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The Relationship Between the Health Services Price Index and The Real Effective Exchange Rate Index in Turkey: A Frequency Domain Causality Analysis

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Abstract

This paper examines whether the causal relationship between the health care price index and the real exchange rate index is temporary or permanent. To do this, we first apply the Toda- Yamamoto causality test with a structural break and then continue with frequency domain causality tests based on the Toda-Yamamoto causality test with a structural break. The results of the Toda- Yamamoto causality test with a structural break indicates that there is causality running from the real exchange rate index to the health care price index. Moreover, the frequency domain causality test results based on the Toda-Yamamoto causality test with a structural break provide evidence that the real effective exchange rate causes temporarily (in the short-and medium term) to the health care price index. The effect of the real exchange rate index on the health care price index lasts between 2 months and 8.37 months. These findings imply that there is a significant exchange rate pass-through in health care inflation in the short-and medium term. Thus, the health authorities should take into account these findings when planning health care policies in Turkey, especially health care services heavily dependent on imported materials.

Keywords

Health Inflation, Exchange Rate Pass-through, Frequency Domain Causality, Toda-Yamamoto Causality Test, Health Sector in Turkey

JEL Classification: F31, E31, I11

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Introduction

In open economies, domestic prices are affected by exchange rate changes. An upward movement in the exchange rate increases the costs of goods subject to foreign trade, causing an increase in domestic prices. The increase in exchange rates increases the prices of imported goods in terms of domestic currencies. In addition, as the production costs of goods using imported inputs also rise, the inflationary effect occurs.

The effects of changes in exchange rate on inflation has been widely investigated in empirical international finance based on the notion of the exchange rate pass-through (ERPT), which is known as the transmission of exchange rate changes to domestic prices, by working with different methodologies and countries. The studies have also used different prices to examine the ERPT. For example, the studies of Bandt and Razafindrabe (2014), Saha and Zhang (2016), López- Villavicencio and Mignon (2020) used import prices, while export prices were analyzed by Toh and Ho (2001), Choudhri and Hakura (2014), Zhang and Li (2017) and Permani (2020). The studies of Alvarez et al., (2012), Campa and Goldberg (2005) and Kiliç (2016) employed the aggregated import prices, whereas the producer prices were used by Prasertnukul et al., (2010) and Simo-Kenge et al. (2020). Jiang and Kim (2013) and Jobarteh and Yeboua (2016) focused on consumer prices. In Turkey, ERPT has been extensively researched and has attracted the interest of academics, practitioners, and policy makers for several decades because of the importance of exchange rates for domestic prices (Leigh and Rossi, 2002; Telatar and Telatar, 2003; Gul and Ekinci, 2006; Peker and Görmüş, 2008; Özkan, 2012; Selim and Güven, 2014; Dereli, 2018). Also, the effect of changes in exchange rates on domestic prices have been one of the most important issue in Turkey when it comes to controlling persistent and long-lasting inflation, due to the heavy reliance on Turkey’s imported inputs in every aspect of life. Thus, understanding how exchange rates are passed through to inflation is a crucial part of economic analysis in Turkey.

Unlike the large volume of research of ERPT in different countries and different time periods, it is hard to find a significant amount of studies aiming to examine the ERPT healthcare in prices. This lack of literature on ERPT in health prices partly results from the belief that in most market economies, consumers are well “protected” by healthcare insurance, and/or public health services so that they never pay the full burden of rising health care prices resulting from the rise in exchange rates. The recent increase in the share of health expenditures in public expenditures and a significant increase in the portion of health expenditures in consumer expenditures has attracted a great deal attention from policy makers and academics. The devastating and globally contagious Covid-19 pandemic also has accelerated this interest.

Rising health expenditures and health care costs have been an increasing concern for both households and governments in almost all countries around the world. As is mentioned in Yip et. al. (2019), because of population ageing, new technology diffusion, growing demand and rising expectations, all nations are facing the major challenge of a sudden increase in health care expenditure. As countries struggle to achieve universal health coverage- ‘affordable and equal access to effective and quality health care for all that does not cause significant financial hardship’- they are trying to allocate more resources to health systems as well as seeking an efficient health system which allows them to effectively manage health expenditure inflation. If they are not succesful, the sustainability of their health systems will be in danger.

The health-care system is considered as one of the important factors playing a significant role in a nation’s development by improving population health. Thus, there is an increasing trend in the effort of governments to increase public expenditures for medical care with a primary aim of enhancing population health. The health system in Turkey is a typical example of a combination of private and public involvement. Since the early 2000s, the portion and domination of private health services especially in large cities has been increasing. It is fair to say that investment in the health sector by the private sector has been a profitable investment recently. Most of the services of private firms are fully financed by the government and they offer extensive health services to government employees demanding additional fees as well. Also, there is a growing health insurance system aiming to serve private sector participants. Moreover, there is a private supplementary health insurance which can be used by private and public sector employees. However, we see public health system dominance in rural towns as opposed to the private health care providers which are abundant in the highly developed and populated western cities of Turkey.

Percentage increase in the Consumer Price Index (CPI) of health is called health inflation. Unlike the general misperception of health policy makers that the health inflation rate is the same as health expenditures, which are the expenditures on health, including both the amount and price of services and the sum of public and private health expenditures. It includes the costs of health services, nutrition activities, family planning activities and emergency aid designated for health. Thus, health inflation is different from the growth in health expenditures. The factors that cause health inflation are different from those of health expenditures. Health inflation is affected by the factors that impact the supply and demand of health services, such as overall inflation rate, number of doctors, hospital beds, and pharmacies, existence of insurances, etc. Besides these factors, the degree of competition between health service deliverers is also considered as a factor affecting the health inflation rate. As a result of an increase in health inflation, there is high possibility that patients will lose their purchasing power and health expenditures will increase up to levels that might jeopardize the sustainability of the health system. Also, an increase in health inflation has the potential to increase the general inflation and create adverse effects on the individuals’ life conditions and human productivity (Teimourizad et al, 2014).

When the current per capita health expenditure (in current US dollars)[1] data shared by the World Bank is analyzed, we see that expenditures have been increasing continuously since the 2000s. Per capita health expenditure, which was 474.978 thousand dollars in 2000, increased to 908.943 thousand dollars in 2010, and to 1.061.147 dollars as of 2017. Over these 17 years, expenditures continuously increased, except for the decrease experienced in 2015 (World Bank, 2020). Together with the increase in health expenditures, the increases in the prices of these expenditures are continuous.

According to the 2020 Health Inflation Trends Report, the world's health inflation rate was calculated as 8% for 2020. This rate was 7.8% in 2019. In the report, the expectation for an increase in general inflation rates was underlined as the source of the increase. The general inflation rate for 2020 was stated as 3.1%, while the average net health inflation rate was 4.9%. Based on this data, we observe that health price inflation was higher than general inflation rates. Another important point stated in the report is that the upward trend in health inflation would not change in the short term. In other words, it was stated that the upward trend in health inflation would continue. In addition to epidemic diseases experienced, health costs are expected to increase worldwide due to the aging of the global population, poor lifestyle and conditions, and harmful habits (GMTRR, 2020)[2].

Another factor that increases the costs of health expenditures is the exchange rate. The relationship between exchange rate and inflation should be analyzed well, especially regarding developing countries. In developing economies, economic activities are externally dependent. The smallest change in the exchange rate due to high external dependence can significantly affect the country's economy. The economy is deeply affected due to the emergence of negative situations in terms of production costs in the health sector and in terms of the prices of health products (Gül & Ekinci, 2006). In developing countries, and especially in Turkey, the pharmaceutical sector is the component that has the most external dependence in the field of health. The added value generated by the pharmaceutical industry in today's world has laid the groundwork for the industry to have strategic power. Although developing countries have increased their investments in the pharmaceutical industry, there has also been a significant increase in drug imports in these countries. At the root of the increasing import rates are the sector's intellectual property rights regulations, health expenditures, and patient profiles (Yasgul, 2016). In today's world, where infectious diseases are widespread, it is possible to say that the import rates of health products will increase more. When forming the sample of cases examined in our study specific to Turkey, we can say that the health imports are at higher levels. The health

1 Details on the data are available at https://data.worldbank.org/indicator/SH.XPD.CHEX.PC.CD

2 For the full report ; https://insights-north-america.aon.com/research/2021-global-medical-trend-rates report?promo_name=CP-health-01-2020-10-05-2021-global-medical-trend-rates-report&promo_position=CP health-01&_ga=2.60184107.745028018.1613560878- 142465722.1612943278

sector's two most important constituent groups are technology and medicine imports. Products including control, adjustment, medical, surgical instruments, and devices and their parts, components, and accessories were imported worth 4.807.051.673 dollars in 2018, 4.505.106.939 dollars in 2019, and 2.980.885.667 dollars as of August 2020. In the same periods, products including control, adjustment, medical, surgical instruments, and devices and their parts, components, and accessories were exported worth 1,070,435,626 dollars in 2018, 1,182,579,232 dollars in 2019, and 796,560,551 dollars as of August 2020 (TURKSTAT, 2020). Given this data, it is seen that Turkey's external dependence is high in terms of health technology, which constitutes an important component in health imports. While the export/import coverage ratio in 2018 was 0.22%, it was 0.26% in 2019. A similar scenario is observed in drug imports. When the data covering pharmaceutical products and organic chemical products are examined, it is seen that imports amounted to 11,031,863,131 dollars in 2018, 10,876,565,214 dollars in 2019, and 6,830,165,762 dollars as of August 2020. Also, in these years, there were exports of 2,004,943,812 dollars, 2,083,372,875 dollars, and 1,480,073,305 dollars respectively. In 2018 and 2019, the export/import coverage ratio in the pharmaceutical and organic chemical products sector was 0.18% and 0.19%.

The health policies, privatization of health services and increasing payments to private health services from the government budget in Turkey has been heavily debated for a long period of time. There are some similarities in patterns of the nominal GDP growth rate and growth of the nominal health expenditures in the sample period, and in recent years, we can see the evidence of a rise in health spending growth due to health care inflation. Moreover, there is a tendency that during the times of the depreciation of the Turkish Lira against major currencies such as the US Dollar and EURO, the health inflation rate has exceeded the general inflation showing the strong ERPT effects on health prices. For example, when the Turkish lira depreciated in recent years, most of the time, the rise in health inflation was greater than that of general inflation. For example, the average health inflation rates were 17,11% and 13,18% in 2019 and 2020 compared with the average inflation rates, which were 15,17% and 11,51% respectively, showing the significance of ERPT in health prices. In these years, the Turkish Lira lost more than 20% of its value against the US Dollar and EURO.

The literature on health expenditures indicates that the areas where the studies are concentrated are the relationship between health expenditures and economic growth[3] and the factors determining health expenditures[4]. Although there is no study directly addressing the effect of the exchange rate, which is an important determinant of health expenditures, on health expenditure prices, this study will contribute to the gap in this area. Although the literature on the effect of exchange rate on inflation is quite extensive, Kiptui et al. (2005) stated that exchange rate changes on prices are reflected in imported goods' prices and imported intermediate goods. The depreciation of domestic currency against foreign currency (in other words, the increase in the exchange rate) causes the prices of imported goods and input costs to increase, causing domestic prices to increase. Numerous studies[5] in the literature revealed that changes in exchange rates affect inflation.

This paper aims to answer the following questions: (i) is there a causal relationship between health inflation and changes in exchange rate, which is evidence of ERPT in health prices? ii) If so, is this causal relationship is temporary or permanent?

This article contributes to the relevant literature. Firstly, we contribute to the literature by establishing a causal relation between changes in exchange rate and health inflation. Secondly, we identify its temporary or permanent nature by combining the analysis of the frequency domain causality and Toda-Yamamoto with a structural break. In today's world where epidemic diseases pose an important problem for humanity, the price increases to be experienced at the point of health expenditures and the revealing of the effect of the exchange rate, which is an important reason for these increases, with empirical evidence is a factor that makes this study significant. It is believed that the results of the study and the policy recommendations in this context will be important, especially from the point of view of developing countries with high external dependence on health products such as Turkey.

The next section introduces the data used in the study. In the third section, we explain our methodology. In the fourth section, we discuss the findings. The last section concludes.

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3 Murthy and Ukpolo (1994); Hansen and King (1996, 1998); McCoskey and Selden (1998); Gerdtham and Löthgren (2000, 2002); Okunade and Karakuş (2001); Freeman (2003); Jewell et al. (2003); Narayan (2006); Chou (2007); Wang and Rettenmaier (2007); Baltagi and Moscone (2010); Moscone and Tosetti (2010); Sülkü and Caner (2011); Mehrara and Musai (2011); Elmi and Sadeghi (2012); Odubunmi et al. (2012); Oni (2014); Kurt (2015)

4 Newhouse (1977); Hitiris and Posnett (1992); Murthy and Ukpolo (1994); Hansen and King (1996); Hitiris (1997); Di Matteo and Di Matteo (1998); Karatzas (2000) ; Okunade and Karakuş (2001); Herwartz and Theilen (2003); Dreger and Reimers (2005); Chou (2007); Baltagi and Moscone (2010); Potrafke (2010); Dhoro et al. (2011); Furuoka et al. (2011); Panopoulou and Pantelidis (2012); Chaabouni and Abednnadher (2014); Murthy and Okunade (2016); Nghiem and Connelly (2017); Ecevit et al. (2018); Karasoy and Demirtaş (2018); Öztürk and Küsmez (2019); Cafrı (2020); and Tiraş and Turkmen (2020).

5 Rana-Dowling (1985); Kholdy-Sohrabian (1990); Leigh and Rossi (2002); Telatar and Telatar (2003); Gül and Ekinci (2006); Ito and Sato (2006, 2008); Peker and Görmüş (2008); Bissoondeeal et al. (2011); Özkan (2012); Madesha et al. (2013) ; Selim and Güven (2014); Yien et al.(2017); Monfared and Akın(2017); Dereli (2018); Akgül and Özdemir (2018); Charef and Ayachi (2018); Allor (2020).

Data

To examine the impact of exchange rates on health care prices, we obtained monthly data for the period 2008M02-2020M07 from the Electronic Data Delivery System of the Central Bank of the Republic of Turkey. The variables used in the study were the health care price index, which has base year of 2003 (*lhinf*) and the real effective exchange rate index (*lreer*), with an increase (decrease) indicating an appreciation (depreciation) of Turkish Lira. Based on the reasoning of Ghosh and Rajan (2009) and Apergis (2015), we chose to use the real effective exchange rate index for the following reasons. Firstly, it is broader than the nominal effective exchange rate and secondly, it leads to robust results since it has more variation than that of nominal effective exchange rate. The logarithmic values of both indices were used in the empirical analysis. Figure 1 displays the time series plots of both variables.

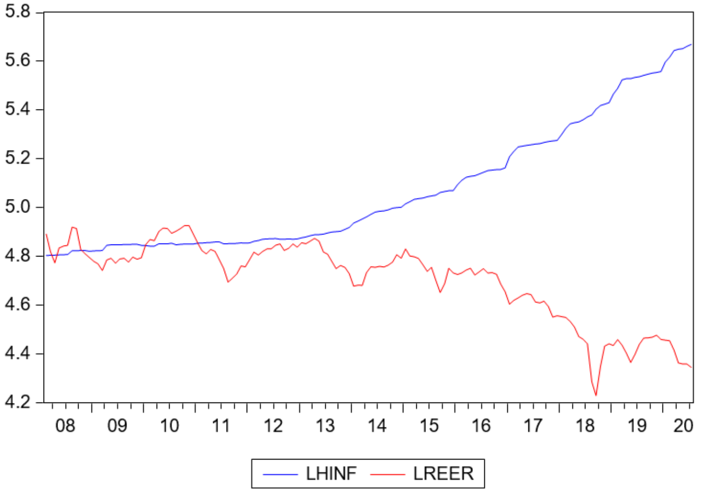

Figure 1. Time series plots of variables.

Visual examination of the times series plots of both variables show that they have structural breaks. Also, *lhinf* exhibits an upward trend after 2013. Thus, further analysis of these two variables does take into account the properties of these variables.

Methodology

In this study, we examined the causal relationship between the health care price index and the real effective exchange rate index in Turkey. To do this, we first determined the existence of any causal relationship by using the Toda-Yamamoto (T-Y) causality test with a structural break. Secondly, we tried to determine whether these causal relationships were permanent or temporary applying the frequency domain causality test based on the Toda-Yamamoto causality test with a structural break.

We started with the Toda & Yamamoto (1995) causality test because of three main reasons. First of all, within the framework of Toda & Yamamoto (1995) methodology, one can test the existence of causal relations between variables even if the variables have a different degree of integration. Secondly, this procedure does not require testing for the existence of cointegration between variables. Finally and most importantly, it prevents the loss of long-run information about variables because of the use of non-stationary series in causality tests.

To carry out the Toda-Yamamoto test with a structural break, we formed the following Equation (1) which is based on Vector Autoregressive Models (VAR) developed by Sims (1980) and the Toda & Yamamoto's (1995) causality test. Since there is a strong deterministic trend especially in *lhinf*, we added a deterministic trend as well as dummy variables representing the structural breaks in variables to the classical Toda & Yamamoto (1995) causality test equation, as was done in Kırca et al. (2020).

$$\begin{bmatrix} lhinf_t \\ lreer_t \end{bmatrix} = \begin{bmatrix} \alpha_0^{lhinf} \\ \alpha_0^{lreer} \end{bmatrix} + \begin{bmatrix} \alpha_{11,1} & \alpha_{12,1} \\ \alpha_{21,1} & \alpha_{22,1} \end{bmatrix} \begin{bmatrix} lhinf_{t-1} \\ lreer_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} \alpha_{11,p+d_{max}} & \alpha_{12,p+d_{max}} \\ \alpha_{21,p+d_{max}} & \alpha_{22,p+d_{max}} \end{bmatrix} \begin{bmatrix} lhinf_{t-p+d_{max}} \\ lreer_{t-p+d_{max}} \end{bmatrix} + \begin{bmatrix} \gamma_{11,1} & \gamma_{12,1} \\ \gamma_{21,1} & \gamma_{22,1} \end{bmatrix} \begin{bmatrix} dummy1_t \\ dummy2_t \end{bmatrix} + \begin{bmatrix} \varphi_{11} \\ \varphi_{21} \end{bmatrix} trend + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (1)$$

Where α0's are constant terms, other α's are slope coefficients, g represents the coefficients of dummy variables[6] and φ represents the coefficients of the trend[7] and e_{1t} and e_{2t} are the error terms. Also, "p" is the optimal lag length of the variables. With an optimal lag length, the assumptions of the basic VAR model hold for VAR (p) model. In other words, in the VAR (p) model, the coefficients are stable, but error variance is constant, and the model's errors do not suffer from the autocorrelation. The "dmax" indicates the maximum degree of integration, which is determined with the help of unit root tests applied to variables[8] as is suggested by the T-Y causality test. After the addition of the maximum degree of integration of the variables to the VAR (p) model as the additional lag, the VAR(p+dmax) model is estimated.

6 Dummy variables represent the break dates determined by using the ADF unit root test with a single break.

7 The trend term was added to Equation (1) as an exogenous variable to take into account any obvious trend in the variables, especially in the *lhinft* variable.

8 To determine the "dmax" value, we employed three different unit root tests. Two of these three tests were the traditional unit root tests of Augmented Dickey-Fuller (ADF) tests developed by Said & Dickey (1984) and PP unit root tests developed by Phillips & Perron (1988). In addition to these two traditional unit root tests, we also carried out an ADF unit root test with a single break, since Perron (1989) concludes that conventional unit root tests may give erroneous results in the presence of structural breaks in variables. In both the ADF and PP unit root tests the null hypothesis states that A unit root is present in a time series sample, and it is non-stationary. In the ADF unit root test with a single break, the null hypothesis indicates that the data under structural break has a unit root and is non-stationary.

Based on the VAR(p+dmax) model in Equation (1), one can search test the existence of causal relationships between variables by testing the following hypotheses:

$H_0 = \alpha_{12,1} = \alpha_{12,2} = ... = \alpha_{12}, p = 0$, "There is no Granger causality running from *lreert* to *lhinft* "

$H_0 = \alpha_{21,1} = \alpha_{21,2} = ... = \alpha_{21}, p = 0$, "There is no Granger causality running from *lhinft* to *lreert"*

H_1 = At least one $\alpha \neq 0$, "There is Granger causality running from *lreert* to *lhinft*" or "There is Granger causality running from *lhinft* to *lreert*"

To compute the sample value of test statistics, the Wald test statistics values, we imposed a restriction on the coefficients expressed by the null hypotheses. To determine the outcome of the test, we compared the computed value of the test statistic with table critical values at the significance levels of 10%, 5%, and 1%. When the computed value of test statistic was greater than the table critical value of any significance level, we rejected the null hypothesis and concluded that there existed a causal relationship between the variables. The outcome of the T-Y test can reveal three different results: an existence of bidirectional causality or a unidirectional causality or absence of causality.

The Toda-Yamamoto causality test with a structural break only gives us information about the direction of causality over the sample period. It provides one statistic for the entire sample and takes one picture of the relationship. But, it does not provide any information about the casual relations across different frequencies and whether the causal relationships between variables are permanent or temporary. Therefore, we additionally investigated whether the causal relationships between *lhinft* and *lreert* were permanent or temporary by using the frequency domain causality developed by Breitung & Candelon (2006).

Breitung & Candelon (2006) stated that traditional causality tests fail to determine causal relationships for different frequencies, referring to Geweke (1982) and Hosoya (1991). In this test one can investigate the existence of the long, medium, and short run causality between variables. The evidence of long-run causality can be interpreted as evidence of permanent causal relationship, while that of short-run causality indicates a temporary causal relationship. Determining whether the causal relations between variables are permanent or temporary becomes crucial when making inferences and offering economic policy recommendations. For this reason, we also carried out the frequency domain causality test.

According to Breitung & Candelon (2006: 368), the frequency domain causality test can also be performed using the equation of Toda & Yamamoto (1995) causality test. In this way, it is not necessary to conduct a cointegration test before this test. In this study, taking this statement of Breitung & Candelon (2006: 368) into consideration and using Equation (1), the frequency domain causality test was applied to determine the duration of the causality relationship between variables. Thus, we labelled the test as the frequency domain causality test based on the Toda-Yamamoto causality test with a structural break, as in the study of Kırca et al. (2020), since we include the dummy variables representing the break dates in the VAR(p+dmax) model in Equation (1).

In the frequency domain causality test developed by Breitung & Candelon (2006), we calculated π different test statistics. Sample value of test statistics (F-values) computed for different frequencies are expressed as $\omega \in (0, \pi)$. To determine the existence of causalities across different frequencies, the following hypotheses were tested:

$H_0: R(\omega)\alpha = 0$; $\alpha = [\alpha_{12,1}, \alpha_{12,2}, \ldots, \alpha_{12,p}, \alpha_{21,1}, \alpha_{21,2}, \ldots, \alpha_{21,p}]$ and

$$R(\omega) = \begin{pmatrix} \cos(\omega) & \cos(2\omega) & \cdots\cdots & \cos(p\omega) \\ \sin(\omega) & \sin(2\omega) & & \sin(p\omega) \end{pmatrix} \tag{2}$$

In this test based on value of ω, we decided whether the causal relations were short, medium or long-term. The sample values of test statistic (computed F-value) corresponding to $\omega=0.05$, $\omega=1.5$ and $\omega=2.5$ indicated permanent (long-term) causality, medium-term causality, and temporary (short-term) causality respectively. When the test statistic values corresponding to these ω values were greater than the table critical values or the probability values of the test statistics were less than the significance levels, we rejected the null hypothesis of H_0: $R(\omega)\alpha = 0$. To convert the frequencies into cycles of t months, we use the expression of $2\pi/\omega$ (Tastan, 2015; Ozer & Kamisli, 2015).

Findings

In this section, we first discuss the results of the unit root tests, aiming to determine the “dmax” and the break dates in data. To do this, we carried out both traditional unit root tests (ADF and PP) and ADF unit root tests with a single break including constant term and trend in test equations as a result of the visual examination of the plots of the time series. Additionally, we tested the statistical significance of constant term and trend coefficients for both variables by using the ordinary least squares (OLS) method[9]. Table 1 represents the results of conventional unit root tests.

9 Results can be obtained from the authors upon request.

Table 1

Traditional Unit Root Test Results

The model with constant and trend

Test:	**ADF[a]**		**PP[b]**	
Variable	t-statistic	Prob.	t-statistic	Prob.
$lhinf_t$	-0.49	0.9826	0.61	0.9995
$Dlhinf_t$	-8.51*	0.0001	-7.99*	0.0001
$lreer_t$	-2.33	0.4142	-2.50	0.3232
$Dlreer_t$	-9.58*	0.0001	-9.37*	0.0001

[*] Indicates that the variable is stationary at a 1% significance level. [a] The optimal lag length was determined based on the Modified Akaike information criterion. [b] Bartlett Kernel and Newey-West Bandwidth were used.

According to the results of traditional unit root tests, both variables were first difference stationary, that is they are I(1). Table 2 shows the results of the single break ADF unit root test.

Table 2

Results of ADF Unit Root Test with a Single Break a

The model with a constant and trend

Variable	**t-statistic**	**Critical Value (1%)**	**Date of the break**
$lhinf_t$	-0.77	-5.71	2013M10
$Dlhinf_t$	-9.20*	-5.71	2019M03
$lreer_t$	-3.60	-5.71	2016M10
$Dlreer_t$	-9.84	-5.71	2018M09

* Indicates that the variable was stationary at a 1% significance level. [a] The optimal lag length was determined using the Modified Akaike information criterion. The intercept + trend break max-F method was used to determine the break date.

According to the results in Table 2, both variables are stationary in their first differences; that is, they are I(1) as is indicated by the traditional unit root tests. Thus, we use maximum degree of integration (dmax) as 1 to avoid the loss of long-run information.

Besides deciding the maximum degree of integration, it is extremely important to determine the structural break dates to carry out the test correctly. These dates were 2013M10 CPI for health inflation and 2016M10 for the real effective exchange rate. These two dates were proxied by the constant term "dummy" variables. Indeed, when we examine the time series plot of CPI for health, it is obvious that the series had a changing trend after 2013. The break date of the exchange rate corresponds to 2016M10 as being the time when the Turkish lira depreciated as a result of certain political and economic developments. As indicated in Eğilmez (2016), one of the most important reasons why the Turkish Lira depreciated at that time was the increase in the Credit Default Swap (CDS) in Turkey. The reasons behind the increase in CDS were the failed coup attempt, terrorism, geopolitical risks, and cross-border issues along with the breakdowns in relations with the European Union and the unpleasant conclusions in the European Union Progress Report.

After determining the maximum degree of integration and break dates, we first determined the optimal lag length of VAR(p) model and then we added "dmax" value to this VAR(p) model as an exogenous variable. The optimal lag length of VAR model was selected as 4, which satisfies the underlying assumptions of the VAR model. Table 3 displays the results of the T-Y causality test with a structural break based on Equation (1).

Table 3
Toda-Yamamoto Causality Test with a Structural Break

Null Hypotheses	Calculated Statistics	Prob.	($p+d_{max}$)
There is no Granger causality from $lreer_t$ to $lhinf_t$	11.66*	0.0200	4+1
There is no Granger causality from $lhinf_t$ to $lreer_t$	4.12	0.3894	4+1

* shows causality at a 5% significance level. The p-value is the optimal number of lags obtained by using the VAR model, and all conditions for VAR are provided in the VAR(p) model. The dmax value is the maximum degree of integration achieved by unit root tests.

According to the results in Table 3, there was a unidirectional Granger causality running from the real effective exchange rate index to the health prices index. But, we indicated above that these results can only provide one picture of the whole sample. This causal relationship between variables can differ across frequencies of short-, medium-and long-run. In other words, these results do not provide any evidence as whether this causal relationship between variables is temporary or permanent. Therefore, we also investigated the existence of causality across frequencies by using the frequency domain causality test based on the T-Y causality test with a structural break. Figure 2 shows the results of these tests.

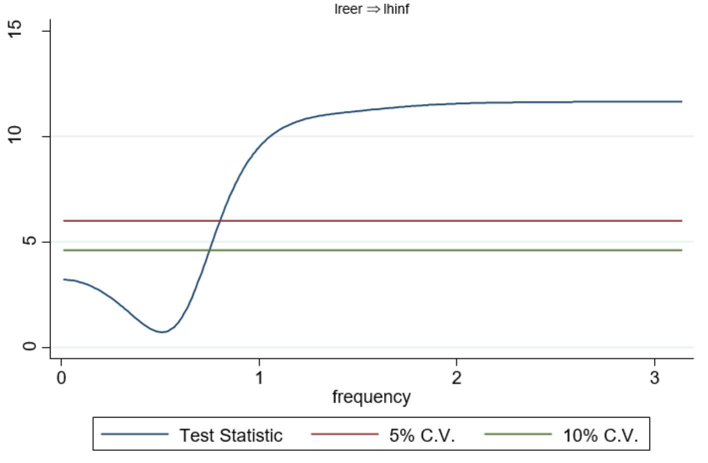

Figure 2. Result of the Frequency Domain Causality test based on the Toda-Yamamoto Causality test with a structural break: From lreert to lhinft

In Figure 2, we presented the Wald statistics of $\omega \in (0,\pi)$ frequencies calculated for different frequencies where Granger causality is tested from *lreer*t to *lhinft*. The test statistic value of ω =0.05 expressing permanent causality, that is, long-run causality, was calculated as 3.17. This test statistic was smaller than the F table value, which corresponds to the 10% significance level and is shown as a red line in the graph. In addition, the probability value was 0.2044. thus, there was no permanent causality running from *lreer*t to *lhinft*. The test statistic value of ω=1.5, which expresses medium- run causality, was calculated as 11.19, and the probability value was 0.0037. This means that there was a significant Granger causality relationship from *lreer*t to *lhinft* in the medium-run. Finally, the test statistic value of ω=2.5, which indicates the short-run, was calculated as 11.62, and the probability value was 0.0030. These values show a significant Granger causality relationship from *lreer*t to *lhinft* in the short-run. Based on the wavelength of the frequencies that are significant in Figure 2, it is seen that $\omega \in (0.75, 3.14)$. Using these wavelength values, we can show how many periods a current change in *lreer*t affects *lhinft* by using the $2\pi/\omega$ formula. When the $\omega \in (0.75, 3.14)$ values with significant test statistics are considered, a current change in *lreer*t affects the *lhinft* between 2 and 8.37 months. Figure 3 displays the result of the frequency domain causality test based on the Toda- Yamamoto Causality test with a structural break from lhinft to lreert.

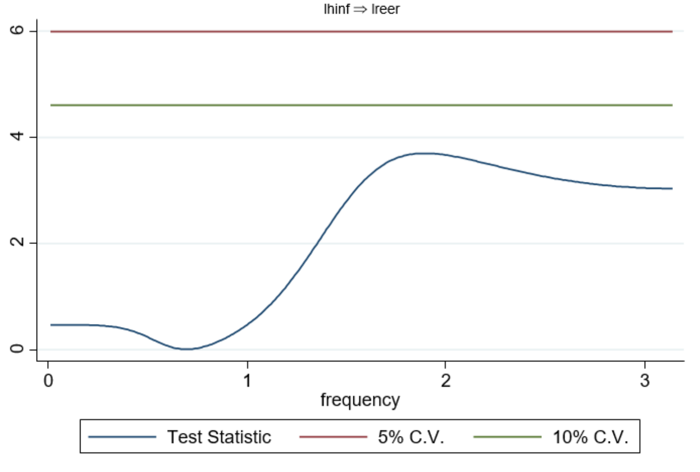

Figure 3. Result of the Frequency Domain Causality test based on the Toda-Yamamoto Causality test with a structural break: From lhinft to lreert

As is clearly seen in Figure 3, there is no evidence of Granger causality running from *lhinf*t to *lreert* at any frequencies.

Conclusion

This paper studies the changes in exchange rate on health care inflation, which is increasingly becoming an important policy topic in today's aging society. The results of the study show that there is significant exchange rate pass through in health care inflation. Also, the results indicate that these pass through effects are temporary and were in effect for between 2 and 8.37 months. These findings have significant implications for health officials, health care providers and policy makers as well.

First of all, Turkey's heavy dependency on imported inputs in producing most of its manufactured products seem to be a case for the provision of health services. Knowing the fact that the exchange rate pass through in health services is a short-run phenomenon, policy makers and health officials should understand that the provision of health services can be interrupted in times of significant surges in exchange rate. Thus, they should focus more on producing most health inputs domestically instead of relying on foreign products. This requires a new approach to the provision of health services by the involvement of the public sector instead of leaving most of the provision of health services in market competition. The resulting increases in the real exchange rate can cause problems in terms of supply across healthcare products and especially pharmaceuticals. Supply and stock problems experienced by sector representatives in this sense are negatively reflected in patients who need health products. Another channel in which currency fluctuations have a negative effect on health products is the drug prices determined by the Ministry of Health of the Republic of Turkey. Drug prices determined by the ministry remain below current exchange rates due to the increase in the exchange rate. In this case, the payments of the Ministry of Health, which provides payment support to pharmacies, become insufficient. Price differences in health products, especially drugs, are projected onto the consumer by suppliers and pharmacies. As a result, citizens have to pay much more for health products. Those who are more negatively affected by the situation have to pay the full price of health products and are not involved in any health insurance system. At the same time, the increases in the prices of health products for which the Ministry of Health does not provide payment support, which have to be purchased without a prescription, directly affect the citizens. To eliminate all these negativities, the Ministry of Health has to make price updates considering the fluctuations in the exchange rate. This situation does not seem likely to happen quickly due to both transaction costs and excessive exchange rate volatility. Therefore, the process may take time, and the health products market may be affected by this case. The finding of our study that the real exchange rate index affects the health prices index for between 2 months and 8.34 months is the empirical evidence of the table we present. This picture, in which we have revealed that changes in the real exchange rate are an important cause of health prices inflation, and the fact that the demand elasticity of health products is low, are issues that governors should pay attention to specifically when making decisions about health. Therefore, all exchange rate change scenarios should be analyzed in detail and placed at the center of these policies while designing health policies.

For the economy policy makers, they should understand that especially in the short-run, rising prices in health care can damage the Central Bank's inflation targeting policies, especially in these Covid-19 pandemic times. They can separately and closely watch this inflation to develop the correct and timely policies to fight against inflation. Also, close association with health officials is required to control the rise in health prices.

One of the primary steps to be taken for Turkey and countries with similar characteristics is to accelerate R&D activities for the health products sector. If this step is taken, external dependence will decrease as domestic products replace imported products. Thus, inflationary effects caused by the exchange rate can be suppressed, which will also provide long-run results. Among the main measures to take in the short-run in terms of market relief is the effective use of monetary policy instruments. Thus, the negative effects of the exchange rate can be reduced. Consequently, since the increasing effect of an overvalued exchange rate on costs is known, it is necessary to be cautious in exchange rate policies and pursue policies compatible with fiscal policy instruments.

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