Original article

Using The Vector Autoregression Model to Determine the Relationship Between Some Macroeconomic Targets and The Volume of Goods Transported by Sea in Vietnam

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Abstract

In the context of world economic integration, Vietnam's market-oriented economy is facing many opportunities and also many challenges. Market factors are gradually dominating and dominating economic activities, affecting overall economic achievements and in almost all production and consumption sectors. Shipping in general and shipping by the sea, in particular, is one of the economic sectors most affected by the process of openness and international economic integration. As government intervention in the economy decreases, the fluctuations in the total output of the economy, according to the cycle theory, are considered more. Continuous fluctuations and cyclical themselves are made up of variables related to the results of production and business of economic sectors, which transport goods by sea are one of them. Quantitative analysis is being used in many types of research on economic and financial fields in the world as well as in Vietnam. For a more holistic, comprehensive, and scientific view, the use of a powerful quantitative tool, it allows assessment of multidimensional relationships between macro variables and variables that reflect the industry's production results. The Vector Autoregression (VAR) is one of the reasonably standard quantitative models used to determine the multidimensional relationship between economic factors supposedly related to each other. Use this model to analyze the relationship between some key macroeconomic indicators and the volume of goods transported by sea in Vietnam. The author finds that there is a relatively close relationship between import and export turnover of goods and sea transport output. This result suggests many policy ideas to develop both international trade and shipping activities in Vietnam in the current period. On the other hand, the quantitative model used in the project can be applied at the enterprise level to help managers identify the impact of economic fluctuations on production and business results. On that basis, appropriate decisions will be made in the context of ongoing short-term economic fluctuations.

Keywords: Marine transport, Vietnam, Macroeconomic, Vector Autoregression

1. Introduction

In each economy, one can easily observe the interaction between economic activities in different fields. This multidimensional, intertwined relationship often attracts researchers, suggesting many heated discussion topics on economic forums. Shipping in general and shipping by the sea, in particular, as a service industry, are considered to be significantly influenced by international investment and trade activities(Vietnam, 2016). This relationship exists and the extent of the influence of the above macro factors on maritime activities? By appropriate quantitative tools, the author wants to find the most convincing and scientific answer(Nguyen, 2016).

Sea transport is the primary mode of international transport. Every year, about 10 billion tons of goods are transported on ocean-going ships. In value terms, sea freight now accounts for more than 71% of the total worldwide freight. The current global shipping volume is more than 3 times that of road transport, 400 times that of air transport(Banomyong, Thai, & Yuen, 2015). Today, global trade activities promote sea transport. In contrast, ocean freight is a crucial factor supporting trade relations between industrialized countries and emerging Asian markets(Glushkova et al., 2017).

Thanks to the restructuring in the right direction, Vietnam's sea transport has prospered, the total output of the Vietnamese fleet has continuously grown. Currently, the fleet of the Vietnamese national flag carries 100% of inland freight by sea(Leitold & Diez, 2019). The seaport system satisfies the requirements of goods circulation, actively serves the socio-economic development, creates a driving force to attract and promote economic development(Tongzon & Lee, 2016). By effective measures, the total transport volume carried out by the Vietnamese fleet in 2018 is estimated at 144.6 million tons, the volume of rotating cargo is estimated at 153,079 million tons.km, an increase of 10.9% compared to 2017, accounting for 55.6% of the total turnover of goods circulating nationwide(Li et al., 2018). The Vietnamese national flag fleet has assumed nearly 100% of inland transport by sea, except for some specialized vessels such as LPG, bulk cement ...(Zhu, Pan, Li, Liu, & Wang, 2017) Inland freight mainly consists of household goods, food, coal, construction materials, machinery and equipment, containers,

petroleum, and general cargo(Stock & Watson, 2018). For international sea transport, the Vietnamese container fleet operates mainly on short routes of Southeast Asia and Northeast Asia, while some bulk carriers transport cargo on European routes. The total output of goods through the seaport of inland waterway vehicles in 2018 was estimated at 171.6 million tons, an increase of 30.5 compared to 2017 (131.5 million tons), the number of vehicles entering and leaving the port reached 30.2 thousand, increasing 39.4% compared to 2017 (21.7 thousand turns), of which VR-SB means 35.2 million tons, increased 88% compared to 2017(Shi, Li, Yang, & Wang, 2017).

In Vietnam, research projects on shipping are mainly focused on micro issues, within enterprises or the industry, with characteristics of exploitation and application. For example, port development planning, perfecting the port management model, building a transportation model, or improving the competitiveness of the fleet, ...(Fan & Yin, 2016) In these studies, the relationship and influence of macro factors on shipping activities are given and analyzed at different angles, for research. However, this topic has never been studied independently and thoroughly. Moreover, researches on shipping economics have mainly stopped at analysis and evaluation based on descriptive statistical methods(Tongzon & Lee, 2015). The use of quantitative research tools is quite limited. In addition to some studies that forecast cargo throughput or port cargo, to date, in the field of shipping, there has not been any research on the relationship between macroeconomics and industry economy using the VAR model as a quantitative analysis tool, method and research tool(Kagkarakis, Merikas, & Merika, 2016).

Transport connects the production activities of an economy, contributing to national economic achievements. The processes of supply, consumption of products, even the manufacturing process of businesses are related to transport(Van Le, Kim, & Jeong, 2015). Among the most popular modes of transport currently, shipping is a major sub-sector. The statistics show that up to 80-90% of commercial goods in the world as well as in Vietnam are transported in this form(Tongzon & Lee, 2015). Thus, there may exist a close relationship between macro variables that reflect the results of economic activities with the volume of goods transported by sea(Pham & Yeo, 2019). This issue has

been mentioned in several specialized studies but only at qualitative and descriptive evaluations or the construction of single regression functions with a small sample size (15 years)(Nguyen, 2016). For a more holistic, comprehensive, and scientific view, the use of a powerful quantitative tool, it allows assessment of multidimensional relationships between macro variables and variables that reflect the industry's production results(Tran, Yuen, Li, Balci, & Ma, 2019). In the context of this paper, the author focuses on examining the relationship between GDP, import-export turnover, total social investment, and sea transport volume using the VAR model to answer the question(Bou-Harb, Kaisar, & Austin, 2017). Are there any quantitative relationships between these indicators or not? Moreover, if the relationship between them exists, what recommendations will be made to promote Vietnam's maritime development in the country's economic development in general?

2. The theoretical and methodological basis

In 2011, the Nobel Prize in Economics was awarded to American economic scientist Christopher Sims for his empirical research on VAR econometric models proposed by him since 1980(Stock & Watson, 2018). These studies are rated as extreme. This is an important period and has a great influence on the macroeconomy. VAR stands for Vector Autoregression(Abrigo & Love, 2015). This model is essentially a combination of two methods: univariate autoregression AR and simultaneous equations (Ses) [4]. The basic form of VAR is:

$$Y_t = A_1 Y_{1t} + A_2 Y_{2t} + \ldots + A_p Y_{pt} + s_t + u_t \qquad (1)$$
Where:

Y_t is a time series consisting of m random variables;

A_i is a square matrix of size m * m, i = 1,2, ..., p;

s_t is a vector of determinants which may include constants, linear or polynomial trends;

$s_t = (s_{1t}, s_{2t}, ..., s_{mt})$';

u_t is the vector of white noise.

Slims's idea when building VAR is to measure the response of macro variables to economic shocks. In particular, one variable can be affected by other variables, and at the same time, it affects itself (independent shock)(Zhu et al., 2017). In general, we can understand that VAR is a vector model with self-regressive variables. In particular, each variable is linearly dependent on its hysteresis values and hysteresis values for all other variables.

Currently, VAR is considered to be a robust quantitative tool, widely used in studies using time series related to the financial and monetary field. In the world, successful studies with VAR model mainly analyze public policy and interaction between macroeconomic variables such as foreign exchange reserves and the fluctuations of monetary policy(Monogan, 2010), the long-term neutrality of money through shocks related to monetary policy(Kent, 2017), ... Many studies funded by the IMF and the World Bank also use VAR as one of the essential quantitative tools. In Vietnam for the past 10 years, VAR has been used extensively in studies to assess the effects of macro variables in economics and finance, such as applying the VAR model in studying the relationship between FDI and economic growth; applying VAR and ECM in analyzing the impact of exchange rates on Vietnam's trade balance from 1999 to 2012, analyzing the determinants of inflation in Vietnam: evidence and discussion, ...

3. The relationship between some macroeconomic targets and the volume of goods transported by sea in Vietnam

3.1. Survey data to ensure the requirements of the model

The paper uses a secondary set of 29 observations collected between 1990 and 2018. The figures for export value (EX), import value (IM), and total social investment (INV) are taken from the World Bank's website (WB). Notably, data on sea transport (STO) is taken from data of the General Statistics Office compiled by the author from the Statistical Yearbook from 1990 to the present.

One of the conditions of the model is that the time series must be stationary. In Table 1, stability tests of all 4 series show that these are non-stop series. However, using the Bob Jenkins method with superlative variance both shows that the series stops at a 1% significance level.

Table 1: Stability test results for model variables

Variable	Differential step 1	Hysteresis value (ADF)	Critical value (significance level 1%)	Conclusion
EX	DEX	-5.127	-3.700	string stops
IM	DIM	-3.733	-3.700	string stops
INV	DINV	-4.756	-3.700	string stops
STO	DSTO	-3.748	-3.711	string stops

Table 2: Defining lag according to AIC selection criteria

Lag	LogL	LR	FPE	AIC
0	-10.69345	NA	3.38e-5	1.088404
1	102.7123	184.7144	2.72e-08	-6.126838
2	125.6232	30.51204*	1.72e-06*	-6.641655*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

The result in Table 2 shows that lag is equal to 2. All solutions are in the unit circle. Thus, the VAR model is stable. The survey results show that the model ensures all conditions of stopping, stability, and having a lag defined by 2 in Table 3.

Table 3: Testing stability

Root	Modulus
0.971432 – 0.054122i	0.974103
0.971432 + 0.054122i	0.974103
0.561923 – 0.426136i	0.715401
0.561923 + 0.426136i	0.715401
-0.232111 – 0.514788i	0.697912
-0.232111 – 0.514788i	0.697912
0.482561	0.482561
-0.069864	0.069864

No root lies outside the unit circle.

VAR satisfies the stability condition.

3.2. Check correlation of residuals

Table 4 shows that the remainder of the equation is correlated, indicating that the shock occurred with one variable affecting the remaining variables.

Table 4: Check the correlation of the residuals

	DINV	DEX	DIM	DSTO
DINV	1.000000	-0.256225	0.539246	0.082898
DEX	-0.256225	1.000000	0.466583	0.029151
DIM	0.539246	0.466583	1.000000	0.296845
DSTO	0.082898	0.029151	0.296845	1.000000

3.3. Causal test

Combining the results in Tables 1, 2, 3 and 4 with the Granger causality test, we get the results in Table 5 as follows:

Table 5: Granger causality test

Dependent variable	Independent variables	Chi sq	P-value	Conclusion
DINV	DEX	13.994	0.0009	Investment depends on exports
DEX	DINV	12.721	0.0017	Export depends on investment

DINV	DIM	9.0132	0.0110	Investment depends on imports
DIM	DINV	8.7519	9.0126	Import depends on investment
DINV	DSTO	2.207	0.3317	Shipping does not affect investment
DSTO	DINV	3.2836	0.1936	Investment does not affect shipping
DEX	DIM	2.3692	0.3059	Import does not impact exports
DIM	DEX	0.1313	0.9365	Export does not impact imports
DEX	DSTO	0.7577	0.6847	Shipping does not affect exports
DSTO	DEX	8.9278	0.0115	Exports impact on shipping
DIM	DSTO	1.9061	0.3856	Shipping does not affect imports
DSTO	DIM	5.3135	0.0702	Imports impact on ocean shipping

3.4. Analysis of push response

Using the Cholesky method, in which, variables are arranged in a causal relationship as follows: DINV, DEX, DIM, DSTO. This arrangement is determined based on the assumption that the results of shipping activities are the result of investment and import-export activities. The increase in overall social investment and international trade has a positive effect on shipping. The results show that the total investment value of the whole society does not affect the results of transporting goods by sea and vice versa. However, the volume of shipping by sea depends quite strongly on the total value of exports and imports, and there is no inverse relationship.

3.5. Variance decomposition

To determine the impact level as well as the impact delay of the variables DINV, DEX, DIM to DSTO, it is necessary to consider the values in Table 6 on variance decomposition:

Table 6: Results of variance decomposition

Period	S.E.	DINV	DEX	DIM	DSTO
1	0.095861	0.681247	0.006684	20.87425	78.54782
2	0.137568	3.245145	5.724512	31.23546	59.74526
3	0.146244	4.987522	9.482563	31.12486	54.42563
4	0.153123	6.738725	14.78925	27.21543	51.23548
5	0.164557	6.507821	20.78952	24.45782	48.33245
6	0.172256	5.426541	25.12345	22.11456	47.32456
7	0.182596	4.458344	28.14785	19.84527	47.45782
8	0.199543	3.712245	30.78954	18.16892	47.42457
9	0.215487	3.178645	32.45621	17.06457	47.24578
10	0.224567	2.812544	33.97851	16.18243	47.12453

Fluctuations in shipping volume mainly depend on the historical value itself. However, we can also see the influence of the value of exports and imports. Data show that fluctuations in export values do not immediately affect shipping volumes. This effect is only observed in the second year, about a year late, with a relatively small level. The influence of exports on shipping volumes tends to increase over time. By the 10th year, this influence has reached 30%. Unlike exports, the impact of import changes on shipping volumes can be observed almost immediately, increasing gradually to year 3. After that, this effect decreases slowly over time.

3.6. Policy recommendations

Although about one year late, the value of exports has a long-term, relatively stable impact on the volume of goods transported by sea and has increased over time. Thus, in order to increase maritime activities, policies to

encourage shipping development must be synchronized with export promotion policies. Vietnam's becoming an official member of the World Trade Organization (2006), joining the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and signing many bilateral and multilateral economic agreements not only facilitate the development of export activities but also indirectly positively impact shipping. However, to become a maritime nation with a developed shipping industry, commensurate with its potential and advantages, consistent joint policy is needed. It is winning the right to transport export goods for the Vietnamese fleet. According to statistics, at present, the Vietnamese fleet only accounts for about 13-20% of total export cargo volume. Thus, if there is a good policy, combined with close cooperation between exporters and ship owners, there will be many opportunities for Vietnam's shipping.

Similar to exports, the value of imports also has an impact on the volume of sea freight. This effect is almost immediately noticeable because as soon as import values change, the volume of shipping will increase at the same time. Although the impact is gradual, if the import growth rate is maintained, the shipping industry will undoubtedly benefit. From a theoretical perspective, imports hurt national output. However, in the current context of global specialization, comparative advantage theory shows that a country that wants to increase output needs to promote both exports and imports. In the context of this article, the author does not mention the deeper aspects of the structure, category of import, and export goods, but Vietnam's shipping will benefit if we use incentive policies. Reasonable and harmonious import of national and international interests. The policy problem now returns to winning the right to transport in import contracts of goods. This depends significantly on the national position, the competitiveness of the import-export enterprises, and the shipping enterprises in Vietnam.

Finally, the endogenous impact of the freight volume by the sea in itself is enormous, especially in the long run. Therefore, besides the policies to promote foreign trade, we also need to focus on policies to support and encourage shipping in terms of capital for fleet development, training on high-quality maritime human resources. Besides, the shipping business of Vietnam must also actively seek ways to improve competitiveness with many measures such as restructuring the fleet, link

and cooperate, expand relationships with import and export partners at home and abroad, ... to create a new position and force, expand the scale and capacity of goods transport.

4. Conclusion

Studying socio-economic development strategies in general and Vietnam's maritime development strategies in particular, we can clearly understand the importance of the marine economy to Vietnam's economic development and political stability in the coming period. In order to have a healthy and enriched economy from the sea, shipping is an economic activity that needs to be concerned with appropriate and sustainable development measures and strategies. Besides, shipping is also considered to be an economic sector greatly affected by physical production activities in the economy, along with other macro fluctuations.

Using quantitative analysis methods to assess the impact of total social investment, export turnover value, and imports to ocean shipping volumes show the significant impact of international trade on sea freight movement. The results of the model are entirely consistent with economic theory, showing that policies to encourage foreign trade development have a positive indirect effect on shipping. Thus, the synchronization of the system of trade and transportation policies will be an important basis for increasing the contribution of both important economic sectors to national economic achievements.

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