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ANALYSING THE IMPACT OF EXCHANGE RATE SHOCKS ON HEALTH TOURISM WITH SVAR ANALYSIS

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ABSTRACT

Health tourism, which has become a significant global market, offers economic opportunities for destinations. In particular, the rise in foreign exchange rates directly influences health tourism, impacting both tourism demand and revenues. Therefore, understanding the effects of exchange rate fluctuations on health tourism is critical for the sector's future success. This study aims to empirically examine the extent and direction to which health tourism is affected by shocks in exchange rates. The research utilizes quarterly time series data from Türkiye covering the period from 2012:Q1 to Q1 2024:Q1. The Augmented ARDL test applied in the study reveals a long-term cointegrated relationship between exchange rates and health tourism. Furthermore, the causality test by Breitung and Candelon (2006) indicates that exchange rates have a causality effect on health tourism. Conversely, health tourism also influences exchange rates across short, medium, and long-term periods. The SVAR test results show that an increase in the exchange rate leads to an increase in health tourism. Nevertheless, the empirical findings suggest that the impact of exchange rate shocks on health tourism is relatively modest

Keywords: Tourism, Tourism Economy, Exchange Rate, SVAR Analysis, Türkiye

DÖVİZ KURU ŞOKLARININ SAĞLIK TURİZMİ ÜZERİNDEKİ ETKİSİNİN SVAR ANALİZİ İLE İNCELENMESİ

ÖZ

Dünya genelinde önemli bir pazar haline gelen sağlık turizmi, destinasyonlar açısından ekonomik fırsatlar sağlamaktadır. Özellikle döviz kurunun artış göstermesi, sağlık turizmini doğrudan etkileyerek turizm talebi ve turizm gelirleri üzerinde etkili olmaktadır. Dolayısıyla döviz kurunda meydana gelen değişimlerin sağlık turizmindeki etkilerini anlamak, sektörün gelecekteki başarısı açısından kritik bir öneme sahiptir. Bu doğrultuda araştırmanın amacı sağlık turizminin döviz kurunda meydana gelen şoklardan ne ölçüde ve ne yönde etkilendiğini ampirik olarak incelemektir. Araştırmada Türkiye'nin 2012:Q1-2024:Q1 yıllarına ait çeyrek dönemlik zaman serisi verileri kullanılarak analiz edilmiştir. Çalışmada uygulanan Genişletilmiş ARDL testi analizi sonucunda döviz kuru ile sağlık turizmi arasında uzun dönemde eşbütünleşik bir ilişkinin var olduğu belirlenmiştir. Ayrıca Breitung ve Candelon (2006) nedensellik testi sonucuna göre hem döviz kurunun sağlık turizmi üzerinde hem de sağlık turizminin döviz kuru üzerinde kısa, orta ve uzun dönemlerde nedensel etkiye sahip olduğu tespit edilmiştir. Çalışmada uygulanan SVAR testi sonucuna göre döviz kurunda yaşanan artışın sağlık turizminde artış meydana getirdiği bulgusuna ulaşılmıştır. Bununla birlikte elde edilen ampirik bulgular döviz kuru şoklarının sağlık turizmi üzerindeki etkisinin çok yüksek olmadığını göstermektedir

Anahtar Kelimeler: Turizm, Turizm Ekonomisi, Döviz Kuru, SVAR Analizi, Türkiye

INTRODUCTION

The tourism sector, while being a significant source of revenue for many countries, also possesses a dynamic structure within the service industry. The continuous development and transformation within the tourism sector have led to various tourism branches, including health tourism (Eryer, 2024; Jahanbani et al., 2021). Health tourism encompasses types of tourism that contribute to “physical, mental, or spiritual health through medical and wellness-based activities” (World Tourism Organization [UNWTO], 2018). According to another definition, health tourism is a type of tourism activity that blends health and tourism values, aiming to provide services most effectively to the target audience. Additionally, this form of tourism is highlighted as an economic activity that not only generates revenue for countries but also creates new employment opportunities for society, representing a significant export item where the tourism and health sectors intersect (Kuşat & Esen, 2022).

Health tourism is generally analyzed under three categories. As one of the three, medical tourism has become one of the most profitable sectors for countries and private hospitals to generate foreign exchange earnings in the international trade of health services and increase the efficiency of health systems (Hanefeld & Smith, 2019). International medical tourism demand is increasing due to the perception that reasonable and affordable healthcare services are available in medical tourism destinations, regardless of whether they are developing economies, emerging markets, or developed countries (Kadir & Nayan, 2021). In the second category, senior and disability tourism includes elderly care, rehabilitation services in a clinical hotel, special care for people with disabilities, and sightseeing tours (Soysal, 2017). As the last category, thermal tourism and SPA-Wellness tourism involve thermal water resources used in treating different diseases, which have been used from the past to the present. This type of tourism is of significant importance for countries regarding health tourism and its contribution to the national economy (Eryer, 2024).

Today, many individuals travel to other countries for treatment to regain their health, leading to the growth of the health tourism sector. Consequently, the health tourism market has become one of the most profitable and competitive sectors globally (Mahdavi et al., 2013). In recent years, people have not only focused on their country's healthcare services, doctors, or costs but have also explored the best treatment options and most affordable prices. Factors such as high treatment costs in developed countries (Ghasemi et al., 2021), long waiting lists domestically (Stojanović et al., 2010), travel considerations (Hanefeld et al., 2015), increased health awareness due to globalization (Carrera & Bridges, 2006), and healthcare expectations (Johnston et al., 2011; Ullah et al., 2021) motivate individuals to travel abroad for treatment. Additionally, factors such as lower labor costs in developing countries (Turner, 2007), the unavailability of certain treatments in one's home country, and the legality of treatments in one's own country (Thoke & Madan, 2017) drive people to seek medical care abroad. In this context, both local and international travel for treatment and vacation, as well as all activities occurring during these travels, fall under the scope of health tourism (Eşitti & Yıldırım, 2024).

Historically, countries preferred for health tourism were predominantly developed nations; however, today, there is a noticeable shift towards an influx of health tourism from developed to developing countries. Furthermore, the global and competitive structure has become increasingly influential in people's choices (Kuşat & Esen, 2022). In this context, the privatization of healthcare has enabled patients to access affordable, high-quality, and accredited health services beyond national borders (Collins et al., 2022). Additionally, travel agencies specializing in health tourism provide potential health tourists with access to information about healthcare institutions in various countries, allowing them to compare options (Aydın & Karamahmet, 2017).

The commercialization of healthcare services and treatment options has prompted healthcare providers, tourism businesses, and vacation destinations to develop products and services to meet this growing demand (Lee & Lee, 2015). Countries aiming to benefit from health tourism are competing to offer innovative, more competitive, and cost-effective services (Kuşat & Esen, 2022). Consequently, as health tourism

becomes a significant source of revenue for countries, it has evolved into a competitive arena among nations. For instance, developing countries can now compete with developed nations by enhancing the quality of healthcare equipment through increased health investments (Aydın & Karamahmet, 2017). To achieve the targeted revenue from health tourism, there is a concerted effort to increase the number of competitive public healthcare institutions and expand the number of private healthcare facilities through government-supported investments (Biri, 2021).

Over time, due to changing demands and needs, strong countries in the health tourism sector have begun to capture a larger share of the tourism industry. Therefore, achieving the desired levels of tourism revenue and maximizing income from this sector depends on improvements in health tourism and the attention given to this area (Edinsel & Adıgüzel, 2014). Türkiye possesses significant potential in health tourism due to its highly advanced medical treatment centers, ability to follow medical innovations, and thermal resources. Additionally, with its robust healthcare system and tourism sector, Türkiye is increasing its share in global health tourism (Ağazade & Ergün, 2022). For instance, in 2022, a total of 1,381,807 people visited Türkiye for medical services, generating revenue of 2,206,750 USD. In 2023, medical tourists increased to 1,538,643, with revenue reaching 3,006,092 USD (Turkish Statistical Institute [TURKSTAT], 2024). Thus, due to its geographical features, historical and environmental attractions, and climate conditions, Türkiye has become one of the leading countries in tourism. Considering Türkiye's efforts in aligning with the European Union, the health transformation program, development plans, the significant progress of the private healthcare sector, and improvements in tourism, it is anticipated that the contributions of health tourism to the national economy will exceed expectations (Doğan & Aslan, 2019).

Health tourism increases foreign exchange earnings and economic opportunities at destinations (Horowitz et al., 2007). Favorable exchange rates direct individuals toward healthcare providers in developing countries (Connell, 2006). The revenue generated from tourism predominantly comes as foreign exchange, which is significant for the national economy. Therefore, in Türkiye, amid economic challenges, exchange rates, particularly those involving the Euro and the Dollar, are considered crucial for balancing foreign trade. Moreover, this situation positively impacts the country's purchasing power and is important for maintaining economic stability through foreign investment (Doğan & Aslan, 2019).

There is an argument that a short-term and long-term relationship exists between a country's health tourism revenue and exchange rates. An increase in the exchange rate has also been reported to boost health tourism revenue in the country (Kadir & Nayan, 2021; Vijaya, 2010). Although rising exchange rates can produce varied outcomes for the national economy, they have a cost-reducing effect on healthcare tourism. The tendency for individuals to travel to regions where they can spend less to receive medical treatment supports the notion of a positive relationship between health tourism revenue and exchange rates (Biri, 2021).

In Türkiye, increases in exchange rates due to the country's dependence on imported production lead to cost inflation. A prominent concept related to this is the currency shock, defined as a sharp devaluation of a country's currency over a short period. Such increases in exchange rates are naturally reflected in product prices by the real sector (Akkoc, 2023). Consequently, fluctuations in exchange rates can significantly impact tourism demand for a destination (Katircioğlu, 2009). Exchange rate changes can cause variations in the value of a tourist's currency, affecting tourist numbers and tourism revenue (Adeleye et al., 2022). One study found that, in the long term, exchange rates have a negative and significant impact on tourism demand (Rookayyah et al., 2024). This study aims to highlight the significance of health tourism, one of the most important sources of revenue for the Turkish economy, by examining the extent and direction of its sensitivity to exchange rate shocks and providing robust evidence through econometric analyses. A review of the relevant literature reveals a limited number of studies addressing this topic, indicating that this research is expected to contribute meaningfully to the existing body of knowledge. The introduction section of the study provides theoretical information on the

topic. The second section, the literature review, summarizes empirical studies on the relationship between health tourism and exchange rates. The third section explains the methodology used in the study. The final section discusses the results obtained in light of the identified findings.

I. LITERATURE REVIEW

A review of the literature (Gülenç, 2003; Gündüz et al., 2019; Hanefeld et al., 2015; Heung et al., 2010; Öztürk & Özcan, 2022; Rookayyah et al., 2024) reveals numerous studies focused on the development of health tourism and the factors affecting health tourism demand. However, research specifically exploring the relationship between exchange rates and health tourism is relatively limited. However, the exchange rate is among the most critical factors influencing competitive advantage (Yapraklı, 2011). One study concluded that surgical costs, the professionalism of surgeons, travel expenses, and the exchange rate are among the key factors affecting tourism demand (Kumar et al., 2012). Moreover, a literature review indicates the existence of studies examining the relationship between exchange rates and the demand for medical tourism. Tang and Lau (2017) investigated the relationship between medical tourism and economic growth. Their study examined Malaysia's medical tourism demand using data from 1998:Q1 to 2013:Q4, applying ARDL boundary testing and cointegration analysis. The findings revealed that Malaysia's medical tourism demand is susceptible to changes in prices and exchange rates. Isikli et al. (2020) aimed to forecast the demand for Türkiye's medical tourism industry using a model incorporating various factors. The Partial Least Squares Regression (PLSR) analysis revealed that factors such as Türkiye's GDP and exchange rate indicators, price attractiveness, tourism, travel, and health investments, as well as the country's capacity to meet patients' medical needs and the reflections of social and political events, influence tourism prices. Kadir and Nayan (2021) aimed to examine the effects of selected economic variables on international demand for medical tourism. Analyzing data from 2001 to 2017 using the PMG/ARDL model on a panel data set of ASEAN-4 countries, the study found that price, travel costs, exchange rates, and healthcare expenditures are statistically significant in influencing international demand for medical tourism in both the short and long term.

Furthermore, the exchange rate is recognized as a significant factor influencing health tourism revenues. Accordingly, the literature includes studies focusing on the relationship between exchange rates, health investments, and the economic dimensions of healthcare services. In this context, Uçak (2016) examined the impact of growth in Türkiye's health and social services sector on inbound health tourism flows between 2004:Q1 and 2015:Q4. The study employed the real exchange rate and relative price changes as proxy variables to test their effects. Based on the Granger causality test results and Johansen cointegration analysis, a long-term Granger causality was identified from domestic health and social service expenditures to health tourism revenues. Besides, Biri (2021) aimed to investigate the factors influencing health tourism revenue. Using annual data from Türkiye for the period 1999-2019, cointegration analysis revealed that both exchange rates and private sector health investments significantly affect health tourism revenue in both the short and long term. Ağazade and Ergün (2022) aimed to examine the relationship between health tourism revenues and the real exchange rate. The study analyzed data from Türkiye from 2002:Q1 to 2019:Q4. The results of the analysis indicated a long-term relationship between health tourism revenues and the real exchange rate. The Granger causality analysis also revealed a unidirectional causal relationship from three types of actual exchange rates to health tourism revenues. Despite the high quality of healthcare services in Türkiye, the study concluded that prices and costs significantly influence health tourists' decisions. Therefore, based on the existing studies, it can be concluded that the exchange rate has a significant impact on health tourism revenues.

The literature includes studies examining exchange rates' effects on health tourism and healthcare services from various perspectives, offering a comprehensive evaluation of the sectoral implications of exchange rate fluctuations. Based on this background, Geçer (2022) aimed to explain the depreciation of the Turkish lira due to exchange rate increases, its advantages and disadvantages in the aesthetic and

cosmetic sector, and the significance of this situation for the national economy. According to ISAPS (2020) data, the study found that the increase in material costs for hospitals, clinics, and other healthcare facilities providing aesthetic/cosmetic services in Türkiye decreased purchasing power. Additionally, it was concluded that the depreciation of the Turkish lira has had both positive and negative impacts on the aesthetic/cosmetic sector, as it has on many other industries. Sey (2023) aimed to analyze the impact of exchange rates on the growing health tourism in Türkiye and the subsequent changes in healthcare service prices. Using quarterly data from 2003 to 2020 and applying Granger causality analysis, the study found that an exchange rate increase boosts Türkiye's health tourism revenue. However, it was determined that this increased revenue did not cause the rise in domestic prices. Batbaylı and Ertürk (2024) investigated the relationship between healthcare services, exchange rates, and economic growth. The Johansen cointegration analysis applied to data from Türkiye from 2002:Q1 to 2019:Q4 revealed that economic growth positively affects tourism revenues and healthcare service exports. However, the analysis also found that service cost, current account balance and real effective exchange rate negatively impact healthcare service exports. In their study, Pailwar and Mitra (2025) examine the nonlinear relationship between exchange rate-driven prices and medical tourists in India. Using the threshold regression technique, their findings reveal that the impact of exchange rate-driven prices on medical tourism is not linear. However, it was determined that these prices exert a significant effect only at moderate levels.

II. EMPIRICAL ANALYSIS

In this study section, an empirical analysis is conducted to determine the extent and direction of the impact of exchange rate shocks on health tourism. To this end, the section first presents the dataset used, the model established, and the variables included in the model. Subsequently, it discusses the econometric methods employed and the empirical findings obtained.

A. THEORETICAL BACKGROUND

The tourism sector is gaining increasing significance for national economies with each passing day. Among the rapidly growing branches of tourism in recent years is health tourism. The widespread effects of globalization have also contributed to heightened activity in this field. Individuals are increasingly opting to travel abroad to access healthcare services that are either unavailable, inadequate, or prohibitively expensive in their home countries. This cross-border movement for medical purposes is referred to as health tourism. A variety of factors, including service quality, cost, patient satisfaction, waiting times, and several macroeconomic variables influences health tourism. Among these, exchange rate movements play a particularly decisive role (Connell, 2013).

Exchange rate fluctuations impact a range of macroeconomic indicators, most notably foreign trade. In addition, they significantly influence foreign demand, including inbound tourism. In the literature, this relationship is commonly explained through the Marshall-Lerner condition and the theory of Purchasing Power Parity (PPP) (Krugman & Obstfeld, 2009). Within this framework, changes in the real exchange rate are considered a determining factor in the cost of travel from the perspective of tourists (Dwyer et al., 2002). Therefore, in countries experiencing exchange rate shocks, fluctuations in the demand for health tourism are likely to occur.

B. DATA SET, MODEL, AND VARIABLES

The study utilizes quarterly time series data for Türkiye from 2012:Q1 to 2024:Q1. Due to data limitations, the data from these years was used. The data used in the model were obtained from the Central Bank of the Republic of Türkiye (CBRT) online database (EVDS). The empirical model was estimated using EViews 9.0 and GAUSS 6.0 software packages. The data and variable information used in the model, are presented in Table 1.

TABLE 1 | Data and Variables

Variable	Description	Term	Source
MT	Arrivals for Health and Medical Reasons	2012:Q1-2024:Q1	EVD5
REER	Real Exchange Rate Index	2012:Q1-2024:Q1	EVD5

A dummy variable representing the pandemic period has been included in the model. This allowed for the calculation of the shock effect of the pandemic period on the tourism sector, which has been isolated in the model. Therefore, the results obtained from the model are expected to be more consistent. The empirical model, expressed functionally with the logarithmic values of the variables, is as follows:

$$MT = f(REER) \quad (1)$$

$$\text{Model: } MT_t = \beta_0 + \beta_1 REER_t - \beta_2 Dummy + \varepsilon_{it} \quad (2)$$

III. METHODOLOGY AND EMPIRICAL FINDINGS

In this section of the study, various tests were conducted for the empirical analysis. Specifically, the study utilized the ADF (Augmented Dickey-Fuller) unit root test (Çelik et al., 2020), augmented test, variance analysis, Breitung and Candelon's (2006) frequency domain causality test, and SVAR test. The results of these methods are analyzed in detail and presented with accompanying tables and interpretations.

A. THE UNIT ROOT TEST RESULTS

The unit root test is used to determine the stationarity of time series. If a time series has the property of stationarity, it means that the changes in the series are fixed around a certain mean over time, and the changes are not random. However, if a time series has a unit root, the changes in the series continue to increase or decrease over time, indicating that the series does not have stationarity. Unit root tests used in econometric studies measure the stationarity levels of variables. It is crucial to perform these tests, that is, to know whether the series has unit roots or not, since it causes the results to be interpreted as deviated or inconsistent. In the unit root test results expressed as I (0), I (1), and I (2) for the series, I (0) indicates that the series is stationary at the level value, I (1) indicates that the series is stationary at the primary difference, and I (2) indicates that the series is stationary at the secondary difference, that is, they do not carry a unit root. In this context, the ADF unit root test, one of the most widely used unit root tests, was used in the research (Çelik et al., 2020):

TABLE 2 | Unit Root Test

Level	Variables		ADF	First Differences	Variables		ADF
	Fixed	MT	-4.070 (0.00)***		MT	-7.918 (0.00)***	
		REER	-3.628 (0.00)***		REER	-9.923 (0.00)***	
	Fixed + Trend	MT	-5.233 (0.00)***		MT	-7.829 (0.00)***	
		REER	-3.727 (0.02)**		REER	-9.807 (0.00)***	

Note: The series has been adjusted for seasonality. $p < 0.01$ *** indicates the stationarity of the series at 1% level.

According to the ADF unit root test results in Table 2, both MT and REER variables are stationary at the level in both the model with a constant term and the model with a constant term and trend.

B. THE AUGMENTED ARDL TEST RESULTS

In this study, the Augmented ARDL method developed by Sam et al. (2019) is used instead of the traditional ARDL bounds test due to the difference in the stationarity levels of the variables. The A-ARDL approach eliminates the methodological limitations of the classical ARDL method by allowing the testing of long-run cointegration relationships even when the dependent variable is stationary at level I(0).

The method is based on three fundamental test statistics:

F_{bound} test: This test examines the joint significance of the lagged level values of both the dependent and independent variables.

t_{stat} test: This test evaluates whether the level value of the dependent variable is statistically significant within the model.

F_x test: This test specifically assesses whether the lagged level effects of the independent variables establish a long-run relationship.

The significance of all three test results indicates the presence of a long-run cointegration relationship among the variables. Within this framework, the lag lengths of the model were determined based on the Schwarz Information Criterion (SIC), and estimations were conducted using the ARDL(2,2) specification. The results of the estimated model are presented in Table 3.

TABLE 3 | The Augmented ARDL Cointegration Test and Long-Run Coefficient

A. Cointegration Test Results			
Test	Test Statistic	Critical Value (5%)	Decision
F_{bound}	14.92	3.74 (Narayan, 2005)	Cointegration established
t_{stat}	-6.53	-2.86 (Pesaran et al., 2001)	Cointegration established
F_x	16.83	3.79 (Sam et al., 2019)	Cointegration established
B. Long-Run Coefficient			
Variable	Long-Run Coefficient		
LNREER	0.0346		

According to the findings above, both the F_{bound} and F_x statistics exceed the upper bound critical value, while the t_{stat} value falls below the threshold. This indicates the presence of a long-run cointegration relationship between the exchange rate and health tourism at the 5% significance level. The estimated long-run coefficient is positive and statistically significant: a 1% increase in the real exchange rate leads to an approximately 0.0346% increase in health tourism revenues. This result aligns with theoretical expectations and previous empirical studies.

Based on the diagnostic test results presented below, it is observed that the model residuals do not exhibit autocorrelation ($DW \approx 2$), the model is structurally stable (CUSUM test), the model specification is correct (RESET test), and no heteroscedasticity is detected (White test). Only the Jarque-Bera test indicates a violation of the normality assumption. However, this is a common occurrence in macroeconomic time series data and does not undermine the model's predictive power. The Jarque-Bera test statistic indicates that the residuals are not normally distributed. However, this does not compromise the reliability of the econometric model. Firstly, the sample size used in this study is relatively large. In such cases, the Central Limit Theorem suggests that the non-normal distribution of residuals does not affect the consistency of the estimates. Moreover, the ARDL and A-ARDL models are flexible structures that remain valid even under non-parametric assumptions. Additionally, the robustness of the model has been confirmed through other tests addressing autocorrelation, heteroscedasticity, and structural breaks.

TABLE 4 | The Diagnostic Test Results for the Augmented ARDL Model

Test	Test Statistic	p-value	Decision
Jarque-Bera Normality Test	2294.422	0.0	Normality rejected
Durbin-Watson Autocorrelation Test	2.051	—	No autocorrelation
Ramsey RESET Specification Test	2.421	0.127	Correct model specification
White Test for Heteroscedasticity	13.934	0.833	Homoskedastic variance
CUSUM Test for Structural Stability	0.555	0.917	No Structural Break

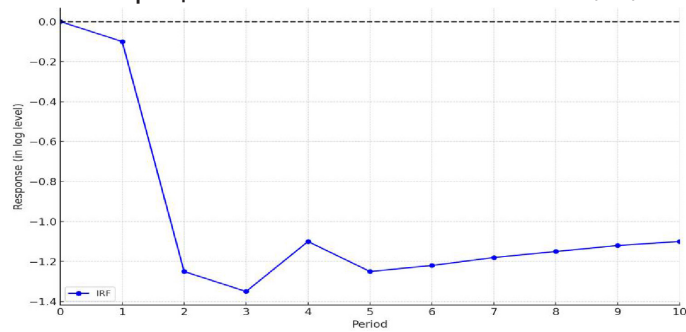
C. THE IMPULSE-RESPONSE FUNCTION AND VARIANCE DECOMPOSITION ANALYSIS

1. Impulse-Response Function Results

In this section, Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD) analyses were conducted within the framework of the Vector Autoregressive (VAR) model to examine the dynamic, time-distributed effects of exchange rate shocks on health tourism. These analyses go beyond mere coefficient estimation, offering insights into key dynamics such as causal direction, magnitude of impact, and temporal persistence among variables. The model includes

two variables: LNMT (health tourism) and LNREER (real exchange rate). The effect of the pandemic was treated as an exogenous shock and controlled for in the pre-analysis interpretation phase.

FIGURE 1 | Response of LNMT to a Shock in LNREER (IRF)



In the IRF analysis, the impact of a one standard deviation shock to the real exchange rate (LNREER) on health tourism (LNMT) was traced over a 10-period horizon, using impulse response functions derived through the Cholesky decomposition method. As shown in Figure 1, LNMT's response to an exchange rate shock is illustrated. As can be observed, the initial impact in the first period is negative, with the effect intensifying during the second and third periods. From the fourth period onward, the effect gradually weakens and eventually dissipates in subsequent periods. These findings indicate that exchange rate volatility suppresses health tourism in the short run; however, this impact diminishes in the long run.

2. Variance Decomposition Results

The Forecast Error Variance Decomposition (FEVD) analysis reveals the extent to which the real exchange rate (LNREER) explains the forecast error variance of the health tourism variable (LNMT) over time. FEVD outputs are highly valuable for understanding the dynamic structure between variables across the forecasting horizon. Based on the current model, forecast error variance decomposition can be analyzed for a maximum of 10 periods. The results obtained from the model are presented in Table 5.

TABLE 5 | The Augmented Forecast Error Variance Decomposition (FEVD) Results

Period	Contribution of LNREER to LNMT (%)
0	3.19
1	7.06
2	9.97
3	12.20
4	13.84
5	15.12
6	16.16
7	17.00
8	17.69
9	18.27

According to these values, the impact of the real exchange rate on health tourism is relatively limited in the first two periods (approximately 10%). However, the effect increases over time, surpassing 15% by the fifth period and reaching around 18.3% by the ninth period. This finding suggests that the influence of exchange rate shocks on health tourism is modest in the short term but becomes more pronounced over time as the effects accumulate. Considering that cost and competitiveness channels often operate with a lag through exchange rate mechanisms, this result is theoretically consistent. It highlights that mechanisms such as competitiveness, cost effects, and international patient preferences respond gradually to exchange rate changes. Furthermore, it indicates that the exchange rate produces not only static but also dynamic and lagged effects.

D. THE BREITUNG-CANDELON FREQUENCY DOMAIN CAUSALITY TEST RESULTS

Traditional causality tests analyze the causality between variables in one dimension. On the other hand, unlike traditional tests, Breitung and Candelon (2006) examine the causality relationship in a cyclical manner as long, medium, and short term. Therefore, it stands out as an advantageous method in this respect. Moreover, this method minimizes and prevents information loss (Breitung & Candelon, 2006, p. 363).

As a result of the cointegration test for the model, cointegration was detected, and the causality test developed by Breitung and Candelon (2006) was used to analyze the causality relationship between the series. The periods for causality are shown in the table below, where 2.00 and 2.50 are the short-term frequencies, 1.00 and 1.50 are the medium-term frequencies, and 0.01 and 0.05 are the long-term frequencies (Coşkun et al., 2023, p. 369). According to Table 6, there is a causality both from MT to REER and from REER to MT in short, medium, and long periods. In other words, both exchange rates have a causal effect on health tourism, and health tourism has a causal effect on the exchange rate.

TABLE 6 | The Frequency Domain Causality Test Outcomes

	Long Term		Medium Term		Short Term	
ω_i	0.01	0.05	1.00	1.50	2.00	2.50
(MT) $\Rightarrow$ (REER)	8.692***	8.646***	3.004*	3.337**	0.839	5.797***
(REER) $\Rightarrow$ (MT)	3.965**	3.547**	0.7273	10.288***	9.666***	12.816***

Note: The F-table value with (2, T-2p) degrees of freedom is approximately 5.99. For every frequency domain within the range of 0 and π ($\omega \in (0, \pi)$), ***, **, and * indicate the presence of causality between the series at significance levels of 1%, 5%, and 10%, respectively. The critical values are 4.99 for 0.01, 3.15 for 0.05, and 2.39 for 0.10.

E. THE SVAR ESTIMATION RESULTS

The VAR model is one in which all variables are considered endogenous without distinguishing between endogenous or exogenous variables. It is especially applied in the estimation of simultaneous (short-run) equation systems established with the help of macroeconomic models in economics. Therefore, it is accepted as a simple, easy, and flexible economic and financial time series analysis model. However, the VAR model has been criticized for changing the analysis results depending on the order of the variables (Güneş et al., 2013, pp. 6-7).

Bernanke (1986), Sims (1986), and Shapiro and Watson (1988) developed the "Structural VAR" model (SVAR) in order to overcome some of the problems arising from the VAR model estimation results. The SVAR model differs from the VAR model in that it uses exogenous shocks to separate error terms, and some of the restrictions applied to the model are based on economic theory. Finally, the variables in the SVAR model are treated as long-run constraints. Each shock should have a continuous (long-run) effect on at least one variable (Gartner & Wehinger, 1998).

The SVAR (Structural Vector Autoregression) analysis is used in econometric modeling. This analysis is used to model a series of time series data and to examine the effects of these series on each other. SVAR is a structural version of the VAR (Vector Autoregression) model, and it is mainly used for economic policy analyses and assessing the effects of economic shocks (Lütkepohl, 2005).

The main features of the SVAR model are as follows:

Multivariate Time Series Modelling: SVAR allows the simultaneous modeling of multiple time series variables. It is used to understand the dynamic relationships between these variables (Sims, 1980).

Structural Restrictions: In the SVAR model, structural restrictions are applied to determine the causal relationships between variables. These restrictions align with theoretical knowledge or information obtained from previous research (Stock & Watson, 2001).

Impact of Shocks: In SVAR analysis, the effects of economic shocks (e.g., monetary policy shocks, supply shocks) on the time series are analyzed. The short and long-term effects of these shocks are evaluated (Stock & Watson, 2001).

Impulse-Response Functions: In the SVAR model, impulse-response

functions are used to analyze the dynamic effects of a shock on a particular variable and other variables. These functions visualize the effects of shocks over time (Kilian & Lütkepohl, 2017).

Variance Decomposition: SVAR analysis performs variance decomposition to determine the extent to which the variances of the variables in the model can be attributed to different shocks. This helps to understand which shocks have a greater impact on the variables (Hamilton, 1994).

TABLE 7 | SVAR Estimation Results

VARIABLES	MT	REER
	C(1)	0
HEALTH TOURISM	1.293621 (0.00)***	
	C(2)	C(3)
EXCHANGE RATE	0.025798 (0.00)***	0.051875 (0.00)***

Note: $p < 0.01$ *** indicates that the series is statistically significant.

The results of the SVAR estimator used to determine the effect of exchange rate shocks on health tourism in the long run and the direction of this effect are presented in Table 7. The coefficient $C(1)=1.293621$ indicates shocks in health tourism, and $C(2)=0.025798$ indicates exchange rate shocks. All coefficients are found to be significant. The finding shows that a 1% increase in the exchange rate with the shock occurring causes an increase of 0.025798% in health tourism. Therefore, this result is in line with the results predicted in the theoretical literature. However, the empirical findings also indicate that the effect of exchange rate shocks on health tourism is not very high.

To demonstrate the consistency of the SVAR estimation results, the results of the FMOLS, DOLS, and CCR coefficient estimators are summarized in Table 8.

TABLE 8 | The Coefficient Estimation Results

	FMOLS		DOLS		CCR	
Variables	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
REER	0.016	0.00***	0.015	0.00***	0.016	0.00***
Constant Term	18.944	0.00***	18.749	0.00***	18.993	0.00***

The results of the FMOLS, DOLS, and CCR coefficient estimators were 0.016, 0.015, and 0.016, respectively. In this context, the results indicate that the positive exchange rate shocks experienced during the period under study led to an increase in demand for health tourism. These findings support the SVAR coefficient estimation results.

DISCUSSION

This study analyzed the impact of exchange rate shocks on health tourism using various econometric methods. Comparing the obtained findings with the existing literature is crucial for highlighting the original contributions of this research. Firstly, the ARDL cointegration test revealed a long-term positive relationship between the exchange rate and health tourism. This result is consistent with the findings of Ağazade and Ergün (2022), who also identified a long-run cointegration between health tourism revenues and the real exchange rate in Türkiye. Similarly, Biri (2021) found that the exchange rate affects health tourism in both the short and long run. This alignment demonstrates the structural consistency of the current study's findings with prior empirical evidence.

In addition, the Breitung and Candelon (2006) frequency domain causality test applied in this study indicated a bidirectional causality relationship between the exchange rate and health tourism. This finding is consistent with the results reported by Incekara (2020), who conducted a similar empirical investigation focusing on the Turkish economy. In that study, the relationship between exchange rate fluctuations and the number of inbound tourists to Türkiye was examined, and it was found that exchange rate changes had a statistically significant effect on tourism demand. These results suggest that volatility in exchange rates can influence international tourism flows, thereby supporting the bidirectional causal structure identified in this study in the context of health tourism. Accordingly, the empirical evidence derived for Türkiye appears to exhibit structural coherence with broader findings in the

existing tourism economics literature.

Moreover, the impulse-response function results show that exchange rate shocks exert a negative short-term effect on health tourism, which gradually weakens in the medium term. This observation is consistent with the short-term exchange rate dynamics reported in the study by Adeleye et al. (2022), which focused on Asian countries. However, in the present study, it is observed that the magnitude of the effect diminishes over time.

Finally, the results of the SVAR analysis indicate that exchange rate shocks have a positive but limited effect on health tourism. These findings are similarly emphasized in the study by Gaberli et al. (2021), which examines the number of international tourists visiting Türkiye and highlights that exchange rate fluctuations have a limited impact on tourism demand. This suggests that while exchange rate advantages may reduce relative costs for international patients and thus support demand, structural constraints and capacity limitations in service provision restrict the magnitude of this effect. Furthermore, Tang and Lau (2017) and Vetitnev et al. (2016) discovered that medical tourism demand is highly sensitive to changes in price and exchange rates. In contrast, Batbaylı and Ertürk (2024) found that the real effective exchange rate, service costs, and the current account balance negatively affect health service exports. Similarly, while Pailwar and Mitra (2025) found that the impact of exchange rate-driven prices on medical tourists is nonlinear, Azimi et al. (2017) concluded that the effect of prices on medical tourists is relatively low. Therefore, it can be concluded that the results of these studies may vary depending on the chosen sample group and the period considered.

When evaluated as a whole, the findings of this study largely align with recent literature, while offering a valuable contribution to the field through the use of up-to-date data and context-specific methods relevant to the case of Türkiye.

CONCLUSION

The results of this study indicate that exchange rate shocks can have both positive and negative effects on health tourism. In this context, healthcare institutions must develop flexible and strategic approaches to adapt to such impacts. Additionally, destination managers need to strengthen their international marketing and promotional strategies in response to exchange rate shocks. Exchange rate fluctuations can affect tourism revenues due to changes in the value of tourists' currencies (Adeleye et al., 2022). Moreover, since exchange rate changes can significantly influence tourism demand for a destination (Katircioğlu, 2009), healthcare providers need to plan pricing strategies that offer a competitive advantage in the international market. Increasing investment and incentives are necessary to remain competitive in the growing health tourism market (Vijaya, 2010). Additionally, since the quality of healthcare services is a determining factor in the preferences of health tourists (Collins et al., 2022), providing high-quality services and maintaining standards is likely to have a positive impact. In this context, policymakers could mitigate the adverse effects of exchange rate shocks on revenues by establishing support mechanisms, such as exchange rate-based income guarantees, tax exemptions, or VAT refunds, for private sector actors engaged in health tourism. Additionally, the creation of price stability funds that are sensitive to exchange rate volatility, within a public-private partnership framework, could help reduce supply-side uncertainties. Furthermore, developing indicator systems such as early warning mechanisms and a health tourism stability index to monitor the impact of exchange rate fluctuations would contribute to more effective sectoral policy design.

In conclusion, the results of this study are specific to the Turkish context. Future research could examine not only exchange rates but also the effects of macroeconomic variables such as inflation and growth rates on health tourism revenues. Additionally, the impact of different exchange rates, such as the Euro and the Dollar, on health tourism could be explored. Furthermore, future studies could explore the relationship between exchange rates and alternative forms of tourism, such as cultural, rural, or gastronomic tourism. All in all, conducting panel data analyses that examine the relationship between exchange rates and health tourism across different provinces and regions would offer a valuable contribution to the existing literature.

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