Toward Sustainable National Shipping: A Comparative Analysis

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ABSTRACT

This study aims to analyse the relationship between national shipping and various factors and its relevance to the blue economy. The analysis using data of 84 countries has found the strong effect of shipping building, international trade and registration on the size of national fleets. In addition, all else being the same, top oil exporting countries and open registry countries have stronger fleet than the other countries. While tourism and fisheries are known to be important contributors to the blue economy, they do not have a significant effect on national shipping. This could be due to the fact that relationships between these sectors have yet been significant. The comparison of sustainable (weighted) ranking and weighted rankings show very significant differences between these. The former is more in favour of countries with a significant maritime industry.

1. BACKGROUND

Traditionally, it has been widely perceived that national shipping was important to economic development because 90% of international trade is carried by ships. While the dependence of international trade on the maritime industry remains, the role of national shipping has shifted for at least four main reasons. First, the shipping is highly international, and the freight market is competitive. This suggests that shippers can access competitive freight rates without relying on their national fleet. Second, bilateral and multilateral trade agreements restrict the government from export protectionism and subsidy. Third, the past two decades have seen a trend in the formation of multinational companies as a result of globalisation, foreign investment and outsourcing. Fourth, the trend in globalisation has also seen the rapid development of the private sector in many export-led, transitional economies, which used to be dominated by state-owned companies.

Yet, new factors have emerged influencing the role of national shipping. Climate change impacts and natural disasters have caused concerns about governments' capability to respond to maritime emergency and the capacity of the national fleet to facilitate the emergency process e.g. evacuation, aids. The development of the blue economy relies more on the

relationship between and within the maritime and marine sectors. This includes, for example, the development of coastal and cruise shipping, shipping policy and shipbuilding, and maritime infrastructure (Smith-Godfrey, 2016), that are better encompassed in a national shipping agenda. National shipping remains important to maritime nations due to its role in maritime, coastal trade, shipbuilding, ports, offshore and fisheries.

Despite of much research on national shipping, there is limited research on national shipping especially from the perspective of the broader maritime sector and blue economy, which is well regarded as one that comprises of "economic and trade activities, and emerges from a need to integrate conservation and sustainability in the management of the maritime domain. It can also be extended to include the marine ecology or environment" (Smith-Godfrey, 2016). In (Spalding, 2016), the term 'ocean economy' was used instead to refer to an economy highly similar to blue economy. Moreover, a traditional and new ocean economy concepts are defined; with a traditional ocean economy including the offshore oil and gas, recreation and commercial fishing, aquaculture, shipping, coastal tourism, and telecommunication sectors; a new ocean economy adds renewable energy, seabed mining, ocean restoration and blue biotechnology, blue carbon, blue technology, and other related sectors such as nutrition, nutraceuticals, cosmetics and the innovative marine molecules sector.

To, and Lee (2018) studied the growth of the Chinese maritime economy using the logit model and found that its growth has been dominated by the contribution of the transport industry. Salvador, Simões, and Soares (2016) studied the Portuguese maritime economy using the input-output analysis and Delphi research methods. Their study focused cross and intra maritime sectoral relationships. It has been found that the three sectors shipping, ports, and recreational boating and marinas, are the main contributors to the maritime economy.

Fernández-Macho et al. (2015) conducted a socio-economic assessment of the Spanish maritime cluster's contribution to the maritime economy. The study proposed a four-digit classification system for economic accounting of maritime activities, which are divided into four groups for 'fully maritime activities', 'mainly maritime activities', 'Strong partially maritime activities', and 'Weak partially maritime activities' respectively. The goal of the maritime cluster is "to strengthen integration between maritime activities, from capture fisheries and aquaculture, to boat and shipbuilding and repair, maritime transport, recreational boating, marine renewable energy systems, ports and port services, among others.".

The focus of this study is to analyse the relationship between national shipping and various factors and its relevance to the blue economy. The analysis is an extension of the studies by Nguyen (2011) and Nguyen, and Bandara (2015) on national shipping competitiveness. For completeness, the study covers two measures of national shipping, namely the own fleet and the beneficial fleet. The latter is defined as the fleet owned and operated by companies located in the country (UNCTAD, 2014). The data set used by the study covers the effect of various factors such as international trade, shipbuilding, shipping history, policy, registration, access to ocean, oil exports, financial system, and the technology development of 84 maritime countries.

The rest of the paper is organised as follows. Section 2 explains the analytical method and data set. Section 3 presents the analysis results. Section 4 discusses the results and

implications for the blue economy. Section 5 summarise the study and discusses the limitations and implications for future research.

2. METHODOLOGY

This study seeks to analyse the development of national shipping using econometric methods presented in Nguyen (2011), and Nguyen, and Bandara (2015). The analysis essentially shows statistical relationship between national fleet as the dependent variable, and a number of influential factors such as international trade, shipbuilding, shipping history, policy etc. as the independent variables. In particular Nguyen (2011) proposed the following equations to explain the effect of various factors the national fleet and the beneficial fleet:

$$\begin{aligned} NATFLEET_i = {} & \beta_0 + \beta_{01}\,DUMOX + \beta_{02}DUMTOPOX + \beta_{03}DUMTOPOI \\ & + \beta_{04}DUMREG + \beta_1 FINDEV_i + \beta_2 BUILDING_i + \beta_3 HISTORY_i \\ & + \beta_4 TRADE_i + \beta_5 OX_i + \beta_6 COAST_i + \beta_7 POLICY_i + \beta_8 REG_i \\ & + \beta_9 GDPCAP_i + u_{1i}. \end{aligned} \quad (1)$$

$$\begin{aligned} BENLEET_i = {} & \gamma_0 + \gamma_{01}\,DUMOX + \gamma_{02}DUMTOPOX + \gamma_{03}DUMTOPOI \\ & + \gamma_{04}DUMREG + \gamma_1 FINDEV_i + \gamma_2 BUILDING_i + \gamma_3 HISTORY_i \\ & + \gamma_4 TRADE_i + \gamma_5 OX_i + \gamma_6 COAST_i + \gamma_7 POLICY_i + \gamma_8 REG_i \\ & + \gamma_9 GDPCAP_i + u_{2i}. \end{aligned} \quad (2)$$

In (1) and (2), the dependent variables NATFLEET and BENFLEET are the deadweight tonnage (all in natural log) of the national fleet and the beneficial fleet as defined by UNCTAD (2014). u_1 and u_2 are the error terms assumed to be a normal variable that is identically and independently distributed, $i.i.N(0,\sigma)$. The subscript i refers to the country under study. The above equation allows for the effect of the following factors on the national fleet:

- DUMOX is the dummy variable representing the effect of oil exports (Spalding, 2016).
- DUMTOPOX is a dummy variable for top ten oil exporting countries.
- DUMREG is the dummy variable to capture the effect of open registration countries.
- FINDEV is the development level of the financial system.
- BUILDING is the output of the shipbuilding sector.
- HISTORY is the shipping history (Nguyen, 2011, Harlaftis, & Kostelenos, 2012).
- TRADE is international trade that represents the country's demand for shipping.
- OX refers to the effect of oil exports on national fleet.
- COAST is the coastline length that represents the country's access to the ocean.
- POLICY refers to the number of national maritime regulations adopted by the country.
- REG refers to the registered tonnage.
- GDPCAP refers to per-capita income representing the overall development level.
- βs and γ are coefficients to be estimated.

Nguyen's (2011) proposed Shipping Competitiveness Index (SCI) rakings are calculated as:

$$SCI_i = rank\left(\sum \hat{\beta}_j X_{ij}\right), \quad (3)$$

where $\hat{\beta}s$ are obtained from the estimation of equation (1). Note that this calculation method cannot be used to estimate national shipping competitiveness raking when there are multiple indicators of national shipping, i.e. national fleet and beneficial fleet; $\hat{\beta}s$ only explain the effect of various factors on the national fleet NATFLET but not the beneficial fleet BENFLEET. Therefore Nguyen, and Bandara (2015) proposed the 'combined rankings':

$$SCI_i = rank\left(\sum \hat{\beta}_j X_{ij} + \sum \hat{\gamma}_j X_{ij}\right), \qquad (4)$$

where $\hat{\beta}_j$ and $\hat{\gamma}_j$ are the estimates of the coefficients from equations (1) and (2) above. While the above calculation considers both the national fleet and beneficial fleets, it requires separate analysis of equations (1) and (2). Therefore they also proposed the 'weight rankings' that are calculated as:

$$SCI_i = rank\sum \hat{\theta}_j X_j\,, \qquad (5)$$

where the coefficients $\hat{\theta}$ are the estimates of θ(s) from the following equation:

$$\begin{aligned} NATFLEET = {} & \alpha BENLEET_i + \theta_0 + \theta_{01}\,DUMOX + \theta_{02}DUMTOPOX + \theta_{03}DUMTOPOI \\ & + \theta_{04}DUMREG + \theta_1 FINDEV_i + \theta_2 BUILDING_i + \theta_3 HISTORY_i + \theta_4 TRADE_i \\ & + \theta_5 OX_i + \theta_6 COAST_i + \theta_7 POLICY_i + \theta_8 REG_i + \theta_9 GDPCAP_i + \theta_{10} TOUR_i \\ & + \theta_{11} FISH_i + u_{6i}. \end{aligned} \qquad (6)$$

This study uses weighted rankings due to their advantage over combined rankings. The main difference between this study and the previous studies on national shipping by Nguyen (2011), and Nguyen, and Bandara (2015) is the addition of TOUR and FISH as the two new, additional variables that were not included in previous studies. The aim of this extension is to explore the potential relationship between the blue economy on national shipping. Because fisheries and tourism, especially cruise shipping, are one of the key contributors to the blue economy, they are expected to have potential effect on sustainable development of national shipping within the blue economy framework. Note that although ocean renewable energy is predicted to be one of the main sources of future energy and blue economy, this sector is in an early stage of development with very limited data availability. As such it will not be included in the analysis. The data set covers 84 maritime nations. Variable description and data sources are detailed in Table 1. Except the TOUR and FISH variables, all other variables have the same definitions as explained in Nguyen, and Bandara (2015). Note in order to compare the results, this study uses most recent data for the new variables and data for the remaining variables are similar to those in Nguyen, and Bandara (2015).

Table 1: Variable names and data sources

Variable	Description	Data source
NATFLEET	National fleet's tonnage	Lloyd's Register Fairplay (2013a)
BENFLEET	Beneficial fleet's tonnage	UNCTAD (2014)
FINDEV	Financial system development level	World Bank (2014)
BUILDING	Shipbuilding capacity	Lloyd's Register Fairplay (2013b)
HISTORY	Shipping history	UNCTAD (1977)
OX	Oil exports	EIA (2014)
TRADE	External trade	World Trade Organisation (2013)
COAST	Coastline length	Pruett, and Cimino (2000)
POLICY	Shipping policy	IMO (2014)
REG	Registered fleet's tonnage	Lloyd's Register Fairplay (2013a)
GDPCAP	Technological advancement	IMF (2014)
TOUR	Output of the tourism sector	UNWTO (2015)
FISH	Output of the fisheries and aquaculture sectors	FAO (2017)

3. ANALYSIS RESULTS

Tables 2 provide descriptive statistics and the correlation matrix for all variables with 84 observations. All variables have exhibited relatively small variations. FINDEV has the largest coefficient of variation of 1.47 followed by OX with the coefficient of variation of 1.39. It is interesting to note TRADE has the lowest coefficient of variation followed by POLICY with the coefficient of variation of 0.11 and GDPCAP with the coefficient of 0.17.

Table 2: Descriptive statistics of the variables

	N	Minimum	Maximum	Mean	Standard Deviation	Coefficient of Variation
NATFLEET	84	6.91	19.2	14.11	2.63	0.186393
BENFLEET	84	2.01	12.46	7.64	2.44	0.319372
FINDEV	84	0	134.02	20.98	30.91	1.473308
BUILDING	84	0	18.02	9.33	6.66	0.713826
HISTORY	84	5.96	18	13.31	2.59	0.194591
TRADE	84	20.87	28.92	25.37	1.78	0.070162
OX	84	0	12.74	3.50	4.85	1.385714
COASTLINE	84	3.28	12.49	8.31	1.75	0.21059
POLICY	84	2.2	3.99	3.42	0.38	0.111111
REG	84	6.91	19.58	13.60	2.78	0.204412
GDPCAP	84	0	11.52	9.16	1.62	0.176856
TOUR	84	9.012	18.252	15.324	1.66	0.11
FISH	84	6.987	18.197	12.342	2.38	0.19

Table 3 presents the variables' correlation matrix. The correlation between BENFLEET and NATFLEET of 0.87 indicates their strong relationship. TOUR has positive correlation with all variables except GDPCAP and FISH. There is also strong correlation between many of the

explanatory variables suggesting analysis of their subsets is useful to gain more comprehensive understanding of their relationships.

Table 3: Correlation matrix

	BENFLEET	NATFLEET	BUILD	REG	POLICY	COAST	GDPCAP	TRADE	HISTORY	OX	FINDEV	TOUR	FISH
BENFLEET	1.000	0.874	0.971	0.972	0.771	0.747	0.047	0.545	0.362	0.409	0.795	0.729	-0.235
NATFLEET	0.874	1.000	0.857	0.848	0.662	0.878	-0.292	0.413	0.432	0.336	0.690	0.716	-0.220
BUILDING	0.971	0.857	1.000	0.958	0.753	0.722	0.049	0.544	0.379	0.396	0.792	0.724	-0.110
REG	0.972	0.848	0.958	1.000	0.736	0.707	0.043	0.540	0.352	0.397	0.793	0.714	-0.219
POLICY	0.771	0.662	0.753	0.736	1.000	0.672	0.092	0.495	0.326	0.325	0.596	0.621	-0.161
COAST	0.747	0.878	0.722	0.707	0.672	1.000	-0.352	0.426	0.309	0.361	0.554	0.630	-0.192
GDPCAP	0.047	-0.292	0.049	0.043	0.092	-0.352	1.000	0.041	-0.056	0.075	-0.020	-0.167	-0.011
TRADE	0.545	0.413	0.544	0.540	0.495	0.426	0.041	1.000	0.130	0.440	0.483	0.626	-0.059
HISTORY	0.362	0.432	0.379	0.352	0.326	0.309	-0.056	0.130	1.000	0.178	0.425	0.437	-0.078
OX	0.409	0.336	0.396	0.397	0.325	0.361	0.075	0.440	0.178	1.000	0.415	0.393	-0.083
FINDEV	0.795	0.690	0.792	0.793	0.596	0.554	-0.020	0.483	0.425	0.415	1.000	0.691	-0.158
TOUR	0.729	0.716	0.724	0.714	0.621	0.630	-0.167	0.626	0.437	0.393	0.691	1.000	-0.098
FISH	-0.235	-0.220	-0.110	-0.219	-0.161	-0.192	-0.011	-0.059	-0.078	-0.083	-0.158	-0.098	1.000

Given that the study uses cross sectional data that are prone to heteroskedasticity, Breusch-Pagan (BP) test was conducted. The P-value of the test is 0.00003935 indicating the existence of heteroskedasticity. Thus, regression analysis using the heteroskedasticity consistent variance covariance matrix is applied. Table 4 shows the results of the regression analysis. Adjusted R-squared is 0.8444 indicating the strong fit. The key factors explaining the size of national fleets are the shipping building, international trade, registered tonnage. In addition, all else being the same, top oil exporting countries and open registry countries have stronger fleet than the other countries.

Table 4: Regression Results for the National Fleet

Variable	Coefficient	St error	t statistic	P-value	Sign level
Constant	-1.866096	2.503865	-0.745	0.45867	
DUMOX	-2.075187	1.163638	-1.783	0.07899	*
DUMTOPOX	0.541434	0.303089	1.786	0.07849	*
DUMTOPOI	0.187199	0.300902	0.622	0.53594	
DUMREG	-4.44906	2.566194	-1.734	0.0875	*
FINDEV	-0.00182	0.003398	-0.536	0.59384	
BUILDING	0.128066	0.038284	3.345	0.00134	***
HISTORY	-0.013581	0.070796	-0.192	0.84844	
TRADE	0.27632	0.145162	1.904	0.0612	*
OX	0.15785	0.108775	1.451	0.15133	
COAST	-0.01831	0.094568	-0.194	0.84705	
POLICY	0.564323	0.340735	1.656	0.10229	
REG	0.451021	0.086597	5.208	0.00000	***
GDPCAP	0.012779	0.11521	0.111	0.912	
TOUR	0.016782	0.081366	0.206	0.83721	
FISH	0.003817	0.069354	0.055	0.95627	

Table 5 reports the sustainability weighted rankings ('Sustainability ranking') based on the regression equation (6) incorporated with the two new variables TOUR and FISH. Weighted rankings from Nguyen, and Bandara (2015) are also presented for comparison purposes. The differences between the two rankings are north worthy. For example, Greece ranks the top in terms of sustainability, but 27 in weight rankings (without considering blue/maritime economy factors). Malta stays at the bottom in terms of sustainable shipping, yet its weighted ranking was 3, etc. Overall, the large differences in the two ranking suggest that the competitiveness rankings of national shipping could vary substantially depending on the calculation method and even variables used.

Table 5: Sustainability Rankings and Weighted Rankings of National Shipping Competitiveness

Country Code	Country Name	Sustainability ranking	Weighted ranking	Country Code	Country Name	Sustainability ranking	Weighted ranking
50	Greece	1	27	11	Bangladesh	43	60
68	Japan	2	8	134	Thailand	44	26
24	China	3	5	75	Latvia	45	58
145	United States	4	4	106	Portugal	46	43
109	Russian Federation	5	22	99	Pakistan	47	70
48	Germany	6	6	2	Algeria	48	46
61	India	7	17	107	Qatar	49	59
97	Norway	8	24	3	Angola	50	49
63	Iran, Islamic Rep. of	9	14	5	Argentina	51	42
73	Korea, Republic of	10	15	40	Estonia	52	56
66	Italy	11	35	108	Romania	53	40
132	Taipei, Chinese	12	16	37	Ecuador	54	64
144	United Kingdom	13	11	124	South Africa	55	55
33	Denmark	14	31	8	Azerbaijan	56	74
21	Canada	15	28	103	Peru	57	61
44	France	16	19	89	Morocco	58	62
62	Indonesia	17	34	79	Lithuania	59	51
114	Saudi Arabia	18	25	91	Myanmar	60	67
139	Turkey	19	23	138	Tunisia	61	57
82	Malaysia	20	20	76	Lebanon	62	76
16	Brazil	21	21	126	Sri Lanka	63	63
143	United Arab Emirates	22	18	25	Colombia	64	37
125	Spain	23	29	60	Iceland	65	81
129	Sweden	24	36	101	Papua New Guinea	66	71
119	Singapore	25	9	94	New Zealand	67	53
87	Mexico	26	30	117	Seychelles	68	83
148	Viet Nam	27	39	1	Albania	69	79
23	Chile	28	47	70	Kazakhstan	70	66
96	Nigeria	29	38	10	Bahrain	71	65
131	Syrian Arab Republic	30	69	146	Uruguay	72	78
30	Croatia	31	54	69	Jordan	73	75
93	Netherlands	32	33	32	Cyprus	74	7
104	Philippines	33	2	71	Kenya	75	77
74	Kuwait	34	12	55	Guyana	76	82
38	Egypt	35	50	140	Turkmenistan	77	72
13	Belgium	36	13	127	Sudan	78	73
43	Finland	37	45	39	Eritrea	79	84
105	Poland	38	32	9	Bahamas	80	10
142	Ukraine	39	41	100	Panama	81	1
18	Bulgaria	40	48	81	Madagascar	82	68
98	Oman	41	52	137	Trinidad and Tobago	83	80
6	Australia	42	44	84	Malta	84	3

4. CONCLUSION

This paper presents a comparative analysis of national shipping and the effect of various factors on the national fleet, including international trade, ship building, registration, policy, history, oil exports, coastline length, tourism, fisheries and the overall development level. The study results indicate that the strong effect of the shipping building, international trade, registered tonnage. In addition, all else being the same, top oil exporting countries and open registry countries have stronger fleet than the other countries. While tourism and fisheries are known to be important contributors to the blue economy, they do not have a significant effect on national shipping. This could be due to the fact that relationships between these sectors have yet been significant. The comparison of sustainable (weighted) ranking and weighted rankings show very significant differences between these. The former is more in favour of countries with a significant maritime industry. The analysis results imply the importance of promoting the relationships between sectors in the blue economy.

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