

## Original Article

# The effects of health tourism on a country's healthcare economy: a case study of selected provinces in Iran

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## Abstract

**Background:** Iran has not enjoyed an optimal economic situation; therefore, improving the conditions for health tourism can have positive effects on the country's economy. The primary purpose of this research was to investigate the influence exerted by medical tourism on the healthcare financial sector within the specific provinces chosen for analysis.

**Methods:** This study was applied in nature and covers the time period from 2011–2021. The research sample included major Iranian cities (Tehran, Karaj, Qom, Isfahan, Mashhad, Shiraz, Tabriz, and Ahvaz). To evaluate how fluctuations in economic policy uncertainty influence capital expenditure within the health tourism industry, a threshold panel methodology was implemented.

**Results:** The level of Economic Policy Uncertainty (EPU) was found to be below the threshold affecting investment in the health tourism sector. Given the positive effect above the threshold, the conclusion is that risk and uncertainty are inseparable parts of the investment process in the health tourism sector. The findings indicate that macroeconomic pressures—specifically inflation, currency volatility, and the repercussions of the COVID-19 pandemic—exerted a detrimental influence on capital allocation within the health tourism industry. Conversely, the empirical results demonstrate that financial development, market liquidity, and the volume of incoming provincial health tourists serve as significant drivers that bolster investment within this sector.

**Conclusion:** The relationship between EPU and Investment in Health Tourism (IT) is non-linear, and the intensity and direction of this relationship depend on the level of EPU. At all levels, economic uncertainty exerts a net downward force on investment in the health tourism sector.

**Keywords:** Economics; Health Policy; Investments; Medical Tourism; Uncertainty.

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## Introduction

The tourism industry is considered one of the vital economic sectors worldwide, including Iran. It has gained special importance in the development plans of countries in recent

years, especially in the form of health tourism (1). Health tourism, as a link between the health system and the economy, plays a key role in attracting capital, developing medical infrastructure,

improving the capacity to provide health services, and increasing the financial sustainability of the health system. The tourism industry serves as a cornerstone of economic advancement across both industrialized and emerging nations. By bolstering foreign exchange reserves and fostering domestic employment, the sector plays a critical role in national growth (1). Furthermore, tourism facilitates broader socio-economic progress by serving as a source of tax revenue and a mechanism for poverty alleviation, while simultaneously fostering human welfare and international harmony through socio-cultural exchange (2). Given that tourism-related income represents a substantial component of global economies, the influx of international visitors acts as a catalyst for foreign direct investment, job creation, and fiscal sustainability. Consequently, nations are incentivized to cultivate and sustain a compelling tourism profile to remain competitive in the global market (3). Quantitatively, tourism stands as the world's third-largest sector, trailing only information technology and finance; it maintained a robust annual growth rate of 3.5% and contributed 10.3% to the global gross domestic product (GDP) in 2019. This sector has accounted for one-tenth of total employment over the past 5 years. It also accounted for 4.4% of total national investment, amounting to 941 billion dollars. This share is also predicted to increase to 5% by 2029 (4, 5).

The tourism sector holds significant economic importance, acting as a critical driver for the strategic choices and viewpoints of primary stakeholders. Consistent with broader investment patterns, these stakeholders typically prioritize environments characterized by

stability and predictable outcomes when allocating capital. Although complete certainty in development is rarely attainable, industry professionals strive to mitigate risks wherever possible. Factors such as geopolitical instability and terrorism often disrupt this equilibrium, as potential travelers naturally gravitate toward regions that demonstrate a reliable history of safety and security, thereby directly impacting the revenue streams of host nations.

Nowadays, it is the largest service in international trade and accounts for one in ten jobs worldwide (9). The systematic importance of the health tourism impacts on a country's treatment economy in tourist areas and significant growth prospects further clarifies tourism's role in destabilizing and improving economies. Thus, it is essential that this relationship be examined and analyzed based on statistical evidence from different countries and regions. The present study examines this issue in Iran.

## **Methods**

### *Research Environment and Population*

The statistical scope of this research encompasses all provinces across Iran. The selection process relied exclusively on the availability of comprehensive tourism investment data, with no secondary constraints applied. The longitudinal analysis spans the thirteen-year period from 2011 to 2023. Within this framework, the study utilizes a sample derived from eight major metropolitan areas: Tehran, Karaj, Qom, Isfahan, Mashhad, Shiraz, Tabriz, and Ahvaz.

### *Data Collection Method*

The present quantitative and theoretical study explained the study subject using the library and case study methods in Iran. This study employed existing and compiled

information from the yearbooks and official reports of the Statistical Center of Iran and the Central Bank.

### Statistical Analysis

#### Research Model

Drawing upon the methodology established by Demir et al. (10), the following functional equation was employed to investigate how economic instability influences tourism-related investments across specific Iranian provinces.

$$TI_{IT} = F (ED_{IT}, FD_{IT}, TO_{IT}, EPU_{IT}) \quad (1)$$

Where:

#### Dependent Variable

Investment in the Health Tourism Sector (TI): The ratio of health tourism investments to GDP in each province.

#### Independent Variable:

Economic Uncertainty (EPU): In line with the study by

To develop the economic uncertainty index, this research adopts the framework established by Najafipour et al. (11), utilizing government spending and tax receipts to represent fiscal management, the money supply to reflect monetary policy, and currency exchange rates as a proxy for exchange rate policy.

Constructing this index includes the following five steps:

- a) LM-Test to ensure the presence of ARCH (Autoregressive Conditional Heteroskedasticity) and GARCH (Generalized Autoregressive Conditional Heteroskedasticity) impacts in the variables
- b) ARCH and GARCH methodologies are utilized to model the mean and variance structures inherent in the variables under consideration.
- c) Determining variable importance coefficients by measuring the specific

effect size of each independent variable on the dependent outcome.

d) Ranking the extracted volatility time series from the previous step

e) Combining the volatilities of the policy variables and constructing the index

These steps is explained here.

#### A) LM-Test

Prior to the estimation of ARCH and GARCH processes, it is essential to conduct a Lagrange Multiplier (LM) test to verify the existence of ARCH effects within the data. This diagnostic procedure begins by estimating the mean equation via Ordinary Least Squares (OLS). Subsequently, the LM test is applied to the resulting residuals to detect potential heteroskedasticity. The null hypothesis posits that the error terms exhibit no serial correlation; therefore, a rejection of this hypothesis provides empirical evidence of ARCH effects, thereby justifying the subsequent fitting of GARCH-type models. To illustrate this, consider the following representation of the mean equation:

$$Y_T = C + BY_{T-1} + U_T \quad (2)$$

This equation is estimated using the OLS method. Then, the LM-Test is performed on the residuals  $U_t$ . This test considers the following equation for the residuals  $U_t$ :

$$\hat{U}_T = A_0 + A_1\hat{U}_{T-1} + \dots + A_Q\hat{U}_{T-Q} + W_T \quad (3)$$

The null hypothesis of this test states that the residuals are independently distributed, and the test statistic follows a Chi-squared distribution with  $Q$  degrees of freedom.

$$H_0: A_0 = A_1 = \dots = A_Q \quad (4)$$

By rejecting the  $H_0$  hypothesis, it is allowed to use ARCH and GARCH models. This test was performed on the mean equations for the variables of government expenditures, tax revenues, money supply, and exchange rate margin, each being a

function of their own lagged values, and the presence of ARCH and GARCH patterns in each was confirmed.

C) Determining the significance coefficient of each variable

The degree of impact from the volatility of each government policy variable is not equal, and in combining variances, equal weights cannot be used for the variables. For this purpose, the method of regression on cyclical components is used. In this method, the cyclical component of each variable used in constructing the composite index is separately entered in a regression with the cyclical component of the variable that the composite index built to explain.

$$Y_T = B_0 + B_1 X_{j,T-K} + U_T \tag{5}$$

Where:

$Y_t$  = The cyclical component that the composite index is built to explain

$X_j$  = The cyclical component of the  $j^{th}$  individual variable

$J$  = The number of individual variables combined to build the individual index

$K$  = The index indicating the lag of the variable

Following the execution of each regression analysis, the coefficient of determination is derived; subsequently, the specific weights assigned to each independent variable are computed via the following methodology:

$$C_j = R^2_j / \sum_{j=1}^4 R^2 \tag{6}$$

Consequently, the weighting scheme for each individual series within the composite index is determined by the extent to which its cyclical fluctuations account for the cyclical variance of the target variable.

**Results**

*Examining the Stationarity of the Investment Model Index in the Health Tourism Sector*

The cross-sectional dependence of the relevant sectors for each of the considered

variables must be tested to perform econometric tests and estimation using panel data methods. As demonstrated in Table 1, the null hypothesis regarding the absence of cross-sectional dependence is refuted, confirming the presence of inter-sectional relationships. Consequently, the LLC stationarity test is deemed appropriate for evaluating the data. In alignment with established econometric standards, it is imperative to verify the stationarity of all research variables prior to estimation; this precautionary step ensures that the analysis remains robust and avoids the pitfalls of spurious regression.

Table 1. Results of the Cross-Sectional Dependence Test

Variables	CD Statistic	Probability Level
Provincial Investment in Health Tourism Sector	7.564	0.0000
Provincial Value Added	3.889	0.0000
Number of Tourists per Province	8.005	0.0000
Uncertainty Index	9.347	0.0000
Provincial Inflation	7.113	0.0000
COVID-19 Index	5.975	0.0000
Liquidity	6.443	0.0000
Exchange Rate	10.187	0.0000
Financial Development	4.353	0.0000

To assess the stationarity of the variables under consideration, we employed the Levin, Lin, and Chu (LLC) procedure. As a cornerstone method for evaluating unit roots within a panel data framework, the LLC test operates under the null hypothesis that a unit root is present in the series. The empirical findings derived from this analysis are detailed in Table 2.

Unit root test diagnostics confirm that all variables included in the study exhibit stationarity at their initial levels.

Unit root test diagnostics confirm that all variables included in the study exhibit stationarity at their initial levels. Estimating the threshold state between economic uncertainty and investment in the health tourism sector

Table 2. Summary of Panel Unit Root Test Results

Variables	LLC test (with intercept and trend)		
	Statistic value	Probability level	Stationary status
Provincial Investment in Health Tourism Sector	-40.372	0.0000	I(0)
Provincial Value Added	-10.1331	0.0000	I(0)
Number of Tourists per Province	-7.109	0.0000	I(0)
Uncertainty Index	-3.93	0.0011	I(0)
Provincial Inflation	-7.134	0.0000	I(0)
COVID-19 Index	-14.099	0.0000	I(0)
Liquidity	-8.222	0.0000	I(0)
Exchange Rate	-2.98	0.0034	I(0)

Following the discussions presented in the methodology section, the null hypothesis of linearity was first tested against the existence of a PSTR pattern considering the economic policy uncertainty index as the transition variable. This stage is crucial both economically and statistically. Statistically, if the data generation process is linear, the PSTR model is not identified, and the linearity test is necessary to avoid estimating unidentified models. Economically, such a test can also be crucial for testing specific theorems from economic theories. The output of Stata software for this test is presented in Table 3.

All test Statistics, the Wald Lagrange Multiplier (LM<sub>W</sub>), the Fisher Lagrange Multiplier, and the Likelihood Ratio (LRT) for one threshold (m=1) confirm the existence of a PSTR pattern for each investment in tourism sector model. Table 3 shows that the null hypothesis (linear model) is rejected at the 1% level for all three tests.

Table 3. Model Linearity Test

Row	Investment in tourism sector Model	
Test	Statistic	sig
Wald Test (LM <sub>W</sub> )	51.44	<0.001
Fisher Test (LM <sub>F</sub> )	9.709	<0.001
Likelihood Ratio Test (LRT)	78.346	<0.001

*Investigating causality between economic uncertainty and investment in tourism sector*

The most important advantage of the TVP-Quantile VAR model over conventional approaches such as DCC-GARCH and DCC-FIAPARCH is its capability to determine the intensity of transfer or volatility reception over time and across different risk quantiles. Based on the maximum likelihood statistic of nonlinear models compared to the linear model, it is concluded that the coefficients and the causality process between the variables are a function of time and change over time.

A: The fifth percentile of causality between economic uncertainty and investment in tourism sector

Table 4 presents information related to the volatility spillover between economic uncertainty and health investment in tourism sector at a low level (conditions where the level of economic uncertainty is low and includes observations in the lower 5%) and is presented at the fifth percentile.

According to the results of Table 4, economic uncertainty explains about 61.05% of the variations in health investment in tourism sector. The results indicate that the net effects on health investment in tourism sector are negative (-1.95%). In other words, at a low level of economic uncertainty intensity, this variable acts as the dependent variable. The economic uncertainty variable also has a positive net impact, indicating the net impacts of these variables. This means that this variable acts as an explanatory variable at a low level of economic uncertainty intensity.

Table 4. Estimation of volatility spillover between variables at a low level of economic uncertainty

Row	Economic uncertainty	Investment in tourism	From: (received spillover)
Economic uncertainty	39.74	36.71	36.71
Investment in tourism sector	24.34	22.39	24.34
To: (transmitted spillover)	39.74	22.39	-
Net	3.03	-1.95	Total Spillover Index 61.05

Graph 1 illustrates the causal and network connections between the variables at a low level of economic uncertainty.

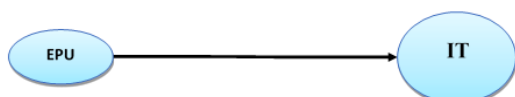


Figure 1. Examining the network causal connection between the studied variables

Note: EPU: Economic Uncertainty; IT: Investment in Health Tourism

According to Figure 1, the causality of volatility spillover is from economic uncertainty to investment in health tourism under conditions where the level of economic uncertainty intensity is low (fifth percentile).

B: The fiftieth percentile of causality between economic uncertainty and investment in tourism sector (Moderate economic uncertainty state)

Table 5 presents information related to the volatility spillover between the research variables at the fiftieth risk percentile of total factor productivity (the conditions where the level of economic uncertainty is moderate and observations in the lower 50%).

According to the results of Table 5, economic uncertainty explains about 62.01 percent of the variations in investment in tourism sector. The results show that the net effects on investment in tourism sector are

Table 5. Estimation of volatility spillover between variables at the fiftieth percentile

Row	Economic uncertainty	Investment in tourism	From:
Economic uncertainty	49.74	25.71	25.71
Investment in tourism sector	36.3	15.39	36.3
To:	49.74	15.39	-
net	24.03	-20.91	Total Spillover Index 62.01

negative (-20.91 percent). In other words, at the moderate level of economic uncertainty intensity, this variable acts as the dependent variable. The economic uncertainty variable also has a positive net impact, indicating that these variables have a net effect. This means that at the moderate level of economic uncertainty intensity, it acts as an explanatory variable. Figure 2 depicts the causal and network connections between the variables at a moderate level of economic uncertainty.

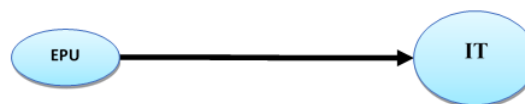


Figure 2. Investigating the network causal relationship between the studied variables under moderate economic uncertainty conditions

Note: EPU: Economic Uncertainty; IT: Investment in Health Tourism

According to Figure 2, under conditions where the level of economic uncertainty intensity is moderate (the 50th percentile); the causality of volatility spillover from economic uncertainty to investment in the tourism sector is similar to the previous state; but the intensity of the effect is stronger, as shown by a darker arrow.

C: The 95th percentile causality between economic uncertainty and investment in tourism sector (High level of economic uncertainty)

Table 6. Estimation of volatility spillover between research variables at a high economic uncertainty level

Row	Economic uncertainty	Investment in tourism	From:
Economic uncertainty	52.74	24.6	24.6
Investment in tourism sector	72.53	41.49	72.53
To:	52.74	41.49	-
net	28.14	-31.04	Total Spillover Index 97.13

Table 6 shows the information related to the volatility spillover between the research variables at the 95th percentile of uncertainty in economic uncertainty (the conditions where the economic uncertainty level is high and includes observations in the lower 95 percent).

According to the results of Table 6, economic uncertainty explains about 97.13 percent of the variations in investment in tourism sector. The results show that the net effects on investment in tourism sector are negative (-31.04 percent). In other words, at the high level of economic uncertainty intensity, this variable, similar to previous states, acts as the dependent variable. The economic uncertainty variable also has a positive net impact. This means that it acts as an explanatory variable at the moderate level of economic uncertainty intensity.

## Discussion

Adopting a multidimensional perspective, this study investigates how economic uncertainty influences investments in the health tourism sector. The analytical process commenced with a series of pre-estimation tests to confirm the validity of the panel data. Findings from the cross-dependence and LLC unit root analyses indicate that the series are stationary at their first differences, confirming they are suitable for further econometric modeling. This procedural rigor mirrors common practices in the field, where the formal validation of data characteristics is essential for producing robust and credible causal insights (12).

A primary finding of this research is the consistent rejection of a linear association between EPU and IT across all empirical tests. This outcome underscores the

inherently nonlinear and threshold-dependent dynamics of this relationship, thereby justifying the application of the Panel Smooth Transition Regression (PSTR) model as an effective analytical framework (13). From a theoretical perspective, this evidence aligns with existing scholarship, which posits that economic shocks exert asymmetric and nonlinear influences on investment behavior (14, 15). Uncertainty-based investment theories predict the asymmetric behavior of firms when facing different levels of risk. This means that investors may react disproportionately under high uncertainty conditions.

The causality and volatility spillover analysis using the TVP-Quantile VAR model provides a very precise picture of how EPU affects IT at different levels of uncertainty. At the low uncertainty level (5th percentile), the Total Spillover Index shows that 61.05% of the volatilities in health tourism investment are explained by EPU shocks. However, the net effect of investment at this level is negative and negligible (-1.95%). This result may indicate that although uncertainty exists at the macro level in relatively stable economic conditions, its direct impact on reducing investment in health tourism is limited, and other factors such as potential tourist demand or government incentives likely play a moderating role (16).

As the uncertainty level increases to a moderate level (50th percentile), the explanatory share of EPU slightly increases (62.01%), but the net negative effect on investment increases significantly to 20.91%. This is a turning point. As the threshold level of uncertainty is crossed, economic uncertainty increasingly

becomes a powerful deterrent to investment in the health tourism sector. This situation is justifiable by the notion of increasing risk aversion among investors when faced with economic ambiguities (17, 18). In such conditions, investors may delay their decisions or shift toward safer assets due to an increase in unforeseen risks, leading to a reduction in net investment in the health tourism sector (19).

At the economic uncertainty peak (95th percentile), the highest degree of dynamic correlation is observed. EPU volatilities can explain 97.13% of the volatilities in investment in health tourism (20, 21). In this crisis condition, investment in this sector is highly affected by macroeconomic factors and becomes a fully passive variable. The net negative impact of 31.04% indicates this sector's ultimate vulnerability to severe economic shocks (22). This result indicates that the health tourism sector not only fails to withstand shocks but is heavily affected by macroeconomic volatility during economic crises and acts as a "net shock receiver. Finally, the policy implications of this study are highly important.

The key result of the nonlinear and threshold relationship between EPU and intensified deterrent effect of uncertainty as its intensity increases highlight the need for multidimensional policy approaches. Policymakers should concentrate their efforts on creating sustainable economic stability, increasing transparency in the business environment, and providing long-term incentives to attract investment, especially at low and moderate levels of uncertainty. These measures can enhance the resilience of the health tourism sector to economic volatilities and prevent it from becoming a passive variable under crisis conditions. Active management of uncertainty will help not only to preserve the level of investment but also to improve its quality and sustainability in the long term.

## **Conclusion**

According to the results, the relationship between EPU and IT is nonlinear, and the intensity and direction of this relationship (the net effect of EPU) depend on the level of EPU. At all levels, economic uncertainty applies a reducing force on investment in health tourism. As the relationship strengthens at higher levels of uncertainty, policymakers should take actions during relative stability (low and medium EPU levels) to reduce volatility and strengthen investor confidence. Measures should include clarifying policies, stabilizing the exchange rate, and creating long-term incentives in this sector, so the health tourism sector shifts from a reactive state to a proactive one.

## **Authors' contribution**

Jaber Kazemi Nasab Hashemabadi and Seyed Ali Reza Alavi Bajgani developed the study concept and design. Jaber Kazemi Nasab Hashemabadi and Abbas Alavirad acquired the data. Jaber Kazemi Nasab Hashemabadi and Seyed Ali Reza Alavi Bajgani analyzed and interpreted the data, and wrote the first draft of the manuscript. All authors contributed to the intellectual content, manuscript editing and read and approved the final manuscript.

## **Informed consent**

Questionnaires were filled with the participants' satisfaction and written consent was obtained from the participants in this study.

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## **Conflict of interest**

The authors declare that they have no conflict of interests.

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