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The Impact of Retail and E-commerce Sales on Inflation Including the Covid-19 Period: Evidence from Turkiye

(Sayfa 1-13)

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Abstract

The aim of this study is to evaluate the effect of retail or online shopping on the producer price index before and during the Covid-19 pandemic period. Thus, the impact of crisis periods will be clearly revealed. For this reason, In the study, data between January 2010 and November 2022 are used in the case of Turkey. As a result of the empirical analyses, it was determined that the causality relationship between the Producer Price Index and the Internet and Mail Order Turnover Index, which was valid in every canton without exception until the Covid-19 pandemic, disappeared with the pandemic. No causal relationship has been identified from Internet and Mail Orders Turnover Index to Producer Price Index. While bi-directional causality was detected between Retail Turnover Index and Producer Price Index in some quantiles, unidirectional causality was detected from Producer Price Index to Retail Turnover Index in some quantiles.

Keywords: E-commerce sales, Retail sales, Inflation, Fourier test, Covid-19

JEL classifications : C32, E31, F14, L86

1 Introduction

Nowadays, consumers have access to information about the products they are considering for purchase quickly and easily. In addition, they know very well what they want and in general they want it to be realized immediately. Basically, in today's marketing world, online and offline channels are mentioned as sales or shopping channels. Offline channel refers to a wholesale or retail sale that operates entirely in real space. These channels are used by both the manufacturer and the wholesaler-retailer. Although the online channel has certain advantages, it may not be attractive to some consumers due to the extended delivery time. According to the marketing research, consumers go to the offline store after shopping online because they want to buy the product immediately. On the other hand, whether the product is in stock in the offline store also influences this purchase (Chen et al., 2008).

Offline and online channels complement each other in many ways. The online channel offers opportunities such as more product diversity, more convenient search and shopping environment, overtime sales and after-sales service. Such a situation also allows the seller to expand his market. The demand in the online channel allows the manufacturer or seller to effectively plan and manage their stocks. In addition, sellers can be more effective in their marketing activities by obtaining information about the behavior of online consumers and allure customers to offline channels with some attractive promotional activities. In online shopping, the consumer is not able to examine priorly the product he/she intends to buy and at the same time is worried with privacy and security. At

this point, the power of a well-known brand with a physical store or a brand that has brand awareness, that is, a long-existing brand, becomes effective and reduces the concerns of the consumer (Xia & Zhang, 2010).

This study has been conducted to reveal the effect of consumers' retail or internet shopping on the Producer Price Index. The variables of the study are Retail Turnover Index, Internet or Mail Order Turnover Index and Producer Price Index. The period of the analysis is 2010:1 - 2022:11.

2 Conceptual Framework

2.1 Dual Sales Channel

A sales channel is a group of interdependent organizations that make goods or services suitable for use or consumption (Sheng & Lu, 2020). The concept has a twofold meaning. While producers or sellers try to deliver the products, they produce or want to sell to the consumer, the consumer also tries to obtain the products they need from the producer or seller in some way. A sales channel that will enable this exchange ensures that both the producer-seller and the consumer achieve their goals. While the sales channels used in marketing are expressed in different ways, today online and offline channels are mainly mentioned.

The concept of dual sales channel was first proposed by Mols (2000) in his study. Since then, other researchers have studied and developed the concept. Gabrielsson et al. (2002) conducted a case study using the dual sales channel to market personal computers in the European market. On the other hand, Steinfield et al. (2002), in their study, asserted that the application of dual sales channels would have four benefits in the form of cost savings, improved product differentiation, increased trust and market expansion, and enabled the concept to take place in the literature (Widodo et al., 2011).

With the development of e-commerce, manufacturers have turned to designing different channel structures for consumers' shopping needs (C. Zhang et al., 2021). With the convergence of technology, competition, and customer expectations, it has become imperative for sellers to sell their products through dual channels (Bilgicer et al., 2015). With rapidly developing technology, manufacturers have combined their existing physical retail channels with an online channel that allows them to reach more consumers. This dual channel strategy has been used extensively for more than a decade. Some companies sell through their own website, others through an electronic marketplace. Dell Computer sells its products in many offline stores, on its own online channel DellAuction.com and also on a marketplace such as eBay (Wang et al., 2018). In particular, the transformation of retail activities into online form has significantly changed all retail systems. It was necessary to create new models with online sales. Online turnover of offline retailers has increased with the introduction of e-commerce (Hübner et al., 2016). One of the main benefits of having dual channels is more satisfied and therefore more loyal customers (Bilgicer et al., 2015). Szolnoki & Hoffmann (2014) segmented consumers in the German wine market according to the sales channel used. Six sales channels were combined, and two sales channels (basic and premium) were selected as the primary active segmentation criteria.

Zhang et al. (2017) investigated a retailer's choice of channel structure as fully offline channel, fully online channel, and dual channel and how these channel choices affect pricing. They found that the retailer's optimal channel choice would vary according to the degree of customer acceptance of the online channel. It has been determined that the offline channel will be more suitable if the customer acceptance rate is low, the dual channel if it is medium, and the online channel if it is high. A retailer working entirely through the offline channel is predicted to establish a strategic online channel where demand will be low in order to receive a wholesale price discount from the manufacturer. They stated that when a retailer working entirely through the offline channel prefers the dual channel, the manufacturer may suffer losses and therefore may not allow the retailer to sell online. In such a case, it has been suggested that the retailer charge the manufacturer a fee that would have a Pareto effect.

Another study Ronayne & Taylor (2020) distinguishes between direct channel and competitive channel. A manufacturer or seller sells its product either through a direct channel through its own store or website, or through a competitive channel where many sellers' offers can be evaluated at the same time. Competitive channels are price comparison websites in the service sector, online marketplaces such as Amazon or eBay in durable goods, or shopping malls where multiple sellers are physically present (Ronayne & Taylor, 2020). Through the competitive channel, consumers can easily make price comparisons, which increases competition among sellers. Seifbarghy & Kafshian Ahar (2022) similarly argue that a manufacturer can sell its products through two channels: the traditional retail channel and the online direct channel.

Online channels are often referred to as agency channels and reselling channels. The agency channel is also a marketplace, where the manufacturer or seller sells its product to the consumer through the platform and pays a certain percentage of the revenue from the sale to the platform as commission. The resale channel is defined as a channel in which the manufacturer or seller sells its product through a wholesale contract with the platform and the platform resells the product to consumers later (Ha et al., 2022). Producers or sellers who want to sell their products through online channels can choose one or both of them. In addition, a new sales channel called live streaming shopping has recently been mentioned on e-commerce platforms. It refers to a channel where a broadcaster acts as a retailer to sell a product to consumers. By uploading a real-time video, he explains the features of the products, interacts with consumers watching the video, and encourages them to purchase (Zhang et al., 2022).

Zheng et al. (2021) investigated channel choice and its coordination in recycling for manufacturers. As a result, it mentions three recycling channel structures. These are: manufacturer's collection mode, retailer's collection mode and third-party collection mode. The preferred channel varies depending on factors such as the intensity of competition in the channel, collection costs and remanufacturing cost savings. In addition, the sales channel model (single or multi-channel model) is also seen as an important factor in the manufacturer's choice of recycling channel.

Zhang et al. (2021) refer to direct selling, agent selling and dual-format selling for a manufacturer or seller selling through electronic channels. In direct selling, the manufacturer or seller sells its products through its own website. In agent selling, the manufacturer or seller sells its products through a third-party platform, such as Amazon.com, and pays a fee for this transaction. In dual-channel selling, they adopt a hybrid selling mode using both. Many companies such as IBM, HP, Apple, Samsung, Sony, IBM, HP, Apple, Samsung, and Sony use dual-channel selling, both establishing direct channels and setting up stores on platforms directly accessible to consumers (Huang et al., 2018; Yang et al., 2018; C. Zhang et al., 2021; S. Zhang et al., 2019).

There are also studies that address the problems of implementing a dual-channel strategy. It is indicated that problems arise especially in supply chain management. Batarfi et al. (2016) stated that the online channel within the dual-channel strategy causes problems such as determining the production quantity of the product and disruption of shipments. It is also expressed that it may cause conflict between the manufacturer and the retailer and reduce the retailer's market share (Hua et al., 2010).

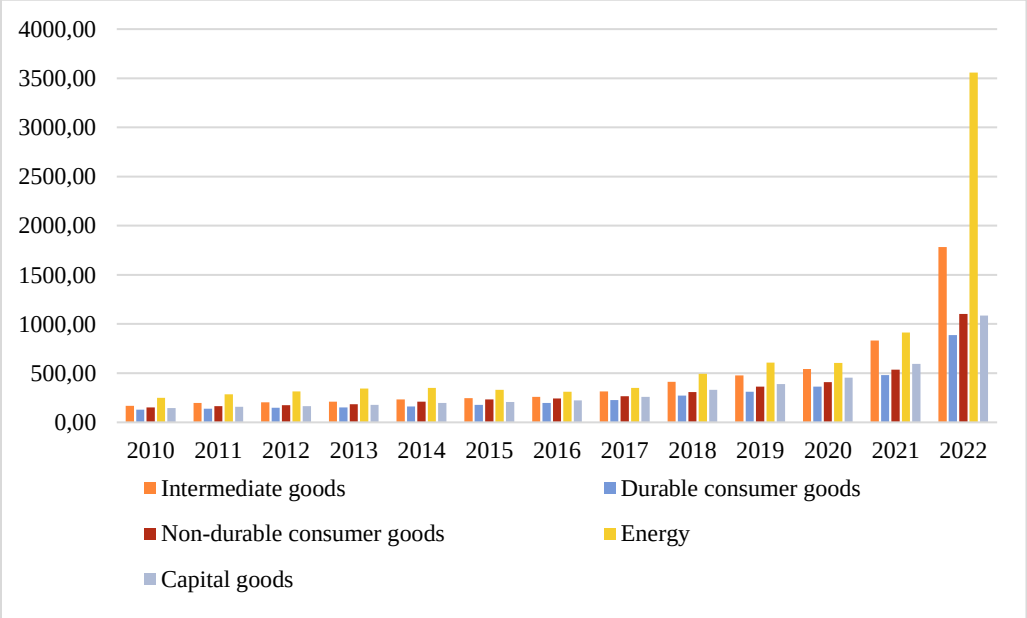
2.2 Producer Price Index

When analyzing the economy of a country, important macroeconomic values such as inflation, unemployment, GDP, exchange rates are used (Meyer & Habanabakize, 2018). PPI, which was previously called Wholesale Price Index (WPI) and has been valid since 2005 (Terzi & Tütüncü, 2017), expresses the average prices of the products in the input basket that producers mostly purchase (Akcay, 2011). The PPI inflation rate shows the price changes of products used as inputs in the production process (Öner, 2018a). PPI is defined as the price index that results from the comparison of the price change in producer prices of products produced in an economy within a certain

period and sold within the country ((Terzi & Tütüncü, 2017). It consists of raw materials, intermediate goods, and manufactured goods (Abdioğlu & Korkmaz, 2012). In general, economists consider PPI as an important indicator of future consumer inflation. This is because producers pay for products before consumers (Akcay, 2011). The increase in the costs of inputs used during production raises final consumer product prices and causes inflation. Such a situation affects the general level of prices (Öner, 2018a). The producer price index and the consumer price index show the general inflation rate in an economy (Erdem & Yamak, 2014).

As of 2005, the PPI index is calculated using the internationally used chain index method. As the starting year, 2003 is based on 100 points. PPI is shown as domestic and international in 2014 and onwards (Öner, 2018b). While calculating the inflation rate, the CPI and the Domestic Producer Price Index (D-PPI) are taken into account. D-PPI measures the change in producer prices of products produced and sold domestically (Koçak, 2021).

Figure 1. Domestic Producer Price Index, main industrial groupings, 2003=100.



Source: TurkStat (2023)

The table shows the producer price index values by main industry category for the period 2010-2022. During this period, it is seen that the values show a continuous increase and a decrease in some years only in the energy industry. In 2022, the highest increase of 1326.86% compared to 2010 was realized in the energy industry producer price index values. Especially in the last 2 years, producer price index values have increased significantly in all industrial categories. In 2022, the producer price index values of intermediate goods increased by 114.42%, durable consumer goods by 85.36%, non-durable consumer goods by 106.37%, energy by 288.57% and capital goods by 82.24%.

In this study, the percentage change in the retail sales index and the percentage change in the internet and mail order sales index are used as independent variables and the producer price index is used as the dependent variable. Monthly data for these variables for the period “2010:1 - 2022:11” are shown in Table 1 below.

3 Literature Review

There are many studies in the literature investigating the effects of retail or online trade on inflation and other macroeconomic variables. These studies mostly explore the effects of online trade, online shopping, or e-commerce on inflation.

Duca & VanHoose (2000) tried to reveal how inflation behavior was affected by the increase in competition in the US goods market in the 1990s. Inflation was found to be lower, and the Phillips curve flattened as there was more competition in the goods market. It was observed that more competition prevented inflation.

Nakamura et al. (2011) investigated the effects of price changes in department store chains on inflation determination based on the prices of coffee, cold cereals, and soft drinks in the United States for the period 2001-2005. It is stated that retail price dynamics are crucial in determining price indices, which are the determinants of inflation. Sectors or products that exhibit volatile prices (such as fresh fruit and vegetables) are often used as samples more frequently than product categories with more stable prices.

Charbonneau et al. (2017) examined the impact of digitalization and e-commerce on inflation in Canada and found that e-commerce had a very small effect on disinflation. They stated that as e-commerce increases, inflation may see downward pressure in the future due to increased competition.

Calson-Öhman (2018) investigated whether increasing e-commerce has a negative impact on inflation based on panel data of 28 European countries in the period 2006-2017. In the analysis conducted with the help of fixed effects regression model, it was found that e-commerce has a negative effect on inflation. When e-commerce increases by 1%, inflation decreases by 0.23%. In addition, in order to determine whether this effect decreases over time, Sweden's 2006-2017 time series data were used. According to the results of the Error Correction Model, it was found that equilibrium was achieved in the long run and 57% of the equilibrium was reached in the first year.

Cavallo (2018) investigated the effects of online competition on pricing behavior in the US. The study examines the pricing behavior of large multi-channel retailers in the US over the last 10 years. Online competition affects retail markets in many ways. Changes in retail pricing decisions can have a lasting impact on price increases on inflation dynamics.

Eştürk & Albayrak (2018) analyzed the impact of price increases in agricultural products and food on inflation using ARDL Bounds Test by utilizing agricultural producer price index data. According to the results, it is determined that there is a long-run relationship between the variables. There is a causality relationship from agricultural producer price index to inflation at 5% significance level.

Fabo & Slovenska (2018) examined the potential effects of e-commerce at the Central Bank of Slovakia. They find that e-commerce has an impact on price stability in the long run rather than the short run. He stated that the Central Bank should monitor online sales prices, especially in the context of inflation targeting.

Goolsbee & Klenow (2018) investigated the effects on inflation with the increase in e-commerce. As a result of the analysis with online data for the period 2014-2017, it was concluded that inflation could be 1.5% to 2.5% lower with the increase in e-commerce.

Jo et al. (2019) examined the effects of e-commerce on inflation in Japan with data for the period 1991-2016. E-commerce was also found to reduce relative inflation rates for goods that were intensively sold online.

Eryüzlü (2020) investigated the short-run effect of e-commerce utilization on inflation in the context of Turkiye. Covering the 2014:1 - 2019:6 period, Hatemi-J causality test is used in the study. In this test, positive and negative component distinction is made for the series and critical values are found using the bootstrap method. As the use

of e-commerce increases, inflation increases. When the use of e-commerce decreases, inflation increases again. It is stated that this situation is caused by foreign trade transactions and government barriers. Another result is that inflation decreases when e-commerce use decreases.

Kulakov & Vinogradov (2020) analyzed the impact of e-commerce development on inflation for the period 2010-2018 and 19 Euro area countries. The linear panel model and a panel vector autoregression revealed the negative impact of e-commerce development and digitalization on inflation. According to the results of the panel analysis, e-commerce has a decreasing effect on inflation.

Matolcsy et al. (2020) argued that e-commerce could lower prices by increasing competition among firms and changing the traditional business model, reduce costs in retail and wholesale trade, and lower costs would contribute to lower prices of goods and services and reduce inflation. In the long run, this would not reduce inflation continuously and would even increase it again.

Çoban (2022) analyzed the effect of internet usage on inflation in ASEAN-5 countries with the panel data method within the scope of 1994-2014 period. It was observed that inflation decreased as the rate of internet usage increased in these countries.

Jiang et al. (2022) measured the impact of online prices on Chinese websites on inflation during the pandemic. Using the Difference-in-differences (DID) model, it was found that the pandemic increased inflation rates in other sectors except for housing, household goods and service sectors and the size of these increases were different.

Yim et al. (2022) tried to measure the impact of "Amazon.com"s online price data on inflation in Korea. According to the results of the analysis with panel regression and VAR model, a high correlation was found between online shopping data and inflation. A high degree of positive correlation was observed especially in food and non-alcoholic beverages. A 1% increase in online shopping increases inflation by 0.30%. The correlation between the two variables was not found in clothing and footwear.

4 The Materials and Methods

In this study, the effect of Internet and Mail Orders Turnover Index Percentage Change and Retail Turnover Index on Producer Price Index (PPI) is revealed. The importance of this study lies in the fact that although the variables are analyzed separately in the literature, no study has been conducted in which they are analyzed together. The causality relationship between PPI and other macroeconomic variables (CPI, exchange rate, GDP, taxes, monetary and fiscal policies, interest rates, commodity prices, etc.) is mostly studied. The series of variables are logarithmically transformed and seasonally adjusted. The study covers the period 2010:1 - 2022:11. The table below provides the abbreviations of the variables and the source information from which they are obtained.

In this study, the Fourier ADF unit root test proposed by Enders & Lee (2012) is used. To apply the Fourier ADF unit root test, the following model is estimated:

$$\Delta y_t = \delta_0 + \delta_1 \sin\left(\frac{2\pi\kappa t}{T}\right) + \delta_2 cos\left(\frac{2\pi\kappa t}{T}\right) + \delta_3 y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + V_t \quad (1)$$

In this study, the causality test based on the quantile autoregression approach of Nazlioglu et al. (2016) and developed by Cheng et al. (2021) is used. The related causality test is called the Fourier Toda-Yamamoto Granger causality test Bootstrap Fourier Granger causality in quantiles (BFGC-Q). Firstly, the Fourier expansion introduced by Nazlioglu et al. (2016) is defined as follows:

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$$d(t) = y_0 + y_1 \sin\left(\frac{2\pi\kappa t}{T}\right) + y_2 cos\left(\frac{2\pi\kappa t}{T}\right) \quad (2)$$

In this equation, soft breaks are captured by d(t). The notation k represents the frequency of the Fourier function. The variable t represents the number of observations.

Cheng et al. (2021) designed a two-stage procedure to test the null hypothesis of non-Ganger causality using the BFGC-Q approach. In the first stage, to control for soft breaks of the deterministic terms, the Fourier expansions of d(t) are included in the following Granger causality equation.

$$Y_t = y_0 + y_1 \sin\left(\frac{2\pi\kappa t}{T}\right) + y_2 cos\left(\frac{2\pi\kappa t}{T}\right) + \sum_{i=1}^{p+h} \theta\, Y_{t-i} + \sum_{j=1}^{m}\sum_{i=1}^{p+h} \vartheta_{j,i} X_{j,t-i} + \varepsilon_t \quad (3)$$

In this equation, Y and X are the dependent and independent variables respectively, p is the lag length, h is the maximum degree of integration and m is the number of covariates. After this stage, the optimum k* and the optimum p* were estimated using the AIC criteria. Equation (4) was estimated by quantile regression with the selected optimum variables.

$$Q_{Y_t}(\tau\backslash Z) = y_0(\tau) + y_1(\tau) \sin\left(\frac{2\pi\kappa^* t}{T}\right) + y_2(\tau) cos\left(\frac{2\pi\kappa^* t}{T}\right) + \sum_{i=1}^{p^*+h} \theta(\tau) Y_{t-i} + \sum_{i=1}^{p^*+h} \vartheta_{j,i}(\tau) X_{j,t-i} + \varepsilon_t \quad (4)$$

Here Z is a matrix of all covariates in the regression model (4). Estimating the regression model (4) with the quantile regression approach allows testing the null hypothesis of Granger causality from X to Y ($X \nrightarrow \ominus Y$) in different quantiles (τ) $\in$ (0, 1) as follows:

H0: There is no causality relationship between variables.

H1: There is a causality relationship between the variables.

The Wald test used in the model is calculated as follows.

$$Wald = \left[T\left(\left(\xi_J(\tau)\right)'\left(\hat{S}(\tau)\right)^{-1}\left(\xi_j(\tau)\right)\right)\right] / \tau(1-\tau) \quad (5)$$

In this equation, the notation $\xi_J(\tau)$ represents the vector coefficient estimate of the quantile (τ). The notation $\hat{S}(\tau)$ indicates the consistency of the estimator of the variance or covariance matrix of $\xi_J(\tau)$. The study also uses the bootstrapping simulation technique based on the approach of Hatemi-J & Uddin (2012) for 10,000 iterations to generate 10%, 5% and 1% critical values from the empirical distribution.

The variables used in the analyses are presented in Table 1.

Table 1. Information about Variables

Variables	Representation	Source
Producer Price Index Percentage Change	PPI	TurkStat (2023)
Retail Turnover Index Percentage Change	RTI	
Internet And Mail Orders Turnover Index Percentage Change	ITI	

Table 1 demonstrates what the variables are, how they will represent and which source they are obtained.

Descriptive Values are presented in Table 2.

Table 2. Descriptive Values

	PPI	ITI	RTI
Mean	2.517327	3.737735	1.910201
Median	2.410389	3.395101	1.603156
Maximum	3.306657	2.970381	2.710846
Minimum	2.217315	-1.381192	-2.023849
Std. Dev	0.260121	6.440460	4.160654
Skewness	1.321274	0.662837	1.035221
Kurtosis	4.211909	5.371780	1.759712
Jargue-Bera	5.458442	4.737268	1.394745
Probability	0	0	0
Sum	3.901857	5.756112	2.941710
Sum Sq. Dev	1.042012	6.346367	2.648590
Observations	154	154	154

Table 2 shows the descriptive values of variables. There are values of mean, median, maximum, minimum, skewness, kurtosis, jargue-bera, probability, sum, sum squared deviations and number of observations.

5 Results

In this section first Fourier Augmented Dickey Fuller Test is applied for the stationarity of the series and then the Fourier granger causality test is applied for the causality relationship between the variables. results The Fourier Quantile Granger Causality test results.

Table 3. Fourier Augmented Dickey Fuller Test Results

Variable	K	Min KKT	FADF Test Statistic	App. Lag Length	F Test Statistics	FADF %1 Critical Value	FADF %5 Critical Value	FADF %10 Critical Value
PPI	3.5	0.01072	4.173031	2	4.081317**	-4,30299	-3,67006	-3,33846
ITI	0.7	5.304516	2.268672	4	-9.041089***	-4,8355	-4,27395	-3,98575
RTI	0.1	2.228916	1.406391	1	-11.29150***	-4,79821	-4,23169	-3,93726

Note: "", "**" and "***" denote significance at the 10%, 5% and 1% levels respectively*.

According to the Fourier Augmented Dickey Fuller Test results in Table 3, all variables are stationary. CPI variable is stationary at 5% level, while ITI and RTI variables are stationary at 1% level.

Table 4. Fourier Quantile Granger Causality Test Results

	Quantile	Wald test.	CV 10%.	CV 5%.	CV 1%.
PPI → ITI	**0.1**	**12.07103*** **	**4.747424**	**6.852365**	**7.517873**
PPI → ITI	**0.2**	**3.873343***	**1.989009**	**4.567983**	**6.968930**
PPI → ITI	**0.3**	**4.872211****	**2.818593**	**3.934112**	**5.056166**
PPI → ITI	**0.4**	**4.182035***	**2.684669**	**5.876118**	**7.312564**

PPI → ITI	**0.5**	**10.00698****	**2.857652**	**5.259510**	**11.41061**
PPI → ITI	**0.6**	**7.322911****	**3.947560**	**6.362480**	**13.85045**
PPI → ITI	**0.7**	**4.186300***	**4.030151**	**5.074748**	**13.49506**
PPI - ITI	0.8	1.351584	4.042196	5.435926	11.26852
PPI - ITI	0.9	2.005237	4.450131	5.167826	10.23480
ITI - PPI	0.1	7.060870	16.55886	18.31896	25.23254
ITI - PPI	0.2	2.543242	8.408716	9.584450	14.26002
ITI - PPI	0.3	3.873537	6.024861	6.802312	8.563236
ITI - PPI	0.4	3.441224	4.924932	6.134506	7.185874
ITI - PPI	0.5	2.072600	4.533.593	5.676212	7.938045
ITI - PPI	0.6	1.820268	3.753659	4.250772	7.636723
ITI - PPI	0.7	4.049115	4.200263	5.059730	16.40002
ITI - PPI	0.8	6.531696	8.647747	9.916015	13.77854
ITI - PPI	0.9	5.519008	7.293119	9.060532	11.55314
PPI - RTI	0.1	0.009217	12.45942	15.40778	46.11712
PPI → RTI	**0.2**	**16.90047****	**8.195683**	**8.929423**	**21.08063**
PPI → RTI	**0.3**	**19.82257*****	**8.636708**	**9.607817**	**17.48759**
PPI → RTI	**0.4**	**26.31778*****	**5.845342**	**9.823330**	**12.43362**
PPI → RTI	**0.5**	**40.47696*****	**8.061773**	**8.843476**	**13.24496**
PPI → RTI	**0.6**	**46.53403*****	**6.885631**	**11.59361**	**18.31637**
PPI → RTI	**0.7**	**42.11468*****	**4.853785**	**6.486407**	**15.15418**
PPI → RTI	**0.8**	**49.24645*****	**4.830009**	**8.202673**	**41.52472**
PPI → RTI	**0.9**	**26.03817****	**8.206139**	**10.10933**	**44.30910**
RTI - PPI	0.1	9.781744	13.56913	20.71404	22.97545
RTI → PPI	**0.2**	**8.296808***	**7.519064**	**9.105456**	**22.54779**
RTI → PPI	**0.3**	**9.533864****	**5.772342**	**8.236413**	**21.87971**
RTI → PPI	**0.4**	**6.233024***	**5.916444**	**7.373073**	**24.21982**
RTI - PPI	0.5	2.704156	4.849678	5.245841	9.649511
RTI - PPI	0.6	1.887666	5.381409	7.120307	13.55519
RTI - PPI	0.7	1.189803	6.133339	8.712182	10.10258
RTI - PPI	0.8	3.352070	8.265812	10.41741	12.38883
RTI - PPI	0.9	9.882043	12.33399	15.46651	19.79418

Note: "", "**" and "***" denote significance at the 10%, 5% and 1% levels respectively.,*

The Fourier Quantile Granger Causality test results in Table 4 indicate that there is a strong causality relationship from the Producer Price Index to the Retail Turnover Index and the Internet And Mail Orders Turnover Index. It is especially important that the causality relationship from the Producer Price Index to the Internet and Mail Orders Turnover Index is present in the first 7 quantiles and there is no causality relationship in the last two quantiles. The last two quantile periods are considered as the period in which Covid-19 effects are observed. Therefore, it was observed that the developments in the Covid-19 process had a disruptive effect on the causality relationship from the Producer Price Index to the Internet and Mail Orders Turnover Index. The causality relationship from the Producer Price Index to the Retail Turnover Index is found to be the most intense causality relationship in the model. In addition, a causality relationship from the Retail Turnover Index to the Producer Price Index was also detected in quantiles 2, 3 and 4. This shows that there is a bidirectional causality relationship between the Producer

Price Index and the Retail Turnover Index in quantiles 2, 3 and 4. In the model, no causality relationship was found from the Internet And Mail Orders Turnover Index to the Producer Price Index.

6 Discussion and Conclusions

Manufacturers or sellers can offer their products to consumers through more channels than in the past. Whereas consumers once had to go to the physical store or shop of the manufacturer or seller to buy a product, nowadays they can also buy the product online and have it delivered to their doorstep. From the manufacturer/seller's point of view, they can offer products offline or online and benefit from a multi-channel system. In online shopping, products can be sold both through the company's website and through competitive online marketplaces with multiple sellers. Recently, social media channels have also been used for product promotion and shopping transactions.

This study analyzes the impact of consumers' retail and online shopping values on the Producer Price Index. The causality relationship between the variables is measured by Fourier Quantile Granger Causality test. The data for the period 2010:1- 2022:11 is analyzed and results that will make a significant contribution to the literature are obtained. The importance of this study is emphasized by the fact that although the variables are analyzed separately in the literature, there is no study in which the variables are analyzed together.

The stationarity of the variables was measured by Fourier Augmented Dickey Fuller test and it was concluded that all variables were stationary. The independent variables were found to be stationary at 1% level and the dependent variable at 5% level.

The Fourier Quantile Granger Causality Test developed by Cheng et al. (2021) was applied to investigate the relationship between the variables found to be stationary. According to the results of this study, the causality relationship from Producer Price Index to Internet and Mail Orders Turnover Index, which was valid in every quantile without exception until the Covid 19 pandemic, has disappeared. No causality relationship was detected from Internet and Mail Orders Turnover Index to Producer Price Index. While a bidirectional causality relationship was detected between Retail Turnover Index and Producer Price Index in some quantiles, a unidirectional causality relationship was detected from Producer Price Index to Retail Turnover Index in some quantiles. The bidirectional causality between Retail Turnover Index and Producer Price Index is found in quantiles 2, 3 and 4. Similar to the findings of Duca & VanHoose (2000); Eştürk & Albayrak (2018) and Nakamura et al. (2011), retail sales have an impact on inflation. On the other hand, the studies in the literature that found that online shopping values have an effect on inflation were based on consumer-side inflation values. In this study, the effect of online shopping values on producer-side inflation values is analyzed and it is found that online shopping values (Internet and Mail Orders Turnover Index Percentage Change) have no effect on the Producer Price Index.

Future research may usefully develop the study of the effects of retail and e-commerce sales on inflation, particularly in other countries. This will undoubtedly provide valuable results.

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