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Tourism productivity and economic growth

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ABSTRACT

This study examines the transmission mechanism between tourism productivity and economic growth, using Spain as an empirical setting. By relaxing the assumption of diminishing return of capital, new growth theory is integrated into the Bayesian dynamic stochastic general equilibrium model for thte first time in the tourism literature. The results demonstrate the impact of tourism productivity on economic growth and illustrate the spill-over effects between tourism and other sectors caused by the externalities of physical and human capital and public services. The simulation results further disclose that when the productivity of overall economy improves, inbound tourism demand expands more than domestic tourism demand, whereas when the productivity of tourism sector improves, domestic tourism consumption increases more than inbound tourism consumption.

Introduction

Productivity is a key concept in economics. In particular, increased productivity can lead to increased output and economic growth without any additional inputs. Thus, tourism destinations are keen to improve their tourism productivity. The research agenda of the United Nations World Tourism Organization (UNWTO) has paid particular attention to tourism productivity (Assaf & Dwyer, 2013). Overall, tourism practitioners want to increase their productivity to generate greater outputs, destination governments seek to improve the productivity of their tourism markets to drive economic growth and academics are interested in how tourism productivity affects economic growth.

Although it is clear that tourism development is positively related to economic growth (Brida, Cortes-Jimenez, & Pulina, 2016; Pablo-Romero & Molina, 2013), few studies have examined how tourism productivity affects the wider economy. In a pioneering study, Blake, Sinclair, and Soria (2006) compare the effects of the productivity of various tourism sectors on economic development. Liu, Song, and Blake (2018) apply exogenous economic growth theory, which assumes that productivity is exogenous and the return of capital is diminishing, to simulate the transmission mechanism from an exogenous tourism productivity shock to economic growth in Mauritius using a dynamic stochastic general equilibrium (DSGE) model.

This study relaxes the assumption of the diminishing return of capital in exogenous growth theory (Liu et al., 2018) by incorporating new growth theory (Romer, 1986) into a Bayesian DSGE model for the first time in the tourism economics literature. Unlike the manufacturing industry, which can improve productivity by introducing new technology into the production process, productivity improvement in the tourism industry is more related to service innovations that improve the experiences of tourists (Chen & Soo, 2007). New growth theory suggests that productivity is not exogenous and can be facilitated by the spill-over effects of the knowledge in human capital and public investment (Romer, 1986), which is more consistent with the more labour-intensive and

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less physical capital-intensive features of the tourism sector. Therefore, in this study, the impact of tourism productivity on economic growth is investigated alongside the effects of the externalities of human and physical capital and public investment under a Bayesian DSGE framework to ensure that the simulation results better reflect reality.

The remainder of this study is organised as follows. Section 2 reviews the literature on tourism productivity and its measurement, in addition to tourism development and economic growth. Section 3 presents the model. Section 4 presents the data and the model estimation results. Section 5 discusses the findings from two perspectives: the impact of tourism productivity on economic growth, and the effects of the determinants of tourism performance on tourism development and economic growth. Section 6 concludes the study and outlines directions for future research.

Literature review

Measurement and estimation of tourism productivity

Productivity is a multidimensional measure that covers various factors such as technical efficiency, the scale effect, innovation and output growth (Assaf & Tsionas, 2018). Due to its wide coverage, productivity is 'widely perceived as the most comprehensive single measure of performance across almost all industries including the hospitality industry' and 'as one of the most reliable indicators appropriate for comparisons' (Chatzimichael & Liasidou, 2019, p. 207). In economics, productivity is traditionally measured by the Solow residual (Solow, 1957), which defines productivity as output that arises from neither physical nor human capital inputs. As the accumulation of physical and human capital is difficult to measure, the Solow residual is more frequently used in positive economic studies (Fan, Liu, & Qiu, 2019; Liu et al., 2018; Nowak, Sahli, & Cortés-Jiménez, 2007; Stauvermann & Kumar, 2017) because it can be directly derived from the production function and is coherent with the equilibrium setting.

In empirical studies, productivity is estimated by the frontier method, which can be further divided into parametric and non-parametric methods. The parametric methods are used to estimate the parameters in given production functions, such as the Cobb-Douglas and Translog functions (Chatzimichael & Liasidou, 2019). Stochastic frontier analysis (SFA) is often used to estimate the parameters because unlike the deterministic methods, it can accommodate random errors when solving frontier production functions (Orea, 2002). In SFA, the deviations from the frontier are divided into two components: random error and inefficiency. This assumption is more consistent with reality because it is common to have stochastic fluctuations when measuring demand and other economic factors, and failure to consider the random error may lead to significant biases in the estimations. In their SFA approach, Chatzimichael and Liasidou (2019) divide hotel productivity into technical efficiency, the scale effect and technical change. Assaf and Tsionas (2018) further separate tourism productivity into three components: input change, output change and frontier change.

Data envelopment analysis (DEA) is a commonly used non-parametric method for measuring changes in productivity and technological efficiency (Assaf, Deery, & Jago, 2011). Based on linear programming, DEA converts multiple inputs and outputs into a single performance score measure by following either a constant return scale (CRS) or a variable return scale (VRS) assumption (Assaf & Agbola, 2011). The different assumptions lead to various frontier shapes. Although a CRS has more favourable geometrical features, a VRS is a more relaxed assumption and closer to the reality.

In DEA, a measure with one unit score indicates the best-practice frontier, and the distances to this frontier are used to measure efficiency (in one time period). The productivity (between two time periods) can be measured by either the Malmquist index (Barros, 2005; Barros & Alves, 2004; Cracolici, Nijkamp, & Cuffaro, 2007) or the Luenberger indicator (Barros, Peypoch, & Solonandrasana, 2009; Peypoch, 2007; Peypoch & Sbai, 2011; Peypoch & Solonandrasana, 2008).

It is clear that SFA and DEA are effective methods for measuring the level of productivity in tourism. However, this study aims to examine the transmission mechanism from tourism productivity to economic growth using a DSGE model, in which only the function rather than the real level of tourism productivity is required. Therefore, the Solow residual is used to present tourism productivity due to its theoretically sound features and close links with the other behaviour equations in the model.

Tourism development and economic growth

A large number of studies have used different methods to examine the relationship between tourism development and economic growth, such as the econometric models, the tourism satellite account (TSA), computable general equilibrium (CGE) models and DSGE models. This subsection briefly reviews the related studies and outlines the research objectives of this study.

In the econometric models, cointegration and the Granger causality are commonly used to examine the relationship between tourism and economic growth (Brida et al., 2016; Pablo-Romero & Molina, 2013; Song, Dwyer, Li, & Cao, 2012). For instance, Chiu and Yeh (2017) use cross-sectional data models to identify a correlation relationship between tourism and economic growth. Some studies use time series models such as Belloumi (2010), Croes and Vanegas Sr (2008) and Shahzad, Shahbaz, Ferrer, and Kumar (2017). Other studies use panel data models (Bilen, Yilanci, & Eryüzlü, 2017; Liu & Song, 2018; Salifou & Haq, 2017), which provide a greater degree of freedom in the model estimation and are especially efficient when the time series are short (Song, Qiu, & Park, 2019; Wu, Song, & Shen, 2017). As Brida et al. (2016) note, although many empirical studies using Granger causality and cointegration tests support a Granger causality relationship between tourism and economic growth, they can only examine the sequence of occurrence between tourism development and economic growth, rather than a real cause-effect relationship (Song et al., 2012).

Different from the econometric models that focus on the correlation between tourism development and economic growth, the TSA method measures the contribution of tourism to the economy from a national accounting perspective. TSA is a standard framework for measuring the direct contribution of tourism to the destination economy. *Tourism Satellite Account: Recommended Methodological*

Framework 2008 (UNWTO, 2008), which was jointly published by the United Nations Statistics Division, the Statistical Office of the European Communities, the Organization for Economic Co-operation and Development and the United Nations World Tourism Organization, provides guidelines for destination TSA compilation. Over 60 countries have used this framework to compile their national or regional TSAs and measure the economic contribution of tourism (UNWTO, 2010). This method is also used to evaluate the contribution of specific activities in the tourism industry such as the meetings industry (Dwyer, Forsyth, & Spurr, 2007; Jones & Li, 2015; Zhang, 2014), yachting and coastal leisure shipping (Diakomihalis & Lagos, 2008, 2011) and the contribution of tourism to the environment (Jones & Munday, 2007; Munday, Turner, & Jones, 2013). The advantage of TSA is that it is standard and the results are comparable across destinations and over time. However, TSA only measures the direct contribution of tourism to the economy. Other methods are required to estimate the total contribution (i.e., direct, indirect and induced) of tourism (Giannopoulos & Boutsinas, 2016; Smeral, 2006; Wu, Liu, Song, Liu, & Fu, 2019).

The CGE model, which combines a systematic model with the national accounts, is often used to measure the reaction of an economy to changes in external factors such as policy or technology. The spill-over effects of different sectors on economic growth can also be estimated. In a CGE model, a series of equations are included to capture the behaviour of different sectors and markets given the optimisation conditions of neoclassical microeconomics (Blake, Arbache, Sinclair, & Teles, 2008; Liu et al., 2018). Studies that use CGE models to measure the effect of tourism on economic growth include Blake (2000) for Spain, Sugiyarto, Blake, and Sinclair (2003) for Indonesia and Pratt (2015) and Li, Liu, and Song (2019) for China. CGE models are often combined with TSA to analyse the economic effects of tourism, and in these cases the outputs of TSA are used as the input for the CGE analysis (Dwyer, Deery, Jago, Spurr, & Fredline, 2007). The CGE models are assumed to measure economic effects more accurately than the traditional input-output (IO) models (Zhou, Yanagida, Chakravorty, & Leung, 1997).

In contrast to the large number of studies that use the above three methods, DSGE models are rarely used in the tourism literature to explore the transmission mechanism from tourism development to economic growth. The DSGE model was proposed by Kydland and Prescott (1982), who focused on the impact of productivity shocks on economic fluctuation. It has since become a standard analytic tool in modern macroeconomics and is widely used by central banks and governments (Smets & Wouters, 2003).

In tourism economics, although some studies draw on the DSGE approach (Chao, Hazari, Laffargue, Sgro, & Yu, 2006; Copeland, 1991; Hazari & Sgro, 1995), the first full DSGE model was introduced in the tourism domain by Liu et al. (2018). They use a Bayesian DSGE model to explore the transmission mechanism from tourism productivity to economic growth from the perspective of exogenous growth theory. The advantage of the Bayesian approach is that the calibration results are used as the prior information for the parameter distributions, and thus the estimation is based on both prior knowledge and real data and is therefore closer to reality.

From the above discussion of the literature, three research gaps are evident. First, although it is widely accepted that productivity is an essential determinant of tourism output (Assaf & Tsionas, 2018) and tourism development is a good predictor of economic growth (Brida et al., 2016), a more comprehensive analysis is needed to directly link tourism productivity to economic growth. Second, because tourism is a labour-intensive industry, new growth theory, which assumes undiminishing effects of capital, is more suitable for the examination of the impact of tourism productivity on economic growth and the spill-over effects. However this theory has not been considered in the tourism productivity literature. Third, the use of a Bayesian approach to generate simulation results based on the information from prior knowledge and real data requires further investigation in the field of tourism economics.

To address the abovementioned gaps, this study aims to examine the transmission mechanism from tourism productivity to economic growth and capture the external effects of human and physical capital and public services on productivity by incorporating new growth theory into a Bayesian DSGE model for the first time. The effects of the determinants of tourism productivity on economic growth are further examined in simulations.

The model

In a pioneer study, Liu et al. (2018) introduce the DSGE model into tourism economics, in which a two-sector artificial economy is constructed based on exogenous growth theory. The current model extends Liu et al. (2018) by relaxing the assumption of the diminishing return of capital in exogenous growth theory and integrating new growth theory into the model, which is more consistent with the features of the tourism industry. This study also introduces a third sector, public services, and another production factor, land, into the model. Specifically, three types of agents (households, firms and the government) and three sectors (tourism, non-tourism and public services) are included in the economy. Except for those that are unemployed, household members work in all three sectors. According to Walrasian economics, households and firms aim to maximise their lifetime utility and profits subject to budget and resource constraints, respectively. Thus, the utility function of households can be written as

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[(C_t - hC_{t-1}) + \frac{u_t^{1+\nu_1}}{1+\nu_1} + \frac{(La_{l,t}\zeta_{la,t})^{1+\nu_2}}{1+\nu_2} \right]^{1-\sigma}}{1-\sigma} \tag{1}$$

Households can obtain utility by consumption (C_t), leisure measured by unemployment (u_t) and private land ($La_{l,\ t}$). $\zeta_{la,\ t}$ is an exogenous variable that follows an auto-regression process to capture the effect of private land inputs on the economy. As a trade-off, households can rent their leisure time and private land to firms as production factors and receive wages and land rent in return. In Eq. (1), E_0 represents the expected utility function hypothesis, β is the discounted rate, h stands for the habit persistence of consumption and σ, ν_1 and ν_2 are the parameters of the constant elasticity of substitution (CES) function, which is the most widely used function form in economics. Other functions, such as the Cobb-Douglas and Leontief functions, are specific forms of the CES. C_t is aggregated by tourism goods ($C_{T,\,t}$), non-tourism goods ($C_{NT,\,t}$), public services ($C_{P,\,t}$) and imports ($C_{M,\,t}$) using a CES function and $C_{M,\,t}$ can be further disaggregated into imports of tourism products ($C_{MT,\,t}$) and non-tourism products ($C_{MNT,\,t}$). In the budget constraint, household income includes wages, earnings from the rent of physical capital and land to firms, and returns on investments in treasury securities. Households spend all of their income on the consumption of different types of goods and the purchase of treasury securities that will mature in the next period. According to Walrasian economics, all agents have complete market information, so there is no cost for households to search for work and investment opportunities in the labour, physical capital rental, land rental and treasury security markets. Thus, for convenience and without loss of generality, the bank sector is omitted in this study.

The production functions of the tourism and non-tourism sectors are assumed to follow the Cobb-Douglas form as

$$Y_{T,t} = \Omega_{T,t} K_{T,t}^{\alpha_1} N_{T,t}^{\alpha_2} La_{T,t}^{1-\alpha_1-\alpha_2}, \tag{2}$$

$$Y_{NT,t} = \Omega_{NT,t} K_{NT,t}^{\alpha_3} N_{NT,t}^{1-\alpha_3}, \tag{3}$$

where $Y_{i,\,t}$ ($i = T, NT$) is the value added of the corresponding sector and $K_{i,\,t}$ ($i = T, NT$) is the physical capital following the evolution process as $K_{i,\,t+1} = I_{i,\,t} + (1-\delta)K_{i,\,t}$ ($i = T, NT$). $I_{i,\,t}$ is the physical capital investment in each sector, which is the aggregation of domestic and foreign direct investments, respectively. δ stands for the depreciation rate. Different from Liu et al. (2018), $La_{T,\,t}$, which represents private land rentals to the tourism sector, is included in the model as a unique production factor for the tourism sector to develop new attractions and sight-seeing activities. In contrast to exogenous growth theory, new growth theory emphasises that the undiminishing return of productivity is the sustained driving force of economic growth. To achieve this, $\Omega_{i,\,t}$ ($i = T, NT$) in Eqs. (2) and (3) is set as a function of the productivity associated with the externalities of physical capital and public services as

$$\Omega_{i,t} = A_t A_{i,t} (\zeta_{P,t} Y_{P,t})^{\varphi_{P,i}} K_{i,t}^{\varphi_i} \left(\frac{K_{P,t}}{K_{T,t} + K_{NT,t}} \right)^{\varphi_{c,i}} i = (T,\ NT) \tag{4}$$

where $K_{i,\,t}$ and $Y_{P,\,t}$ measure the externality of physical capital and public services, respectively. $\left(\frac{K_{P,t}}{K_{T,t}+K_{NT,t}}\right)$ indicates that the spill-over effect of $K_{P,\,t}$ will be reduced if the physical capital in the tourism and non-tourism sectors accumulates faster than that in the public sector, representing the congestion of public services by the private sector. $\varphi_{P,\,i}$, φ_i and $\varphi_{c,\,i}$($i = T, NT$) are the parameters, for which zero equals no externality or congestion. $A_{i,\,t}$ and A_t are auto-regression processes that represent sector and total productivity shocks and $\zeta_{P,\,t}$ is an exogenous shock to the spill-over effect of public services.

Human capital improvement is another driving force for economic growth in new growth theory. Thus, it is assumed that $N_{i,\,t} = H_t n_{i,\,t}$($i = T, NT, P$), where $n_{i,\,t}$ is the labour force for the sectors. Following Arrow's (1962) learning-by-doing hypothesis, H_t can be expressed as

$$H_t = \frac{EX_{T,t}^{a_T} (Y_{T,t} - EX_{T,t})^{b_T} \zeta_{H,t}}{H_t^{\pi T}} + \frac{EX_{NT,t}^{a_{NT}} (Y_{NT,t} - EX_{NT,t})^{b_{NT}}}{H_t^{\pi NT}} - \delta_H H_{t-1} \tag{5}$$

where a_i, $b_i$and π_i are the parameters, δ_H is the depreciation rate of human capital and $\zeta_{H,\,t}$ is an exogenous variable designed to capture the shock to human capital accumulation. $EX_{T,\,t}$ and $EX_{NT,\,t}$ are the exports of tourism and non-tourism products, respectively. Thus, $EX_{i,\,t}{}^{a_i}$ and $(Y_{i,\,t} - EX_{i,\,t})^{b_i}$ measure the effect of the current tourism product (i.e., innovation) on human capital. $H_t^{\pi_i}$ represents the effect of experience and when the level of human capital increases, the growth rate of human capital is faster for $\pi_i > 1$ (or slower for $0 < \pi_i < 1$). By addressing the spill-over effects of capital in Eq. (4) and the accumulation of human capital, this study extends Liu et al. (2018) by using new growth theory to explain the transmission mechanism between tourism productivity and economic growth.

The exports are determined by the global income level and price index as follows:

$$EX_{i,t} = \left(\frac{P_{i,t}}{RER_t} \right)^{\theta_{EXi}} Y_{ROW,t}^{\omega_i} \ (i = T,\ NT). \tag{6}$$

Because it is not necessary to split the aggregated demand into different source markets in the current model, the general price level adjusted by the real exchange rate towards USD ($\frac{P_{i,t}}{RER_t}$) is used. In a small economy, the exchange rate (RER_t) and the world income level ($Y_{ROW,\,t}$) are considered to be exogenous and follow an auto-regression process. As a result, the balance of international payments equals net exports minus foreign direct investment.

The income resource of the government includes the taxation of wages and production and the sale of the treasury securities for the next period. Government expenses comprise the payment of the treasury securities that mature during the period and the purchase of public services, which are represented by a Cobb-Douglas function as $Y_{P,t} = A_{P,t} K_{P,t}^{\alpha_4} N_{P,t}^{1-\alpha_4}$. As in Liu et al. (2018), the Taylor rule (which is associated with the relationship between the economic growth rate, interest rate and inflation rate) is used to close the model. Due to space limitations, the mathematical description of the full model is available upon request.

In this study, 62 variables emerge in 62 equations. Of these, 40 variables describe the optimal behaviour of various agents, 11 are exogenous variables and the remaining 11 are the corresponding stochastic shocks, with the auto-regression process being $X_{i,t} = \rho_{i,t}^X X_{i,t-1} + \varepsilon_{i,t}^X$. The model can be further estimated using a Bayesian approach after log-linearisation.

Data and model estimation

Data

In 2017, Spain was the second largest tourist destination in terms of both arrivals and tourism receipts (UNTWO, 2018). Accordingly, Spain is often used as an example to show the impact of tourism on economic development, because the country managed to industrialise through the development of tourism (Balaguer & Cantavella-Jordá, 2002; Lanza, Temple, & Urga, 2003). Unfortunately, the Spanish economy has not yet fully recovered from the global financial and sovereign debt crises. Therefore, it is useful and valuable to explore whether tourism can help the Spanish economy rise out of recession.

Given that the model contains 11 exogenous variables, 11 observed variables can be used at most. To obtain more robust estimation results for the model estimation, data on the six variables with the longest sample period from 1995 Q1 to 2016 Q4 were collected from the Spanish Statistical Office. Specifically, the observed variables used for the model estimation are the real terms of the GDP index (2010 = 100), household consumption, investment, government consumption, exports and imports.

Calibration of the prior distributions

The parameters in the model can be categorised into three types: structural parameters, shock parameters and steady-state values. Only the first two types require estimation using the Bayesian approach. In contrast to the naïve Bayesian method commonly used in management studies, in the field of economics, information on the prior distributions of the parameters is often collected from the literature or macroeconomic statistics, or is estimated by the researchers. As a result, the estimation results reflect both prior knowledge and real data.

In this study, the information for the conventional parameters such as the depreciation rate of physical capital (δ) is taken from Burriel, Fernández-Villaverde, and Rubio-Ramírez (2010), who estimate a DSGE model with a Bayesian method using macroeconomic data from Spain from 1986 to 2007. The parameters in H_t and $\Omega_{i,\ t}(i = T, NT)$, which are related to the accumulation of human capital and the spill-over effects of physical capital, use the calibration results of Zhang (2015, 2016), which address the spill-over effects of capital in tourism contexts. The information for the shock parameters is obtained from Gertler, Sala, and Trigari (2008). The selection of the prior distributions follows Guerrón-Quintana and Nason (2013) and Liu et al. (2018). Some parameters, such as the income and price elasticities of exports, are estimated using real tourism and macroeconomic data. The results are presented in Table 1. Steady state values related to the tourism sector are calculated using 2010–2016 annual TSA data and the remaining steady state values are calculated from national statistics. All of the steady state values are shown in Table 2. Due to data availability, the results presented in Tables 1 and 2 are generated based on annual data.

Estimation results

In the model, 55 parameters (33 structural parameters and 22 shock parameters) need to be estimated. The Monte Carlo based optimisation routine is used to estimate the posterior mode and based on this, five Markov chains with 30,000 draws in each chain are used to simulate the posterior distribution of the parameters. For robustness, the first 45% of draws are discarded. Fig. 1 presents the multivariate convergence diagnostic test, which is used to examine the reliability of the estimation results (Brooks & Gelman, 1998). The top, middle and bottom figures represent the raw sequences and the corresponding second and third central moments, respectively. When the gap between the blue dotted line and red line becomes closer or horizontally stable, it means the five drawn

Table 1
The estimated priors of selected parameters.

	ΔLog(EX_T)	ΔLog(EX_{NT})	Log(RER)	Log(WGDP)
Log(EX_T(−1))	−0.423 (−1.246)			
Log(EX_{NT}(−1))		−0.848*** (−4.813)		
ΔLog(EX_{NT}(−1))		−0.305 (−1.467)		
Log(RP)		−0.161* (−1.982)		
Log(RP(−2))	−0.169** (−2.359)			
Log(RER(−1))			0.779*** (6.387)	
Log(WGDP(−1))	0.113 (−1.121)	0.695*** (4.469)		0.993*** (56.542)
ΔLog(WGDP(−1))		1.921* (1.850)		
D02	−0.068 (−1.763)			
D08	0.051 (−1.523)		−0.112 (−1.359)	
D09		−0.340*** (−7.659)		−0.048*** (−5.061)
Constant	4.855 (1.478)	8.187*** (4.477)	1.058*** (1.848)	0.063 (0.800)
R^2	0.554	0.868	0.724	0.996
F-statistic	2.487	14.208***	23.584***	1598.643***

Notes: 1. Log is the operator of the nature logarithm and Δ is the first order difference. 2. Figures in parentheses after the variables are the lagged order. 3. *, ** and *** represent significance at the 0.1, 0.05 and 0.01 levels, respectively. 4. D08 and D09 are dummies representing the global financial crisis in 2009, and D02 represents the lagged effect of the 9/11 terrorist attack.

Table 2
The calibration of the steady-state values.

Variables		Value in Steady State	Time Period
GDP/GDP	$\overline{Y}$	1.000	–
Tourism Value Added/GDP	$\overline{Y}_T$	0.107	2010–2016
Non-tourism Value Added/GDP	$\overline{Y}_{NT}$	0.721	2010–2016
Public Service Value Added/GDP	$\overline{Y}_P$	0.171	2010–2016
Final Consumption/GDP	$\overline{C}$	0.581	2010–2016
Total Investment/GDP	$\overline{I}$	0.206	2010–2016
Imports/GDP	$\overline{CM}$	0.293	2010–2016
Tourism Exports/GDP	$\overline{EX}_T$	0.046	2010–2016
Non-tourism Exports/GDP	$\overline{EX}_{NT}$	0.225	2010–2016
Tourism Imports/GDP	$\overline{CM}_T$	0.005	2010–2016
Non-tourism Imports/GDP	$\overline{CM}_{NT}$	0.288	2010–2016
Tourism Investment/GDP	$\overline{I}_T$	0.013	2010–2016
Non-tourism Investment/GDP	$\overline{I}_{NT}$	0.155	2010–2016
Public Service Investment/GDP	$\overline{I}_P$	0.038	2010–2016
Tourism FDI/GDP	$\overline{I}_T^{DF}$	0.007	2010–2016
Non-tourism FDI/GDP	$\overline{I}_{NT}^{DF}$	0.055	2010–2016
Balance of Payments/GDP	$\overline{BP}$	0.040	2010–2016
Unemployment	$\overline{u}$	0.152	2002–2016
Tourism Consumption/(Final Consumption + Imports)	γ_1	0.079	2010–2016
Non-tourism Consumption/(Final Consumption + Imports)	γ_2	0.502	2010–2016
Public Service Consumption/(Final Consumption + Imports)	γ_3	0.197	2010–2016
Tourism Employment/Employment	$\overline{n}_T$	0.113	2010–2015
Non-tourism Employment/Employment	$\overline{n}_{NT}$	0.593	2010–2016
Public Service Employment/Employment	$\overline{n}_P$	0.274	2010–2016
CPI	$\overline{P}$	1.000	–
Tourism Price	$\overline{P}_T$	1.000	–
Non-tourism Price	$\overline{P}_{NT}$	1.000	–
Public Service Price	$\overline{P}_P$		
Average Growth Rate of GDP	g_y	Log(1.024)	1995–2016
Average Growth Rate of Final Consumption	g_C	Log(1.017)	1995–2016
Average Growth Rate of Investment	g_I	Log(1.015)	1995–2016
Average Growth Rate of Government Consumption	g_P	Log(1.023)	1995–2016
Average Growth Rate of Exports	g_{EX}	Log(1.039)	1995–2016
Average Growth Rate of Imports	g_{CM}	Log(1.032)	1995–2016
Production Tax Rate	τ_Y	0.120	–

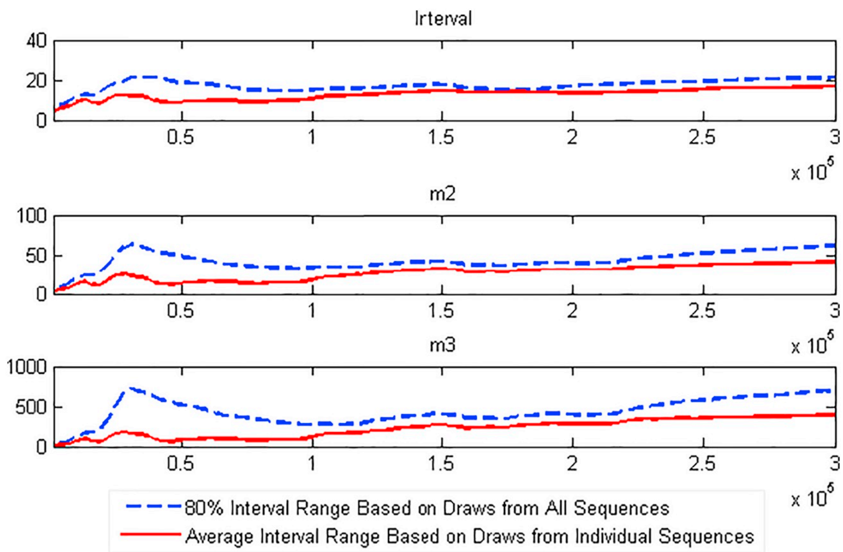

Fig. 1. Multivariate convergence diagnostic test of the model.

Table 3
Estimation results for Spain (1995Q1-2016Q4).

		Prior Distribution	Posterior Mean	90% Interval	
				Low	High
Structure Parameter					
Discount Rate	β	Beta (0.990,0.001)	0.990	0.989	0.990
Physical Capital Depreciation Rate	δ	Beta (0.018,0.001)	0.019	0.019	0.020
Output Elasticity of Physical Capital in the Tourism Sector	α_1	Beta (0.362,0.100)	0.558	0.513	0.615
Output Elasticity of Human Capital in the Tourism Sector	α_2	Beta (0.440,0.100)	0.071	0.024	0.120
Output Elasticity of Physical Capital in the Non-tourism Sector	α_3	Beta (0.638,0.100)	0.650	0.605	0.719
Output Elasticity of Physical Capital in the Public Service Sector	α_4	Beta (0.638,0.100)	0.698	0.659	0.740
Habit Persistent	h	Beta (0.847,0.010)	0.859	0.855	0.864
Elasticity of Leisure	ν_1	Gamma (2.000,0.100)	1.969	1.904	2.038
Elasticity of Private Land	ν_2	Gamma (2.000,0.100)	2.120	2.060	2.197
Elasticity of Intertemporal Substitution	σ	Gamma (2.000,0.100)	1.954	1.901	2.005
Substitute Elasticity between Tourism, Non-tourism Goods and Public Services	θ_1	Gamma (0.400,0.100)	0.383	0.371	0.395
Substitute Elasticity between FDI and Domestic Investment	θ_2	Gamma (1.500,0.100)	1.443	1.403	1.479
Substitute Elasticity between Tourism and Non-tourism Imports	θ_3	Gamma (0.400,0.100)	0.531	0.502	0.565
Price Elasticity of Tourism Exports (Absolute)	$\theta_{EX,\ T}$	Gamma (0.399,0.100)	0.392	0.366	0.435
Price Elasticity of Non-tourism Exports (Absolute)	$\theta_{EX,\ NT}$	Gamma (0.189,0.100)	0.318	0.284	0.351
Income Elasticity of Tourism Exports	ω_T	Gamma (0.820,0.100)	1.018	0.934	1.122
Income Elasticity of Non-tourism Exports	ω_{NT}	Gamma (0.267,0.100)	0.050	0.029	0.072
Autoregressive Coefficient of Return Rate	θ_{tr}	Beta (0.800,0.100)	0.944	0.911	0.973
Elasticity of Price in the Taylor Rule	θ_p	Gamma (1.700,0.100)	1.729	1.682	1.774
Elasticity of GDP in the Taylor Rule	θ_y	Gamma (0.125,0.050)	0.135	0.130	0.139
Elasticity of Tourism Exports in Human Capital Accumulation	a_T	Gamma (0.300,0.100)	0.483	0.425	0.532
Elasticity of Non-exports of the Tourism Sector in Human Capital Accumulation	b_T	Gamma (0.050,0.010)	0.042	0.037	0.048
Scale Effect of Human Capital Accumulated by the Tourism Sector	π_T	Gamma (0.300,0.100)	0.307	0.273	0.339
Elasticity of Non-tourism Exports in Human Capital Accumulation	a_{NT}	Gamma (0.300,0.100)	0.423	0.385	0.460
Elasticity of Non-exports in the Non-tourism sector of Human Capital Accumulation	b_{NT}	Gamma (0.050,0.010)	0.056	0.051	0.060
Scale Effect of Human Capital Accumulated by the Non-tourism Sector	π_{NT}	Gamma (0.300,0.100)	0.378	0.329	0.420
Depreciation Rate of Human Capital	δ_H	Gamma (0.040,0.010)	0.047	0.041	0.053
Spill-over Effect of Public Service on Tourism Productivity	$\varphi_{P,\ T}$	Gamma (0.100,0.010)	0.108	0.105	0.112
Spill-over Effect of Tourism Physical Capital on its Productivity	φ_T	Gamma (0.050,0.010)	0.051	0.044	0.056
Congestion Effect of Physical Capital on Tourism Productivity	$\varphi_{C,\ T}$	Gamma (0.050,0.010)	0.047	0.039	0.053
Spill-over Effect of Public Service on Non-tourism Productivity	$\varphi_{P,\ NT}$	Gamma (0.100,0.010)	0.110	0.108	0.113
Spill-over Effect of Non-tourism Physical Capital on its Productivity	φ_{NT}	Gamma (0.050,0.010)	0.043	0.039	0.047
Congestion Effect of Physical Capital on Non-tourism Productivity	$\varphi_{C,\ NT}$	Gamma (0.050,0.010)	0.043	0.038	0.049
Autoregressive Parameter					
Productivity of the Tourism Sector	ρ_{ZT}	Beta (0.500,0.200)	0.572	0.421	0.722
Productivity of the Non-Tourism Sector	ρ_{ZNT}	Beta (0.500,0.200)	0.993	0.991	0.995
Productivity of the Public Service Sector	ρ_{ZP}	Beta (0.500,0.200)	0.031	0.004	0.057
Total Productivity of all Sectors	ρ_Z	Beta (0.500,0.200)	0.903	0.860	0.946
World Output	ρ_{Yrow}	Beta (0.500,0.200)	0.930	0.903	0.956
Real Exchange Rate	ρ_{RER}	Beta (0.779,0.200)	0.831	0.817	0.844
Land Supply Shock	ρ_{La}	Beta (0.500,0.200)	0.296	0.136	0.405
Tourism Imports Price	$\rho_{CM,\ T}$	Beta (0.500,0.200)	0.852	0.789	0.910
Non-tourism Imports	$\rho_{CM,\ NT}$	Beta (0.500,0.200)	0.857	0.847	0.867
Human Capital Accumulation Shock	ρ_H	Beta (0.500,0.200)	0.824	0.729	0.953
Public Service Production Shock	ρ_P	Beta (0.500,0.200)	0.995	0.991	1.000
Standard Deviation					
Productivity of the Tourism Sector	ε^{ZT}	IGamma (0.150, 0.250)	0.130	0.100	0.159
Productivity of the Non-Tourism Sector	ε^{ZNT}	IGamma (0.150, 0.250)	0.130	0.118	0.144
Productivity of the Public Service Sector	ε^{ZP}	IGamma (0.150, 0.250)	0.136	0.101	0.161
Total Productivity of all Sectors	ε^{Z}	IGamma (0.150, 0.250)	0.101	0.100	0.103
World Output	ε^{Yrow}	IGamma (0.150, 0.250)	0.109	0.100	0.126
Real Exchange Rate	ε^{RER}	IGamma (0.150, 0.250)	0.104	0.100	0.108
Land Supply Shock	ε^{La}	IGamma (0.150, 0.250)	0.365	0.308	0.428
Tourism Imports Price	$\varepsilon^{CM,\ T}$	IGamma (0.150, 0.250)	0.196	0.100	0.317
Non-tourism Imports	$\varepsilon^{CM,\ NT}$	IGamma (0.150, 0.250)	0.494	0.445	0.538
Human Capital Accumulation Shock	ε^{H}	IGamma (0.150, 0.250)	0.124	0.100	0.147
Public Service Production Shock	ε^{P}	IGamma (0.150, 0.250)	0.245	0.210	0.280

chains converge (Brooks & Gelman, 1998), indicating good reliability. Fig. 1 indicates that the drawn chains generally converge. The 55 individual convergence diagnostic tests also demonstrate satisfactory patterns between the sequences and the test results are available upon request due to space limitations.

Table 3 shows the mean and standard deviation of the prior distributions of each parameter. The corresponding mean of the posterior distributions and the 90% interval range generated by the Bayesian approach are also presented. The estimation results of some of the conventional parameters, such as β, δ, α_3, $\alpha_4$and h, are similar to the prior means because the structure of the optimal equations they serve in this study is similar to Burriel et al. (2010), who use a Spanish DSGE model and are the source of the above prior distributions. However, the tourism sector is not included in Burriel et al. (2010) and land is not a production factor in their model, so more information from real data is used to correct the prior information. As a result, α_1 increases from 0.362 to 0.558 whereas α_2 decreases from 0.200 to 0.071. Compared with the non-tourism and public service sectors, production in the tourism sector is still more reliant on labour, which is consistent with reality.

The leisure (ν_1), private land (ν_2) and intertemporal substitution (σ) parameters are estimated as 1.969, 2.120 and 1.954, indicating that the corresponding elasticities are 0.508 ($\frac{1}{\nu_1}$), 0.472 ($\frac{1}{\nu_2}$) and 0.512 ($\frac{1}{\sigma}$), respectively. The elasticities are less than a unit, which is consistent with the literature (Domeij & Floden, 2006; Havranek, Horvath, Irsova, & Rusnak, 2015; Liu et al., 2018).

The substitute elasticity between tourism and non-tourism goods (θ_1) is 0.383, which is supported by Lanza et al. (2003), who argue that the elasticity in developed countries is more likely to be less than one unit. The elastic substitutional effect between FDI and domestic capital investment ($\theta_2 = 1.443$) indicates the spill-over effect of FDI in Spain. As with the preference between tourism and non-tourism products, the substitute elasticity between tourism and non-tourism imports is also not sensitive ($\theta_3 = 0.531$).

The prior information from the regressions is also corrected using real data in the Bayesian estimation. The price elasticity of tourism exports is slightly corrected, with an increase from -0.397 to -0.392. Significant information is absorbed by the income elasticity of tourism exports, which leads to a change from 0.882 in the prior distribution to 1.018 in the posterior distribution. As the second largest inbound tourism destination in the world (UNTWO, 2018), Spain is popular among international tourists. Thus, when international incomes increase, more people travel to Spain. Moreover, given the popularity and attractiveness of Spain, even if travel costs increase by 1%, this will only lead to a < 0.4% decrease in the number of tourists. According to Workman (2018), the most valuable non-tourism exports from Spain are vehicles, automotive parts, refined petroleum and agricultural products. However, these items are not as competitive as Spanish tourism products. Therefore, the price and income elasticities of the non-tourism sectors are much smaller in absolute value than those of the tourism sector. Other structural parameters involved in the accumulation of human capital and the spill-over effects of physical capital are also informed by the real data and are corrected using the Bayesian approach.

Most of the auto-regressive coefficients increase to above 0.800, indicating a smooth connection with the last period (except for ρ_{zt}, ρ_{zp} and ρ_{La}). The coefficient of productivity in the tourism sector is estimated as 0.572, which is similar to the findings of Liu et al. (2018) in the Mauritian context. A possible reason for the lower auto-regressive coefficient is the high turnover rate in the tourism sector, which causes strong fluctuations in productivity. The coefficient of productivity in the public service (ρ_{ZP}) decreases from 0.500 in the prior distribution to 0.031 in the posterior distribution, possibly due to the fluctuation of government consumption after the sovereign debt crisis in 2010. In a mature tourist destination and developed economy, there is limited undeveloped spare land, which may lead to a low auto-regressive coefficient in the shock to land supply. All of the estimated standard deviations of the shocks also change significantly with the prior information, highlighting the value of the Bayesian approach when using real data.

Findings and discussion

The effect of tourism productivity on economic growth

Impulse response functions (IRFs) are used to simulate the effect of a tourism productivity shock on the economic growth of Spain and investigate whether tourism development can help Spain fully recover from the economic recession. The IRFs of selected variables used in the Spanish model are presented in Fig. 2.

With a 10% positive shock to the productivity of the tourism sector, given the same amount of production factors, the supply of tourism products increases, and the price of tourism products decreases by 15.85%. Moreover, tourism exports and domestic tourism consumption expand by 6.17% and 6.13%, respectively. Because the estimated price elasticity of tourism products is less than one unit in absolute value, the response of the inbound tourism demand is less than the price change. Attracted by the lower price, households prefer to consume more tourism products at the cost of less investment in future production. Thus, physical capital investment drops by 11.78%. In total, the value added of the tourism sector is stimulated by 4.11%. The spill-over effect of physical capital in the tourism sector also accelerates the development of the tourism sector. To maintain further demand expansion in the following periods, households resume and increase their investment from the second period.

As shown in Fig. 2, the growth of tourism exports leads to the improvement of human capital, which spills over to the non-tourism and public service sectors. As a result, the productivity of the non-tourism sector increases and prices fall. Cheaper prices can also stimulate exports and the domestic consumption of non-tourism products. Similarly, although households sacrifice investment in the first period for greater consumption, investment will recover from the second period. The improvement in tourism productivity increases the value added of the non-tourism and public service sectors by 0.21% and 0.12%, respectively. Overall, a 10% increase in tourism productivity leads to 0.61% growth in Spanish real GDP. In terms of the employment market, the tourism, non-tourism and public service sectors benefit from the productivity shock by 1.78%, 0.46% and 0.45%, respectively, and the unemployment rate decreases by 3.86%.

In the last decade, Spain has had a real annual GDP growth rate of -0.83%. Thus, although the 0.61% growth stimulated by the 10% productivity improvement in the tourism sector is marginal in volume, the contribution to the Spanish economy is significant. The simulation results of this study support the TLEG hypothesis and confirm the findings of Liu et al. (2018), who reveal the transmission mechanism between tourism development and economic growth. These results extend the literature by shedding additional light on the spill-over effects of physical and human capital and public services on economic growth when positive

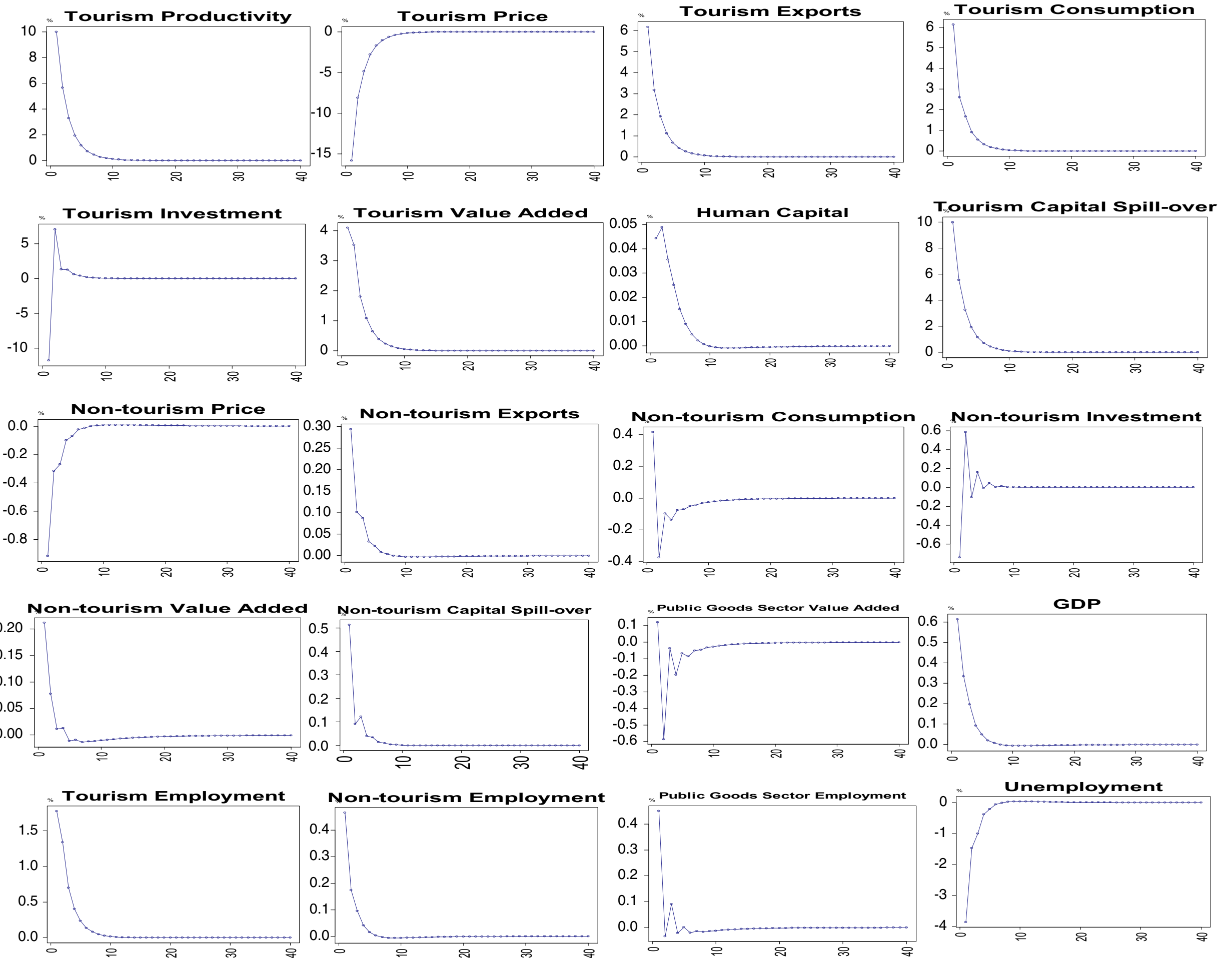

Fig. 2. IRFs of Spain (%).

productivity shocks occur. As Mankiw, Romer, and Weil (1992) argue, a model that incorporates the accumulation of human and physical capital can reflect the real economy better than models without human capital accumulation. Thus, the model developed in this study may complement the tourism economics literature and improve our understanding of the relationship between increased tourism productivity and economic growth in a destination.

The effects of the determinants of tourism performance on tourism development and economic growth

Assaf and Josiassen (2012) identify eight determinants of tourism performance that can stimulate the development of the tourism sector and economic growth, as shown in Table 4. In their study, government policies refer to visa policies and the launch of new airline route agreements. Moreover, improvements in terms of accessibility can increase the productivity of the tourism sector ($A_{T,\ t}$) (Sun, Zhang, Zhang, Ma, & Zhang, 2015). Because a more attractive environment will stimulate tourism demand, environmental

Table 4
Shocks to simulate the effects of the determinants of tourism performance.

Tourism Performance Determinants (Assaf & Josiassen, 2012)	Matched Variables in the Spanish Model
1. Government Policies	1. Tourism Productivity Shock ($A_{T,\ t}$)
2. Environmental Sustainability	
3. Security, Safety and Health	2. Total Productivity Shock (A_t)
4. Economic Conditions	
5. Tourism and Related Infrastructure	3. Public Service Spill-over Shock ($\zeta_{P,\ t}$)
6. Tourism Price levels	4. Real Exchange Rate (RER_t)
7. Labour Skills and Training	5. Shock to Human Capital Accumulation ($\zeta_{H,\ t}$)
8. Natural and Cultural Resources	6. Shock to Land Supply ($\zeta_{La,\ t}$)

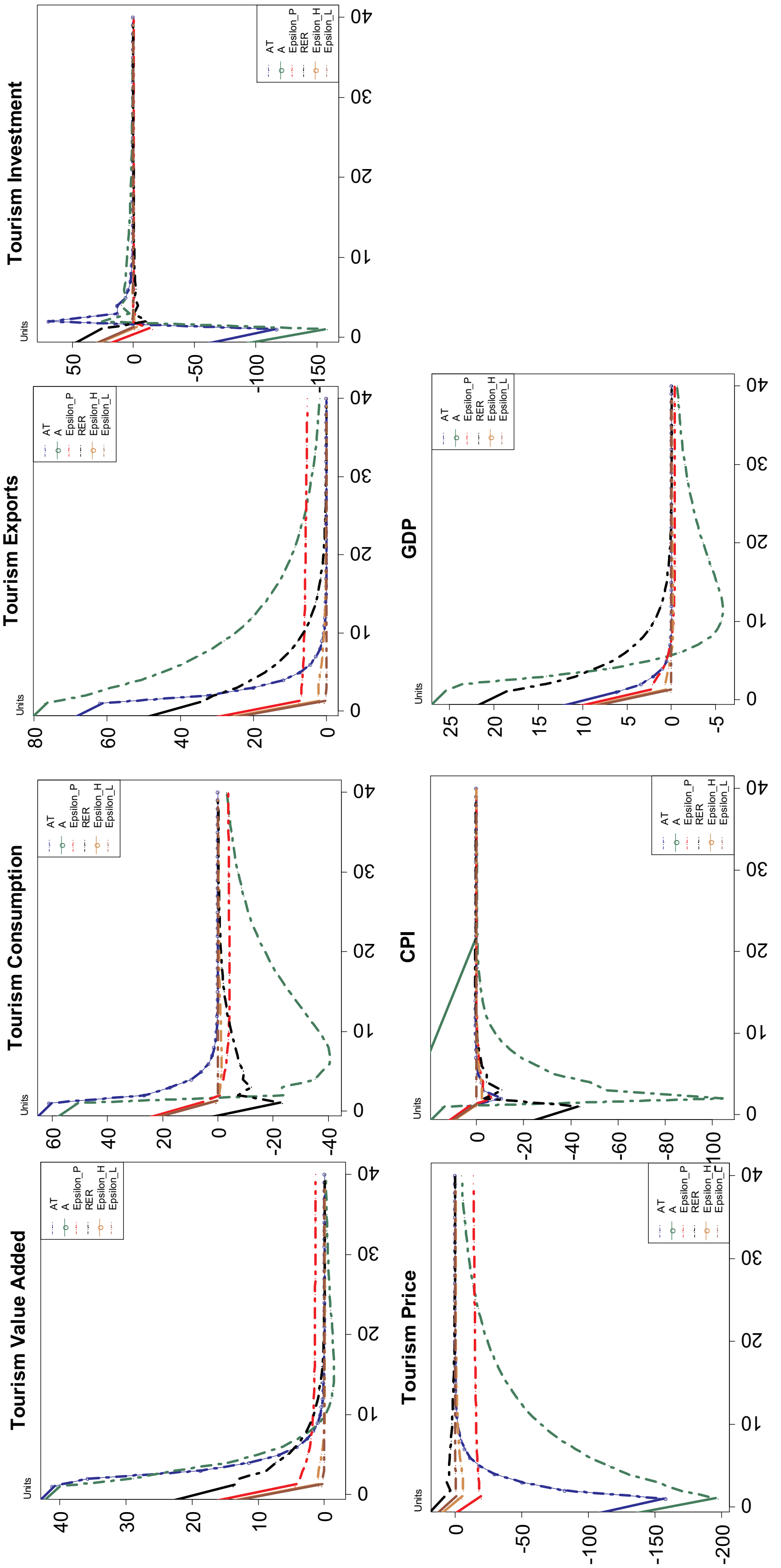

Fig. 3. Effects of tourism performance on tourism development and economic growth.

sustainability is also assumed to influence $A_{T,\ t}$. Security, safety, health and economic conditions are more related to the macro environment of the overall economy, and thus are assumed to affect the total productivity of Spain (A_t). An exogenous shock to the spill-over effect of public services ($\zeta_{P,\ t}$) is used to simulate the effects of tourism and the related infrastructure on tourism performance in Assaf and Josiassen (2012). Because the focus of this study is the overall Spanish market, the inbound tourism demand is not split into different source markets. The real exchange rate (RER_t) is used to represent the effect of price on tourism performance. Shocks to human capital accumulation ($\zeta_{H,\ t}$) and the land supply ($\zeta_{La,\ t}$) are used to measure the influence of labour skills and training, and natural and cultural resources in Assaf and Josiassen (2012).

Six standardised 100-unit shocks are introduced to the model to compare the effects of the determinants of tourism performance on tourism development and economic growth, as shown in Fig. 3. One-hundred-unit improvements in tourism and total productivity can increase the tourism value added by 40 units, followed by the real exchange rate (13.81 units). Because the spill-over effects of public services and human capital accumulation require sustained investment and the effects will be observed in the long-term, one-off shocks have a limited impact on the two determinants of tourism performance. Given the small marginal productivity of land in the tourism sector (0.07) and the large volume of land stock in the economy, the limited contribution of land to tourism development stimulated by a 100-unit supply shock is reasonable.

Different determinants affect the performance of the tourism sector in different ways. The increased tourism productivity boosts domestic tourism consumption and tourism exports by 61.16 and 61.86 units, respectively, whereas the total productivity improvement leads to the expansion of the two variables by 51.62 and 71.08 units, respectively. Tourism productivity stimulates more domestic demand, whereas total productivity stimulates more inbound demand for tourism products. It is assumed that tourism products, non-tourism products and public services are substitutes with an estimated elasticity (θ_1) of 0.383. Thus, the domestic tourism consumption demand is determined by the difference between the tourism price and the consumer price index. Because the relative price change caused by the sector productivity shock is stronger than the total productivity, more tourism products are reallocated to the domestic market in the former case. In the first period, households prefer to consume more tourism products at the expense of physical capital investment when facing sector and total productivity shocks. Because a total productivity shock may push down the tourism price more strongly than a sector shock, stronger inbound demand is generated in the future periods. As a result, when households experience a total productivity shock, they must reduce their domestic consumption and leave sufficient resources for physical capital investment and exports.

The effect of the real exchange rate is more moderate. The depreciation of the real exchange rate stimulates the value added and exports of the tourism sector by 13.81 and 35.23 units, respectively. Although domestic consumption drops due to the relative price increases, more resources are available for physical capital investment. The effects of the other determinants are also limited to tourism performance. As a result, the total productivity has a greater influence on economic growth than the other determinants, which results in real GDP growth of 25.74 units after a standardised 100-unit shock, followed by the tourism sector productivity and real exchange rate shocks, respectively.

Although the improvement of the tourism sector and total productivity may result in the same growth of value added in the tourism sector, the productivity of the tourism sector is able to stimulate more domestic demand, and total productivity tends to stimulate greater inbound tourism demand. Thus, to further boost domestic tourism, the Spanish government should prioritise industry-specialised policies to stimulate tourism productivity, such as encouraging entrepreneurship and introducing more digital and artificial intelligence technologies into the sector. However, if the government would rather expand the inbound market, more light needs to be shed on the ways to improve the image of the destination, for instance, in terms of security and safety. However, the development of total productivity is the most efficient way to increase real GDP and help Spain to escape recession.

Exchange rates can also serve as an effective means of stimulating tourism development and economic growth. Because the changes in the Spanish exchange rate are tied to the policies of the European Central Bank, other countries in Europe that are suffering similar problems to Spain should consider developing a more comprehensive strategy for Europe. However, the simulation results should be interpreted with caution. The IRFs do not indicate improvements to the externalities of physical and human capital and the increase in land supply cannot contribute to tourism development and economic growth. Given the limited effects of one-off shocks on the determinants of tourism performance, sustained investment in areas such as the development of infrastructure and employee training is strongly recommended.

Conclusion

This study reveals the transmission mechanism between tourism productivity and economic growth and identified the spill-over effects between tourism and other sectors through the externalities of physical and human capital and public services from the perspective of positive economics. In particular, a three-sector open economy model is developed under the new growth theory framework, which relaxes the assumption of the diminishing return of capital to be more consistent with the characteristics of the tourism sector. The model is estimated with a Bayesian DSGE approach using quarterly data on Spain from 1995 to 2016. Most of the posterior parameters change significantly from the prior distributions, indicating that new information from the data corrected the calibration values in the Bayesian estimation process. The simulation results show that a 10% improvement in tourism productivity can increase the value added of the tourism sector by 4.11% and cause 0.61% growth in real GDP. Considering the sustained negative growth of the Spanish economy in recent years, 0.61% real growth is significant.

This study also extends the framework of Assaf and Josiassen (2012) and examines the efficiency of different determinants of tourism performance in boosting tourism development and economic growth. The simulation results suggest that although total productivity is more efficient in stimulating economic growth than the other determinants, the benefits to tourism development are similar to those stemming from the increased productivity of the tourism sector. Furthermore, total productivity has a greater effect on inbound tourism demand than domestic tourism demand, whereas the tourism sector productivity sheds more light on domestic tourism consumption than inbound tourism consumption. The results also indicate that the real exchange rate can be an effective policy tool for increasing tourism in the European Union and that the externalities of physical and human capital require sustained long term investment. These findings provide different policy options for destination governments to stimulate tourism development and economic growth.

This study makes two main contributions to the literature. First, this study extends the work of Liu et al. (2018) by incorporating new growth theory into a Bayesian DSGE framework for the first time in the field of tourism economics. The innovative model relaxes the assumption of the diminishing return of capital, which is more consistent with the labour-intensive nature of the tourism sector. Second, using the framework developed by Assaf and Josiassen (2012), this study further examines how the determinants of tourism performance boost tourism development and economic growth based on the simulations generated by the IRFs.

The findings of this study suggest a number of future research directions. First, due to the unavailability of quarterly TSA data on Spain, this study does not include TSA data in the model estimation. In the future, TSA data with specified tourism sector information could be included in the Bayesian estimation to improve the accuracy of the posterior distribution. Second, IRFs with confidence intervals should be incorporated into the simulation analysis because confidence intervals take uncertainty into consideration and thus may provide more information for policymakers (Li, Wu, Zhou, & Liu, 2019; Shen, Li, & Song, 2011). Third, it would also be interesting to extend the framework of the current study by investigating how increased tourism productivity affects the well-being of the residents in the destination and focusing on issues relating to the alleviation of inequity and poverty. Finally, it would be worth applying the Bayesian estimated DSGE framework to more destinations to examine the generalisability of the model.

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