

A Survey of Fuel Price Effect on Sea Freight, Case Study: Port and Maritime Administration of Khorramshahr

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Abstract

Sea transportation is the base of trading and plays a major role in supplying commodity chain. In this chain, Ports as the stimulants of economic activities of countries and connecting ring between land and sea transportation ensure the steady flow of goods and services and provide traders and owners with the economical way to exchange goods. Khorramshahr is one of the most important ports in Iran and is located in the northwest of Persian Gulf and southwestern Iran (Shalamcheh land border) neighboring southeastern Iraq and is located at the confluence of the Arvand and Karoon rivers in Khuzestan province. This study examined the effects of changes in fuel prices on sea freight in Khorramshahr port in order to determine the effectiveness level of each factor in changes of transportation costs .This study is based on annual data time series 1996 to 2012. The research results show that the ship's fuel price is directly proportional to the sea freight, the demand for sea transportation varies inversely with the increase in fuel prices are, fuel consumption rate is directly proportional to weight of transported goods (ton/mile) and increasing in the number of freighters varies inversely with sea freight.

JEL classification numbers: Q4, Q49, R4, R49

Keywords: Fuel prices, Sea transportation, Khorramshahr port, Sea freight

1 Introduction

Today, the economic development of every country needs applied and macro programs, and since every country has its own infrastructure, development programs in each country has major differences with other countries. Sea transportation has always been considered

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as one of the most important ways in global trade transportation - this kind of transportation plays a major role in the development of foreign trade activities. Lower cost and risk, capability of moving bulky and voluminous cargos and faster conveyance are some of the important advantages of this method over the other methods of transportation.

Sea transportation due to having advantages such as "low-cost transportation of goods", "Massive volume and different dimensions of transported goods", "excessive weight of transported goods", "safe transport of goods (safety carriage)", "paying cash against using valid documents" and "quick action to transport goods from the manufacturer to the country entries" is considered as the most appropriate method of transportation (Roshandel, 2008). As the development of sea transportation, containerized transportation is also growing day by day. Figures released by the world association of marine show that the progress in this sector of sea transportation has been far more dramatic compared to the other sectors (Hassanzade.2011)

Using the high seas and having a considerable portion in global goods transportation between different countries has attracted an international attention to the sea transportation compared to other alternative. Studies show that the cost of fuel includes 30 percent of operating costs of a ship. Sharp decline in sea freight and falling revenues and on the other hand rising fuel prices, has negatively influenced the profit margins of shipping companies (Mortezapoor, 2013). This study examined the effects of changes in fuel prices on sea freight in Khorramshahr port in order to determine the effectiveness level of each factor in changes of transportation costs and to achieve results for optimal planning on fuel prices and sea freight. It can play an important role in planning and rational decision-making about freighters fuel costs in Khorramshahr and other ports in Iran.

2 Theoretical Principles of Research

Fuel is One of the important consumptions in shipping industry.(Three kinds of fuel are used: Intermediate fuel oil, High viscosity fuel oil, Marine diesel oil) and uncontrolled changes in its price in the world market has had undesirable effects on transportation costs, especially sea freight costs. Big fuel consumers can protect their financial targets by fuel contracts from future

Fluctuations in fuel prices may be higher than the current price. When a large fuel consumer company using exchange method of buying fuel, fuel prices reduce, and the company should pay a higher price than the market price of fuel.

However, if that same company buys fuel using replacement method, and fuel prices rise, the company will receive preferential difference to moderate the actual cost of fuel. Because of the sharp fluctuations in crude oil and other fuels prices in the last few years, providing the funds needed to compensate imposed higher fuel costs has become a cause of concern for sea freight shipping companies. Since the fuel cost takes a significant portion of these companies annual budgeting, they have applied appropriate methods to control their fuel costs and predict allocated budget for the following periods. Because crude oil is the source of the fuel, so its price is one of the major determinants in the future price of ships fuel in sea freight. So there is a strong Correlation between the crude oil price and ships fuel price. In addition, other factors such as refinery capacity may cause abnormal changes in crude oil and fuel prices. Today, due to unpredictable fuel

prices, the supplying method of dealing fuel is more common in the shipping industry in Iran and shipping companies use this method to reduce the risk of sudden rise in fuel prices and companies. Usually provide "between one-third to two-thirds" of their fuel by future method.

Most shipping companies choose six-months and some choose a one-year method but fuel has been purchased rarely for two or more years. Companies use the different ways of dealing fuel in supplying method some companies use secondary ways of dealing to provide protection against future inevitable risks. Today, fuel demand management has an important role in the countries planning. On the other hand fuel is fundamental to supply economic security and also it is one of the most basic requirements of each country's economic and social development. And as one of the production factors in all economic sectors, plays a major role in production process directly and indirectly. Achieving a powerful technique with higher capabilities and lower errors to simulate and forecast energy demand is one of the issues of researchers and policy makers involved with energy. (Sadeghi et al, 2009).

3 Literature

This research topic is assessing the effects of changes in fuel prices on sea freight costs in Khorramshahr port using econometric methods. The following related researches have been done in the past:

Morteza, M (2013), in a study titled "Effects of global economic recession and sanctions on the sea freight industry and (it's) existing challenges " reached the conclusion that: recession in global markets, excess capacity and rising fuel prices are the most important challenges in today's shipping industry. A sharp decline in transportation fares and falling revenues and on the other hand rising fuel prices, has negatively influenced the profit margins of shipping companies. Declining oil revenues reduces trade and consequently reduces ship traffic in the ports of the country and this will cause a reduction in revenues of shipping companies, activists and stakeholders in ports.

Moshrefi , R (2009). In a study titled "Oil price developments, sea freight costs and international trade patterns". reached the conclusion that: The fluctuating international economy and oil price developments in the first decade of the third millennium and their effects on economic pattern of sea trade could be appropriate context to analyze the dependency of international trade and sea transportation on future energy prices. The biggest obstacle to international trade not tariffs but higher cost of transportation was argued. Declining in oil prices and consequently transportation costs, will not leave a significant part of the final product cost for transportation costs.

Seyf, M., Tavakkoli, M (2003). In a study titled "Methods of reducing fuel consumption in marine vessels" reached the conclusion that: one of the most important and influential parts of vessels running costs is the fuel cost. During recent years , different methods have been used to reduce ship fuel consumption. Since the most important parameter in fuel consumption is the vessel's resistance, first, the various components of resistance and methods to reduce them were investigated. Also, methods such as improving hull forms, new coverings, reduce weight and improve fuel efficiency of propulsion systems was evaluated to reduce fuel consumption. Using the new propellant systems and accuracy in utilization and maintenance of vessel are the other important factors that have been mentioned and can be effective in reducing the vessel fuel consumption.

4 Research hypotheses

- An increase in ship fuel price increases the rate of Sea freight.
- An increase in ship fuel price reduces the Sea freight demand.
- An increase in fuel consumption rate increases the weight of transported goods.
- An increase in number of freighters reduces the of Sea freight rate.
- An increase in GDP increases the of Sea freight rate.

The scope of this study is Khorramshahr port and the time period is 17 years from 1996 to 2012.

5 Materials and Methods

5.1 Method of Investigation

Data used in this study was time series based and econometric methods and Eviews7 application are used to analyze information. This study is based on annual data time series 1996 to 2012. The estimated model is as follows:

$$FT = f(TM, FW, NC, FC, NS, GDP, INF)$$

Where;

FT= the average fare for sea freight (per IRR / t)

TM= the average amount of transported goods (per ton / miles)

FW= the average price of consumed fuel (per IRR / t)

NC= the total bearing capacity of the freighters (in tons)

FC = fuel consumption(per thousand of liters)

NS = number of freighters (depending on units)

GDP = growth rate of GDP (per cent)

INF = inflation rate (per cent)

5.2 Research Methodology

Econometric modeling methodology that is commonly used is shown in the following graph:

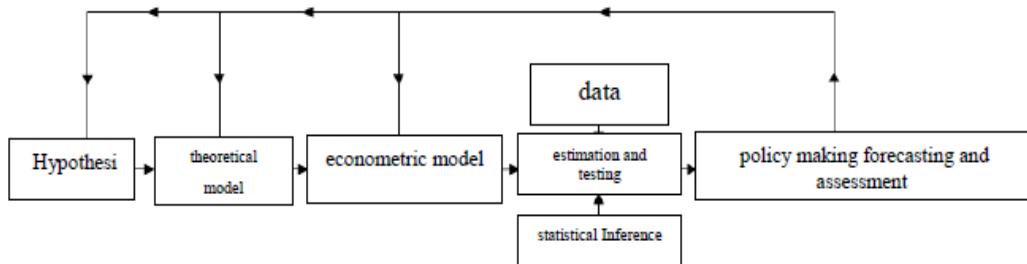


Figure 1: The methodology of research chart

6 Data Analysis using Descriptive Statistics

This part of the research reported in tables and graphs to analyze data descriptively. A comparison between trends in sea freight rate and the ship fuel price in Khorramshahr port.

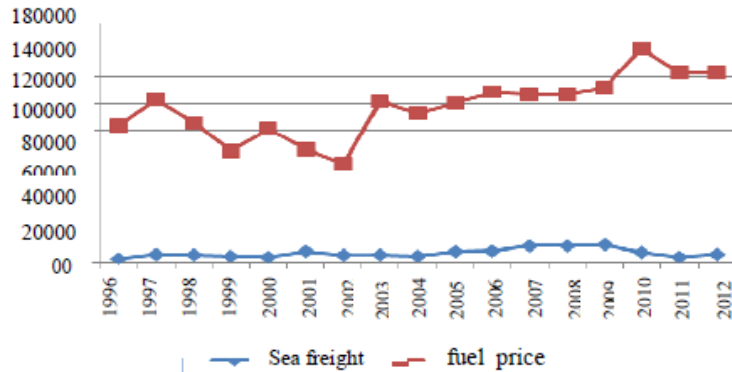


Figure 2: Comparison of ship fuel prices and sea freight in Khorramshahr port.

The above chart shows the correlation between changes in fuel prices and sea freight rate in Khorramshahr port.

A comparison between demand for sea transportation and ship fuel price in Khorramshahr port.

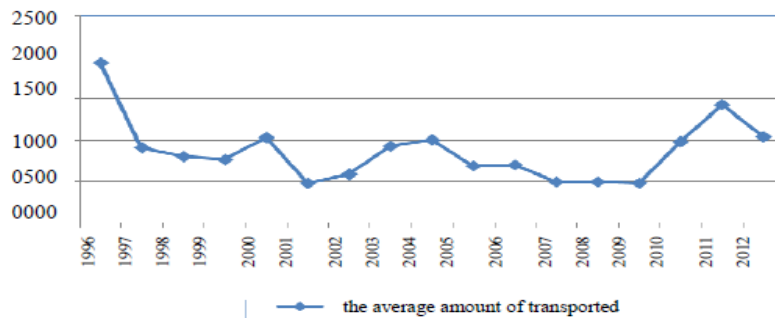


Figure 3: The average amount of transported goods (ton/miles) in Khorramshahr port.

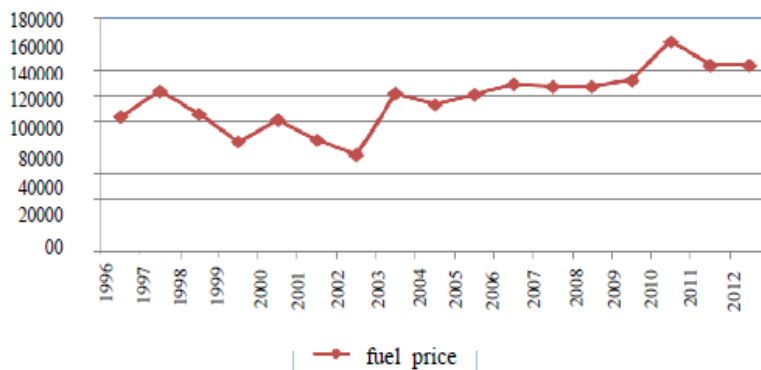


Figure 4: Ship fuel price (RLS / ton) in Khorramshahr port.

All above graphs show an inverse relationship between the demand for sea transportation and increase in ship fuel price in Khorramshahr port.

Ship fuel consumption rate (thousands of liters)

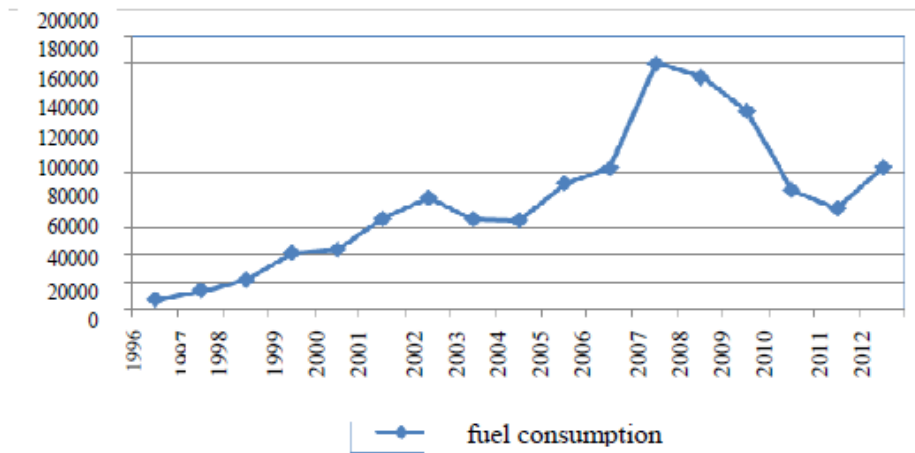


Figure 5: Ship fuel consumption (per thousand of liters) in Khorramshahr port.

The above graph shows an upward trend in fuel consumption between 1996 and 2007 and reached its peak at 2007 and a downward trend between 2008 and 2011, But in 2012, fuel consumption in shipping fleet has increased again.

number of freighters (unit) in Khorramshahr port.

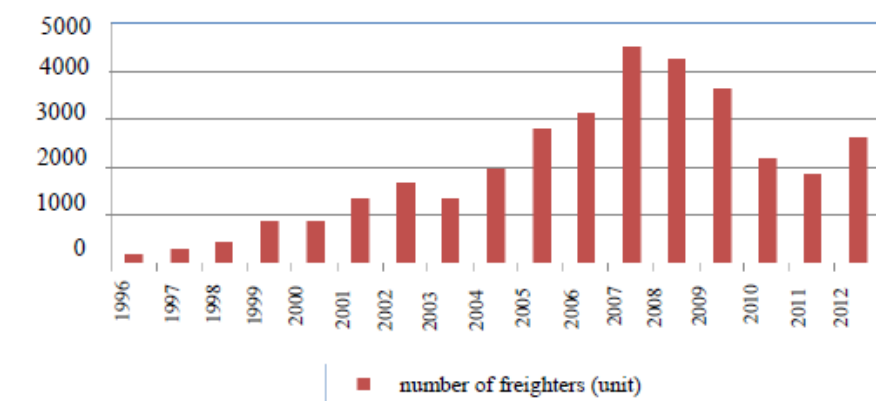


Figure 6: Number of freighters (unit) in Khorramshahr port.

The above chart shows that an increase in number of freighters is directly related to the ships fuel consumption rate and the highest number of freighters is shown in 2007. And also making a comparison between above charts shows that the increase in number of freighters varies inversely with sea freight.

GDP growth rates and inflation rates

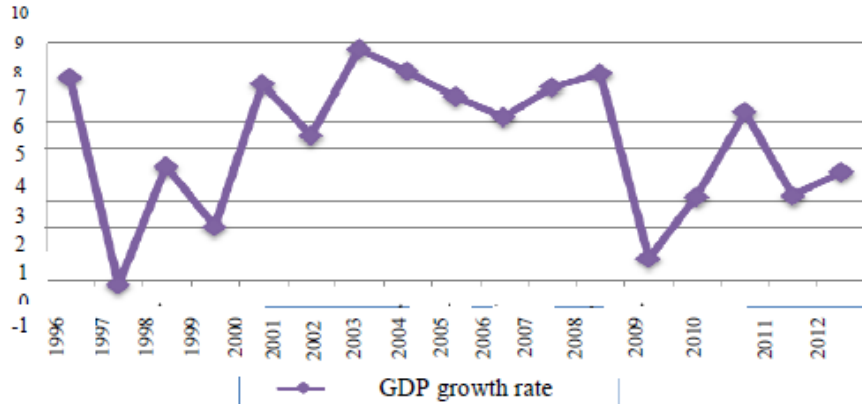


Figure 7: GDP growth rate (percent)

Above Graphs show that GDP rates are directly related to sea freight.

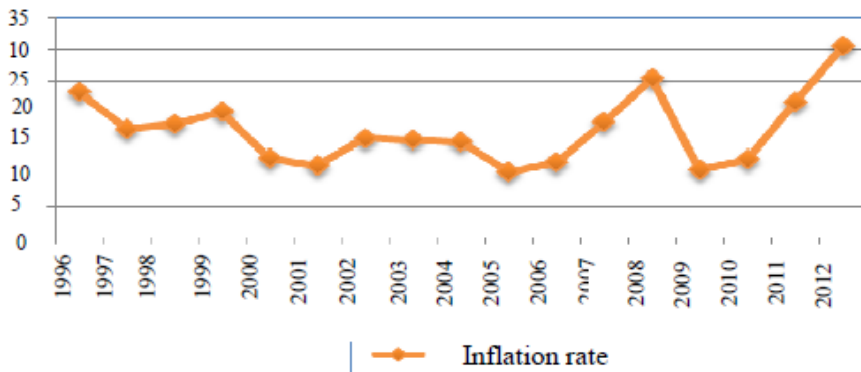


Figure 8: Inflation rate (percent)

From the above graph it can be seen that there is an inverse relationship between inflation and GDP. So there is an inverse relationship between the Inflation rate and the sea freight.

7 Estimation of Model

a. Reliability of variables

To examine the reliability of the variables used in this research, data is tested by Augmented Dickey Fuller test (ADF) and also to show if they are reliable enough to assess fuel prices changes on sea freight in Khorramshahr port.

Summarized results of variables reliability evaluation are presented in Table 1:

Table 1: The effective variables stability tests of the study of the effects of changes in fuel prices on sea freight in Khorramshahr port

condition	The degree of stability	Number of optimal lags	Critical value	ADF statistic	Variable name
With y-intercept	I(1)	1	-3/100	-3/293**	LTM
With y-intercept	I(1)	1	-4/011	-4/148***	LFW
With constant value	I(0)	1	-3/082	-3/309**	LNC
Without constant value and y-intercept	I(1)	1	-1/969	-2/488*	LFC
Without constant value and y-intercept	I(1)	1	-2/776	-3/514***	LNS
With y-intercept	I(1)	1	-3/100	-3/364**	GDP
With y-intercept	I(1)	1	-3/082	-3/510**	LNF

Source: research findings,***Significant at 1%,**Significant at 5%,*Significant at 10%

In the present study, after estimating the equation and coefficients using econometric methods, a number of tests are used to evaluate validity and accuracy of the estimated relationship statistically. These tests include:

- Collinearity test to assess the correlation between variables
- Autocorrelation test LM (Breusch Godfrey)
- Wald test (restrictions on the coefficients test)
- Omitted variables test
- Redundant variables test
- Ramseys reset test
- Normality of error term (residuals)

b. Estimating long coefficients of the study of effects of changes in fuel prices on sea freight (fares) in Khorramshahr port

The estimated model is:

$$LFT = -0.3445445862*LTM - 2.648433886*D(LTM/LFW) + 0.5791251707*LFC + 0.4640380618*D(LNC) - 0.9870049544*D(LNS) + [AR(1)=0.6134365628]$$

AR(1) statistic is there to eliminate the first-order correlation.

Final results of model estimation are presented as application outputs and statistical analysis of the results is based on econometrics that presented in the following tables (2) and (3)

Table 2: overall results of the final model.

SEE	Prob(F-statistic)	F	D.W	Adjusted R-squared	R-squared
0.082	0.00001	34.27	1.92	0.922	0.950

Table 3: Coefficients, standard deviation, T-tests and probabilities of final model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTM	-0.344545	0.112714	-3.056799	0.0136
D(LTM/LFW)	-2.648434	1.045865	-2.532290	0.0321
LFC	0.579125	0.006887	84.08916	0.0000
D(LNC)	0.464038	0.155974	2.975094	0.0156
D(LNS)	-0.987005	0.186710	-5.286311	0.0005
AR(1)	0.613437	0.102783	5.968255	0.0002

By observing the above tables we come to the conclusion that the model come up to our applied and theoretical expectations and is powerful to provide rational explanations in estimated values such as standard deviation of regression, Watson camera, the mean and standard deviation of dependent variables and the average squared error, statistic F,T and ...

In order to verify the validity of estimated relationship, a set of diagnostic tests performed by the application and the results are summarized and presented in Table (4):

Table 4: The tests related to the effects of changes in fuel prices on sea freight in Khorramshahr port.

Type of test	Statistic of test	AUC of the test statistic	The test result
Collinearity			There is a weak correlation between the variables and this indicates the absence of collinearity
Lm	F=0.0912 $\chi^2=0.431$	P=0.91 P=0.81	Error terms are not correlated consecutively
Jarque-Bera	$\chi^2=0.45$	P=0.798	Error terms are normally distributed
Ramsey	F=0.689	P=0.444	Model is correctly stipulated
Wald	F=599677.2 $\chi^2=599677.2$	P=000 P=000	Efficiency relative to the estimated demand function scale is not fixed
Omitted variables test	F=4.959	P=0.0765	LINF variables are not included in the model variables and should be removed.
Redundant variables test	F=9.357	P=0.0222	It is not justified to remove LNC variable from demand function

According to the specified model for the period in question, we can compare the actual values with predicted values to evaluate the model.

Table 5 and Figure 9 compare the actual values and processed values and residuals:

Table 5: Comparison of actual and predicted values and residuals

obs	Actual	Fitted	Residual	Residual Plot
1998	6.53277	6.47983	0.05294	
1999	6.36027	6.33545	0.02481	
2000	6.24300	6.33444	-0.09144	
2001	6.84907	6.93955	-0.09048	
2002	6.50429	6.58277	-0.07848	
2003	6.53073	6.38746	0.14327	
2004	6.38012	6.37003	0.01009	
2005	6.82329	6.72240	0.10089	
2006	6.86933	6.83732	0.03201	
2007	7.20682	7.23632	-0.02950	
2008	7.20667	7.27923	-0.07255	
2009	7.27351	7.20301	0.07050	
2010	6.75775	6.77379	-0.01604	
2011	6.25805	6.35968	-0.10163	
2012	6.57730	6.52903	0.04828	

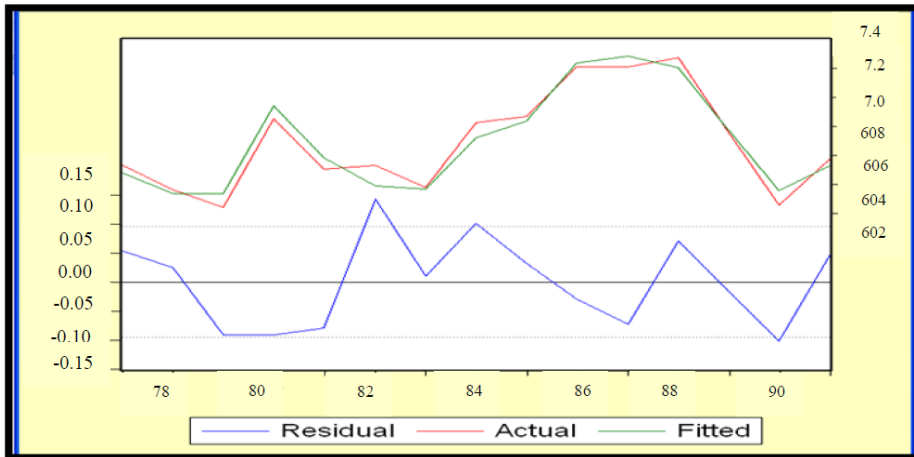


Figure 9: Actual values, predicted values and residual

In general, randomness in residuals values can be realized by observing the residuals timeline, and we will be aware of stipulated regression accuracy to a significant extent. Histogram-Normality test is used to test the normality of the error term. The results of this test on model is shown in figure (4)

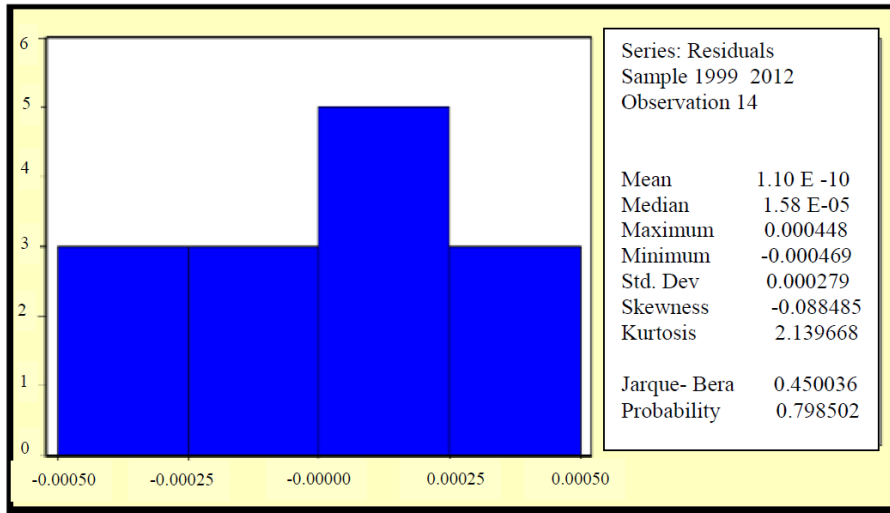


Figure 10: Normality test of the model error term

According to the results table, the statistic of Jarque-Bera test is about 0/450 with the expected value of 0/798. Therefore, the null hypothesis of normality of error sentence is acceptable.

8 Discussion

World trade volume carried by sea is rising day by day in a way that it exceeded 6.5 billion tons by now. According to the conducted analysis in different industries what are most eye catching and obvious and analysis focused on them are booms and records in these industries trend. But dare to say that sea transportation industry have had upward trend significantly in the overwhelming majority of cases. Therefore it can be concluded that this industry has always an upward trend no matter the others fall or rise. On the other hand increase in global trade and increase in longevity of shipping fleet caused an increase in international demand for new vessels not only to meet the needs of sea trade volume but also to replace the vessels which are not able to carry goods for any reason.

For a vessel, besides being technically unable to sail, there are numerous conventions and protocols to keep them in compliance with international standards which everyone imposes certain requirements to the vessels to ensure safe transportation. Despite the economic fluctuations in Iran and the region, sea transportation follows an upward trend. Actually there is not a very strong connection between the nature of sea transportation and recession in some industries and if a decline occurs in any industry, with an increase in other industries, regional sea transportation experiences positive outcomes. Certainly there are many evidences to show economic recession in some industries or even in all parts of a country's economy. These can be local, regional or international evidences and yet rooted in economic, social or political issues. But beyond all these developments what has always been fixed is the steady rise of sea transportation without any fall.

The vessels that are capable of sailing in a country or a region can travel to other parts of the world to work during the recession period. This capability provides necessary guarantees of the growth for this sector and to a great extent immune it from losses.

However, due to development of loading and unloading capacity to 150 million tons, development of containerized terminal to 5 million tones capacity and establishing a transit and export terminal for regional distribution with 25 million tons capacity by the year 2021 in our country, the future looks bright for this industry.

9 Conclusion

Khorramshahr Port having an area of over 230 acres is the third largest and one of the most important commercial ports in the Iran. This port is the second largest containerized port in the country and is located near Iraq and its sea and land borders. In this study, six key variables: average of sea freight rate, average of transported goods (tons/mile), average of consumed fuel price, amount of consumed fuel, total bearing capacity of vessels and number of vessels have been considered.

The results of this study show that: business cycles form the basis of sea freight cycles. Fluctuations in economic growth rates are transmitted to sea trade and make a cyclical demand pattern for ships. Business cycle of world industries is the most common cause of short-term fluctuations in sea trade and the demand for ships. The demand for transportation is derived from international trade, and doesn't follow the sea freight in the short-term. In the long term, a sharp increase in sea freight will reduce the proportion of sea transportation. But this assumption is not acceptable in the short-term because the demand for transportation doesn't follow the sea freight in the short-term and is not much affected by changes in sea freight and this indicates a non-elasticity of demand for sea transportation and sea freight in the short-term.

Fuel costs make up the largest portion of operating costs of a ship. So an increase in ship's fuel price causes an increase in total transportation costs, particularly in sea transportation and this reduces the demand for sea transportation. Demand for sea transportation varies inversely with the increase in fuel prices. However, fuel cost does not increase commensurate with the size of the freighter. But the increase in freighter speed lead to increase in fuel costs and so increases its proportion in vessels operating costs and ship owner- the supplier of transport services- should bear the costs. So increasing in fuel prices reduces services with previous fares. Demand for sea transportation is directly proportional to nominal capacity of all freighters. An increase in the number of freighters reduces sea freight that led to an increase in demand for sea transportation.

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