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THEORISING ON TOURIST FLOWS AND BUSINESS CYCLES IN CASINO CITIES

Two models of gambling destinations were developed to illustrate how external shocks from tourist origin countries are spread via tourist flows into destinations. Theorising on such mechanisms made it possible to simulate the driving forces behind business cycles and offer a theoretical construct for numerical analysis. It was found that favourable changes in push and pull factors can create a sound environment of lower prices, more tourism and growing income.

Keywords: push factors, pull factors, business cycles, visitor flows

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1. INTRODUCTION

1.1. Background

The cyclical movement of tourism flows has attracted more and more attention in the research literature (Guizzardi and Mazzocchi, 2010; Smeral and Song, 2013; Gunter and Smeral, 2016; Sheng et al., 2017). This research trend is attributable to the increasing significance of the tourism industry, which contributes 9.8% of global GDP and 6% of world exports, with one out of eleven employment opportunities generated by such economic activity (WTTC, 2015). Numerous studies have examined the link between the economy and the tourism cycle, especially since the 2008-2009 global financial crisis (Smeral, 2008, 2018). However, there is a lot to improve in this field, as demonstrated by this work.

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1.2. Literature review

First and foremost, the majority of studies in this field are empirical investigations, based on the application of established theories of consumption to tourism data. Tourism is a distinct form of trade activity across jurisdictional borders (Copeland, 1991), which exports tourism products to visiting customers. Although the gravity model, which is commonly used to examine global trade concerns has been used in empirical tourism research (Uysal and Crompton, 1985), it lacks a microeconomic basis. It is necessary for further research in tourism economics, to reinforce theoretical foundations and refine the regression of norms. Through theoretical contributions, this aimed to expand tourism research.

Secondly, various econometric studies have appeared in the literature to estimate tourism demand, since tourism flows are primarily determined by demand forces (Bronner and de Hoog, 2017), yet no attempt has been made to evaluate the influence of tourism supply, possibly because the tourism sector is so small in comparison to other economic sectors that its supply elasticity is simply regarded as infinite. Some theoretical models of tourism markets have been proposed, even though their supply side has not been formulated (Morley, 1992, 1995; Morley et al., 2014; Li and Sheng, 2018). Thus, additional research should give adequate prominence to the supply side, assessing the cross-border interactions between a travel destination and its source markets. Some of the previously developed tourism-economy models (Sheng, 2017; Song et al., 2012) can be enlarged to accomplish this research objective, intended to provide a comprehensive market analysis for tourism.

Thirdly, there is a lack of dynamic modelling in the literature, which is required to examine tourism cycles over time in travel destinations. This research seeks to bridge this gap by formulating the dynamic behaviour of tourists' income fluctuations, which are profoundly affected by source market business cycles (Smeral, 2012). The purpose was to construct a dynamic model of tourism demand from the source markets alongside a standard model of supply behaviour in travel destinations, with both models interacting over time via competitive prices. Specifically, the author applied dynamic programming to rigorously simulate a model of the connections generated from the external business cycle through the cross-border market to the local tourism cycle, as accurately observed by Moore and Whitehall (2005); Croes and Ridderstaat (2017), Sheng and Gao (2018). This series of studies allowed to pinpoint the fact that the impact of a pervasive shock on tourism performance can be an amplified or attenuated propagation mechanism. The shock can be cyclical fluctuations in pull or push factors on either the supply or demand side of the market, respectively.

As illustrated above, several enhancements are still attainable. For the first time, operational research was applied to the study of tourism industry cyclicality in this article.

The rest of the paper proceeds as follows: Section 2 demonstrates a dynamic programming model based on residual utility from travel enjoyment; Section 3 presents another dynamic model for total utility from travel-consumption substitution; Section 4 summarizes.

2. MODEL BASED ON RESIDUAL UTILITY FROM TRAVEL ENJOYMENT

2.1. Budget constraint and the conditions for maximizing utility

Through a dynamic programming model, the optimal travel decision of a representative consumer from a source market was interpreted in the study. The residual utility is identified below as the degree of satisfaction obtained from tourist travel after its utility in consuming all other commodities has been ignored. Such residual utility $U(q_t)$ in period t is derived from the total amount q_t of time spent throughout all the visited destinations. The budget constraint, which encompasses all types of expenditure, is as follows:

$$A_{t+1} = R_t\left(A_t + Y_t - C_t - p_t q_t\right), \tag{1}$$

where A_t is the accumulated asset, Y_t is labour income, C_t is the money amount of all other goods (except tourist travel) consumed, R_t is the single-period gross rate of return on asset, and p_t is the tourism price (measured as the average cost of all visits per unit of time spent at the destination, the transit time on the road is omitted for simplicity). Let ξ_t (=1–C_t/Y_t) be the gross rate of saving, with travel spending excluded for the time being. Consumption spending, while still included in the budget constraint, can be taken out of Equation (1) in order to allow for a greater focus on tourism expenditure.

The consumer's travel decision-making problem is formulated as:

$$\max \sum\nolimits_{t=1}^{\infty} \beta^t U(q_t), \text{ s.t. } A_{t+1} = R_t\left(A_t + \xi_t Y_t - p_t q_t\right), \tag{2}$$

where $0 < \beta < 1$ is a discount factor. A restriction is imposed on the Equation (2) problem to exclude infinite consumption through unbounded borrowing (i.e. assuming no Ponzi game):

$$p_t q_t + \sum\nolimits_{j=1}^{\infty}\left(\Pi_{k=0}^{j-1} R_{t+k}^{-1}\right) p_{t+j} q_{t+j} = y_t + \sum\nolimits_{j=1}^{\infty}\left(\Pi_{k=0}^{j-1} R_{t+k}^{-1}\right) y_{t+j} + A_t. \tag{3}$$

The state variable of the problem in Equation (2) is defined as $x_t = (A_t, y_t, R_{t-1})$, where $\xi_t Y_t$ is denoted by y_t for convenience of notation. The control variable of this problem is defined as $u_t = R_t^{-1} A_{t+1}$ (=$A_t + y_t - p_t q_t$), where the net saving, $y_t - p_t q_t$, equals income minus travel expenses and all other categories of consumption.

Following the dynamic programming method in Sargent (1987), Bellman's equation for the problem is demonstrated as a recursive system:

$$V(A_t, y_t, R_{t-1}) = \max_{u_t}\left\{U\left[\frac{1}{p_t}(A_t + y_t - u_t)\right] + \beta V(u_t R_t, y_{t+1}, R_t)\right\}. \quad (4)$$

Combining the first-order condition (FOC) with the Benveniste-Scheinkman formula leads to the utility optimising condition for Equation (4):

$$\begin{aligned} &-\beta^t \frac{d}{dq_t} U\left[\frac{1}{p_t}\left(A_t + y_t - R_t^{-1} A_{t+1}\right)\right] + \\ &\beta^{t+1} R_t \frac{d}{dq_{t+1}} U\left[\frac{1}{p_{t+1}}\left(A_{t+1} + y_{t+1} - R_{t+1}^{-1} A_{t+2}\right)\right] = 0, \end{aligned} \quad (5)$$

which is also referred to as the Euler equation derived for the scenario, in which the transition equation has no state variables.

The optimal plan for tourist travel must satisfy the Euler equation in Equation (5) and the isoperimetric condition in Equation (3). To be precise, to adapt the planning problem to the case in which $U(c_t) = \ln c_t$, $y_t = \lambda y_{t-1}$, $p_t = \kappa p_{t-1}$ (i.e. κ measures local inflation), $R_t = R$ for all t, and $R > \lambda > 0$ (i.e. growth is faster for capital income than for labour income, and this is basically the case in many economies, including tourist destinations). The optimal amount of travel can be derived as:

$$q_t^* = \frac{1-\beta\kappa}{p_t}\left(A_t + \frac{\xi_t Y_t}{1-\lambda R^{-1}}\right) = q_t^D\left(p_t; A_t, Y_t, \lambda, \xi\right), \quad (6)$$

which represents the tourism demand arising from the source market.

2.2. Push factors and pull factors

The classification and analysis of push and pull factors are critical in this model, which is why there are two lemmas below to interpret their role in the equation.

Lemma 1. The underlying parameters A_t, Y_t, ξ_t, λ in Equation (6) are the *push factors*, and any increase in their level is conducive to the growth of tourism demand, which is able to prove from $\partial q_t^D / \partial(A_t, Y_t, \xi_t) > 0$ (unconditionally true) and $\partial q_t^* / \partial\lambda > 0$ (conditional on $R > \lambda > 0$ as assumed above).

For Lemma 1, a representative firm operates in a competitive destination to maximize its profit Π_t during period t from tourism business by optimizing sales revenue $p_t q_t$ against production cost $C_t = C(q_t, \gamma)$. The cost function is specified as: $C_t = q_t^{1+\theta}/\gamma^\tau$, where $\theta > 0$ indicates the fact that marginal cost rises with more production as usual, and $\tau > 0$ denotes the role of *pull factors* $\gamma > 1$ (such as natural amenities and man-made facilities) for cost reduction among tourism companies. The company's business decision is constructed to be an unconstrained optimisation problem:

$$\max_{q_t} \Pi_t = p_t q_t - C(q_t, \gamma). \tag{7}$$

The solution to this problem yields the company's optimal supply of service hours to cater for visiting tourists:

$$q_t^* = \left(\frac{p_t \gamma^\tau}{1+\theta} \right)^{\frac{1}{\theta}} = q_t^S \left(p_t ; \gamma \right). \tag{8}$$

Obviously, increasing the destination's attractiveness to tourists as measured by a higher value of γ reduces the cost of business operation with significant implications for the output and profitability of tourism operation.

Lemma 2. All *pull factors* summarized as index γ for tourism attractiveness in a travel destination are positive for its output production and profitability, which can also be easily proved by noting $\partial q_t^S / \partial \gamma > 0$ and by applying the envelope theorem to the profit function in Equation (7), that is, $d\Pi_t^*/d\gamma = \partial \Pi(q_t, \gamma)/\partial \gamma|_{q=q^*}$.

For Lemma 2, the aggregation of all agents and tourism sources within the destination can be used to yield the market demand and the industry supply. Nonetheless, such aggregation is omitted for simplicity's sake without impairing the nature of the derived results. This is because representative agents (visitors and firms) were assumed to base their demand and supply behaviour on the tourism price. Then it is proved how local tourism cycles are correlated with external business cycles.

Therefore, it is reasonable to set the two proposals of how these factors affect the total revenue.

Proposal 1. The market equilibrium of cross-border tourism is the ultimate result of interactions between the demand and supply sides. Travel price p_t^{**}, visitation amount q_t^{**} and tourism revenue TR_t^{**} are found to be affected positively by all the *push factors* A_t, Y_t, ξ_t, λ. *Pull factors* γ have a negative effect on the price, a positive effect on the quantity, but have no effect on the revenue.

Proposal 2. If income growth λ in source markets accelerates and approaches asset return R, a propagating mechanism exists through which their small income shocks (i.e. ΔY_t) and saving shocks ($\Delta \xi_t$) can be transformed into much larger tourism income fluctuations (ΔTR_t^{**}) in a related travel destination. The reverse may also be true if income growth λ slows or reverses.

By setting demand q_t^D in Equation (6) equal to supply q_t^S in Equation (8), one obtains price p_t^{**} and quantity q_t^{**} of equilibrium tourism activity along with total revenue TR_t^{**}:

$$p_t^{**} = \left(\frac{1+\theta}{\gamma^\tau} \right)^{\frac{1}{1+\theta}} \left[\left(1 - \beta\kappa\right) \left(A_t + \frac{\xi_t Y_t}{1 - \lambda R^{-1}} \right) \right]^{\frac{\theta}{1+\theta}},$$

$$q_t^{**} = \left(\frac{1+\theta}{\gamma^{\tau}}\right)^{\frac{-1}{1+\theta}} \left[(1-\beta\kappa)\left(A_t + \frac{\xi_t Y_t}{1-\lambda R^{-1}}\right)\right]^{\frac{1}{1+\theta}}, \tag{9}$$

$$TR_t^{**} = p_t^{**} q_t^{**} = (1-\beta\kappa)\left(A_t + \frac{\xi_t Y_t}{1-\lambda R^{-1}}\right).$$

Clearly, $\partial(p_t^{**}, q_t^{**}, TR_t^{**}) \,/\, \partial(A_t, Y_t, \xi_t, \lambda) > 0, \partial p_t^{**}/\, \partial\gamma < 0$, $\partial q_t^{**}/\partial\gamma > 0$, and $\partial TR_t^{**}/\partial\gamma = 0$.

As indicated in Equation (9), revenue TR_t^{**} or profit $\Pi_t^{**} = [\theta/(1+\theta)]TR_t^{**}$ has no bearing on the *pull factor* in tourism equilibrium, albeit hinging positively on the *push factors*. This could be explained by the above-mentioned actual situation of residual utility. In other instances, or more broadly, as illustrated in the following section, the pull factor can be proven as a contributor to tourism business, thus Proposal 1 can be proved valid.

Moreover, it follows from Equation (9) that $TR_t^{**} \rightarrow \infty$ if $\lambda \rightarrow R$. A plausible realistic interpretation of this case is that a small income or saving variation (ΔY_t, $\Delta\xi_t$) in the source markets will be amplified to exert a large effect on tourism revenue (ΔTR_t^{**}) in the related travel destination. However, in another case when $\lambda\downarrow$ or $\lambda < 0$, there will be a smaller and limited change of TR_t^{**} in the destination even following a significant change of income or saving factors (Y_t, ξ_t) in its source markets, as mathematically implied by Equation (9), hence proving Proposal 2.

2.3. Implications of tourism in Macao

The outcome of this proposal was confirmed by business developments in Las Vegas and Macao, the world's two most popular travel destinations and the most illustrative examples of casino tourism. Actually, Macao is more relevant to global tourism than Las Vegas, owing to the fact that Macao's tourism revenue is seven times greater (Sheng and Zhao, 2016). *Pull factors* are critical for Las Vegas, as the city has had to renovate and expand non-gaming hospitality facilities in the last decade, as the US demand for casino gambling has declined. On the contrary, *push factors* are crucial to Macao since its Chinese visitors mainly arrive not for outdoor sightseeing but indoor gambling. Indeed, Macao, with a land area less than a tenth of that of Las Vegas, lacks natural resources and tourist attractions geared toward non-gaming visitors.

Intuitively, if income growth in source markets such as China is rapid enough, the desire for tourist travel is likely to outweigh the desire for asset accumulation. For the twenty years up to 2014, China's GDP grew at an annual rate of about 10% (China National Bureau of Statistics, 1995, 2014). In this case, income effects on tourism demand became so strong that tourism revenue in the travel destination could accelerate to quite high levels, as predicted by this proposal and observed in Macao.

Between 2002 and 2014, the city's gaming revenue grew rapidly at a rate of 28%-30% per year, as Mainland Chinese were permitted to gamble in its casinos (Macao Statistics and Census Services, 2002, 2014). However, when China's GDP growth slowed to less than 7% between 2015 and 2017, and the Xi Jinping administration stepped up its anti-corruption campaign, Macao's tourism-based economy went into an outright recession. The external shocks were so severe that Macao's tourism revenue fell by 49.4% and GDP dropped by 28.9% during this time period (Deng et al., 2018).

3. MODEL BASED ON TOTAL UTILITY FROM TRAVEL-CONSUMPTION SUBSTITUTION

3.1. Steady state solution for the deterministic control problem

The above formulation of a tourist's problem in Equation (2) is based on the residual utility $U(q_t)$ from travel enjoyment q_t. Consumption spending C_t on all other goods and services was suppressed from this utility function, despite the fact that it was still subject to budget constraint. As a result, pull factor γ is missing from the tourism demand function q_t^D and hence from the equilibrium tourism revenue and profit functions TR_t^{**} and Π_t^{**}. One can compensate for this omission by factoring the attractiveness of tourism into consumer preferences. Thus, in the utility function (UF), consumption C_t must be considered alongside travel q_t. With the new UF denoted by $U_t = U(C_t, q_t)$, relative preferences for consumption and travel can be formulated, and a subjective substitution between the two expenditure items can be considered.

As is customary, the UF is specified as Cobb-Douglas: $U(C_t, q_t) = C_t^a q_t^b$, with consumer satisfaction influenced by both consumption spending and tourist travel, where a and b denote elasticities of utility with respect to these two activities. The ratio of a/b indicates their relative preferences. Consumers' preference for tourism increases with the increase of tourism attractiveness. Therefore, the utility elasticity b for travel hinges positively on the tourism attraction index γ: $b = b(\gamma)$ with $b'(\gamma) > 0$. Next, the consumer's travel decision problem was re-formulated as:

$$\max_{\forall q_t} \sum_{t=1}^{\infty} \beta^t U\left(C_t, q_t\right), \text{ s.t. } A_{t+1} = R_t\left(A_t + Y_t - C_t - p_t q_t\right), \qquad (10)$$

where $C_t = vA_t$ is specified due to the fact that the current consumption expenditures are typically proportional to the stock of accumulated assets, and consumption rate $v \in (0,1)$ is assumed under the infinite horizon.

While this reformulation appears straightforward, it significantly complicates the mathematical analysis of dynamic programming (DP) problem. To address such difficulties, this study followed Chow (1992) by applying an alternative to DP. Chow proposed to solve a standard multi-period optimisation problem by using Lagrange multipliers rather than the value function in a Bellman equation. Chow's problem is a general stochastic model as illustrated below:

$$\max_{\{x_t\}_{tt=0}^{T}} E_o\left[\sum_{t=0}^{T}\beta^t f(y_t, x_t)\right], \text{ s.t. } y_{t+1} = g(y_t, x_t) + \varepsilon_{t+1}, \tag{11}$$

where $f(\ ,\ )$ and $g(\ ,\ )$ are differentiable and concave, y_t is a $p \times 1$ vector of state variables, x_t is a $q{\times}1$ vector of control variables, $E_t[\equiv E(\cdot \mid I_t)]$ is the expectation operator conditional on the information set I_t at time t with respect to $y_t \subseteq I_t$, ε_{t+1} is an *iid* residual vector with zero mean and covariance matrix.

Chow's method to solve dynamic optimisation without using DP is to introduce a $p \times 1$ vector λ_t of Lagrange multipliers and set to zero the derivatives of a Lagrangian function for Equation (11) with respect to x_t, y_t, and λ_t for all $t = \{T, T\text{-}1, \ldots, 1, 0\}$, as presented below:

$$\frac{\partial f}{\partial x_t} + \beta\frac{\partial g}{\partial x_t}E_t\lambda_{t+1} = 0, \quad \frac{\partial f}{\partial y_t} + \beta\frac{\partial g}{\partial y_t}E_t\lambda_{t+1} = \lambda_t, \quad y_{t+1} = g(y_t, x_t) + \varepsilon_{t+1}. \tag{12}$$

Except for the stochastic aspect, this set of FOCs for Equation (11) turned out to be similar to the result obtained by applying Pontryagin's maximum principle. In many applications, a steady state solution (x^*, y^*, λ^*) for a deterministic control problem can be computed by setting $\varepsilon_{t+1} = 0$ in Equation (12), eliminating all time subscripts t, and omitting the operator E_t (Chow, 1979).

In the deterministic case, $\varepsilon_{t+1} = 0$ is set to eliminate randomness, variable vectors were omitted since $p = 1 = q$ in Equation (10), and $T\rightarrow \infty$ was assumed so that an infinite horizon can be considered for analytical convenience. Then, rather than using Equation (12) backward in time, the author concentrated on its steady state solution. Simplifying Equation (12) in this way and applying it to this case provided an easy tool to solve Equation (10) for tourism demand that fluctuates due to the push and pull factors.

3.2. Influences of the push and pull factors

Due to the demonstrations above, Lemma 3 was set to show the favourable changes:

Lemma 3. Favourable changes both in all push factors ($Y\uparrow$, $R\uparrow$, $v\downarrow$) and pull factor ($\gamma\uparrow$) increase the tourism demand.

In Equation (10), q_t is the control variable and A_t or $C_t = vA_t$ is the state variable, with R_t, Y_t, and p_t treated as exogenous processes. Applying Equation (12) to Equation (10) yields a set of FOCs with respect to (q_t, A_t,λ_t) as follows:

$$\frac{b}{q_t}U_t = \beta R_t p_t E_t\lambda_{t+1}, \quad \frac{a}{A_t}U_t + \beta\varsigma R_t E_t\lambda_{t+1} = \lambda_t, \quad A_{t+1} = R_t(\varsigma A_t + Y_t - p_t q_t), \tag{13}$$

where $\zeta=1-v[=\zeta(v)]$ is defined for convenience. By setting $\varepsilon_{t+1} = 0$, dropping t, and omitting E_t, the study derived from Equation (13) the steady state solution for the optimal amount of travel:

$$q^* = \frac{Y}{p}\left\{1 + \frac{a}{b(\gamma)}\frac{\beta[1 - R\varsigma(v)]}{1 - \beta R\varsigma(v)}\right\}^{-1} = q^D(p; Y, \gamma, v, R) \tag{14}$$

as tourism demand from a source market. When defining $\omega = (1 - R\zeta)/(1 - \beta R\zeta)$, it is known that $\omega'(R\zeta) < 0$. This sign together with $b'(\gamma) > 0$ and $\zeta'(v) < 0$ can be used to derive from Equation (14) other signs such as $\partial q^D/\partial(Y, R, \gamma) > 0$ and $\partial q^D/\partial v < 0$.

As usual, Lemma 3 suggests that a higher income level directly contributes to tourism demand. The lemma also shows that a decrease in competing consumption tends to increase travel spending. This occurs because when consumer preferences (i.e. $v\downarrow$) for tourist travel rise relative to goods consumption, some degree of substitution between consumption and travel occurs. Since asset A_t (like q_t) is a choice variable in Equation (13), its steady-state role in supporting various expenditures is superseded by its gross rate of return R in Equation (14). A higher such rate will almost certainly increase consumer demand for travel (note that R is another push factor). Moreover, the pull factor γ reintroduces itself into the tourism demand schedule, positively affecting travel, which has a positive impact on travel as expected, since the increase in relative preference is conducive to the given consumption of travel: $\gamma\uparrow\Rightarrow[a/(b\uparrow)]\downarrow$.

While tourism demand q^D differs between the above two formulations in Equations (6) and (14), tourism supply q^S in Equation (8) remains unaltered except for the omission of the time subscript for a steady-state analysis of tourism markets.

In this dynamic model, the author also established two proposals to predict the influences of the total revenue and transaction volume, following the favourable changes in all the push factors and the pull factor.

Proposal 3. In the state of market equilibrium, total income, transaction volume and tourism prices were positively affected by the favourable development of all the push factors ($Y\uparrow$, $R\uparrow$, $v\downarrow$). The effects of pull factor γ also had a positive impact on the total revenue and transaction volume of tourism businesses, although its effect on tourism price is unclear.

Proposal 4. There are some **deep parameters** in Equation (10) that describe the consumer preferences, i.e. β, $a/b(\gamma)$, $\zeta(v)$, and dynamic process, i.e. R. These parameters define the propagation mechanism in Equation (15) by which external economic shocks are translated into fluctuations in local tourism. Tourism performance (i.e. q^{**}, TR^{**}, Π^{**}) can either improve tremendously or deteriorate precipitously, depending on the relative magnitudes of those underlying parameters (i.e. the push and pull factors).

Setting q^D in Equation (14) equal to q^S in Equation (8) yields the market equilibrium, including tourism price p^{**}, transaction amount q^{**}, and total revenue TR^{**}:

$$p^{**} = \left(\frac{1+\theta}{\gamma^{\tau}}\right)^{\frac{1}{1+\theta}} \left\{ Y\left[1+\frac{a}{b(\gamma)}\frac{\beta[1-R\varsigma(\nu)]}{1-\beta R\varsigma(\nu)}\right]^{-1}\right\}^{\frac{\theta}{1+\theta}},$$

$$q^{**} = \left\{ \frac{\gamma^{\tau}Y}{1+\theta}\left[1+\frac{a}{b(\gamma)}\frac{\beta[1-R\varsigma(\nu)]}{1-\beta R\varsigma(\nu)}\right]^{-1}\right\}^{\frac{1}{1+\theta}}, \tag{15}$$

$$TR^{**} = p^{**}q^{**} = Y\left[1+\frac{a}{b(\gamma)}\frac{\beta[1-R\varsigma(\nu)]}{1-\beta R\varsigma(\nu)}\right]^{-1}.$$

Since $\omega'(R\zeta) < 0$, $b'(\gamma) > 0$, and $\zeta'(v) < 0$, it follows from Equation (15) that $\partial(TR^{**}, q^{**}, p^{**})/\partial(Y, R) > 0$, $\partial(TR^{**}, q^{**}, p^{**})/\partial v < 0$, $\partial(TR^{**}, q^{**})/\partial\gamma > 0$, and $\partial p^{**}/\partial\gamma < 0$ or > 0.

Under the restatement of Equation (10), tourism performance is expressed in quantity q^{**}, revenue TR^{**}, and profit $\Pi^{**}=[\theta/(1+\theta)]TR^{**}$, which shows that it positively correlates with pull factor γ, but this factor has a sophisticated bearing on tourism price p^{**}. Although its price effect is generally ambiguous, $\partial p^{**}/\partial\gamma < 0$ can be observed if $b = b_o\gamma^2$, $\tau = 2\theta$, and $b_o=1$. Typically, the pull factor must substantially reduce production costs for tourism prices to be reduced. Therefore, it is clear that the pull factor does contribute to the performance of each tourism index, hence Proposal 3 is significant.

Furthermore, since $\omega \rightarrow \infty$ as $R\zeta \rightarrow 1/\beta$, we know that $(q^{**}, TR^{**}, \Pi^{**}) \rightarrow 0$; in this case, tourism would perform extremely poorly. Conversely, local tourism business could enjoy tremendous performance if $R\zeta \rightarrow [1+b/(a\beta)][1+b/a]^{-1}$ ($\equiv X_\Delta$, a limit from the left) because, in this case, $1+a\beta\omega/b \rightarrow 0_+$ and $(q^{**}, TR^{**}, \Pi^{**}) \rightarrow +\infty$. Note that interval $[X_\Delta, 1/\beta]$ for $R\zeta$ must be ruled out in order for (q^{**}, TR^{**}) to be positive, thus Proposal 4 is also valid.

3.3. Implications of Macao's casino performance

The conclusion of this proof merely illustrates a theoretical possibility that tourism could perform extremely well or extremely poorly. Such extreme outcomes occur in a small number of circumstances, most of which have to do with the push and pull factors. The critical point made in Proposal 4 is that the propagation mechanism described in Equation (15) can convert relatively small (or large) economic shocks in the source markets into significantly larger (or smaller) tourism fluctuations in a travel destination. All of those shocks and fluctuations are caused by changes in a variety of push and pull factors. Naturally, determining the sensitivity of local tourism flows to various external shocks is an empirical question. Indeed, a few empirical studies have recently been published to address this sensitivity observed in a variety of travel destinations. Specifically, it was discovered that while Las Vegas casino tourism is quite responsive to US business cycles, this is not the case in Macao (Deng et al., 2018). Instead, Macao's casino performance is highly susceptible to China's anti-corruption campaign. Most notably, the COVID-19 pandemic has had a profound effect on tourism. Both Macao and Las Vegas have seen significant declines in gambling revenue as a result of declining tourist numbers, reiterating the critical nature of the external shock propagation mechanism on hospitality performance.

4. CONCLUSION

4.1. Summary and empirical results

In this article, macroeconomic models of the tourism economy with *micro foundations* were established to demonstrate how external shocks from the source markets spread through the flow of tourists to tourist destinations, ultimately affecting their tourism revenue.

The author demonstrated that the *propagation mechanism* may be so robust that a small shock to external business cycles can have a significant effect on local tourism cycles. Additionally, due to the weaker propagation mechanism, larger external shocks may also have smaller local effects. Modelling these mechanisms enabled to deduce the driving forces behind tourism cycles and to establish a theoretical foundation for subsequent empirical research. This study contributes to the body of knowledge regarding theoretical tourism studies, which have been far less successful than their empirical counterparts.

Two such models were proposed in this paper to examine the impact of *push and pull factors* on tourism performance. The first model, based on residual utility from travel enjoyment, is capable of identifying the effects of all push factors but not pull factors. In any case, the full effect of asset return cannot be determined in this model. The second model attempts to overcome these constraints by taking into account the total utility gained from travel-consumption substitution. Such a flexible specification of a consumer's preference enabled to incorporate pull factors into tourist demand, thereby deriving their impact on tourism revenue, as well as another push factor to calculate the full effect of asset returns. By employing two models, one can determine whether the primary findings are robust to alternative model formulations. This is the first study to use operational research to outline a fundamental theoretical framework for tourism cyclicality though both the supply and demand sides of tourism markets.

4.2. Further study

This work has the potential to be expanded on two fronts in order to increase understanding of critical tourism issues relating to the economic impacts of push and pull factors. First, the author analysed the second model by following Chow

(1992), and considered its *steady-state solution*, as is performed in the majority of macroeconomic studies. Much of the intermediate dynamics was therefore lost, and this limitation can be compensated for by evaluating the *steady-growth solution* as was done in this study for the first model by following Sargent (1987). Second, as the propagation mechanisms operate at varying rates in practice, an external shock can have a transient or a long-lasting local effect. Therefore, the duration of the local fluctuations caused by external shocks is of interest. The short and long-term implications of shocks, such as economic downturns, man-made and natural disasters, and their propagation mechanisms on the performance of tourism destinations require additional attention in the future to assist tourism destinations in recovering more quickly from sudden crises such as the COVID-19 pandemic. Future theoretical work should address this issue empirically in order to generate policy implications.

REFERENCES

Bronner, F., de Hoog, R., *Tourist demand reactions: Symmetric or asymmetric across the business cycle?* Journal of Travel Research, 56(7), pp. 839-853, 2017.

China National Bureau of Statistics, *China statistical yearbook* (1995-2014), http://www.stats.gov.cn/tjsj/ndsj/.

Chow, G.C., *Optimum control of stochastic differential equation systems*, Journal of Economic Dynamics and Control, 1(2), pp. 143-175, 1979.

Chow, G. C., *Dynamic optimization without dynamic programming*. Economic Modelling, January, pp. 3-9, 1992.

Copeland, B.R., *Tourism, welfare and de-industrialization in a small open economy*, Economica, 58, pp. 515-529, 1991.

Croes, R., Ridderstaat, J., *The effects of business cycles on tourism demand flows in small island destinations*, Tourism Economics, 23(7), pp. 1451-1475, 2017.

Deng, X., Law, R., Lian, Z. T., Gu, X. H., *A comparative study for determinants of gaming performance in Macao and Las Vegas*, Working Paper, University of Macau and Hong Kong Polytechnic University, 2018.

Guizzardi, A., Mazzocchi, M., *Tourism demand for Italy and the business cycle*, Tourism Management, 31(3), pp. 367-377, 2010.

Gunter, U., Smeral, E., *The decline of tourism income elasticities in a global context*, Tourism Economics, 22(3), pp. 466-483, 2016.

Li, T., Sheng, L., *Corruption and travel: effects of China's anti-graft campaign on Macao,* Die Erde, 149(1), pp. 111-120, 2018.

Macao Statistics and Census Services, *Yearbook of Statistics* (2002-2014), https://www.dsec.gov.mo/zh-MO/Home/Publication/YearbookOfStatistics

Moore, M., Whitehall, P., *The tourism area lifecycle and regime switching models*, Annals of Tourism Research, 32(1), pp. 112-126, 2005.

Morley, C. L., *A microeconomic theory of international tourism demand*, Annals of Tourism Research, 19, pp. 250-267, 1992.

Morley, C. L., *Tourism demand: characteristics, segmentation and aggregation*, Tourism Economics, 1, pp. 315-328, 1995.

Morley, C. L., Rossello, J., Santana-Gallego, M., *Gravity models for tourism demand*, Annals of Tourism Research, 48, pp. 1-10, 2014.

Sargent, T. J., *Dynamic macroeconomic theory*. Harvard University Press, Cambridge, Massachusetts, 1987.

Sheng, L., Zhao, W., *Strategic Destination management in the face of foreign competition: The case of Macao SAR*, Journal of Travel & Tourism Marketing, 33(2), pp. 263-278, 2016.

Sheng, L., Li, T., Wang, J., *Tourism and externalities in an urban context: Theoretical model and empirical evidence,* Cities, 70, pp. 40-45, 2017.

Sheng, L., *Factors determining the success or failure of a tourism tax: a theoretical model,* Tourism Review, 72(3), pp. 274-287, 2017.

Sheng, L., Gao, J., *Foreign investors versus host communities: An urban political economy model for tourist cities,* Argumenta Oeconomica, 41(2), pp. 257-275, 2018.

Smeral, E., *The impact of the financial and economic crisis on European tourism*, Journal of Travel Research, 48(1), pp. 3-13, 2008.

Smeral, E., *International tourism demand and the business cycle*, Annals of Tourism Research, 39(1), pp. 379-400, 2012.

Smeral, E., *Variations in seasonal outbound travel across the business cycles*, Journal of Travel Research, 57, pp. 936-946, 2018.

Smeral, E., Song, H., *Varying elasticities and forecasting performance*, International Journal of Tourism Research, 17, pp. 140-150, 2013.

Song, H., Dwyer, L., Zhengcao, L., *Tourism economics research: A review and assessment*, Annals of Tourism Research, 39(3), pp. 1653-1682, 2012.

Uysal, M., Crompton, J. L., *An overview of approaches used to forecast tourism demand*, Journal of Travel Research, 23(7), pp. 7-15, 1985.

WTTC, *Travel and tourism: economic impact 2015*, Report by the World Travel and Tourism Council, 2015.

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