MARINE SECTOR GROWTH IN VIETNAM, THAILAND, MYANMAR, LAOS AND CAMBODIA V/S AUSTRALIA AND NEW ZEALAND

By

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ABSTRACT

This paper tries to analyse and compare the Marine Sector growth in Australia, New Zealand, Vietnam, Thailand, Myanmar, Cambodia and Laos through various factors affecting it such as Port Throughput, Fishing sector, Marine tourism sector, Coastline, GDP, Shipbuilding, Import-Export and numerous others. In the first part of the paper we conduct a qualitative analysis of the impact of indicators such as number of ports, length of coastline, GDP growth, ship-building and marine tourism on the marine sector growth of each country. Next we attempt to establish different factors that affect the handling capacity of ports across countries and attempt to explain them through Regression Analysis from 2007 to 2018 data of the variables such as Liner Connectivity Index, Peripheral Port Throughput, Number of ships, International Trade. Finally we try to forecast Total Marine Fish Production of seven countries (Australia, New Zealand, Vietnam, Thailand, Myanmar, Laos PDR, Cambodia) during the period 1981-2016. A statistical analysis has been employed to forecast fish production for next five years by using the ARIMA model. ARIMA is one of the most widely used non-stationary time series analysis. The main findings for major factors affecting Port throughput are that Peripheral Port Throughput and International Trade Value are Statistically Significant Variables for 3 out of 6 countries.

Keywords: Port Throughput, Regression, ARIMA model, Stationary series, Shipbuilding,Marine Tourism

INTRODUCTION

The maritime sector is an essential component of a country's economy. The sector plays a crucial role in determining the socio-economic development of the country's society as it contributes to various economic activities and is also responsible for the employment of a major section of the workforce in its many sub-sectors. The maritime sector in essentiality is defined by its various sub sectors that have contributed significantly over the ages in shaping the backbone of the countries' economy.

Shipping is a well known mode of transportation that is undoubtedly of great economic importance to any country. It is arguably one of the cheapest and most popular modes of transportation and has proved to be a large source of employment and revenue over the years. With there being over 53,000 cargo and commercial ships worldwide (World Bank Databook, 2018), this sector has experienced numerous expansions as it continues to define the transportation and global trade landscape. Global trade through marine waterways is another key component of economical and political importance to a country. There has been a real trend in expansion with respect to trade volumes as the world has moved towards globalisation and the maritime sector has thus played a crucial part in enforcing this possibility. Commercial fisheries and aquaculture is another major contributor to the marine sector. Fish production, which is an integral component of overall food production of a country, has clearly seen an expansion over time with respect to volume and productivity. In addition to being integral to the food industry, the fisheries sector has proven to be a major source of occupation for those living in coastal areas. With the development of technology, this occupation has evolved in terms of its efficiency and output and hence continues to be a key aspect of the marine sector. The marine sector is also composed of port operations and activities that are necessary for enforcing trade and consequently serve as a representation of the structural integrity capable of their respective countries. Container throughput in ports is an important indicator of the same. In addition to all this the marine sector is composed of a number of smaller sub sectors that in their own way are responsible for the development of a stable and advancing economy. Coastal and marine tourism which includes the cruiser and recreational industry contributes in a major way to the overall tourism revenue generated by a country. Subsequently, sub-sectors such as offshore oil mining, research and development and other marine related activities are all responsible for adding on to a country's economy .

To really understand the continued impact that the marine sector has, it is necessary to analyse developments within the sector and the factors that influence it. This helps to fully gauge the economic impact and the subsequent influence that the advancement of the marine sector thus has in the overall development of the country. The purpose of this paper is to analyze and compare the marine sector growth in Australia, New Zealand, Vietnam, Thailand, Myanmar, Cambodia and Laos. We consider multiple dimensions throughout the study to gather a greater understanding of how the sector has shaped up over the years in terms of its sub sectors. We also compare the developments in the marine sector between countries in order to get a comprehensive overview of the factors that influence the growth and progress of this sector. We categorize Australia and New Zealand as high income countries, Vietnam, Thailand and Myanmar as middle income countries and Cambodia and Laos as low income countries based on an assessment of their GDP per capita. By including a diverse array of countries in our study, we aim to analyse the dynamics involved in the growth of the marine sector as well as draw comparisons in order to single out relevant parameters that would prove decisive in helping the sector grow. The marine sector is one of

the largest growing parts of the economy of Australia (**AIMS Index of Marine Industry**, **2019)** and the same is true for New Zealand. On the other hand, the marine sectors of countries like Thailand, Vietnam, Myanmar and Cambodia are relatively smaller and less developed. Their industries show lack of modernisation, outdated vessels as well as the problem of sedimentation of rivers. However, we find that these countries exhibit real potential as we analyse and forecast the growth of the sectors in these countries.

For the purpose of this report, our focus lies on analysing the developments in the marine sector in terms of number of ports, length of coastline, GDP growth, ship-building, coastal and marine tourism, container throughput of ports, fishing sector and import-export in addition to other relevant parameters. We have shortlisted the above factors based on the guidance offered by **Mandale, Maurice et al. (1998)** who sought to value the total economic contributions of marine and coastal related activities by considering four main indicators, namely, the "Gross Domestic Product (GDP); number of people employed by the industries; amount of wages and salaries received by the industries' employees; and export values of outputs produced by these industries". In addition to this, we have excluded factors based on cross examination of the results we had obtained after including them. Our paper tries to establish a comprehensive understanding of the various sub-sectors of the marine sector through an investigation into factors affecting productivity and projections that could forecast growth of these subsectors. This would thus help better understand the driving forces behind the development of the marine sector in the selected countries.

In the first part of the paper we conduct a qualitative analysis of the impact of indicators such as number of ports, length of coastline, GDP growth, ship-building and marine tourism on the marine sector growth of each country. Next we attempt to establish different factors that affect the handling capacity of ports across countries and attempt to explain them through Regression Analysis from 2007 to 2018 data of the variables such as Liner Connectivity Index, Peripheral Port Throughput, Number of ships, International Trade. Finally we try to forecast Total Marine Fish Production of seven countries (Australia, New Zealand, Vietnam, Thailand, Myanmar, Laos PDR, Cambodia) during the period 1981-2016. All the above analyses would lead to a better overall understanding of the marine sector growth of the selected countries.

LITERATURE REVIEW

The commercial fishing and aquaculture industry is an integral component of a country's maritime sector. The productivity of this sub-sector is a vital indicator of the overall growth of the maritime sector as it adds to the total food production of the country. It is also economically critical with respect to aspects such as employment in the marine sector and agricultural exports. To critically assess the contribution of fisheries and aquaculture to the marine sector, it is necessary to forecast the productivity of the sector in terms of production and other essential criteria. **Mahalingaraya et al. (2018)** conducted a forecasting assessment using the Autoregressive Integrated Moving Average (ARIMA) model to analyze fish production in India. They were able to forecast the overall fish production in the country successfully. It was, however, found that the ARIMA model did not work quite as effectively as Artificial Neural Networks in terms of forecasting accuracy. **Paul and Das (2010)** also applied the ARIMA approach to their analysis of fish production in India. They were able to forecast and model the total inland fish production for India using data over 50 years. **Ravichandran and Prajneshu (2001)** carried out statistical modelling of marine, inland and total fish production within India. They used the 'Local Linear Trend' model to carry out the forecasting for the five subsequent years. It was found that their results were in line with the ARIMA method of forecasting, although the former method proved to be more accurate. It can be broadly surmised that the ARIMA method of modelling is a sufficiently intelligent approach that can be used to forecast fish production.

Another important sub-sector of the marine industry is port and marine transportation. Container throughput of ports and an analysis of its growth as well as factors influencing it in trade is one such signal that can be used to measure the competitive strength and influence of ports and subsequently the marine sector impact on the trade and marine productivity aspects of the marine economy. **Lechao and Gyei-Kark (2011)** conducted a thorough analysis of factors influencing container throughput in Korea and China. They employed techniques of empirical and regression analysis to conclude the relevance of hypothesized factors. The study confirmed the significance of factors such as geographical position, service level for Korea and hinterland economic level and government attitude for China. There is further scope to identify factors that can allow a win-win situation between the two countries' ports. **Park and Lee (2002)** researched in order to forecast container output of ports in their study. They used a neural network with a backpropagation learning algorithm. They considered variables such as "import container traffic, export container traffic, transhipment traffic, number of incoming vessels, number of outgoing vessels, unload capability, economically active population, and per capita income".

The shipping and marine tourism industry in addition to other minor sub-sectors such as offshore oil rigging, cruiser industry, research and development and other marine services contribute extensively to the overall impact that the marine sector has on the economy of a country. Comprehensive research has been conducted to identify the significance of these sub-sectors in terms of their contributions to the growth and productivity of the marine sector. **Douglas-Westwood Limited. (2005)** sought to identify "the world market value for each marine sector and its regional segmentation”. The study was used to forecast shipping data using “ projections of total seaboard world trade in ton-miles”. Port sector growth was

analyzed using data on tonnages and revenue coming from important ports and applying the average costs per tonne on total cargo volumes. Marine tourism was analyzed using all tourism expenditures except travel and accommodation. The study was able to compute the total value added in monetary terms by the sub-sectors, as mentioned earlier to the world economy. **Mandale, Maurice et al. (1998)** aimed to estimate “the total economic contributions of coastal- and oceans-related industries to the overall performance of Nova Scotia’s economy”. They employed four leading indicators to analyze the contribution of marine subsectors. These were consequently the “Gross Domestic Product (GDP); a number of people employed by the industries; the number of wages and salaries received by the industries’ employees; and export values of outputs produced by these industries”. They were able to evaluate the value impact of coastal related activities (including port and marine tourism) on Nova Scotia in terms of GDP, household income, employment and export. **The Allen Consulting Group. (2004)** purported to “measure the economic contribution of marine-based industries to Australia’s economy”. The study employed the concept of “value-added” in order to assign economic values to marine-related activities. The parameters used were “an assessment of economic activity, employment, taxation revenue and export revenue”. Significant findings of this study included an estimation of value, growth and productivity-based contribution of marine-related activities such as shipping, port and marine tourism to Australia’s economy. **Kildow, Judith and Colgan, Charles. (2005)** sought to measure the contribution of the coastal and ocean economy to California’s economy with time. They conduct the study using “the ES-202 employment data collected monthly by each state’s Department of Labor and reported to the US Department of Labor. The study was able to confirm the “high significance” of such coastal and ocean activities including construction, fish harvesting and aquaculture and marine transportation to the US economy. **United Nations. (2019),** in their annual publication, *Review of Maritime Transport* “examine main developments in world maritime transport and provide updated statistical data”. The study attempts to show the correlation existent “between global trade and maritime transport”. Through an update of statistical data, the study “highlights developments of maritime activities in developing countries vis-à-vis other groups of countries”.

ABOUT COUNTRIES:

In this section we talk about three variables namely GDP growth rate, Number of Ports and their Coastline with respect to these 7 countries.

1. **NUMBER OF PORTS:**

COUNTRY	NO. Of ports
CAMBODIA	2
MYANMAR	5
THAILAND	21
VIETNAM	15
NEWZEALAND	25
AUSTRALIA	106

Table 1 : Number of Ports

This shows that Australia has maximum number of ports (106) followed by New Zealand with 25 ports. Cambodia has only 2 functional ports.
And since Australia and New Zealand are High-income countries, they also have good infrastructure to support it. Vietnam and Thailand have 15, 21 ports respectively.

2. **COASTLINE DATA IN KM:**

COUNTRY	COASTLINE
Cambodia	443
Myanmar	2228
Thailand	2815
Vietnam	3280
New Zealand	15000
Australia	34000

Table 2 : Coastline length

The coastline data also has a similar trend with Australia at the top followed by New Zealand. This is due to the fact that both of these are surrounded completely by water.

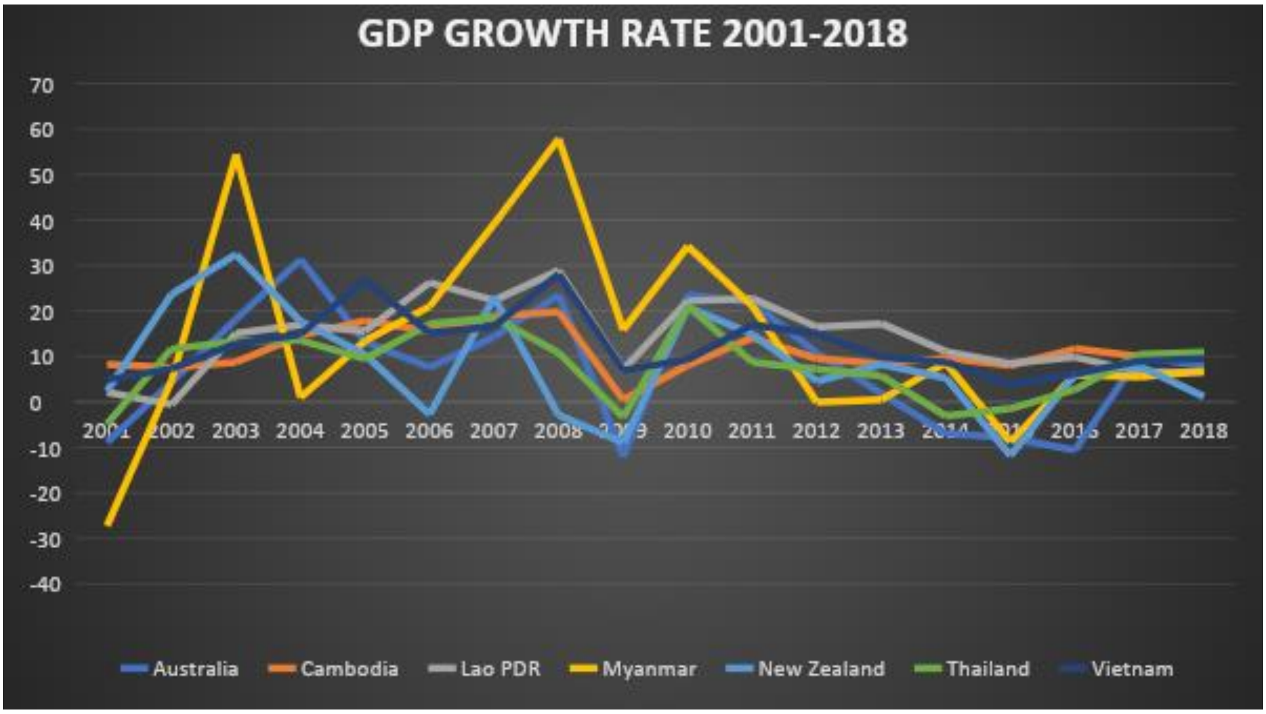
Then Vietnam has more Coastline than Thailand and Cambodia being a small country has least.Also, note that Laos is Landlocked so no coastline and ports.

3. **GDP GROWTH RATE:**

The data of GDP of each country for the past 19 years are attached at the back in the appendix.
Considering that most of the countries included in the study are relatively comparable in terms of the proportion of all their economic activities that are marine in nature, we make the assumption that the proportion of the GDP growth

rate due to marine activities is the same amongst all countries. Hence the trend and inferences made by the data can be assumed to be in line with marine trend. We took the data from the World Bank website from 2001-2019 and calculated the percentage growth rate of each year and plotted a line chart which is shown below.

As it can be seen Myanmar has had some significant growth rates and post 2002 each country has grown each year.



13. Fig 1 : GDP growth rate

Also, if we take the ratio of GDP in 2000 to 2018 of all the countries, we see that Laos's GDP has Grown by the maximum amount (10.3 times) followed by Myanmar, Vietnam, Cambodia, Thailand, New Zealand and then Australia. This shows that Thailand even being a Middle-Income country hasn't grown that much relative to its competitors

Country	GDP
Australia	3.453338598
Cambodia	6.6729626
Lao PDR	10.37072951
Myanmar	7.99711109
New Zealand	3.894168327
Thailand	3.995438992
Vietnam	7.866341859

Table 3 : GDP growth rate comparison

SHIPBUILDING

Shipbuilding refers to the construction of ships and other floating vessels. The process takes place at a particular place called Shipyard.

Shipbuilding is an integral part of the marine industry. It shows how advanced a country is in terms of manufacturing of ships.

It is measured in terms of gross tonnage, which is a nonlinear measure of ships overall internal volume.

It is a humongous work, and not all countries are involved in shipbuilding. Out of the seven countries we are discussing, shipbuilding is carried out by the following:

YEAR	Australia	New Zealand	Thailand	Viet Nam
2014	2245	200	1236	335862
2015	6488	438	1503	574181
2016	1721	349	229	435512
2017	11032	349	742	344818

Table 4 : Shipbuilding comparison

Among the above four, Vietnam is leading in Shipbuilding and New Zealand is at the last. Vietnam is also one of the major shipbuilding countries in the world.

From the above data we can see that there was a sudden increase in production in the year 2015 which led to an oversupply in the market, resulting in lowering of prices, excess inventory and then a sudden decrease in production in the year 2016.

MARINE TOURISM

Marine tourism is defined by Orams (1999) as “those recreational activities that involve travel away from one’s place of residence and which have as their host or focus the marine environment (where the marine environment is defined as those waters which are saline and tide-affected)”. The definition can be extended to include that marine-based recreational activities also include shore-based activities such as yachting and cruise-related activities, reef exploration and beach resort activities (Hall 2001,pp.2-3).

“Tourism can support the economic development of both the local community and the economy of a country, through earnings from domestic and foreign visitors”. (Bunghez 2016, p.3). In order to visualize the development of marine tourism in the countries of the study, we consider the metric of earnings from inbound visitors in the form of receipts (in $). We assume this to be an accurate indicator of marine tourism’s impact on economic development. Domestic earning in the form of receipts have not been considered due to a lack of sufficient data.

The data has been taken from the database of **The World Bank** from the years 2014 to 2018. The data represent overall tourism receipts. Considering that most of the countries included in the study are relatively comparable in terms of the proportion of all their economic activities that are marine in nature, we make the assumption that the proportion of the tourism receipts due to marine activities is the same amongst all countries. Hence the trend and inferences made by the data can be assumed to be in line with marine trends, which is the purpose of this study. We note that Laos has not been included as it is landlocked and thus can not have any benefit from marine tourism.

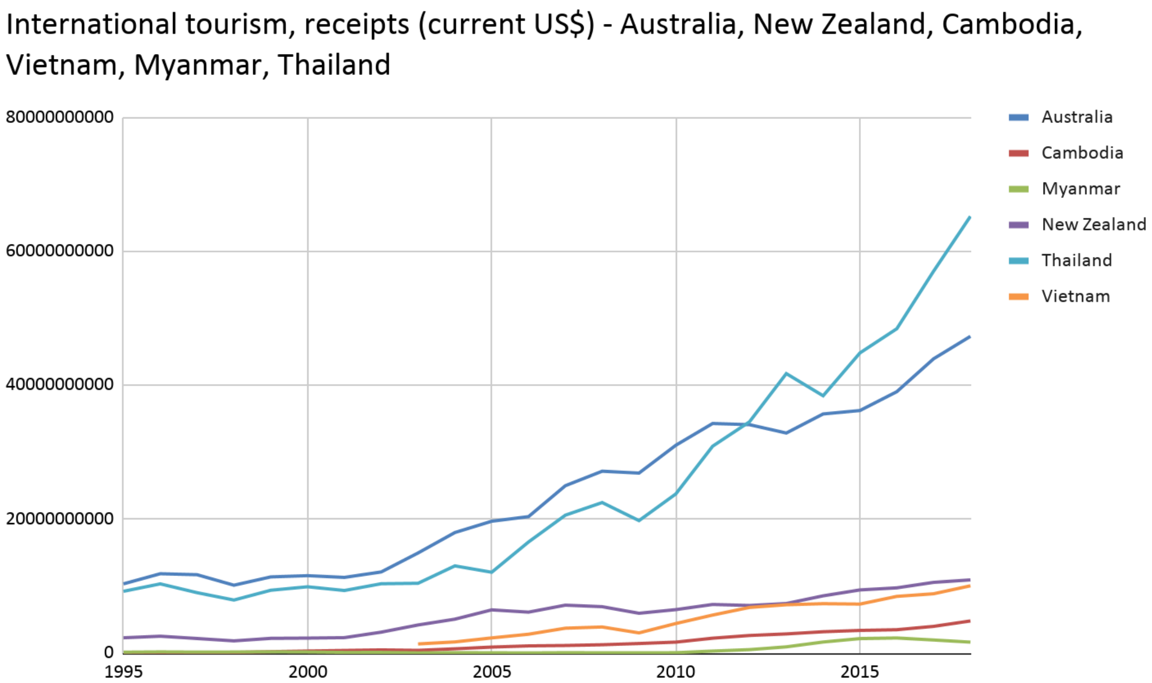


Fig 2 : International tourism, receipts(current US$)

Source: World Tourism Organization, Yearbook of Tourism Statistics, Compendium of Tourism Statistics and data files

From the graph, it is clear that Thailand is currently leading in (marine) tourism revenue even though it is a middle-income country. New Zealand, which is a high-income country is seen to generate receipts comparable to other middle and low-income countries. We can hence possibly infer that there exist other important factors that have more bearing on the development of the (marine) tourism sector which in turn adds on to the economy. It is also clear that Thailand relies heavily on tourism for economic development compared to other countries in a similar or lower-income bracket.

ANALYSIS OF PORT THROUGHPUT:

Port throughput reflects the quantity of Cargo or number of vessels the port handles over time. It is measured in a unit called TEU (Twenty-Foot Equivalent Unit).

Today, globalization has resulted in a massive increase in trade volumes, and due to this, new port areas have developed significantly.

Here in this study, we try to establish the factors that affect the handling capacity of these ports.

For this study, we can use numerous modelling techniques which are discussed below.

1. **TIME-SERIES MODELS**:
   Time series models like ARIMA, AR, MA are used when the data is sequential in nature taking place in fixed time intervals. It could derive the significance of the variables
   ADVANTAGES: Useful when data is limited.
   DISADVANTAGES: Autocorrelation may exist and other serial correlations possible.

2. **SYSTEM-DYNAMIC MODELS:**
   System Dynamics Models are the models wherein parameters are obtained from existing literature and by trial and error rather than estimating them statistically. They explain the relationship between variables through. These arrows provide feedback which can be negative or positive. The input can be both quantitative or qualitative.
   ADVANTAGES: Can be applied to both Qualitative and Quantitative variables
   DISADVANTAGES: Cannot be tested statistically and hence econometric models are still needed.

3. **REGRESSION MODEL:**
   Another way to explain the handling of Cargo is by use of regression analyses on cross-sectional data. The Idea is to determine a relationship between cargo throughput in ports and several variables affecting it. This analysis helps to explain data and estimate parameters. A regression model can be linear or nonlinear.
   ADVANTAGES: Good for illustrating the effects.
   DISADVANTAGES: Difficult to find proper functional form.

4. **NEURAL NETWORKS:**
   Another could be a neural network model. They are based on the human brain (Lam et al., 2004). This could be verified by the fact that the model learns from the environment and improves itself (Gosasang et al., 2010). Mainly there are 3 layers: the input layer, the hidden layer (optional) and the output layer. Each layer is connected with the other by so called neurons.
   Using logistic regression, we could build a neural network and train it to yield outcomes.

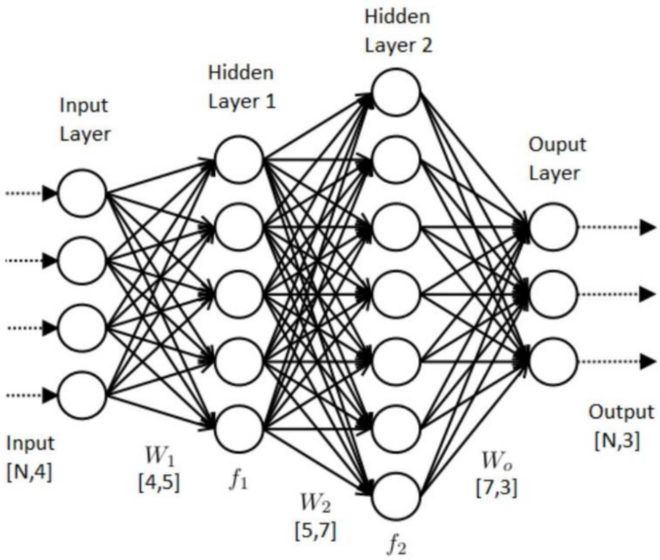


Fig 3 : Neural Networks

ADVANTAGES: Good for predicting the results

DISADVANTAGES: Requires large amount of Data

As we can see there are so many models which could be used to do this study.

We chose the regression model for the following reasons:

1. Data Limitations : Including All the Variables we had the data from 2007 to 2018 only
2. Significance of Variables: It was important to identify the statistical significance of all the variables used here.
3. Cause: Also, it was important to factor out the Cause that affects the port throughput. This implies that we need the individual behavior of each variable and not just the overall model implications.

The most plausible choice was using a **REGRESSION MODEL**

So now we briefly Explain the Regression Model used here:

In this model we find out the relationship between a Dependent Variable (Y) and the Independent variables (X1, X2, X3….) and the model is represented as -:

$$Y_i=\beta_0+\beta_1 x_{i1}+\beta_2 x_{i2}+\ldots+\beta_p x_{ip}+\epsilon$$

Where :

for i=n,

Y_i=dependent variable

x_i= Explanatory Variables

β_0= Intercept Term

β_p= Slope coefficient for each X_i's

ϵ= Error/Residual term

The concept used here is to find a linear equation that fits the model at the same time minimizing the error. The error we take into consideration is SSE(Sum of Squared Errors) which is then used to determine the Regression Result.

This method is called OLS Estimation.

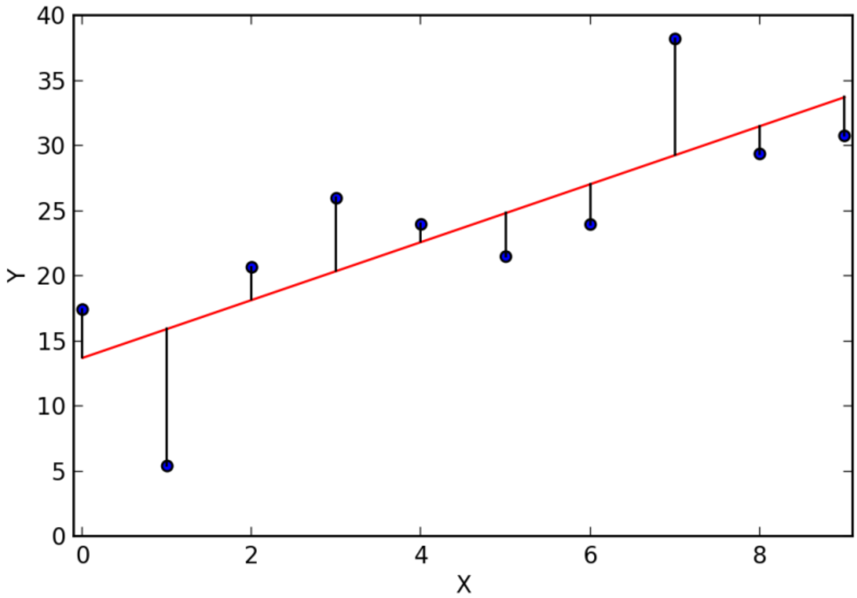


Fig 4 : Regression Line

Now we explain some of the key terms to understand in this model

Coefficient of determination($R2$): It is the percentage of the error in the dependent variable that is explained by the independent variables. But the problem with this is that it is a non-decreasing function of independent variables and hence not a reliable measure

Adjusted $R2$: It rectifies $R2$'s non-decreasing property by dividing it with the degree of freedom. It is one of the ways for checking the overall model.

$$\text{Adjusted } R2 = 1 - (1-R2)(n-1)/(n-k-1)$$

Where n-> no. of observations and k-> no. of parameters

t-statistic: It is used to check the statistical significance of individual variables and is used extensively here to check whether our variables impact the port throughput.

F-statistic: It is used to evaluate overall model's Goodness of Fit and is also used in this paper.

CHOICE OF VARIABLES:

To compare the marine sector of the countries, in the following model we ran a regression between Port throughput and factors affecting it.

PORT THROUGHPUT is used for measuring container handling activity, and is expressed in TEU (Twenty-Foot Equivalent Unit). Throughput depends on many factors and the two important categories of throughput are O&D and transhipment. Throughput generally includes the handling of imports, exports, empty containers and transshipments.

Y -> Port throughput

Port throughput depends on the following factors:

1. **LINER CONNECTIVITY INDEX:**

The Liner Shipping Connectivity Index (LSCI) aims at capturing the level of integration into the existing liner shipping network by measuring liner shipping connectivity. It can be calculated at the country and at the port level. This factor helps us by defining how well are the port of the countries connected to the world.

X1 -> Liner Connectivity Index

2. NUMBER OF SHIPS:

Number of ships registered under the flag of a country will depict how well a country can ship its shipments, and hence is a factor for determining the port throughput.

X3 -> Number of Ships

3. **PERIPHERAL PORT THROUGHPUT**:

Peripheral Port Throughput gives us the total port throughput of all the ports in the world excluding the country we are running the model for.

This helps us to compare the country's change in port throughput to that of the world, and by doing so we try to see whether the changes in the country's throughput is a global change faced by all countries or not.

X2 -> Peripheral Port Throughput

4. **INTERNATIONAL TRADE**:

An export in international trade is a good or service produced in one country that is sold into another country. An import in the receiving country is an export from the sending country. Port throughput depends on use of marine transport which further depends on how much goods is traded internationally by the country.

X4 -> International trade

5. **BERTH LENGTH** :

A berth is a designated location in a port or harbour used for mooring vessels when they are not at sea. Berths provide a vertical front which allows safe and secure mooring that can then facilitate the unloading or loading of cargo or people from vessels.Due to unavailability of data for all seven countries we were not able use it as an independent variable in our model.

6. **FTZ AREA (FREE TRADE ZONE)**:

It is a custom duty-free geographic area dedicated for handling, storing, manufacturing, landing, or reconfiguring and re-exporting under specific customs regulation.

Due to unavailability of data for all seven countries we were not able to use it as an independent variable in our model.

7. **TRANSHIPMENT:**

Transhipment is a process where the goods or containers are shipped to an intermediate destination, and then to another destination. This occurs when the ship doesn't directly go to the destination from origin, rather the ship takes a stop on its way.

Due to unavailability of data for all seven countries we were not able to use it as an independent variable in our model.

8. PORT TARIFF:

Port tariff is the amount payable to the port authorities for their services. Port tariff plays an important role in determining the port throughput as it determines whether people can choose the shipping service or not.

Due to unavailability of data for all seven countries we were not able us it as an independent variable in our model.

<u>Therefore, the model has,</u>

Port throughput as dependent variable (Y);

Liner Connectivity Index (X1), Peripheral Port Throughput (X2), Number of Ships (X3), International Trade (X4).

(A) Geographical Position : Liner Connectivity Index (X1) Peripheral Port Throughput (X2)

Throughput(Y)

(B) Port's Services : Number of Ships (X3)

(C)Demand/Supply of Economy : International Trade (X4)

METHODOLOGY:

We have taken our data from 2 Sources:

1. United Nations Conference on Trade and Development
   https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx
2. World Bank
   https://databank.worldbank.org/home.aspx

We used a Backward Elimination Method to determine the number of regressors to be taken into our model.

It means that we Output the entire model and then remove a variable and check for the Adjusted R2. If it increases that means the New model is better and we eliminate the variable.

Using this we eliminated Number of ships Variable in Australia.

Again, due to data limitations in the case of Cambodia we haven't taken 2010,2011 data for Cambodia.

Also due to the high correlations of GDP and Trade Value and Trade Value being more relevant we eliminated GDP from the Regressors.

Finally, we performed the regression in EXCEL from year 2007 to 2018 data of which results are shown below.

ASSUMPTIONS

1. All the assumptions of the regression model like Homoscedasticity, Linearity in parameters, no Multicollinearity etc.
2. It assumes that the variable International Trade is Import + Export because we want to analyze its impact on Port Throughput, and both Import and Export affect Port Throughput.
3. It assumes Number of Ships as Number of general Cargo Ships due to its relevance.
4. For Peripheral Port Throughput It Takes the Port Throughput of all countries other than the country in analysis

NOTE: LAOS WAS EXCLUDED FROM THIS ANALYSIS DUE TO THE FACT THAT IT HAS 0 PORTS AND HENCE NO DATA.

DATA:

Group 1: (Australia, New Zealand)

Country	Variables	PORT THROUGHPUT (Y)	LINER CONNECTIVITY	PERIPHERAL PORT THROUGHPUT	NUMBER OF SHIPS	INT. TRADE
New Zealand	2007	2311569	24.84489772	487506740.00	130.911	57821348.00
	2008	2317823	24.03944898	513834509.88	173.599	64945320.00
	2009	2324970	22.53251767	469850155.40	163.646	50498452.00
	2010	2525722	21.25284201	557582708.68	155.753	62008523.00
	2011	2620005	20.96513579	603491139.91	29.478	94578152.00
	2012	2822305	20.71214541	631691666.99	28.162	75547416.00
	2013	2891355	22.32604042	653862667.06	23.396	79062239.00
	2014	3003096	23.55481072	684744738.24	23.396	84129786.00
	2015	3173355	23.40236057	693973399.16	23.396	70885653.00
	2016	3165355	22.37524108	707450955.93	41.679	69775238.00
	2017	3189100	34.45078146	754798490.00	54.714	78178725.00
	2018	3328700	22.92425503	789931906.02	50.048	83575145.00
Australia	2007	6290090	29.09289918	483528219.00	130.3	306694.36
	2008	6102342	30.76688077	510049990.88	136.498	341631.36
	2009	6200325	31.16899030	465974799.80	139.594	306829.36
	2010	6412164	30.80151078	554662729.56	132.972	342997.36
	2011	5946383	32.88869200	601281621.61	147.598	385059.36
	2012	7251198	31.09054073	628338651.50	145.038	402298.36
	2013	7179668	31.02391771	650634018.83	133.45	383498.36
	2014	7404551	34.15061332	681339181.45	124.823	378710.13
	2015	7633532	32.54619005	690393383.32	89.597	349859.15
	2016	7689776	33.52609338	703856881.76	94.777	337627.90
	2017	8010472	33.01616157	750548688.00	101.881	370138.13
	2018	8747113	34.10809992	783911554.34	97.48	376744.00

Table 5 : Regression Variables for Australia and New Zealand

Group 2: (Thailand, Cambodia, Myanmar, Vietnam)

Country	Variables	PORT THROUGHPUT (Y)	LINER CONNECTIVITY	PERIPHERAL PORT THROUGHPUT	NUMBER OF SHIPS	INT. TRADE
Thailand	2007	6339261	38.43669000	483479048.00	1654.53	293833.12
	2008	6726237	36.48339000	509426096.07	1550.07	357002.35
	2009	5897935	34.58980000	466277190.28	1502.633	286130.74
	2010	7553154	40.48766095	552555276.68	1300.224	376226.51
	2011	8302063	39.27477622	597809081.91	650.196	451362.38
	2012	8413800	38.18054696	626100171.99	568.28	478220.67
	2013	8890500	39.46906571	647863522.06	520.356	478911.69
	2014	9420450	40.90547167	678327384.24	441.91	455210.58
	2015	9522320	42.54692398	687624434.16	424.926	416962.57
	2016	9940320	44.63575529	700675990.93	425.407	409585.56
	2017	10732000	42.37285669	747255590.00	389.197	458153.49
	2018	11185200	45.06229469	782075406.02	365.489	501158.02
Myanmar	2007	170000	3.35057037	489648309.00	574.124	9499.30
	2008	180000	4.74856952	515972333.07	236.553	11138.42
	2009	163692	4.54022660	472011433.28	193.221	11009.16
	2010	335346	5.57652355	559773084.68	210.133	13420.74
	2011	380675	5.50125771	605730469.91	193.0681	18257.01
	2012	474300	6.48290080	634039671.99	182.262	18078.31
	2013	567156	7.13743344	656186866.06	182.262	23275.30
	2014	716926	7.58210061	687030908.24	263.944	27911.42
	2015	827249	9.09203379	696319505.16	286.276	28313.90
	2016	1026216	11.28089026	709590094.93	218.238	27536.00
	2017	1120000	9.09370243	756867590.00	192.128	33132.20
	2018	1288000	9.97000581	791972606.02	271.892	36018.30
Vietnam	2007	4009066	22.20462739	485809243.00	1795.499	111243.23
	2008	4393699	24.66615324	511758634.07	1906.178	143398.55
	2009	4936598	24.31420115	467238527.28	2052.776	127045.14
	2010	5968343	41.24913150	555106550.56	2287.099	157075.22
	2011	6530867	48.24186186	600697137.61	2927.381	203655.53
	2012	8361573	47.45572380	627228276.50	3053.314	228309.60
	2013	8966773	42.14221755	648846913.83	3080.536	264065.41
	2014	10188873	41.82889476	678554859.45	2952.709	298066.40
	2015	11478573	48.39608366	686548342.32	2939.389	327674.17

	2016	11853000	60.05788425	699693657.76	2939.593	351384.62
	2017	15325509	57.57371845	743233651.00	2968.005	427933.12
	2018	16374195	60.37992183	776284472.34	2963.155	480561.20
Cambodia	2007	253271	4.16042677	489565038.00	1730.204	9527.35
	2008	258775	6.71776240	515893558.07	1902.603	11216.43
	2009	207577	4.67894850	471967548.28	2036.298	10026.67
	2012	224206	3.61553027	635365643.50	1603.71	19188.10
	2013	230000	5.99865568	657583686.83	1548.064	16221.10
	2014	342000	5.95525908	688401732.45	1518.739	17538.00
	2015	392000	7.57264530	697634915.32	1282.534	21803.00
	2016	400000	9.15689742	711146657.76	1239.956	23935.57
	2017	644500	9.02549091	757914660.00	511.733	26313.96
	2018	742100	8.35246166	791916567.34	516.583	31077.62

Table 6 : Regression Variables for Thailand ,Cambodia, Myanmar and Vietnam

RESULTS:

The following graph shows the variation in Port Throughput for all the countries for a period of 12 years from 2007 to 2018.

The data for the graph has been scaled down to 0 to 1, so that we get a better understanding of the graph and hence of the Port Throughput. It will be convenient as we can analyze how much a country has actually improved its port throughput over the years.

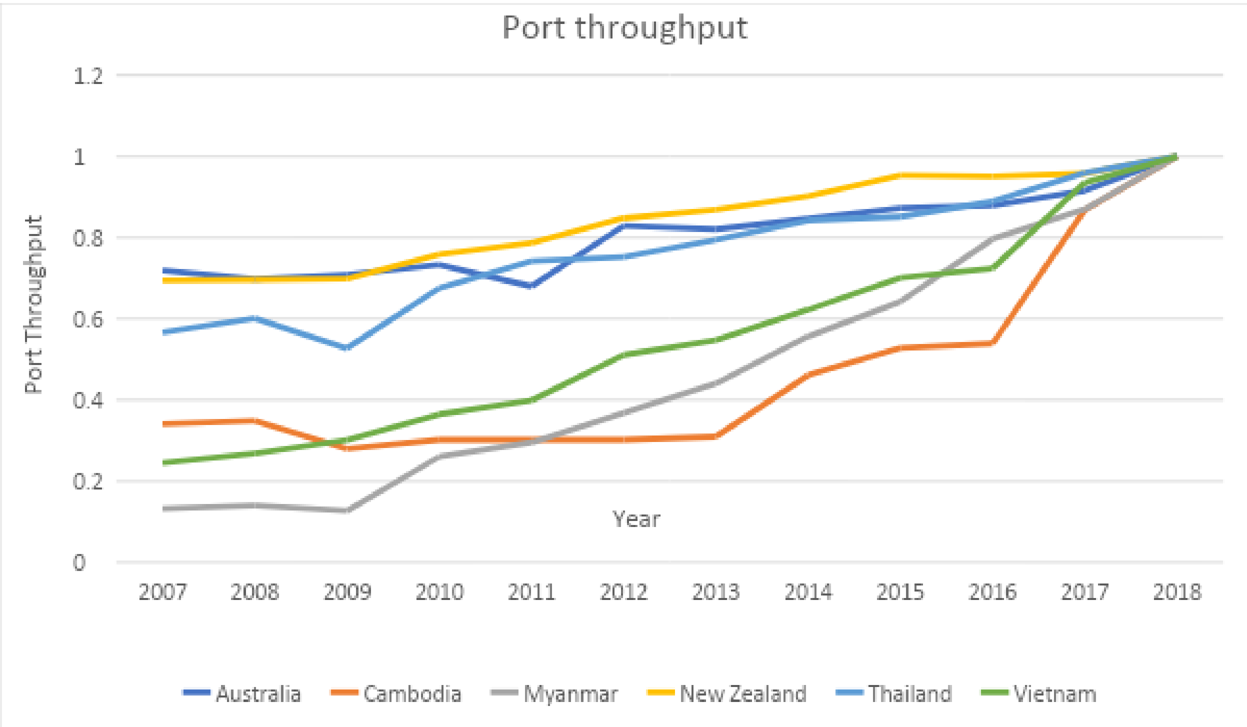


Fig 5 : Port Throughout scaled down to 1

A) AUSTRALIA (HIGH-INCOME COUNTRY) :

Australia			
R Square		0.900681356	
Adjusted R Square		0.863436865	
F		24.1829415	
	Coefficients	*t Stat*	*P-value*
Intercept	7451131	2.573597	0.032943
LINER CONNECTIVITY INDEX	-136971	-1.29409	0.231741
PERIPHERAL PORT THROUGHPUT	0.01087	5.995787	0.000325
INTERNATIONAL TRADE	-7.82366	-1.91728	0.091499

Table 7 : Regression Table for Australia

The Peripheral Port Throughput variable is Statistically significant in case of Australia. Its t-statistic Value is 5.995 which implies it is significant even at 99.9% confidence level.

(p-value = 0.000324)

The implication is that the Demand of Cargo of the Rest of the World is affecting the Demand of Cargo in Australia in a positive way. The positive coefficient indicates that as the World demand of Cargo excluding Australia increases the demand of Cargo in Australia also increases.

Also, the Liner Connectivity Coefficient is not statistically significant at 5% significance

(p-value = 0.23) implying it doesn't have a significant impact on Port throughput.

B) NEW ZEALAND (HIGH-INCOME COUNTRY) :

New Zealand			
R Square		0.995460249	
Adjusted R Square		0.992866106	
F		383.7336947	
	Coefficients	*t Stat*	*P-value*
Intercept	1334199.101	9.44027843	3.1235E-05
LINER CONNECTIVITY INDEX	-4471.065357	-1.4782416	0.18287113
PERIPHERAL PORT THROUGHPUT	0.003644526	21.6786082	1.1209E-07
NUMBER OF SHIPS	-1353.28482	-4.2717952	0.0036925
INTERNATIONAL TRADE	-0.008456927	-6.6338911	0.00029489

Table 8 : Regression Table for New Zealand

The model gave a significant result for all variables for New Zealand except Liner connectivity index.The Peripheral Port Throughput variable is Statistically significant in case of New Zealand. Its t-statistic Value is 21.789 which implies it is significant even at 99.999% confidence level. (p-value = 1.1209E-07)

The implication is that the Demand of Cargo of the Rest of the World is affecting the Demand of Cargo in New Zealand in a positive way. The positive coefficient indicates that as the World demand of Cargo excluding New Zealand increases the demand of Cargo in New Zealand also increases.

Number of ships with t-statistic -4.272 is also statistically significant at a 1% significance (p-value = 0.0036925). It implies that the port throughput is negatively affected by the number of ships, that is, a greater number of ships registered under the flag of New Zealand, the less is the port throughput. International trade with t-statistic -6.634 is also statistically significant at a 1% significance (p-value = 0.00029489). It implies that the port throughput is negatively affected by the amount of international trade, that is, the more international trade done by New Zealand, the less is the port throughput.

C) THAILAND (MIDDLE-INCOME COUNTRY) :

Thailand			
R Square		0.997255595	
Adjusted R Square		0.995687363	
F		635.9108728	
	Coefficients	*t Stat*	*P-value*
Intercept	-3291047.809	-3.398314294	0.011468782
LINER CONNECTIVITY INDEX	43409.17549	1.621267058	0.148991173
PERIPHERAL PORT THROUGHPUT	0.015665237	10.59750368	1.45749E-05
NUMBER OF SHIPS	153.2951041	0.715904854	0.497230474
INTERNATIONAL TRADE	0.565079698	0.503647514	0.629968874

Table 9 : Regression Table for Thailand

The model gave a significant result for some variables for Thailand.

The Peripheral Port Throughput variable is Statistically significant in case of Thailand. Its t-statistic Value is 10.597 which implies it is significant even at 99.9% confidence level. (p-value = 1. 45749E-05) The implication is that the Demand of Cargo of the Rest of the World is affecting the Demand of Cargo in Thailand in a positive way. The positive coefficient indicates that as the World demand of Cargo excluding Thailand increases the demand of Cargo in Thailand also increases.

The Liner Connectivity Coefficient with t-statistic 1.621 is not significant at 5% significance level and is significant at 85% confidence (p-value = 0.1489). Number of ships with t-statistic 0.716 is not significant for Thailand (p-value = 0.49723). International Trade with t-statistic 0.504 is not significant for Thailand (p-value = 0.6299).

D) MYANMAR (MIDDLE-INCOME COUNTRY) :

Myanmar			
R Square		0.972487759	
Adjusted R Square		0.956766478	
F		61.85804931	
	Coefficients	*t Stat*	*P-value*
Intercept	-741150.11	-1.4441627	0.19191862
LINER CONNECTIVITY INDEX	59680.3271	2.3525505	0.0508961
PERIPHERAL PORT THROUGHPUT	0.00061361	0.48199376	0.64451532
NUMBER OF SHIPS	335.613122	1.37141774	0.21258724
INTERNATIONAL TRADE	21.167572	1.48257486	0.1817488

Table 10 : Regression Table for Myanmar

The Peripheral Port Throughput variable is not that significant in case of Myanmar. Its t-statistic Value is 0.482 (p-value = 0.6445).
The Liner Connectivity Coefficient with t-statistic 2.353 is statistically significant at 5% significance (p-value = 0.0508). It implies that the port throughput is positively affected by liner connectivity index, that is, the better the connectivity of the ports from Myanmar, the more is the port throughput.

E) VIETNAM (MIDDLE-INCOME COUNTRY) :

Vietnam			
R Square		0.990711343	
Adjusted R Square		0.98540354	
F		186.6518414	
	Coefficients	*t Stat*	*P-value*
Intercept	2380485	0.673288	0.522364
LINER CONNECTIVITY INDEX	8767.975	0.290323	0.779982
PERIPHERAL PORT THROUGHPUT	-0.00704	-0.61689	0.556831
NUMBER OF SHIPS	268.4388	0.310856	0.764962
INTERNATIONAL TRADE	38.26491	5.309965	0.001111

Table 11 : Regression Table for Vietnam

In Case of Vietnam only Trade Value (which is Export + Import) is Statistically Significant with t-statistic = 5.309 and p-value=0.0011 meaning it is Statistically significant at 99.99% confidence level.

Its implication is that Vietnam's port handling is majorly determined by its Trade Value.

F) CAMBODIA (LOW-INCOME COUNTRY):

Cambodia			
R Square		0.944058136	
Adjusted R Square		0.899304644	
F		21.09462529	
	Coefficients	*t Stat*	*P-value*
Intercept	1143965.83	3.19755433	0.02406085
LINER CONNECTIVITY INDEX	13323.6451	0.88709512	0.41565319
PERIPHERAL PORT THROUGHPUT	-0.0008238	-1.4326667	0.21138837
NUMBER OF SHIPS	-351.43647	-3.3306077	0.02076513
INTERNATIONAL TRADE	8.31474686	0.73220813	0.49690511

Table 12 : Regression Table for Cambodia

For Cambodia Number of General Cargo Ship came significant with t-statistic = -3.33 and p-value = 0.02 meaning it is Statistically Significant at 98% confidence level.

This means that one of the determinants of Cambodia's Port handling is Number of Cargo ships it owns.

CONCLUSION OF THE MODEL:

After running the model for all six countries, we were able to get the following result:

Country	LINER CONNECTIVITY	PERIPHERAL PORT THROUGHPUT	NUMBER OF SHIPS	INT. TRADE
Australia	-	Positive	-	Negative
Cambodia	-	-	Negative	-
Myanmar	Positive	-	-	-
New Zealand	-	Positive	Negative	Negative
Thailand	-	Positive	-	-
Vietnam	-	-	-	Positive

Table 13 : Conclusion of Regression

- 'Positive' implies there is a positive relationship between the given variable the Port throughput for the given country.
- 'Negative' implies there is a negative relationship between the given variable the Port throughput for the given country.
- '-' implies there is no significant relationship between the given variable the Port throughput for the given country.

Therefore, on examining our result we can observe that,

1. Linear connectivity was not a very significant independent variable for Port throughput as out of six countries we found only one significant relationship.
2. Peripheral port throughput was a significant independent variable for Port throughput as out of six countries we found three significant relationships. Also, all the three observations were positive in nature.
3. Number of ships was a significant independent variable for Port throughput as out of five countries we found two significant relationships. Also, both the two observations were negative in nature.

4. International trade was a significant independent variable for Port throughput as out of six countries we found three significant relationships. Two of those observations were Negative and the one was Positive in nature.

Also, on comparing the High-Income country (Australia, New Zealand) with the Low-Income (Cambodia) and Middle-Income (Thailand, Vietnam, Myanmar) country we observe that,

1. In case of High-Income countries, the growth in Port throughput was less as compared to the others. The growth was minimum for Australia (139 %) and maximum for Myanmar (757 %).
2. The High-Income countries have a consistent significant relationship for the variables – Peripheral Port throughput (Positive relationship) and International trade (Negative Relationship).
3. On the other hand, the Middle-Income and the Low-income countries don't have a consistent significant relationship, that is, Cambodia has Number of ships as a significant variable, Myanmar has Liner connectivity, Thailand has Peripheral port throughput and Vietnam has International Trade. There is no consistency in the observation.

Therefore, we can conclude that,

There is a consistency with High-Income countries implying that the Port Throughput for developed countries significantly depends on the Peripheral Port Throughput and the International Trade.

On the other hand, no consistency was found with Low-Income and Middle-Income countries. The Port Throughput for developing countries doesn't show any pattern rather it depends on various other factors than the ones we examined.

LIMITATIONS:

1. Due to data limitations, some good variables like berth-length and port-tariffs were left out of this model
2. Another limitation is that the Data ranges from 2007-2018 so sudden shocks could possibly influence the results of this model
3. Some Variables have slight Correlation(Multicollinearity) and also some variables skewness may lead to heteroskedasticity
4. To analyze the differences in the results between High-income, middle-income and low-income countries no factor was considered due to data limitation.

ARIMA MODEL

ARIMA is one of the most widely used non-stationary time series analysis In the present study, total marine fish production of seven countries (Australia, New Zealand, Vietnam, Thailand, Myanmar, Laos PDR, Cambodia) during the period 1981-2016 has been analyzed to forecast for next five years by using ARIMA model. Log of the time series data is used to respond to skewness towards large values and decrease the variability of the data set. Laos and Cambodia have been grouped in this analysis because of their shared fishing areas.

ASSUMPTIONS OF ARIMA AND MODEL

There are no known explanatory variables, the model parameters are constant over time and the error process is homoscedastic over time. Data from 1960-1980 has been excluded to get an accurate forecast using more recent data.

INTRODUCTION

The marine sector is one of the essential sectors which helps in combating global hunger and helps in the development of the blue economy. All countries in our analysis are from the East Asia & Pacific region. However, Australia and New Zealand are high-Income Countries. Cambodia, Laos, Myanmar, Vietnam are lower middle income and Thailand is an upper-middle-income country.

Time series data refers to observation on a single phenomenon at different intervals in time. An underlying assumption of the time series modelling is that some aspects of past patterns will continue to occur in future. The most widely used technique for analysis of time series data is obviously, the Box Jenkin's auto-regressive integrated moving average models (ARIMA). The benefit of using ARIMA over regression models is that the ARIMA model allows time-series data to be explained by its past values or stochastic error terms. Whereas, regression requires independent variables to explain the time-series data. Time series forecasting using ARIMA models have been widely applied in fisheries. Examples are Modelling and Forecasting Marine Fish Production in Odisha (Mahalingaraya,2018), Modelling and Forecasting of Total Fish Production of India (Raman,2017).

DATA DESCRIPTION

The Fisheries production data set of the countries from1960-2016 were collected from https://data.worldbank.org . Data from 1980-2016 was used for model building and forecasting for the year 2017-2021.

STATISTICAL MODEL: ARIMA MODEL

An ARIMA model is expressed as ARIMA (p, d,q) were p= order of Auto Regression(AR), d= Integrating order (I), and q= order of Moving Average (MA).

$Y_t = \Theta + a_1Y_{t-1} ..... + a_pY_{t-p} + b_0u_t + b_1u_{t-1} .....+b_qu_{t-q}$

Y_t = the variable to be estimated
Θ = a constant term
p= order of Auto Regression (AR)
d= Integrating order (I)
q= order of Moving Average (MA).

The different stages in ARIMA modelling are identification, estimation, diagnostic checking and forecasting. The statistical tools used in identification stage are analyses of autocorrelations, and partial-autocorrelations, ADF (Augmented Dickey- Fuller Test) test is used to find integrating order. In the estimation part, parameters of the model are estimated by nonlinear least squares method and the significance of parameters are statistically tested also the goodness of fit is measured through AIC (Akaike information criteria). In the diagnostic checking stage, the adequacy of fitted model is tested by evaluating the residuals and applying significance tests of residual autocorrelations. Forecasts of future values of the time series are generated along with a confidence interval of 95% using the finalized model in the forecasting stage.

RESULTS AND CONCLUSIONS OF THE MODEL

The time series data of fisheries production is a non-stationary series which is evident from Fig1, as it increases with time. To use ARIMA model differencing must be done to make the time series stationary. Augmented Dickey Fuller Test was used to check the stationarity of the series and ACF, PACF plots were used to order the ARIMA model. In doing so it was observed that the time series of each country followed a different ARIMA model (evident from Table 14,17,20,23,26,29).

Using these ARIMA models each country's fisheries production forecasting has been done for years 2017-2021 (16,19,22,25,28,31) . Table 32 shows the expected annual growth rate for each country. It can be observed that Australia and New Zealand grow at more or less at the same growth rate but there is significant difference in growth rate of other 5 countries.

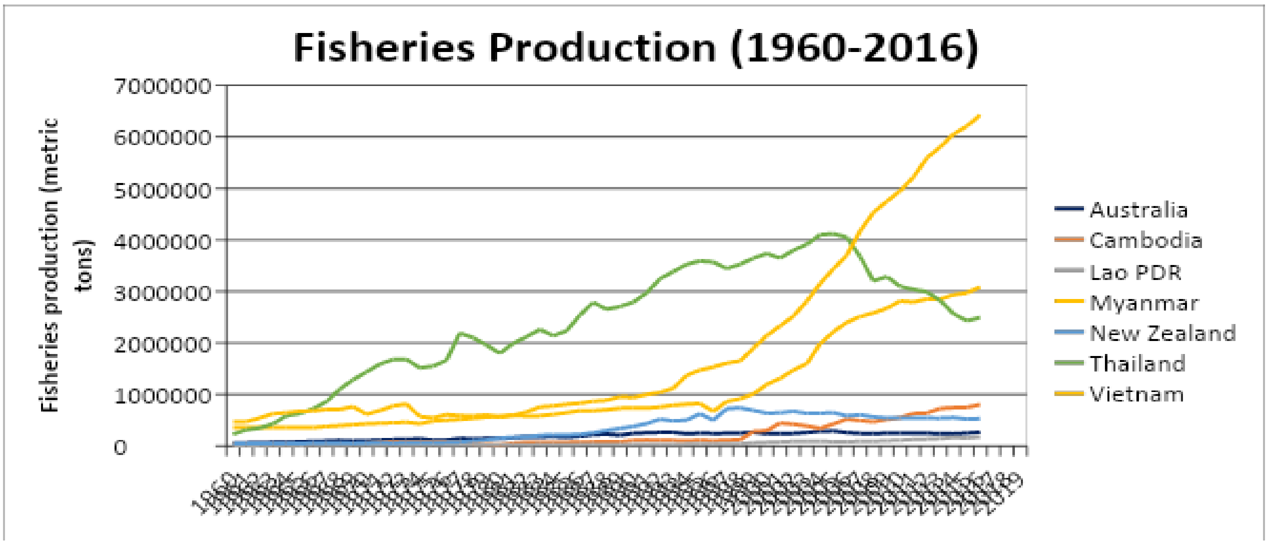


Fig 6 : Fisheries Production plotted against time

AUSTRALIA

ARIMA Long Run Mean	0.00345
Standard deviation	0.0402
ADF (after differencing)	-7.78
ARIMA(p,d,q)	ARIMA(1,1,0)
AIC	-25.89

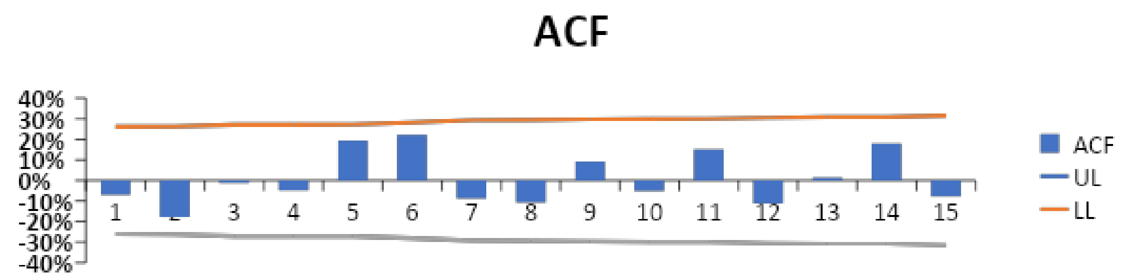
Table 14 : ARIMA summary statistics table for Australia

		Target	Significance
AVG	0.00	0.00	True
Sample Standard deviation	1.05	1.00	True
Skew	0.43	0.00	True
Kurtosis	-0.31	0.00	True
Noise			True

Table 15 : Residuals (standardized) Analysis for Australia

Year	Forecast (metric tons)	Upper limit	Lower limit
2017	272414.7	294760.9	251762.6
2018	273355.6	305597.4	244515.4
2019	274299.7	314434.1	239288.1
2020	275247.2	322256.4	235095.4
2021	276197.8	329444.2	231557.4

Table 16 : Forecasting of fisheries production for Australia



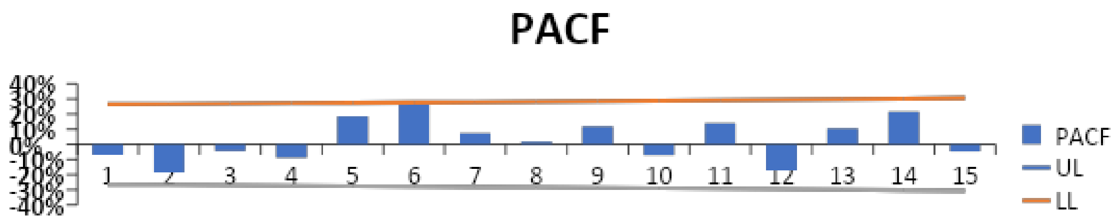


Fig 7 : ACF and PACF plots after differencing for Australia

VIETNAM

ARIMA Long Run Mean	-0.0017
Standard deviation	0.0506
ADF (after differencing)	-4.94
ARIMA(p,d,q)	ARIMA(1,2,1)
AIC	-61.99

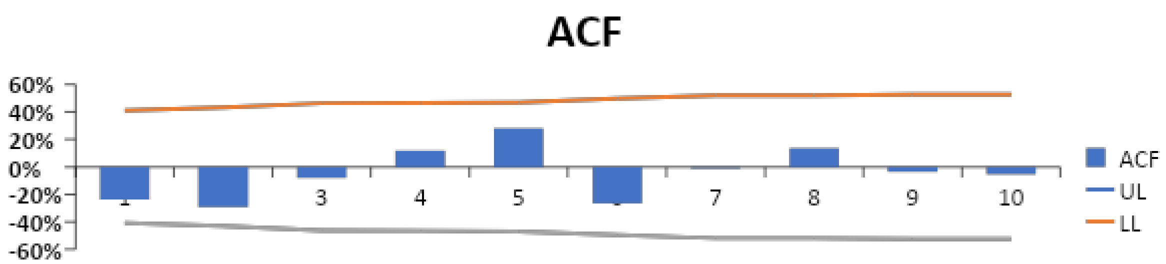
Table 17 : ARIMA summary statistics table for Vietnam

		Target	Significance
AVG	0.00	0.00	True
Sample Standard deviation	1.02	1.00	True
Skew	0.63	0.00	True
Kurtosis	2.81	0.00	True
Noise			True

Table 18 : Residuals (standardized) Analysis for Vietnam

Year	Forecast (metric tons)	Upper limit	Lower limit
2017	6629312	7320345	6003512
2018	6833174	8529322	5474323
2019	7031190	10189579	4851784
2020	7222502	12432371	4195863
2021	7406258	15451241	3550049

Table 19 : Forecasting of fisheries production for Vietnam



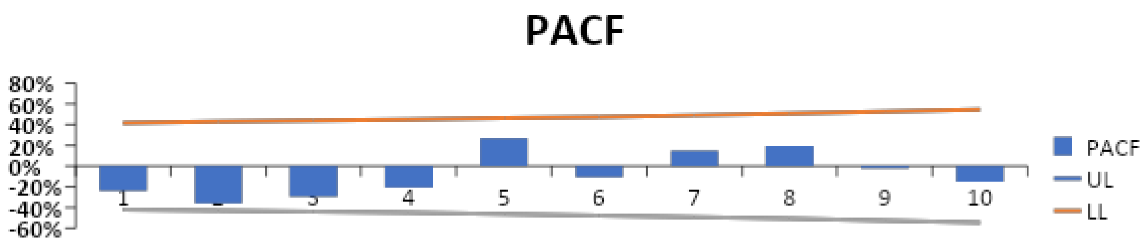


Fig 8 : ACF and PACF plots after differencing for Vietnam

NEW ZEALAND

ARIMA Long Run Mean	0.0339
Standard deviation	0.1058
ADF (after differencing)	-3.63
ARIMA(p,d,q)	ARIMA(1,1,3)
AIC	-50.56

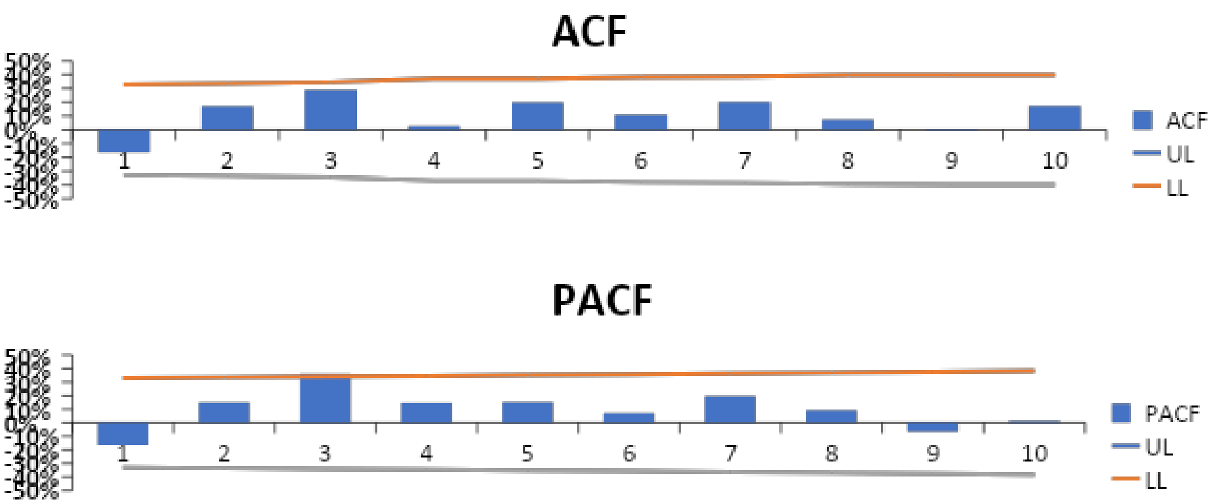
Table 20 : ARIMA summary statistics table for New Zealand

		Target	Significance
AVG	0	0	True
Sample Standard deviation	1.014185	1	True
Skew	0.68253	0	True
Kurtosis	2.14561	0	True
Noise			True

Table 21 : Residuals (standardized) Analysis for New Zealand

Year	Forecast (metric tons)	Upper limit	Lower limit
2017	552208.4	679468.9	448783.1
2018	571244	765940.3	426038
2019	590935.7	846330.6	412610.6
2020	611306.2	925533	403762.3
2021	632379	1005477	397724.7

Table 22 : Forecasting of fisheries production for New Zealand



1. Fig 9 : ACF and PACF plots after differencing for New Zealand

MYANMAR

ARIMA Long Run Mean	0.0384
Standard deviation	0.0618
ADF (after differencing)	-3.75
ARIMA(p,d,q)	ARIMA(2,1,2)
AIC	-139.84

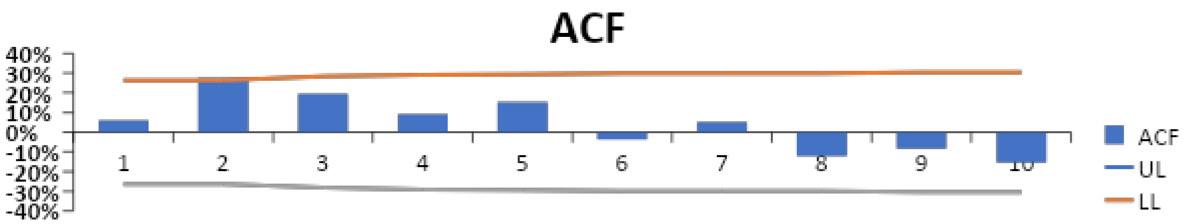
Table 23 : ARIMA summary statistics table for Myanmar

		Target	Significance
AVG	0	0	True
Sample Standard deviation	1.00905	1	True
Skew	0.256108	0	True
Kurtosis	5.944893	0	Not True
Noise			True

Table 24 : Residuals (standardized) Analysis for Myanmar

Year	Forecast (metric tons)	Upper limit	Lower limit
2017	3210954	3624519	2844577
2018	3336605	3960186	2811215
2019	3467174	4276710	2810875
2020	3602852	4590702	2827573
2021	3743839	4908750	2855378

Table 25 : Forecasting of fisheries production for Myanmar



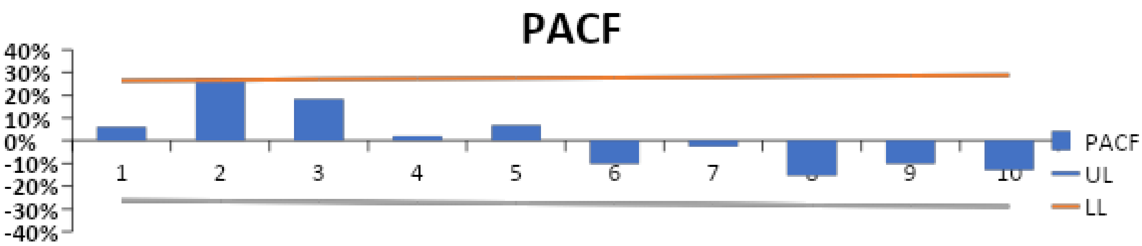


Fig Fig 10 : ACF and PACF plots after differencing for Myanmar

THAILAND

ARIMA Long Run Mean	-0.00226
Standard deviation	0.0581
ADF (after differencing)	-4.5283
ARIMA(p,d,q)	ARIMA(1,2,6)
AIC	-54.77

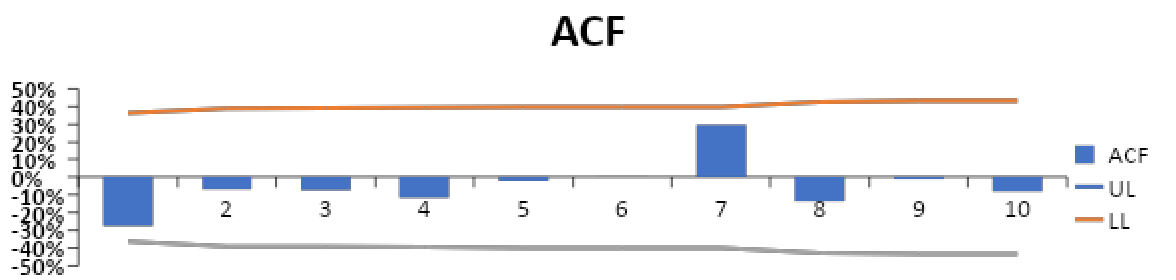
Table 26 : ARIMA summary statistics table for Thailand

		Target	Significance
AVG	0.00	0.00	True
Sample Standard deviation	1.02	1.00	True
Skew	0.37	0.00	True
Kurtosis	1.46	0.00	True
Noise			True

Table 27 : Residuals (standardized) Analysis for Thailand

Year	Forecast (metric tons)	Upper limit	Lower limit
2017	2552204	2859909	2277605
2018	2606737	3362338	2020938
2019	2656406	4066964	1735077
2020	2700893	5038302	1447873
2021	2739907	6373374	1177883

Table 28 : Forecasting of fisheries production for Thailand



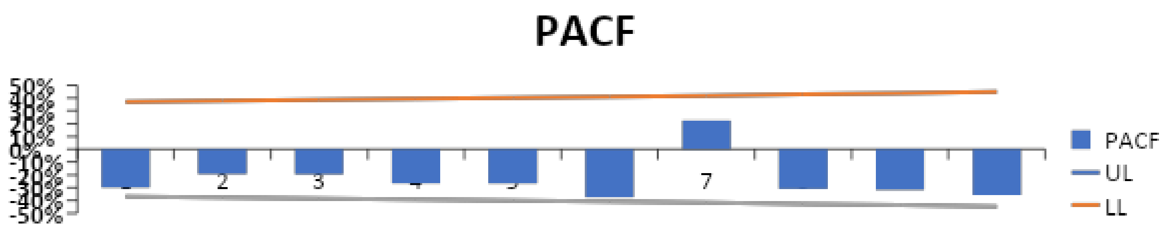


Fig 11 : ACF and PACF plots after differencing for Thailand

LAOS and CAMBODIA

ARIMA Long Run Mean	0.001289
Standard deviation	0.2337
ADF (after differencing)	-457874
ARIMA(p,d,q)	ARIMA(1,2,1)
AIC	7.06

Table 29 : ARIMA summary statistics table for Laos and Cambodia

		Target	Significance
AVG	0	0	True
Sample Standard deviation	1.01835	1	
Skew	0.050656	0	True
Kurtosis	3.680662	0	Not True
Noise			True

Table 30 : Residuals (standardized) Analysis for Laos and Cambodia

Year	Forecast (metric tons)	Upper limit	Lower limit
2017	1063900	1682040	672923
2018	1152708	3210352	413891.2
2019	1250540	6941383	225293.9
2020	1358425	16697443	110515
2021	1477519	44144642	49452.52

Table 31 : Forecasting of fisheries production for Laos and Cambodia

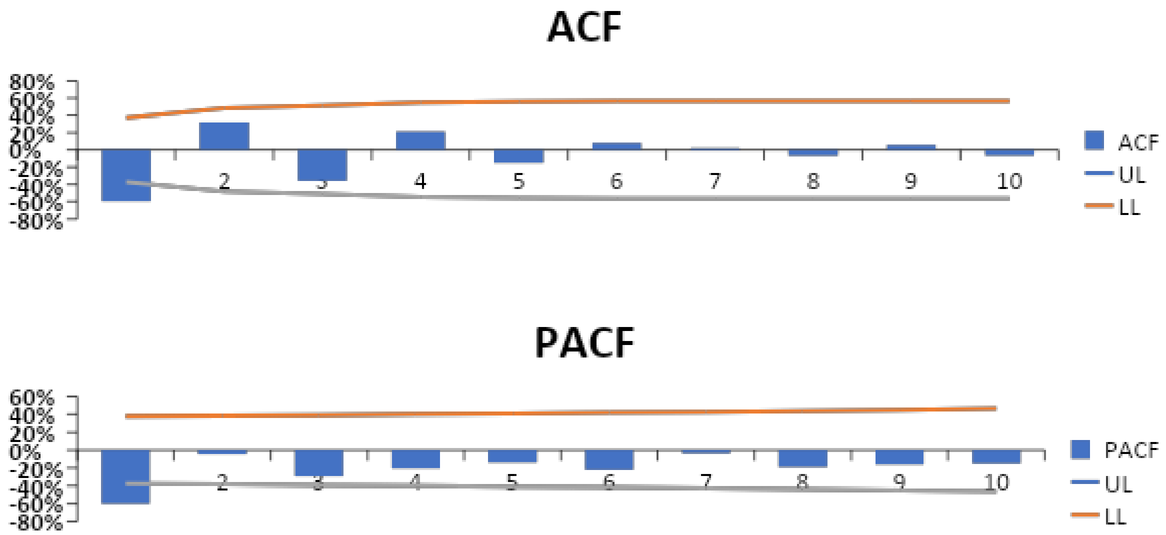


Fig 12 : ACF and PACF plots after differencing for Laos and Cambodia

CONCLUSION/INFERENCES:

This research is aimed at generating a comprehensive understanding of the marine sector growth in Australia, New Zealand, Vietnam, Thailand, Myanmar, Cambodia and Laos through a series of analyses and comparisons of relevant indicators. Based on qualitative and empirical analyses of indicators and factors pertaining to the sub-sectors that compose the marine sector of a country, the following inferences can be developed.

Qualitative analyses as regards the metrics related to a number of ports, length of coastline, GDP growth, ship-building and marine tourism yield the following results. Australia and New Zealand have the largest number of ports on account of them being high-income countries and thus having sufficient infrastructure and resources to lead in these criteria. The length of the coastline reveals a similar trend due to the factors such as size of the nation and the fact that both Australia and New Zealand are surrounded by water on all sides. In terms of GDP growth rate, we see that Laos's GDP has grown by the maximum amount (10.3 times) followed by Myanmar, Vietnam, Cambodia, Thailand, New Zealand and then Australia. This shows that Thailand even being a Middle-Income country hasn't grown that much relative to its competitors. On the whole, however, the higher income countries continue to have a comparatively greater GDP (marine related), which is a signal of better state of development. As a consequence, the aforementioned metrics place the higher income countries above the rest when it comes to marine sector development impacting their economy. However, there are more findings that suggest many other factors are also responsible for significant marine sector growth in the countries.

Another relevant metric is ship-building. We find that among the countries that are involved in shipbuilding, Vietnam is leading and New Zealand is at the last. There was a sudden increase in production in the year 2015 which led to an oversupply in the market, resulting in lower prices, excess inventory and then a sudden decrease in production in the year 2016. Coming to marine tourism, Thailand is currently leading even though it is a middle-income country. New Zealand, which is a high-income country is seen to generate receipts comparable to other middle and low-income countries. We can hence possibly infer that there exist other important factors that have more bearing on the development of the (marine) tourism sector. Further, we observe that Thailand is comparatively more reliant on its (marine) tourism revenue for its marine sector growth and thus overall economic development.

The following are the conclusions we derived from our empirical analyses related to regression analysis of container data of ports and forecasting analysis of fish production among the countries. The results of the Port Throughput analysis show that there is consistency with high-income countries implying that the Port Throughput for developed countries significantly depends on the peripheral port throughput and the international trade. On the other hand, no consistency was found with low-income and middle-income countries. The Port Throughput for developing countries doesn't show any pattern. It rather depends on various other factors that have not been included in the analysis. Our findings of the forecasting reveal that the time series data of each country followed a different ARIMA model (evident from Table 14,17,20,23,26,29).

Using these ARIMA models each country's fisheries production forecasting has been done for years 2017-2021 (16,19,22,25,28,31).

The gaps in our study are due to limitations faced in our analyses which are as follows. To analyze the differences in the results between high-income, middle-income and low-income countries no factor was considered due to data limitation. No comparative analysis has been carried with regards to smaller marine sub-sectors such as research and development, offshore oil mining and other marine services, which could yield results that provide a more comprehensive understanding of the overall growth of the marine sector. Further research could expand on the contribution of other sub-sectors mentioned in the limitations. Through relevant analyses and comparisons of the chosen parameters that define the marine sector our study has thus managed to build a substantial insight into the marine sector growth of the selected countries

	Countries	**Annual Expected growth rate for 2017-2021**
1	Australia	2.76%
2	New Zealand	2.75%
3	Vietnam	2.24%
4	Thailand	1.43%
5	Myanmar	3.12%
6	Laos and Cambodia	6.70%

Table 32 : Annual expected growth rate for 2017-2021

APPENDIX

Year	Australia	Cambodia	Lao PDR	Myanmar	New Zealand	Thailand	Vietnam
1960	61345	35000	12000	360080	52289	231420	473160
1961	61778	45000	12000	360110	51134	316340	474120
1962	67136	45000	15000	360140	49815	351160	544980
1963	72999	40000	15000	360180	50046	430905	629940
1964	73332	40000	15000	360230	44557	590050	648510
1965	83876	45000	15000	360290	49007	629865	676590
1966	95708	45000	18000	360350	56418	722092	682170
1967	99757	50000	18000	381130	60971	861366	712460
1968	110337	50000	18000	396620	59651	1102121	711850
1969	98579	52000	18000	414520	50543	1285154	765750
1970	104218	52200	20000	432400	60203	1437837	618000
1971	115969	77100	20000	442700	66800	1587432	688300
1972	126697	87100	20000	453300	59068	1679152	778500
1973	128690	84700	20000	463400	66884	1679559	814300
1974	143486	84700	20000	433840	70040	1516024	572800
1975	113404	84700	22000	485140	65076	1548924	546800
1976	115016	84704	22000	501560	71637	1661315	610800
1977	147697	84711	22000	518700	79229	2191381	588800
1978	140839	40925	22000	539690	99727	2101681	584000
1979	146614	30053	24000	564070	120169	1954258	601000
1980	145867	19706	24000	580010	157585	1799988	559660
1981	162333	51594	24000	594540	170302	1990460	597866
1982	180767	68715	24000	584410	175682	2121455	662208
1983	178157	68161	26000	587550	205347	2261922	758138
1984	185799	64424	26000	613691	218943	2140261	777308
1985	172379	70578	26000	648804	214819	2233375	809510
1986	192817	73651	26000	686523	225147	2541990	830322
1987	222489	82224	28000	685864	260335	2785311	869000
1988	232526	86896	28000	704547	304555	2652089	885033
1989	210964	82184	28000	733763	343092	2704781	954939
1990	246942	111427	28000	743818	380303	2789953	941227
1991	258397	117854	29000	735494	435024	2972104	999174
1992	266556	111228	30000	757498	521751	3246490	1041006
1993	266979	108969	30500	791378	485518	3385003	1120204
1994	239526	103254	35000	810825	503846	3524996	1369993
1995	250116	112511	40250	823410	627114	3590578	1474008
1996	245323	104310	39000	673788	500241	3570116	1531932
1997	247004	114600	40000	863540	725767	3442715	1608703
1998	252579.4	122000	40858	912618	741836.1	3524933	1647874
1999	268522	284156	60403	1011124	691838	3646070	1897168
2000	238126	298798	71316	1192112	639099	3735279	2143129
2001	240630	445700	81000	1309146	645860	3648095	2327856

2002	246082	424432	93156	1474460	675232	3797036	2520639
003	263343.2	390657	94700	1595870	635570	3914076	2808507
2004	287701	343332	94700	1986960	638292	4099653	3153651
2005	293773.3	428000	86560	2217470	650762	4118527	3440200
2006	262276	523510	86925	2398440	584322	4053100	3699327
2007	246298.3	493760	91660	2512410	606600	3675407	4174900
2008	242554.4	471000	93500	2582074	564892.3	3204293	4532150
2009	249222.3	515000	105800.5	2671896	544720.4	3287370	4749480
2010	254615.8	550094	113000	2813941	547185.4	3096742	4951028
2011	252843.6	632839	129600	2795076	547604	3036581	5221685
2012	248311	640695	136001	2850599	542087.5	2991728	5590574
2013	243449.4	729468	146946	2849780	541150.2	2822344	5803722
2014	236915.4	745310	168597	2934806	552572	2567898	6048983
2015	251486	751193	158600	2970100	524588.2	2429956	6207514
2016	271477	802450	180750	3090034	533807.2	2493154	6420471

Table 33 :Total fisheries production time series data in metric tons from 1960-2016

Year	**Australia**	**Cambodia**	**Lao PDR**	**Myanmar**	**New Zealand**	**Thailand**	**Vietnam**

1995	10370000000	71000000	52000000	169000000	2318000000	9257000000	
1996	11882000000	117000000	63000000	215000000	2553000000	10367000000	
1997	11735000000	99000000	61000000	183000000	2211000000	9052000000	
1998	10169000000	129000000	97000000	196000000	1857000000	7954000000	
1999	11408000000	240000000	86000000	222000000	2234000000	9416000000	
2000	11594000000	345000000	114000000	195000000	2272000000	9935000000	
2001	11333000000	429000000	108000000	132000000	2340000000	9378000000	
2002	12148000000	509000000	110000000	136000000	3159000000	10388000000	
2003	14981000000	441000000	77000000	70000000	4232000000	10456000000	1400000000
2004	18032000000	673000000	122000000	97000000	5098000000	13054000000	1700000000
2005	19719000000	929000000	143000000	83000000	6486000000	12103000000	2300000000
2006	20408000000	1109000000	160000000	59000000	6148000000	16624000000	2850000000
2007	25024000000	1169000000	190000000	97000000	7190000000	20625000000	3750000000
2008	27189000000	1280000000	280000000	80000000	6961000000	22510000000	3930000000
2009	26909000000	1463000000	271000000	75000000	5979000000	19811000000	3050000000
2010	31064000000	1671000000	385000000	91000000	6523000000	23796000000	4450000000
2011	34315000000	2258000000	413000000	334000000	7295000000	30924000000	5710000000
2012	34137000000	2663000000	461000000	550000000	7142000000	34565000000	6850000000
2013	32889000000	2895000000	613000000	964000000	7434000000	41765000000	7250000000
2014	35736000000	3220000000	642400000	1687000000	8582000000	38451000000	7410000000
2015	36249000000	3419000000	725000000	2199000000	9464000000	44851000000	7350000000
2016	39059000000	3523000000	717000000	2289000000	9773000000	48459000000	8500000000
2017	43975000000	4024000000	655000000	1988000000	10594000000	57057000000	8890000000
2018	47327000000	4832000000	757000000	1670000000	10961000000	65242000000	10080000000

Table 34 : International tourism, receipts(current US$)

Country Name/Year	Figures in $ Millions						
	Australia	Cambodia	Lao PDR	Myanmar	New Zealand	Thailand	Vietnam
2000	415,222.63	3,677.90	1,731.20	8,905.07	52,623.28	126,392.31	31,172.52
2001	378,376.09	3,984.00	1,768.62	6,477.79	53,872.43	120,296.75	32,685.20
2002	394,648.91	4,284.03	1,758.18	6,777.63	66,627.73	134,300.85	35,064.11
2003	466,488.06	4,658.25	2,023.32	10,467.11	88,250.89	152,280.65	39,552.51
2004	612,490.40	5,337.83	2,366.40	10,567.35	103,905.21	172,895.48	45,427.85
2005	693,407.76	6,293.05	2,735.56	11,986.97	114,720.13	189,318.50	57,633.26
2006	746,054.21	7,274.60	3,452.88	14,502.55	111,608.85	221,758.49	66,371.66
2007	853,099.63	8,639.24	4,222.96	20,182.48	137,316.09	262,942.65	77,414.43
2008	1,053,995.52	10,351.91	5,443.92	31,862.55	133,280.38	291,383.08	99,130.30
2009	927,805.18	10,401.85	5,832.92	36,906.18	121,338.62	281,710.10	106,014.66
2010	1,146,138.47	11,242.28	7,127.79	49,540.81	146,583.83	341,105.01	115,931.75
2011	1,396,649.91	12,829.54	8,749.24	59,977.33	168,462.00	370,818.75	135,539.44
2012	1,546,151.78	14,054.44	10,191.35	59,937.80	176,193.70	397,558.09	155,820.00
2013	1,576,184.47	15,227.99	11,942.23	60,269.73	190,784.38	420,333.33	171,222.03
2014	1,467,483.71	16,702.61	13,268.46	65,446.20	200,834.00	407,339.36	186,204.65
2015	1,351,693.98	18,049.95	14,390.44	59,687.41	177,208.11	401,295.97	193,241.11
2016	1,208,846.99	20,159.27	15,805.69	63,256.18	187,854.02	412,352.79	205,276.17
2017	1,330,135.76	22,180.38	16,853.09	66,719.08	202,590.81	455,275.52	223,779.87
2018	1,433,904.35	24,542.47	17,953.79	71,214.80	204,923.92	504,992.76	245,213.69

Table 35 : GDP (in million USD)

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