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The role of tourism in driving economic growth: An asymmetric augmented autoregressive distributed lag analysis of Singapore's experience

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Abstract

Tourism has long been recognized as a potential force for economic growth in various parts of the globe. This study revisits this causal relationship to demonstrate the consequences of long-run and short-run effects between tourism development and economic growth in the context of Singapore for the period 1983:1 to 2020:4. We employ an augmented autoregressive distributed lag (AARDL) to prevent degenerative results and ensure the robustness of findings. We also control for variables such as foreign direct investment, net export, gross fixed capital formation, labor, and government expenditure. The overall empirical results provide support for the positive implications of tourism development for economic growth in Singapore in the long run, and its elasticity is 0.14 in increasing and 0.08 in decreasing. This implies that tourism can be one of the important factors for Singapore's economic growth in the long run, but in the short run, the impact is either negative or insignificant. This study provides important policy implications and recommendations.

KEYWORDS
AARDL, economic growth, Singapore, tourism

1 | INTRODUCTION

Research on the key drivers of sustainable economic growth has always been vital to ensure inclusive development and socio-economic well-being. Amongst these factors tourism has long been recognized as a potential force for economic growth (accounting for 9% of the world's total GDP and 8.8% of total employment) (Aliyev & Ahmadova, 2020). Through an established hypothesis known as tourism-led economic growth (TLEG) various research provided supporting evidence on the important role of tourism in economic growth for both developing (Aliyev & Ahmadova, 2020; Chou, 2013; Croes et al., 2018) and developed (Aratuo & Etienne, 2019; Chen & Chiou-Wei, 2009; Liu & Wu, 2019) countries. However, the findings of a growing body of literature in search of validating the economic impacts of tourism have proven to be inconclusive and often contradictory. For instance, while (see Habibi et al., 2018; Narayan et al., 2010; Tu & Zhang, 2020) report positive results validating TLEG, a strand of literature believes that it is the favorable economic conditions including availability of resources, infrastructure, and stable political situations which drive tourism development (see Antonakakis et al., 2019; Liu & Song, 2018; Shahzad & Ferrer, 2020). A third hypothesis referred to as the feedback or reciprocal view, finds a bidirectional relationship between the two variables (see Chen & Chiou-Wei, 2009; Neuts, 2020; Zhang & Zhang, 2021). Additionally, Oh (2005) reports no long-term relationship, Aliyev and Ahmadova (2020) and Ekeocha et al. (2021) found a negative relationship between the two variables. Other related findings imply a time-varying (Pérez-Rodríguez et al., 2022; Santamaria & Filis, 2019), country-specific

(De Vita & Kyaw, 2017; Tugcu, 2014) and a partial relationship including short-term (Croes et al., 2018) and long-term (Aratuo & Etienne, 2019) between the aforementioned concepts. This calls for more rigorous research to investigate the unverified question of tourism's contribution to economic growth. This discrepancy can be attributed to various factors including the regional specifications, the research period, and also the methods utilized by researchers. Additionally, while literature covers this issue in various geographical settings such as globally (see Fahimi et al., 2018; Saboori et al., 2023; Sahni et al., 2023; Sokhanvar, 2019; Tang, 2021) and individual countries such as Tang and Tan (2015) for Malaysia, Liu, Xiao, et al. (2022) for China, Inchausti-Sintes (2015) for Spain, Croes et al. (2021) for Poland and Özer et al. (2022) for leading tourist destinations, there seems to be a dearth of information in case of Singapore. Although, a relatively small country, Singapore ranks 3rd amongst South East Asian countries in terms of tourism arrivals, generating around US$20.42 billion before the pandemic, which accounts for around 5% of its GDP (World bank, 2022). The tourism industry in Singapore has also contributed to employment (directly and indirectly) by generating 527,500 jobs in 2020. Furthermore, investment in the tourism industry reached up to US$14.5 billion in 2017 which constituted more than 20% of its total investment (Al-Shboul et al., 2021). Given the fact that Singapore ranked amongst the highest GDP per capita globally (US$72,794) in 2021 (World Bank, 2022), it is an interesting and ideal context to revisit the issue of the nexus between tourism and economic growth. Our research objectives and analytical framework were best suited to the application of the AARDL method for possible degenerate cointegration, which may exist in traditional cointegration methods, despite the value of wavelet coherence and other recently adapted methods for analyzing time series data. Our choice of methodology was driven by the need to examine the long-run and short-run relationships between variables, which are central to our research questions. Our choice of methodology was driven by the need to examine the long-run and short-run relationships between variables, which are central to our research questions. The critical values for MSG Wald test are provided by Sam et al. (2019). They demonstrate the possibility of a false cointegration in the case of the significance of the PSS F-test and PSS t-test. The Augmented ARDL (AARDL) method allows for the test for possible degenerate cointegration. On the other hand, the reason for using nonlinear and asymmetric methods is that tourist arrivals influence economic growth by affecting the demand for consumable goods and services, as well as influencing long-term investments in accommodation and leisure facilities. Consequently, an increase in tourist arrivals leads to an upsurge in new facility investments and expands investment opportunities for both local and foreign entrepreneurs. However, a decrease in tourist arrivals may not entirely reverse the aforementioned effects. Therefore, investigating assumptions about the asymmetric effect of tourist arrivals on economic growth is crucial.

Therefore, to fill the aforementioned research gaps, the present study attempts to investigate the asymmetrical relationship between tourism and economic growth[1] in Singapore for both short-run and long-run by using an augmented autoregressive distributed lag (AARDL) mode from 1983:1 to 2020:4.

This study extends the theoretical understanding of the TLEG hypothesis by exploring the asymmetric relationship between tourism and economic growth using an AARDL model. The application of this model to the Singapore context provides several theoretical contributions that are relevant beyond the specific case study:

First, our findings contribute to the theory by demonstrating that the impact of tourism on economic growth can be asymmetric in the short and long run. This asymmetry challenges the traditional linear assumptions prevalent in earlier TLEG studies. By showing that increases and decreases in tourism arrivals have different magnitudes of impact on economic growth, this study supports the argument for incorporating non-linear models in economic growth theory, as suggested by Shin et al. (2014). This approach provides a more nuanced understanding of economic responses to tourism fluctuations, which can be applied to other economies with similar tourism dynamics.

Second, the use of the AARDL model in this study contributes to methodological advancements by providing a robust framework for analyzing cointegration relationships in a small sample size, typical of quarterly data spanning several decades, as is the case with Singapore. This methodological contribution is significant as it offers a refined tool for researchers exploring economic relationships in similar small or island economies where traditional models might fail to capture complex dynamics.

Third, the findings highlight the importance of considering economic resilience in the face of tourism volatility. This study theorizes that the resilience of an economy to tourism shocks can be enhanced through diversified tourism strategies and robust economic policies. This theoretical insight extends the application of economic resilience theory to the tourism sector, offering a framework for policymakers in other small or tourism-dependent economies to devise strategies that buffer against global tourism market fluctuations.

Fourth, by analyzing the case of Singapore, a highly developed and service-oriented economy, this study extends the TLEG hypothesis to include economies at different stages of development and varying degrees of tourism dependency. The nuanced findings contribute to a more comprehensive theory of economic growth driven by tourism, suggesting that the effects are context-dependent and influenced by a country's unique economic and institutional characteristics.

Lastly, the implications of this study extend to global economic theory by suggesting that the growth effects of tourism are not universally applicable but are mediated by local factors such as government policy, infrastructure, and the broader economic environment. This contributes to a more differentiated view of globalization and economic development, emphasizing the need for tailored economic strategies that reflect local realities.

We begin our analysis with a review of the concepts under study. We then elaborate on the study's empirical model followed by a description and sources of data. The empirical results are outlined, followed by a discussion of their linkage to the extant literature, accompanied by related managerial and policy implications, research limitations, and future research suggestions. The study's main conclusions are presented in the final section of this paper.

2 | REVIEW OF RELATED LITERATURE

Although there exists an extensive literature on the linkage between tourism and economic development a brief review of extant research reveals that the findings often vary and in many cases are contradictory. This discrepancy can be attributed to various factors including the regional specifications, the research period, and also the methods utilized by researchers (Aratuo & Etienne, 2019). A great portion of the literature consists of studies that provide support for the tourism-led economic growth (TLEG) hypothesis including Tu and Zhang (2020) who indicated that tourism has a significant nonlinear effect on the economic growth in Chinese ethnic minority areas, and Habibi et al. (2018) who showed that the growth of GDP in tourism per capita in Iran increases significantly annually and that this growth is higher than the overall economic growth. Similar results were found by Narayan et al. (2010) confirming the contribution of tourism to the economic growth in Fiji, Tonga, the Solomon Islands, and Papua New Guinea indicating that a 1% increase in tourism translates into 0.72% growth in GDP in the long run and 0.24% in the short run. Comparing developed and developing countries Paramati et al. (2017) reported a significant and positive impact for both and finally, Beladi et al. (2019) looked into the impact of medical tourism and confirmed its positive contribution to the host economies' output growth particularly for non-OECD countries.

Another stream of studies asserts the positive relationship between the two concepts however in the opposite direction. It is referred to as the economic-driven tourism growth (EDTG) hypothesis and postulates the idea that favorable economic conditions including availability of resources, infrastructure, and stable political situation are the stimulating force for tourism growth. Proponents of this hypothesis include Liu and Song (2018) whose results support the EDTGH in the long-run causality test carried out in a mixed-frequency framework for Hong Kong from 1974 to 2016. Similarly, Antonakakis et al. (2019) assert that amongst 113 countries over the period 1995 to 2014, the EDTGH seems to prevail in countries that are developing, non-democratic, highly bureaucratic and have low tourism specialization. Furthermore, the real GDP growth was identified as a net transmitter of spillovers to tourism growth by Shahzad and Ferrer (2020), supporting the EDTGH in the case of the US economy.

There exists a third strand of research known as the feedback or reciprocal hypothesis that identifies a bidirectional relationship between tourism and economic growth. Studies in this category include Chen and Chiou-Wei (2009) who found a reciprocal causal relationship between the two variables for South Korea. Similarly, the bidirectional relationship between tourism and economic growth (measured by real GDP) was confirmed by Neuts (2020) in the context of 89 German cities. Other studies supporting the reciprocal hypothesis include Zhang and Zhang (2021) for 30 Chinese provinces, Benkraiem et al. (2021) for France, Mexico, Spain, and Italy, and Wu and Wu (2019) in the case of Jilin, Anhui, and Hubei provinces in China.

Apart from these hypotheses, the literature contains studies presenting various results including Oh (2005) reporting no long-term relationship between the two series, Aliyev and Ahmadova (2020) and Ekeocha et al. (2021) who found that the impact of tourism development on economic growth is negative; Santamaria and Filis (2019), Pérez-Rodríguez et al. (2022) and Enilov and Wang (2022) who suggest that tourism-expected growth is time-varying without any country-specific differences. Another strand of literature asserts that tourism's contribution to the economy depends on country groups (De Vita & Kyaw, 2017; Tugcu, 2014). Additionally, few contradictory partial supports for the relationship between tourism and economic growth were observed, for instance, Aratuo and Etienne (2019) suggest that the positive impact of tourism can be seen only in the long run while Croes et al. (2018) provide evidence in favor of short-term impact. In terms of regional coverage, apart from studies focusing on the global context (see Fahimi et al., 2018; Saboori et al., 2023; Sahni et al., 2023; Sokhanvar, 2019; Tang, 2021) literature has also covered individual countries such as Tang and Tan (2015) for Malaysia, Liu, Xiao, et al. (2022) for China, Inchausti-Sintes (2015) for Spain, Croes et al. (2021) for Poland and Özer et al. (2022) for leading tourist destinations.

In terms of methodology, a wide majority of literature employs panel data techniques with linear models which are likely to be inadequate to describe tourism and growth experience. To overcome this issue, recent studies utilized more advanced methods such as nonlinear autoregressive distributed lag (ARDL) (see Amir et al., 2022), quantile autoregressive distributed lag (QARDL) (see Benkraiem et al., 2020), seemingly unrelated regression (SUR) (see Eyuboglu & Eyuboglu, 2020), autoregressive moving average with exogenous variables (ARMAX) (see Liu, Xiao, et al., 2022), asymmetric Granger causality test (see Suresh & Tiwari, 2018), panel smooth transition vector autoregressive model (PST-VAR) (see Wu et al., 2021), and quantile on quantile (see Wu et al., 2022) (Table 1). However, as indicated by Nunkoo et al. (2020), due care needs to be paid to the methodological aspects particularly ARDL, as some reported degenerative cases, can undermine the robustness of outcomes. Therefore, to avoid this issue we employ an augmented ARDL as suggested by Sam et al. (2019).

The theoretical exploration of the nexus between tourism and economic growth has predominantly been guided by the tourism-led economic growth (TLEG) hypothesis, which posits that tourism development leads directly to economic enhancement. This hypothesis has been extensively studied and supported by numerous empirical investigations across various geographical settings and economic contexts (Brida et al., 2020; Chen & Chiou-Wei, 2009). However, the TLEG hypothesis often assumes a linear and symmetric relationship, which may not adequately capture the complexities and nuances of real-world economic interactions.

Recent advancements in economic theory have emphasized the importance of considering asymmetrical and nonlinear dynamics in the tourism-economic growth relationship. The notion of asymmetry, which addresses how positive and negative economic shocks may have different impacts on economic outcomes, is particularly relevant in contexts where external shocks or policy changes lead to fluctuations in tourism activity. Shin et al. (2014) argue that macroeconomic variables often behave differently in response to positive versus negative changes, suggesting that the traditional linear models may oversimplify the impacts of tourism on economic growth.

TABLE 1 Summary of recent research on tourism and economic growth using an asymmetric approach.

Author	Variable description	Sample	Method	Findings
Amir et al., 2022	Environmental degradation and economic growth with tourism demand	Pakistan 1995–2020	Non-linear autoregressive distributed lag (ARDL)	Economic growth is influenced by changes in tourism demand. Furthermore, environmental degradation can reduce tourism demand while improvements in environmental conditions do not seem to impact tourism.
Balsalobre-Lorente et al., 2021	Air transport and economic growth	Spain 1970–2015	Non-linear autoregressive distributed lag (ARDL)	Air transport, urbanization, and social globalization exert positive and significant impacts on economic growth, however, renewable energy consumption decreases economic growth as a result of the energy mix sustained by fossil fuels
Benkraiem et al., 2020	Tourism development and economic growth	10 top tourist destinations 1990–2015	Quantile autoregressive distributed lag (QARDL)	The findings indicate a nonlinear cointegration association between economic growth and tourism in sample countries
Eyuboglu & Eyuboglu, 2020	Tourism development and economic growth	9 emerging countries 1995–2016	Seemingly Unrelated Regression (SUR)	The empirical results do not show any causality between economic growth and tourism development
Fareed et al., 2018	Tourism, terrorism, and economic growth	Thailand 1990–2017	Non-linear autoregressive distributed lag (ARDL)	They found a statistically significant asymmetric association between economic growth, tourism, and terrorism in the case of Thailand
Kumar et al., 2022	Tourism development and economic growth	Papua New Guinea 2008–2019	Non-linear autoregressive distributed lag (ARDL)	The positive growth of tourism positively influences economic growth while the downturns in tourism did not significantly affect economic growth.
Liu, Ramos, et al., 2024	Tourism and expected economic growth	Thailand 2004–2019	Autoregressive Moving Average with exogenous variables (ARMAX)-GJR-GARCH	They report a significant co-movement between economic growth and tourism development which signifies the importance of accounting for nonlinearities and extreme events.
Pata, 2021	Tourism and Economic Growth	G10 countries 1995–2017	He proposed a new test by adding asymmetric components to the lag-augmented vector autoregressive models (LA-VAR)	A significant and direct relationship was found between tourism and economic growth where the positive development in tourism boosts the economy and a negative trend, reduces the economic growth.
Sokhanvar and Jenkins, 2022b	Foreign direct investment and international tourism on long-run economic growth	Estonia 1995–2019	Non-linear autoregressive distributed lag (ARDL)	The rate of foreign direct investment and tourism development has positively influenced the economic growth in Estonia.
Sokhanvar & Jenkins, 2022a, 2022b	FDI, tourism, and accelerating the rate of economic growth	Spain 2000–2019	Non-linear autoregressive distributed lag (ARDL)	Tourism development was found to have a significant impact on economic growth while due to the low rate of return, FDI did not seem to play a significant role in the economy.
Suresh & Tiwari, 2018	International tourism, international trade and economic growth	India 1991–2012	Asymmetric Granger-causality test	Tourism arrivals were affected by both positive and negative fluctuations in economic growth and international trade, while only positive movements in tourism arrivals seemed to impact the economy and trade
Uzuner et al., 2020	Globalization, tourism, CO_2 emissions, and economic growth	Turkey 1970–2014	Non-linear autoregressive distributed lag (ARDL)	There was a different interaction dynamic between tourism and CO_2 emissions in the long versus short term. This interaction was significant for positive and negative shocks in tourism in the long term while it was significant only for the negative shocks in short term.

TABLE 1 (Continued)

Author	Variable description	Sample	Method	Findings
Wu et al., 2021	Financial technology development impact on the causality between tourism and economic growth	22 OECD countries 2003–2017	Panel smooth transition vector autoregressive model (PST-VAR)	They found a time-varying and region-specific bilateral causal relationship between tourism and economic growth where the Fintech index played a significant role.
Wu et al., 2022	International tourism development and economic growth	China 1995–2020	Quantile-on-quantile (QQ)	The report a positive relationship between tourism and economic growth in eastern China, while this impact was weakest for the regions such as Hebei and Zhejiang
Xiangyu et al., 2021	Energy consumption, economic growth, and tourism's effect on carbon footprints	USA 2000–2018	Quantile autoregressive distributed lag (QARDL)	There was a long-run equilibrium connectedness between energy consumption, economic growth, tourism, and carbon footprints.

In response to this theoretical gap, studies have begun to adopt more sophisticated econometric models, such as the augmented autoregressive distributed lag (AARDL) model, which allows for the exploration of both short-term and long-term asymmetrical effects (Sam et al., 2019). This approach provides a deeper understanding of how tourism shocks affect economic growth over different time horizons, reflecting more realistic economic conditions.

Moreover, the feedback hypothesis presents another layer of complexity by proposing a bidirectional relationship between tourism and economic growth. This theory suggests that while tourism can stimulate economic growth, the economic conditions can, in turn, affect tourism development, creating a cycle of mutual reinforcement (Paramati et al., 2017). This reciprocal relationship is supported by empirical findings from studies conducted in various economic environments, further challenging the unidirectional assumption of the TLEG hypothesis (Neuts, 2020).

By integrating these theoretical frameworks into the analysis, the study not only contributes to the empirical literature but also advances theoretical understanding by demonstrating the applicability and relevance of asymmetric and nonlinear analyses in economic growth models. This theoretical perspective is crucial for developing more tailored and effective economic policies that recognize the variable impacts of tourism under different economic conditions (Kumar, 2023; Kumar & Patel, 2023; Song & Wu, 2022).

In the following section, the methodology and model specifications are accordingly outlined.

3 | METHODOLOGY

3.1 | Model specification

The Econometric model is based on Solow (1956) as the latest theory on economic growth, Solow sets up a mathematical model of long-run economic growth, which is consistent with the stylized facts of economic growth. And the general equation of this neoclassical growth model is given as:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta}, \tag{1}$$

Where Y is real GDP, A is the technology stock, K and L are the capital, and labor stock, α, and β are the capital and labor shares, respectively. According to Jalil, Mahmood, and Idrees (2013), we can assume:

$$y_t = f(T, Z_t) \tag{2}$$

Where, Z_t is a vector of growth-improving variables such as the indicators of tourism development, trade openness, inflation, and other macroeconomic policies, so according to this growth model, and following Balaguer and Cantavella-Jordá (2002), we specify an econometrically estimable equation in the long-run as follows:

$$\begin{aligned} \mathrm{lgdp}_t = {} & \alpha_0 + \alpha_1 \mathrm{lfdi}_t + \alpha_2 \mathrm{llabor}_t + \alpha_3 \mathrm{lnx}_t + \alpha_4 \mathrm{lk}_t + \alpha_5 \mathrm{lcomp}_t \\ & + \alpha_6 \mathrm{ltur}_t + \alpha_7 \mathrm{lgov}_t + \epsilon_t \end{aligned} \tag{3}$$

where lgdp_t is the logarithm of the gross domestic product, lfdi_t represents the logarithm of the net inflows of foreign direct investment, lnx_t is the logarithm of the net export, lk_t is logarithm of the gross fixed capital formation, llabor_t is the logarithm of the number of workforce in the country, lgov_t is the logarithm of the government's expenditure, ltur_t is defined as the logarithm of the number of tourist arrivals,[2] and lcomp_t is the logarithm of the Composite Leading Index, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ and α_7 in Equation (3) are the long-run coefficients. The openness index (denominated by open) is calculated as the sum of the export and import ratio to gross domestic product and included in the models as an exogenous short-run variable. To estimate the long and short-run effects of all seven exogenous variables on GDP simultaneously, we specify in an ARDL model as follows where Δ denotes quarterly change:

$$\begin{aligned}\Delta \mathrm{lgdp}_t = {} & \psi + \eta_0 \mathrm{lgdp}_{t-1} + \eta_1 \mathrm{lfdi}_{t-1} + \eta_2 \mathrm{llabor}_{t-1} + \eta_3 \mathrm{lnx}_{t-1} + \eta_4 \mathrm{lk}_{t-1} \\ & + \eta_5 \mathrm{lcomp}_{t-1} + \eta_6 \mathrm{ltur}_{t-1} + \eta_7 \mathrm{lgov}_{t-1} + \sum_{j=1}^{p} \beta_{1j} \Delta \mathrm{lgdp}_{t-j} \\ & + \sum_{j=0}^{q} \beta_{2j} \Delta \mathrm{lfdi}_{t-j} + \sum_{j=0}^{m} \beta_{3j} \Delta \mathrm{llabor}_{t-j} + \sum_{j=0}^{n} \beta_{4j} \Delta \mathrm{lnx}_{t-j} \\ & + \sum_{j=0}^{v} \beta_{5j} \Delta \mathrm{lk}_{t-j} + \sum_{j=0}^{w} \beta_{6j} \Delta \mathrm{lcomp}_{t-j} + \sum_{j=0}^{b} \beta_{7j} \Delta \mathrm{ltur}_{t-j} \\ & + \sum_{j=0}^{h} \beta_{8j} \Delta \mathrm{lgov}_{t-j} + \gamma_1 \mathrm{open}_t + e_t \end{aligned} \tag{4}$$

The ARDL model (Equation 4) is based on Pesaran et al. (2001), henceforth PSS. This model possesses some strength over others. One of the biggest strengths of this model is that it enables us to estimate the short versus long-rn effects in one step as in Equation (4). Short-run effects are obtained by estimates of $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7.

To obtain long-term effects, $\eta_1, \eta_2, \eta_3, \eta_4, \eta_5, \eta_6$ and η_7 are estimated and normalized on $-\eta_0$. Two cointegration tests are required to ensure the validity of the long-term estimates: the F test, which tests the joint significance of lagged-level variables, and the t-test, which tests the significance of η_0. These tests have non-standard distributions, so Pesaran et al. (2001) propose new critical values based on a Monte Carlo experiment while accounting for the integrating properties of the variables. Their approach can handle variables that are a combination of $I(0)$ and $I(1)$, eliminating the need for pre-unit-root testing.

ARDL model emphasizes on $H_0: \eta_0 = \eta_1 = \eta_2 = \eta_3 = \eta_4 = \eta_5 = \eta_6 = \eta_7 = 0$ (PSS F-test) hypotheses for cointegration. Rejection of this hypothesis using the PSS F-test may imply that cointegration is valid. However, the significance of all lagged variables may be because of either the significance of lagged dependent or lagged independent variables. To solve this critical problem, Sam et al. (2019) and McNown et al. (2017) proposed the AARDL method. The hypotheses for this method contain two different hypotheses tests. The first test involves testing for $H_0: \eta_0 = 0$ (PSS t-test). The second test involves testing for $H_0: \eta_1 = \eta_2 = \eta_3 = \eta_4 = \eta_5 = \eta_6 = \eta_7 = 0$ (MSG Wald test). Rejection of both hypotheses is necessary to establish a cointegrating (long-run) relation which avoids the degenerate case where either or both of these hypotheses are rejected.

The critical values for the **PSS F-test** and **PSS t-test** are obtained from Pesaran et al. (2001). The critical values for **MSG Wald test** are provided by Sam et al. (2019). They demonstrate the possibility of a false cointegration in the case of the significance of the PSS F-test and PSS t-test. The Augmented ARDL (AARDL) **method** allows for the test for possible degenerate cointegration. This method also eliminates the need for the assumption that the dependent variable is $I(1)$ (McNown et al., 2017 and Pata & Caglar, 2021). Besides, better performance for small samples makes the AARDL a **reliable method** for time-series analysis (Xue et al., 2022).

The assumption is that any changes in the variables on the right-hand side have a symmetrical impact on GDP. However, Kumar et al. (2020) have argued and shown that this may not be true because entrepreneurs may react differently when tourism revenues decrease compared to when they increase, which could lead to asymmetrical effects on GDP. Tourist arrivals influence economic growth by affecting the demand for consumable goods and services, as well as influencing long-term investments in accommodation and leisure facilities. Consequently, an increase in tourist arrivals leads to an upsurge in new facility investments and expands investment opportunities for both local and foreign entrepreneurs. However, a decrease in tourist arrivals may not entirely reverse the aforementioned effects. Therefore, investigating assumptions about the asymmetric effect of tourist arrivals on economic growth is crucial. Using the approach of Kumar et al. (2020) and the asymmetric cointegration and error-correction method of Shin et al. (2014), we modify Equation (5) to examine the short-term and long-term asymmetric effects of tourism revenues. The revised model is presented below:

$$\begin{aligned}\Delta \mathrm{lgdp}_t = {} & \psi + \eta_0 \mathrm{lgdp}_{t-1} + \eta_1 \mathrm{lfdi}_{t-1} + \eta_2 \mathrm{llabor}_{t-1} + \eta_3 \mathrm{lnx}_{t-1} + \eta_4 \mathrm{lk}_{t-1} \\ & + \eta_5 \mathrm{lcomp}_{t-1} + \eta_6^{+} \mathrm{ltur}_{t-1}^{+} + \eta_6^{-} \mathrm{ltur}_{t-1}^{-} + \eta_7 \mathrm{lgov}_{t-1} \\ & + \sum_{j=1}^{p} \beta_{1j} \Delta \mathrm{lgdp}_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta \mathrm{lfdi}_{t-j} + \sum_{j=0}^{m} \beta_{3j} \Delta \mathrm{llabor}_{t-j} \\ & + \sum_{j=0}^{n} \beta_{4j} \Delta \mathrm{lnx}_{t-j} + \sum_{j=0}^{v} \beta_{5j} \Delta \mathrm{lk}_{t-j} + \sum_{j=0}^{w} \beta_{6j} \Delta \mathrm{lcomp}_{t-j} \\ & + \sum_{j=0}^{b} \beta_{7j}^{+} \Delta \mathrm{ltur}_{t-j}^{+} + \sum_{j=0}^{b} \beta_{7j}^{-} \Delta \mathrm{ltur}_{t-j}^{-} + \sum_{j=0}^{h} \beta_{8j} \Delta \mathrm{lgov}_{t-j} \\ & + \gamma_1 \mathrm{open}_t + e_t \end{aligned} \tag{5}$$

where the $\mathrm{ltur}^{+}(\mathrm{ltur}^{-})$ is a partial sum of positive (negative) changes in tourist arrivals and reflects only an increase (decrease) of it. The two partial sum variables are constructed as:

$$\mathrm{ltur}_t^{+} = \sum\nolimits_{i=1}^{t} \Delta \mathrm{ltur}_i^{+} = \sum_{i=1}^{t} \max(\Delta \mathrm{ltur}_i, 0);$$

$$\mathrm{ltur}_t^{-} = \sum_{i=1}^{t} \Delta \mathrm{ltur}_i^{-} = \sum_{i=1}^{t} \min(\Delta \mathrm{ltur}_i, 0)$$

Model (3) is a linear ARDL model that considers all variables together. However, model (5) is a nonlinear ARDL model due to the introduction of partial sum variables, which lead to nonlinear adjustment of one of the variables, specifically tourist arrivals, and distinguishes it from the linear ARDL model (4).

Shin et al. (2014) argue that both models (4) and (5) are estimated using the same OLS estimation method and diagnostic tests. They suggest using the same critical values for cointegration tests, even though model (5) has one more variable than model (4), in order to maintain high conservative levels. After estimating model (5), we can test several asymmetry assumptions. Asymmetric effects in the long run due to an increase or decrease in tourist arrivals will be present if the estimate of $\eta_6^{+} \neq \eta_6^{-}$. On the other hand, much more robust evidence of the short-run asymmetric cumulative effects will be established if the Wald test rejects the null hypothesis of $\sum\beta^{+}_{7j} = \sum\beta^{-}_{7j}$ (WALD-S test). As for the long-run effects of tourism revenues increase versus decrease, they will be asymmetric if the Wald test rejects the null hypothesis of $H_0 : -\frac{\eta_6^-}{\eta_0} = -\frac{\eta_6^+}{\eta_0}$ (WALD-L test).

The following equation is used if the asymmetries are there only for the long run:

$$\begin{aligned}\Delta\text{lgdp}_t = {} & \psi + \eta_0\text{lgdp}_{t-1} + \eta_1\text{lfdi}_{t-1} + \eta_2\text{llabor}_{t-1} + \eta_3\text{lnx}_{t-1} + \eta_4\text{lk}_{t-1} \\ & + \eta_5\text{lcomp}_{t-1} + \eta_6^+\text{ltur}^+_{t-1} + \eta_6^-\text{ltur}^-_{t-1} + \eta_7\text{lgov}_{t-1} \\ & + \sum_{j=1}^{p}\beta_{1j}\Delta\text{lgdp}_{t-j} + \sum_{j=0}^{q}\beta_{2j}\Delta\text{lfdi}_{t-j} + \sum_{j=0}^{m}\beta_{3j}\Delta\text{llabor}_{t-j} \\ & + \sum_{j=0}^{n}\beta_{4j}\Delta\text{lnx}_{t-j} + \sum_{j=0}^{v}\beta_{5j}\Delta\text{lk}_{t-j} + \sum_{j=0}^{w}\beta_{6j}\Delta\text{lcomp}_{t-j} \\ & + \sum_{j=0}^{b}\beta_{7j}\Delta\text{ltur}_{t-j} + \sum_{j=0}^{h}\beta_{8j}\Delta\text{lgov}_{t-j} + \gamma_1\text{open}_t + e_t\end{aligned} \tag{6}$$

Here we can observe that while tourism arrival has asymmetric effects, in the long run, their effects are symmetric in the short run. On the other hand, if asymmetries exist only in the short run, the following equation can be used:

$$\begin{aligned}\Delta\text{lgdp}_t = {} & \psi + \eta_0\text{lgdp}_{t-1} + \eta_1\text{lfdi}_{t-1} + \eta_2\text{llabor}_{t-1} + \eta_3\text{lnx}_{t-1} + \eta_4\text{lk}_{t-1} \\ & + \eta_5\text{lcomp}_{t-1} + \eta_6\text{ltur}_{t-1} + \eta_7\text{lgov}_{t-1} + \sum_{j=1}^{p}\beta_{1j}\Delta\text{lgdp}_{t-j} \\ & + \sum_{j=0}^{q}\beta_{2j}\Delta\text{lfdi}_{t-j} + \sum_{j=0}^{m}\beta_{3j}\Delta\text{llabor}_{t-j} + \sum_{j=0}^{n}\beta_{4j}\Delta\text{lnx}_{t-j} \\ & + \sum_{j=0}^{v}\beta_{5j}\Delta\text{lk}_{t-j} + \sum_{j=0}^{w}\beta_{6j}\Delta\text{lcomp}_{t-j} + \sum_{j=0}^{b}\beta^+_{7j}\Delta\text{ltur}^+_{t-j} \\ & + \sum_{j=0}^{b}\beta^-_{7j}\Delta\text{ltur}^-_{t-j} + \sum_{j=0}^{h}\beta_{8j}\Delta\text{lgov}_{t-j} + \gamma_1\text{open}_t + e_t\end{aligned} \tag{7}$$

Here tourism revenues have a symmetric effect on GDP, but it is reversed in the short run, which demonstrated by Δltur^+_t and Δltur^-_t. The cumulative dynamic multiplier effects of asymmetric variables on GDP can be evaluated as follows:

$$\begin{gathered} m_h^+ = \sum_{i=0}^{h}\frac{\partial\text{lgdp}_{t+i}}{\partial\text{ltur}^+_t}; m_h^- = \sum_{i=0}^{h}\frac{\partial\text{lgdp}_{t+i}}{\partial\text{ltur}^-_t} \\ \lim_{h\to\infty} m_h^+ = \alpha_1^+, \lim_{h\to\infty} m_h^- = \alpha_1^- \end{gathered} \tag{8}$$

3.2 | Data

In order to perform the analysis, we use quarterly data for the periods 1983:1–2020:4. The data include the number of tourist arrival, net foreign direct investment in US dollars, the total labor force (thousand), gross domestic product (million dollars constant 2005), net exports of goods and services (million dollars), composite leading index, government expenditure (in million dollars), and openness index. The data were retrieved from the World Development Indicators (WDI) and the department of statistics Singapore. All data utilized in our analysis have been seasonally adjusted. The variables FDI and LABOR, initially provided as yearly data, were converted into quarterly data by assuming a constant growth rate throughout the year, based on exponential growth. The descriptive statics for our data are presented in Table 2.

The results of the BDS test applied to the variables used in the model are presented in Table 3. According to this table, it is evident that all variables exhibit nonlinearity for all embedding dimensions (*m*). Therefore, the ARDL method, which uses lagged values, is suitable for variables with nonlinearity. Additionally, using the logarithm of variables can be beneficial due to the presence of nonlinearity.

4 | EMPIRICAL RESULTS

The critical condition for the ARDL model is all data have to be stationary in $I(0)$ or $I(1)$. The unit root test statistics of our variables are displayed in Table 4. The ADF, PP, Zivot Andrews and HEGY tests applied to the first difference of the data series reject the null hypothesis of non-stationarity for all the variables used in this study so that all variables are stationary at zero or one level. Therefore, there is not any restriction on performing autoregressive dynamic models.

We made four possible models containing asymmetry either in the long or short run. The NARDL models include positive and negative decompositions of tourism revenues variable can be considered in three types. We assume that nonlinearity exists in the short and long run and is demonstrated in Equation (5) by having asymmetry in both the short and long run. We can claim that while there is an asymmetric effect in the short run, the long-run impact is symmetrical (Equation 7). On the other hand, we have to check the possibility of symmetric implications in the short run and asymmetric effects in the long run (Equation 6).

Performing related estimations, the standardized long-run results alongside their diagnostic test results are presented in Table 5. The estimated short-run coefficients for four models are shown in Table 6.

The PSS' null hypothesis (Cointegration bounds test of Pesaran et al. (2001)) was rejected in all models by checking the PSS F and PSS t-test statistics. Therefore, we can claim that there is cointegration in all models in the ARDL framework. But there is a risk of degenerated cointegration in the models. The first condition of the existence of cointegration in the AARDL framework is the significance of Pesaran's t statistics. These statistics are not significant in the models but in the linear model. The cointegration in the AARDL framework can be determined by the F test for the lagged level of regressors utilizing the critical values of Sam et al. (2019). According to our findings, the first condition for AARDL couldn't be met in nonlinear models but in linear models (Equation 4). We found 4.79 for this test's statistics which exceeds the upper bound of Case III and $k = 7$ (4.42) in the

TABLE 2 The descriptive statistics of variables.

Variable	Mean	Median	Min	Max	Std. dev	Skewness	Kurtosis	JB
Lcomp	4.24	4.25	3.52	4.71	0.34	−0.51	2.23	10.49***
Lfdi	23.34	23.47	20.77	25.44	1.36	−0.27	1.94	8.85**
Lgdp	10.79	10.81	9.56	11.71	0.66	−0.27	1.86	10.04***
Lgov	8.50	8.63	7.16	9.64	0.68	−0.25	1.80	10.64***
Lk	9.49	9.54	8.36	10.38	0.61	−0.31	1.89	10.20***
Llabor	7.73	7.75	7.16	8.23	0.35	−0.06	1.70	10.79***
Lnx	8.79	8.94	3.30	10.59	1.34	−0.90	3.94	26.28***
Open	2.66	2.7	1.4	3.6	0.68	−0.45	1.77	14.6***
Ltur	14.39	14.44	8.24	15.43	0.87	−3.54	23.05	2864.35***
Ltur^{+}	−1.91	−1.47	−10.70	0.00	1.76	−2.37	12.94	763.24***
Ltur^{-}	2.87	2.46	0.01	8.12	1.83	0.17	2.02	6.78**

Note: *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

TABLE 3 BDS test results.

	ε/σ				
	m	**0.5**	**1**	**1.5**	**2**
FDI	2	27.99553	30.54277	31.09828	26.73965
	3	39.02383	35.93756	33.3465	26.28065
	4	57.23016	43.0951	36.12788	25.9082
LABOR	2	465.2766	117.2872	57.23808	46.17987
	3	907.5771	155.5079	62.86795	45.62058
	4	1952.3791	214.2378	69.97717	45.28242
GDP	2	167.1813	81.79351	53.97378	40.67529
	3	320.7088	104.002	59.21709	40.71156
	4	676.1616	136.41637	65.64997	40.73079
K	2	235.6349	71.32695	47.67127	38.82834
	3	448.1414	92.67393	53.14998	39.29722
	4	932.2001	123.21514	59.46451	39.14147
NX	2	41.06965	50.18643	35.02054	25.59222
	3	65.17418	62.76985	38.52137	26.55471
	4	109.35117	79.9593	42.06074	26.88475
OPEN	2	105.0425	151.9877	48.87843	37.72948
	3	190.6237	207.9158	53.5687	38.3997
	4	376.4542	295.5731	59.2458	39.28143
TUR	2	61.8517	41.33662	33.95691	29.95143
	3	108.6407	50.72818	37.10092	30.16773
	4	207.1759	63.27059	40.40092	29.93967
GOV	2	74.98129	48.82052	27.13058	22.30395
	3	118.19407	61.06154	29.72593	22.93719
	4	196.51445	75.77748	31.72444	22.90352
COMP	2	465.7058	138.5775	64.92346	45.66486
	3	919.7079	185.7746	70.0984	44.54281
	4	2009.8742	259.7493	76.99038	43.76413

TABLE 4 The unit root test results.

	ADF		PP		ZIvot Andrews		HEGY	
Variable	Level	First difference	Level	First difference	Level	First difference	Level	First difference
Lcomp	−1.78	−8.37***	−1.25	−8.57***	−3.97	−9.29***	29.9*	54.6*
Lfdi	−1.6	−3.58***	−1.15	−4.01***	−2.9	−5.73***	54.39*	60.65*
Lgdp	−1.6	−4.56***	−2.09	−12.73***	−2.93	−13.01***	4.22**	2.13
Lgov	−0.79	−51.68***	−2.7*	−70.95***	−18.11***	−24.97***	1.18	1.17
Lk	−0.88	−16.34***	−1.1	−16.53***	−3.56	−17.16***	15.75*	15.89*
Llabor	−1	−3.22**	−0.84	−4.02***	−1.7	−5.22**	118.2*	118.98*
Lnx	−1.89	−9.71***	−2.51	−32.67***	−12.6***	−21.35***	17.31*	11.41*
Open	−1.36	−13.7***	−1.33	−14.01***	−4.11	−13.96***	27.81*	9.01*
Ltur	−3.41**	−14.28***	−3.33**	−14.89***	−30.48***	−16.8***	49.34*	1.47

Note: *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

TABLE 5 The models' estimated long-run results and the diagnostic tests.

	Asymmetry in short-run		Symmetry in short-run	
	Asymmetry in long-run (Equation 5)	Symmetry in long-run (Equation 7)	Asymmetry in long-run (Equation 6)	Symmetry in long-run (Equation 4)
$Ltur_t$		0.08 (1)		0.19 (4.13) ***
$Ltur_t^+$	0.14 (3.91) ***		0.20 (5.65) ***	
$Ltur_t^-$	0.08 (2.02) **		0.17 (4.72) ***	
$Lfdi_t$	−0.04 (2.14) **	−0.08 (1.86) *	−0.04 (2.02) **	−0.06 (2.21) **
$Lgov_t$	0.28 (5.22) ***	0.32 (2.96) ***	0.25 (4.72) ***	0.27 (3.83) ***
Lnx_t	0.08 (4.35) ***	0.13 (2.89) ***	0.08 (4.32) ***	0.10 (4.01) ***
$Llabor_t$	−0.06 (0.41)	0.32 (1.73) *	0.24 (1.8) *	0.40 (3.38) ***
Lk_t	0.21 (5.07) ***	0.09 (1.57)	0.16 (3.82) ***	0.11 (2.61) **
$Lcomp_t$	0.49 (4.29) ***	0.44 (1.97) *	0.28 (2.41) **	0.22 (1.45)
$Open_t$	−0.002 (0.14)	0.008 (0.59)	0.02 (1.98) *	0.03 (2.1) **
Intercept	4.76 (7.72) ***	2.42 (2.05) **	4.04 (6.59) ***	0.99 (2.38) **
PSS F-test	4.81 ***	4.05 **	4.29 ***	4.51 ***
PSS t-test	−0.50 (4.22)	−0.25 (2.75)	−0.48 (4.07)	−0.36 (4.23) *
MSG F-test	5.08***	4.17**	4.51***	4.79***
BG LM	0.48	0.17	0.000009	0.09
Reset	0.88	0.06	0.0008	0.03
Cusum	S	S	S	S
CusumQ	S	S	S	S
Adj. R^2	0.86	0.84	0.83	0.83
Wald-S	6.48 **	3.30 *		
Wald-L	16.62 ***		3.41 *	
Arch	0.12	0.24	0.002	0.01

Note: *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

linear model. Therefore, we can claim no degenerated cointegration in the linear model, while the rest of the models suffer from degenerated cointegration.

The long-run results show that tourism arrival positively impacts GDP in all models. The increase in tourism arrival has a significant and positive effect on Singapore's output in the models with asymmetry in the long run. The decrease in tourism arrival will cause a significant reduction in the domestic production of the country. The long-run elasticity of tourism arrival in the model containing short and long-run asymmetry (Equation 5) is 0.14 for an increase and 0.08 for a

TABLE 6 The short-run results of the models.

	Asymmetry in short-run		Symmetry in short-run	
	Asymmetry in long-run (Equation 5)	Symmetry in long-run (Equation 7)	Asymmetry in long-run (Equation 6)	Symmetry in long-run (Equation 4)
$\Delta lgov_t$	0.02 (1.5)	0.01 (0.91)	0.02 (1.8) *	0.02 (1.39)
$\Delta lgov_{t-1}$	−0.09 (2.69) ***	−0.05 (2.85) ***	−0.07 (3.66) ***	−0.06 (3.34) ***
$\Delta lgov_{t-2}$	−0.07 (2.19) **	−0.02 (1.89) *	−0.03 (2.69) ***	−0.02 (2.29) **
$\Delta lgov_{t-3}$	−0.04 (1.31)			
$\Delta lgov_{t-4}$	−0.04 (1.65)			
$\Delta lgov_{t-5}$	−0.03 (1.94) *			
$\Delta lfdi_t$	0.01 (0.77)	0.007 (0.52)	0.02 (1.32)	0.02 (1.22)
$\Delta lfdi_{t-1}$	0.04 (2.68) ***	0.03 (2.42) **	0.02 (1.6)	0.02 (1.64)
$\Delta lfdi_{t-2}$	−0.01 (0.77)	−0.01 (0.81)	−0.0002 (0.01)	−0.00008 (0.006)
$\Delta lfdi_{t-3}$	0.03 (1.69) *	0.03 (2.25) **	0.02 (1.32)	0.02 (1.56)
$\Delta lfdi_{t-4}$	0.04 (2.42) **	0.03 (2.2) **	0.04 (2.45) **	0.04 (2.48) **
$\Delta locmp_t$	0.16 (2.41) **	0.16 (2.3) **	0.16 (2.38) **	0.16 (2.35) **
$\Delta lcomp_{t-1}$	0.11 (1.32)	0.23 (3.15) ***	0.27 (3.12) ***	0.32 (3.96) ***
$\Delta lcomp_{t-2}$	−0.11 (1.39)		−0.08 (0.94)	−0.05 (0.64)
$\Delta lcomp_{t-3}$	0.16 (2.41) **	0.16 (2.3) **	0.16 (2.38) **	0.16 (2.35) **
Δlk_t	0.09 (3.32) ***	0.09 (3.47) ***	0.10 (3.57) ***	0.10 (3.47) ***
Δlk_{t-1}	0.03 (0.75)	0.11 (3.17) ***	0.06 (1.68) *	0.09 (2.74) ***
Δlk_{t-2}	0.02 (0.41)	0.06 (1.71) *	0.03 (0.87)	0.05 (1.52)
Δlk_{t-3}	0.06 (1.64)	0.10 (2.71) ***	0.05 (1.31)	0.07 (2.02) **
Δlk_{t-4}	0.09 (2.49) **	0.13 (3.78) ***	0.10 (2.8) ***	0.12 (3.69) ***
Δlk_{t-5}	0.07 (2.12) **	0.10 (3.05) ***	0.09 (2.67) ***	0.10 (3.28) ***
Δlk_{t-6}	0.04 (1.42)	0.05 (2) **	0.04 (1.38)	0.04 (1.73) *
$\Delta llabor_t$	0.54 (2.09) **	0.52 (2.04) **	0.62 (2.4) **	0.65 (2.52) **
$\Delta llabor_{t-1}$	−1.00 (3.55) ***	−1.09 (3.78) ***	−1.12 (3.71) ***	−1.17 (3.87) ***
$\Delta llabor_{t-2}$	−0.05 (0.17)	−0.03 (0.1)	0.11 (0.35)	0.13 (0.41)
$\Delta llabor_{t-3}$	0.12 (0.39)	0.07 (0.24)	−0.11 (0.36)	−0.16 (0.53)
$\Delta llabor_{t-4}$	0.40 (1.32)	0.21 (0.7)	0.12 (0.42)	0.12 (0.4)
$\Delta llabor_{t-5}$	−0.32 (1.08)	−0.16 (0.54)	−0.08 (0.26)	−0.07 (0.25)
$\Delta llabor_{t-6}$	0.02 (0.07)	−0.08 (0.27)	0.19 (0.64)	0.18 (0.61)
$\Delta llabor_{t-7}$	−0.44 (1.8) *	−0.52 (2.04) **	−0.63 (2.44) **	−0.68 (2.64) ***
Δlnx_t	0.01 (3.07) ***	0.010 (2.71) ***	0.01 (3.5) ***	0.01 (3.3) ***
Δlnx_{t-1}	−0.02 (3.1) ***	−0.02 (2.31) **	−0.02 (2.83) ***	−0.02 (2.55) **
Δlnx_{t-2}	−0.02 (2.94) ***	−0.01 (2.39) **	−0.01 (2.58) **	−0.01 (2.37) **
Δlnx_{t-3}	−0.009 (2.46) **	−0.008 (2.25) **	−0.009 (2.49) **	−0.008 (2.4) **
$\Delta ltur_t$			0.02 (7.93) ***	0.02 (8) ***
$\Delta ltur_{t-1}$			−0.08 (3.68) ***	−0.07 (3.36) ***
$\Delta ltur_{t-2}$			−0.07 (3.45) ***	−0.06 (3.15) ***
$\Delta ltur_{t-3}$			−0.04 (2.1) **	−0.03 (1.8) *
$\Delta ltur_{t-4}$			−0.02 (1.5)	−0.02 (1.2)
$\Delta ltur_{t-5}$			0.02 (1.75) *	0.03 (2.09) **
$\Delta ltur^{-}_{t}$	0.02 (6.82) ***	0.02 (6.96) ***		
$\Delta ltur^{-}_{t-1}$	−0.03 (0.99)	−0.009 (0.36)		
$\Delta ltur^{-}_{t-2}$	−0.03 (1.22)	−0.02 (0.77)		
$\Delta ltur^{-}_{t-3}$	0.04 (0.91)	0.03 (0.6)		

TABLE 6 (Continued)

	Asymmetry in short-run		Symmetry in short-run	
	Asymmetry in long-run (Equation 5)	Symmetry in long-run (Equation 7)	Asymmetry in long-run (Equation 6)	Symmetry in long-run (Equation 4)
$\Delta ltur^{-}_{t-4}$	−0.03 (0.76)	−0.03 (0.65)		
$\Delta ltur^{-}_{t-5}$	−0.003 (0.08)	−0.0008 (0.02)		
$\Delta ltur^{-}_{t-6}$	0.10 (2.72) ***	0.09 (2.44) **		
$\Delta ltur^{+}_{t}$	0.06 (2.32) **	0.05 (1.98) *		
$\Delta ltur^{+}_{t-1}$	−0.05 (1.52)	−0.04 (1.01)		
$\Delta ltur^{+}_{t-2}$	−0.02 (0.36)	−0.02 (0.38)		
$\Delta ltur^{+}_{t-3}$	−0.07 (1.6)	−0.06 (1.3)		
$\Delta ltur^{+}_{t-4}$	−0.06 (1.31)	−0.05 (1.13)		
$\Delta ltur^{+}_{t-5}$	0.11 (2.54) **	0.12 (2.8) ***		
$\Delta ltur^{+}_{t-6}$	−0.04 (2.55) **	−0.03 (1.48)		

Note: *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

decrease. The model with only long-run asymmetry (Equation 6) reveals that the increased elasticity is 0.2 and the decreased elasticity is 0.17. The model with asymmetry only in the short-run (Equation 7) shows 0.08 for the elasticity but is insignificant. The linear model (Equation 4) reveals a significant and positive impact on domestic production.

The estimated short-run coefficients, presented in Table 6, have interesting results. Comparing the models with symmetry (Equations 4 and 6) and asymmetry (Equations 5 and 7) in the short run reveals that a decrease in tourism arrival has conflicting impacts on GDP. Considering models containing asymmetry in the short run reveals that while all significant coefficients of decrease in tourism arrival are positive, there are positive and negative signs in the short run. The models with linearity in the short run have a different pattern; most of them negatively impact GDP. Therefore, it is critical whether the existence of asymmetry is in the short run or not. Despite the statistical significance of all of the models, the results have crucial differences. If we had not eliminated degenerate models, erroneous results would have been analyzed as valid models. The differences between degenerated and healthy models are apparent. All nonlinear models (Equations 5, 6, and 7) revealed suffering from degenerate cointegration. However, the linear model (Equation 4) claims a healthy long-run relationship, which is tested by the AARDL framework. The nonlinear models' short-run estimated signs differ from the linear model entirely. Despite similar direction and significance levels in the long run for most variables, there are conflicting results for COMP and OPEN coefficients in the long run. While COMP is significant in all the nonlinear models, it is insignificant in the linear model. the situation is inverse for OPEN. While its estimated coefficients are insignificant for the nonlinear models, there is a significant and positive value in the linear model. Therefore, eliminating degenerated cointegrated models is critical to evaluating tourist arrivals' impact on Singapore's domestic production.

In Pesaran F bound framework, all of our models report the existence of cointegration. However, we found degenerated cointegration in all asymmetric models by dividing the lagged regressors' F test into the dependent and independent variable's F tests. The estimated results for the linear model, which was found to be cointegrated in the AARDL framework, can be interpreted as the sole valid model. The AARDL framework enabled us to avoid the degenerated cointegration models. Otherwise, any asymmetric model would be construed as a valid model. Utilizing the traditional ARDL model would mislead us about the results. Hereafter we will interpret just the linear model for which there is not any degenerated cointegration.

The positive impact of tourism arrival on GDP, in the long run, is accompanied by an inverse effect in short-run and results indicate that the long-run coefficient for tourism arrival on economic growth is positive (0.19) and is significant at the 1% level, which implies that a boost in tourism arrivals lead to increase in economic growth in Singapore. On the other hand, in the short run, the changes in tourism arrival are statistically significant and have negative impacts on economic growth in most short-run coefficients. Concentrating on the short-run effects reveals that the previous years' revenues positively affect economic activities. While the tourist arrivals have a significant negative sign in one to three lags, its coefficient in the zero lag has a significant and positive impact. Regarding the positive and significant impact of tourist arrival, in the long run, we can observe this pattern in Figure 1. These behaviors are consistent with the tourism industry. Any increase in tourist arrivals at the visiting time increases the gross domestic product of countries because of the shifting demand function for goods and services (zero lag). Because the tourism industry's investors' predictions about the arrival of the tourists are formed by previous demands, any increase in prediction about passengers in a moment requires replanning future expenditures. Therefore, any shocks in tourism arrivals would stimulate the costs of the next periods for providing edible and non-edible services in the short run. Nonconstant changes in tourist arrivals may decrease the profit of the industry. However, in the long run, any increase or decrease in guests stimulates new investments and additional capacity. Therefore, the

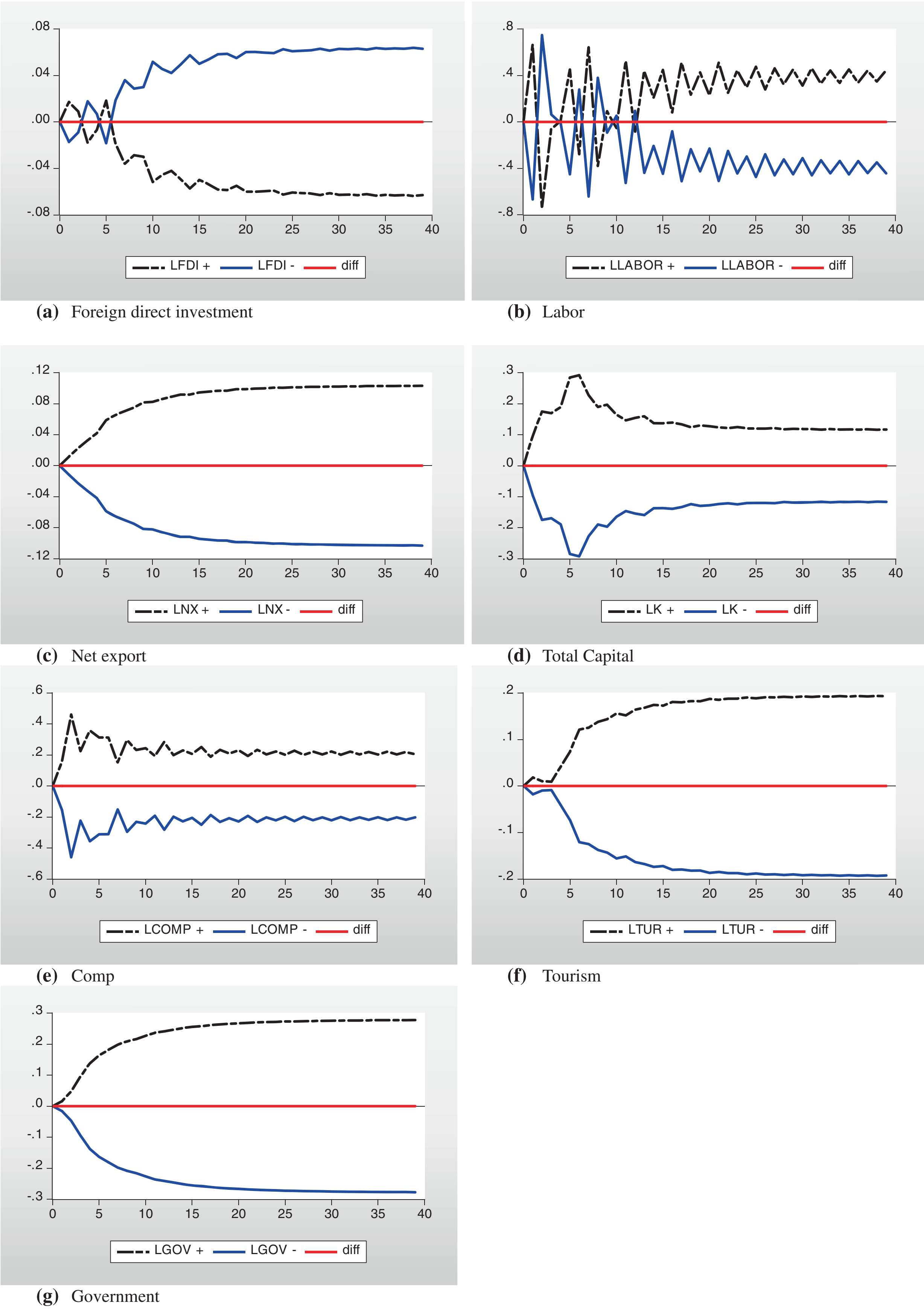

FIGURE 1 Dynamic multipliers of GDP. Multiple plots are showing the cumulative effect of variables, the blue line shows the negative, and the black dotted line is a positive impact.

long-run effects conflict with the short-run impacts and are compatible with the tourism industry.

In control variables, net FDI inflow has a negative effect in the long run and just positive significance in the short run. It means that despite stimulating domestic production by increasing foreign direct investment in the short run, the domestic investment would crowd out the domestic investors' opportunities. The composite leading index estimated results show a significant positive effect in the short and long run. The effect of net exports on GDP reveals a negative impact on GDP in the short run and a positive and significant one in the long run. An increase in the export of goods and a decrease in the import of the commodities may cause a shortage in the domestic market. On the other hand, any decrease in the raw material imports and increasing the net export may shrink the next period's outputs. The injection of export revenues into the economy may be delayed, and its impact can be revealed in the future. But, despite its negative effect in the short run, it will cause the growth of GDP in the long run.

Capital positively and significantly affects GDP in the short and long run, which matches our expectations for Singapore. At the same time, labor has a distinct effect on the GDP. The short-run effect impact of the labor is negative or insignificant, while its influence is positive and significant in the long run. The training process and adaptation of the labor force in the short run may be taken into account. The government's expenditures impact is similar to the labor force. Financing government expenditures in the short run, either by taxation or borrowing from the domestic money market, may negatively impact GDP. However, increasing the infrastructure and the services which are providing by the state would have a positive impact in the long run. Overall, Singapore's economic growth is influenced positively in long term by the tourism arrival from various regions.

5 | CONCLUSIONS AND POLICY IMPLICATION

Given the reported evidence in the empirical literature on the causal link between tourism and economic growth in country-specific studies (Habibi et al., 2018; Narayan et al., 2010; Tu & Zhang, 2020) by using time series, linear and symmetric methods, this study revisits the issue in Singapore over the periods 1983:1–2020:4 by employing a non-linear asymmetric approach. We utilized the AARDL approach, which empowered us to avoid degenerated cointegration in our analysis. Traditional cointegration methods can be utilized to detect long- and short-term relationships among the variables, but there is a risk of degenerated cointegration. Because of the existence of conflicting signs in the estimated results, either for short or long-run coefficients, recognition of the most significant model is crucial for this analysis. Hence, we applied Augmented ARDL to determine the most fitted model. Four possible types of linear and non-linear models were estimated in this paper. The diagnostic tests of all of the models claim that there are significant relationships among the variables. If we had not utilized the AARDL framework, we would interpret the model with asymmetry in the short and long run. But we found degenerated cointegration in all of the non-linear models. Therefore, only the linear model is eligible for consideration as a valid model, and all asymmetric models are eliminated.

The findings of the present study provide two potentially significant research contributions; First, as expected, the main results indicate that there is a statistically significant positive symmetric relationship between tourism receipts and GDP in the long run. In addition, the impact of tourism in the short-run in estimated models isn't significant or has a negative impact on GDP. Our empirical results confirmed a significant relationship between the selected variables under study. The results in long-run models are generally in line with previous time-series study but estimated results in the short run, in the case of Singapore is different.

Our findings also resonate with those of Croes et al. (2018), who noted a significant long-term impact of tourism on economic growth in Poland, a country with a similarly advanced economic structure. However, unlike Narayan et al. (2010), who found a strong short-term linkage in Pacific Island countries, our study indicates that Singapore's short-term outcomes are more volatile and less predictable. This discrepancy could be attributed to differences in economic structures and levels of dependency on tourism.

According to our results on short versus long-run impacts of tourism on economic growth, at the micro level, due to capital intensive nature of investments in this industry and usual constraints with regard to the availability of funds, individual investors must be vigilant of the overall economic situation and that precedes the tourism industry and tie their investment to the economic performance in order to ensure successful achievement of their business goals, particularly in the short run. In light of these results, Singapore should have a policy that is aimed at improving economic growth through tourism and helping their tourism industry expand as much as possible, and at the same time, they should focus their attention on long-run policies. Given the significant long-term benefits of tourism, policy makers in Singapore should consider strategies to bolster this sector. Investments in sustainable tourism infrastructure can be prioritized to enhance the resilience and capacity of the tourism industry. This includes upgrading transportation and accommodations, focusing on environmental sustainability, and promoting cultural heritage sites that attract international tourists. To mitigate the short-term volatility observed in the tourism-economic growth nexus, the government could implement policies aimed at diversifying tourist offerings, thereby attracting a broader range of visitors throughout the year. Furthermore, stabilizing measures such as contingency funds or temporary fiscal supports could be established to shield the sector from sudden downturns in tourist arrivals, similar to strategies recommended by Suresh and Tiwari (2018) for India. Comparatively, economies like Malaysia and Thailand, which have implemented successful tourism diversification policies (Fareed et al., 2018; Tang & Tan, 2015), provide a benchmark for Singapore. These policies include the development of medical and educational tourism, which have less susceptibility to economic cycles and can provide more stable revenue streams. The interaction between broader economic variables such as FDI and tourism also deserves attention. While FDI has been seen as a driver of economic growth, our study suggests that it has a nuanced role in conjunction with tourism. Policies aimed at enhancing FDI in tourism-specific sectors could be beneficial, particularly in developing high-value tourism services that leverage Singapore's technological advancements and high service standards (Kim & Hyun, 2024; Lee et al., 2024; Pai et al., 2023).

Although it should be noted that the number of inbound tourists to Singapore is restricted by the size of Singapore and its shortage of natural and historical attractions. Due to the existing research gap in the context of Singapore, our research was only focused on this region therefore the results are limited to the given sample. Future research can extend the methodology to include a boot-strap rolling window or Wavelet to analyze the impact of tourism on economic growth. Future research should also explore the specific types of tourism that most effectively contribute to sustainable economic growth in Singapore. Additionally, longitudinal studies could examine the evolving nature of the tourism-economic growth relationship in the context of global economic changes and technological advancements in travel and tourism.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ENDNOTES

[1] We distinguish between economic growth and economic development in this research by referring to Cárdenas-García et al. (2015, 1–2) who posits that apart from the potential positive impact of tourism on economic activities and growth in areas such as GDP, employment and foreign exchange market, the real impact of tourism, given the appropriate conditions, is to enhance the overall welfare and well-being of the society and improve its cultural progress.

[2] In this paper, the existence of multiple proxies for tourism, such as tourism receipts, tourism expenditure, and others, is acknowledged. However, the focus is specifically on tourist arrivals for several reasons. First, tourist arrivals are often considered a primary indicator of tourism activity and are widely used in empirical studies assessing the impact of tourism on economic variables. Second, data availability and reliability play a crucial role in empirical research, and tourist arrival data are typically readily accessible from official sources with high levels of accuracy and consistency. Third, tourist arrivals capture the direct influx of tourists into the destination, providing a clear and straightforward measure of tourism activity. Therefore, given the prominence, reliability, and simplicity of tourist arrival data, it is believed to serve as a robust proxy for assessing the impact of tourism on economic growth in the study context. However, the potential value in exploring other proxies for tourism is recognized for future research endeavors.

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