

Anomalies in the prices of chicken meat were observed between April and July in 2019, and after October 2020 during last three years. There were no anomalies only in May and June in 2021, however the prices were moderately high in these moths, and anomalies were very close to one.

The reason for anomalies between April and July in 2019 were the increase in the prices of feeding stuffs, which constitutes of 66% of total production cost, and the problems with Iraq had the highest share in chicken meat export of Türkiye that Iraq implemented extra taxes for saving domestic production by 2018 and import prohibitions for poultry products by May 2019. This caused sectoral shrinkage in chicken meat production and this shrinkage directly affected the prices together with the increase in the domestic demand for chicken meat in Türkiye in summer months (MoAF, 2022b).

During COVID-19 pandemic, no price anomalies were observed as a result of increasing chicken meat production and decreasing demand because of curfew up to August 2020. However, increasing in demand for chicken meat due to ending curfew and the prices of feeding stuffs caused price anomalies at the end of 2020 and in 2021.

Anomalies in the prices of fresh fish were intensively observed between July 2020 and September 2021 during last three years. There were no anomalies in the last quarter of 2021. The reason for anomalies during this period were bad weather conditions, prohibition of fishing for preventing of fishing of inappropriate fish length, and mucilage event in the Çanakkale Strait (Dardanelles) and Sea of Marmara.

We can therefore conclude from the study results that the abnormally and moderately high prices were intensively observed after COVID-19 pandemic. Data on food price anomalies in Türkiye by food items are not available. It is therefore not possible to validate the results obtained. However, the studies about food inflation in Türkiye showed that the food prices increased faster in recent years than before (Sahin Kutlu, 2021; Yavuz, 2021; Cavlak and Selvi 2022). Proportion of countries recording abnormally high food prices according to the IFPA increased dramatically in 2020, the last year for which data is available, compared to 2019 in the world and in the sub-regions of the world (UN, 2022a). Similar to this result, food price anomalies in Türkiye increased after 2019.

Global food prices have reached the highest level in recent years, but what made the situation in Türkiye more fragile was that the high cost of inputs in agricultural production because of high foreign dependency on these inputs. The price increase in the production inputs causes a rocketing increase in the general price level, while the price decrease causes a feathery drop in the general price level according to the effect called “rocket and feather” (Berghe, 2018). Sudden increases in the exchange rate in Türkiye increases the cost of agricultural inputs, which has a rocketing effect on food prices. So, it is crucial to make policies to prevent the depreciation of the Turkish lira against the foreign currency in order to avoid food price anomalies.

The measures taken to suppress raw milk prices, increased due to rising feed prices, in order to control the market prices of milk and milk products in the short term caused that dairy cows to go to slaughter and therefore decreased in the number of livestock and red meat supply in the medium and long term in Türkiye. This situation caused an increase in the number of animals imported for slaughtering and meat and milk prices. In addition, the effect of animal imports to suppress meat prices negatively affected the income-expenditure balance of domestic breeders and caused them to leave the sector. In food systems, it is seen that direct public interventions in market prices such as taxes, subsidies, standards, pricing schemes can show results contrary to the intended transformation and improvement in the long run (EU, 2022). Instead of this direct interventions in market prices, it is important to take necessary measurements to maintain supply-demand balance by optimizing production capacity and productivity, improving irrigation methods against drought, decreasing the prices of agricultural inputs with reducing foreign dependency, popularizing effective cooperative systems, ensuring the equality of income distribution, shifting consumer behavior to prevent loss and waste. To achieve this, it is

necessary to monitor all components and interactions between components in the food supply chain. Thus, it will be possible to produce policies based on evidence/data.

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