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RESEARCH ARTICLE

Reexamined the Dynamic Impact between Selected Macroeconomic Variables and Tuorists Arrival in Malaysia Using VECM Model

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ABSTRACT

This study examines the dynamic long-term relationship between tourist arrivals and key economic indicators in Malaysia using annual time series data from 2013 to 2022. The Vector Error Correction Model (VECM) is employed to analyze both short- and long-term interactions among tourist arrivals (TOU), financial development (FD), gross domestic product (GDP), average income (AVINCOME), hotel rooms (ROOMS), and the real effective exchange rate (COST). The Johansen-Juselius cointegration test confirms the existence of long-run equilibrium relationships among the variables, with the error correction term (ECT) found to be negative and statistically significant for TOU, FD, and COST, validating the model's stability. The findings indicate that financial development, GDP, average income, and infrastructure improvements positively influence tourist arrivals, while the real effective exchange rate plays a crucial role as a determinant. This study provides actionable insights for policymakers, particularly the Ministry of Tourism a nd Culture Malaysia, to develop targeted strategies that enhance tourism competitiveness and sustainability. Recommendations include improving infrastructure, managing exchange rates, and promoting financial development to stimulate tourism-driven economic growth.

INTRODUCTION

Malaysia is a vibrant and diverse travel destination, renowned for its rich cultural heritage, stunning natural landscapes, and historical significance (Zakaria, Z., & Hua, A. K. , 2024). As one of Southeast Asia’s most popular tourist hubs, it attracts millions of visitors annually (Khusanov, C. K., 2023). According to the World Tourism Organization (WTO), Malaysia ranked 12th globally in international tourist arrivals in 2021, welcoming 26.1 million visitors. Tourism contributed 15.9% of the country’s GDP and supported 23.6% of its total employment, underscoring the industry’s significant role in Malaysia’s economic landscape. Major attractions including Penang Island, Kota Kinabalu, Kuching, Malacca City, Ipoh, Johor Bahru, Kuala Lumpur, and Langkawi, show Malaysia’s rich natural resources, cultural diversity, and historical significance (MOTAC, 2021).

Tourism’s contribution to Malaysia’s economy is far-reaching, affecting numerous sectors directly and indirectly (Akarsu, G., 2023). The country’s natural, cultural, and unique attributes attract international tourists and generate income, employment, andforeign exchange, investment, and tax revenue, stimulating the growth of ancillary sectors such as transportation, agriculture, manufacturing, and services (Epperson, 1983; Rahim et al., 2022). Malaysia’s tourist arrivals from 2013 to 2022 show clear fluctuations influenced by both global and domestic factors. Arrivals remained relatively stable from 2013 to 2019, peaking at 6.75 million in the third quarter of 2019. However, numbers fell sharply from late 2019 onwards, dropping to 19,543 in the second quarter of 2020 due to COVID-19 and related travel restrictions.

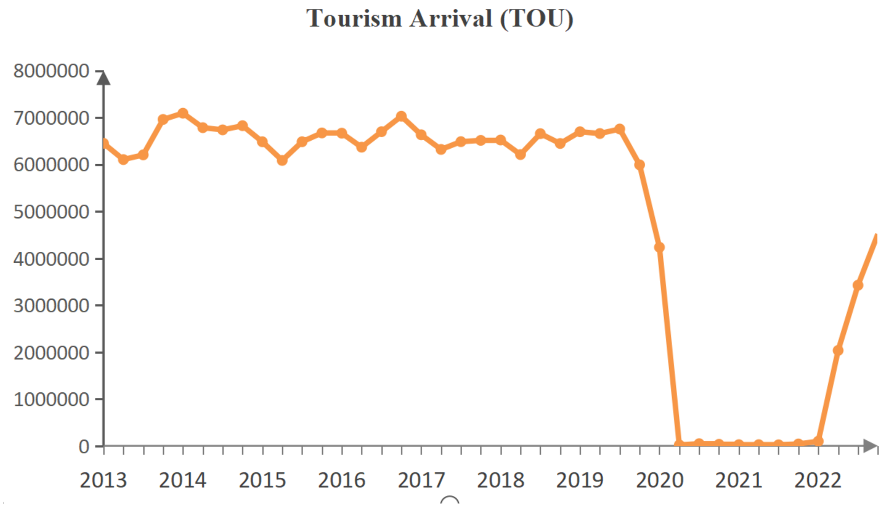

Figure 1: Tourist of Arrivals In Malaysia from 2013 to 2022

The tourism industry in Malaysia faced significant challenges during this period due to international travel restrictions and lockdowns. Although domestic tourism recovered slightly in the third quarter of 2020 with 46,422 visitors following the Recovery MCO, international arrivals remained low. By the third quarter of 2021, tourist numbers had declined further, reflecting ongoing travel limitations and health concerns. A turning point came in late 2021 and into 2022, as Malaysia began reopening its borders and implemented the Tourism Recovery Plan 2022 (PRE2.0). These measures helped revive the tourism sector by attracting international visitors, boosting domestic tourism, and supporting recovery and growth.

Tourism plays a key role in Malaysia's economic development, consistently contributing significantly to GDP and employment (Raihan et al., 2023). In 2019, tourism was the third-largest contributor to Malaysia's GDP and the country was the 11th most visited destination globally. Despite the COVID-19 shock, Malaysia still welcomed 4.33 million tourists in 2020, generating RM12.69 billion in revenue. These figures highlight tourism's resilience and its ability to drive economic growth. Higher tourist arrivals can boost income, employment, and related sectors, while stable exchange rates and strong infrastructure help attract more tourists. However, the COVID-19 crisis and subsequent recovery show the vulnerability of tourism to external shocks and the importance of policy measures in strengthening the industry (Raihan et al., 2023). Thus, understanding the relationship between tourism and macroeconomic factors is crucial for policy decisions and sustainable development. This study aims to investigate the short- and long-term relationships between tourist arrivals and key economic indicators in Malaysia, using a Vector Error Correction Model (VECM). The researcher explores how financial development, GDP, income, hotel infrastructure, and exchange rates affect tourism.

The relationship between financial development (FD) and tourism has been widely studied in the literature, emphasizing its key role in shaping tourism growth and expansion. Rasool et al. (2021) applied a panel ARDL approach to BRICS countries and found a long-term bidirectional relationship between financial development, tourism, and economic growth, suggesting that financial development and tourism mutually reinforce each other over time. Mulali et al. (2021) found that financial development positively influences tourist arrivals and expenditures in the top 20 destination countries from 1995 to 2017. Bari (2023) further demonstrated that financial development drives tourism expansion through various channels, including greater trade openness, improved infrastructure, and human capital formation, particularly in South Asia. Similarly, Tsaurai (2018) identified a bidirectional causal link between banking sector development and tourism in Southern Africa, reflecting a close interaction between financial institutions and tourism activity. Furthermore, Khanna and Sharma (2021) provided empirical evidence that financial development positively influenced tourist arrivals and expenditures, with a more pronounced impact in high-income countries. These findings collectively underline financial development's critical role in enhancing tourism growth through improved access to credit, investments in infrastructure, and greater financial inclusion. Nonetheless, regional disparities and the specific mechanisms through which FD influences tourism remain underexplored, highlighting the need for further empirical research.

In addition, the relationship between tourist arrivals and GDP has received considerable attention in the literature due to its implications for economic growth. Hashim et al. (2022) employed Ordinary Least Squares (OLS) to investigate this relationship in Malaysia and found that tourist arrivals and trade positively contribute to GDP growth. Pedak, M. (2018) show that while international tourism is positively related to GDP per capita, tourism specialisation tends to be negatively associated with GDP per capita, particularly in small Caribbean states. Similarly, Arslanturk et al. (2011) applied a Vector Error Correction Model (VECM) to Turkey's data from 1963 to 2006 and observed that tourism's role in driving economic growth became more important after the 1980s. Furthermore, Go and Ng (2022) used a nonlinearly autoregressive distributed lag (NARDL) approach to show that exchange rate appreciation and strong economic growth positively influence tourist arrivals, particularly from key markets. However, while international tourism is positively related to GDP per capita, tourism specialisation tends to be negatively associated with GDP per capita, particularly in small Caribbean states (Pedak, M., 2018). Nicolae et al. (2021) also showed that a large number of tourists arrival did not necessarily mean generating a considerable increase in Gross Domestic Product. Sadekin, M. N. (2025) revealed that tourism receipts, expenditures, and FDI have a long-term impact on economic growth, with tourism expenditures positively and FDI negatively affecting growth in the short term, and clear causal links found between tourism variables and GDP in Bangladesh,.

Moreover, tourism development is closely linked to income growth and inequality, with effects that vary across regions and economic contexts. Vlad et al. (2016) found a strong relationship between household income growth and tourist arrivals in Romania. Their study also showed regional differences in accommodation types. Rural Central areas had mostly low-comfort facilities, while the South East was dominated by hotels. He and Li (2019) highlighted that although tourism can increase average income, it may also widen income gaps due to unequal access to tourism opportunities.

Raza and Shah (2017) tested the tourism Kuznets Curve in 43 countries. They found that tourism initially increases income inequality, but in the long run, it can help reduce it as the benefits become more widely shared. Nguyen et al. (2021) further distinguished between international and national tourism. They showed that international tourism tends to reduce inequality, while national tourism requires institutional support, especially in low and middle income countries to achieve similar results. Fang et al. (2021) confirmed that in developing economies, tourism helps reduce inequality, but in developed countries, its effect is weak. They also found that economic globalization increases inequality in developing countries but has little impact in developed ones. These studies showed that tourism had both positive and negative effects on income distribution, depending on regional development levels, tourism types, and policy environments. Thus, the researcher explore this relationship in the context of Malaysia.

Furthermore, the availability and quality of hotel rooms are key factors influencing tourism development. Naudé and Saayman (2005) found that the number of hotel rooms per 1,000 residents had a significant positive effect on tourist arrivals, highlighting the importance of accommodation infrastructure in meeting tourism demand. Supporting this view, Seetanah and Fauzel (2019) studied tourism-related foreign direct investment (FDI) in Mauritius and found that FDI contributes to economic growth by improving hotel infrastructure. Although their analysis did not focus directly on hotel rooms, their findings suggest that investment in accommodation facilities plays an indirect but important role in attracting tourists.

In addition to quantity, service quality also matters. Chen and Chen (2010) examined Taiwan's hotel industry and found that better hotel service and room quality significantly increase customer satisfaction and loyalty, encouraging repeat visits and boosting tourism demand. Hernández-Rojas et al. (2021) further confirmed the importance of hotel infrastructure by showing a positive relationship between hotel room availability and tourist spending in their study of visitor behavior at the Alhambra in Spain.

Exchange rate dynamics, particularly the real effective exchange rate (REER), play a critical role in shaping tourism demand by influencing a destination's cost competitiveness. Tang (2011) identified a long-term relationship between REER, tourism, and real output in Malaysia, highlighting REER's significant impact on the tourism sector. Similarly, Nisthar and Nufile (2019) found that exchange rate fluctuations affect tourist arrivals in Sri Lanka, with currency depreciation enhancing destination affordability.Likewise, Alleyne et al. (2020) confirmed REER's strong influence on tourism flows in Barbados. In addtion, Chaudhry et al. (2022) showed that real exchange rate had a positive and significant relationship with tourism receipts in East-Asia and Pacific region.

These findings highlighted the importance of exchange rate stability in promoting international tourism and suggest that effective exchange rate management should be an integral part of tourism development strategies.

METHODOLOGY

This section presents the empirical framework and methods used to analyze the relationship between tourism and economic indicators in Malaysia. By employing a Vector Error Correction Model (VECM) in combination with complementary econometric tools, the Augmented Dickey-Fuller test and Johansen cointegration analysis, this study captures both short- and long-term dynamics among variables to effectively addressing the research objectives. This study uses methods from Rambeli et al. (2019). It applies the Dickey-Fuller test to check stationarity, the Johansen cointegration test to find long-term relationships, and Granger causality within a VECM to explore short-term links between variables.

Time Series Data

This study uses quarterly time series data for Malaysia from 2013 to 2022. Key variables include Tourist Arrivals (TOU), Money Supply (FD), GDP, Average Income of Malaysians (AVINCOME), Hotel Rooms (ROOMS), and Real Effective Exchange Rate (COST). Data were collected from Bank Negara Malaysia, the Department of Statistics Malaysia, CEIC Data, and the IMF. All variables were converted to natural logarithms to ensure consistency and comparability to analyse the impact of financial development on tourism growth in Malaysia.

Table 1: Variable and description

Symbol	Variable Name	Measurement	Source
TOU	Tourist Arrival	Tourist arrival , total (people)	CEIC
FD	Financial Development	M3, money supply total (RM Billion)	CEIC
GDP	Gross Domestic Product	Consumer Price Index (2010=100)	CEIC
AVINCOME	Average Income	Average income of Malaysians, total (RM)	International Monetary Fund
ROOMS	Hotel Rooms	Number of Malaysia's Hotel Rooms (unit)	CEIC
COST	Real Effective Exchange Rate	Consumer Price index (2010=100)	CEIC

Model Specification

This study uses the Cobb-Douglas production function, which explains output based on capital and labor. Originally developed by Cobb and Douglas (1928), it is widely used in productivity analysis. The method also follows Fauzel and Seetanah (2023), who used a dynamic model to study the link between financial development and tourism. The basic form of the Cobb-Douglas model is as follows:

$$TOU = \alpha FD^{\beta_1} GDP^{\beta_2} \varepsilon^{\mu_t} \quad (1)$$

Building upon the basic Cobb-Douglas framework, Rambeli et al. (2020) proposed an augmented model that incorporates additional macroeconomic variables to capture more comprehensive effects on productivity. For this study, the augmented model isexpressed as:

$$TOU = \beta_0 FD^{\beta_1} GDP^{\beta_2} AVINCOME^{\beta_3} ROOMS^{\beta_4} COST^{\beta_5} \varepsilon^{\mu_t} \quad (2)$$

Where, TOU represents Tourist arrivals, FD represents financial development, GDP represents gross domestic produc, AVINCOME represents average income, ROOMS represents hotel tooms and COST represents real effective exchange rate. Since equation (2) is a nonlinear model, the nonlinear model was converted to log-linear form for ease of estimation. This transformation allows for more accurate estimation of the coefficients and ensures comparability across variables with different units. The log-linear model is specified as:

$$\log TOU_t = \beta_0 + \beta_1 \log FD_t + \beta_2 \log GDP_t + \beta_3 \log AVINCOME_t + \beta_4 \log ROOMS_t + \beta_5 \log COST_t + \varepsilon_t \quad (3)$$

In Equation (3), all variables are in natural logarithmic form to address unit differences and improve model accuracy. The error term captures unobserved factors, and the coefficients (β_1 to β_5) represent elasticities. This means each coefficient shows the percentage change in Tourist Arrivals (TOU) from a 1% change in the corresponding variable.

Augmented Dickey Fuller Tests

The Augmented Dickey-Fuller (ADF) test is used to determine whether a time series is stationary. A unit root indicates the presence of a stochastic trend, meaning the series does not revert to its long-term mean.The test is predicated on the subsequent model:

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta_1 \Delta Y_{t-1} + \ldots + \delta_p \Delta Y_{t-p} + \varepsilon t \quad (4)$$

where t denotes a time trend, $\Delta y_t = y_t - y_{t-1}$, the lagged level of the series, and ΔY_{t-i} are the lagged differences of the series.

To conduct the test, the equation above is estimated using ordinary least squares, and the ADF test can be summarized with the following null and alternative hypotheses:

Null hypothesis:

$H_0: \gamma = 0$ (the series has a unit root and is non-stationary).

Alternative hypothesis:

$H_1: \gamma \neq 0$ (the series is stationary).

The unit root hypothesis of the ADF can be rejected if the t-test statistic from these tests is negative and less than the critical value tabulated. In other words, through the ADF test, a unit root exists in the series e (implies non-stationary) if the null hypothesis of delta equal zero is not rejected (Gujarati, 2004).

$$ADF = \frac{\hat{y}}{SE(\hat{y})} \quad (5)$$

where $\hat{y}$ is the estimated coefficient and $SE(\hat{y})$ is its standard error. The test statistic follows a non-standard distribution under the null hypothesis, so it is compared with the critical values from the Dickey-Fuller table. If the test statistic is more negative than the critical value, the null hypothesis is rejected and the series is considered stationary. The test can be performed with or without a constant and a time trend, depending on the characteristics of the series. The number of lags p can be determined by various criteria, such as the Akaike information criterion or the Bayesian information criterion.

Johansen Juselius Cointegration Tests

Following the application of the Augmented Dickey-Fuller (ADF) unit root test (Dickey & Fuller, 1979) to confirm stationarity in the time series data, the study employs the Johansen-Juselius cointegration test (Johansen & Juselius, 1990) to identify long-term cointegrating relationships among the variables.

The Johansen method relies on two likelihood ratio (LR) test statistics: the trace test (λ_{trace}) and the maximum eigenvalue test (λ_{max}). These test statistics are defined as follows:

Trace Test (λ_{trace}) evaluates the null hypothesis that there are at most r cointegrating vectors against the alternative of n cointegrating vectors:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \quad (6)$$

Maximum Eigenvalue Test (λ_{max}) examines the null hypothesis of r cointegrating vectors against the alternative of r+1:

$$\lambda_{max}(r, r+1) = -T\ln(1-\lambda_{r+1}) \qquad (7)$$

Where, T is the number of observations, λ_i represents the eigenvalues associated with the system of equations.

The trace test and maximum eigenvalue test complement each other by ensuring the identification of cointegration relationships within the model. Critical values for these test statistics are compared against the calculated values, as provided in the Osterwald-Lenum (1992) tables.

Vector Error Correction Model (VECM)

The Vector Error Correction Model (VECM) is used to investigate the short-term dynamics while accounting for the long-term equilibrium relationships among tourist arrivals, money supply, GDP, average income, hotel rooms, and real effective exchange rate. Granger (1969) explains that a variable X Granger-causes Y if the past values of X contain significant information to predict Y. For this causality to hold in a cointegrated system, both variables must be stationary at their first differences.

The Error Correction Term (ECT) plays a central role in the VECM by capturing deviations from the long-term equilibrium and describing how quickly the system adjusts back to its steady state. As Engle and Granger (1987) emphasized, excluding the ECT can lead to incorrect inferences in causality tests. The ECT ensures that short-term dynamics remain consistent with the cointegrating relationships.

The VECM equations employed in this study are as follows, where Δ denotes the first difference of each variable, tt represents time, and υ_t is the white noise residual:

$$\Delta TOU_t = \alpha_1 + \sum_{i=1}^{n} \alpha_i\, \Delta TOU_{t-i} + \sum_{t=1}^{n} \beta_i\, \Delta \log FD_{t-i} + \sum_{t=1}^{n} \theta_i\, \Delta \log GDP_{t-i} + \sum_{t=1}^{n} \delta_i \Delta \log AVINCOME_{t-i} + \sum_{t=1}^{n} \varphi_i\, \Delta \log ROOMS_{t-i} + \sum_{t=1}^{n} \omega_i\, \Delta \log COST_{t-i} + \gamma_i ECT_{t-1} + \upsilon_1 \qquad (8)$$

$$\Delta FD_t = \alpha_2 + \sum_{i=1}^{n} \alpha_i\, \Delta TOU_{t-i} + \sum_{t=1}^{n} \beta_i\, \Delta \log FD_{t-i} + \sum_{t=1}^{n} \theta_i\, \Delta \log GDP_{t-i} + \sum_{t=1}^{n} \delta_i\, \Delta \log AVINCOME_{t-i} + \sum_{t=1}^{n} \varphi_i\, \Delta \log ROOMS_{t-i} + \sum_{t=1}^{n} \omega_i\, \Delta logCOST_{t-i} + \gamma_i ECT_{t-1} + \upsilon_2 \qquad (9)$$

$$\Delta GDP_t = \alpha_3 + \sum_{i=1}^{n} \alpha_i\, \Delta TOU_{t-i} + \sum_{t=1}^{n} \beta_i\, \Delta \log FD_{t-i} + \sum_{t=1}^{n} \theta_i\, \Delta \log GDP_{t-i} + \sum_{t=1}^{n} \delta_i\, \Delta \log AVINCOME_{t-i} + \sum_{t=1}^{n} \varphi_i\, \Delta \log ROOMS_{t-i} + \sum_{t=1}^{n} \omega_i\, \Delta logCOST_{t-i} + \gamma_i ECT_{t-1} + \upsilon_3 \qquad (10)$$

$$\Delta AVINCOME_t = \alpha_4 + \sum_{i=1}^{n} \alpha_i\, \Delta TOU_{t-i} + \sum_{t=1}^{n} \beta_i\, \Delta \log FD_{t-i} + \sum_{t=1}^{n} \theta_i\, \Delta \log GDP_{t-i} + \sum_{t=1}^{n} \delta_i\, \Delta \log AVINCOME_{t-i} + \sum_{t=1}^{n} \varphi_i\, \Delta \log ROOMS_{t-i} + \sum_{t=1}^{n} \omega_i\, \Delta logCOST_{t-i} + \gamma_i ECT_{t-1} + \upsilon_4 \qquad (11)$$

$$\Delta ROOMS_t = \alpha_5 + \sum_{i=1}^{n} \alpha_i\, \Delta TOU_{t-i} + \sum_{t=1}^{n} \beta_i\, \Delta \log FD_{t-i} + \sum_{t=1}^{n} \theta_i\, \Delta \log GDP_{t-i} + \sum_{t=1}^{n} \delta_i \Delta \log AVINCOME_{t-i} + \sum_{t=1}^{n} \varphi_i\, \Delta \log ROOMS_{t-i} + \sum_{t=1}^{n} \omega_i\, \Delta logCOST_{t-i} + \gamma_i ECT_{t-1} + \upsilon_5 \qquad (12)$$

$$\Delta COST_t = \alpha_6 + \sum_{i=1}^{n} \alpha_i \, \Delta TOU_{t-i} + \sum_{t=1}^{n} \beta_i \Delta \log FD_{t-i} + \sum_{t=1}^{n} \theta_i \, \Delta \log GDP_{t-i} + \sum_{t=1}^{n} \delta_i \, \Delta \log AVINCOME_{t-i} + \sum_{t=1}^{n} \varphi_i \, \Delta \log ROOMS_{t-i} + \sum_{t=1}^{n} \omega_i \, \Delta logCOST_{t-i} + \gamma_i ECT_{t-1} + \upsilon_6 \quad (13)$$

From equations (8) to (13), the notation $\sum$ symbolizes the optimum lag selection for each variable in the dynamic modeling. In this study, the Akaike Information Criterion (AIC) in vector autoregression (VAR) is utilized in order to select the optimum lag length for each variable in the equation system (Guttierrez, 2007). Additionally, the notations to are denoted as constants. In each system of the dynamic equation, the ECT has been developed. The notation represents the white noise of each dynamic system.

A critical component of the VECM is the inclusion of the Error Correction Term (ECT), which quantifies the speed of adjustment of the dependent variable in response to deviations from the long-term equilibrium. The ECT captures the residual dynamics between cointegrated variables and provides insights into short-term adjustments driven by long-term disequilibria. As highlighted by Engle and Granger (1987), omitting the ECT can lead to model misspecification and inaccurate Granger causality test results.

In the VECM framework, the ECT not only ensures consistency with the long-term cointegrating relationship but also enhances the reliability of short-term causality inferences. If all variables in the study are found to be stationary at the first-difference level, the regression residuals of the long-term relationship can be used to estimate the ECT. The VECM is then specified to include the first-difference terms of each variable alongside the ECT, ensuring a comprehensive representation of both short-term and long-term dynamics.

Diagnostic and Stability tests

To ensure the model is free from parameter bias, inefficiency, and estimation errors, it is essential that the residuals exhibit a normal distribution, have a constant mean of zero, constant variance, no autocorrelation, and no multicollinearity (Bekhet & Othman, 2018). To verify these conditions, diagnostic tests such as the ARCH test, Breusch-Godfrey Lagrange Multiplier (LM) test, and Durbin-Watson (DW) test are conducted.

RESULTS

This section analyzes the relationship between tourist arrivals and key economic indicators in Malaysia using the VECM framework. The results reveal both short- and long-term links, highlighting the roles of financial development, GDP, income, hotel infrastructure, and exchange rates in shaping tourism demand. Supported by unit root, cointegration, and Granger causality tests, the findings offer practical insights for policymakers on how tourism can support sustainable economic growth in post-pandemic Malaysia.

Augmented Dickey Fuller Unit Root Test

The results of the Augmented Dickey-Fuller (ADF) unit root tests indicate that all variables are non-stationary at their level forms, as the t-statistics for all tests are statistically insignificant for rejecting the null hypothesis of non-stationarity. This implies that the series are integrated of order one, I(1), exhibiting unit root processes or common stochastic trends. Consequently, differencing was performed to achieve stationarity. As shown in Table 2, the null hypothesis of non-stationarity is rejected at the 1% and 5% significance levels for all variables in their first-difference forms. The ADF test results, accounting for both the time trend (trend and intercept) and no time trend (intercept only), confirm that the series are stationary after first differencing. Specifically:

At the level form, variables TOU, FD, GDP, AVINCOME, ROOMS, and COST are non-stationary under both trend and intercept specifications. For GDP, non-stationarity is also observed with a lag length of 17 (intercept only) and 18 (trend and intercept). At the first-difference form, all variables become stationary with t-statistics significant at the 99% confidence level across lag lengths of 8 and 9.

These findings validate the integration order of I(1) for all variables, meeting the precondition for cointegration analysis. The stationarity achieved at the first difference ensures the robustness of subsequent econometric modeling, such as the Johansen-Juselius cointegration test and the Vector

Error Correction Model (VECM). This confirms the appropriateness of the chosen methodological framework for examining the relationships among the variables.

Table 2: **Augmented Dickey Fuller (ADF) of Unit Root Test**

Variables	**At level**			**First difference**		
	None	Intercept	Trends and Intercept	None	Intercept	Trends and Intercept
TOU	-0.272509 [9]	-1.537686 [9]	-1.564661 [9]	-5.795115 *** [9]	-5.716328*** [9]	-5.674559*** [9]
FD	3.785015 [9]	-0.255287 [9]	-1.887516 [9]	-4.459111 ***[9]	-5.616250*** [9]	-5.553335*** [9]
GDP	-0.192141 [9]	0.036692 [18]	-1.576931 [17]	-5.798754 ***[9]	-5.709975*** [8]	-5.664550*** [8]
AVINCOME	3.354839 [9]	-1.162214 [9]	-2.997775 [9]	-6.633582 ***[9]	-6.262573*** [9]	-6.248127*** [9]
ROOMS	2.897743 [9]	-1.347893 [9]	-1.487099 [9]	-5.283203 ***[9]	-6.227837*** [9]	-6.272633*** [9]
COST	-1.496601 [9]	-2.089107 [9]	-2.124218 [7]	-4.442226 ***[9]	-4.669146*** [9]	-4.609922*** [9]

Noted: Numbers in [ ] are numbers of lag that follow Akaike Info Criterion (AIC). The sign *** indicates the significant level at 1%

The recorder value of AIC in Vector AutoRegression (VAR) Model

The determination of the optimal lag length is a critical step for conducting the Johansen-Juselius cointegration test, as it ensures the robustness of the estimation. The Vector AutoRegression (VAR) framework is employed to identify the optimal lag by comparing the Akaike Information Criterion (AIC) values across different lag lengths. For this study, lag lengths ranging from 1 to 4 were considered, as shown in Table 3.

The results reveal that the AIC value reaches its minimum at lag 4 (-26.40574), indicating it as the optimal lag length for the model. This finding implies that lag 4 provides the best fit for the unrestricted VAR model, minimizing information loss and improving the accuracy of parameter estimates. The optimal lag length identified here will be utilized consistently in the subsequent stages of analysis, including the development of the Error Correction Model (ECM) and the Vector Error Correction Model (VECM).

Table 3: The recorder value of AIC in Vector Auto regression (VAR) Model

Lag Length	**Akaike Information Criterion (AIC)**
1	-23.72757
2	-23.47640
3	-23.81037
4	-26.40574*

The Result of Johansen Juselius Co-integration System

Table 4 reports the results of the Johansen-Juselius cointegration test, which is employed to examine the long-term equilibrium relationships among the dependent and independent variables. This test identifies the presence of cointegrating vectors, indicating a stable long-term relationship among the variables in the system. The inclusion of an error correction term (ECT) in the Vector Error Correction Model (VECM) becomes necessary when cointegration is confirmed, as it accounts for short-term deviations while preserving the long-term equilibrium.

The cointegration analysis uses two likelihood ratio statistics—trace (λtrace) and maximum eigenvalue (λ_{max})—to determine the number of cointegrating vectors. The critical values are obtained from the Osterwald-Lenum (1992) table. The results indicate the existence of at least one cointegrating vector, signifying a long-term equilibrium relationship among the variables. For the first cointegrating vector, the trace statistic (λ_{trace}) is 189.4950, which exceeds the 5% and 1% critical values of 94.15 and 103.18, respectively. The maximum eigenvalue statistic (λ_{max}) is 75.68285, which is also greater than the corresponding critical values of 39.37 and 45.10. Similarly, the second cointegrating vector shows a trace statistic of 113.8121, surpassing the 5% and 1% critical values of 68.52 and 76.07. The maximum eigenvalue statistic for this vector is 52.76473, which exceeds the critical values of 33.46 and 38.77. For the third cointegrating vector, the trace statistic is 61.04741, exceeding the critical values of 47.21 and 54.46 at the 5% and 1% significance levels, respectively, while the maximum eigenvalue statistic of 38.92426 also surpasses the critical values of 27.07 and 32.24.

These findings confirm the presence of three significant cointegrating relationships in the system, establishing a long-term equilibrium among the variables. This highlights the necessity of incorporating error correction terms in the subsequent VECM estimation to capture both short-term adjustments and long-term dynamics effectively.

Table 4: The Result of Johansen Juselius Co-integration System

Hypothesis		**Co-integrating System**					
H0	*H1*	Trace Statistics	5% Critical Value	1% Critical Value	Max Eigenvalue	5% Critical Value	1% Critical Value
r = 0	r > 0	189.4950**	94.15	103.18	75.68285**	39.37	45.10
r ≤ 1	r > 1	113.8121**	68.52	76.07	52.76473**	33.46	38.77
r ≤ 2	r > 2	61.04741**	47.21	54.4h6	38.92426**	27.07	32.24
r ≤ 3	r > 3	22.12315	29.68	35.65	15.09986	20.97	25.52
r ≤ 4	r > 4	7.023291	15.41	20.04	5.264333	14.07	18.63
r ≤ 5	r > 5	1.758958	3.76	6.65	1.758958	3.76	6.65

Note: Critical values are obtained from Osterwald-Lenum (1992). Sign (**) indicates rejected critical values at significant level of 5% and (*) at 1%.

Granger Causality Test in VECM Framework

After applying the parsimonious model, the results of the Granger causality test within the Vector Error Correction Model (VECM) framework provide further insights into the short- and long-run dynamics among the variables. As shown in Table 5, the Error Correction Term (ECT) values for financial development (FD), gross domestic product (GDP), and the real effective exchange rate (COST) are negative, less than one, and statistically significant. These results indicate that these variables help restore the system to its long-run equilibrium. In contrast, the ECT values for tourist arrivals (TOU), average income (AVINCOME), and the number of hotel rooms (ROOMS) are positive, less than one, and statistically significant. While positive ECT coefficients do not necessarily imply divergence, they may reflect complexities or inefficiencies within the cointegrated system. Overall, these findings support the existence of long-term causal relationships, with causality flowing from variables with negative ECT coefficients to those with positive ones.

The Error Correction Term (ECT) measures the speed at which variables adjust to deviations from long-run equilibrium. Negative ECT values indicate movement toward equilibrium, while positive values may suggest divergence or the influence of other structural factors.

As shown in Table 6, the Granger causality test reveals both bidirectional and unidirectional relationships among variables. For example, GDP Granger-causes TOU (F-statistic = 4.036838, p = 0.0396), and FD Granger-causes GDP (F-statistic = 7.345926, p = 0.0161), highlighting the importance of financial and economic factors in influencing tourism growth, and vice versa. Additionally, COST Granger-causes FD (F-statistic = 7.594388, p = 0.0033), suggesting that exchange rate dynamics have a significant impact on financial development.

There is also a unidirectional relationship from AVINCOME to FD (F-statistic = 4.229433, p = 0.0173), indicating that income levels affect the growth of the financial sector. Similarly, AVINCOME Granger-causes GDP (F-statistic = 5.242628, p = 0.0076), underscoring the link between income, economic output, and financial development. However, ROOMS and COST do not show significant causal relationships with TOU in the parsimonious model.

In conclusion, the results support the existence of long-term relationships among the variables while clarifying short-term dynamics. The significant ECT coefficients confirm the system's stability, indicating that deviations from equilibrium are gradually corrected. These findings offer valuable insights for policymakers, emphasizing the need to understand the interactions between tourism, macroeconomic variables, and structural factors in promoting sustainable growth.

Table 5: The results of Granger Causality in VECM Framework

Dependent Variables	**Independent Variables**						
	TOU	FD	GDP	AVINCOME	ROOMS	COST	ECT
TOU	-	2.443995 (0.0994)	2.440207 (0.1170)	2.013125 (0.1642)	1.628845 (0.2253)	1.130514 (0.3647)	0.000264 (0.9925)
FD	1.601686 (0.2253)	-	2.623328 (0.1054)	4.229433 (0.0173)	2.514077 (0.0978)	1.088478 (0.3619)	-0.001151 (0.0216)**
GDP	4.036838 (0.0396)	7.345926 (0.0161)	-	5.242628 (0.0076)	2.655737 (0.0741)	2.969579 (0.0655)	-0.321023 (0.0067)***
AVINCOME	0.36789	-	-	-	-	-0.298194 [0.7675]	0.000978 [0.0128]**
ROOMS	0.617326 [0.6111]	0.915235 [0.4497]	1.559576 [0.2249]	0.621375 [0.4389]	-	0.004533 [0.9469]	0.000667 [0.1369]
COST	3.222922 [0.0602]	7.594388 [0.0033]	1.214242 [0.3169]	2.896969 [0.1035]	3.670904 [0.0429]	-	-0.000137 [0.5747]

Table 6: Summarize of overall Temporal Granger Causality test

Number of Directions	Unrecovered Regime (Direction of Causality)	Wald Test	p-value	Decision
1	FD does not Granger Cause TOU	1.601686	0.2253	Accept
	TOU does not Granger Cause FD	2.443995	0.0994*	Reject
2	GDP does not Granger Cause TOU	4.036838	0.0396**	Reject
	TOU does not Granger Cause GDP	2.440207	0.117	Accept
3	AVINCOME does not Granger Cause TOU	-	-	-
	TOU does not Granger Cause AVINCOME	2.013125	0.1642	Accept
4	ROOMS does not Granger Cause TOU	0.617326	0.6111	Accept
	TOU does not Granger Cause ROOMS	1.628845	0.2253	Accept
5	COST does not Granger Cause TOU	3.222922	0.0602*	Reject
	TOU does not Granger Cause COST	1.130514	0.3647	Accept
6	GDP does not Granger Cause FD	7.345926	0.0161**	Reject
	FD does not Granger Cause GDP	2.623328	0.1054	Accept

7	AVINCOME does not Granger Cause FD	-	-	-
	FD does not Granger Cause AVINCOME	4.229433	0.0173**	Reject
8	ROOMS does not Granger Cause FD	0.915235	0.4497	Accept
	FD does not Granger Cause ROOMS	2.514077	0.0978*	Reject
9	COST does not Granger Cause FD	7.594388	0.0033***	Reject
	FD does not Granger Cause COST	1.088478	0.3619	Accept
10	AVINCOME does not Granger Cause GDP	-	-	-
	GDP does not Granger Cause AVINCOME	5.242628	0.0076***	Reject
11	ROOMS does not Granger Cause GDP	1.559576	0.2249	Accept
	GDP does not Granger Cause ROOMS	2.655737	0.0741*	Reject
12	COST does not Granger Cause GDP	1.214242	0.3169	Accept
	GDP does not Granger Cause COST	2.969579	0.0655*	Reject
13	ROOMS does not Granger Cause AVINCOME	0.621375	0.4389	Accept
	AVINCOME does not Granger Cause ROOMS	-	-	-
14	COST does not Granger Cause AVINCOME	2.896969	0.1035	Accept
	AVINCOME does not Granger Cause COST	-0.298194	0.7675	Accept
15	COST does not Granger Cause ROOMS	3.670904	0.0429**	Reject
	ROOMS does not Granger Cause COST	0.004533	0.9469	Accept

Diagnostic and stability tests

To ensure the reliability of the Vector Error Correction Model (VECM), this study conducted several diagnostic tests, including the Autoregressive Conditional Heteroskedasticity (ARCH) test, the Breusch-Godfrey Lagrange Multiplier (BG-LM) test, and the Durbin-Watson (DW) statistic. As shown in Table 7, the ARCH test results show no significant heteroskedasticity, with p-values above 0.05, indicating stable residual variance. The BG-LM test confirms the absence of serial correlation, supporting the model's dynamic specification. Additionally, DW values are close to 2 for all dependent variables, suggesting no first-order autocorrelation. These diagnostic results confirm that the residuals meet key statistical assumptions, reinforcing the reliability and stability of the VECM (Shahzad et al., 2014; Saygin & Iskenderoglu, 2022).

Table 7: Diagnostic and Stability test

Dependent Variables	ARCH	BG-LM	DW
TOU	0.0123	0.1235	1.6845
FD	0.0321	0.0842	2.1839
GDP	0.0543	0.1023	2.1820
AVINCOME	0.0215	0.1542	2.2823
ROOMS	0.0623	0.2025	2.0275
COST	0.03424	0.1821	2.0856

DISCUSSIONS AND IMPLICATIONS

Summarizing the key findings, our research reveals significant long-term relationships between tourist arrivals and key macroeconomic indicators in Malaysia, including financial development, gross domestic product (GDP), average income, hotel infrastructure, and the real effective exchange rate (REER). These findings provide important insights into how tourism interacts with broader economic variables to shape Malaysia's development path.

A breakthrough in our study is evident in the identification of financial development (FD) as a major driver of tourism growth. This aligns with the findings of Rasool et al. (2021) and Tsaurai (2018), who also observed a bidirectional relationship between financial development and tourism in both

BRICS and Southern African countries. Our findings strongly support the notion that a well-developed financial system facilitates tourism by improving investment access, enhancing infrastructure, and stimulating broader economic activity. This is further corroborated by Bari (2023), who highlighted the role of financial development in promoting trade openness and human capital formation. However, the reverse causality from financial development to tourism arrival was not statistically significant, suggesting that in Malaysia's case, tourism may be a more proactive driver of financial engagement than vice versa.

It is evident from our results that GDP has a positive influence on tourist arrivals, supporting the tourism-led growth hypothesis. This observation is in line with Hashim et al. (2022), who demonstrated that tourism and trade significantly contribute to economic growth in Malaysia. Similarly, Arslanturk et al. (2011) reported that tourism became a more important contributor to growth in Turkey after the 1980s. However, our findings also suggest that the relationship between tourism and GDP may not be universally linear. For instance, Pedak (2018) found that tourism specialization can negatively impact GDP in small island economies, a view echoed by Nicolae et al. (2021), who observed that high tourist volumes do not always result in proportional economic growth.

The study indicate that hotel infrastructure (ROOMS) may play a facilitating role in driving tourist arrivals (TOU). Although it is not strongly significant, this result suggests that improvements in accommodation capacity could precede and potentially stimulate tourism growth. This finding is consistent with Naudé and Saayman (2005), who emphasized the critical role of hotel availability in attracting tourists. Moreover, Chen and Chen (2010) highlighted that the quality of hotel services significantly influences customer satisfaction and loyalty, further enhancing tourism demand. However, the infrastructure investment likely serves as a proactive rather than reactive component in tourism development.

This suggests that, within the Malaysian context during the study period, exchange rate fluctuations did not play a strong predictive role in shaping short-term tourism demand. This result contrasts with earlier findings by Tang (2011) and Nisthar and Nufile (2019), who reported a significant long-term relationship between exchange rates and tourism flows in Malaysia and Sri Lanka, respectively. One possible explanation for this discrepancy could be that other macroeconomic or structural factors, such as visa policy, destination image, or geopolitical stability, vershadow the impact of cost competitiveness in the short run. Therefore, while exchange rate remains a theoretically important determinant of international tourism demand, its predictive power in this model appears limited, warranting further investigation using alternative specifications or longer time horizons.

CONCLUSIONS

This study explored the relationship between financial development and tourism growth in Malaysia from 2013 to 2022, using a Vector Error Correction Model (VECM). The results show that financial development has a significant long-term positive effect on tourism. Key economic factors such as GDP, average income, and hotel infrastructure were also found to influence tourist arrivals. Importantly, the study found a bidirectional causal link between financial development and tourism, as well as between financial development and GDP. This suggests that improvements in the financial sector support tourism growth, and vice versa. The findings provide useful policy implications. Expanding credit access and investing in tourism-related infrastructure can strengthen the tourism sector. Maintaining steady economic growth and reducing income inequality are also important for increasing tourism demand. Improving hotel facilities and managing exchange rate stability can further enhance Malaysia's competitiveness as a tourist destination. However, this study has some limitations. It uses annual data, which may miss short-term effects. The focus on national-level data means regional differences are not captured. Also, external shocks such as pandemics or global crises were not included in the model. Future studies can use more frequent or regional data and apply different models such as ARDL or SEM to test the results further. Including external factors could also help improve the understanding of the tourism-finance relationship. Despite these limitations, the study provides strong evidence that financial and economic development are closely linked to tourism growth in Malaysia.

Authors' Contributions

Li Yijun contributed to the design and implementation of the research, and Norimah Rambeli2, Norasibah binti Abdul Jalil, Nooraisah Katmon, Muhammad Ikhmal Bin Mazlan, Puvashini A/P Krishnan contributed to data analysis.

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