Threshold Effects of Monetary Policy on Tourism Demand: A Panel Smooth Transition Regression Model

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Abstract

This paper employs the panel smooth transition regression (PSTR) model to evaluate the threshold effects of monetary policy on inbound tourism and its determinants. The panel dataset includes the nineteen main countries from which there was inbound tourism to China during the 2006–2018 period. The empirical results indicate that the marginal effect of the determinants (gross domestic product (GDP), customer price index (CPI), and the substitution effect) on inbound tourism is nonlinear for different time, country, and transition variables. Moreover, prior currency devaluation policy (against the US dollar) can nonlinearly reduce the positive impact of GDP and the substitution effect in Greater China on inbound tourism and nonlinearly increase the negative effect of CPI on inbound tourism in China. Clearly, the government's monetary policy plays an important role in moderating China's tourism demand and its determinants.

Keywords: Panel Smooth Transition Regression (PSTR) Model, Tourism Demand, Monetary Policy, Substitution Effect, Threshold Effect

JEL Classification: E32, E52, C50

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I. Introduction

With its rapid economic growth, China has emerged as the fastest-growing source market in the world and the top spender in the international tourism industry. However, according to the World Tourism Organization (WTO), the number of inbound tourists entering China increased from 120 million in 2005 to 141 million in 2016, an increase of 17.9% over the 12-year period, with an average annual increase of only 1.5%. The growth in the number of inbound tourists to China has actually been negative in recent years. Furthermore, the development of inbound and outbound tourism in China is inconsistent, and the gap between inbound and outbound tourism has also gradually expanded. According to a report from the Center for China and Globalization (CGO), China had fewer inbound tourists than outbound tourists prior to 2011, and the gap between the two reached more than 31 million in 2015. Over the next five years, the gap will continue to increase and may even exceed 100 million. Clearly, the development of Chinese inbound and outbound tourism is extremely inconsistent.

According to tourism demand theory, as a country’s economic growth promotes the development of more progressive and comprehensive infrastructure in the country, the national tourism environment will be friendlier, which will benefit inbound tourism. However, the recent development of China’s inbound tourism has not been consistent with the trend of economic growth in China. Other scholars have put forward different views suggesting that the volatility of the renminbi will not have a major impact on China’s inbound tourism. Tang et al. (2016) argue that exchange rate fluctuations are not a determining factor in the fluctuation of demand for inbound tourism in China. Some scholars believe that the fluctuation in this demand is related to fluctuations in the value of the RMB that offset the positive impact of economic growth on inbound tourism. Gao et al. (2018) contend that as exchange rate fluctuations increase, inbound tourists will pay more attention to the exchange rate. In the existing relevant literature, the relationship between exchange rate fluctuations and mainland inbound tourism appears inconsistent. The inconsistency of these results may stem from differences in data sources and research methods. Another possible explanation for the inconsistency is that exchange rate fluctuations may lead to the over adjustment or misalignment of tourism prices. Therefore, there may be an asymmetric relationship between tourism demand and changes in the exchange rate that is not taken into account in the traditional linear model.

Inbound tourism in China has recently attracted considerable attention from researchers, and the related studies in the existing literature offer a solid foundation. However, there are still some related topics that are rarely mentioned or generally ignored in the existing literature. First, most studies still use linear, time series or structural models to investigate tourism demand. Since most macroeconomic variables have a nonlinear trend, the estimation results obtained using the traditional linear model may be biased due to specification error if there is heterogeneity among the variables in the model (Granger and Teräsvirta, 1993). Therefore, traditional linear estimation may not capture asymmetric threshold effects in tourism demand. In addition, China’s exchange rate system has changed from a fixed exchange rate and experienced a marketization process in recent decades, and these changes are infrequently taken into account in the extant literature on tourism demand. Finally, the cost of visiting alternative tourism destinations is also an important factor that affects tourism demand. According to the theory of substitution effects, the cost of visiting substitute destinations has a positive relationship to tourism demand, meaning that when tourism demand increases (declines), the cost of visiting substitute destinations also increases (declines). Few studies in the existing literature have investigated the impact of substitution effects on tourism demand.

To solve the above problems, we adopt a panel smooth transition autoregressive model (PSTR) to estimate tourism demand in China. This model can resolve the problems of data nonlinearity and heterogeneity, and the predictive ability and discrimination accuracy of the model are superior to those of the traditional linear regression model. In addition, according to exchange rate differential theory, movements in a country’s exchange rate will influence changes in price levels, and changes in the exchange rate will also change the relative price of a country's inbound tourism product (that of the country in question with respect to other tourist destinations), thereby affecting the country's inbound tourism demand. Obviously, monetary policy is a key factor that nonlinearly affects tourism demand and is also an appropriate transition variable in the PSTR model. Therefore, we select the return rate of the RMB against the US dollar as the transition variable in the PSTR model. Finally, we recognize that the choice of countries as substitute tourism destinations is closely related to culture, distance, and economic environment. This paper selects the relative cost of visiting countries in the Greater China region as a proxy variable for substitute tourism destinations and uses this variable to estimate the impact of substitution effects on tourism demand. In the selection of alternative tourism destinations, attention should be paid to their homogeneity, such as cultural and landscape consistency (Song and Wong, 2003).

This paper makes specific contributions to the existing literature. First, we evaluate China’s tourism demand using estimates obtained using the PSTR model; the result of this evaluation reveals a smooth and dynamic regime-switching process. Traditional linear models are unable to obtain this result, which is important to accurately estimate changes in tourism demand. In addition, this paper adopts the concept of the substitution effect, a concept that is rarely mentioned in the existing literature, and evaluates the effects of consumers’ substitution of alternative tourism destinations in the Greater China region on tourism demand. Finally, we use the exchange rate of the RMB against the US dollar as the threshold variable of the PSTR model to evaluate whether monetary policy nonlinearly influences the change in current inbound tourism demand and examine how monetary policy alters tourism demand and its determinants in China. These approaches can aid government authorities in formulating appropriate economic policies and operating strategies to stimulate inbound demand and to further the development of the travel and tourism industry.

The next section of the paper provides a review of the relevant literature. Section 3 introduces the empirical models. Section 4 describes the estimation procedures of the PSTR model, including linearity and elimination of the remaining nonlinearity. Section 5 presents the data, the empirical results (including the results of unit root tests, linearity tests, and threshold regime tests) and the discussion. Section 6 concludes the paper.

II. Literature Review

A. Tourism Demand

The definition of tourism demand can be determined from various aspects of the economy, psychology, geography and politics. Cooper et al. (1993) presented that tourism demand can defined as the total number of people who travel (or wish to travel) to use tourist services and facilities far away from their residence from geographical perspective. Song et al. (2009) defined tourism demand as the number of combinations of tourism products and services that consumers are willing and able to purchase for a particular destination in a specific period.

The interaction between tourism activities and social development has a very close relationship, and the tourism industry has become one of the most important industries in global economic development. Therefore, the issue of tourism demand has long attracted the attention of authorities, scholars and researchers. In the existing tourism literature, Kim (1988) proposed four measurement criteria to categorize the types of tourism demand (i.e., a doer criterion, a pecuniary criterion, a time-consumed criterion and a distance-travelled criterion). Among them, the doer criterion and the pecuniary criterion are the most common. The doer criterion includes the number of tourist visits and tourist arrivals, and the pecuniary criterion usually includes the share of expenditure in income and the level of tourist expenditure.

Mikulicz (1983) proposed three categories of determinants of tourism demand, including market volume (i.e., income, population and leisure time), cost of travel (i.e., cost of tourist and destination services) and utility image (i.e., publicity, tourist appeal and weather). Furthermore, later studies added other influencing factors, such as substitute prices of alternative destinations, political unrest, terrorism and various travel restrictions and dummy variables, to discuss the relationship with tourism demand.

In recent years, with the rapid changes in society, the economy, politics, and technology, the tourism industry has become an important industry that is actively developing in countries around the world. Therefore, how to study tourism demand to determine the constructive suggestions and guidelines for developing the tourism industry is becoming a very important issue for the authorities and relevant tourism industry operators.

B. China’s Inbound Tourism

During the past two decades, China’s inbound tourism and outbound tourism have not exhibited parallel development; inbound tourism, in particular, shows only slight growth. Inbound tourism is recognized as one of the key indicators that reveals a country's level of international competition and the overall strength of its tourism industry. The inconsistent development of China’s tourism and travel industry has attracted a great deal of attention from government authorities and academics in recent years. Most studies in the existing literature still use the traditional gravity model to investigate factors influencing China’s tourism demand (Shan and Wilson, 2001), while other studies examine the economic contribution of the tourism industry and forecast tourism demand in China (Goh and Law, 2002; Chen and Wang, 2007; Pratt, 2015).

Although economic development, infrastructure construction and tourism-friendly policies (for example, visa facilitation and increased numbers of international air routes) are key factors influencing inbound tourism, some scholars believe that the imbalance in China's tourism industry is not only affected by these policies but also closely related to the effects of specific factors (pollution, monetary policy, cultural distance and substitution effects, among others). Therefore, some scholars have recently considered the effects of specific influencing factors, for example air pollution (Xu and Reed, 2017; Zhou et al., 2018), the exchange rate

(Tang et al., 2016; Gao et al., 2018), cultural distance (Yang and Wong, 2012) and the effects of travel substitution (Yang, 2007) when investigating inbound tourism in China.

Summarizing the above-mentioned relevant literatures, factors such as GDP, CPI, the exchange rate, air pollution, cultural distance, and substitution effects are considered to have a key impact on China’s inbound tourism. In addition, except for those of some scholars who presented inconsistent empirical results on the impact of exchange rate factors on China's inbound tourism, the rest of the key factors related to China’s inbound tourism demand are mostly consistent in the empirical results in the literature. Although most existing relevant studies still use the traditional linear model, in order to be more sophisticated in estimating tourism demand, a small number of scholars have tried to use new measurement methods for empirical estimation of tourism demand. For example, Song et al. (2011) use the TVP-STSM model proves that the seasonal pattern of tourism demand and the effect of various influencing factors on demand will change over time. The TVP-STSM is a structural time series model established based on the time-varying characteristics of parameters. The main advantage of this model is that it cannot only solve the situation that the parameters of the empirical process change with time, but also through the concept of structural equations, it presents the model's parameter trends, Structural factors such as cycles or seasons may produce a process of change that changes with the times. Although both the TVP-STSM and PSTR models have the characteristics of solving the change of model parameters with time, The TVP-STSM model cannot clearly describe the inconsistent changes of parameters in the model before and after a certain threshold value, like the PSTR model.

Overall, the existing literature provides rich and valuable information on China's tourism demand. However, most of the empirical models that have been presented are closely related to macroeconomic variables and are still based on traditional linear methods. Therefore, to obtain more accurate estimation results, this study adds the concepts of the travel substitution effect and the exchange rate and uses a nonlinear model to explore the threshold effect of monetary policy on inbound tourism in China.

C. Nonlinear Model

Hsiao (2003) argued that cross-sectional data often exhibit heterogeneity that can be misleading in a panel context if the measurement process includes the same assumptions regarding the effects of a specific variable. To avoid estimation bias in a model arising from the heterogeneity of the data structure, scholars have increasingly replaced traditional linear models with nonlinear models for empirical estimation. The nonlinear models frequently used in the literature include the threshold autoregressive (TAR) model, the Markov switching (MS) model, the smooth transition autoregressive (STAR) models, the panel threshold (PTR) model, and the panel smooth transition regression (PSTR) model.

Although the above models are classified as nonlinear models with different state transitions, each model has its own unique characteristics and appropriate uses due to the different transition processes and properties of each model. For example, because the nonlinear transition process is radical and discrete in the TAR (Tong, 1978) and MS (Hamilton, 1989) models, it is almost impossible to capture the actual transition process of the model through an empirical process. Thus, these types of models are not suitable for data models of a low-frequency structure. In addition, if the threshold is replaced with a smooth transition function, the TAR model can be extended to a STAR model (Chan and Tong, 1986), which includes a transition function that links two nonlinear AR parts. The transition process allows the transition variable to move in two different regimes, and the smooth transition process depends on the value of the lagged transition variable. The transition process of the STAR model has smooth transitions and logical properties, but this model is not suitable for modeling cross-sectional data. Although the PTR model (Hansen, 1999) uses the threshold of time varying to divide cross-sectional data into different regimes, the transition process produces a jump phenomenon when the observed variable reaches the transition threshold. This phenomenon is not common in the real world.

Finally, if the jump transition process of the thresholds is corrected to a smooth transition mode and a parameter of transition speed is included in the model to describe the smooth transition phenomenon of the model, PTR models can be generalized to the PSTR (González et al., 2005) model. In addition, the transition threshold parameters are obtained by measurement methods rather than through personal settings, which provides a more objective estimation method that avoids model estimation bias caused by the subjective concept of the researcher. Considering that the PSTR model has the advantages of capturing data heterogeneity and more accurately describing the individual and time effects in the model, scholars have increasingly used this model in their recent research (Cheng and Wu, 2013; Saidi et al., 2017). Recently, in order to emphasize the importance of the correct selection model for the empirical results, some scholars have chosen the PSTR model and the traditional linear model to study research issues at the same time. Recently, in order to emphasize the importance of the correct selection model for the empirical results, some scholars have chosen the PSTR model and the traditional linear model to study research issues at the same time. The estimation results presenting the linear method may hide relevant estimation information on structural changes. This confirms that the PSTR model can present the estimation results more completely than the traditional linear model (Wu et al., 2014; Wu and Lee, 2018).

Tourism-related literature has also gradually adopted nonlinear models for research on related topics. For example, Chou (2013) used the panel threshold model proposed by Hansen (1999) to explore the threshold effect of consumer prices in destination countries on the number of outbound tourists from Taiwan. Wang (2014) used a logistic transition regression model to explore the relationship between international tourism expenditures and per capita GDP based on different types of savings regimes from 2001 to 2010. Yang and Lee (2018) used a panel smooth transition regression model to explore the threshold effect of the service quality of Taiwan's international tourist hotels on profitability during 2000 to 2013 period. This paper primarily discusses the threshold effect of monetary policy on China's inbound tourism, and most of the model variables have macroeconomic and time series properties. Therefore, the PSTR model is used in the subsequent empirical analysis.

III. Model and Methodology

This paper first constructs a linear panel model for the estimation of inbound tourism demand in China. Most studies in the existing literature adopt the traditional gravity model, which focuses on income and price levels in other countries on a bilateral basis, to study the determinants of tourism demand. To extend the analysis to other factors affecting tourism demand, some scholars also include other characteristic variables such as crisis, culture, religion, weather, and personal experience in their empirical models (Ryan, 1993; Huang and Min, 2002; Cohen, 2003; Khadaroo and Seetanah, 2008; Vietze, 2012; Balli et al., 2013). This paper employs the relative real gross domestic product (*GDP*) and the relative customer price index (*CPI*) as proxies for income level and price level as dependent variables and includes a proxy variable for the travel substitution effect in investigating inbound tourism demand in China. The empirical model is as follows:

$$T_{it} = \alpha_{i0} + \alpha_1 GDP_{it} + \alpha_2 CPI_{it} + \alpha_3 S_t + \mu_{it} \tag{1}$$

Where $i = 1, 2, ..., N$ is the number of countries and $t = 1, 2, ..., T$ is the number of periods. T_{it}, GDP_{it}, CPI_{it}, and S_{it} are the number of tourists coming to China from country i at time t, the relative real *GDP* index between China and country *i* at time *t*, the relative *CPI* between China and country *i* at time *t*, and the relative price level of countries in the Greater China region at time *t*, respectively. μ_{it} is a residual. Our study follows the approach of Yang (2007), who used the relative ratio of CPI and exchange rate to estimate the price of alternative tourist destinations and to construct a model of substitution effects in the Greater China region. The model is as follows:

$$S_t = \sum_{j=1}^{5} (CPI_j / EX_j) w_j \tag{2}$$

where *j* is an alternative tourism destination in the Greater China region (including

Singapore, Malaysia, Taiwan, Hong Kong and Macau, and w_j is the ratio of the number of inbound tourists in country *j* to the number of inbound tourists in the Greater China region. When the sample countries in the empirical model are the same as those in Greater China, the country is not included in the substitution effect model; that is, the number of alternative tourism countries in Greater China will be reduced to four.

Most macroeconomic variables are typically asymmetric when the adjustment of the error correction term is asymmetric or when it exhibits a threshold effect. Estimation results obtained from traditional linear models may be biased. Therefore, this paper follows Fok et al. (2005) and González et al. (2005) in structuring the PSTR model, and we rewrite Eq. (1) using the PSTR framework. The PSTR model can account for heterogeneity and can more accurately describe and analyze individual and time effects in the data. The threshold value is obtained empirically, which is more objective and logical than the traditional method of subjective determination. The PSTR model can be written as follows:

$$T_{it} = \pi_i + \beta_0 X_{it} + \beta_1 X_{it} G(Z_{it};\gamma;\tau) + \varepsilon_{it} \tag{3}$$

where π_i is the vector of individual fixed effects, X_{it} is the vector of exogenous explanatory variables, $X_{it} = X_{it}(X_{i1t}, X_{i2t}, X_{i3t}) = X_{it}(GDP_{it}, CPI_{it}, S_{it})$, $i = 1,2,...,N$ denotes the cross-sectional estimates, $t = 1,2,...,T$ denotes time, and T_{it} denotes the dependent variable. $G(Z_{it};\gamma;\tau)$ is a transition function; its value ranges from 0 to 1, and it is a continuous function. Z_{it} is the transition variable, γ is the slope of the transition function, τ represents the value of the transition threshold or location parameter, and ε_{it} is a residual term. The logistic specification of the transition function is as follows:

$$G(Z_{it-d};\gamma;\tau) = \left\{1 + \exp\left[-\gamma(Z_{it-d} - \tau)\right]\right\}^{-1} \tag{4}$$

where $\gamma > 0$, $\tau_1 \le \tau_2 \le ... \le \tau_m$, $\tau = (\tau_1, \tau_2, ..., \tau_m)$, and m is the matrix vector location parameter. The larger the value of γ is, the steeper the transition function G (.) will be. $\gamma \to \infty$ approximately represents the transition function G (.) for structural changes at a single time point, and $\gamma \to 0$ G (.) is an approximately linear function. In the previous literature, the transition function is usually set to $m = 1$ or $m = 2^2$. The case in which $m = 1$ is called the logistic PSTR model; in the logistic model, the transition threshold divides the data into two regimes. The case in which $m = 2$ refers to the exponential PSTR model; in the exponential model, the transition threshold divides the data into three regimes. A PSTR model that tests for only $m = 1$ or $m = 2$ is sufficient to capture the nonlinearity caused by the switching regimes (González et al., 2005). The PSTR model can be written as follows:

$$T_{it} = \pi_i + \beta_0 X_{it} + \sum\nolimits_{j=1}^{r} \beta_j X_{it} G(Z_{it}; \gamma; \tau) + \varepsilon_{it} \tag{5}$$

where $j = 1, 2, \cdots, r$ indicates that there may be r smooth transition functions and (r + 1) transition regimes in the model.

IV. SpecificationTests and Estimation

Following González et al. (2005) and Wu et al. (2013), we employ a three-step procedure to estimate Eqs. (3) and (5) and thereby to test whether the PSTR model satisfies the linearity condition. When the null hypothesis of linearity is rejected, we confirm the number of transition functions. We then remove the individual specific means and apply the nonlinear least squares method to estimate the parameters of Eqs. (3) and (5).

A. Selection of Transition Variable

Facing the trend of economic globalization, government authorities usually adopt monetary policy to intervene in the market to maintain domestic price stability and improve financial development and promote national economic growth. However, because monetary policy has inconsistent effects on the development of various industries, when the government uses monetary policy to stabilize the country’s economic development, it may have significant fluctuations or even negative effects on the development of domestic industries. In addition, since the tourism industry has been recognized as the fastest-growing industry in the world in recent years, and it still has very large opportunities for development in the future, how to correctly use monetary policy tools to maintain the steady growth of the country’s economy while considering China’s inbound tourism development is a very important issue for the current government authorities.

Exchange rates are important factors in cross-border travel flows, and they represent a government’s efforts to stimulate economic growth and tourism demand by altering its monetary policy. In addition, according to exchange rate differential theory, changes in a country’s exchange rate affect price levels and will change the relative price of a country's inbound tourism product (that of the country in question with respect to other tourist destinations), thereby affecting the country's inbound tourism demand. Some scholars believe that the exchange rate is another form of price reaction (Dwyer et al., 2002; Luo, 2007; Zhao, 2011), but many studies suggest that tourists’ travel decisions are focused more on the perception of exchange rates than on actual prices (Chadee and Mieczkowski, 1987; Rosensweig, 1988). That is, monetary policy may have an asymmetric impact on tourism demand. Thus, this paper selects the return of the RMB against the US dollar as a transitional variable in the PSTR model.

B. Specification Tests

Following González et al. (2005) and Wu et al. (2013), we test the linearity of Eq. (4) by adopting the first-order Taylor expansion for $\gamma = 0$ to take the place of the transition function $g(Z_{it-d};\gamma_j;c_j)$. We can then obtain the auxiliary equation as follows:

$$P_{it} = \theta_{i0} + \sum_{j=1}^{j} \theta_j P_{it-j} + \sum_{j=1}^{j} \theta'_j \theta P_{it-j} Z_{it-d} + \mu_{it} \quad (6)$$

where d = 0, 1, 2, 3, or 4 to allow for the current and lagged exchange rate return. The linearity test is employed to test the null hypothesis that $H_0 : \theta'_1 = \theta'_2 = \theta'_3 = 0$. Rejection of the null hypothesis of linearity implies that the model has at least one threshold variable. We then compare a one-threshold model against a two-threshold model to determine the number of model regimes. The analytical procedure is continued, testing the optimal number of threshold functions until the hypothesis of an added threshold is not rejected.

Here, SSR_0 denotes the panel sum of squared residuals under the null hypothesis (i.e., the linear panel model with individual effects), and SSR_1 denotes the panel sum of squared residuals under the alternative hypothesis (i.e., the PSTR model with two regimes). The corresponding LM statistic is given by the following:

$$LM_F = \left[((SSR_0) - (SSR_1))/P\right] / \left[SSR_0/(TN - N - P)\right] \quad (7)$$

where P is the number of explanatory variables. The LM statistic has an asymptotic $X^2(K)$ distribution under the null hypothesis.

V. Empirical Results

This study considers source countries for inbound tourism to China as sample objects. The data used in this study were compiled yearly; they span the period from 2006 to 2018 and were collected from the Ministry of Culture and Tourism of the People's Republic of China and from the International Monetary Fund (IMF). Descriptive statistics and a correlation coefficient analysis of the variables are presented in Tables 1 and 2.

Table 1 Data Measurement

Name	Code	Measurement	Data source
Inbound tourists to China	*T*	The logarithm of the number of tourist arrivals from every country of origin to China	Ministry of Culture and Tourism of the People's Republic of China
Income level	*GDP*	The relative real GDP index (2010=100) between China and country *i*	IMF
Price level	*CPI*	The relative CPI (2010=100) based on the national currency per US dollar (end of period/2010=100) between China and country *i*	IMF
Substitution effect	*PY*	The relative price levels of countries in the Greater China region	IMF
Exchange rate return	*EX*	The exchange rate is the RMB against the US dollar at the end of the period (2010=100)	IMF

Table 2 Descriptive Statistics

Variable	Min	Max	Mean	Median	Std. Dev.
T	0.915	2.679	1.781	1.795	0.423
GDP	0.639	1.766	1.099	1.078	0.240
CPI	0.595	1.876	1.112	1.101	0.221
PY	0.667	1.210	1.039	1.042	0.129
EX	–0.065	0.071	-0.011	-0.030	0.046

The data employed herein are time series data, and omitted variables may create a nonstationary situation due to the problem of spurious regression. To avoid the problem of empirical estimation bias, we use two panel data unit root test methods, the Levin et al. (2002) test and the Phillips–Perron test, to examine the relevant variables. Table 3 presents the empirical results, which indicate that all variables satisfy the condition of stationarity.

The test and estimation results for inbound tourism to China obtained using the PSTR model are presented in Tables 4, 5 and 6. In Table 4, the test statistics reject the null hypothesis of linearity at one and two location parameters in the PSTR model. These results suggest that inbound tourism to China can be depicted as a nonlinear dynamic path. Therefore, this paper uses a nonlinear model to perform the empirical estimation to avoid biasing the empirical results in this structural asymmetric change process.

According to the test results shown in Table 5, except for the case of one location parameter (*m*=2) and the specified transition variable $SR_{it-d}, d = 0$ the test statistics reject the null hypothesis that there is one transition function, indicating that the PSTR model has at least two transition functions. Each of the remaining cases has only one transition function.

Following the tests that were conducted to ensure that there is no remaining nonlinearity and the determination of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), the estimation results of the optimal PSTR inbound tourism model are reported in Table 6. The optimal number of lag periods for the transition variable is four, and the threshold value c and the transition parameter γ are 1957 and -0.063, respectively.

Table 3 Panel Unit Root Test

Variable	LLC		PP – Fisher	
	Statistic	*p-value*	Statistic	*p-value*
T	−1.395*	0.082	51.916*	0.066
GDP	−8.191***	0.000	195.308***	0.000
CPI	−7.304***	0.000	47.938	0.130
PY	−6.080***	0.000	36.074	0.559
EX	−3.994***	0.000	80.557***	0.000

Note: H_0: Unit root (assumes a common or individual unit root process). *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 4 Linearity Test

SR_{it-d}	Test statistic	Number of location parameters			
		m = 1		m = 2	
		W	*p-value*	*W*	*p-value*
	LM	9.455**	0.024	21.45	0.002
d = 0	*LMF*	2.980**	0.032	3.517	0.002
	LRT	9.646***	0.000	22.469	0.000
	LM	11.126**	0.011	17.12	0.009
d = 1	*LMF*	3.516**	0.016	2.743	0.014
	LRT	11.416***	0.000	17.819	0.000
	LM	14.088***	0.003	21.187	0.002
d = 2	*LMF*	4.498***	0.005	3.457	0.003
	LRT	14.604***	0.000	22.382	0.000
	LM	8.517**	0.036	21.969	0.001
d = 3	*LMF*	2.620*	0.053	3.593	0.002
	LRT	8.722***	0.000	23.404	0.000
	LM	7.257*	0.064	14.917	0.021
d = 4	*LMF*	2.191*	0.092	2.318	0.037
	LRT	7.422***	0.000	15.639	0.000

Note: 1. H_0: Linear model. H_1: *PSTR* model with at least one threshold variable (r = 1). *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

2. *LM*, *LMF*, and *LRT* refer to the Wald test, the Fisher test, and the likelihood ratio test, respectively.

Table 5 Test for No Remaining Nonlinearity

SR_{it-d}	Test statistic	Number of location parameters			
		m = 1		m = 2	
		W	*p-value*	*W*	*p-value*
	LM	0.004	7.678	0.263***	0.004
d = 0	*LMF*	0.006	1.151	0.334***	0.006
	LRT	0.003	7.804	0.253***	0.003
	LM	2.139	0.544	4.478	0.612
d = 1	*LMF*	0.629	0.597	0.655	0.686
	LRT	2.149	0.542	4.524	0.606
	LM	2.391	0.495	2.291	0.891
d = 2	*LMF*	0.695	0.556	0.327	0.922
	LRT	2.405	0.493	2.304	0.890
	LM	4.763	0.19	8.613	0.197
d = 3	*LMF*	1.381	0.251	1.251	0.283
	LRT	4.826	0.185	8.823	0.184
	LM	4.051	0.256	7.193	0.303
d = 4	*LMF*	1.148	0.332	1.017	0.417
	LRT	4.102	0.251	7.355	0.289

Note: H_0: *PSTR* with r = 1 against H_1: *PSTR* with at least r = 2. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

In the PSTR model, GDP has a significant and positive effect on inbound tourism. The result may indicate that when China's GDP performs better than that of the source country, China’s basic public facilities, transportation construction, and human resources will also be better than those of the source country. On the other hand, people might also then pay more attention to leisure tourism due to GDP growth. As a result, the quality and development of tourism are enhanced, which in turn improves China’s domestic tourism environment, making tourism activities in China more attractive to foreign tourists. Nieh and Chou (2002) reported similar results in their study of the macroeconomic factors that affect the number of inbound visitors and revenues in Taiwan. Moreover, the marginal effect of GDP on inbound tourism is

$0.281 - 0.363 \times G(Z_{it};\gamma;\tau) > 0$. That is, when the transition variable exceeds the threshold value −0.063, the impact of GDP on inbound tourism will change from 0.281 to −0.082 ($= 0.281 - 0.363$). In other words, the greater the lag on exchange rate returns (the devaluation of the RMB) is, the smaller the marginal effect of GDP on inbound tourism. A possible explanation for this result is that devaluation of the RMB reduces relative real GDP, thereby offsetting the benefits of GDP growth for inbound tourism.

As expected, CPI has a significant and negative effect on inbound tourism. Both theoretically and empirically, the price factor has been a key factor that determines people's willingness to travel, and there is a negative correlation between them. In other words, higher CPIs will entail relatively higher travel prices and fewer arrivals. In addition, the marginal effect of CPI on inbound tourism is $-0.136 - 0.038 \times G(Z_{it};\gamma;\tau) > 0$. That is, when the transition variable exceeds the threshold value -0.063, the impact of CPI on inbound tourism will change from −0.136 to −0.159 ($= -0.136 - 0.038$). This result implies that when one includes a lagged term for currency devaluation policy, the marginal effect of CPI is more disadvantageous for tourism demand in China. The reason is that devaluation policy can reduce the value of real GDP, which reduces the arrivals of foreign tourists to China.

The relative price levels of countries in the Greater China region have a significant and positive relationship to tourist inflows to China, implying that the price levels of other countries in the Greater China region have a substitution effect on Chinese tourism. In other words, tourists who choose to travel to China when the relative CPIs of other countries in the Greater China region decline (when the price of tourism declines) may change their destinations due to the impact of price differences, resulting in fewer people visiting China. This result echoes the concept of the substitution effects in economics, which argues that when an alternative provider exists, the alternative provider’s price will have a positive relationship to demand. This means that as the price rises, demand increases and that as the price declines, demand declines. The resulting effect is called the substitution effect, and the goods that replace one another are known as substitute goods. According to the empirical results in Table 6, the marginal effect of the substitution effect on inbound tourism is

$0.387 + 0.357 \times G(Z_{it};\gamma;\tau) > 0$. That is, when the transition variable exceeds the threshold value of -0.063, the impact of the substitution effect on inbound tourism will change from 0.387 to 0.744 ($= 0.387 + 0.357$). This result implies that when one includes a lagged term for currency devaluation policy, the marginal effect of the relative price level of countries in the Greater China region helps to attract foreign tourists. For this reason, when China devalues its currency, real tourism prices may decline, thereby prompting travelers who might be considering a visit to the Greater China region to ultimately choose China as a tourist destination.

To determine the superiority of PSTR models in estimating inbound tourism relative to the traditional linear model, this paper also adopts a linear panel data model to estimate the determinants of inbound tourism and reports the estimation results in Table 6. In addition, this paper uses a Hausman test to select the appropriate linear panel data model, and the results show that the random effects model is the optimal method for estimating the linear model. In Table 6, all variables have significant effects on inbound tourism. The impacts of GDP, CPI, and the substitution effect are −0.106, −0.143 and 0.671, respectively. Compared to the PSTR models, the linear panel data model estimate for inbound tourism may cause bias in the estimation results. In traditional linear, for example, the impact of GDP on inbound tourism is fixed at −0.106; however, in the PSTR model, the effect is $0.281 - 0.363 \times G(Z_{it};\gamma;\tau)$ across countries and varies with time. Therefore, choosing an appropriate econometric method is relatively necessary for the correctness of the research.

Table 6 Estimation Results for Inbound Tourism

Chosen model Variable parameter	PSTR model *r=m=1 d=3*		Linear model
γ	1957		–
τ	–0.063		–
c	–		1.350 (12.147) ***
β_1	0.281 (2.954)	***	–0.106 (–3.604) ***
β_2	–0.136 (–1.755)	*	–0.143 (–6.024) ***
β_3	0.387 (5.092)	***	0.671 (11.920) ***
β'_1	–0.363 (–3.784)	***	–
β'_2	–0.023 (–0.288)	***	–
β'_3	0.357 (4.511)	***	–
AIC	–7.267		–
BIC	–7.154		–
R^2	–		0.495
Hausman test	–		0.835
N	240		240

Note: 1. The parameters *r*, *m*, and *d* are the transition functions, location parameter, and lag length of monetary policy, respectively.

2. γ, τ and c are the estimates of transition parameter, threshold value and intercept term, respectively.

3. β_i and β'_i, $i=1,2,3$ are the coefficients of GDP, CPI and substitution effect, respectively.

4. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

5. *t*-statistics are shown in brackets.

6. AIC and BIC are used to determine the degree of model suitability. The smaller the value calculated by AIC and BIC is, the better the goodness-of-fit of the model.

VI. Conclusion

It is important for government authorities to evaluate inbound tourism to maintain the travel and tourism industry and to further economic growth. This study constructs a panel smooth transition model using monetary policy as the transition variable to evaluate the threshold effects of inbound tourism in China. Our empirical results have several implications. First, the macroeconomic variables and the travel substitution effect of the Greater China region on inbound tourism show a nonlinear relationship in the PSTR model. Second, the marginal effects of the macroeconomic variables and the travel substitution effect of the Greater China region on inbound tourism reveal a nonlinear dynamic process in which there are differences in the changes over time and across countries. Third, China's currency devaluation policy (the transition parameter > −0.063) can reduce the positive contribution of GDP to tourism demand and increase the positive impact of CPI and the travel substitution effect in the Greater China region on tourism demand in China.

We offer the following policy propositions. First, monetary policy has nonlinear influences on tourism demand in China, and its marginal effects will differ depending on the variables considered. For example, when currency devaluation exceeds the threshold value, the impact of tourism prices and substitution effects on tourism demand may increase, but the impact of increasing national income on tourism demand may also be offset. Therefore, when making monetary policy adjustments, government authorities should consider the possible impact of these adjustments on various aspects of the market. Moreover, when government authorities adopt an expansionary monetary policy, although the demand for inbound tourism may decline, the empirical results show that as long as the appreciation of the exchange rate does not exceed the threshold (−0.063), the overall marginal effect of the economic variables on tourism demand persists. Finally, tourism substitution in the Greater China region has a significant and positive impact on China's tourism demand. Therefore, when adjusting exchange rate policy, the price levels in the Greater China region should also be taken into consideration to achieve the optimal monetary policy effect.

This paper provides empirical results showing that the substitution effect has a significant impact on China's inbound tourism. However, in this study, the data used to measure the substitution effect include the relative price and exchange rate in the region. In fact, the sources of the substitution effect not only include economic factors; distance and cultural awareness are also very important factors. Therefore, future studies should use other influence factors of the substitution effect to enrich the research on inbound tourism in China.

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貨幣政策對旅遊需求的門檻效果:縱橫平滑轉換迴歸模型之應用

周錦梅 *

摘　要

本文採用縱橫平滑轉換迴歸模型 (panel smooth transition model, PSTR) 評估貨幣政策對旅遊需求決定因素的門檻效應。使用的資料爲 2002-2018 年間入境中國的 19 個主要國家的時間序列及橫斷面資料。實證結果顯示，在不同的時間、國家與關鍵因素 (國內生產毛額 (GDP)、消費者物價指數 (CPI) 與替代效果) 對中國入境旅遊存在非線性邊際效果。另外，先前的貨幣貶值政策 (相對於美元) 可以非線性地減少 GDP 和大中華地區入境旅遊替代效應對中國入境旅遊的正面影響，並且非線性地增加 CPI 對中國入境旅遊的負面影響。明顯的，政府的貨幣政策對中國旅遊需求及其決定因素方面扮演著至關重要的作用。

關鍵詞：縱橫平滑轉換迴歸模型、旅遊需求、貨幣政策、替代效果、門檻效果
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