

Mahpour, Alireza et al.

## Article

# Modeling the impact of logistic performance, economic features, and demographic factors of countries on the seaborne trade

Asian Journal of Shipping and Logistics (AJSL)

## Provided in Cooperation with:

Korean Association of Shipping and Logistics, Seoul

*Suggested Citation:* Mahpour, Alireza et al. (2023) : Modeling the impact of logistic performance, economic features, and demographic factors of countries on the seaborne trade, Asian Journal of Shipping and Logistics (AJSL), ISSN 2352-4871, Elsevier, Amsterdam, Vol. 39, Iss. 2, pp. 60-66, <https://doi.org/10.1016/j.ajsl.2023.02.003>

This Version is available at:

<https://hdl.handle.net/10419/329714>

## Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

## Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by-nc-nd/4.0/>



# Modeling the impact of logistic performance, economic features, and demographic factors of countries on the seaborne trade

Alireza Mahpour<sup>a,\*</sup>, Iman Farzin<sup>b</sup>, Amirhossein Baghestani<sup>a</sup>, Sina Ashouri<sup>a</sup>, Zahra Javadi<sup>c</sup>, Latifeh Asgari<sup>c</sup>

<sup>a</sup> Faculty of Civil, Water and Environmental Engineering, Shahid Beheshti University, Iran

<sup>b</sup> Faculty of Civil and Environmental Engineering, Tarbiat Modares University, Iran

<sup>c</sup> Institute for Management and Planning studies, Iran

## ARTICLE INFO

### Article history:

Received 1 May 2022

Received in revised form 12 December 2022

Accepted 7 February 2023

### Keywords:

Seaborne trade

Developing countries

Gravity model

LPI

Tariff

Middle-east

## ABSTRACT

The shipping industry continues to have strong growth prospects due to increased efficiency and economic liberalization. Through seaborne trade, port infrastructure and logistics impact economic growth in developing countries. This makes studying the factors affecting seaborne trade for such countries particularly important. The current paper aims at analyzing the impact of logistics, economic, and demographic variables on seaborne commodity trade between Qatar, Oman, Turkey, Pakistan, and Iran. Employing a gravity model, results show that a 1% improvement in Logistics Performance Index (LPI) consignments in the importing country can result in a 0.8% increase in total trade flows. Based on results, a 1% increase in the tariff rate reduces the value of trade by 0.4%. Furthermore, a 0.5% increase in trade is caused by the increase in population of the destination country. A sensitivity analysis also shows that logistics variables are more significant than economic and demographic variables. It can be concluded that trade policymakers in developing countries can get better results by improving logistics performance and investing on logistics infrastructure leads to more trade.

© 2023 The Authors. Production and hosting by Elsevier B.V. on behalf of The Korean Association of Shipping and Logistics, Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

The growth of seaborne trade is providing benefits for consumers around the world through low freight costs. Further growth of the shipping industry is expected as a result of the increasing efficiency of shipping as a mode of transport and the increasing liberalization of the economy.

A major share of global seaborne trade was still carried out by developing economies, both in terms of exports and imports. 59.5% of the world's cargo was loaded and 69.5% was discharged by developing economies (Angelopoulos et al., 2021). Most of these shares came from developing economies in Asia and Oceania. While developing economies remain the main maritime trade centers, the structure of their trade has changed over the years with their share of world seaborne imports increasingly surpassing their share of exports since 2013 (Michail, 2020).

Investigating on the literature showed that a variety of studies focused on the pricing models in the shipping industry. Surprisingly, studies on this issue relentlessly carry on, thanks to many computer programs capable of forecasting the freight rates and also available data regarding the freight rates at disposal of the shipping industry (Mahpour et al., 2021) but modeling The Impact of logistic, economic, and demographic factors on the seaborne trade especially in the developing countries focusing in the middle east has not been studies (Gani, 2017).

The Freight transport perspective in west Asia has been simultaneously growing and changing. maritime transport, to be precise, short sea shipping, is the only real hope in holding back the spectacular growth in freight transport between west Asian countries (Mustafa et al., 2021).

Although previous literature used different methods to study the impact of different variables on trade (mostly, for one country as an origin or destination), it seems that more research is still required to examine different mathematical models for such case studies (e.g. Mahpour et al., 2018; Vahidnia et al., 2019; Yousefikia et al., 2013). In this regard, this paper aims to study the impact of different variables on seaborne commodity trade between Qatar, Oman, Turkey,

\* Corresponding author.

E-mail address: [ar.mahpour@gmail.com](mailto:ar.mahpour@gmail.com) (A. Mahpour).

Pakistan, and Iran by using time series data in a gravity model framework. The empirical data was collected from the commodities that are the most seaborne traded between Iran, Turkey, Qatar, Oman, and Pakistan.

Accordingly, this paper is organized as follows: in Section 2, a brief history of studies on the logistics and transport is provided. Section 3 describes the case studies along with some freight transportation statistics. The methodology of the research is presented in Section 4 and Section 5 shows the results and discussion. Lastly, the paper concludes with a summary of findings and outlines future research directions.

## 2. Literature review

### 2.1. Effective variables

Seaborne transport is of significance to international trade in terms of both quality and efficiency since the inadequate logistics infrastructures and operational processes could negatively impact global trade integration (Arora & Siddiqui 2022). Previous research employed different variables in their studies to estimate the countries trade including the logistics performance indices (Sunitiyoso et al., 2022), liner shipping connectivity (Soh et al., 2021), distance (Alexander & Merkert 2021), import and export volumes, gross national income, gross domestic product, port handling charge (Han, 2018), population, and tariffs (Papapostolou et al., 2014). Since logistics and transport are major determinants of international trade relations, the world bank defined an interactive benchmarking tool: Logistics Performance Index (LPI) to specify the logistics costs and infrastructure quality (Martí et al., 2014). Additionally, the geographical factors together with transport infrastructure are important for the trade international competitiveness (Bensassi et al., 2015). Reviewing literature has shown that the trade facilitation, along with the geographical distance between partners, is usually indicative of the competitive position of a region in the international markets (Vrakas et al., 2021).

Costs for delivering goods to the end-user consist of different items; some of them are transportation, distribution (wholesale and retail), tariffs /non-tariff barriers, information costs,<sup>1</sup> contract enforcement, and currency exchanges (Tsioumas et al., 2021). Korinek and Sourdin (2009) investigated the transportation costs aiming to analyze their impact on the trade. In doing so, they employed the recently compiled OECD<sup>2</sup> Maritime Transport Cost database to examine the role of the maritime freight costs in determining the ocean-shipped imports. Their results showed that the maritime transportation costs markedly affect the trade rates. Moreover, they observed that a 10% increase in maritime transport costs would reduce the trade by 6–8%.

Using the tariff reduction, Brandt et al. (2017) investigated the consequence of China's entry into the WTO by evaluating its impact on the manufacturing companies' performance. Aiming to assess the impact of trade liberalization on the domestic vertical integration, Liu et al. (2019) considered China's accession to the WTO as a quasi-natural test. Employing the gravity model, China's customs data with the World Integrated Trade Solution's (WITS) tariff data spanning from 2002 to 2013 were combined to analyze the multi-level impact of the destination tariffs on China's exports. Based on the results, the tariffs adversely affected the exports at the country level and additionally, when the inter-firm composition effects were controlled, the tariffs exhibited a negative impact on the exports at the firm

level. Nugroho and Lakner (2022) tried to evaluate how tariffs could dynamically impact the economic boom in Vietnam. Surprisingly, it was perceived that the tariff leaves positive impacts on the economy in the both short and long terms. Accordingly, relying on the findings of this study, the Vietnamese government was advised to retain and enhance the tariff, due to its positive impacts on the economy (Kuo et al., 2020).

Furthermore, it has been already approved that the macro-economic parameters affecting the demand rates are of significance in the maritime industry. Based on previous literature, it can be found that the parameters closely pertained to the world economic perspective, such as the G-7 industrial production and variations in the oil price (Michail & Melas 2021) are influential on the risks ahead for the shipping companies as well as their overall performance (Bloom et al., 2016). What is more, the macroeconomic parameters majorly determine the freight rate volatility (Lim et al., 2019). Table 1 indicates the effective variables that are reviewed in the literature along with their features classification.

### 2.2. Mathematical models

The main approaches used to model the flow of commercial exchanges between regions are:

- Spatial interaction models and especially the gravity model
- Discrete choice models such as logit and logit nest <sup>3</sup>
- Constant Substitution Stretch (CES) <sup>4</sup>(nest) functions that are used as a part of Spatial Computable General Equilibrium (SCGE)<sup>5</sup> computational models

Spatial interaction model is an aggregate model that considers economic activities and regions as aggregate. The most common spatial interaction model is the gravity model and assumes that the flow of trade exchanges (or other flows such as migration) between two regions have a direct relationship with economic activity in these regions and have an inverse relationship with transportation costs. Gravity models in the past few decades widely used for modelling freight transport (Tavasszy, 2013; Bektaş, 2017; Ghisolfi et al., 2022). The problem with conventional models is that they use cross-sectional data while we use time series data. Distance between the countries usually indicated the seaborne trade impedance which was challenged by the researchers (Van Bergeijk & Brakman 2010). In this case, the impedance between neighboring countries is a tariff instead of their distance among case studies which does not vary during the time of study. Indeed, the tariffs posed a greater obstacle to their trade.

The gravity model rose as a powerful method to assess the effect of trade integration in an ex post way (Head & Mayer 2014). Gravity's main comparative advantage lies in its ability to use real data to assess the sensitivity of trade flows to policy factors. Therefore, this approach is used in this article.

The gravity model of trade may be derived acquired as an analogy from physics but developed further since its first introduction development and became common knowledge in economics (Anderson, 2011). Sabaruddin et al. investigated the factors that influence the performance of bilateral trade between Indonesia and Yemen in 2016 (Tsouknidis, 2016). Their used conventional bilateral trade model is a modified gravity model of international trade approach by using multiple regression analysis with the Ordinary Least Square method. The results indicated that three independent variables significantly pointedly affect the value of the bilateral trade

<sup>1</sup> - Expenditure of time and money that are required to obtain information of different things from purchase price to information of trade, market and consumers' portfolios.

<sup>2</sup> The Organization for Economic Co-operation and Development

<sup>3</sup> Logit and Nested Logit

<sup>4</sup> Constant elasticity of substitution(CES)

<sup>5</sup> Spatial computable general equilibrium(SCGE)

**Table 1**  
Effective variables reviewed in the literature.

Variable Category	Description
Economical	Tariff
	Total Port Handling charge
	Gross Domestic Product (GDP) in the Origin/ Destination country
	Gross national Income (GNI) in the Origin/Destination country
Geological	Sea distance
	Road distance
	Air distance
Demographic Logistics	Population of the Origin/Destination country
	Import volume index
	Foreign direct investment, net inflows in the Origin/ Destination country
	Time to import, border compliance (hours)
	Logistics performance index: Ability to track and trace consignments in the Origin/Destination country
	Logistics performance index: Competence and quality of logistics services in the Origin/Destination country

between Indonesia and Yemen including the GDP of Yemen, political uncertainty and security in Indonesia, along with the presence of Indonesian Representative in the Republic of Yemen.

In order to construct the gravity model in the view of institutional conditions of trade, EU Melnyk et al. (2018) evaluated the trade turnover between Ukraine and the UE in 2018. The results revealed that the gravity model with including such explanatory factors, as the gross domestic product of trade partners in purchasing power parity and the sophisticated specifications of “trade distance” between countries as an indicator of the influence of institutional factors on foreign trade relations.

There are some studies in the literature evaluating the impact of macroeconomics as well as demographic variables on international trade (Devlin & Yee 2005). For instance, Genç et al. (2011) studied the determiners of trade in BSEC<sup>6</sup> region using the gravity model. They found that the GDP and population leaves positive effects. On the other hand, they concluded that the distance negatively affects the trade in the case of BSEC countries (Genç et al., 2011). Similarly, Uğurlu and Bayar (Uğurlu & Bayar 2014) employed the gravity model for Turkish trade data from 2001 to 2011 for 44 leading trade partnerships in Turkey. The results prove that the GDP increases both trade and distance leave negative impacts. Moreover, changed trade costs to replicate the increase in imports and studied how global shock exposures change in response to trade agreements based on country characteristics. Also Fan et al. (2022) in analyzing the promotion effect of the belt and road initiative on China's tea export trade showed that population, economic scale and trade barriers of trading countries have a significant influence on China's tea export.

Marti et al. (2014) studied the application of a gravity model to specify the impact of the major factors affecting the bilateral trade between Ecuador and Germany in 2014. Ecuador's GDP is the most influential factor role in the bilateral trade flows, while on the contrary, Germany's GDP has the opposite impact than expected, reducing the trade when the GDP goes up. Likewise, it is determined that, although total trade flows decrease with increasing trade costs, Ecuadorian imports do not decrease.

Additionally, Muratoglu et al. (2017) managed to assess the critical factors influencing the trade flows between Russia and the other BSEC countries for which, the augmented gravity equations were developed for the imports and exports variables of Russia. Based on the results, the GDPs of Russia and the partner countries positively influence the export and import rates of Russia. Added to this, the export rates of Russia are not merely affected by its

population, however, the population of the partner countries impacts these rates as well. Meanwhile, it was concluded that the distance between countries negatively affects the import and export rates and constitutes an important relationship between these rates (Dai et al., 2015).

Lately, Siddiqui and Vita examined the impact of logistics performance on the trade in the garment sector in Cambodia, Bangladesh, and India by means of panel data analysis. Based on the results, the logistics infrastructure has played an important role in enhancing the soybean bilateral trade, approving the concerns of the exporter and importer countries to upgrade the quality of movement corridors. Additionally, the positive coefficient of distance and low impact of GDP implies that the soybean trade is associated with factors other than basic variables on gravity models such as culture, land availability, and logistics costs (Siddiqui & Vita 2021).

Furthermore, Karagoz and Saray (2022) found that the trade flow of a country could markedly grow if any of the LPI's components is enhanced. Such components are gradually gaining importance in international trade worldwide. In this study, a boosted trade gravity model specifically comprised of the logistics and transport infrastructure indicators is evaluated. By means of bilateral exports of 45 countries and 19 Spanish regions between 2003 and 2007, the efficiency of this model is evaluated. The results indicate that the number, size, and quality of the logistics facilities make positive effects on the export flows (Bensassi et al., 2015). Moreover, it is observed that the LPI of the importing countries, as well as the land infrastructure index for the Spanish regions, positively affect the trade flows and consequently, develop a positive relationship with the export rates (Muratoglu, 2020).

### 3. Case study

In this study, we examine the sea trade between Iran, Turkey, Pakistan, Qatar, and Oman. These five countries have a total population of more than 400 million, which is more than 0.5% of the world's population. Fig. 1 indicates the geographical location of the case studies.

In order to better understand the case studies, Table 2 indicates demographic and economic features of the studied countries for 2018 (World Integrated Trade Solutions, 2022; Worldometer, 2022; The World Bank Group, 2022). Although Pakistan has the largest population among the countries studied, it is Qatar that has the highest amount of GDP and Oman is in the second place (Osman et al., 2022). Also, Turkey has the largest value of exports and imports, but in 2018, Iran had the most Country growth index among the studied countries.

#### 3.1. Logistics feature

In maritime transportation, goods are generally classified according to the means of transportation and storage, such as ships and infrastructure. This paper focuses on solid bulk because of its significant share of total flows, as well as the availability of data for the case studies. According to maritime and port authorities, “Fruit and nuts, edible; peel of citrus fruit or melons”, “Plastics, and articles thereof” are the most traded commodities with containers between these countries, which are considered in the current research.

The growing scope of logistics performance and increasing recognition of its contribution to growth and economic integration call for holistic policies. More and more countries, especially emerging economies, see logistics as a sector of the economy requiring consistent policy making that cuts across traditional logistics areas. Previous LPI reports have referred to many countries having set up national strategies or dedicated organizations advancing logistics, such as Canada, China, France, Indonesia, Morocco, the Netherlands, and Thailand. For the 2018 edition, the examples include Oman and

<sup>6</sup> Black Sea Economic Cooperation





Fig. 1. Geographical Position of Case Studies for this research.

**Table 2**  
Demographic and economic features of case studies.

Feature Country		Iran	Turkey	Qatar	Oman	Pakistan
Pop		80,673,888	81,116,450	2724,727	4665,926	207,906,209
Exports	Export (US\$ Mil)	105,844	164,495	67,498	32,904	21,878
	No. of products	2790	4326	147	3104	2792
	No. of partners	146	214	152	160	194
Imports	Imports (US\$ Mil)	51,612	238,715	29,896	26,435	57,440
	No. of products	3686	4406	4132	4026	4162
	No. of partners	119	219	135	148	209
HH Market concentration index		0.12	0.03	0.09	0.20	0.05
Index of export market penetration		4.21	26.23	3.16	2.70	8.44
Country Growth		19.52	4.98	7.45	8.82	4.06
GDP (US\$)		445,345	858,996	161,099	70,586	304,567
GNI per capita, Atlas method (US\$)		5420.00	10,970.00	56,920.00	13,970.00	1400.00
Trade Balance (% of GDP)		1.10	-3.68	14.28	2.84	-9.34
Trade Balance (current US\$ Mil)		4915.00	-31,640.00	23,012.00	2003.00	-28,441.00
Trade (% of GDP)		48.78	55.76	91.49	86.41	25.85
Duty Free Tariff Lines Share (%)		*	69.64	25.06	37	*

\*Not available

**Table 3**  
Aggregate mean LPI score ranking and scores, 2012–18.

Economy	Mean rank	Mean LPI score, 2012–18	% Of highest performer
Qatar	30	3.50	83.7
Turkey	37	3.29	78.6
Oman	46	3.16	75.5
Iran	81	2.71	64.8
Pakistan	95	2.64	62.9

India, which in 2017 set up a dedicated logistics body under a Special Secretary. Table 3 shows Aggregate mean LPI score ranking and scores calculated by the data from 2012 to 2018 which gives a perspective of countries performance in the logistics section.

#### 4. Method

The gravity model is used to model the seaborne trade (in US Dollar) between the case studies (e.g. Muratoglu et al., 2017; Melnyk et al., 2018; Tonon & García 2019; Alexander & Merkert 2021;

Karagoz & Saray 2022). Eq. 1 Indicates the general form of the gravity model.

$$A_{ij} = k \frac{b_i B_i C_j}{(D_{ij})^\alpha} \quad (1)$$

Where,

i: Origin i.

j: Destination j.

$A_{ij}$ : Seaborne trade (Tonnage/ US\$ value) between origin I and destination j.

k: Adjustment factor.

$B_i$ : Trade attractiveness in origin i.

$C_j$ : Trade attractiveness in destination j.

$D_{ij}$ : Seaborne trade Impedance between origin i and destination j.

$b_i$ : Adjustment factor of Trade attractiveness in origin i.

$c_j$ : Adjustment factor of Trade attractiveness in destination j.

$\alpha$ : Adjustment factor of Seaborne trade Impedance between origin i and destination j.

Previous literature considers population, LPI index, and Gross domestic product (GDP) as trade attractiveness in origins and

**Table 4**  
Trade attractiveness (GDP and population) of the case studies in 2018.

Country	GDP (billion USD)	Population (million)
Iran, Islamic Rep.	445.3	80.67
Oman	70.59	4.666
Pakistan	304.6	207.9
Qatar	161.1	2.725
Turkey	859	81.12

destinations followed by distance (cost) as the impedance function. This research employs the related data collected in 2018 due to inaccessibility to the recent ones. Table 4 indicates the trade attractiveness of the case studies in 2018. Based on Table 4, Iran and Turkey had the highest value in terms of GDP, and Pakistan and Turkey were the most populated countries. Furthermore, the lowest GDP and population belong to Oman and Qatar, respectively.

To calibrate the gravity model presented in Eq. 1, a natural logarithm is taken from both sides of the equation based on previous studies. Accordingly, we can rewrite the equation as follows:

$$\ln(A_{ij}) = K + b_j \ln(B_i) + c_j \ln(C_j) + \alpha \ln(D_{ij}) \quad (2)$$

## 5. Results and discussion

To calibrate the model, different variables are first tested including the population, the gross national product, shipping time, sea distance, and the logistics performance index. Next, their combinations are evaluated based on various measures such as statistical significance, F-statistics, and  $R^2_{adj}$ . Testing around 150 models with different trade attractiveness, the final model with the best goodness of fit has been obtained as follows:

$$\begin{aligned} \ln(A_{ij}) = & \frac{4.72}{(0.371)} + \frac{0.64}{(0.036)} \times \ln(pop_i) + \frac{8.64}{(0.018)} \times \ln(LPI_j) \\ & - \frac{4.7}{(0.008)} \times \ln(Tariff_{ij}) \\ R^2 = & 0.4890 \\ R^2_{adj} = & 0.3932 \\ Prob > F = & 0.0115 \end{aligned} \quad (3)$$

In which:

$A_{ij}$ : Seaborne trade (Tonnage/ US\$ value) of Fruit and nuts, edible; peel of citrus fruit or melons" and "Plastics, and articles thereof".

$pop_i$ : Population of origin i.

$LPI_j$ : LPI index of destination j.

$Tariff_{ij}$ : Tariffs for trading between origin i and destination j.

The values in parenthesis show the P-value of each coefficient.

According to the model calibration's result, it can be said that

- The constant in this model is insignificant. Since the constant number represents the mean of systematically unobserved variables, this indicates reveals that these factors are not statistically significant and therefore, confirms the goodness adequacy of the model.
- As expected, the sign of population in the origin (exporting country) is positive. That is, the value of the exchanges increases as the population of the exporting country increases.
- LPI index represents the case studies logistics performance in 6 terms of efficiency in the commodity clearance process (speed, simplicity, and predictivity of customs formalities), the quality of trade and transport infrastructures (such as entrance ports, railways, roads, and information technology), facility to access international transportation with a competitive price (costs), the quality of logistic services (the performance of transport operators, brokers, and customs intermediaries), ability to track and trace consignments and the appropriateness of delivery time as

scheduled. As above, the sign of this variable is also in line with the positive expectation. This means that increasing in LPI index in destination (indicating trade comfortability) would raise the exchanges. Since the value of LPI index is released every two years, the interpolation of values in 2016 and 2018 is used to estimate the value of 2017.

- The sign of tariff variable is negative which is also logical. As expected, the value of trade between countries decreases as tariffs increase and importers/exporters tend to choose cheaper modes for trading.
- The goodness-of-fit of this model is about 0.5. This indicates that about 50% of the changes in the dependent variable are expressed by explanatory variables. The range of this coefficient is acceptable. It should be noted that  $R^2_{adj}$  for the model is about 0.4 which is within the acceptable range. We used disaggregate data for developing the gravity model. Using such data would change the coefficients and also decrease some measures like  $R^2$  in comparison to aggregate data (e.g. Jayasinghe and Sarker, 2008; Mamdohi et al., 2016).
- The significance level of the F statistic, indicating that all variables can be considered to be statistically zero, has been estimated with a value of 0.0115. This rejects the null hypothesis which means that all variables cannot be considered statistically insignificant.

## 6. Conclusion

The quality and efficiency of seaborne transport can be important for the trade since a weak logistics infrastructure and operational process can be a noteworthy obstruction to the countries trade integration. On the other hand, an improved seaborne transport trade, with more liberal and freer economic environment, can escalate trade and economies of scale and scope in distribution and production activities. Seaborne transport provides sectorial connections within the local economy.

With the constant escalation of the global trade and as the intention of countries speeds up to integrate themselves within such structure, the system will be dependent on preserving open global economy along with improving the quantity and effectiveness of the supporting structures. Inadequate services such as lack of coordination among countries on border procedures; inefficiency of customs clearance procedures at the ports; inconsistency and low quality of transportation infrastructures; shipping with low-frequency and high costs (with long and indirect shipping routes), delay in tracking and tracing of shipments, delays in terminal handling and clearance of goods; absence of cool storage facilities at ports; and the inability to certify product quality; amongst others; are serious issues and obstacles of international trade.

Even though logistics play a significant role in helping commercial activities, the level of analysis and research on trade policy have stayed low from applied economics perspective. The existing literature indicates that there are a few detailed empirical works on the effects of logistics on trade performance. One of the likely reasons for this deficiency can be lack of numerical measures to represent a consistent and time-based logistics performance with large country coverage and sector specificity. While trade researchers have provided some qualitative assessment of the developments in logistics services (like Tariff) at country level, an empirical investigation on effects of logistics on trade can provide some helpful insight to trade policy-makers and logistics operators.

The share of seaborne trade within the selected countries makes a small portion of the international trade which are related to some problems such as higher transaction cost of cargo flow within these countries compare to other regions. One important reason for this problem would be related to high seaport duties and customs tariffs

in import, export and transit procedures through international corridors between the mentioned countries due to the lack of preferential tariffs agreements.

This paper is related to “modeling the impact of logistic performance, economic features, and demographic factors of countries on the seaborne trade”. The main objective of this paper is to find the effective variables and give some advices to the policy makers to find a practical solution to decrease the international seaborne transportation cost between developing countries.

In this regard, after modeling and interpretation of results on studied countries' some advices raised to the policy makers. Based on the results the effective solution is Tariff reduction. Secondly, improving Logistics performance index: Ability to track and trace consignments would lead to more seaborne trade. To increasing LPI it is necessary to port development and increasing ports generations. It needs to fleet renewal and using clean and safe technology in ports.

although, in this paper we try to consider the effective variables and situations to the extent possible, there are some limitations. So, we think some suggestions for next research may cover these limitations. This study was based on data before the Covid-19 pandemic. Probably, the outbreak of Corona has affected the results of the study. It is suggested to re-do this study based on post-Corona data. In this study, the seaborne trade of the mentioned countries was investigated. It is probable that the trade of these countries with other developed countries would change the results.

## Funding

This work was supported by Standing Committee for Economic and Commercial Cooperation (COMCEC) research funding.

## CRediT authorship contribution statement

**Alireza Mahpour:** Funding acquisition, Conceptualization, Methodology, Investigation, Supervision, Writing – original draft, Writing – review & editing. **Iman Farzin:** Modelling, Writing – original draft. **Amirhossein Baghestani:** Conceptualization, Resources, Investigation, Writing – original draft. **Sina Ashouri:** Software, Investigation, Writing – original draft. **Zahra Javadi:** Software, Writing – original draft. **Latifeh Asgari:** Data curation, Investigation, Writing – original draft.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## References

- Alexander, D. W., & Merkert, R. (2021). Applications of gravity models to evaluate and forecast US international air freight markets post-GFC. *Transport Policy*, 104, 52–62.
- Anderson, J. E. (2011). The gravity model. *Annual Review of Economics*, 3(1), 133–160.
- Angelopoulos, J., Vitsounis, T., Pafioti, P., Chlomoudis, C., & Tsmourgelis, I. (2021). Reflecting economic activity through ports: The case of Australia. *Maritime Transport Research*, 2, Article 100021.
- Arora, K., & Siddiqui, A. A. (2022). Exploring trade and technological linkages: Evidence from India's sectoral GVC participation. *Transnational Corporations Review*, 1–15.
- Bektaş, T. (2017). *Freight transport and distribution: concepts and optimization models*. CRC Press.
- Bensassi, S., Márquez-Ramos, L., Martínez-Zarzoso, I., & Suárez-Burguet, C. (2015). Relationship between logistics infrastructure and trade: Evidence from Spanish regional exports. *Transportation Research Part A: Policy and Practice*, 72.
- Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity. *The Review of Economic Studies*, 83(1), 87–117.

- Brandt, L., Van Biesebroeck, J., Wang, L., & Zhang, Y. (2017). WTO accession and performance of Chinese manufacturing firms. *American Economic Review*, 107(9), 2784–2820.
- Dai, L., Hu, H., & Zhang, D. (2015). An empirical analysis of freight rate and vessel price volatility transmission in global dry bulk shipping market. *Journal of Traffic and Transportation Engineering (English Edition)*, 2(5), 353–361.
- Devlin, J., & Yee, P. (2005). Trade logistics in developing countries: The case of the Middle East and North Africa. *World Economy*, 28(3), 435–456.
- Fan, Z., & Liu, K. (2022). The Promotion Effect of the Belt and Road Initiative on China's tea export trade. *Journal of Sociology and Ethnology*, 4(1), 94–100.
- Gani, A. (2017). The logistics performance effect in international trade. *The Asian Journal of Shipping and Logistics*, 33(4), 279–288.
- Genç, M., Artan, S., & Berber, M. (2011). KARADENİZ EKONOMİK İŞBİRLİĞİ BÖLGESİNDE TİCARET AKIMLARININ BELİRLEYİCİLERİ: ÇEKİM MODELİ YAKLAŞIMI. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 25(2), 207–224. Retrieved from <https://dergipark.org.tr/en/pub/atauniibid/issue/2702/35650>
- Ghisolfi, V., Tavasszy, L. A., Correia, G. H. D. A., Chaves, G. D. L. D., & Ribeiro, G. M. (2022). Freight transport decarbonization: A systematic literature review of system dynamics models. *Sustainability*, 14(6), 6666 3625.
- Han, C. H. (2018). Assessing the impacts of port supply chain integration on port performance. *The Asian Journal of Shipping and Logistics*, 34(2), 129–135.
- Head, Keith, & Mayer, Thierry (2014). Gravity equations: Workhorse, toolkit, and cookbook. In *Handbook of International Economics*, vol. 4, Amsterdam: Elsevier 131–195.
- Jayasinghe, S., & Sarker, R. (2008). Effects of regional trade agreements on trade in agri-food products: Evidence from gravity modeling using disaggregated data. *Applied Economic Perspectives and Policy*, 30(1), 61–81.
- Karagoz, K., & Saray, M. O. (2022). Trade potential of Turkey with Asia-Pacific countries: Evidence from panel gravity model. *International economics. Studies*, 36(1), 19–26.
- Korinek, J. and Sourdin, P., (2009) Maritime transport costs and their impact on trade. Organization for Economic Co-operation and Development TAD/TC/WP (2009), 7.
- Kuo, K.C., Lu, W.M., Le, M.H. (2020). 'Exploring the Performance and Competitiveness of Vietnam Port Industry Using DEA'. *The Asian Journal of Shipping and Logistics*, 36, Elsevier 136–144.
- Lim, K. G., Nomikos, N. K., & Yap, N. (2019). Understanding the fundamentals of freight markets volatility. *Transportation Research Part E: Logistics and Transportation Review*, 130, 1–15.
- Liu, Q., Qiu, L. D., & Zhan, C. (2019). Trade liberalization and domestic vertical integration: Evidence from China. *Journal of International Economics*, 121, Article 103250.
- Mahpour, A., Amiri, A. M., Deldar, M., Saffarzadeh, M., & Nazifi, A. (2018). A heuristic method to determine traffic bottlenecks based on ant colony: a case study of Iran. *Case Studies on Transport Policy*, 6(4), 716–721.
- Mahpour, A., Nazifi, A., & Mohammadian Amiri, A. (2021). Development of optimization model to reduce unloading and loading time at berth in container ports. *Iranian Journal of Science and Technology, Transactions of Civil Engineering*, 45(4), 2831–2840.
- Mamdohi, A. R., Mahpour, A., Hossein Rashidi, T., & Sfar Zadeh, M. (2016). Identification of effective personal factors in attracting customers to shopping centers—case of Tehran. *Journal of Business Management*, 8(3), 681–698.
- Marti, L., Puertas, R., & García, L. (2014). The importance of the Logistics Performance Index in international trade. *Applied Economics*, 46(24), 2982–2992.
- Melnik, T., Kalyuzhna, N., & Pugachevska, K. (2018). A gravity model of trade turnover between Ukraine and the EU. *Baltic Journal of Economic Studies*, 4(4), 217–222.
- Michail, N. A., & Melas, K. D. (2021). Market interactions between agricultural commodities and the dry bulk shipping market. *The Asian Journal of Shipping and Logistics*, 37(1), 73–81.
- Michail, N. A. (2020). World economic growth and seaborne trade volume: Quantifying the relationship. *Transportation Research Interdisciplinary Perspectives*, 4, Article 100108.
- Muratoğlu, A. (2020). Assessment of wheat's water footprint and virtual water trade: a case study for Turkey. *Ecological Processes*, 9(1), 1–16.
- Muratoğlu, G., Uğurlu, E., & Muratoğlu, Y. (2017). Trade flows between Russia and other black sea economic cooperation countries: a gravity model analysis. *Gümüşhane University Electronic Journal of the Institute of Social Science/Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, 8, 20.
- Mustafa, F. S., Khan, R. U., & Mustafa, T. (2021). Technical efficiency comparison of container ports in Asian and Middle East region using DEA. *The Asian Journal of Shipping and Logistics*, 37(1), 12–19.
- Nugroho, A. D., & Lakner, Z. (2022). Effect of globalization on coffee exports in producing countries: A dynamic panel data analysis. *Journal of Asian Finance Economics and Business*, 9(4), 419–429.
- Osman, R. A. H., Gheraissa, M., & al-Zuhimi, S. (2022). History of economic relations between Oman and The Malay archipelago via maritime networks. *Journal of Positive School Psychology*, 6(2), 301–312.
- Papapostolou, N. C., Nomikos, N. K., Pouliasis, P. K., & Kyriakou, I. (2014). Investor sentiment for real assets: the case of dry bulk shipping market. *Review of Finance*, 18(4), 1507–1539.
- Siddiqui, A. A., & Vita, S. (2021). Impact of logistics performance on trade with specific reference to garment sector in Cambodia, Bangladesh and India. *Global Business Review*, 22(2), 517–531.
- Soh, K. L., Wong, W. P., & Tang, C. F. (2021). The role of institutions at the nexus of logistic performance and foreign direct investment in Asia. *The Asian Journal of Shipping and Logistics*, 37(2), 165–173.

- Sunitiyoso, Y., Nuraeni, S., Pambudi, N., F., Inayati T., Nurdayat, I., F., Hadiansyah, F., Tiara, A., R., (2022) Port performance factors and their interactions: A systems thinking approach, *The Asian Journal of Shipping and Logistics*, In Press.
- Tavasszy, L., De Jong, G (2013). *Modelling freight transport*. Elsevier.
- The World Bank Group [WWW Document], (2022) URL [https://data.worldbank.org/indicator/SP.POP.TOTL?end=2017&locations=ZQ&most\\_recent\\_year\\_desc=true&start=1960](https://data.worldbank.org/indicator/SP.POP.TOTL?end=2017&locations=ZQ&most_recent_year_desc=true&start=1960) (Accessed 12.10.22).
- Tonon, L., & García, P. (2019). Application of a gravity model to the bilateral trade between Ecuador and Germany. *UDA AKADEM*, 3, 115–131.
- Tsioumas, V., Smirlis, Y., & Papadimitriou, S. (2021). Capturing the impact of economic forces on the dry bulk freight market. *Maritime Transport Research*, 2, Article 100018.
- Tsouknidis, D. A. (2016). Dynamic volatility spillovers across shipping freight markets. *Transportation Research Part E: Logistics and Transportation Review*, 91, 90–111.
- Uğurlu, E., & Bayar, Y. (2014). Foreign direct investment and international trade in Turkey: Time-series-cross-section methods. *Ekonomik Yaklasim*, 25(91), 69–84.
- Vahidnia, M. H., Vafaeinejad, A., & Shafiei, M. (2019). Heuristic game-theoretic equilibrium establishment with application to task distribution among agents in spatial networks. *Journal of Spatial Science*, 64(1), 131–152.
- Van Bergeijk, P. A., & Brakman, S. (2010). The gravity model in international trade: Advances and applications. *Review of International Economics*, 19(5), 979–981.
- Vrakas, G., Chan, C., & Thai, V. V. (2021). The effects of evolving port technology and process optimization on operational performance: The case study of an Australian container terminal operator. *The Asian Journal of Shipping and Logistics*, 37(4), 281–290.
- World Integrated Trade Solutions [WWW Document], 2022. URL [https://wits.worldbank.org/about\\_wits.html](https://wits.worldbank.org/about_wits.html) (Accessed 12.10.22).
- Worldometer [WWW Document], 2022. URL <https://www.worldometers.info/world-population> (Accessed 12.10.22).
- Yousefikia, M., Mamdoohi, A.R., Moridpour, S., Noruzoliaee, M.H. and Mahpour, A., (2013) October. A study on the generalized TFlowFuzzy OD estimation. In *Proceedings of Australasian Transport Research Forum 2013*, Brisbane, Australia.