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Local tourism cycle and external business cycle

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ABSTRACT

This paper uses a Markov switching model (MSM) to decompose Macao's tourism cycle into high and low growth states (HGS, LGS) for the period of 2005Q2–2017Q2. The likelihood of the cycle maintaining HGS is 93% but the risk of staying in LGS is 80%. The Macao cycle is favorably asymmetric, with HGS (14.7 quarters) lasting much longer than LGS (5.1 quarters). Further, the paper combines structural regressions with the MSM to identify determinants of the Macao cycle, with useful policy implications derived from the regression results. We find that Macao's tourism cycle is heavily affected by Mainland China's business cycle and other external factors. Additionally, outward-looking marketing, albeit very costly, is found to be effective for keeping the local cycle in HGS.

Introduction

As a main impetus of economic growth and a major source of foreign exchange for all travel destinations, tourism and hospitality account for 9.8% of global GDP and 6% of world exports, with 1 out of 11 jobs created by this economic activity (UNWTO., 2013; WTTC., 2015). However, business cycles commonly shift between expansion and recession in economic activity. In fact, tourism flows (or cycles) move in concert with business (or economic) cycles contemporaneously or with a time lag. Cyclical tourism fluctuations, if severe but not tamed, can have devastating effects on local residents and economic welfare due to unbearable losses in employment and revenue. Economic cycles across source markets may have diverse impacts on a particular tourism destination. The impact of the economic or tourism cycle may not be symmetric but can be more serious during busts than during booms. As such, different types of marketing strategies and policy responses are key elements required of business managers and local governments to effectively manage cyclical changes and favorably influence tourism dynamics.

Macao is a recent success story of tourism and hospitality that rest on casino gaming. Its tourism boom began in 2003 when Mainland China (MC) launched a “Free Travel Scheme” (FTS) to allow mainlanders to visit Macao for gambling (that is prohibited by law in MC). As a monopoly place for casinos in China, Macao has since achieved a greater success in commercial gaming and related tourism than all other destinations in the world. A massive influx of tourists, especially those from MC, led Macao's casino hospitality to expand fast at 28.2% per year in 2002–13. As a result, its real GDP grew rapidly at the average rate of 13.0% a year during this period. Macao used to be less developed than Hong Kong for > 100 years, but its real GDP per capita rose to a level more than twice as high as Hong Kong's and reached the world's top-three position in 2013 (World Bank., 2015). In that year, Macao received gaming revenue worth US$ 45.2 billion that was seven times as high as Las Vegas's. Macao's casino hospitality has shifted from a

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monopolistic to an oligopolistic industry, with six gaming firms becoming publicly listed and now running 40 large casinos as compared with only 11 small ones in 2002. This industry creates so many jobs that 1/3 of the labor force has to be imported from outside during business booms. The gaming sector also generates substantial tax revenue at the rate of 40% on casino receipts, so that public savings accumulated to a dizzily high amount of US$ 61.25 billion in 2017 from previous government surpluses.

Although possessing the world's largest casino tourism in revenue terms, Macao has a great deal of bitter experience in riding an economic rollercoaster (Shu, 2014). Its gaming hospitality receipts fell dramatically in 2008Q2–09Q2 and far more steeply in 2014Q2–16Q2. In consequence, Macao recently witnessed two economic recessions, with the second one much worse than the first one. Its reliance on casino gambling for economic growth has become alarmingly serious, as shown by the fact that its gross gaming revenue (GGR) rose from 39.9% of GDP in 2002 to 91.4% in 2011. Such overreliance renders the local economy highly vulnerable to adverse external shocks such as the global financial crisis that started in 2008 and the MC anticorruption campaign that was intensified from 2014 onwards. The 2008–09 setback in Macao's casino tourism was also reinforced by MC's FTS policy tightening as a response to its citizens' pathological gambling in Macao. The 2014–16 disastrous impact on Macao's gaming hospitality stemmed from multiple factors such as MC's widespread anticorruption movement, further FTS tightening, economic growth slowdown from 10% to 7% a year, and the restricted use of BankUnion cards for casino products. In 2013Q4–16Q2, prices of Macao casino shares in the Hong Kong stock exchange dropped by 64–82% from their peak levels because GGR had declined by 49.4%. In the meanwhile, GDP fell by 28.9%, resulting in massive lay-offs of migrant workers and large wage- cuts among local employees. Although the recovery that began in 2016Q3 is well underway, economic volatility remains a worry in Macao due to its susceptibility of gaming hospitality to external shocks.

The fast growing but wildly fluctuating casino hospitality in Macao has attracted wide attention in op-eds discussions, yet no formal research has been undertaken to seriously examine Macao's tourism cycle. Our paper is devoted to addressing this issue in the hope of prompting sustainable tourism development and stable economic growth in Macao. We first propose an economic model to show that tourism performance variations depend both on altered supply conditions in a destination like Macao and demand fluctuations arising from its source markets. This prediction provides a theoretical basis for our subsequent regression of local tourism cycles on external business cycles. We use an econometric model to perform the time-series analysis of cyclical movements of economic variables in tourist resorts like Macao. Our time-series analysis is conducted with a Markov switching model (MSM) proposed by Hamilton (1989). We then incorporate the MSM results into regression models to identify driving forces behind tourism cycles observed in Macao and derive policy implications for mitigating its tourism fluctuation and stabilizing its economic growth.

Two methodologies used in this paper include an economic model and an econometric model (i.e., MSM). The first model formulates tourism as a typical form of trade activity across borders, with emphasis put on interactions between source markets and travel destinations. Gravity models that are widely used to study trade interactions have also been introduced into tourism research (Uysal & Crompton, 1985). However, these models that are borrowed from physics lack microeconomic foundations when used to study behaviors of tourism firms and their customers. Several theoretical models have been proposed in the tourism literature, yet their focus is mainly on the demand side of a tourism market while largely neglecting its supply side (Morley, Rossello, & Santana-Gallego, 2014). The two sides, albeit separated by geographic boundaries, are linked through tourist visitations as trade flows. Our model is based partly on previous studies of tourism demand (Song, Dwyer, & Zhengcao, 2012), but designed to explicitly capture the interaction between demand and supply in a destination and its source markets. The second model used in our study is a popular MSM that Hamilton (1989) proposes as a tractable approach to modeling shifts in regimes. The parameters of an auto-regression such as the mean growth of a non-stationary series are treated as the outcome of a discrete-state Markov process. Those shifts may not be directly observable, but probabilistic inference can be drawn about whether and when they may have occurred based on the observed behavior of the series. An algorithm for drawing such inference takes the form of a nonlinear iterative filter. This filter is used to estimate population parameters via the method of maximum likelihood, and can also serve as a foundation for forecasting future values of the series.

Our study attempts to generate economic implications for practical use by tourism managers and policy makers. The MSM estimation can provide industrial practitioners with valuable information on business cycles, directional changes, and turning points as well as expected growth, standard deviation, and average duration for each phase of a typical cycle. Our use of MSM focuses on tourism cycles to estimate cyclical components of Macao's tourism economy. The information derived is helpful for casino operators to manage their hospitality business more efficiently as they can better predict future industry movements and assess relevant market environments. Following Chen (2013), our study combines regression models with the filtered and smoothed probabilities of the tourism cycle being in different stages as estimated from the MSM, so that underlying drivers for this cycle can be elicited with statistical confidence. On the other hand, differing from Chen (2013) with only exchange rates serving as a channel to connect domestic cycles with external environments, our work incorporates business cycles in source markets into regressions for tourism cycles in Macao as a popular destination for travel and gambling by non-residents. With a better understanding of driving forces behind cycle dynamics, policy makers can perform countercyclical policy interventions more effectively to alleviate the vulnerability of tourism business and the volatility of the local economy. This paper elucidates the importance of industrial diversification for tourism sustainability and economic stability. Corresponding strategies can then be designed for business marketing and policy making, as called for in the literature (Hao, Sheng, & Pan, 2017).

The rest of the paper is structured as follows. Section "Brief literature review" presents a short review of the related literature. Section "Theoretical models" contains an economic formulation for the link of a destination with its source markets and an econometric description of MSM testing for tourism cycles. Section "Macao data and MSM tests" provides the test results by applying the MSM to Macao. Section "Determinants of Macao's tourism cycle" reports the estimation results from structural regressions for determinants of Macao's tourism cycle. Section "Conclusions" concludes the paper with summarizing remarks and policy implications.

Brief literature review

This section presents a brief review of the related literature on the use of the MSM and other empirical techniques. In fact, there are more detailed and hence better reviews that have already been published (Moore & Whitehall, 2005; Cuñado & Gil-Alaña, 2007; Claveria & Datzira, 2010; Song et al., 2012; Chen, 2015). The review here is only a narrower one to serve our purpose.

Business cycle is a long existing macroeconomic issue that has spurred active research for decades. A growth trend rests on demand and supply equilibrium, and economic activities may experience growth spurts above the trend or slowdowns below it. Any such deviation from the trend is viewed as a business cycle under demand and supply misalignment. Both big busts and booms can hurt the economy, and especially, large downturns often lead to capacity under- utilization and job losses with serious socioeconomic consequences. There are two strands of research on business cycles: the first one finds shocks of the cycle to be transitorily interruptive (Romer, 2001) and the second one predicts the shocks to be persistently disruptive (Aghion & Howitt, 1998). It is crucial to understand how economic fluctuations propagate over time and across industries (including tourism) since resource allocation, demand response, and private spending would alter as business cycles enter into different stages.

Two types of modeling techniques are used in economic and financial studies analyze business cycles. The first type is of linear nature, including the autoregressive integrated moving average (ARIMA) model and the Kalman filter model (Campbell & Mankiw, 1987; Ozbek & Ozale, 2005; Rigatos, Siano, Ghosh, Busawon, & Binns, 2017). These models, albeit computationally convenient, are not compatible with the observed asymmetric properties of business cycles (Sichel, 1993). The second type of models is a set of variants of the non-linear Markov switching model (MSM) originating from Hamilton (1989). These models, which are able to characterize the cycles as asymmetric processes, can be used to estimate the average duration for each phase of a cycle and predict its turning points similar to official dates of cycle stages. Ever since Hamilton achieved an empirical success in predicting the U.S. business cycle, the MSM has been widely applied to various economic, financial, and industrial issues such as the behavior of exchange rates, the movement of interest rates, the volatility of stock returns, the impact of monetary policy on financial markets, and the dynamics of supply chains between interlinked industries [see Chen (2015) for a good review]. The MSM is also used in the context of panel data for economic comparison among related countries.

Relatively, there are much fewer applications of the MSM in the tourism literature, as admitted by researchers in their recent publications (Song & Li, 2008; Guizzardi & Mazzocchi, 2010, p.368; Merida & Golpe, 2016, p.41). However, tourism flows into and out of a travel destination are by no means immune from business cycles in its source markets. This is because tourism demand is directly related to private spending that in turn is subject to income fluctuations (Song et al., 2012). Tourist arrivals can deviate from their long-run trend and follow a typical cycle that may move in line with business cycles of source markets in a synchronized manner or with a certain delay (Smeral, 2012). Tourism cycles vary greatly in the size of effect, the depth of permeation, the width of diffusion, and the length of persistence, thus impacting on the economies of various destinations differently. It is therefore necessary to integrate cyclical fluctuations into tourism and hospitality models. In fact, the importance of doing so has long been recognized in the literature (Gonzalez & Morales, 1996; Wong, 1997). Recently, rapid progress has been made in analyzing tourism cycles in the literature; published studies are mostly empirical. Their findings facilitate our understanding of the nature of tourism fluctuations and their impact on local economies (Gouveia & Rodrigues, 2005; Kulendran & Wong, 2011; Mayers & Jackman, 2011; Narayan, 2011; Kozic, 2014; Croes & Ridderstaat, 2017). Particularly, the MSM has been actively employed to address cyclical characteristics of tourism flows in various jurisdictions, producing insightful results with practical implications (Moore & Whitehall, 2005; Chen, 2015; Valadkhani & O'Mahony, 2015; Hsu, 2017).

Although the above studies enrich the literature by examining business cycles, tourism dynamics and cyclical patterns, our study makes an additional contribution by focusing on the Macao case in three dimensions. First, we select Macao for a tourism cycle study because there is no study of the same kind for Macao. This place is a typical case of tourist destination with a volatile economy and also a success story of casino hospitality yet with the susceptibility to external shocks. Second, past studies resort to various vector autoregressive (*VAR*) models to elicit underlying determinants of tourism cycles. We will not conduct such a-theoretic tests for tourism determinants but rather use structural regression models as in Chen (2013).[1] Third, this paper differs somewhat from Chen (2013) for more sensible specification of regressors based on two considerations. One is that tourism cycle in a destination cannot be immune from the impacts of business cycles in source markets so that main factors of tourism sources should be included in regression models. The other consideration is that the tourism and hospitality industry needs to be comprehensively examined from the market perspective, so that both the demand and supply sides of the cross-border market should be reflected in regression models. Our paper pays attention to main factors on both sides for completeness of structural analysis. As such, the empirical results from our analysis can be hoped to yield reliable implications for public policy making and tourism business marketing.

Theoretical models

In this section we first propose an economic model of tourism demand from source markets and supply behavior in travel destinations. This model serves as a theoretical underpinning for the linkages running from external business cycles to local tourism

[1] Our study differing from others addresses Macao's issue best. For example, Kulendran and Wong (2011) employ basic structural models as a linear nonparametric approach to smooth growth cycles, whereas we use nonlinear parametric MSMs to date the turning points. Moore and Whitehall (2005) also utilize the MSM framework, but they focus on the cycle of tourist arrivals while we deal with the cycle of tourism revenue (proxied by GGR). Existing studies including Croes and Ridderstaat (2017) can only establish the link between cycles themselves in a destination and its source markets via *VAR* models; by contrast, our study following Chen (2013) is able to identify the specific effects of more (demand and supply) factors on tourism cycles.

cycles. We then re-describe Hamilton's (1989) two-regime Markov switching model (MSM) for econometric analysis of business cycles. We follow Chen (2013) to provide a concise description of the MSM in the context of tourism cycles specific to Macao.

Tourism economics model

A representative consumer in a source market derives utility U from consuming a composite volume of various goods c in her home community and enjoying a total amount of time t spent in all her visited destinations. Their characteristics of natural amenities and man-made facilities are summarized by $z = t^{\gamma}$ as a pull factor for tourism, where $0 < \gamma < 1$ measures the attractiveness of these characteristics. A scale restriction of $t > 1$ is used to ensure that the pull factor z strengthens with greater attractiveness γ. The Cobb-Douglas utility function $U(c, t) = c^{\alpha}z^{\beta}$ is specified for tourism demand analysis, where $\alpha > 0$ and $\beta > 0$ are substitution-related elasticities, and β is also a push factor whose rising value represents stronger preferences for travel. The consumer's utility maximization is subject to her income level Y as another push factor, and also affected by the composite price p of consumption goods and the total expenditures TEs incurred during both the time of transit on the road and the time of stay in travel destinations. Let q refer to the average cost of all visits per unit of stay time, and $\lambda > 1$ to the ratio of TEs to the money spent during the stay time. Thus the consumer's budget constraint can be expressed as $pc + \lambda qt \leq Y$. Her optimal choice problem $\{\max_{(c,\ t)} U = c^{\alpha}t^{\beta\gamma}$, s.t. $pc + \lambda qt \leq Y\}$ is solved for the tourism demand function:

$$t^{*} = t^{d}(q;Y, \beta, \gamma) = \frac{\beta\gamma Y}{\lambda q(\alpha + \beta\gamma)}. \tag{1}$$

Suppose a competitive market structure prevails in a travel destination. A representative firm catering for out-of-area visitors in this environment maximizes profits π from its tourism business by weighing the sales revenue qt against the operational cost C. The cost function is specified as $C = C(t, \gamma) = \gamma^{-\tau} t^{\theta}$, where $\tau > 0$ shows that higher tourism attractiveness is good for lower business cost and $\theta > 1$ is assumed as usual to reflect the fact that the marginal cost of business activity rises with its increased size. This assumption of θ ensures that the second-order condition is satisfied for profit maximization. The firm's optimal choice problem, $\max_{t} \pi = qt - \gamma^{-\tau\cdot}t^{\theta}$, is solved via the first-order condition for its supply function of service hours to accommodate visiting tourists:

$$t^{a}st = t^{s}(q;\theta, \gamma, \tau) = (\frac{q\gamma^{\tau}}{\theta})^{\frac{1}{\theta-1}}. \tag{2}$$

Since representative consumers and firms have been assumed for both sides of the tourism market, there is no need for aggregation across all private agents to solicit market equilibrium. Setting the demand t^{d} in Eq. (1) equal to the supply t^{s} in Eq.(2) yields the equilibrium price in the cross-border market:

$$q^{*} = q(Y, \beta, \gamma, \tau) = \left[\frac{\beta Y}{\lambda(\alpha + \beta\gamma)}\right]^{\frac{\theta-1}{\theta}} \theta^{\frac{1}{\theta}}\gamma^{\frac{\theta-\tau-1}{\theta}}. \tag{3}$$

The comparative static analysis of Eq.(3) gives unconditional results of $\partial q^{*}/\partial(Y, \beta, \tau) > 0$ and another result of $\partial q^{*}/\partial\gamma > 0$ conditional on a high θ and a low τ. These results show that the push factors (Y, β) on the demand side and the pull factors (γ, τ) on the supply side are the underlying contributors to the tourism market price q^{*}. Using the envelope theorem, we also know that higher tourism attractiveness γ and prices q^{*} are favorable to destinations for profit making π^{*} and wealth creation since $d\pi^{*}/dq = t^{*} > 0$ and $d\pi^{*}/d\gamma = t^{*\theta}\ \tau/\gamma^{\tau+1} > 0$.

In sum, the push factors in source markets exert strong impacts on tourism performance in a destination while the pull factors have relatively weak effects, as evidenced by previous studies for the case of Macao (e.g., Gu, Tam, Lei, & Chang, 2016). This result implies that tourism performance variations observed in a destination hinge not only on its altered supply conditions but also, perhaps more importantly, on demand fluctuations arising from its source markets. Such an implication has been derived by using concrete functional forms for utility and cost, but can also be proved to be true for a general setting via complicated mathematical analysis (that goes beyond the scope of this paper with empirics being its main theme). The above economics model provides a theoretical basis for our subsequent regression of local tourism cycles on external business cycles. An econometrics model is presented below for the time-series analysis of cyclical movements of economic variables in tourist resorts.

Markov switching model

The stochastic process of growth Z_t in gross domestic product (GDP) or gross gaming revenue (GGR) is formulated by the following MSM:

$$Z_t - \mu_{S_t} = \sum_{k=1}^{q} \varphi_k (Z_{t-k} - \mu_{S_{t-k}}) + \sigma_{S_t}\varepsilon_t,$$

$$\mu_{St} = \mu_0(1 - S_t) + \mu_1 S_t \text{and} \sigma_{St} = \sigma_0(1 - S_t) + \sigma_1 S_t, \tag{4}$$

where φ_k's are coefficients of an order-q autoregressive process $AR(q)$, $\varepsilon_t \sim i.i.d.\ N(0, 1)$ is the white noise, $S_t = \{0, 1\}$ is the regime index indicating two unobserved states of the tourism cycle, and μ_{St} and σ_{St} are, respectively, the state-dependent conditional mean and standard deviation of Z_t. Note that μ_0 ($/\mu_1$) is the mean value of Z_t in state 0 (/state 1) while σ_0 ($/\sigma_1$) is the standard deviation of Z_t

in state 0 (/state 1).

Regime changes in Eq. (4) are governed by a two-state Markov chain process, where transition from one state to the next is specified by the following matrix of fixed probabilities:

$$P = \begin{pmatrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{pmatrix},$$

where

$$p_{00} = Pr(S_t = 0|S_{t-1} = 0),\ p_{10} = Pr(S_t = 1|S_{t-1} = 0) = 1-p_{00},$$
$$p_{11} = Pr(S_t = 1|S_{t-1} = 1),\ p_{01} = Pr(S_t = 0|S_{t-1} = 1) = 1-p_{11}.$$

Note that p_{ij} denotes the probability of staying in the same state if $i = j$ or the probability of switching from state j to state i if $i \neq j$. Those probabilities can be made time-variant but there would be a consequent rise in the complexity of analysis; therefore we leave this interesting topic for future research.

The distribution of random growth Z_t, conditional on state S_t, is characterized by the following normal density function:

$$f(z_t \mid S_t = i;\theta) = \frac{1}{\sqrt{2\pi\sigma_i^2}}\exp\left[\frac{-(z_t-\mu_i)^2}{2\sigma_i^2}\right],$$

where $\theta = (\mu_0, \mu_1, \sigma_0, \sigma_1, p_{00}, p_{11})$ is the vector of underlying parameters. Note that this density function, albeit not explicitly containing (p_{00}, p_{11}), is ultimately affected by these regime switching probabilities because the mean and the variance $(\mu_0, \mu_1, \sigma_0^2, \sigma_1^2)$ are state-dependent parameters.

The lag length of the autoregressive process $AR(q)$ in Eq. (4) is selected according to the Akaike information criterion (AIC) and Schwarz's Bayesian criterion (SBC), as shown below:

$$\text{AIC} = N*\log(SSR) + 2K \quad \text{and} \quad SBC = N*\log(SSR) + K*\log(N), \tag{5}$$

where SSR is the sum of squared residuals, N is the number of observations, and K is the number of regressors.

The framework of two-regime MSM makes it possible to calculate the expected duration of one regime, conditional on the tourism cycle being in the other. This mean length of regime is:

$$\delta_0 = (1-p_{00})^{-1} \quad \text{and} \quad \delta_1 = (1-p_{11})^{-1} \tag{6}$$

for state 0 and state 1, respectively.

It is also possible to examine whether or not there is a regime shift by testing the null hypothesis of no shift, i.e., H_o: $\mu_0 = \mu_1$, based on the Wald statistic:

$$w = (\hat{\mu}_0-\hat{\mu}_1)^2/[\hat{v}ar(\hat{\mu}_0) + \hat{v}ar(\hat{\mu}_1) + 2\hat{c}ov(\hat{\mu}_0, \hat{\mu}_1)] \sim \chi^2 \tag{7}$$

We can confirm a regime change if H_o is rejected at some level of statistical significance, α.

The MSM parameters in Eq. (4) are estimated using the maximum likelihood estimator (MLE). This approach is used to estimate the smoothed probability to check whether a typical tourism cycle is in state 0 or state 1 and determine the turning point of growth states.

Macao data and MSM tests

This section displays the crucial importance of casino hospitality to the local economy through data analysis, and presents the main results on Macao's tourism cycle from MSM testing. The MSM is found to closely reflect tourism realities based on the specification tests.

Preliminary data analysis

GDP and GGR are used in this study to analyze the tourism cycle in Macao. The data for all variables, not just Macao's GDP and GGR, are taken from three sources: the DSEC (Direcção dos Serviços de Estatística e Censos). (2017) time-series data (provided by the Macao Statistics and Census Service Bureau), the DICJ (Direcção de Inspecção e Coordenação de Jogos). (2017) online datasets (supplied by the Macao Gaming Inspection and Coordination Bureau), and the CEIC databases (available worldwide). Our study spans the most recent period from 2005Q2 to 2017Q2 that experienced wild fluctuations of tourism economic growth in Macao.

As shown in Fig. 1, Macao's tourism-based economy was less badly hit by the worst impact of the 2008–09 global financial crisis than were other travel destinations because Mainland China (MC) as Macao's key source market was least affected by this severe crisis. Only three quarters saw slightly negative growth rates during this period, and a subsequent long period had witnessed positive or strong economic growth until 2014Q2. The next troubled period started from this quarter when several adverse external shocks arrived in Macao and its casino hospitality felt the severity of their chill. Those shocks included MC's economic growth slowdown, intensified anticorruption campaign, visa policy restriction (on Macao visits), limited bankcard use (for gambling consumption), and money laundering crackdown (against casino facilitation). Macao's gaming hospitality and entire economy experienced the sharpest decline in GGR and GDP in the recent history, with this catastrophic decline persistent for nine quarters. Since 2016Q3, Macao has

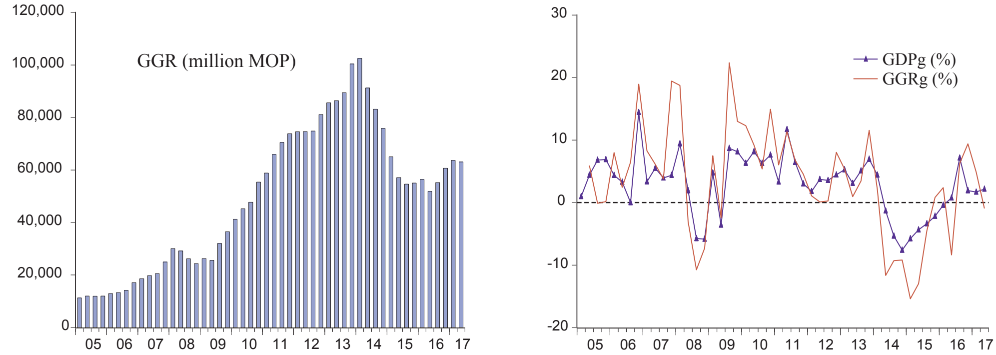

Fig. 1. The dynamic evolution of GDP and GGR in Macao as a tourism economy. *Note:* 8MOP = US$1.

Table 1
MSM test results.

Parameter	GDP growth		GGR growth	
μ_0	4.948^{***}	(0.597)	7.068^{***}	(1.872)
μ_1	-3.626^{***}	(1.299)	-6.508^{**}	(3.090)
φ_k in $AR(1)$	0.048	(0.178)	0.349^{*}	(0.187)
σ	1.114^{***}	(0.126)	1.776^{***}	(0.138)
p_{00}	0.940^{***}	0.932^{***}		
p_{11}	0.771	0.803^{*}		
Duration 0	16.617	14.674		
Duration 1	4.361	5.072		
Wald test stat	41.831^{***}	18.068^{***}		

Note: The MSM postulates two states, with an $AR(1)$ term identified. The error variance (denoted by σ^2) is tested to be homogenous (H_o: $\sigma_0^2 = \sigma_1^2$) across the two regimes (H_o is not rejected at $\alpha = 0.01$ since the F-stat for the GGR variance ratio is *0.8897*, which is associated with a P-value equal to *0.3738*). Standard errors are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

seen a rejuvenation of its economy due to tourism rebounding that in turn is attributable to MC's relaxation of visa policy for Macao visits. It can also be seen from Fig. 1 that the level and growth of GDP move closely in line with those of GGR, implying that as a small open economy, Macao depends heavily on casino hospitality as a demand-driven business. While tourism prosperity is good for economic growth, it is a serious problem that Macao has become increasingly vulnerable to adverse external shocks when its ratio of GGR to GDP rose from 39.9% in 2002 to 91.4% in 2011 with no proper industry diversification.

The quarterly data of GDP and GGR are seasonally adjusted for their use in MSM testing. Unit root tests are also applied to those data to check for their (non)stationarity. We find that the null hypothesis of one unit root is not rejected for the level data of GDP or GGR but can be rejected for their first differences at the 1% significance level, suggesting that growth rates of GDP and GGR are stationary time series. The summary statistics show that the mean value of GGR growth is 3.5% over the whole sample period, ranging from -15.4% to 22.4%, with the standard deviation being 8.7%. The GDP data exhibit similar volatility around their own mean.

MSM testing results

The lag length of $AR(q)$ in Eq. (4) is selected to be one for Macao's economic and tourism cycles on the basis of the Eq. (5) criteria: AIC and SBC. The related MSM is estimated using the MLE approach, with the estimation results presented in Table 1. The following interpretation of these results refers mainly to the tourism cycle characterized by dynamics of GGR for expository convenience, and the explanation for the GDP-related economic cycle is quite similar.

As shown in Table 1, the Eq. (4) model splits up the growth rate of GGR into two distinct states. This separation of states can be confirmed by the Wald test in Eq. (7) because the null is rejected under $w = 18.07 > 3.84 = \chi^2_{0.05}(1)$. Since the average growth rate is 7.07% in state 0 and −6.51% in state 1, it follows that state 0 (/state 1) is the high (/low) growth state, denoted by HGS (/LGS). The estimated probabilities of regime transition are: $p_{00} = 0.93$ and $p_{11} = 0.80$, indicating that $p_{10} = 0.07$ and $p_{01} = 0.20$. The Markov transition probability matrix for Macao implies, to some extent, the severity of its tourism vulnerability or economic volatility. Although it is not very likely for the local economy to plummet into the abyss of gaming business collapse due to a low p_{10}, it is a bit hard for the economy, if suffering from troubled tourism and sluggish hospitality, to return to the phase of high growth because of a low p_{01}.

Fig. 2 (left panel) plots the smoothed probability of Macao's tourism cycle being in HGS [i.e., the P(S_t = 0_GGRg) curve] and of LGS [i.e., the P(S_t = 1_GGRg) curve]. Clearly, the tourism cycle is highly asymmetric in Macao, to the extent that the mean length of a

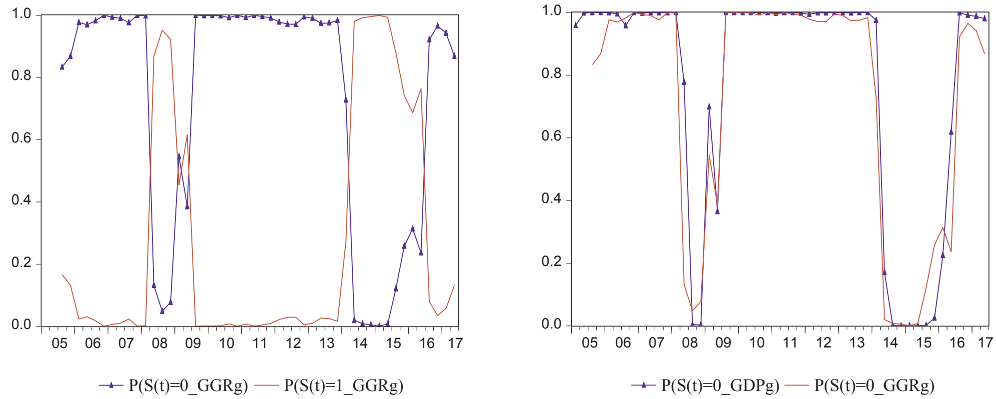

Fig. 2. Smoothed probabilities of the economic and tourism cycles (Left: GGR; Right: GDP vs GGR).

Table 2
Turning points for the economic and tourism cycles.

States	Growth in GDP	Growth in GGR
HGS	2005Q2-08Q2	2005Q3-08Q1
LGS	2008Q3-09Q2	2008Q2-09Q2
HGS	2009Q3-14Q1	2009Q3-14Q1
LGS	2014Q2-16Q2	2014Q2-16Q2
HGS	2016Q3-17Q2	2016Q3-17Q2

regime is 14.7 quarters in HGS but only 5.1 quarters in LGS according to the formula of δ_i in Eq.(6). It is favorable for HGS to last for much longer than LGS (i.e., $\delta_0 \gg \delta_1$). Fig. 2 (right panel) also plots the smoothed probabilities for both the economic and tourism cycles that are in their respective HGSs, as depicted by the P(S_t = 0_GDPg) and P(S_t = 0_GGRg) curves. Obviously, the two curves move together quite closely, as confirmed by their very high correlation coefficient of 0.947 at the high level of statistical significance 1%. In Table 2 we determine the turning points of the economic or tourism cycle by setting the cutoff probability of LGS to be equal to 0.7. Once again, it is shown that there is an extremely high correlation between the economic and tourism cycles in Macao. It therefore suffices to discuss one of the two cycles, with emphasis put on the tourism cycle.

Determinants of Macao's tourism cycle

This section conducts an empirical study to explore driving forces for tourism and business cycles in Macao. Regression specifications in this study are based on predictions of the economic model proposed earlier. The model suggests the interaction between the demand and supply factors in cross-border tourism markets, so that local tourism cycles identified via the MSM can be regressed on external demand factors as well as on internal supply conditions. Other determinants of tourism cycles such as the global financial crisis are treated as control variables in regressions.

The regression model used for Macao's tourism cycle determinants is specified as follows:

$$Y_t = \beta_0 + X_{1t}'\beta_1 + X_{2t}'\beta_2 + \eta_t, \tag{8}$$

where Y_t is a binary variable based on the MSM probability, which is equal to one if P($S_t = 0$) > 0.7 or zero otherwise. If Y_t had been directly defined as P($S_t = 0$), all HGS and LGS would be pooled in Eq. (8) since a low enough value of Y_t = Pr(HGS) actually indicates an LGS that occurs with the correspondingly high probability of Pr(LGS) = 1 − Pr(HGS). The cutoff probability 0.7 is used to distinguish between HGS and LGS to make the predicted turning points the same as those actually observed. Additionally, X_{1t} is a vector of demand-side factors in tourism markets, X_{2t} is a vector of supply-side factors, η_t is the error term, and β_k's are the intercept and the vectors of slope coefficients. Consistent estimates can be obtained from the Eq. (8) regression by using the logit estimator that is often used for discrete-choice regression in the literature. Since all time-series data used for regression are found to be stationary after unit root testing, we have no need for co-integration test but rather opt for a static model specified in Eq. (8).

The demand-side factors in X_{1t} include: total tourist arrivals (T.TA), tourist arrivals from Mainland China (MC.TA), tourist arrivals from Hong Kong (HK.TA), tourist arrivals from other places (O.TA), MC's economic performance (MC.GDP), MC's anticorruption (MC.Anticorr), transportation infrastructure construction in nearby Guangdong Province (GD.TIC), and the 2008–09 global financial crisis (Dummy2008). The supply-side factors included in X_{2t} are: VIP service offerings to high rollers (VIP.HR), mass market services to ordinary tourists (MASS.Mkt),[2] total expenses on marketing promotions and junket commissions (Mktg.Cost), the supply of table

[2] The mass market is a market segment that targets a large number of tourists who place small amounts of bets.

games (T.Game), the provision of slot games (S.Game), the number of casinos (No.Casino), and new openings of casino facilities (NEW.Open). Most of the explanatory variables X_{kt} (except MC.Anticorr, Dummy2008, and NEW.Open) are measured in terms of their growth rates when included in Eq. (8) for regression.

It is necessary to provide discussions about the selection of explanatory variables based on the theory proposed earlier in this paper and previous studies in the literature (Chen, 2013; Gu, Li, & Tam, 2013; Croes & Ridderstaat, 2017). First, Macao's casino hospitality used to depend mainly on tourists from Hong Kong (63.8% of total arrivals in 1999) but has now relied increasingly on visitors from MC (66.1% in 2016). Customers from all other sources become even less important for gaming revenue generation since their per-visit spending is much lower than that of an average visitor from MC (Gu et al., 2016). The number of MC visitors rose from 2.78 million in 2002 to 20.45 million in 2016, representing an average rise of 15.3% per year. Thus MC business cycles proxied by MC.GDP and MC.TA should exert a strong positive impact on Macao's tourism cycle, whereas other source markets (HK.TA or O.TA) may not have such an effect.

Second, since the vast majority of MC customers comes from nearby Guangdong Province (44.1% of MC arrivals in 2016), its massive construction of transportation infrastructure (proxied by the gross fixed capital formation) facilitates its residents' travel to Macao for gambling (Li, Gu, & Wu, 2015). Such infrastructure also benefits Macao visitors arriving from other Chinese provinces. The independent variable GD.TIC is then expected to have a certain positive effect on Macao tourism.

Third, around 2/3 of Macao's GGR is reaped from VIP gambling services offered to high rollers who are willing and able to place huge amounts of bets (Pontell, Fang, & Geis, 2014). Over 95% of high rollers are corporate and public officials from MC. It is very costly for local junkets to bring them into VIP rooms and organize them for gambling. VIP operation (VIP.HR) and associated marketing costs (Mktg.Cost) must have a significant influence on casino performance. Many VIP customers from MC have various links to money laundering and organized crime via closed-door VIP rooms. Thus the anticorruption campaign in MC (proxied by MC.Anticorr via the number of arrests of corrupt officials) exerts a direct impact on opaque VIP gaming in Macao (Lin, Fu, Song, & Gu, 2017).

Fourth, since Macao's VIP tourism was hit badly by the MC anticorruption, it has become increasingly important to solicit business from mass markets (1/3 of GGR) to reduce the vulnerability of the local economy to external shocks. While the VIP market has been undergoing negative growth due to anticorruption shocks, the mass market seems immune from them and has still kept on expanding thanks to growing arrivals of small-bet tourists. The problem is that the mass market, albeit hosting a rising number of customers, still contributes much less to GGR than does the VIP market (Loo, Raylu, & Oei, 2008). Thus there is a need to use a variable like MASS.Mkt to detect how differently the tourism cycle is affected by the two market segments.

Fifth, the key to mass market success is to promote slot games, but another problem is that most Chinese customers prefer table games with large stakes over slot games with small wagers (Vong, 2007). Different types of casino games (T.Game versus S.Game) are included in our regression to look at whether they might have any bearing on tourism cycles. It goes beyond the scope of this paper to address how to deal with tourists' problem gambling through casinos' responsible gaming.

The choice of regression model specifications is due to four considerations. The first one is to steer clear of possible data problems embedded in the sample. The correlation coefficient between any two regressors is not high except for that between T.TA and MC.TA. These two variables are then included separately in different regressions to avoid the potential problem of multi- collinearity. The second one is to check if main estimates are robust from different perspectives of regression analysis. Both demand- and supply-side factors are related to MC as a key source market. We use multiple models to explore whether MC-related factors do have a robust effect on Macao's tourism cycle. The third one is to confirm the insignificant or weak role of Hong Kong and other source markets for Macao's tourism cycle. These markets are first included in some regressions and then excluded in others due to their weak role in cyclical movements of Macao's GGR. The fourth one is to strike a proper balance between the sample of observations and the combination of regressors. To ensure the overall significance of regression and the completeness of market analysis, each combination includes at least one demand- and one supply-side factor but cannot exceed six regressors due to the limited sample size.

A binary variable taking on either 0 for HGS or 1 for LGS is designed according to the cutoff probability *0.7*. Thus one can infer from estimation results what factors lead to HGS and what problem lies behind LGS. Alternative models (logit, probit, or linear probability) are available for estimation, and we choose the logit model to obtain results that are intuitively interpretable. These results, if statistically significant and robustly strong, will be economically useful and hence managerially helpful to policy makers and tourism practitioners.

Our regression results for determinants of the Macao tourism cycle are reported in Table 3 that contains important estimation results and associated test results. As interpreted shortly, each of our estimates in Table 3, whether significant or not, conveys certain economic messages in its own right.

A brief interpretation of estimation results in Table 3 is given below for greater clarity. First, tourist arrivals from MC and its GDP growth are found to be two significant factors that keep the Macao tourism cycle in HGS, but those from Hong Kong or other tourist sources are not. This finding is consistent with the general perception about the relative importance of source markets among academic researchers and tourism practitioners (Lv & Zhang, 2015). Second, Guangdong's construction of transportation infrastructure is good for Macao's gaming hospitality to stay in HGS, as evidenced by the significantly positive estimate for the related regressor. This evidence accords well with the result from another study in the literature (Li et al., 2015). Third, two mega events that impacted adversely on the Macao tourism and hospitality are the 2008–09 global financial crisis and the 2014–16 MC anticorruption campaign. The two events are estimated to be significant factors that cause the Macao tourism cycle to switch from HGS to LGS, as discussed in the literature (Lin et al., 2017), with the second event having a larger and more persistent effect than the first one.

Three other empirical results in Table 3 are separately interpreted here. Fourth, while the effect of VIP business is surely positive and crucially important, the impact of mass market operation is somewhat conducive to tourism growth (Shu, 2014). This finding is

Table 3
Logit regression results for determinants of the Macao tourism cycle.

Variable	M1	M2	M3	M4	M5	M6	M7	M8	M9
T.TA in M (1,2) MC.TA in others	1.291^{**} (0.150)	1.317^{**} (0.154)	1.302^{***} (0.131)	1.208^{***}(0.075)	1.147^{**}(0.078)	1.125^{*} (0.080)			
HK.TA				1.033 (0.066)	0.984 (0.055)	0.987 (0.054)			
O.TA				1.088 (0.083)	1.009 (0.043)	1.011 (0.056)			
MC.GDP in M(5,7) Lag.MC.GDP in M(6,9) GD.TIC in M8					3.640^{***} (1.762)	11.78^{***} (7.755)	6.090^{**} (4.994)	1.046^{**} (0.045)	6.049^{*} (6.693)
MC.Anticorr in M3Lag.MC.Anticorr in M(4,9)			0.976^{***}(0.009)	0.955^{***}(0.013)					0.920^{***}(0.022)
Dummy2008						0.001^{***}(0.002)	0.000^{***}(0.001)	0.001^{**}(0.004)	0.000^{***}(0.000)
Lag.Mktg.Cost in M2 Mktg.Cost in M3		1.263^{***}(0.103)	1.431^{***}(0.187)						
VIP.HR	1.364^{***}(0.140)	1.307^{**}(0.162)					1.291^{**}(0.166)	1.455^{***}(0.157)	
MASS.Mkt							1.397^{**}(0.151)		
T.Game	1.173(0.268)		1.218(0.178)					1.121(0.261)	
S.Game	1.063(0.113)							1.106(0.143)	
No.Casino in M(4,5,6)NEW.Open in M9				1.162(0.149)	1.015(0.115)	1.051(0.156)			2.557(2.804)
LR chi-squared	11.87^{**}	9.80^{**}	20.01^{***}	18.21^{***}	14.43^{**}	20.49^{***}	16.50^{***}	16.01^{***}	32.29^{***}
Pseudo *R*-squared	0.595	0.671	0.631	0.460	0.365	0.554	0.829	0.671	0.735

Notes: All explanatory variables except Dummy2008, measured in terms of growth rates, are tested to be stationary. A constant term is included but its estimate is not reported since it is unimportant. Since the estimated coefficients reported here are transformed to odds ratios, they may indicate positive effects (of *X* on *Y*) if greater than one or negative impacts otherwise. The *LR* statistic is used to test for overall significance of the regressions. Standard errors are in parentheses, and robust estimates are reported. ***p < 0.01, **p < 0.05, and *p < 0.1.

encouraging for Macao to minimize the vulnerability and volatility of casino hospitality since mass markets were previously perceived as unimportant but now have to be developed in focus to diversify away from VIP gaming. Fifth, the Macao tourism cycle is found to have no strong bearing on casino business types (i.e., table versus slot games), other supply factors (such as openings of new facilities and the number of casinos established) turn out to make no significant contribution, either, to tourism development towards HGS (Liu & Wan, 2011). A notion preached by casinos, especially those operated by foreign investors (for the purpose of tax reduction), is that it is their new opening that brings in tourists to support the local economy. Yet the truth is that gaming hospitality is a demand-driven business, as confirmed by our econometric estimation which finds supply factors to be weak in explaining tourism cycles. Lastly, what all casinos should do for their own good is to strengthen their marketing to mass market customers (Lam, 2010). Business promotion, especially cross-border marketing, albeit highly costly, is found to be good for business expansion. This finding is corroborated by our estimate for the related regressor that is statistically significant and robustly positive.

Finally, it is important to point out that tourism cycles in a travel destination like Macao are ultimately attributable to business cycles and other external factors occurring in its source markets like MC. This empirical result is different from the finding in Chen (2013) (that has nothing but exchange rates as the only link with out-of-area factors), but consistent with our theoretical prediction made earlier. It is found from Table 3 that the demand and supply factors contribute significantly to Macao's tourism cycle as long as they are related to MC's market. On the demand side, tourists from non-MC sources such as Hong Kong and other places play no significant role in Macao's tourism cycle. On the supply side, Macao's marketing schemes are designed to cater to MC customers' preferences for baccarat games with large bets and for VIP gambling behind closed doors. Casino junkets incur large marketing costs in MC to bring its high rollers to Macao VIP rooms. Our logit estimation for the link of source-destination cycles is statistically robust to different model specifications. Similar results are also established for other tourism-dependent small economies (Croes & Ridderstaat, 2017).

Conclusions

This study first analyzes tourism and business cycles using a two-regime Markov switching model (MSM), and then examines potential driving forces behind cyclical movements of a tourism economy by using usual regression models. We focus on Macao as a suitable case for casino hospitality to generate policy implications useful for sustainable tourism development and stable economic growth.

The MSM is used to separate the Macao tourism cycle into two states: HGS and LGS, and their characteristics are summarized below. First, the mean growth rate of tourism revenue (i.e., GGR) is 7.07% in HGS but -6.51% in LHS, clearly indicating that the tourism and hospitality industry did enter recessions that were not serious in 2008–09 but severe in 2014–16. Second, the likelihood of the industry sustaining HGS is 93% but the risk for remaining in LGS is 80%. In other words, the industry has a high tendency to stay in HGS, but a low chance to recover from LHS and shift to HGS. Third, the average duration of HGS is 14.7 quarters but that of LGS is only 5.1 quarters, so the tourism cycle in Macao is highly asymmetric but fortunately favorable given that HGS lasts almost three times longer than does LGS. Fourth, unlike other (large) travel destinations, Macao is a small open economy, which rests on casino hospitality so heavily that it is its tourism cycle that affects its economic cycle, not the other way around. It is therefore critical to promote tourism development for sustaining economic growth.

The logit estimator is used to identify what factors keep the Macao tourism cycle in HGS. Our regression results confirm and extend evidence from previous studies. First, this cycle is significantly affected by the economic cycle of Mainland China (MC) as Macao's main tourism source and by other external factors related to this source, such as visitor arrivals from MC and transportation infrastructure construction in Guangdong. Higher levels of those factors make it more likely for the Macao tourism cycle to stay in HGS. Second, the global crisis and the MC anticorruption are two external disruptive events plunging the Macao cycle into LGS. Their effects expose the vulnerability of the local economy that depends only on inbound tourism with no industry diversification. Third, this vulnerability hinges largely on VIP gaming tourism, not on mass market hospitality. It is fortunate that the mass market now contributes more to the whole tourism than ever before, albeit still to a lesser extent than does the VIP market. Fourth, since casino hospitality is a demand-driven business with large sunken costs and small marginal costs, the industry needs to engage in costly marketing for high profitability. While the promotional cost has proved to be a significant contributor to the prosperity of inbound tourism and to the sustainability of its HGS, all other supply-side factors are found to be insignificant factors for tourism growth as implied by our proposed theory.

The above results have policy implications useful for economic authorities and tourism managers. Countercyclical policy interventions can be adopted to safeguard the local economy, with decisive measures taken to sustain tourism in HGS. First, the volatility of Macao's business cycle is rooted in the VIP operation of inbound tourism that is subject to MC's economic cycle and other external factors. Given the persistent anticorruption that prevails in MC, Macao can no longer make big fortunes by relying on VIP gaming that targets MC officials as cash cows. Tax policy adjustment may serve as a catalyst for change. Gaming taxes on unhealthy VIP operation must be increased to reduce exports of social costs to MC, while tax relief for mass market business should be granted to maintain the stability of casino hospitality. Second, since the supply-side factors have no significant impact on tourism dynamics, the local lawmakers cannot continue to allow for the new-opening of casino facilities or the over-expansion of VIP rooms. Instead, responsible gaming needs to be encouraged among casino firms to minimize the vulnerability to external shocks. Since cross-border promotion is substantially costlier for VIP than for mass market business, diversifying from the former market towards the latter segment would significantly reduce marketing costs and hence boost hospitality profits. Third, there is a limitation on the development of mass tourism in Macao, however. As a territorially tiny city, Macao has already reached the highest ratio of touristic visitors to local inhabitants in the world, with its ratio (as high as 50:1 in 2014) exceeding that of better-known destinations such as Venice (37:1), Hong Kong (8.4:1), London (2.1:1), and Paris (1.8:1) (Lai & Hitchcock, 2017). Complaints from local residents seem to have arisen over mass tourism, and hence Macao has to take an alternative approach to economic diversification (with less of ill-famed casino gambling and more of well- reputed industries). A viable way is to develop those industries that yield high value added but entail low land use. Only when such a diversification is effective can the local economy be put back on the right track with lower vulnerability and longer sustainability.

Finally, it is worth pointing out certain limitations of this study that indicate the direction for future research. First, our theoretical model establishes the dependence of local tourism cycles on external business cycles. It makes such prediction without distinguishing between tourism and non-tourism business. As tourism industry in a destination touches upon all sectors in the local economy, a general rather than partial equilibrium model needs to be used for more complete analysis. Second, our theory is formulated by assuming a competitive market structure. More suitable modeling should address the uncompetitive nature of the industry whose supply may affect tourist arrivals. The Stackleberg game-theoretic approach can be used for more realistic analysis by treating a destination as a leader and its customers as followers. This approach may be able to articulate the strong impacts on tourism performance of pull as well as push factors. Third, our empirical study is conducted only for Macao. If panel data are available, it is interesting to look into whether the findings in this paper can be extended to other destinations. If situations are different in various places, nonlinear or threshold regressions for heterogeneous panels should be used to derive more general insights for policy making.

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