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Factors Determining Maritime Transport Market: Time Series Econometric Analysis on Container Throughput of Cambodia's Ports

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Abstract:-The significantly increased demand for container throughput and cargo traffic volume transported in Cambodia has improved and accelerated the port output advancement and the development of new terminal. The main objective of this research is to investigate the long-run and short-run relationships, as well as to identify the influences on Cambodian combined international ports' container throughput.The researcher collected the yearly data (1992 - 2017) from reliable and official sources of PAS and PPAP ports, IMF, WB, and MOC, and additionally interviewed with port authorities, port operators, and qualified stakeholders. The econometric approaches of The Unit Roots Test, Johansen Test of Cointegration, VECM, and Test for Stability are performed and applied in the analysis on the time series data between container throughput as the dependent variable and independent variables such as number of ship call, export, import, and GDP per capita. The estimation result confirmed and explained the effect of long-run relationships between container throughput and number of ship call, export, import, and GDP per capita for one rank of vector cointegration. That means all the factors move together to explain the changing demand for container throughput of Cambodia's ports in the long-run equilibrium. The number of ship call and export has a significantly positive impact. Alternatively, the import and GDP per capita shows a statistically significant and relatedly negative influence on container throughput. Nevertheless, it is crucial to disclose the estimation resultfrom the VECM did not find a short-run relationship. That means, in the short-run equilibrium, the affecting factors did not move together to demonstrate the change of container throughput demand. It is crucial for policy implication for government, port authorities, etc. The best attentive insights, measures and actions would help manage and achieve the growing container throughput demand, yielding fruitful results in output and performance of the port through the planning, developing and building new ports, port facilities, infrastructures, and terminals etc. Furthermore, the findings have also contributed to closing the previously identified study gap. Because the model and analysis on container throughput has encouraged the export activities and domestic productions and stimulated growth of economy, as well as in order to propose and develop the maritime transport strategic policy and development for Cambodia to support the higher demand of ports throughput in the future.

Keywords:- *Time Series, Econometrics, Vector Error-Correction Model, Maritime Transport, Container Throughput and Ports.*

I. INTRODUCTION

According to Ng and Liu (2014), the container ports have become the backbone of world logistics and supply chain efficiencies, served as the crucial mode of world transport services in terms of cost-saving, capacity benefits. Nam and Song (2011) pointed out that sea trade through the ports increased by nearly 90 percent in volume and roughly 70 percent in value of world trade. Scholars and industry practitioners have been drawn to study of container throughput or performance measurement in ports and terminals. According to Pallis et al. (2011) and Woo et al. (2011a), the port and terminal performance could be considered as a well-established part of the port-related literature reviews; and Tongzon (2001); Cullinane et al. (2004); Da Cruz et al. (2013) also demonstrated the container throughput or port output conventionally focused on the productivity and efficiency of port operation. With an uncertain logistics environment, container ports have recently faced with numerous challenges and restructuring in order to continue and maintain. As a result, the up-to-date container ports are now parts integrated into complex systems that operate in a volatile transportation characteristics.

This study aims to provide insights into the maritime transport markets and ports, and to explain how important factors determine container throughput by empirically analyzing and testing the equilibrium effects on long-run and short-run relationships among key explanatory factors of ports in Cambodia. Two major international ports are Phnom Penh Autonomous Ports (PPAP), the inland port on the Tonlé Sap River, accessed via the Mekong River, and Sihanoukville Autonomous Port or Port Autonome du Sihanoukville (PAS) as the seaport (PAS, 2015; PPAP, 2016). PPAP transfers containers, vessels, barges, petroleum, and gas directly to Phnom Penh. Sihanouk Ville Autonomous Port provides access for other heavy goods that presently transported by road and rail. This paper also focuses on investigation and estimation the demand for container throughput by using and selecting the factors of determinants to see relation effects whether there is a long-run and short-run equilibrium of port performance to meet the supportive purposes that can give policy implications for the port sector and maritime transport and effective decision-making supporting tool to improve efficiency and output.

According to PAS and PPAP, the total container throughput of international ports in 2000 accounted for 130,435 TEUs, increased to 222,928 TEUs in 2010 and 459,839 TEUs in 2017, respectively. In 2016 and 2017, there were about 400,187 TEUs and 459,839 TEUs going through PAS, and showing a 15 percent increase over 2016. PPAP's container throughput achieved by 184,805 TEUs in 2017, up from 62,256 TEUs in 2010 and 746 TEUs in 2002. PPAP came to 184,805 TEUs, up 21.76 percent compared from 151,781 TEUs in 2016. Many previous studies and researches have also examine and mainly focused on the forecasting the port performance and efficiency and many others conducted the container cargo volumes and flow of the container port throughput. However, until today there has been no any study and research to determine the factors influenced on the container throughput of Cambodia's International Autonomous Ports. For that reason, this research is intending to fill the gap by attempting to investigate and examine to identify and measure factors that determine the container throughput of Cambodia's International Autonomous Ports accordingly. This research question will mainly restrict to factors determining maritime transport markets for Cambodia's ports by applying the time series econometric analysis on the container throughput of Cambodia's ports. To analysis this framework, the econometric analysis of VECM is proposed and used STATA software program to observe the effect of the long-run relationships between container throughput and four key factors determined, such as the number of shipcall, export, import, and GDP per capita. In terms of scope, this study does not specify any other related area of economics and management in general due to the limited constraint of time of study and data collection. This research study may has many fruitful and advantageous contributions for the country and the globe based on the maritime economics and logistics and management as a special instrument to promote the sustainable economic growth and development of regulative principle and strategic policy. The maritime industries, governments, and port authorities should follow and stay updated with the fluctuating dynamics of the maritime transport sectors, as well as movements and growths that affect it.

II. LITERATURE REVIEW

The literature review will conduct theoretical and empirical overviews with reference to objectives and topics. The literature review first provides the theoretical overviews of the maritime transport market and how the maritime transport economics are related to broad trends in academic research of maritime transport and ports. The review then outlines academic research on analysis of port container throughput, characteristics of changing port business environment, and port output measurement to establish the guideline of the conceptual framework model about port output indicator selection as well as identifying the relationship between the variables. The research review will also present and investigate previous research findings of other researchers to determine whether the study of Cambodia's port can be defined and identified through the use of statistical and econometrical tools to measure and investigate the long-run relationships of container throughput, and to set out the maritime transport policy implications.

A. Theoretical Foundation

The research's theoretical foundation and literature reviews are selected the best theoretical and empirical frameworks, hypothesis development and conceptual frameworkrelated to the key variables to reveal the research gaps of study. Furthermore, the hypothesis development is paramount related to the research's objectives and presented and discussed.

a) Port Performance

Many types of measures can be used to evaluate port performance according to Langen, Nijdam, and Horst (2007). The most commonly used indicator is the measurement of goods throughput volume, which can be expressed and measured in TEU or Ton, but another measurement of monetary value can be used as well. The investigated study of the influence of port supply, port demand, and value-added activity of port on the development of regional economics in five Chinese costal port clusters performed by Deng, Lu, and Xiao (2013) showed that supply and demand for the port had a significant positive relationship with each other. Value-added activity was found to be significantly related to port demand, and value-added activity had a significant influence on the regional economy, whereas port supply and port demand had no direct significant impact on the regional economy. Port supply, on the other hand, has had an indirect influence on the regional economy through port demand and value-added activity. Similarly, port demand influenced the regional economy indirectly through value-added activities. United Nations proposed several port performance indicators since the seminal works (Unctad, 1976; De Monie, 1987). In recent years, the studies of port performance and throughput has started to rise interestingly and to be analyzed in numerous methods with utilizing small samples size of ports all over the world, growing continuously (Chung, 1993 &Poitras et al., 1996).

b) Port Throughput

Unctad (1976) and MRC (2018) define the meaning of TEU (Twenty-Foot Equivalent Unit) as the standard dimensions of container throughput, measures 20 foot (length) 8 foot (width) 9 foot, and is used to describe the carrying capacity of a container ship, cargo ship and container port, can load and unload onto the ships, truck, trains and planes. Throughput is well-defined as a number of container activities that occur as it passes through the port terminal (Liu and Park, 2011) as well as the amount of commitment required to transfer cargos in terms of container movements per unit of time are measured. Container throughput, according to Langen et al. (2007), is one of the most widely used performance measures in the port industry. Alternatively, various factors such as the number of ship call and export and import or transshipment cargo, berth and yard utilization, crane and ship productivity, and service time could have an effect on port throughput growth. All of these are internal factors that the port company or port authority can influence directly or indirectly. Besides the internal environmental factors that port authorities or port operators have direct or indirect control over must be taken into account, it is also important to consider external environmental factors based on macroeconomics when evaluating the impact. When an output handle is assembled in a port, the port's throughput is determined by the performance of respective independent industries (Paflioti et al., 2017).

B. Theoretical and Empirical Review

Throughout many capturing and selecting literature reviews, the study of many researchers dealt with, which just merely or mainly compared a single port or many ports in each country or in regional country as preferred, particularly and practically in Hong Kong, Korea, China and ASEAN countries etc. and many are also focus on the forecast of container throughput. Yet there were not many articles or researches focused on which factor has the strongest determining or affecting to container throughput in Cambodia and the main concern. The many attributes determined port and the economic factors influence on attracting shipping liners and industries, and thus, throughput volume or container throughput. The number of ship call, export, import, and GDP per capita will be discussed as the four major influences on the throughput of port.

a) Factor Affecting Container Throughput

The focus on this study is on the demand-side of TEU's output of Cambodia's ports. From a practical standpoint view, determining and predicting container throughput by using the volume of throughputs in TEU rather than the volume of cargo in Tonne produces numerous advantages for ports, operators, and carriers (Levinson, 2006) because operational decisions and services offered are directly and indirectly dependent on the number of loading and unloading changes per unit. Numerous studies examining the factors affecting the maritime market and the factors affecting the container port throughput has decreased significantly in recent years. To assist in analyzing container throughput determinants, the impact on the port's container handling performance will need to be considered. The throughput in a container can be measure and stored in many different behaviors (Langen et al., 2007; Liu Bin et al., 2002; Jiang, J. et al., 2007; ArjunMakhecha, 2015-2016). The utmost commonly used indicator is the throughput volume of cargoes, which is defined as the number of containers in TEU. An increase in throughput is regarded as evidence of the output efficiency with which container ports deal with throughput (Langen et al., 2007). In this research, the author will present and examine the key selected determinants of container port throughput founded by the related reviews.

b) Number of Ship Call

In literature reviews, Barros (2005); Tovar and Trujillo (2007); Gonzalez and Trujillo (2008) identified the number of ship call as one of the multiple outputs of a port at a given time, i.e., this study is conducted annually, as the number of ship call. There are a number of perceptions regarding key players in the decision making process for terminal or port selection. Shipping lines are the most important players in determining which port to use. Ports play an important role when it comes to value-driven chain systems. Ports and their services need to provide customers with consistent value compared to their competitors in value chain systems. The reality is that many industries, either shippers or shipping lines, determine cargo flow, which will look for a route that will provide the lowest price for a given level of servicewhile maintaining quality. Container ports capable of providing this service will be selected as call ports in the logistics chain, acting as a node in the chain (Yap and Lam, 2006). According to Kutin (2017), after the annual throughput of containerized goods as a general indicator, the number of ship call is another possible indicator in measuring port's performance. Several researchers emphasized the number of shipcall, which refers to the frequency with which shipping lines come and call at a port with more competitive service and cargo flows (Lam and Yap, 2008). In the analyses by Slack (1985); Bird (1988); Bardi (1973); Brooks (1984 & 1985); Saleh and Lalonde (1972), shipping lines are the key players in determining port choice, value-driven chain system, and port choice. According to Unctad (2004), the shipping connectivity index by country includes the number of ships, carrying capacities, and services, as well as the number of shipping companies, ship call, and maximum vessel size. In the calculation of PAS and PPAP, the total number of ship call measured in the unit of the ship also included a general cargo ship, an oil tanker, a container ship, and a passenger ship.

The capability of a seaport to attract maximum container ship traffics, such as ship call, container ship, and the frequency of ship arrived at ports, are factors of container throughput. Ship owners are increasingly selecting the port choice to call (Huybrechts, 2002; Hilde Meersman, 2016). Cullinane (2004); Brooks (1985) revealed that increasing the frequency or number of ship call can attract more customers and cargoes, resulting in an increase in cargo volume and throughput, which will have a positive and significant effect on port performance (Song and Han, 2004). Moreover, an increase in ship call frequencies is attracting both shippers and shipping lines alike. Slack (1985) conducted a study that revealed some intriguing information about port selection.

c) Import and Export

For the time being, as soon as it is aware that, not many studies are published that review the factors affecting container throughput volumes or port throughput handling, i.e. the trade volume of container throughput – export and import of container throughput. There are now only a few papers that attempt to review a part of the literature on forecasting container throughput within the multi-port region (Jiaweia et al., 2012).By theoretical and empirical models and various numerical studies for the Asia-Europe and Asia-North America trade lanes found that multi-purpose of ports was superior in terms of the total cost. Theoretically, developing a multi-port region in Asia trade is efficient, as evidenced by the rapid container throughput growth. Thus, in terms of a multi-port region, the analysis of port throughput in the North America, Japan, and Southeast Asia and in the Pearl River Delta is both necessary and feasible (Imai et al., 2009). According to Drewry (2010), container throughput benefited from the estimation of consumer price index in selected developed and developing countries such as the United States, the European Union, and BRIC countries such as China and India.

Therefore, these actors are required for the operationalization of container throughput handling at ports;

alternatively, maritime transport is the derived demand for the economic system.Moreover, when determining the container throughput, it is important to consider the macroeconomic components of a country's trade value, such as export and import, among other things. Tongzon (1995) accepted that, these factors significantly impact container throughput handling at ports. According to some studies, the value of import and export into a country is the most important factors (Seabrooke, W. et al., 2003), and it is also discovered a nation's economic development is largely responsible for port expansion. This container throughput considers both inter-port interactions and other influences. Nonetheless, Jiaweia et al. (2012) confirmed that a demand-based module provides incremental data as well as the impact of random events on the maritime industries, which was required to forecast container throughput volumes at ports in South China's Pearl River region during the global financial crisis.

d) GDP Per capita

Langen et al. (2012) argued that selected factors, such as growth of GDP and growth of trade are used to prove the existing relationship among the throughput and factors.Langen (2003) also developed a model for analyzing and forecasting future demand for transportation between two countries. Within the framework of reference of the investigation, it emphasizes the high degree of uncertainty in trade flows and attempts to explain the pivotal need for flexibility in economic interest decisions relating to port investments. Andrea Mainardi (2016) explored cargo throughput forecasting in Portuguese ports using econometric indicators related to the Portuguese economy, such as Portuguese GDP, population, inflation, domestic consumption, and world GDP.

C. Econometric Review

According to Liu and Park (2011); Seabooke et al. (2003); Gosasang (2011); Peng and Chu (2009); Langen et al. (2012) conducted research on forecasting demand for container throughput in TEU by using the regression model. The effect of container throughput on port performance will need to be measured to aid in analyzing container throughput determinants. Port performance can be measured in several ways (ArjunMakhecha, 2015-2016). Most studies that used the regression approach to analyze container throughput used GDP as an independent factor. Containerized trade flows can be estimated using long-term global GDP growth, and the multiplier effect of container growth results in three to four times GDP growth (Unctad, 2013). Liu B. et al. (2002) also used a linear regression model to examine the relationship between container throughput and GDP, fixed asset investment, interest rates, and international trade. Using per capita GDP data, Nakano H.P. (2004) discovered that rising per capita GDP in major developed countries would lead to a decrease in the number of containers per capita. Jiang et al. (2007) conducted a value-based economic analysis of container throughput, local GDP, and international trade volume using a binary linear regression model, and Xu Xiao (2014) also examined the relationship between natural miniaturization of GDP and container throughput using a time series method.

The econometrics model is the most useful method for determining the relationship between variables. If the relationship is known between them, there can be a significant change among the variables over the forecast limit (Armstrong, 2001). Several techniques applied to determine and estimate or predict container volume throughput, such as Neural Network (Gosasang et al., 2011), Regression Model (Chou et al., 2008), Grey Forecasting Model (Qiuhong, 2009), and Vector Error Correction Model (VECM) (Rashed et al., 2013), etc. Much research is found in container analyzing forecasting that indicates a correlation between macroeconomic variables and container throughput of ports (Chou et al., 2008b). Thus, in this study, The VECM will be used to investigate and analyze whether a long-run relationship exists between the container throughput of Cambodia's combined international ports, namely PAS and PPAP. In most literature reviews, many researchers have implemented the VECM as the best model to examine and estimate the container volume demand in the long run effect in different ports. The empirical reviews of the econometric approach of VECM conducted by many researchers and scholars to estimate the container throughput are more accurate and reasonable than regression analysis (Syafi'I, 2005).

D. Development of Hypothesis

This study can conceptualize framework analysis on variables in the estimated model, a basic conceptual framework or structure organized around the theory. It defines the kind of variables that are going to be conducted in the estimation and analysis. Four exogenous variables, namely the number of shipcall, export, import, and GDP per capita, are categorized as factors determining the container throughput of Cambodia's combined international ports. Container Throughput measures in TEU, which is the endogenous or dependent variable. This study aims to test the four hypotheses which are previously mentioned and considered as the claim or assumption about the value of a population parameter. The proposed hypotheses are as the following;

- H1: The number of ship call is statistically significant with container throughput.
- H2: Import is statistically significant with container throughput.
- H3: Export is statistically significant with container throughput.
- H4: GDP per capita is statistically significant with container throughput.

III. METHODOLOGY

A. Research Design

The correct econometric methodology and research design are found to be critical for using and testing the data. To begin, the unrestricted Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests are employed to examine the stationarity of series among variables. Second, Vector Autoregression (VAR) is utilized to select the most appropriate lags. Third, the Johansen Cointegration test is performed to see if there are any cointegrating vectors or maximum ranks. The cointegration test determines long-term cointegration amongst variables. Fourth, constraints are

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placed in the model of VAR, and VECM is estimated to determine effects of long-run effects and short-run dynamics. To maintain the current results and findings, Impulse Response Function (IRF) is also used in this study. Furthermore, model diagnostic tests such as system stability tests, autocorrelation, heteroskedasticity, and normality tests are run to ensure the model's reliability and validity and to verify the findings. The VECM, on the other hand, is estimated using the STATA/IC15.0 software program. Unknown parameters can be determined using a variety of analysis techniques and estimates. Nonetheless, the VECM model is much more efficient and accurate in its research and detailing of long and short-run equilibrium relationships.

B. Data for Analysis

This research is utilized the quantitative approach from 1992 to 2017 to analyze and assessed in annual time series data. Further, the dataset was transformed to logarithm to get elasticity coefficients. The data of container throughput of Cambodia's port was included import and export of laden and empty container throughput in TEUs. Container throughput data was collected from PAS and PPAP and aggregated and combined into the total container throughputs of Cambodia's ports. In addition, container throughput variable is used as dependent variable. The number ship call measured in unit of ship was also collected from PAS and PPAP ports of Cambodia, and included general cargo, oil tanker, container and passenger ship. Export and import and GDP per capita value measured in USD million which was collected from the IMF. The data of annual GDP per capita was calculated by dividing annual GDP to total population of Cambodia from 1992 to 2017.

C. Econometric Model

The container throughput was taken as the dependent variable. The number of ship call, export, import, and GDP per capita were chosen as the independent factors to explain and control container throughput in Cambodian ports. Multiple regression analysis was used to identify factors that are related to the dependent variable and to investigate the nature of the relationship as well as to conduct research, prediction, and forecasting. Multiple regression models were used to investigate causal relationships between independent and dependent variables.

The equation formula and selected variables are written as follows:

$lncont_t = \beta_0 + \beta_1 lnnsc_t + \beta_2 exp_t + \beta_3 imp_t + \beta_4 gdppc_t + \varepsilon_t$ (1)

Where,
Container Throughput in TEU = cont
Number of Ship Call in Unit = nsc
Export in USD = exp
Import in USD = imp
GDP Per Capita in USD = gdppc
β_0: The Intercept
β_1, β_2, β_3, and β_4: Coefficients
t: Time Series
ε_t: Error-Term

All variables are basically transformed into natural logarithms. Transforming the nature of dependent and independent variables to logarithmic form help us to measure the elasticity of dependent variable with respect to the independent variables. β_0 is constant or intercept, and β_1, β_2, β_3, and β_4 are the parameters or slopes measured by each independent variable, and whereas the ε_t is the long run error-term or random disturbance term. The time series econometric model was used in this study to investigate cointegration vectors and causality directions of demand for container throughput of combined ports in Cambodia.

D. Step of Estimation

- Step 1: Data must be stationary.
- Step 2: Optimal lag is selected.
- Step 3: Johansen cointegration test is identified.
- Step 4: VECM is estimated.
- Step 5: Diagnostic tests is performed.

E. Time Series and Stationary

The time series model uses the movements of variables in the past to estimate values and results in the future. The timeseries model, according to Stock and Watson (2003), is not economic theory. However, unlike structural models, the predictability of the estimated equation should be evaluated based on the model's performance outside the sample.The timeseries econometric model, according to Keck, Raubold, and Truppia (2009) can produce relatively accurate forecasting in most cases, particularly when variables have multi-dimensional relationships. Because of its complexity, it is vulnerable to omitted variable bias, misspecification, multiple simultaneous causalities, and other issues, all of which can result in significant forecasting errors.According Gujarati (2012) pointed out that the value of covariance between two time series of period is determined only by the distance or gap between two time series of periods, rather than the actual time series at which the covariance is computed, indicating that a time series is stationary if its mean and variance remain constant over series of time.

F. Unit Roots Test

Unit root tests are used to determine whether or not data sets are stationary. According to Gujarati (2008), the unit root test is a stationarity or nonstationarity test that has received widespread popularity over several years due to simplicity (Gujarati, 2008). To evaluate if the series is stationary in level I(0) or nonstationary in level, but stationary in first differencing I(1), i.e. integrated of degree on I(I), the unit root test of time series is carry out . Dickey-Fuller suggested that ADF for unit root test (Engle and Granger, 1991) is conducted with a constant and trend term based on the critical values. The null hypothesis test of unit root is the only assumption that is rejected. To determine the appropriate or optimal lagged selection to ensure that the error becomes approximately white noise, the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC) are used for testing purposes. Standard tools for stationary testing include the enhanced Dickey-Fuller and Phillip-Perron methods. Because the PP test corrects for serial correlation, autocorrelation and heteroskedasticity problem in the errors disturbance, the estimation finds preferable to the ADF test for many applications. Furthermore, PP tests do not necessitate lag selection and are based on a serially linked regression error term rather than a random effect model. ADF tests are similar in that estimates are centered on the null hypothesis that the series is not stationary. The null for PP tests are similar (Dickey F., 1979; Perron P., 1989).

G. Cointegration Test

Engle and Granger (1987) proposed that presence of number of cointegration vectors addressed the problem of integrating the dynamic effect of short-run relationship with long-run equilibrium. This approach, which has been frequently utilised in quantitative studies but has a number of drawbacks that include distortion in sample size and non-unique characteristics depending on the normalization variable employed, cannot identify numerous cointegrating vectors (Banerjee et al., 1993). Engle and Yoo (1991); Johansen (1991, 1998) proposed and suggested a three-step approach and maximum likelihood model. There are numerous cointegration tests, and cointegration may have when the test is performed. The most commonly used is the multivariate test based on the autoregressive representation developed by Johansen (1988 & 1991); Johansen, Juselius (1990 & 1994); Gonzalo (1990 & 1994). Johansen and Juselius (1988 & 1991) were the first to identify the cointegrating vectors in a system, providing a maximum likelihood technique to test for the existing presence of cointegrating vectors in the system. This method, which is a variation of the VAR method, is commonly referred to as Johansen Maximum Likelihood or VECM in the scientific literature reviews. In the VAR framework, all of the variables in the VAR model are identified and evaluated utilizing theoretical economic theory. It needs to conduct a pretest of the series for unit root before applying the VECM technique. To identify the number of cointegration of Johansen process, the Johansen maximum likelihood technique provides and constructs two different types of likelihood ratio tests: the trace test and the max eigenvalue test, which are both employed. The Johansen technique has better properties than other estimators (Johansen &Juselius, 1990, 1994; Gonzalo, 1994), and the finite sample properties are consistent with asymptotic findings. The VECM can be analyzed by using the Johansen technique, which includes the error correction term or speed of adjustment in each equation. When the computed trace test and max eigenvalue test statistics are greater than the critical values of 1 percent, 5 percent, or 10 percent, the null hypothesis of no cointegration is not accepted. If the estimates of trace and eigenvalue statistics are less than the critical value, the alternative hypothesis of one or more cointegrating vectors is accepted.

H. Vector Error-Correction Model (VECM)

The VAR equation is one of the particular variants of the system simultaneous equation. The VAR model can be employed if all of the variables are stationary. When the variables in the vectors, on the other hand, are not stationary, then the model used is the VECM if the variables in the vectors have at least one or more cointegration relationships. Enders (20150) defined VECM as a VAR that built specifically for use with nonstationary data that has a cointegrating relationship with the original data. The time series model is one of the few that can accurately analyze the level at which a variable can be restored to equilibrium following a shock to other variables. The VECM method is extremely beneficial for estimating the short-run and long-run effects in series data. Under the assumption of cointegration, the VAR can be represented as VECM, as shown below.

$$\Delta \mathrm{cont}_t = \alpha + \psi \mathrm{cont}_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta cont_{t-i} + \theta Z_{t-1} + \varepsilon_t \quad (2)$$
(2)

α = The Intercept
ψ = Vector of Intercept ($\alpha\beta$')
k-1 = Lag Length
Γ = Vector of Variables [cont, nsc, exp, imp, gdppc]
θ = Speed of Adjustment
ε_t = Residual or Error-Term
Z_{t-1} = Error-Correction Term (ECT)(-1)
$cont_t$ = Vector of Lagged Variable
β'$cont_t$, $\Delta cont_t$ = Coefficient of Vectors

Utilizing an econometric model is a clear framework for developing and testing economic hypotheses. The model demonstrates anfull insights of the effect and dynamic behavior. The use of likelihood methods providesfor undertaking inference without the need to derive estimator and tests.

Unrestricted VAR is the estimate of ψ matrix applied and tested by using the Johansen's approach whether the restricted suggested by the reduced rank of the matrix is rejected. This equation can be used to indicate the rank N x N matrix as $\psi = \alpha \times \beta$' where N x R matrix of rank. According to the model employed in this investigation, N = 5, cont = (cont, nsc, exp, imp and gdppc). b' $cont_t$ is stationary and is viewed as long-run equilibrium relationship between the jointly influenced factors because b' is a matrix that indicating the cointegration relations, It is critical to highlight that unless a normalization or identification procedure is specified, it is impossible to predict the individual coefficient b'. In the short run, stochastic shocks may push and drive the system, but in the presence of a cointegration relationship, pushing variables that will lead the system to intersect with the long-run relationship.The stationary process proved byb'$cont_t$, and the speed of adjustment coefficient formed by A for the equation showed the equilibrium relation and deviation. The max eigenvalue and the trace test are utilized to determine the number of cointegration vectors under the ψmatrix of reduced rank hypothesis. Ifψ has a rank of zero, no stationary linear integration can be found, indicating that the variables in $cont_t$ are not cointegrated. If rank R of ψ matrix > 0, then R is not possible nonstationary linear integrations after considering the parametric constraints implied by long-run relationships, the short-run function is estimated steadily in consistent manner. In response to short-run disequilibrium, the VECM helps numerous factors that influence simultaneous dynamic adjustments at different rates than the others because theory is frequently unsatisfactory for defining the dynamic adjustment process. By presenting a multivariate VECM, this study aims to investigate how the key elements of independent variables affect container throughput.

I. Long-Run Causality

Johansen and Juselius (1990) developed the economic relationship of long-run equilibrium effect. The Johansen cointegration test typically comprised of 3 general steps, which are as follows: First, ensure that all variables in the model are integrated in the same order by running unit root tests on each variable. Second, calculate the appropriate lag selection for the VAR model in order to ensure that the estimated residuals are not autocorrelatedwith the observed residuals. Three, Enders (2004 & 2010) proposed to estimate VAR model in order to generate the cointegration vectors, which identify the rank of cointegration using the trace test and the max-eigenvalue statistical tests. The coefficient of error-correction term (ETC) of one-period lagged value indicates the causality of long-run effect and expresses the adjustment speed. The expected value of β_t should be significant and have a negative sign. β_t (-1&0) of absolute value indicates how quickly the equilibrium effect is reinstated and restored. The significance of ECT implies that the long-run equilibrium relationship of the independent variable is moving and can explain the effect on dependent variable.

J. *Short-Run Causality*

The jointly significant variables describe how the endogenous variables respond to short-run dynamics. This study, as discussed by Hakim and Merkert (2016), also assesses the jointly significant level of the coefficients of the endogenous variables γ_t and δ_t by testing the short-run relationships effect.

K. *Impulse Response Function*

It is intriguing to determine the shocking reaction by performing the Impulse Response Function (IRF) in one variable to an impulse in another variable in a system with several other variables. It is said to have the latter occurrence of the causally responsible for the earlier occurrence if there is a shocking reaction in one factor of variable to an impulse in another factor. The IRF takes a look for the moving average reaction and explains how the factor influences a shocking reaction over time to a single response growth in itself or any other variables influences a variable over time to a single response growth in itself. According to Lutkepohl’s (1991) research, the impulse shock or effect of dynamic multipliers can be acquired using a K-dimensional VAR model with an infinite moving average factor. The impulse shocking is an effective and efficient measure for determining and a useful tool in assessing the stability of the estimated equation within the framework of the vector autoregression model. The combined effect of shocking reactions and response to zero indicates that a system is stability.

L. *Post Diagnostic Check*

The statistical diagnostic tests such astest for stability,test for multivariate heteroskedasticity, and LM test of autocorrelation and testing for normality was performed and carried out on the VECM model to verify that it represents the data generating process adequately and the appropriated model.

IV. RESULT AND DISCUSSION

A. *Descriptive Statistics*

The econometric analysis could be guided by the nature of available time series data and patterns of relationship between container throughput and number of ship call, export, import, and GDP per capita. The findings of descriptive analyses may also provide better hints and insights about the causal relationships of the variables discussed in the following sections. The growth of container throughput at Cambodia's combined ports has been studied in relation to the number of ship call, export, import, and GDP per capita. For comparison purposes, the ports that have encouraged and enabled Cambodia's maritime transport market are also taken into account. Correlation coefficients could present the relationship between two variables.

Summary Statistics of the Variables (1992 to 2017)							
Variable	Obs	Mean	Std. Dev	Min	Max	Skewness	Kurtosis
lncont	26	11.98846	1.02611	9.96	13.38	-0.66849	2.2884
lnnsc	26	7.578077	0.365885	6.84	8.12	-0.45156	2.4558
lnexp	26	8.297308	1.066469	6.55	9.97	0.08363	1.630
lnimp	26	7.781538	1.377768	5.22	9.7	-0.36930	1.9906
lngdppc	26	6.231538	0.5829147	5.49	7.23	0.3128	1.5741

Table 1: Descriptive Results

Source: Author’s calculation

It has been noted that lncont has the highest average of 11.99 percent, while lngdppc has the lowest average of 6.23 percent. According to table 1, the lnimp is the most volatile at 1.378 percent, ranging from 5.22 percent to 9.7 percent, whereas the lnnsc is the least volatile at 0.36 percent. Table 1 also demonstrates that lncont, lnimp, and lnsc are negatively skewed, whereas lnexp and lngdppc are positively skewed. A normal distribution curve's kurtosis measures the peak in the center of the curve. The distribution is described as mesokurtic, which implies that it is normal, if the value is close to three. The distribution is leptokurtic as long as the number is greater than or equal to 3. As a result, all of the series with values less than 3 in table 1 exhibit platykurtic behavior (Wooldridge, 2010).

Correlation Coefficients Between Variables					
Variable	lncont	lnnsc	lnexp	lnimp	lngdppc
lncont	1				
lnnsc	0.9684	1			
lnexp	0.9326	0.9546	1		
lnimp	0.9834	0.9716	0.965	1	
lngdppc	0.8805	0.9185	0.9857	0.9236	1

Table 2: Correlation Coefficients

Correlation Coefficients Between Variables					
Variable	lncont_d1	lnnsc_d1	lnexp_d1	lnimp_d1	lngdppc_d1
lncont_d1	1				
lnnsc_d1	0.3871	1			
lnexp_d1	0.3497	0.3228	1		
lnimp_d1	0.2108	0.1127	0.0972	1	
lngdppc_d1	0.1832	0.3132	0.4968	-0.1564	1

Table 3: Correlation Coefficients

Source: Author's calculation

Before establishing the VECM and avoiding a multi collinearity problem, the correlation analysis of all factor variables will be performed. If there is a correlation between the independent variables and they have an approach to influence the dependent variable. The correlation matrix of two-sided Pearson Correlations between all variables is shown in tables 3 and 4. Correlations show that all variables are related to one another. Number of ship call, export, import, and GDP per capita all has significance and strong relationships with container throughput. Table 2 shows the coefficient correlation for the entire series. The results show that the model's dependent variables have a strong positive correlation relationship. Because each dependent variable is highly correlated, their presence in the same model will result in a multicollinearity problem. As a result, it is decided to look into their impact on the first difference. Similarly, the results of the variables at first difference presented in Table 3 show a positive relationship, with the exception of the correlation coefficients between lnimp_d1 and lngdppc_d1. The covariance matrix in tables 4 and 5 shows that the coefficients of all variables are positive, indicating that as one variable increases, so does another. But except for the negatively related coefficient between lngdppc_d1 and lnimp_d1. Descriptive analysis and graphical representative indicate that there is most likely a long-run and short-run relationship between the study's dependent vs. independent variables.

Covariance Matrix between Variables					
Variable	lncont	lnnsc	lnexp	lnimp	lngdppc
lncont	1.0529				
lnnsc	0.363581	0.133872			
lnexp	1.02054	0.372487	1.13736		
lnimp	1.39023	0.489775	1.41786	1.89825	
lngdppc	0.526687	0.195895	0.612784	0.741801	0.33979

Table 4: Covariance Matrix

Covariance Matrix between Variables					
Variable	lncont_d1	lnnsc_d1	lnexp_d1	lnimp_d1	lngdppc_d1
lncont_d1	0.024689				
lnnsc_d1	0.004982	0.006708			
lnexp_d1	0.007393	0.003557	0.018098		
lnimp_d1	0.00558	0.001555	0.002201	0.028374	
lngdppc_d1	0.002082	0.001856	0.004835	-0.00191	0.005233

Table 5: Covariance Matrix

Source: Author's calculation

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B. Stationarity Check

Before selecting an appropriate model, performing estimation, and avoiding erroneous analysis and spurious results, it is necessary to determine whether each variable is stationary or nonstationary. The purpose of this analysis is to see if the data has stationarity properties using graphical analysis, Dickey-Fuller, and Phillips-Perron tests. Table 10 shows the results of two different tests that were carried out. Both test revealed that the series levels under discussion are I(1), that is, not stationary. Furthermore, the graph of autocorrelation and the partial autocorrelation function (ACF) are shown. Correlogram techniques are also used to ensure the accuracy of the results.

The VECM model technique is being used to determine whether there is a relationship between container throughput and the number of ship call, export, import, and GDP per capita. It is also interesting in determining a long-run effect and equilibrium. Before estimating the model, the statistical conditions of series must be checked to determine whether they are stationary or not. The graphs of the series under consideration are depicted in Figures 1 and 2. If the time series is not stationary, the series may be typically converted to stationarity using a technique known as differencing. Because the variables in Figure 1 are non-stationary, so it is best thing to turn them into stationary variables. To be valid, the VECM model requires that the time series must be stationary. The stationary variables after first differencing are shown in Figure 2. The graph depicts a constant mean and variance over time. It is necessary to conduct Q-statistic tests to determine whether the variables are correlated to assess the absence of autocorrelation. Correlograms of all variables at the same significance level show that the relationship is statistically and significantly related. The Q-statistic test is used to determine whether or not there is an autocorrelation issue. Table 6 displays the Correlogram Q-statistics test of lncont.

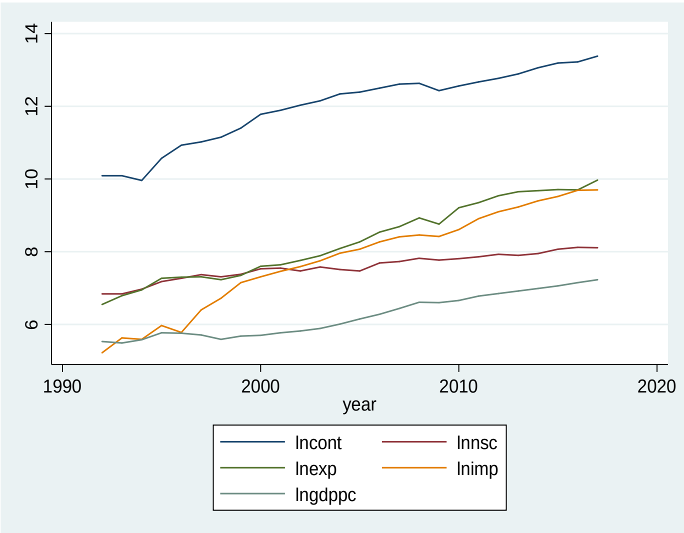

Fig. 1: Trends of All Variables

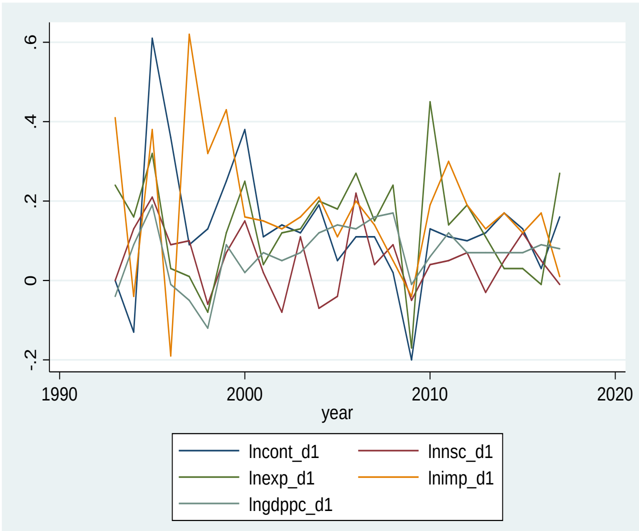

Fig. 2: Trend of All Variables at I (1)

LAG	AC	PAC	Q	Prob>Q	-1 0 1 [Autocorrelation]	-1 0 1 [Partial Autocor]
1	0.8753	0.9521	22.309	0.0000		
2	0.7402	-0.0450	38.926	0.0000		
3	0.5849	0.3124	49.754	0.0000		
4	0.4652	-0.0296	56.915	0.0000		
5	0.3617	-0.2132	61.451	0.0000		
6	0.2574	0.0419	63.862	0.0000		
7	0.1601	0.2326	64.844	0.0000		
8	0.0762	0.1008	65.079	0.0000		
9	0.0186	0.1902	65.093	0.0000		
10	-0.0480	0.1649	65.198	0.0000		
11	-0.1094	0.2616	65.779	0.0000		

Table 6: Results of Correlogram lncont

LAG	AC	PAC	Q	Prob>Q	-1 0 1 [Autocorrelation]	-1 0 1 [Partial Autocor]
1	0.1135	0.1140	.36254	0.5471		
2	-0.2270	-0.2437	1.8748	0.3916		
3	0.0382	0.1453	1.9197	0.5892		
4	0.2808	0.2711	4.4543	0.3480		
5	0.0722	0.0122	4.6304	0.4626		
6	-0.1719	-0.1503	5.6799	0.4600		
7	-0.0028	0.0563	5.6802	0.5775		
8	-0.0182	-0.0989	5.6934	0.6815		
9	-0.1484	-0.0929	6.6228	0.6763		
10	-0.1553	-0.1287	7.708	0.6573		

Table 7: Results of Correlogram lncont_d1

Source: Author's calculation

Autocorrelation Coefficient (AC) is close to zero, indicating that the autocorrelation problem has been fixed. The Q-statistic test result specifies that, despite being statistically significant, Partial Autocorrelation Coefficients (PAC) for all other lags is not statistically significant. Table 7 shows that the correlation Q-statistic test lncont_d1 is not statistically significant at the 0.05 of critical level, indicating that there is no significant serial correlation in the model. As a result, the test estimates imply that there is no evidence of autocorrelation. The results show that the observed Chi-square probability value is not statistically significant for critical values of 5 percent or less. It is concluded that the estimated model contains no presence of serial correlation. In this regard, the model is appropriate for economic analysis. The graph demonstrates that AC and PAC are significant at the level. Because the p-values of the Q-statistic test are greater than 5 percent after converting the time series data to I(1), the null hypothesis for all variables can be accepted. As a result, each variable confirms to be stationary. Figure 4 shows that there is no evidence of autocorrelation in the white noise.

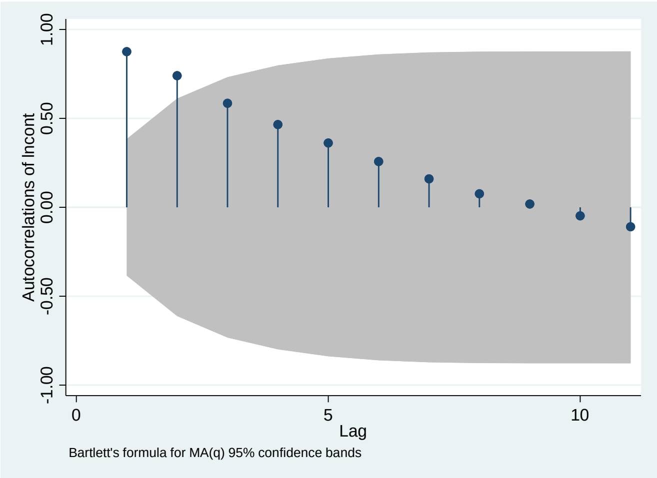

Fig. 3 : Autocorrelation at I(1)

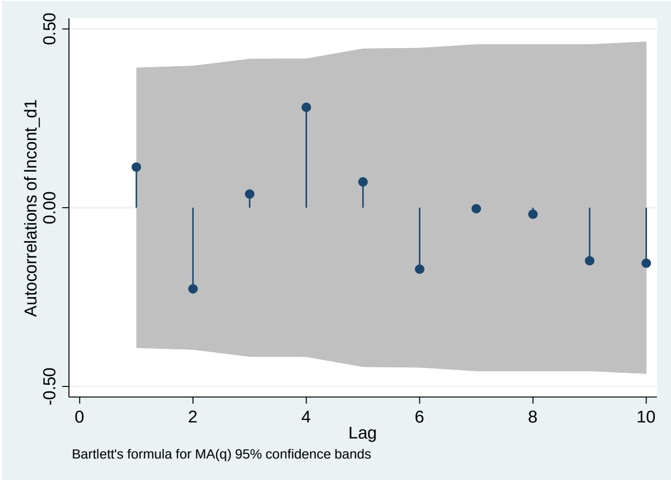

Fig. 4 : Autocorrelation at Level

Source: Author's calculation

C. Unit Root Test

The logarithmic form of the original series were utilized to solve and eliminate the possible problem of heteroskedasticity and to make the series more comparable between themselves. The Phillips-Perron test of stationary similarly reveals that all level series have unit roots; however, first differencing series are determined to be stationary at least at the 5 percent significant level. To ensure robust results, the Dickey-Fuller and Phillips-Perron tests are carried out by applying a constant and trend term to the test. Because the null hypothesis of unit root is not accepted at I(1), and the variables become stationary at I(1), which is also known as integrated order 1 or I(1) (1). The Dickey-Fuller and Phillips-Perron tests are analyzed to validate the confirmation of results. The estimated outcome demonstrated that all variables uncovered are nonstationary at the level. Because the null hypothesis is not accepted, it turned out that these variables become stationary at I (1). Tables 10 shows that the augmented Dickey-Fuller and Phillips-Perron models used to evaluate the data are stationary. The Dickey-Fuller and Phillips-Perron tests have a critical value of -4.380 at a 1 percent significance level, -3.600 at a 5 percent significance level, and -3.240 at a 10 percent significance level. For the 5 percent, the nonstationary null hypothesis is rejected.

Unit Root Test					
Variables	Augment Dickey Fuller		Phillips-Perron		Order
	Test Statistic		Test Statistic		
	Level	First Difference	Level	First Difference	
lncont	-1.379	-4.582	-1.309	-4.648	I(1)
lnnsc	-2.801	-5.299	-2.680	-5.375	I(1)
lnexp	-2.303	-5.571	-2.416	-5.566	I(1)
lnimp	-1.907	-6.933	-1.872	-6.699	I(1)
lngdppc	-1.773	-3.765	-1.853	-3.810	I(1)

Table 10: Dickey-Fuller and Phillips-Perron Tests

Source: Author's calculation

D. Lag Length Selection

The long-run relationship effect is estimated using the Johansen cointegrating technique, which tests for the significant existent presence of the long-run relationship effect.However, before running this test, which employs a VAR model, it is necessary to ensure that the VAR's lag specification is correct. The estimated result of this test is positive, as shown in table 11. The analysis results show that all variables are nonstationary at level but stationary in I(1) after differencing. However, before performing this test, which makes use of a VAR model, it is necessary to ensure that the VAR's lag specification is valid. As stated in table 11, the estimated result of this test is positive. The analysis result shows that all variables are nonstationary but stationary in I(1) after differencing at level. It is possible to determine whether or not these series are cointegrated in the long run equilibrium by consistently integrating them across time. To estimate the long-run effect between the variables, the appropriate lagged order of the VAR model must be determined using lagged selection criteria. Because of the series' small sample size, the 2 lag selection will be applied by auto lag selection.

Sample: 1994 - 2017 Number of obs = 24

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	31.6382				7.5e-08	-2.21985	-2.15473	-1.97442
1	135.794	208.31	25	0.000	1.1e-10	-8.81619	-8.42552	-7.34362*
2	173.774	75.96*	25	0.000	5.0e-11*	-9.89784*	-9.1816*	-7.19813

Table 11: Appropriate lag selection

Source: Author's calculation

E. Cointegration Test

The Johansen technique is used to determine the existence and number of cointegrating vector relationships, which is used to calculate the tests of max eigenvalue (max) and trace statistics. The null hypothesis of absent cointegration, that is, no cointegration (Rank = 0), is not accepted by the max and trace test statistic at a 1 percent or 5 percent significance level. As a result, the null hypothesis is not counted by the max and trace test results. On the contrary, it is not rejected the null hypothesis in these criteria where r ≤ 1,2,3,4 compared to the alternative hypothesis with the value of r = 2, 3, 4 at 1 percent significance level. Table 12 shows that the λmax test result of 44.6275 is not less than the critical value of 33.46 and 38.77 at 0.05 and 1 percent significance level, thus revealing the null hypothesis of no cointegration is not accepted, and there is at least one cointegrating vectors of equation. Table 12 further supports this conclusion. The calculated trace test of 96.1011 is also greater than the critical values of 68.52 and 76.07 at level 1 percent or 5 percent that is the evidence of cointegration in the series. The λmax test result of 51.4737 is still more than the critical value of 47.21. However, less than the critical value of 54.46 at 1 percent significance level. However, the results show that the λmax 25.4173 is not greater than the critical values of 27.07 and 32.24 at 1 percent or 5 percent, respectively. Thus, the null hypothesis is not rejected, and one cointegrating equation cannot be rejected. The value of optimal lag length and the optimal order of vector autoregressive model are chosen 2 shown in Table 11. By Johansen's approach result, it is found that there are one cointegration equations shown at both 5 percent and 1 percent level at the Max-Eigen value or Max statistic value result, and also one cointegration equations at the same level of 1 percent in the trace results.

Johansen Tests for Cointegration							
Rank	Parms	LL	Eigen Value	Trace Test	Max Test	1% Critical Value	5% Critical Value
0	30	125.72347	.	96.1011	44.6275	76.07	68.52
1	39	148.0372	0.84425	51.4737*1	25.4173*1	54.46	47.21
2	46	160.74584	0.65322	26.0564**5	14.3436	35.65	29.68
3	51	167.91766	0.44990	11.7128	9.6180	20.04	15.41
4	54	172.72665	0.33018	2.0948	2.0948	6.65	3.76
5	55	173.77404	0.08358	-	44.6275	-	-

Table 12: Trace and Max Statistic Test

Source: Author's calculation

As a result, this study concludes this study opines that one identified cointegration relationships are measured in the Johansen approach among the variables at the 1 percent significance level. This connection among variables specifies the significant identification of a long-run economic relationship. This link among the variables indicates the significant identification of a long-run relationship. Finally, only one cointegration vector equation's null hypothesis can be accepted. As a result, the cointegration test indicates that the VECM, rather than a VAR, is appropriate for analyzing the relationship among factors such as container throughput, number of ship call, export, import, and GDP per capita because the series are well-cointegrated.

F. Vector Error-Correction Model (VECM)

Therefore, this paper has applied this model to estimate the long-term container throughput as combined international ports of PAS and PPAP in Cambodia. The cointegration result by the Johansen approach reveals that the influenced factors of variables are cointegrated and have a long-run equilibrium relationship. The calibration of the VECM is carried out using the Johansen procedure for the estimation period from 1992 to 2017 with the time series data. VECM estimation result is presented in Table 14, 15 and 16 as below. The number of cointegrating equation among container throughput, number of ship call, export, import, and GDP per capita in the analyzed model is determined, and the estimation of VECM parameters of multivariate time series is carried out, and the output of the estimation is provided and seen that equation is statistically significant and the model fits well.

In Table 14, the results of the VECM model with all variables such as container throughput, number of ship call, export, import, and GDP per capita are found to be statistically and strongly significant at the 1 percent level of significance, indicating a strong effect among all variables in the long run equilibrium relationships. As a result of the cointegration test establishing that the data is cointegrated, it is now appropriate to estimate the VECM. Table 15 displays the outcome of one cointegration vectorfor Cambodia's ports in identifying the long-run relationships among variables.

The long-run equilibrium relations in the VECM are represented in table 16 by the coefficients of the one rank of cointegrating equation and trend and constant term. In the long run, coefficients on lnexp and lnnsc have strong positive effects on lncont, whereas coefficients on lnimp and lngdppc have strong negative effects on lncont. The estimates of the one cointegrating coefficient in the long-run equilibrium relationship (Johansen normalized on the coefficient) can be interpreted as indicating that all coefficient parameters are statistically significant at the 1 percent and 5 percent level.

The estimated coefficient of error-correction term (ECT) or speed of adjustment is negative sign of the coefficient on _ce1 L1 value - 0.312 (error term from the first cointegrating and lagged one-period) and strong significant at the 1 percent and 5 percent level, which is the correct sign (negative) for equilibrium and the probability of p-value is significant at the 1 percent and 5 percent level. It is confirmed that there is long-run economic equilibrium between dependent and independent variables exist over time. The long-run equilibrium causality is moving and running from lnnsc, lnexp, lnimp, and lngdppc to lncont towards the equilibrium. This implied that the ECM is well specified, well-identified.

This confirmed the expectation of a dynamic adjustment toward long-run economic equilibrium relations. Thus, if the error term _ce1 is negative in period t-1, which can be seen as the demand for container throughput of PAS and PPAP being too high in comparison to the equilibrium relationship other four determinants, then d cont must rise, which can happen if the coefficient for _ce1 is negative and significant. The greater negative coefficient on _ce1 L1, the faster the correction.

To begin with, lnnsc and lnexp have a significant positive effect on lncont. In other words, it suggests that, in the long run, an increase in demand for Cambodia's port's container throughput is associated with an increase in the number of shipcall that travelled (arrival and departure from ports) and an increase in the export of cargo that port handled. Second, lncont is significantly negatively affected by lnimp and lngdppc. In the long run, it proves that the increase in container throughput at Cambodia's ports is explained by the deduction of imports and GDP per capita, and vice versa. This can be expressed as an equation as follows;

$$lncont = -16.34352 + 1.82213 lnnsc + 1.00068 lnexp - 1.51536 lnimp - 1.00532 lngdppc \qquad (3)$$

The estimate result can be interpreted as long-run elasticities. A 1 percent increase in the number of shipcall is expected to increase container throughput by 1.82 percent, and this estimate is significant at the 1 percent level. When export rises by 1 percent, container throughput rises by 1 percent in response. Import is found to be negative to container throughput in the long run equilibrium relationship. A 1percent decrease in imports leads to a 1.5 percent increase in container throughput; this coefficient is significant at the 1 percent significance level. Similarly, a 1 percent decrease in GDP per capita will have an increased impact on container throughput of nearly 1 percent as well.

Following that, the estimates of the adjustment parameters in table 17 for one cointegration equation, lncont, lnnsc, lnexp, and GDP per capita are significant at the 5 percent level, except for lnimp. From the perspective of empirical economic interpretation, the question is whether imports adjust when the cointegration equation is out of long-run equilibrium or disequilibrium.

$$\hat{\alpha}\ (-0.3125, -0.2082, -0.2329, 0.1574, -01142)$$
$$\hat{\beta}\ (1.0000, 1.8221, 1.0006, -1.5153, -1.0053)$$
$$\hat{V}\ (0.0565, 0.0139, 0.1331, 0.3689, 0.0567)$$

$$\hat{\Gamma}\begin{pmatrix} 0.3805 & 0.7291 & -0.3496 & -0.2390 & -0.1152 \\ 0.2148 & 0.0074 & 0.0539 & -0.2558 & -0.1334 \\ -0.0963 & -0.1429 & -0.1416 & -0.2341 & 0.2146 \\ -0.1010 & 0.0765 & 0.0455 & -0.297 & -1.4128 \\ -0.0696 & -0.0541 & 0.1821 & -0.1904 & 0.0927 \end{pmatrix}$$

```
Sample:  1994 - 2017                              Number of obs     =         24
                                                  AIC               =  -9.086434
Log likelihood =  148.0372                        HQIC              =  -8.578559
Det(Sigma_ml)  =  3.02e-12                        SBIC              =  -7.172096
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_lncont	7	.151375	0.6201	27.75378	0.0002
D_lnnsc	7	.073772	0.5897	24.43424	0.0010
D_lnexp	7	.118232	0.7186	43.41968	0.0000
D_lnimp	7	.128344	0.7872	62.87356	0.0000
D_lngdppc	7	.056013	0.7774	59.36823	0.0000

Table 14: Vector Error-Correction Model

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	4	835.2753	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
lncont	1	.	.	.	.	.
lnnsc	1.822134	.4472684	4.07	0.000	.9455042	2.698764
lnexp	1.000689	.402085	2.49	0.013	.2126167	1.788761
lnimp	-1.515368	.15391	-9.85	0.000	-1.817026	-1.21371
lngdppc	-1.005326	.5167297	-1.95	0.052	-2.018098	.0074452
_cons	-16.34352	.	.	.	.	.

Table 15: Johansen Normalization Restriction Imposed

Source: Author's calculation

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lncont						
_ce1 L1.	-.3125449	.1304574	-2.40	0.017	-.5682367	-.0568531
lncont LD.	.3805853	.2570005	1.48	0.139	-.1231265	.8842971
lnnsc LD.	.7291129	.4489831	1.62	0.104	-.1508778	1.609104
lnexp LD.	-.3496832	.2947484	-1.19	0.235	-.9273795	.228013
lnimp LD.	-.2390774	.2299161	-1.04	0.298	-.6897048	.2115499
lngdppc LD.	-.115222	.5276947	-0.22	0.827	-1.149485	.9190407
_cons	.0565418	.066212	0.85	0.393	-.0732312	.1863149

Table 16: VECM

Equation	Parms	chi2	P>chi2
D_lncont	1	5.739677	0.0166
D_lnnsc	1	10.72874	0.0011
D_lnexp	1	5.226074	0.0223
D_lnimp	1	2.026001	0.1546
D_lngdppc	1	5.604963	0.0179

alpha	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lncont						
_ce1						
L1.	-.3125449	.1304574	-2.40	0.017	-.5682367	-.0568531
D_lnnsc						
_ce1						
L1.	-.2082494	.0635784	-3.28	0.001	-.3328608	-.0836381
D_lnexp						
_ce1						
L1.	-.2329378	.1018948	-2.29	0.022	-.432648	-.0332276
D_lnimp						
_ce1						
L1.	.157439	.1106095	1.42	0.155	-.0593517	.3742297
D_lngdppc						
_ce1						
L1.	-.114285	.0482728	-2.37	0.018	-.208898	-.019672

Table 17: Adjusted Long-Run Relationships

Source: Author's calculation

```
( 1)  [D_lncont]LD.lncont = 0
( 2)  [D_lncont]LD.lnnsc = 0
( 3)  [D_lncont]LD.lnexp = 0
( 4)  [D_lncont]LD.lnimp = 0
( 5)  [D_lncont]LD.lngdppc = 0

       chi2(  5) =    6.11
     Prob > chi2 =    0.2956
```

Table 18 : Short-Run Causality

Source: Author's calculation

Overall, the results show that the equation model fits well. The coefficients on lncont, lnnsc, lnexp, and lngdppc in the cointegrating equation are statistically significant. The ECT, or speed of adjustment toward equilibrium of lncont, has a negative sign and is statistically significant (ce1 L1. = -0.31 and p-value = 0.017), confirming the existence of adjustment toward equilibrium and identifying the existence of a long-run causality running from lnnsc, lnexp, lnimp, and lngdppc to lncont.The error-correction components in the VECM represent the speed of adjustment to the equilibrium. Typically, the ECT should be between 0 and 1 and must have a negative sign in value (Brooks, 2008). Table 18 shows the estimates, standard errors, z statistics, and confidence intervals for the short-run parameters. The parameters in this model's adjustment matrix are the five coefficients on L. ce1.

The L. ce1 of D_lncont, D_lnnsc, D_lnexp, and D_lngdppc is significant, indicating that the adjustment to equilibrium is relatively slow. Table 18 shows the statistical procedure used to test for short-run causality between these variables. The null hypothesis is zero, which means it cannot explain the lncont. The chi^2 (5) value is 6.11, and Prob> chi^2 = 0.2956; that is the p-value is greater than 5 percent, so the null hypothesis cannot be rejected and it implies that there is no short-run causality running from lnnsc, lnexp, lnimp, and lngdppc to lncont.

G. Impulse Response Function

The impulse responses of each variable to itself are determined, and other variables die out after a specific duration. A container throughput shock responds positively to itself and other variables. The early response of container throughput to a unit shock in ship call, export, import, and GDP per capita is positive and considered as significant. It is proven that the container throughput is caused by the number of ship call, export, import, and GDP per capita Granger-Cause. Rising container throughput may be viewed as having a significant impact on the number of ship call, export, import, and GDP per capita. The outcome shows that among the variables, the impulse response of shock exists to each other and becomes extinct after a specific period, confirming the constancy of the estimate model. The impulse response of number of shipcall to container throughput, the impulse response of export to container throughput, and the impulse response of import to container throughput are observed, and it is observed that the number of shipcall and value of export and import enacts clearly than the result frequencies of ship, schedule of shipping line of shipcall when increasing, GDP, and population, which also denotes the increasing volume of throughout may have significant impacts. Additionally, it is observed that the impulse response of GDP per capita to container throughput is a shock of GDP to container throughput that gives a clear response. Furthermore, the impulse response of GDP per capita to container throughput is a shock of GDP to container throughput that produces a clear response.

After that, the initial shock response of container throughput to export and GDP per capita is positive and can be considered significant. It is simple to illustrate that increasing export will increase GDP per capita, thereby increasing total container throughput. Figure 4 also asserted that an import shock responds negatively to itself and all other variables, whereas container throughput responds more positively than other variables. It suggests that increasing import will have a greater impact on increasing container throughput than other variables. As shown in Table 16 and 17, the equilibrium adjustment process is relatively quick and leads to long-run equilibrium.

H. Post Diagnostics Check

Following the evaluation of the VECM model, the next step is to determine whether the appropriate model chosen provides efficient data estimates and is well-specified. Various post-estimation tests are performed to check for misspecification and stability issues, as well as the problem of serial correlation, among other things. All diagnostic checks show that the model is stable, with no signs and symptoms of autocorrelation, normality, or heteroskedasticity.

As a result, the model is well-designed and free of any econometric issues and mistakes. The inverse roots of the AR polynomial stability condition test display that no points are outside the circle, indicating that the VECM model is stable and the results are correct and valid. Based on the serial correlation test results, the probability values show no evidence of serial correlation among residuals. The null hypothesis of no serial correlation is accepted at a 5 percent level of significance.The heteroskedasticity test revealed that there is no heteroskedasticity in the model.

a) Stability Test

The VECM was tested for stability using an eigenvalue stability test, which revealed that the system is stable. K – r unit eigenvalues are contained in the companion matrix of the VECM with K endogenous variables and r cointegrating equations. The moduli of the remaining r eigenvalues are strictly less than one if the process is stable. It is difficult to determine whether the eigenvalues' moduli are too close 1 and similar because there is no general distribution theory for moduli. The general rule in this test is that there would be a sustainability problem if some of the remaining calculated modules were very close to one. Eigenvalues appear in table 19 below. Only one of the eigenvalues is one, while the other computed modules are not close to one.

The results show that there are about 0.338 of real roots. There is no distribution theory that can be used to determine how close this root is. Nonetheless, the root 0.339 supported earlier estimate concluded that the predicted cointegration equation was most likely not stationary. The eigenvalue graph reveals that the remaining eigenvalues are not found near the unit circle. The stability check does not indicate that the model was incorrectly specified. The graph that accompanies figure 4 shows that all eigenvalues are within the unit circle. The companion matrix has (5-1) unit eigenvalues for a five-variable model with one cointegration relationship. For stability, the remaining eigenvalue coefficients must be exactly less than unity. Below, diagnostic checks will be carried out on heteroskedasticity, the autocorrelation of residuals, and normality.

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
.3384209 + .6716343*i*	.752078
.3384209 - .6716343*i*	.752078
.6027718	.602772
-.4764774 + .05195964*i*	.479302
-.4764774 - .05195964*i*	.479302
-.3340626	.334063

The VECM specification imposes 4 unit moduli

Table 19: Stability Test

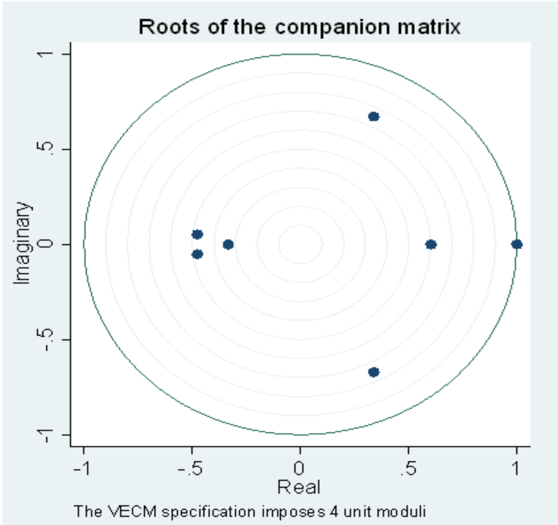

Fig. 5: Stability Test

b) LM Test of Autocorrelation

The Lagrange-Multiplier test is then used to check and look for autocorrelation in the residuals of the VECM. The null hypothesis of no autocorrection occurs at the optimal lag selection. After evaluating the VECM model, we test whether the residuals of this model are white noise or not. If autocorrelation is observed between the residues, then it is implied that some information is left out of the model, such as insufficient lags. The Lagrange-Multiplier (LM) test detects serial correlation of residues up to a specified order of lag, which should be the same as the corresponding VAR. The result of the LM test at the 5 percent level is shown in Table 17. The null hypothesis, that there is no autocorrelation in the residuals for any of the orders investigated, cannot be rejected. As a result, no evidence of model misspecification can be found in this test.

c) Multivariate Heteroskedasticity Test

Statistical evidence shows that the system is homoskedastic or free of heteroskedasticity by checking the test in table 20 for the multivariate ARCH effect because the p-value under the null hypothesis is nonsignificant up to the order of lagged 2.

d) Test for Normality of Residuals

Finally, an analysis of model disturbances is required. The test aims to check whether the residual has a normality distribution or not. Jarque-Bera test, Kurtosis test, andSkewness testcomputes series test statistics for H_0, which aid in confirming the VECM disturbances are normally distributed. Failure to reject H_0 indicates that the model is incorrectly specified or misspecified. However, the lack of residual normality does not render or cause the cointegration tests and VECM invalid. The results of table 21, 22, and 23 shows that the model is not misspecified because null hypothesis H_0 is accepted. Thus the results regarding the variables which have an effect on the container throughput could be accepted. Kurtosis test statistics do not reject H_0 that the terms of disturbance have kurtosis and skewness test consistent with normality.

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	21.5027	25	0.66427
2	21.6318	25	0.65691

H0: no autocorrelation at lag order

Table 19: Lagrange-Multiplier Test

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	21.5027	25	0.66427
2	21.6318	25	0.65691

H0: no autocorrelation at lag order

Table 20: Heteroskedasticity Test

Equation	chi2	df	Prob > chi2
D_lncont	2.136	2	0.34367
D_lnnsc	0.322	2	0.85139
D_lnexp	0.906	2	0.63568
D_lnimp	0.450	2	0.79843
D_lngdppc	0.610	2	0.73704
ALL	4.424	10	0.92618

Table 21: Jarque-Bera Test

Equation	Kurtosis	chi2	df	Prob > chi2
D_lncont	4.2665	1.604	1	0.20534
D_lnnsc	2.5146	0.236	1	0.62739
D_lnexp	2.6695	0.109	1	0.74101
D_lnimp	2.8556	0.021	1	0.88516
D_lngdppc	2.5828	0.174	1	0.67654
ALL		2.144	5	0.82891

Table 22: Kurtosis Test

Equation	Skewness	chi2	df	Prob > chi2
D_lncont	-.36473	0.532	1	0.46572
D_lnnsc	-.14675	0.086	1	0.76914
D_lnexp	-.44634	0.797	1	0.37203
D_lnimp	-.32763	0.429	1	0.51231
D_lngdppc	.33022	0.436	1	0.50897
ALL		2.281	5	0.80910

Table 23: Skewness Test

Source: Author's calculation

V. DISCUSSION

This study has discovered many interesting findings of the factors affecting the maritime transport markets by using applying the VECM model of time series econometric analysis to investigate the container throughput of Cambodia's port and the problem that needs to be taken action and solved for better improvement to Cambodia's international ports to support the higher increases of the container throughput traffics and demands in Cambodia in long run plan and project of maritime transport as well as strategy development of port and shipping market.The findings of analysis and estimation in the also reveal many interesting findings, which are discussed below;

A. *Number of Ship Call and Container Throughput*

The number of ship called has a significant and positive impact on the combined container throughput of PAS and PPAP. This result demonstrates that the flow of traffic demand in ports explains Cambodia's port throughput and is related to port performance and efficiency from an increase in number of ships that called at ports. It means that the port authorities of PAS and PPAP are paying attention to and focusing on the number of ship called at ports in order to meet the increased demand for container throughput in ports, because port performance is measured in terms of the number of containers throughput. This is consistent with JICA's master plan, which studied master plan ports in both PAS and PPAS to have deep-sea port construction expand the large port terminals and port facilities to support the higher container throughput from the increased frequency of ship call in the long run. The total number of ship call exhibits a positive sign of association for statistically significant variables. It is positive for port throughput; ship call represent a lot of opportunity and demand for the global shipping network, as shown in Japan, indicating a congested condition at the port level. The call frequency will help to support this circumstance. The higher shipping frequency improves the more efficiency of terminal operations. The researchers also found that significant container ship call in Cambodia improved container traffic throughput due to a significant increase in the average volume carried by each ship. The volume of containers passing through a terminal or port is influenced by the number of ship call. If the number of ship call is increased, it will be more appealing to exporters and importers. Furthermore, suppose the port or terminal is capable of providing higher quality and additional services to commercial shipping. In that case, shippers will determine container cargo flows, thereby providing a competitive port. Besides, liner shipping agreements and ship or vessel upsizing strengthen the relationship between container shipping lines and container terminals. As a result, shipping alliances can choose to come to a port that will benefit them the most in terms of deployed capacity, ports of call, network structure, and port choice, and so on.

B. *Import and Container Throughput*

The findings result of import has a significant and negative relationship with the container throughput of ports PAS and PPAP. This result proves that Cambodia's port throughput in the long term of the plan is explained by a decrease in imports and is related to improved higher port efficiency, port performance and terminal traffic efficiency. This negative impact can be described as the fact that most imports or seaborne trade of imported goods from other countries' trading partners to Cambodia will be reduced due to the high cost of maritime shipping transportation and logistics and other surcharges. Imported goods are becoming more expensive, resulting in a decrease in import demand.The customs charge, tariff, and port due are still the most significant impediments to improving future import balance. As a result, other modes of transport, such as land and air, which are less expensive than shipping by sea, will be phased out. The variable import coefficient has a negative sign, indicating that Cambodia appeared to be diverting trade. It demonstrates a decline in imports via shipping from ASEAN member countries or trading partners. However, despite having a negative sign, the estimated coefficient on import is significant, implying that there is insufficient evidence that maritime transport shipping of imported goods will affect Cambodia's imports in the future. The existence of a direct relationship between import and container throughput of international ports of Cambodia, in other words, implied that a 1 percent increase in import would lead to a negatively long-run effect on the performance by 1.5 percent. This result contradicted the expected increase in positively affected imports.

Several economic facilitation programs will be implemented to address the economic problems of international trade, the reduction and/or exemption of custom tariffs for imported goods, the compensation of tax and duty paid on domestic goods for export, the reduction of import duty for parts and spare parts for all types of automobiles, including the reduction and/or exemption of income tax related to international trade, and the reduction of the cost of export production. This crucial policy framework and mechanism will be promote and help define as the tools of economic sector in order to measure the direct and indirect impact of international trade promotion, and trade exchanges.It should be noted that the above-mentioned economic facilitation programs aim to lower a component of import and export costs. The government, on the other hand, will be forced to increase national spending in the trade sector.

C. Export and Container Throughput

At the 5 percent level, the estimated coefficient export is positive and statistically significant, indicating that export influences the demand for container throughput at the combined Cambodian ports of PAS and PPAP. Export trade volumes will rise in parallel with economic growth. Cambodia is expected to move 4.1 times more products in 2030 than it did in 2018. Maritime transport sectors and ports will increase cargo and port throughput due to the increase in domestic commodity exports. This significant and substantial growth will require the development of both soft and hard logistics infrastructure. Maritime transport policy is becoming more efficient and effective to handle and process the increased export volumes and increased export volumes and a wider range of import and export values. Cambodia must improve its competitiveness to ensure that its exports-to-GDP ratio remains at or near current levels in order to sustain strongly significant economic growth in the medium and long term. Cambodia should look into efficient and effective ways to reduce logistics and supply chain bottlenecks in order to improve service reliability and keep its international market competitiveness. Because exports are satisfied with tariff-free preferences in the markets of the US and EU, and are not heavily influenced by ocean freight fees, rates, and surcharges, reducing logistics costs, charges, and delays will be the main strategic ways for Cambodia to further strengthen and maintain its high economic growth rates over the next 15 years.

Similarly, an increase in demand for imported goods by a trading partner may result in higher demand created by an increase in the countries' exports. Some of the higher partners' demand may increase Cambodia's exports, resulting in an increase in maritime transport activities through Cambodia's busiest ports, resulting in an increase in container throughput. Export cargo is transported via the international trade ports of PAS and PPAP. Some commodities are shipped by road from or to Thailand, Laos, and Vietnam, as well as by air. Export volume through both international ports has been increasing, with the growth rate of containers through Phnom Penh Port being particularly remarkable. The International distribution ports will expand in the future, and export container and bulk cargo will increase as a result of rational role sharing between land and sea transportation. PAS and PPAP have served as international distribution centers in Cambodia and will continue to do so in the future. Foreign trade through private ports, on the other hand, is increasing, and private port capacity is expanding rapidly. In the future, the private sector intends to construct additional large ports. The roles of these ports must be rationally assigned, taking into account the unique characteristics of each port as well as the efficient use of resources. Cambodian ports will improve their overall functions through cooperation and competition among themselves.

D. GDP Per capita and Container Throughput

GDP per capita has a negative sign and has a significant impact on the demand for port throughput, which is considered the port output and efficiency. In terms of the economic variable, container throughput and economic growth are fundamentally linked with a tightening relationship that is similar to China and generates a lot of container throughput or port cargo like several other large developing countries. Nonetheless, GDP per capita is lower than average, resulting in a negative estimate. According to Vanoutrive, Thomas (2010), a study linking economic activities and port throughput in Belgium discovered very similar results that demonstrated the correlation. The reason for this has already been discussed, and it is due to Cambodia as a small country. The relationship between port throughput and neighboring countries' GDP is frequently stronger than or equal to the relationship between port throughput and the GDP of the country in which the port is located.

More trade, particularly in intermediate products, is accompanied by regional or global supply chains, according to Goldfarb and Beckman (2007); Robinson (2002); Goldfarb and Thériault 2008). Because values are created at various points along the supply chains, the relationship between what is transported via container ship and port and its economic impact is more complex. Musso et al. (2002) provides another plausible explanation of outcome and result described how the national economy was becoming increasingly irrelevant to port success. This means that external economies, foreign countries are becoming more important than national or local economies. The effects of GDP per capita on port performance or container throughput yields may be minor in the long run. The economic crisis, illness, or shock will all have a greater impact, and GDP per capita has even become negatively and significantly related on the demand for throughput of ports. According to Wildenboer, E. (2015) shown that when per capita GDP rises by 1000, container falls by 451,608 TEU. This parameter has a large negative impact on container throughput. This is a remarkable discovery because a significant positive relationship between per capita income and national GDP on the one hand, and port performance on the other, can be predicted.

VI. CONCLUSION

Based on the estimated results and discussions, it is possible to conclude that the endogenous variable was container throughput for Cambodia's international ports, namely the PAS and PPAP ports. Simultaneously, the exogenous variables are the number of shipcall, export, import, and GDP per capita, which are all in natural logarithms. To estimate research work, the cointegration equation and the VECM are used. Meanwhile, it is discovered that the series used in this analysis is nonstationary at the level but stationary at the first differencing.A sequential likelihood ratio test was performed on the rank of the estimated parameter matrix from the VECM model to identify the number of cointegration relations. Recently, the IRF was used to determine whether or not there is any shock in the response of one factor to another.The empirical analysis of this study reveals the best fit of the model by developing the long-run equilibrium relationship advancement of the actual data time series data, as evidenced by appropriate estimation findings of results. The study also further examines the long-run causal relationships among the variables influencing container throughput in time series data. The statistical and econometric evidence revealed that the estimating series has a statistically and significantly long-run equilibrium relationship, which affects Cambodia's overall container throughput.

Besides that, it is critical to emphasize that the VECM results are not based on the short-run granger-causality relationship that runs from GDP per capita, ship call, import and export, to container throughput. According to the estimation results of the IRF test, the shock response of independent variables to container throughput disappears after a while. Furthermore, the container throughput at Cambodia's ports generated by VECM yielded satisfactory results.The model was appropriate, and other methods of measuring tests were considered in order to evaluate the model's goodness and accuracy. The PP and ADF results for unit root tests demonstrate that all series are nonstationary at the level but stationary in the first differencing, i.e. they are integrated with the order one I (1). The research then keeps moving on to examine the long-run equilibrium relationship among exogenous variables using Johansen's multivariate cointegration test. The findings revealed the presence of a cointegration vector between these variables. Various diagnostic and post-estimation tests are performed to investigate misspecification issues as well as the model's stability and robustness in order to obtain the best possible results and correctly confirm them. The stability check shows that our model is not misspecified or incorrectly specified. Based on the Lagrange-Multiplier for LM test results, we cannot reject the null hypothesis, which states that there is no serial correlation or autocorrelation the residuals for any of the orders studied. As a result, the results of the tests show that there is no evidence of model misspecification. Our model does not have misspecification, according to Jarque-Bera, Kurtosis, and Skewness test results. For all equations, the null hypothesis for the normality of distributed convergence to recover the long-run equilibrium position is not rejected. As a result, the model is satisfied and appropriate in the research and analysis. As a matter of conclusion, it is possible to conclude that the number of ship call has a statistically and significantly positive effect on container throughput. The coefficient of a number of ship call is 1.82213, indicating that it is more elastic (greater than 1). It shows that a 100 percent rise in the number of ship called is likely to increase container throughput by 182.22 percent in the long run in a positive relationship to Cambodia's port throughput. An rise in the number of ships calling at Cambodian ports would boost maritime sector activities such as loaded or unloaded cargo transportation and the frequency of shipping traffic at the ports.As a result, container throughput would increase. Export has a statistically significant impact on container throughput and has a positive effect on Cambodian container throughput.The coefficient value is explained by 1.00068, which is greater than 1 and is considered elastic. When exports increase by 100 percent, container throughput increases by more than 100.068 percent. As a result, Cambodia should prioritize export promotion policies in order to increase seaborne trade and export cargoes of final products from its countries, allowing maritime time transport activities to become more interesting and busy as the tools and measure in TEUs of container put throughput at port.

The findings of import also indicated and thus confirmed a long-run negative relationship between import and container throughput. The coefficient value is produced by minus 1.51536, which is greater than 1 of absolute value and considered elastic, implying that a 100 percent increase in import will reduce the impact of nearly 151.53 percent of container throughput long-run negative relationship. The findings revealed a long-run negative relationship between import and demand for container throughput because imports of goods are valued at their free on board market prices at foreign ports, which do not include Cambodian import duties, ocean freight, maritime transport services such as insurance, travel expense and maritime transport freight paid to foreign carriers or firm that need to be shipped because imported goods are not produced in Cambodia, so the cost will be more expensive.

Also, GDP per capita and container throughput have a significant effect on and a negative long-run relationship with each other in line with the studies conducted by OECD (2014) on time efficiency at world port container,. The value of the coefficient is explained by minus 1.00532, which is greater than 1 and is considered elastic in absolute value. The result indicated a 100 percent increase in GDP per capita; however, with a negative long run relationship, container throughput is reduced by more than 100.53 percent. This can lead to the conclusion that international economies and the hinterland, neighboring countries, or the rest of the world are given more weight than national or local economies. This demonstrates that the national economy is becoming less and less essential for port performance as a result of the economic crisis, random shocks, and diseases in the country, such as SARs in Hong Kong and Covid-19 of the global pandemic, all of which reduce a country's GDP and GDP per capita. Despite this, the higher container port cargo throughput was still significantly higher.With the best results, it can now conclude that the coefficient values are all elastic. As a result, it is concluded that container throughput is relatively more elastic in terms of the number of ship call than in terms of import, export, and GDP per capita, and there are also long-run equilibrium relationships. In the short run, the granger causality test revealed no causal relationship among container throughput and exogenous variables like GDP per capita import and export, and ship call.

In the short run, the granger causality test revealed no causal relationship between container throughput and exogenous variables like GDP per capita import and export, and ship call. This finding was consistently responsible for the long analysis, which is explained by the fact that the joint variables of GDP per capita, number of ship call, import, and export do not granger-cause container throughput is rejected.

VII. POLICY IMPLICATION AND RECOMMENDATION

Cambodia's government ports, MPWT, and port authority should develop, design, and implement the best port policy and strategy planning, such as developing future terminals, infrastructure, container ports, and facilities, in order to provide better maritime transport service, quality port services, and shippers and liner shipping companies.Moreover, due to the capacity of the existing container port, the building of new ports to meet the future demand will increasingly be unable to handle such massive container demand (Syafi'i et al., 2005; JICA, 2007).The government and MPWT should consider developing and formulating a maritime transport strategic policy to promote long-term economic growth and sustainability. The findings of this study suggested that port authorities may have to make all necessary decisions to invest in developing infrastructures of ports and port facilities, transportation, container terminals, and logistic connectivity, among other things, because increased productivity of port facilities will lead to increased demand for container throughput or volume of throughput in the future.Port capacity must be increased in order to meet and forecast rising demand. As a result, the robust analysis and estimated results of the findings found in this research greatly assist the government, MPWT, and port authorities in making better decisions that could provide appropriate values for meeting the increasing demand of throughput of Cambodian ports and investment, finance, and operation in the future to handle and sustain the higher demand of throughput.

VIII. DECLARATION

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