Elasticity of the Number of World Cruise Tourists Using the Vector Error Correction Model

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Abstract: Along with the growth of the marine tourism industry, the number of global cruise tourists is rapidly increasing; the competition among regions to attract cruise tourists is increasing. The current study aims to verify that the global cruise tourism industry can be sustainable through its inherent power for long-term balanced convergence within the industry and can flexibly respond to external shocks such as COVID-19. This study applies the Vector Error Correction Model (VECM) to estimate the long-term balance function that determines the number of world cruise tourists. This study reveals that the number of world cruise tourists finally converges to long-term balance if the number of world cruise tourists at present is lower than the one at long-term equilibrium. In summary, the results of the VECM in the present study suggest the presence of an “invisible hand” in the global cruise tourism industry converging to a long-term balance. A few previous studies have suggested ways to increase global cruise tourists and promote the cruise tourism industry through qualitative methods, however, little research has estimated the decision function of the number of cruise tourists at a long-term equilibrium point. This study shows the dynamic characteristics of the cruise tourism market using the VECM.

Keywords: cruise tourism industry; number of cruise tourists; elasticity of cruise tourists

1. Introduction

In accordance with the Cruise Lines International Association (CLIA) [1], the global cruise market recorded approximately 29.7 million tourists with USD 53.6 billion in direct consumption in 2019. The global cruise market shows an annual average growth of 2.12% in cruise tourists from 2000 to 2019. The growth of the cruise tourism industry is expected to continue in the future by CLIA. CLIA explained that cruise tourism is eco-friendly, as it uses eco-cruise ships and predicts that the number of tourists is expected to increase in the future as tourists’ preference for eco-friendly tourism increases.

Paniccia et al. [2] mentioned that eco-friendly tourism for global sustainable tourism has been critical for the advancement of tourist destinations in recent decades and value co-creation in particular. Cruise tourism is in the spotlight as an eco-friendly option in the post-COVID-19 era, with less environmental pollutant emissions compared to trips using aircrafts or land transportation, according to Ma et al. [3]. Saerens et al. [4] noted that the surge in the number of global tourists is feared to increase environmental pollutant emissions and predicted that cruise ships that strengthen their environmental capabilities are likely to emerge as the main alternative in the sustain global tourism, cutting across borders. In addition, several prior studies have focused on the emerging means of travel, including the cruise, for the sustainability of the global tourism industry. Chang and Hsieh [5] analyzed the commercialization of festivals as tourism goods, referring to cruise tours as the appropriate tools for enjoying the traditional festivals of the country or city. Han et al. [6] predicted that the cruise would become a future growth engine for the
world tourism industry and that the size of the cruise tourism industry needed to be regularly estimated.

Several factors can affect cruise tourists’ attractions. A few previous studies analyzed the correlations among factors affecting cruise tourists’ attraction. Wild and Dearing [7] and Brida et al. [8] explained that global economic growth, consumption, and the cruise fleets are major factors affecting cruise tourists’ attraction. Andriotis and Agiomirgianakis [9] and Juan and Chen [10] explained the attractiveness of the tour destination, the service quality of cruise tours, and the price of cruise tour packages are major factors affecting cruise tourists’ attraction. Recent literature conducted after the COVID-19 outbreak pointed to the cruise ship’s quarantine systems and customs convenience, etc., as the major factors affecting cruise tourists’ attraction. Li et al. [11] stressed that the installation of a systematic quarantine system in the cruise ship is an essential factor, and Kenji and Chowell [12] mentioned that customs convenience should be maintained even after the outbreak of COVID-19 for cruise tourists’ attraction. However, most of the prior studies have not conducted an econometrical analysis for exploring major factors affecting cruise tourists’ attraction.

Meanwhile, this study uses cruise data presented by the British shipping consulting firm Clarksons to estimate the magnitude of the influence of the various explanatory variables on the number of worldwide cruise tourists from 1996 to 2020 as a dependent variable. The explanatory variables used in this study are worldwide total cruise fleets by year, cruise order volume by year, and GDP growth rates in the EU and Asian regions by year from 1996 to 2020 [13]. In addition, this study aims to identify that the global cruise tourism industry can be sustainable through its inherent power for long-term balanced convergence within the industry and its flexibility in responding to external shocks such as COVID-19.

In summary, while most prior studies qualitatively present key factor-specific influences on the global cruise tourism industry, this study aims to quantitatively estimate key factors in the number of worldwide cruise tourists and shows critical factors influencing the global cruise tourism industry. To improve cruise tourists’ attraction in the post-COVID-19 era, it is necessary to discern the determinants that positively influence the increase in cruise tourists. In addition, this study confirms whether the invisible hand in the global cruise tourism industry converging to a long-term balance exists or not for recovering from external shock such as COVID-19 for sustainability.

The remainder of the current study is formed as the follows: Section 2 examines preceding studies with similar methodologies using the VECM or ones related to the tourism or cruise tourism industry. Section 3 introduces the regression model used in this study, and Section 4 presents the regression analysis results using a co-integration model, VECM, etc. In Section 5, the primary conclusion of this study is summarized and suggestions are presented.

2. Review of Prior Studies

2.1. Prior Studies Related to Methodologies (Econometric Models)

This study reviews the previous research using econometric models such as the co-integration model, the VECM, and so on. We particularly examine the prior studies that analyzed factors affecting the demand of some variables or the correlation between dependent variables and explanatory variables. Through reviewing, this study attempts to grasp the similarities between previous studies and the present study and find implications in prior studies.

Stock and Watson [14] performed an empirical analysis applying time-series data to illustrate the usefulness of the VAR (Vector Autoregression) model. Before the 1980s, single equation models were often used to estimate the correlation between variables. However, using a new macro-econometric framework, called the VAR model, it is possible to obtain more statistically promising results through multivariate analysis. The VAR model means an n-equation, an n-variable linear model where each variable is interpreted by its lagged
values and the current and past values of the rest variables. Such a framework offers an organized method to catch robust dynamics in many time series, so the statistical tool that followed VARs was easy to apply [14].

Hoover et al. [15] performed a theoretical review of the VECM. Two facts argue for the VECM method: (1) a statistical basis shows that nonstationary data are pervasive; (2) the economic theoretical issue is primarily related to the revision of one variable to another in pursuit of separately optimal, systematically more organized results. Through the combination of differenced and co-integrated data, the VECM corresponds to those. Economic data are examined as short-run fluctuations around a moving long-run equilibrium. Long-run forces are split into the forces which move the equilibrium and forces that correct deviations from the equilibrium. Interpreted in this way, the VECM provides an opportunity for whether the invisible hand converging to a long-term balance exists or not [15].

Brolund and Lundmark [16] investigated whether environmental regulations affected productivity in the European pulp and paper industries and caused technological changes using a dynamic panel data approach based on VECM. The VECM regression results showed that the regulation of nitrogen oxides was related to productivity improvements, especially in the short term. In contrast, sulfur dioxide and carbon dioxide rules have no statistically significant relation to industries’ productivity. This study showed that productivity converges on balance in the short term, but the level of deviations from balance increases in the long term, contrary to findings in the present study that cruise tourists converge on balance in the long term [16].

Lee and Lee [17] focused on the rapidly growing number of Korean cruise tourists. They analyzed some major variables influencing marine tourists’ consumption expenditure through a probit model using time series data. This study showed that tourists’ job status, annual income, and nationality significantly affected consumption expenditure in marine tourism. In addition, this study found that Japanese and Chinese tourists’ spending was higher among tourists of various nationalities who enjoyed marine tourism. This study analyzed the major factors affecting marine tourists’ consumption expenditure and showed that it is desirable to target their nationality for attracting consumption expenditure [17].

Georgantopoulos [18] identified the tourism industry as an important factor in the Greek economy. They used the VAR model and VECM to calculate the relationship between tourism expenditure and the growth rate of the tourism industry using time series data from 1988 to 2011. This study classified tourism expenditure into business and leisure purpose expenditures. It estimated the elasticity of tourism expenditure to the development of the tourism sector at a long-term equilibrium point. According to the results of this study by forecasting for tourism market during 2012–2020, tourism expenditure is expected to increase continuously, especially for business purposes [18].

Gosse and Serranito [19] estimated the long-term balance function using VECM with panel data to analyze factors affecting economic growth in the major developed and developing countries in world, including the US, Spain, Japan, Australia, and Greece. It showed that developed countries converge on long-term balance faster than developing countries when the economic growth of these countries differs from the ones at long-term balance. This result indicates that advanced countries with sufficient resources, including human and financial capital, can overcome economic crises faster than developing countries. This study is similar to our study in that it estimated long-term balance function through regression analysis based on rich data collected over a long time period [19].

Fung [20] estimated future container shipments for Hong Kong ports using the VECM, estimating a long-term balance function for Hong Kong container traffic volume by using long-term time-series data and the application of differential transformation. Meanwhile, the Hong Kong Port Development Board (PDB), a port authority in Hong Kong, also regularly forecasts future container volume, which is lower than the predicted results of this study. Therefore, Fung’s [20] study proposed an earlier construction of new terminals
considering the underestimation by the PDB and proposed effectively helpful policies based on regression analysis results.

2.2. Prior Studies Focusing on Tourism (Including Cruise Tourism)

Next, this study examined prior studies which researched the tourism or cruise tourism industry, including features of tourism, cruise tourism, cruise tourists, etc. Many prior studies have analyzed various aspects of the cruise tourists, including their motivation and satisfaction.

Wild and Dearing [7] conducted an analysis on various factors related to the European cruise industry and estimated its growth rate in the future. This study analyzed various aspects related to both hardware and software in the EU cruise industry, including cruise ships and cruise seafarers calling at EU ports and exclusive cruise terminals within EU regions. According to this study, the EU cruise market ranked second only to North America in cruise tourists. However, the gap in the cruise market size between the EU and North America could be reduced if the EU cruise market steadily strengthens its collaborations between the government and the private sector [7].

London et al. [21] stated that major cities around the world are facing a crisis of suspension of cruise infrastructure development due to the spread of the COVID-19. Meanwhile, competitive interests must be considered when developing infrastructure; for example, if neighboring countries started developing cruise infrastructure earlier due to the relief of COVID-19, this could delay the development of their own cruise infrastructure. This study conducted interviews with significant stakeholders in New Zealand. Empirical findings reveal that network fragmentation was obvious, resulting in crucial risks of suspension of cruise infrastructure development. This study identified that network fragmentation could be caused by social instability, competing interests, inadequate governance, and so on [21].

Encalada et al. [22] stated that Information and Communication Technologies (ICTs) make organizations and communities smart. As cities become complex, ICTs contribute to a more competitive tourism destination for new tourists. This study noted that as travelers’ chances of acquiring information have increased recently, travelers and travel agencies conduct in-depth analyses, such as utilizing big data and selecting the travel destination that best matches them. In addition, the study quantitatively showed that if most of the existing trips were by airplane, the number of new conceptual and experiential travel products using various means such as cruises, rafts, and steamers has also been increasing recently [22].

Andriotis and Agiomirgianakis [9] proposed measures to improve the satisfaction level of cruise tourists by comprehensively analyzing major factors related to cruise tourists visiting the Heraklion port in Greece, including the motivation of cruise tour, cruise tour satisfaction level, and the possibility of a return to Heraklion in future, using the survey method. According to this study, curiosity and exploration were the main motivations for cruise tourists’ visiting the Mediterranean area, including Greece. The diversity of cruise tour programs and service levels in cruise ships are important factors in determining satisfaction in cruise tourism [9].

Brida et al. [8] analyzed cruise tourists’ tendency for expenditure, preference for tour program, overall cruise tour experiences, among others, based on a survey of 1361 cruise tourists visiting the Cartagena area. Based on survey results, this study proposed strengthening the security of Cartagena, developing marketing policies, and extending inland tourism time to encourage cruise tourists. This study presented specific policies based on a survey with a large sample constituting 1361 cruise tourists [8].

According to Chung et al. [23], the number of tourists who like free travel has increased, given the recent developments in information technology, including Facebook and Instagram. Thus, the tourists will visit more tourist spots and make more complex travel styles than those in the past. They visualized the movement patterns of European travelers and showed major factors affecting European cruise tourists’ attraction through survey analyses [23].
Pham et al. [24] estimated the economic effects of the inbound tourism sector on the Australian economy during COVID-19 using a novel method with complete economy data incorporated in tourism CGE modeling. Results from their study present that the COVID-19 affects various industries and jobs that are even beyond the tourism field. Their study suggested that the recovery of the tourism industry could produce spillover effects for other sectors in the Australian economy and across whole occupations in the labor market [24].

Holland et al. [25] stated that COVID-19 has ravaged the cruise industry. Their study estimated the effect of COVID-19 on willingness to cruise for respondents who lived in Australia and the United Kingdom. Their results show that the cruise industry in both countries is transforming into the following five forms of cruise tourism for the sustainability of the cruise industry: (a) clean and safe tourism, (b) luxury tourism, (c) domestic-centered tourism, (d) flexible tourism that can be rescheduled, and (e) noncontact tourism in small groups and individuals are now highlighted. Their study derived a strategy of change for the survival of the cruise industry and suggested that the effects of COVID-19 on the cruise sector should be discussed within the social amplification of the risk framework [25].

For the Asia cruise study, Juan and Chen [10] analyzed the main factors affecting Taiwanese cruise tourists at each stage, ranging from planning cruise tours to the decision-making phase of travel and repurchase. This study showed that the price and duration of travel are the main factors affecting the decision making of Taiwanese cruise tourists. However, their study showed that the quality of service rather than the price level is the most significant factor when deciding the future repurchase of cruise tour products. Their study provided the most important factors that affect cruise tourists’ decisions at each stage, from choosing the cruise tour products to the repurchases [10].

Since the COVID-19 outbreak, a few kinds of research related to the reconstruction of the tourism industry and the tour quarantine system have been carried out. Sharma et al. [26] proposed the resilience-based structure for recovering the world tourism sector. On the basis of the previous study review, their study suggested a structure to recover the world tourism sector in the post-COVID-19 era. The structure in their study outlined four major determinants for constructing resilience in the tourism industry, such as administration footwork, innovation, and so on [26].

Abbas et al. [27] presented the substantial influence of COVID-19 on the tourism sector and suggested policy initiatives for resetting the tourism sector’s sustainability. Their study demonstrated that COVID-19 has led to global, economic, and healthcare emergencies. According to their study, the leisure and domestic tourism sectors experienced a steep drop. The findings provided in this study for regaining the global tourism industry are the government subsidies, the strengthened quarantine system, and the promotion of travel packages [27].

Zhang et al. [28] proposed a mixed approach for forecasting tourism demand in COVID-19 era. For this purpose, quantitative methods were integrated with qualitative methods. Their study presented tourists’ perception of safety, health infrastructure, tourism occasions, financial support, etc., for the reconstruction of the travel industry [28]. Škare et al. [29] evaluated the effects of COVID-19 on the tourism sector. Through VAR and system dynamic modeling, their study addressed the effect of the COVID-19 crisis on the global tourism sector [29].

3. Methodology

3.1. Granger Causality Test

Through the Granger Causality test, we can decide whether time series is helpful in forecasting another. Granger Causality means an econometrical notion of causality based on variables forecasting. In accordance with Granger causality, when a signal $X_1$ Granger causes a signal $X_2$, the past values of $X_1$ should include information that supports
the estimate $X_2$ above the information included in past values of $X_2$. Granger Causality equation is shown in Equations (1) and (2) below:

\[ X_1(t) = \sum_{j=1}^{p} A_{11j}X_1(t-j) + \sum_{j=1}^{p} A_{12j}X_2(t-j) + E_1(t) \]  

\[ X_2(t) = \sum_{j=1}^{p} A_{21j}X_1(t-j) + \sum_{j=1}^{p} A_{22j}X_2(t-j) + E_2(t) \]  

where $p$ means the maximum number of lagged observations, the matrix $A$ reflects the coefficients of the model of the contributions of lagged observation to the anticipated values of $X(t)$, and $E(t)$ reflects residuals. When the variance of $E(t)$ is decreased by the incorporation of the $X(t)$ terms in the equations, it is reported that $X_2$ (or $X_1$) Granger causes $X_1$ (or $X_2$). $X_2$ Granger causes $X_1$ since the coefficients in $A_{12}$ are conjointly meaningfully different from zero. Such matter will be examined by conducting an F-test of the null hypothesis that $A_{12} = 0$, considering assumption of covariance stationarity on $X_1$ and $X_2$. The F-statistic test was employed to estimate the extent of a Granger causality of the variables in the present study.

3.2. Unit Root Test

The stationarity of a series is significant because information at the long-term equilibrium among the variables may be lost even though the problem of non-stationarity could be simply solved by using the difference. When $X$ and $Y$ series are non-stationary random procedures (integrated), $X$ and $Y$ relationships in an OLS (Ordinary Least Squares) model will only generate a spurious regression in the following Equation (3):

\[ Y(t) = \alpha + \beta X_t + \epsilon_t \]  

Stationarity of time series means the statistical features of a series such as its mean and variance, and the series is said to be a stationary when both are constant over time; otherwise, the series is called as being a non-stationary procedure. Differencing a series means differencing the variables of other sets of observations such as the first-differenced values, the second-differenced values, and so forth.

\[ X \text{ level } X_t \]  

\[ X \text{ 1st-differenced value } X_t - X(t-1) \]  

\[ X \text{ 2nd-differenced value } X_t - X(t-2) \]  

When a series is stationary without any differencing, it is designated as I (0), integrated of order 0. Whereas a series that has stationary first differences is called I (1), unit root order one (1). The Augmented Dickey–Fuller test was applied to examine the stationarity of the variables.

3.3. Co-Integration Test

The present study uses two tests (the maximum Eigen value test and the trace test) to decide the number of cointegration vectors. The maximum Eigen value statistic examines the null hypothesis of $r$ cointegrating relationships against the alternative of $r + 1$ cointegrating relations for $r = 0, 1, \ldots + \ldots + n - 1$. Equation (5) describes the maximum Eigen value test as follows:

\[ R_{\text{max}}(r/n + 1) = -T \times \log(1 - \lambda) \]  

where $\lambda$ is the maximum Eigenvalue and $T$ means the sample size (=25 years).

The trace test investigates the null hypothesis of $r$ cointegrating relations against the alternative of $n$ cointegrating relations. Its equations can be described as the following Equation (6):

\[ R_{\text{tr}}(r/n) = -T \times \sum_{i=r+1}^{n} \log(1 - \lambda_i) \]
On some occasions, the maximum Eigen value test, and the trace test may show different results, and usually, the results of the trace test are preferable in this case. The present test refers to both results of two tests.

Moreover, the following Formula (7) describes the Co-Integration equation of the present study:

\[
\ln(CT_t) = \alpha + b_1 \ln(CS_t) + b_2 \ln(NCS_t) + b_3 \ln(EUGDP_t) + b_4 \ln(ASIAGDP_t) + Z_t
\]

In this model, \(\alpha\) represents a constant, and the \(b_1\)–\(b_4\) represents the coefficients for each explanatory variable. \(CT\) shows the number of cruise tourists by year as the dependent variable, \(CS\) is the amount of cruise fleet by year, \(NCS\) is the amount of new building cruise fleet by year, \(EUGDP\) is the economic growth rate in the EU area by year, and \(ASIAGDP\) means economic growth rate in Asian areas by year. \(Z_t\) is the error term of the co-integration model.

3.4. VECM Model

If cointegration has been perceived among series data, this result shows the long-term equilibrium relationship among variables. If there exists a long-term equilibrium relation, it is possible to apply the VECM to assess the short-run properties of the cointegrated series. The general regression equation form for VECM can be described as the following Equation (8). The cointegration rank reflects the number of cointegrating vectors:

\[
\Delta Y(t) = \alpha_1 + \eta_1 \Delta e_1 + \sum_{i=0}^{\eta} \beta_i \Delta Y(t - 1) + \sum_{i=0}^{\eta} \delta_i \Delta X(t - 1) + \sum_{i=0}^{\eta} \gamma_i Z(t - 1)
\]

We use the VECM that is regarded as a VAR model with co-integration constraints. The VAR model introduced by Sims [30] is established in the basis of the statistical features of data. In the VAR model, each endogenous variable in the equations is regarded as the lagged values of all endogenous variables in the equations; the univariate autoregressive model is popularized to the VAR comprising multivariate time series variables. There is a co-integration relation in the VECM; when there is a rich scale of short-term dynamic fluctuation, VECM can limit the long-term action of the endogenous variables and converge to co-integration relationship. So far, as there is a co-integration relationship among variables, the error correction model can be drawn from the autoregressive distributed lag model, and integrated data becomes stationary through differential conversion in VECM.

The following Equation (9) describes the VECM equation of the present study. A negative coefficient of variables in VECM means that any short-term variations among the independent variables and the dependent variable may result in a steady long-run relationship among variables at the next period \((t + 1)\). Equation (9) is expressed as follows:

\[
\Delta \ln(CT_t) = a + \beta_1 \Delta \ln(CS_t) + \beta_2 \Delta \ln(NCS_t) + \beta_3 \Delta \ln(EUGDP_t) + \beta_4 \Delta \ln(ASIAGDP_t) + \gamma_t D t - 1
\]

\[
\begin{align*}
&\Delta t - 1 = 1 \quad \text{if } Z t - 1 > 0 \quad \text{or} \\
&D t - 1 = 0 \quad \text{if } Z t - 1 \leq 0
\end{align*}
\]

In the VECM, \(a\) represents a constant, and \(\beta_1\)–\(\beta_4\) represents the coefficients of each explanatory variable. \(\gamma\) represents the rate of convergence from short-term balance to long-term balance, and \(\eta\) is the residual. \(D\) is a dummy variable, and it equals 1 if \(Zt - 1\) is greater than 0 and equals 0 if \(Zt - 1\) is less than or equal to 0. \(\Delta\) represents a differential conversion.

4. Empirical Results
4.1. Granger Causality Test

This study conducts the Granger Causality test and attempts to confirm the dynamic causality among variables.

According to the Granger Causality test results, the cruise fleet, cruise order volume, EU GDP, and Asian GDP are independent variables influencing cruise tourists as the dependent variable. However, there is no statistically meaningful relationship in the opposite
direction. According to this result, the null hypothesis, that is, “all four independent variables do not affect the number of cruise tourists as the dependent variable,” can be rejected at a 1% significance level. It is concluded that there is a causal relationship in the direction of the “independent variable → dependent variable.” The analysis results of the Granger Causality test are shown in Table 1.

| Direction                  | F-Statistics | p-Value |
|----------------------------|--------------|---------|
| Cruise fleet → Cruise tourists | 5.82103 | 0.0096  |
| Cruise tourists → Cruise fleet       | 0.03618 | 0.9620  |
| New building cruise order → Cruise tourists | 6.82715 | 0.0041  |
| Cruise tourists → New building cruise order | 0.03591 | 0.9702  |
| EU GDP → Cruise tourists             | 6.0950  | 0.0073  |
| Cruise tourists → EU GDP             | 0.01625 | 0.9921  |
| Asia GDP → Cruise tourists           | 6.71264 | 0.0059  |
| Cruise tourists → Asia GDP           | 0.07961 | 0.9105  |

4.2. Unit Root Test

After the Granger Causality test, this study conducts a unit root test and attempts to confirm whether the time series variables are non-stationary and have unit roots. The null hypothesis is regarded as the presence of unit roots, and the alternative hypothesis is regarded as the presence of stationarity in the time series variables. The unit root test results show that there are unit roots in all independent variables, such as the cruise fleet, cruise order volume, EU GDP, and Asian GDP. These results imply that there are cointegration relations in our variables in the present study, and integrated variables should be stationary for an accurate estimation when performing a regression analysis. The results of the unit root test are depicted in Table 2.

| Variables             | Critical Value at 5% | t-Value |
|-----------------------|----------------------|---------|
| Cruise Tourists       | −3.012363            | −1.287901 |
| Cruise Fleet          | −3.012363            | −0.381791 |
| Cruise Order Volume   | −3.012363            | −1.800188 |
| EU GDP                | −3.012363            | −0.731982 |
| Asia GDP              | −3.012363            | −1.054285 |
| Error Term (Zt)       | −3.012363            | −4.329184 |

4.3. Co-Integration Model

After performing the unit root test, this study conducts a co-integration estimation. The adjusted coefficient of determination is 0.9411, reflecting that the co-integration equation can account for approximately 94% of the variation of the number of cruise tourists as a dependent variable. Table 3 shows that the error term is inferred as a stationary time series because it rejects the null hypothesis that “the error term is integrated time series at a significance level of 5%”.

| Dependent Variable | Estimated Coefficients | t-Value | p-Value |
|--------------------|------------------------|---------|---------|
| Constant           | −0.017201              | −0.030572 | 0.975914 |
| Cruise Fleet       | 0.941177 *             | 12.419988 | 0.000000 |
| New Building Order Volume | 0.052800 | 1.179520 | 0.252032 |
| EU GDP             | 0.029135               | 1.274757 | 0.217007 |
| Asia GDP           | −0.000291              | −0.025578 | 0.979848 |

Adjusted R Squared: 0.941105

Notes: * represents statistical significance at the 1% level.
According to the co-integration estimation results, the number of cruise tourists increases by 0.94% when the cruise fleet increases by 1.0% and increases by 0.05% when the new cruise order building increases by 1.0%. Additionally, if the European GDP increases by 1.0%, the number of cruise tourists increases by 0.029%, and the number of cruise tourists decreases by 0.00029% when Asia’s GDP increases by 1.0%

This result in Asia’s GDP shows that Asian people tend to prefer other tourism services rather than cruise tourism, even if their income increases. This indicates that in the Asian market, cruise tourism services are not the type of luxury goods commonly mentioned in economic research.

Although p-values of the three explanatory variables are somewhat higher, the coefficient of determination is high (=0.9411), and the sign (plus or minus) of each independent variable on the dependent variable shows the right direction, consistent with common intuition.

4.4. VECM Model

After confirming the stationary time series data by a Co-Integration model, this study conducts the regression analysis using the VECM. We find that the number of cruise tourists is finally converged toward a long-term balance when the number of cruise tourists at \( t - 1 \) is lower than the one at the long-term equilibrium point only at a time of recession. The estimated results show that the number of cruise tourists increases by 0.280% (\( \gamma_1 \)) in the next period when they are 1% higher than the one in the long-term equilibrium point and increases by 1.236% (\( \gamma_0 \)) in the next period when it is 1% lower than the one in the long-term equilibrium point. Such findings indicate that only in the case of the number of cruise tourists at the current time is lower than the one at the long-term equilibrium, the number of cruise tourists will finally converge to a long-term balance. In short, the number of cruise tourists converges at the long-term equilibrium point, indicating that natural forces (so-called invisible hand) exist within the cruise tourism industry to recover from external shocks such as COVID-19.

The standard deviation of (\( \gamma_1 \)), higher than the number of cruise tourists at the long-term equilibrium point, is estimated as 0.9377. The standard deviation of (\( \gamma_0 \)) lower than one at the long-term equilibrium point, is estimated as 1.1099. According to estimated results on the standard deviation, we can conclude that the scale of the gap between the number of cruise tourists at the current time or equilibrium point is larger (1.1099 > 0.9377) in times of depression than in times of industrial boom. The estimated high recovery elasticity (scale of standard deviation) during the recession is also a result of supporting the sustainability of the cruise tourism industry.

Although the p-value of each coefficient is estimated to be relatively high, the sign (plus or minus) of each independent variable on the dependent variable shows the right direction, consistent with common intuition. The result of the VECM is shown in Table 4.

| Explanatory Variable                  | Estimated Coefficients | t-Value  | p-Value  |
|---------------------------------------|------------------------|----------|----------|
| Constant                              | −0.030927              | −0.266095| 0.793789 |
| Cruise Tourists \( \Delta \ln(CTt) \) | 0.051237               | 0.057126 | 0.955199 |
| \( \Delta \text{Cruise Fleet} \)     | 0.261182               | 0.190255 | 0.851660 |
| \( \Delta \text{New Building Order Volume} \) | −0.075761             | −1.59400 | 0.306180 |
| \( \Delta \text{EU GDP} \)           | 0.030704               | 0.813002 | 0.428933 |
| \( \Delta \text{ASIA GDP} \)         | 0.002655               | 0.179235 | 0.860152 |
| \( \gamma_1 \)                        | 0.280318 (0.9377)      | 0.298927 | 0.769097 |
| \( \gamma_0 \)                        | −1.236250 (1.1099)     | −1.113810| 0.282890 |
| Adjusted R Squared                    |                        | 0.144482 |          |
5. Conclusions

This study analyzes the influences of various factors on the number of global cruise tourists through the co-integration model and the VECM. A few previous studies have suggested ways to increase global cruise tourists and promote the cruise tourism industry through qualitative methods. However, only a few studies have estimated the decision function of the number of cruise tourists at a long-term equilibrium point. On the contrary, this study quantitatively analyzes determinants of the number of cruise tourists and identifies the sustainability of the cruise tourism industry.

Notably, this study examines how fast the number of cruise tourists responds to the imbalance from the number of cruise tourists at the long-term equilibrium point by classifying the whole phase as boom and recession seasons. According to our VECM results, it converges to long term balance at 1.236% against 1% error when there is a recession (error term is negative) in the cruise tourism industry.

This convergence toward equilibrium in the recession of the cruise tourism industry is attributed to the inherent characteristics of the cruise tourism industry. During a recession, the number of cruise tourists rises significantly, showing an overshoot toward the one at the long-term equilibrium. However, the gap in the number of cruise tourists between now and in times of industrial boom is shown to widen. The cruise tourism industry tends to quickly converge to long-term balance in recessions rather than in boom seasons. The estimated results from the VECM in this study imply that the number of cruise tourists converges to the one at the long-term equilibrium point only in the case of a recession in the cruise tourism industry. Therefore, this study concludes that there is a unique mechanism through which the cruise tourism industry quickly heals its recession naturally due to the expansion of tourism demand in the cruise tourism industry.

In summary, the findings of the VECM in the present study suggest the presence of an “invisible hand” in the global cruise tourism industry converging to a long-term balance. In short, the number of cruise tourists converges at the long-term equilibrium point, indicating that natural forces exist within the cruise tourism industry to recover from external shocks. This study identifies that the global cruise tourism industry can be sustainable through its inherent power for long-term balanced convergence within the industry and can flexibly respond to external shocks such as COVID-19.

This study analyzed factors affecting global cruise tourists and those that influence levels using econometric regression models. In the follow-up study, it is expected that it is possible to obtain more significant analysis results if explanatory variables are diversified and the analysis period is extended to a more long-term one.

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