TOURISM AND THE CHAOTIC ECONOMIC GROWTH MODEL: THE ASEAN COUNTRIES

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Abstract
The main aim of this paper is to analyze the tourism total contribution to GDP growth stability in Brunel Darussalam, Indonesia, Malaysia, Vietnam, Thailand, and Philippines in the period 2010-2019. Four members of ASEAN were excluded due to a lack of data. This paper applies the chaos theory and creates the model. Also, this paper confirms the existence of the growth stability of the tourism total contribution to GDP in the observed countries in the observed period.

Keywords: Tourism Total Contribution to GDP, ASEAN, Growth, Stability, Chaos,
JEL classification: Z3, C2, O4, E22,

1. Introduction

The Association of Southeast Asian Nations, or ASEAN, was established on 8 August 1967 in Bangkok, Thailand (Bangkok Declaration). The five Founding Members of ASEAN are Indonesia, Malaysia, Philippines, Singapore and Thailand, or ASEAN-5. Further, ASEAN-10 refers to Brunei Darussalam, Cambodia, Indonesia, Lao P.D.R., Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

Table 1. ASEAN-10

	Joined ASEAN	Capital	Language(s)	Currency
Brunei Darussalam	on 7 January 1984	Bandar Seri Begawan	Malay, English	B$ (Brunei Dollar)
Cambodia	on 30 April 1999	Phnom Penh	Khmer	Riel
Indonesia	on 8 August 1967	Jakarta	Indonesian	Rupiah
Lao PDR	on 23 July 1997	Vientiane	Lao	Kip
Malaysia	on 8 August 1967	Kuala Lumpur	Malay, English, Chinese, Tamil	Ringgit
Myanmar	on 23 July 1997	Nay Pyi Taw	Myanmar	Kyat
Philippines	on 8 August 1967	Manila	Filipino, English, Spanish	Peso
Singapore	on 8 August 1967	Singapore	English, Malay, Mandarin, Tamil	S$ (Singapore Dollar)
Thailand	on 8 August 1967	Bangkok	Thai	Baht
Vietnam	on 28 July 1995	Ha Noi	Vietnamese	Dong

Source: https://asean.org/

Table 2. ASEAN-10, economic indicators

	GDP, constant prices % change	GDP per capita, constant prices Purchasing power parity; 2017 international $	Total investment % of GDP	Inflation, average consumer prices Index	Unemployment rate % of total labor force	Population Persons Millions	Current account balance % of GDP	General government net debt % of GDO
Brunei Darussalam	-1.628	59,772.82	25.851	106.48	5.2	0.441	19.567	2.531
Cambodia	5.239	4,753.45	24.5	197.995	-	15.993	-27.285	-0.88
Indonesia	5.309	12,438.76	29.745	111.031	5.86	274.859	0.961	-2.341
Lao PDR	2.252	7,797.81	-	144.443	-	7.477	-5.957	-1.632

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Malaysia	8.65	29,501.73	23.506	127.233	3.825	32.652	-5.879	3.076
Myanmar	1.971	4,104.77	32.285	194.102	-	53.886	-5.14	-4.298
Philippines	7.57	8,888.77	24.698	115.283	5.4	111.57	-5.477	-4.481
Singapore	3.647	92,607.92	21.922	108.37	2.1	5.637	19.332	0.842
Thailand	2.643	17,915.86	27.807	106.472	1.3	70.078	-2.968	-4.555
Vietnam	8.02	11,250.46	33.407	296.455	2.32	99.462	-0.264	0.257

Source: www.imf.org

Dolezal C., Trupp A., and H. T. Bui (Ed) (2020) analyze the role tourism plays for sustainable development in Southeast Asia. They offer new understandings of tourism dynamics and shows an overview of tourism's role in economic development.

Harrison D., et al., (Ed.) (2018) analyze the literature on tourism in East and South-east Asia and explain the historical development of tourism, and the economic, political, social, cultural and environmental issues.

Ward T., et al., (2020) confirm that COVID-19 (coronavirus) is affecting nearly 47.7 million travel and tourism jobs across South Asia. Their regional expected losses are over 50 billion US dollars in gross domestic product. According to the World Bank's regional portfolio, governments intervention is important. This region covers Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

According Baek et al., (2023), the ASEAN-5 region (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) has benefited through trade. It is important to advance financial integration. This regional financial integration and digitalization could generate output benefits for the region.

According IMF (2022), growth in Asia and Pacific is expected to moderate to 4.0 percent in 2022 and rise to 4.3 percent in 2023.

According OECD (2023b), economic growth in 2023 is projected to 5.3 % on average in Emerging Asian economies (ASEAN-10, China and India). Before the COVID-19 pandemic, travel and tourism generated approximately 12% of GDP in Southeast Asian economies. According OECD (2023a), tourism will be key factor of economic growth in ASEAN economies. Tourism is composed mostly of micro, small and medium-sized enterprises. Digitalization in tourism is important process.

According to Makun and Jayaraman (2022), for the South Asian countries, the crisis has negative effect on economic growth in 2020 and 2021. Their study uses a nonlinear econometric methodology. They state the existence of an asymmetric association between tourism and economic growth for six South Asian countries for the period 1995 to 2018.

Maneejuk P., et al., (2022) examine the nonlinear impact of tourism development on economic growth in Southeast Asian countries. They also find a positive influence of gross capital formation, real effective exchange rate, international tourism expenditure, and tourism receipts on Southeast Asian economic growth.

According, ASEAN Tourism Strategic Plan 2016-2025 (2015), it is anticipated that by 2025: (a) The GDP contribution of ASEAN tourism could increase from 12% to 15%; (b) Tourism's share of total employment could increase from 3.7% to 7%; (c) Per capita spending by international tourists could increase from US$ 877 to US$ 1,500; (d) Increase the average length of stay of international tourist arrivals from 6.3 nights to 8 nights; (e) The number of accommodation units could increase from 0.51 units per 100 head of population in ASEAN to 0.60 units per 100 head of population; (f) The number of awardees for the ASEAN tourism standards could increase from 86 to 300; (g) The number of community-based tourism value chain project interventions could increase from 43 to over 300.

Sirisuthikul (2018) suggests the branding of ASEAN tourism. National Tourism Organizations (NTOs), Destination Marketing Organization (DMO) and other stakeholders of ASEAN tourism should create a consistent positioning of the destination.

According Yin, et al., (2020), explain the structure of tourism cooperation in China-ASEAN relations. Namely, differences in the political system, security, population density, and language have positive effects on tourism cooperation, while differences in governance, income, and consumption level have negative effects on tourism cooperation.

Beh L-S., & Leong L.W. (2021) examine the possible causality that exists between COVID-19 and tourist arrivals in ASEAN countries. Their results revealed that international tourism can seriously be affected by the COVID-19 crisis.

Zhang H., et al., (2023) confirm that the tourism sustainable development index has a positive and linear relationship with the green economic growth index in ASEAN (The Association of Southeast Asian Nations) countries throughout 2000–2021.

According Rahayu, R. K., et al., (2017), each country in ASEAN has their own tourism slogan: a) Brunei (Brunei, The Green Heart of Borneo, The Kingdom of Unexpected Treasures), b) Cambodia (Kingdom of Wonder), c) Indonesia (Wonderful Indonesia), d) Laos (Simply Beautiful), e) Malaysia (Malaysia Truly Asia), f) Myanmar (Mystical Myanmar), g) Philippines (It's More Fun in the Philippines), h) Singapore (Your Singapore), i) Thailand (Amazing Thailand, Always Amazes You), j) Vietnam (The Timeless Charm).

According to Kotler (2008) brand is a name, term, sign, symbol or design or a combination of them, intended to identify the goods or services of one seller of a group the of seller and to differentiate them from those of competitors. This paper is trying to explain how city branding has been developing in almost all ASEAN country.

According Rahmiatia et al., (2021), the COVID-19 pandemic has had the greatest effect on the travel and tourism industry. This study examined the performance of tourism contribution to Gross Domestic Product (GDP) in ASEAN countries (Indonesia, Singapore, Malaysia, Myanmar, The Philippines, Vietnam, Lao PDR, Myanmar) in the period 2009-2018. The result shows that tourism receipts and tourist expenditure have a significant positive effect, whereas tourist arrivals have a significant negative effect, and the exchange rate has no significant effect on GDP.

According OECD (2023a), Indonesia's real GDP grew by 5.3% in 2022. In Malaysia, real GDP grew by 8.7% in 2022. The Philippines' real GDP grew by 7.6% in 2022. In Thailand, real GDP grew by 2.6% in 2022. In Vietnam, real GDP grew by 8.0% in 2022. Brunei Darussalam's economy rebounded with 0.9% growth in Q3 2022. In Singapore, real GDP growth will moderate to 2.2% in 2023. In Cambodia, real GDP grew by an estimated 5.1% in 2022. Lao PDR's GDP growth is expected to be at 3.5% in 2023. In Myanmar, economic growth is expected to be 2.0% in 2023.

According OECD (2023a): a) Indonesia should maximize the potential of its 17 000 islands; b) Tourism share of GDP has declined over the past decade in Lao PDR; c) Malaysia prefers to become the world leader in Islamic tourism; d) In Myanmar, tourism planning is an important activity; e) The Philippines has a rich cultural heritage and natural landscapes; f) In Singapore's tourism should be an important economic factor. Also, tourism should create employment opportunities. Singapore is also a world destination for meetings, incentives, conferences and exhibitions (MICE) tourism; g) Much tourism in Thailand is international; h) Vietnam is known for its beautiful scenery, including long coastlines and deep forests, …

Scarlett (2021) examines the economic influence of tourism on economic growth in a panel of 46 countries. Tourism has a statistically significant positive effect on economic growth. Increase in the tourism receipts relative to GDP is expected to positively impact the net FDI inflows to GDP ratio.

Chaos theory is applied in this paper. This paper creates the chaotic economic model. Namely, this paper develops the chaotic, nonlinear growth model (Jablanovic, 2022/23).

2. The model

The chaotic growth model is presented by the following equations (Jablanovic, 2022/23):

$$S_t = \left(\frac{Y_1}{Y}\right)_t \quad (1)$$

$$I_{1,t} = \gamma Y_{1,t} \qquad 0< \gamma <1 \quad (2)$$

Now, it is important to introduce the share of non-tourism sector in the GDP, $\left[1 - \left(\frac{Y_1}{Y}\right)_t\right]$, in the model (Jablanovic, 2022/23), i.e.,

$$\frac{S_{t+1}-S_t}{S_t} = \alpha + \beta \left(\frac{I_1}{Y}\right)_t + \delta\left[1 - \left(\frac{Y_1}{Y}\right)_t\right] = \alpha + \beta \left(\frac{\gamma Y_1}{Y}\right)_t + \delta\left[1 - \left(\frac{Y_1}{Y}\right)_t\right] \quad \alpha, \beta.\delta > 0 \quad (3)$$

Or

$$S_{t+1} = (1+\alpha+\delta) S_t + (\beta\gamma-\delta) S_t^2 \qquad \alpha, \beta, \delta > 0 \quad (4)$$

with Y – the gross domestic product (GDP) , Y_1 – tourism GDP, S - the percentage of tourism in GDP, I – investment in tourism , γ – investment in tourism rate, α, β, δ – the coefficients of the tourims total contribution to GDP growth function.

We introduce s as $s = S / S^m$, where S is the percentage of tourism in GDP and S^m is the maximal size of the percentage of tourism in GDP in time series. Thus s range between 0 and 1. Now the tourism total contribution to GDP growth rate is measured as

$$s_{t+1} = (1+\alpha+\delta) s_t + (\beta\gamma-\delta) s_t^2 \qquad \alpha, \beta, \delta > 0 \quad (5)$$

For most choices of α, β, γ and δ, there is no explicit solution for the logistic model (5). Lorenz (1963) discovered this effect - the lack of predictability in deterministic systems. Sensitive dependence on initial conditions is one of the central parts of what is called deterministic chaos.

3. The logistic equation

Iteration process for the logistic equation

$$z_{t+1} = \pi z_t (1 - z_t), \quad \pi \in [0,4], \quad z_t \in [0,1] \quad (6)$$

is equivalent to the iteration of growth model (8) when we use the identification

$$z_t = -\left[\frac{\beta\gamma-\delta}{(1+\alpha+\delta)}\right] s_t \quad \text{and} \quad \pi = (1+\alpha+\delta) \quad (7)$$

Using (5) and (7) we obtain:

$$z_{t+1} = -\left[\frac{\beta\gamma-\delta}{(1+\alpha+\delta)}\right] s_{t+1} = -\left[\frac{\beta\gamma-\delta}{(1+\alpha+\delta)}\right]\left[(1+\alpha+\delta)s_t + (\beta\gamma-\delta)s_t^2\right] = -(\beta\gamma-\delta)s_t - \left[\frac{(\beta\gamma-\delta)^2}{(1+\alpha+\delta)}\right] s_t^2$$

On the other hand, using (6) and (7) we obtain:

$$z_{t+1} = \pi z_t (1 - z_t) =$$

$$= -(1+\alpha+\delta)\left[\frac{(\beta\gamma-\delta)}{(1+\alpha+\delta)}\right]s_t\left\{1+\left[\frac{(\beta\gamma-\delta)}{(1+\alpha+\delta)}\right]s_t\right\} = -(\beta\gamma-\delta)s_t - \left[\frac{(\beta\gamma-\delta)^2}{(1+\alpha+\delta)}\right]s_t^2$$

Thus we have that iterating (5) is really the same as iterating (6) using (7). It is important because the dynamic properties of the logistic equation (6) have been widely analyzed by Li & Yorke (1975), and May (1976).

It is obtained that :(i) For parameter values $0 < \pi < 1$ all solutions will converge to $z = 0$; (ii) For $1 < \pi < 3{,}57$ there exist fixed points the number of which depends on π;(iii) For $1 < \pi < 2$ all solutions monotonically increase to $z = (\pi - 1) / \pi$; (iv) For $2 < \pi < 3$ fluctuations will converge to $z = (\pi - 1) / \pi$; (v) For $3 < \pi < 4$ all solutions will continously fluctuate; (vi) For $3{,}57 < \pi < 4$ the solution become "chaotic".

4. Empirical evidence

The main aim of this paper is to analyze the tourism total contribution to GDP growth stability in Brunel Darussalam , Indonesia, Malaysia , Viet Nam, Thailand, and Philippines https://www.unwto.org/tourism-statistics/economic-contribution-SDG. Four countries of ASEAN were excluded due to a lack of data.

In this sense, it is important to use the logistic model (8):

$$s_{t+1} = \pi s_t + \upsilon s_t^2 \qquad (8)$$

where s– the percentage of tourism in GDP , π - $(1+\alpha+\delta)$ υ - $(\beta\gamma-\delta)$, where γ – investment in tourism rate, α, β, δ – the coefficients of the tourism total contribution to GDP growth function.

Now, the model (8) is estimated (see Tables 1-6.).

Table 1. The estimated model (8): Brunel Darussalam, 2010-2016. (R=0.33230)

	π	υ
Estimate	1.675798	-0.79256
Std.Err.	0.495100	0.57518
t(4)	3.384765	-1.37793
p-level	0.027663	0.24029

Source: Author's calculations

The estimated value of π shows that tourism direct GDP as a proportion of total GDP (%), monotonically increased in Brunel Darussalam in the period 2010-2016.

Table 2. The estimated model (8): Indonesia , 2009-2019. (R=0.93813)

	π	υ
Estimate	0.947833	0.081469
Std.Err.	0.138716	0.158366
t(8)	6.832919	0.514437
p-level	0.000133	0.620853

Source: Author's calculations

The estimated value of π show s that tourism direct GDP as a proportion of total GDP (%), monotonically increased in Indonesia in the period 2009-2019.

Table 3. The estimated model (8): Malaysia, 2010-2019. (R=0.93023)

	π	υ
Estimate	1.128385	-0.117694
Std.Err.	0.142822	0.156636
t(7)	7.900616	-0.751390
p-level	0.000099	0.476914

Source: Author's calculations

The estimated value of π shows that tourism direct GDP as a proportion of total GDP (%), monotonically increased in Malaysia in the period 2010-2019.

Table 4. The estimated model (8): Vietnam, 2013-2019. (R=0.97289)

	π	υ
Estimate	0.963037	0.145876
Std.Err.	0.142921	0.181167
t(4)	6.738236	0.805204
p-level	0.002528	0.465840

Source: Author's calculations

The estimated value of π shows that tourism direct GDP as a proportion of total GDP (%), monotonically increased in Viet Nam in the period 2013-2019.

Table 5. The estimated model (8): Thailand, 2010-2017. (R=0.95019)

	π	υ
Estimate	1.22687	-0.166400
Std.Err.	0.158541	0.207422
t(5)	7.738518	-0.802227
p-level	0.000576	0.458837

Source: Author's calculations

The estimated value of π shows that tourism direct GDP as a proportion of total GDP (%), monotonically increased in Thailand in the period 2010-2017.

Table 6. The estimated model (8): Philippines, 2010-2019. (R=0.99067)

	π	υ
Estimate	1.17151	-0.12201
Std.Err.	0.05880	0.07450
t(7)	19.92363	-1.63770
p-level	0.00000	0.14550

Source: Author's calculations

The estimated value of π shows that tourism direct GDP as a proportion of total GDP (%), monotonically increased in Phillipines in the period 2010-2019.

5. Conclusion

This paper creates the tourism total contribution to GDP chaotic growth model. For most choices of α, β, γ, and δ there is no explicit solution for the chaotic growth model (5).

A key hypothesis of this work is based on the idea that the coefficient π - (1+α+δ), where α, β, and δ are the coefficients of the tourism total contribution to GDP growth function play a crucial role in explaining the local growth stability of the tourism total contribution to GDP .

An estimated values of the coefficient π confirm stable growth of the tourism total contribution to GDP in Brunel Darussalam , Indonesia, Malaysia , Viet Nam, Thailand, and Philippines in the observed periods, respectively.

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