Original Article

Impact of economic uncertainty on investment in health tourism and healthcare service capacity building: a multicenter provincial study in Iran

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Abstract

Background: Health tourism is increasingly recognized as a strategic component of health system development, contributing to investment attraction, service capacity enhancement, and financial sustainability. However, economic instability and policy uncertainty may adversely affect investment decisions in this sector. In recent years, Iran has experienced elevated levels of economic uncertainty. This study aimed to examine the impact of economic policy uncertainty on investment in health tourism across selected provinces of Iran.

Methods: This applied–analytical study utilized secondary panel data covering the period from 2011 to 2021. The study population included major metropolitan provinces of Iran (Tehran, Karaj, Qom, Isfahan, Mashhad, Shiraz, Tabriz, and Ahvaz). A Panel Smooth Transition Regression (PSTR) model was employed to estimate the nonlinear effects of economic policy uncertainty on health tourism investment.

Results: The results indicated a threshold value of −0.428 for the economic policy uncertainty index. Above this threshold, economic uncertainty exerted a positive effect (−0.353), whereas below the threshold it had a negative effect (0.218) on health tourism investment. Inflation, exchange rate fluctuations, and the COVID-19 pandemic demonstrated significant negative effects, while financial development, liquidity, and provincial tourist volume showed positive and significant associations with investment levels.

Conclusion: The findings suggest that economic uncertainty plays a complex and nonlinear role in shaping investment behavior in health tourism. Effective economic and health policy coordination may enhance investment stability and promote the sustainable development of health tourism services.

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. Thus, the development of this sector has become

one of the priorities of health and economic policymakers (2).

Health tourism is more important for developing countries, including Iran, since these countries often face challenges such as high unemployment rates, limited foreign exchange resources, dependence on a single-product economy, and financial pressures on the health system (3). Investment in health tourism can improve access to health services and quality of health care, create job opportunities, increase foreign exchange, and tax revenues. Previous studies have revealed that investment in tourism is directly associated with increased tourist arrivals, increased related revenues, and socio-economic development (4). However, achieving these goals requires sustained and continuous investment in related infrastructure, including healthcare facilities, accommodation, transportation, and health technologies (5).

Empirical evidence suggests that increased tourism investment significantly affects the development of this sector, so 1% increase in tourism investment can increase tourist arrivals by 0.98% (4) and significantly improve tourism revenues (6). These results emphasize that health policymakers should encourage investment in health tourism. Economic and political uncertainty can disrupt investment in health tourism. Firms and investors tend to postpone their investment decisions during economic instability. This phenomenon is known as "wait and see" (7). This condition can negatively affect investment through various channels, such as real options (8-10), increased financing costs and default risk (11), and reduced tourism demand (12, 13).

Several studies at the firm and macroeconomic levels have indicated that increased economic policy uncertainty significantly reduces corporate investment (14-16). However, there is little evidence about the nonlinear and threshold behavior of economic uncertainty on investment in health tourism, especially in Iran. Thus, the primary goal of the present study is to examine the threshold behavior of the economic policy uncertainty index on investment in health tourism and capacity building of health services in Iranian metropolises.

Methods

Research Setting and Population

This study was an applied study regarding purpose and retrospective regarding its time. The study setting included selected metropolises of Iran known as potential and actual hubs of health tourism and health service provision. The study population included the urban provinces of Tehran, Karaj, Qom, Isfahan, Mashhad, Shiraz, Tabriz, and Ahvaz. They were purposefully selected due to their availability of specialized medical centers, health infrastructure, and significant contribution to attracting health tourists.

The unit of analysis in this study was the province-year. The data were from 2011 and 2021. Methodologically, this study was descriptive-analytical and correlational. Given the nature of the data, it was a quantitative study. The primary focus of the study was to investigate the relationship and causal relationships between economic uncertainty, investment in health tourism, and indicators related to the capacity building of health services at the metropolitan level. Selecting this study setting allows for the analysis of structural and economic differences between different regions of the country and their implications on health-oriented investment.

Data Collection Method

The data used in this study were secondary data and were extracted from official and reliable national sources. Information related to investment in health tourism, macroeconomic variables, and financial indicators was extracted from statistical reports of the Central Bank of the Islamic Republic of Iran, the Statistical Center of

Iran, and other official databases. The Economic Policy Uncertainty Index, as the main independent variable, was calculated and used based on data published in reliable sources and previous studies**.** After collecting data, causal relationships between variables were examined using descriptive and inferential statistical methods to adapt health economics theories to the realities of the country's health system. The Panel Data econometric method with the Panel Smooth Transition Regression (PSTR) model approach was used to test hypotheses and analyze the nonlinear and threshold behavior of economic uncertainty on investment in health tourism. This method allows for the identification of different effects of economic uncertainty at different levels and examines changes in investment behavior at different thresholds.

Statistical Analysis

In panel data regression models, the heterogeneous time and cross-sectional effects in the data were determined by a fixed or random effects model. In this regard, various panel data approaches have been developed that allow the regression coefficients to vary over time and across cross-sectional units. A sample of these models is panel threshold regression, presented by Hansen (17). In this model, the regimes are homogeneously distributed. However, in this type of model, there are observations very close to the threshold value placed in two different groups due to insignificant differences. Thus, their effect is associated with a sharp jump (18). To overcome this problem, the panel smooth transition regression (PSTR) model has been developed by Gonzalez et al. (19) and Chen et al. (20). A panel smooth transition regression (PSTR) model with two limit regimes and a transfer function is defined as follows:

$$Y_{it} = \mu_i + \beta_0 X_{it} + \beta_1 X_{it} G(q_{it};\gamma,C) + U_{it} \quad (1)$$

Where Y_{it} *i*s the dependent variable, X_{it} is a vector of independent variables, μi is the cross-sectional fixed effects, and U_{it} is the error term distributed identically and independently. G (qit;γ,C) is the transfer function, which is a continuous and bounded function between zero and one, determined by a threshold variable and specified as a logistic function as follows.

$$G(q_{it};\gamma,C) = \begin{cases} 1 & 0,\quad c1\leq c2,\ldots \\ & \gamma> \leq cm \end{cases} + exp\left[-\gamma \prod_{j=1}^{m}(q_{it}c_j)\right]^{-1} \quad (2)$$

For the transition function, we have:

$$G(q_{it};\gamma,C) = \begin{cases} 1\ if\ q_{it} \geq c \\ 0\ otherwis \end{cases} \quad (3)$$

In Equation 3, γ is the slope parameter and represents the speed of adjustment from one regime to another, and q_{it} is the transition (threshold) variable. Based on the study by Chen et al. (20), it can be selected among the explanatory variables, the dependent variable lag, or any other variable outside the model that is based on theoretical foundations related to the study model and is the cause of the nonlinear relationship. cj is also the m-dimensional vector of the threshold parameters (21). The generalized form of the PSTR model with more than one transfer function is specified as Equation 4:

$$Y_{it} = \mu_i + \beta_0 X_{it} \sum_{j=1}^{r}[\beta_j X_{it}] G_j\left(q_{it}{}^{j};\lambda_j,C_j\right) + U_{it} \quad (4)$$

Where r represents the number of transfer functions to specify the nonlinear behavior. The panel smooth transfer regression method is estimated by removing fixed effects by removing individual means and using the non-linear least squares method, which is equivalent to the maximum

likelihood estimator. Based on the studies by Gonzalez et al. (19) and Chen et al. (20), the estimation involves several steps. First, a linearity versus nonlinearity test is performed. If the null hypothesis of linearity between the variables is rejected, the number of transfer functions should be selected to fully specify the nonlinear relationship between the variables. Although the linearity test can be performed by testing the null hypothesis H0=γ=0 or H0=β1=0, the test statistics of both hypotheses are non-standard since the PSTR model under the null hypothesis has uncertain parameters. To solve this problem Gonzalez et al. (19), have proposed the Taylor approximation of the transfer function $G_j(q_{it}{}^j; \lambda_j, C_j)$ based on the parameter γ around the value γ=0, which is as follows.

$$Y_{it} = \mu_i + \beta_0 X_{it} + \beta_1 X_{it} q_{it} + \cdots + \beta_m X_{it} q_{it}{}^m + U_{it} \quad (5)$$

$$LM_W = \frac{TN(SSR0 - SSR1)}{SSR0} \quad (6)$$

According to the above equation, the null hypothesis, representing the linearity of the relationship between the variables, is presented as $H0 = \beta_1 = \cdots = \beta_m$. Rejecting the null hypothesis indicates a nonlinear relationship, and non-rejecting it indicates a linear relationship between the model variables. To test this hypothesis, following Chen et al. (20), the statistics of Wald's Lagrange coefficient (LM_W), Fisher's Lagrange coefficient (LM_F), and the likelihood ratio (LR) are used, which are calculated based on the following equations.

$$LM_F = \frac{[(SSR0 - SSR1)/Km}{SSR0/(TN - N - mK)]} \quad (7)$$

$$LR = -2[LOG(SSR1) - LOG(SSR0)] \quad (8)$$

In the above equations, SSR_0 is the residual sum of the linear panel model, and SSR1 is the residual sum of the nonlinear PSTR. T is also the time period, N is the number of sections, K is the number of explanatory variables included in the model, and m is the number of threshold limits. If results indicate a PSTR pattern, it will be necessary to select the number of transfer functions to fully specify the nonlinearity of the model. For this purpose, the null hypothesis, the existence of one transfer function, is tested versus the hypothesis of the existence of at least two transfer functions. The steps of this test are also similar to the linearity test, but the Taylor approximation of the second transfer function is tested. This approximation is as follows.

$$Y_{it} = \mu_i + \beta_0 X_{it} + \beta_1 X_{it} G_j(q_{it}{}^1; \lambda_j, C_j) + \beta_{21} X_{it} q_{it}{}^2 + \cdots + \beta_{2m} X_{it} q_{it}{}^{2m} + U_{it} \quad (9)$$

Next, it is necessary to test the absence of a nonlinear relationship in the residuals by testing the null hypothesis H0: β_{21}=β_{2m}=0 based on Equation (9). If the null hypothesis is not rejected, it is sufficient to consider a transfer function to examine the nonlinear relationship between the variables. However, if this hypothesis is rejected, at least two transfer functions are tested versus the hypothesis of the existence of at least three transfer functions. This process continues until the null hypothesis is accepted. In this method, the effect of the uncertainty threshold of the economic policy will be analyzed. In other words, this method will indicate from what threshold the uncertainty of the economic policy negatively affects the investment level in the tourism sector. Figure 1 shows the process of applying this approach in a panel mode.

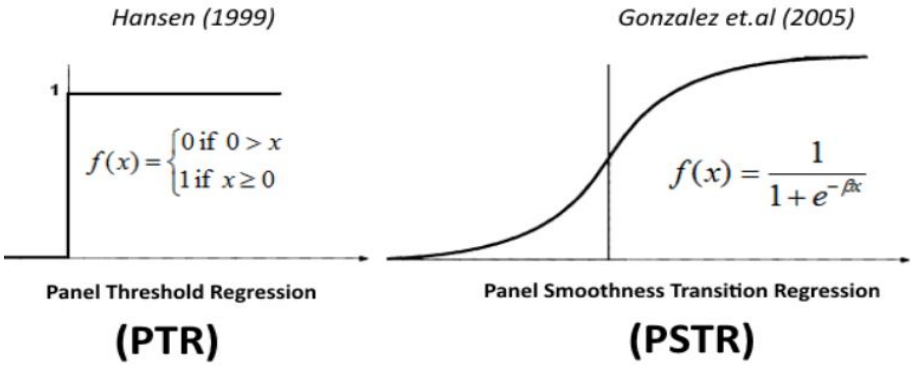

Figure 1. Panel Smooth Transition Regression Model Process and its Comparison with Panel Smooth Transition Regression

Results

To present a general view of the study structure, Table 1 shows the basic characteristics of the provinces, the unit of analysis, the spatial-temporal domain, the research design, the type of data, and the primary variables used. This study was conducted using an applied, retrospective, and quantitative method. Its data were collected in the province-year format for eight selected metropolitan cities of the country from 2011 to 2021. Data were extracted from official national sources. Investment in health tourism was considered the primary dependent variable, the economic policy uncertainty index as the key and threshold variable, and a set of economic variables and the COVID-19 shock as control factors in the model. Data were analyzed using Panel Smooth Transition Regression (PSTR).

The dependence of the desired components on each of the variables must be tested to perform econometric tests and panel estimation.

Based on the results in Table 2, the null hypothesis of no dependence between components is rejected, and dependence between sections is confirmed. Thus, the LLC stationary method can be used to examine the stationarity. Based on the econometric literature, before any estimation and to prevent the creation of spurious regression, it is necessary to first ensure that the research variables are stationary. If the research variables are stationary, the estimates created will not have the problem of spurious regression. To examine the stationarity of the variables in this study, the Levin, Lin, and Chu test was used.

Table 1. Basic characteristics of the provinces studied during the study period (2011-2021)

Component	Description
Unit of analysis	Province-year
Provinces studied	Tehran, Karaj, Qom, Isfahan, Mashhad, Shiraz, Tabriz, Ahvaz
Study period	2011 to 2012 (11 years)
Study design	Applied, retrospective, descriptive-analytical study
Study area	Health Economics and Health Tourism Policymaking
Data type	Secondary Provincial Data (Panel Data)
Data sources	Statistical Center of Iran, Central Bank of the Islamic Republic of Iran, Ministry of Cultural Heritage and Tourism, Official Health Reports
Primary dependent variable	Investment in Health Tourism (at the provincial level)
Healthcare capacity index	Health Infrastructure and Health Tourist Attraction Indices
Key independent variable	Economic Policy Uncertainty Index
Threshold variable	Economic Policy Uncertainty Index (EPU)
Economic control variables	Inflation rate, exchange rate, liquidity, financial development
Public health shock variable	COVID-19 pandemic (dummy variable: before/after 2020)
Statistical analysis method	Panel Smooth Transition Regression (PSTR)

Table 2. Results of the cross-dependence test

Variables	Statistic CD	Probability level
Provincial Investment in Tourism	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

This test is one of the most important unit root tests in mixed data. In this test, the null hypothesis is that there is a single root. Table 3 presents a summary of the test results.

The results of the unit root test for the study variables indicate that all variables are at the stationary level. Following the issues discussed in the methodology section, the null hypothesis of linearity was first tested versus the existence of the PSTR pattern by considering the economic policy uncertainty index as the transition variable. This step is crucial both economically and statistically. If the data generation process is linear, the PSTR model will not be identified, and the linearity test is necessary to avoid estimating unknown models. Economically, such a test may also be important for testing certain theorems of economic theories. Table 3 presents the Stata software output for the mentioned test. All statistics of Wald's Lagrange coefficient, Fisher's Lagrange coefficient, and the likelihood ratio for a threshold (m=1) confirm the existence of the PSTR pattern for each tourism sector investment model. Table 4 shows that the null hypothesis (linear model) is rejected at the 1% level for all three tests.

Table 4. Linearity test of the model

Test	Tourism sector investment model	
	Statistic	sig
Wald Test (LM_W)	51.44	0.000
Fisher Test (LM_F)	9.709	0.000
Likelihood Ratio Test (LRT)	78.346	0.000

After rejecting the linear model and confirming that it is nonlinear, the PSTR model has at least one threshold. The hypothesis of the number of regimes in the PSTR model must be tested to determine the number of thresholds (or regimes). This process is presented in the statistical test of Figure 2.

Table 3. Summary of the results of the panel unit root test.

Variables	LLC test (with intercept and trend)		
	Statistic value	Probability level	Stationary status
Provincial investment in tourism	-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)
Liquidity	-14.099	0.0000	I(0)
Exchange rate	-8.222	0.0000	I(0)
Financial development	-2.98	0.0034	I(0)

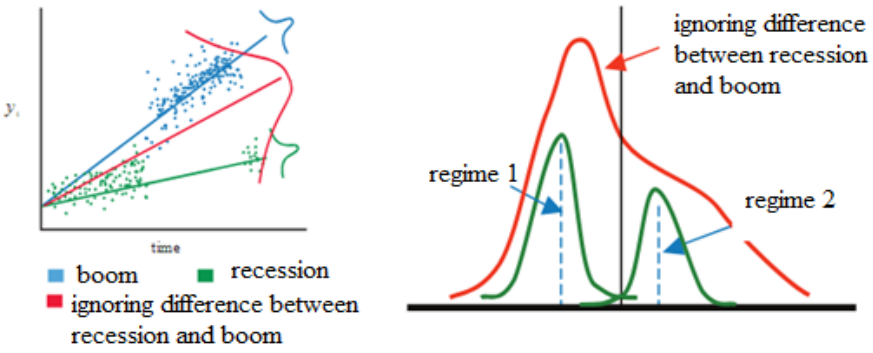

Figure 2. Distribution of variables with different regimes

The goal of this test is to examine whether separating the regimes and considering different distributions will improve the efficiency of the model, or whether considering a common distribution and only one regime for both cases will be desirable. This explanation is shown in the following hypotheses.

H0: The PSTR model has at least two thresholds (r = 2).

H1: The PSTR model has one threshold (r = 1).

To examine the hypothesis H0, we use two tests, namely the Fisher test (LMF) and the likelihood ratio test (LRT). If the Fisher statistic and the likelihood ratio are significant, we reject the hypothesis H0 and conclude that the PSTR model has one threshold and thus has two regimes. Table 5 presents the results of these two tests.

The results of Table 5 show that the null hypothesis H0 is rejected at the 1% level for both tests. This hypothesis means that only two regimes can be identified in the research data, and there is only one threshold, and thus a two-regime model should be estimated. Graphically, one threshold is more effective than two thresholds for examining the relationship between variables. Thus, since there is a threshold, two coefficients are estimated to estimate the relationship between variables. Figure 3 shows the graph with positive and negative slopes (two dotted lines).

Table 5. Determining the optimal number of regimes

Test	Tourism sector investment model	
	Statistic	sig
Fisher Test (LM_F)	113.609	0.000
Likelihood Ratio Test (LRT)	12.556	0.000

Next, the estimation of the confirmed model of economic policy uncertainty, with one transfer function and one threshold, is examined in two regime models. Table 6 presents the estimation results of the economic policy uncertainty model (as the transfer variable), respectively. The numerical value of the presented coefficients cannot be interpreted directly,

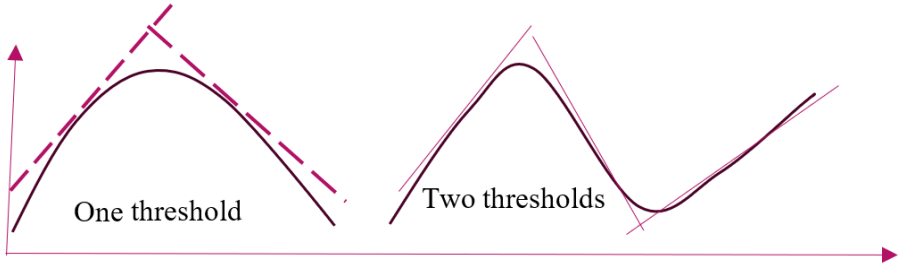

Figure 3. The existence of one and two thresholds

Table 6. Estimation results of the PSTR model with the transfer variable of economic policy uncertainty

Row	Systematic	
	Coeff	T-Stat
Provincial Value Added	0.387	22.14
Number of Tourists per Province	0.401	8.456
Provincial Inflation	-0.128	-1.69
Covid-19	-0.487	-11.28
Liquidity	0.021	1.72
Exchange Rate	-0.128	-2.01
Financial Development	0.092	-2.36
Uncertainty Index	-0.428	-4.02
I*g(q_{it}, Y, c)	0.218	8.31
	-0.353	-5.123
I *g(q_{it}, Y, c)	Regime Zero (Above Threshold)	
	Regime One (Below Threshold)	
C	1.999	8.398
F	F(21, 322)	14.09

and only the signs should be analyzed, as the coefficients of the variables are calculated regarding the transfer function, and this transfer function is not constant over time.

The results of the PSTR model estimation show that the economic policy uncertainty index is 0.428 percent. According to the results, the economic policy uncertainty index has a negative effect of 0.353 percent on tourism sector investment at the upper threshold level and a positive impact of 0.218 percent below it. Considering the positive effect above the threshold, it is concluded that uncertainty is an inseparable part of the investment process and has caused a reduction and difficulty in investment in the tourism sector from one level to another. According to the results, the variables of inflation, exchange rate, and COVID-19 negatively affect investment in the tourism sector. The results also indicate that financial development, liquidity, and the number of provincial tourists positively and significantly affect investment in the tourism sector. The F-statistic indices in the present study are at a high level, indicating a good fit in the research model and the validity of the estimated regression line.

Discussion

This study aimed to investigate the nonlinear impact of economic policy uncertainty on investment in health tourism and healthcare service capacity across eight major provinces of Iran from 2011 to 2021. By employing a Panel Smooth Transition Regression (PSTR) model, we moved beyond traditional linear assumptions to uncover the asymmetric dynamics governing this relationship. The findings reveal that the effect of uncertainty is not constant but rather regime-dependent, shifting significantly once a threshold level of uncertainty is crossed. This discussion interprets these findings in the context of existing literature and explores their implications for theory, policy, and future research.

The initial diagnostic tests confirmed the suitability of our nonlinear approach. The rejection of the null hypothesis of linearity and the identification of a single optimal threshold provide strong evidence that the relationship between economic policy uncertainty and health tourism investment is inherently nonlinear. This aligns with the growing body of research that recognizes the complex, regime-switching behavior of economic variables, particularly in the context of tourism. For instance, studies on the macroeconomic determinants of health tourism in Turkey have successfully utilized nonlinear models like Markov Regime Switching to show that the impact of economic factors on health tourism revenues differs markedly between "low" and "high" regimes (22-23). Our finding that a two-regime model best fits the data from Iranian provinces corroborates this perspective, suggesting that the health tourism market responds differently to economic stimuli depending on the prevailing level of uncertainty.

The results revealed that the economic uncertainty index has a certain threshold, and above this level limits the capability to invest. This reflects investment behavior in conditions of economic instability that has also been observed in other tourism sectors. Generally, international evidence suggests that economic policy uncertainty and uncertainty shocks negatively affect investment and tourism demand, especially in sectors where the sensitivity of tourist demand to economic stability is high (in studies on international tourism in Italy, Spain, and the United States, the economic uncertainty index and uncertainty caused by the COVID-19 pandemic negatively affected tourism) (23-26).

Our core finding reveals the dual and asymmetric role of economic policy uncertainty. The negative and significant coefficient for the uncertainty index in the linear component of the model confirms its overall detrimental effect on investment. More importantly, the PSTR model's results show that this effect is regime-dependent: in the regime below the uncertainty threshold, its impact is positive, while above the threshold, it turns negative and stronger. This suggests that a moderate level of uncertainty, perhaps perceived as a normal part of the business cycle, might not deter investors who are already committed or who see potential for high returns. However, once uncertainty surpasses a critical tipping point, it creates an environment too risky for new investment, leading to a sharp contraction. This finding provides a granular understanding that surpasses traditional linear estimates. It resonates with research on systemic risk in Iran's medical tourism industry, which highlights how "demand volatility due to systematic risks can hurt industry players" and identifies factors like liquidity and operational efficiency as crucial for resilience against such shocks (27). Our study quantifies this risk, showing precisely how a key systematic factor—policy uncertainty—shifts from a negligible to a powerfully negative force.

The findings of the present study, which demonstrate a significant negative impact of economic policy uncertainty on investment in the health tourism sector (as shown by the coefficient of -0.428 in the linear component), are strongly supported by a broad range of international evidence. Multinational studies have consistently indicated that EPU significantly and negatively affects tourism sector investment and travel-related expenditures. For example, in a panel of 20 selected destinations, increased economic uncertainty was associated with reduced outbound tourism expenditures, confirming the suppressing impact of political-economic instability on tourism activities (27-30). This negative relationship is not limited to specific geographies; evidence from both OECD and non-OECD economies suggests that economic uncertainty generally reduces investment in the tourism sector, underscoring the need for targeted macroeconomic policies to support investment during periods of instability (31-33). Furthermore, our results align with research at the firm level, which has indicated that increased EPU reduces investment efficiency and makes access to capital more difficult. This mechanism is particularly relevant for capital-intensive hospitality and healthcare-related businesses, providing a micro-level explanation for the aggregate provincial-level decline observed in our study (34-35).

This finding is further corroborated by evidence from the Mediterranean region, where studies have documented a bidirectional causal relationship between EPU and tourism. This suggests that economic policy fluctuations not only affect investment—as our study demonstrates—but also directly influence tourism demand, creating a feedback loop that can amplify the initial impact of uncertainty (36-38). The consistency between our findings and this regional evidence reinforces the notion that the sensitivity of tourism to policy uncertainty

is a robust phenomenon across different geographical contexts.

From a health policy perspective, our results have important implications that align with the broader literature. The significant negative impact of uncertainty on health tourism investment, particularly when compounded by shocks like the COVID-19 pandemic, underscores the inherent vulnerability of this sector to both economic and health-related global risks. Previous research has similarly emphasized that the health tourism sector is distinctively intertwined with such multifaceted risks, requiring policymakers to adopt integrated approaches that address both economic stability and health system resilience (39-41). Our study provides empirical support for these arguments by quantifying the threshold at which economic uncertainty becomes particularly detrimental, thereby offering a more nuanced basis for policy intervention.

In Iran, our results are in line with global patterns as increased economic uncertainty has had a significant and negative impact on health tourism investment, and variables such as inflation, exchange rate, and the COVID-19 crisis have also had significant negative effects, while financial development, liquidity, and the number of provincial tourists has affected investment (42). These results recommend that policymakers consider risk management and reducing economic instability in health tourism development planning, demand modeling, and supporting health sector investors, as health tourism is more sensitive to uncertainty than other tourism branches due to its close relationship with welfare and access to health services.

The positive and significant coefficient for the number of tourists per province is a classic finding, confirming that higher demand (patient volume) is a primary driver of further investment in capacity and infrastructure. This validates the use of this variable as a key component of the healthcare capacity index in our study.

Finally, the significant and positive effect of provincial value-added highlights the role of local economic strength. A wealthier provincial economy can generate more domestic resources for investment in health infrastructure and also signals a more robust market to potential investors. This finding can be linked to broader discussions on how social and economic development fosters tourism. For instance, recent research from Vietnam demonstrates that higher per capita GDP amplifies the positive interaction between social protection (like health insurance) and tourism outcomes, suggesting that economic strength creates a virtuous cycle for the tourism sector.

Recommendations

Considering the significant impact of uncertainty on tourism investment, it is recommended that the government encourage tourism companies to invest sustainably in the tourism sector by providing tax incentives and supporting them. Additionally, authorities should implement public-private partnership (PPP) investments in tourism infrastructure. All these policies are expected to help the tourism sector remain sustainable even in the face of significant uncertainty. Policymakers' failure to adopt the necessary and timely policies to deal with the increasing uncertainty can have adverse impacts on the tourism sector and the overall economy. Finally, it is recommended that future studies in this area could use seasonal data and time series estimation techniques to examine the impact of uncertainty shocks on tourism indicators in large developing economies such as China, India, Mexico, and Turkey, if data are available.

Conclusion

The present study revealed that economic policy uncertainty plays a key role in determining the investment level in health tourism, and its impact becomes significantly negative beyond a certain

threshold. The results suggest that economic instability and macroeconomic factors such as inflation and exchange rates, along with public health shocks such as the COVID-19 pandemic, can reduce the capacity to invest in health tourism infrastructure development. Additionally, financial development indicators, liquidity, and the number of tourists as positive drivers increase the capacity to invest in this sector. Due to the sensitivity of the health tourism sector to economic and public health changes, policymakers and investment managers should consider economic stability, risk reduction, and transparency of economic policies as key tools to promote investment. These results also indicate that economic uncertainty indicators should be considered seriously in estimating domestic and foreign tourism demand to enable more accurate predictions and optimal decision-making at the macro and enterprise levels. The results emphasize that integrating economic and public health approaches in health tourism policymaking can lead to improved access and quality of healthcare services in Iranian metropolises, in addition to increasing economic efficiency. They also pave the way for sustainable utilization of health tourism capacities in Iran.

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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