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LNG Shipping as a Diversification Tool for Energy Security: The Impact of the Ukraine-Russia War on LNG Ship Orders

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Abstract

Natural gas is one of the most important energy sources used in many fields since ancient times. Because it is monopolized by some countries due to its random distribution throughout the world, it can be difficult to supply this energy source in times of crisis with its suppliers. The most recent example of this is the war between Russia and Ukraine. Especially since European countries are mostly dependent on Russia and have problems in gas supply, they have turned to LNG transportation for resource diversification and increased demand. On the other hand, increasing demand caused a backlog in LNG ship orders. In this study, we aimed to determine whether there is a structural break in the order amounts of LNG ships, especially due to the recent war. As a result of the structural break analysis applied to monthly data, it was determined that an increase in orders started months before the war and that the highest orders of all time were placed during the war period. This situation can be explained by the fact that European countries accelerate their LNG infrastructure investments in order not to experience the problems brought by high dependency again, and this situation increases the high demand expectations in the sector and increases ship orders. Thus, the LNG market will continue to be an important sector in ensuring energy supply security in the near future.

Keywords: Shipbuilding, Energy security, Liquefied natural gas

1. Introduction

Natural gas is one of the most important fuel types known and used since ancient times. While resources near the surface could have been used economically in the past, nowadays its accessibility and global trade volume have increased thanks to the development of drilling techniques, pipeline projects, and widespread liquid natural gas (LNG) technologies [1]. In 2021, approximately 24.4% of the total energy consumption in the world was provided by natural gas [2]. It is generally used as an energy source for heating in homes, as a fuel in power plants, as an input in the production of products in industry, as a diversification tool in the energy security of countries, and as a transition fuel in projects that reduce environmental pollution.

However, the fact that natural gas resources are concentrated in certain countries may in some cases threaten the energy security of countries. As of 2020, Russia has 19.9% of the world's proved reserves and ranks first in the world in this regard. It is followed by Iran with 17.1% and Qatar with 13.1%. Russia alone accounts for 23.6% of the world's natural gas exports and ranks first in the world in this regard. This dominant role causes many countries to depend on Russia for natural gas energy resources. European countries' dependence on Russia for natural gas is very high and is at a level that can cause political disapproval [3]. As of 2021, European countries supply 71.7% of their total natural gas imports from Russia through the pipeline. They also supply 16% of their total LNG imports from Russia. The natural gas that Europe supplies from Russia via pipelines and LNG ships constitutes 54% of its total imports [2]. However, because of the sabotage that occurred in the Nord Stream in September 2022, there were problems in the gas flow from Russia to Europe [4]. In December 2022, natural gas flow from Russia to Europe decreased by 79% compared with the same month

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in 2021 [5]. European countries are attempting to solve this gap in their energy needs by primarily turning to coal [6] and extending the life of existing nuclear power plants [7].

On the other hand, the US, as one of the main LNG providers in the world, has turned the energy crisis between Europe and Russia into an opportunity and has become one of the main energy providers in the European market [8]. While the European market accounted for 34% of the total US LNG exports in 2021, this rate increased to 68% in 2022. In addition, LNG exported to Europe increased by 119% in 2022 compared to 2021 [9]. Moreover, there are even those who argue that the Nord Stream incident could have been a sabotage of the US state [10]. As a result of this event, while obtaining a large market for its LNG industry, the US also had the opportunity to increase its influence in Europe with a factor other than military power.

With the restriction of gas flow from Russia to Europe, especially with the Nord Stream event, and the increase in Europe's global demand, LNG supply increased by 5.5% in 2022 compared to 2021. Due to the increasing demand for LNG in Europe and the insufficient infrastructure, congestion has occurred at LNG terminals around Europe, and thus the amount of LNG on floating platforms broke a record in the last quarter of 2022. For this reason, especially Germany has started the construction of LNG import structures in numerous capacities. Thus, it plans to increase its energy security by increasing its gas supply and storage capacity via LNG [11]. Due to all these factors, the awareness of other countries to ensure energy security by diversifying their energy supply, especially by LNG ships, has increased. Thus, the demand for LNG ships will increase, and naturally, as there will be a shortage in the market, freight rates will also increase. In this case, shipowners may want to order new ships to meet demand sustainably and to obtain more returns from high freight levels in the market. It was basically the war between Russia and Ukraine that destroyed the perspective of countries on energy security and encouraged them to generate a new paradigm. Therefore, the period when gas flow problems started due to the war may have generated a structural break in the order trends of LNG ships.

In this study, considering the use of LNG imports to increase energy diversification of countries due to the war, we aimed to econometrically analyze whether there was a positive break in order quantities of LNG ships. Accordingly, monthly LNG ship orders as cubic meters (CBMs) by date was used in the analysis. Since delivery times for ships can take several years considering shipyard density and complexity of ship construction, changes in the energy security paradigm may be reflected primarily in the amount of tonnage ordered. Rather than evaluations based on the current situation and policies in the literature, the supply changes of LNG ships ordered in the near future as a result of very detailed analyses and studies by companies can provide more concrete findings. Our research focuses on whether environmental policies, climatic changes, geopolitical events, and especially the Russia-Ukraine war generate a scientifically significant break in the trend in the LNG ship order book. The results showed that the demand for LNG ships experienced a positive break, especially in the period when the risk of war increased. In other words, countries attempted to prepare in advance for supply restriction situations. However, the construction period of the ships, which took a few years, prevented the fruits of these preparations from being taken in a short time. In the next section, the literature studies that form the framework of our research have been compiled. Then, the dataset and the method used in the study are introduced.

2. Literature Review

LNG is an important energy source in terms of being used in the economic activities of countries due to policies aimed at minimizing emissions and reducing dependence on natural gas supplied by pipelines. In addition, since transportation is carried out by sea, LNG supply countries can be easily changed in case of any dispute, and this provides great flexibility compared to pipelines, which have much lower transportation costs. Today's disputes between countries show that energy security is much more important than supplying cheaper energy. In addition, the use of LNG in maritime vessels is becoming widespread [12], and challenging policies are being developed for the use of LNG as a secondary alternative fuel in newly designed ships. Although we could not find any studies directly related to the demand for LNG ships within the scope of our research, we have compiled several studies that indirectly affect the demand for LNG transportation.

Studies on the diversification of LNG in terms of energy security have focused not only on the use of LNG as a means of diversifying natural gas and other types of energy but also on issues related to the diversification of LNG suppliers. In the study conducted by Shaikh et al. [13], LNG supply security was examined using the ecological network analysis method for the countries of the Asia-Pacific region. As a result of the research, they found that increasing supplier diversity increases energy security and that the country with the highest energy security is China, followed by India, Japan, South Korea, and Taiwan. In a similar context, Vivoda [14] examined LNG import diversification in its research through the 5 largest LNG-importing countries in Asia, namely, China, India, Japan, South Korea, and Taiwan. The author conducted his research using the Herfindahl-Hirschmann index, which was developed to measure market concentration. Although there were fluctuations

in some periods, the results generally showed that all the countries subject to the research developed their LNG import portfolios.

Since the natural gas dependence between the European Union (EU) and Russia is at a very high level, studies on energy diversification have also been conducted in the literature on this subject. A study examining the impact of the Russia-Ukraine war on EU's energy diversification policies was conducted by Lambert et al. [15]. The effects of the sanctions imposed by the EU on Russia and Russia's classification of the EU countries as unfriendly nations were examined within the scope of the current capacities, contract agreements, and growth strategies of the LNG exporting countries. As a result, they determined that the EU's diversification policies could produce effective results in the medium and long term, even if not in the short term. Hauser [16], who examined Europe's diversification policies in the natural gas market, stated that the natural gas pipeline coming in transit through Ukraine poses a risk, that Europe's purchasing of gas from North African countries via pipeline and investing in LNG infrastructures will increase energy security, but the cost will be high, and that the most cost-effective way for EU is establishing trusting relations with Russia. Since EU and Russian relations directly determine the system costs of the European gas market, establishing trust-based relationships will reduce the costs to the most effective level and cause diversification policies to be kept aside. In a similar framework, Devaraj et al. [17] examined the importance of diversification in terms of supply security for Ireland and Portugal using the MCDM method. As a result, it has been shown that European countries are largely dependent on Russia and Norway for natural gas supply and that to increase energy security, increasing the number of FSRU units, expanding the pipeline import network, and investing in increasing gas storage capacities are some options. As mentioned in the study by Gritsenko [18], policies aimed at making investments to increase energy security through LNG infrastructure investments in the Baltic region have been implemented for a while. The use of natural gas as a weapon in the Ukraine conflict due to Europe's dependence on Russia was reflected as a shock to Europe's energy security. In the research conducted by Gritz and Wolff [19], it was determined that this shock was a compelling factor for European countries to develop their policies regarding LNG, an alternative energy source. Also, Russian supply can be replaced by supplying sufficient gas from the LNG market, increasing energy savings, and turning to alternative renewable energy sources. Some LNG markets that Europe is turning to increase its energy security are located in North Africa and the Middle East regions. The effect of the war and the role of the countries in this region in Europe's energy security has been examined by Al-Saidi [20]. The author has determined that the problem posed by the Ukrainian war in Europe's energy security has increased the importance of African and Middle Eastern countries, and partnerships with LNG supplier countries in the region should be increased to ensure long-term energy security.

The US's desire to turn the crisis between Europe and Russia into an opportunity in terms of LNG has also found its place in the literature. The US's efforts to become a dominant actor in the natural gas market and its efforts to use this situation to strengthen its ties with Asian and European countries and weaken their dependence on Russia were evaluated in a study conducted by Medlock et al. [8]. The authors stated that the liberalization of the LNG market would support policies in line with the interests of the US.

On the other hand, focusing on LNG is used not only to increase energy security by diversification but also to reduce dependence on a single source by energy-rich countries. In the study conducted by Shabaneh and Schenckery [21], the effects of Saudi Arabia's low- and high-capacity LNG terminals on global prices and the country's energy supply cost were examined using general equilibrium modeling by two scenarios. As a result, the opportunity cost between switching to LNG fuel and using oil was not much different and supported the country to become an actor in the gas market in the long term. This will also contribute to the country's rapid transition from oil-fired generation to natural gas-fired generation.

Geographical conditions, as well as countries' demands and policies toward LNG, can have significant effects on the market. The LNG market may undergo a major change if the ice disappears or breaks along the route in an economically sustainable way on the Northeast Passage (NEP) route, which is currently not economically navigable due to ice. In a study conducted by Schach and Madlener [22], it was stated that if the ice problem in the NEP is solved, Russia's power in the LNG market may increase significantly due to its rich reserves in North-Western Siberia. This will enable the formation of a competitive shipping route with the Asian market.

When the literature is examined in general, issues such as the diversification of LNG-importing countries, the diversification of the EU region countries' energy resources with LNG, the US's effort to increase its influence in the region by turning the crisis into an opportunity, the turning of countries trying to transition to clean energy to LNG, and the possible effects of climate changes on the LNG market are examined. The findings of all these studies indicate that the demand for the LNG market will increase both in terms of infrastructure and LNG ships. The event that largely accelerated this process was the devastating shock

of the war between Russia and Ukraine on energy security. Since the construction processes of ships take time and can vary between 1 and 4 years depending on the density of the shipyards and the complex engineering of the ship, the first reflections of the paradigm shift in the perspective on energy security can be seen in LNG ship order quantities. In this direction, whether there is a significant break in the order trend makes it possible to scientifically determine the paradigm transition. In parallel with the existing literature, we tested whether there was a break in LNG ship tonnage on order at points close to the war period and aimed to offer a unique complementary perspective to the literature.

3. Data and Methodology

The data used in this study is the CBMs value of LNG ship tonnage ordered monthly [23]. CBM over deadweight tonnage was used as a variable because we decided that it was a more accurate measure for gas transportation. The reason why tonnage was used rather than the number of ships ordered is to take into account the changing trend in ship sizes. The data used shows the tonnage in the order book in the relevant month. In other words, when these ships are completed in the near future, they will enter the market and increase the supply side of the world LNG fleet. The data set consists of 337 monthly observations covering the period of May 1995 to May 2023. Descriptive statistics of our variable are presented in Table 1. Descriptive statistics contain important parameters, including the central tendency values and characteristics of the variables.

Table 1. *Descriptive statistics*

Variable	CBM
Mean	482096.5
Median	170520.0
Maximum	4868520.
Minimum	0.000000
Std. Dev.	749660.5
Skewness	2.600537
Kurtosis	11.64394
Jarque-Bera	1429.005
Probability	0.000000
Observations	337
Source: Braemar [9] CBM: Cubic meter	

However, since the orders for ships, especially LNG- type ships, were not placed very heavily and were greatly affected by market sentiment, no ships were ordered for 129 months in the period under consideration. In addition, the standard deviation value is very high and even higher than the mean. Therefore, the coefficient of variation (standard deviation/mean) emerges as 155%, indicating that ship order tonnage is highly volatile.

The course of the data used in the study between May 1995 and May 2023 is presented in Figure 1. It follows very volatile course. In some months, there was no ship order, whereas in some months, this rate was very high. In fact, no LNG ships were ordered during 2009 because of the shrinking of demand due to the global economic crisis. Because the figure is difficult to read, the trend value obtained using STL decomposition has also been added. Especially after the period when coronavirus disease-2019 started, there was a very high order trend. Since the Russia-Ukraine crisis, where tension was felt until February 2022 and then turned into a physical war, increased the demand for LNG ships, there is an increase in ship orders in 2022. Of course, in this case, the sabotage of the Nord Stream pipeline was also effective, and Europe had to supply its needs with LNG ships.

The variables in the time series show fluctuations and changes over time, as shown in Figure 1. These changes can sometimes occur on a very small scale and on a large scale. Events that significantly affect the course of the series generate structural breaks in the series. These breaks show the effect of an important event in that period on the series. Thus, inferences can be made about that event and future policies can be developed considering its effect on the trend of the variable.

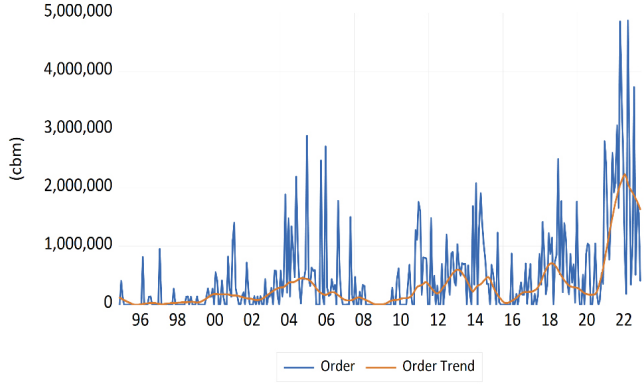

Figure 1. *Monthly orders of LNG ships and its trend*

Bai and Perron [24] test was preferred to analyze possible structural breaks in LNG ship order books. These breaks may be due to global events, policy changes, geopolitical crises, or random shocks that change the demand trend for LNG ships. The test is one of the most widely used methods for investigating structural breaks in a series. Its main purpose is to determine whether there is a structural break in the series and, if so, in which period. The test can achieve this by starting from the changes in some statistical properties

of the series, such as mean, variance, autocorrelation, and distribution. Therefore, it is important to identify structural breaks to detect incoming regime shifts, change the relationships between variables, and make more successful predictions. The most important advantage of this method is that there is no need for prior knowledge of the date of the structural break. This test makes it possible to detect multiple unknown break dates [25].

There are multiple versions of the test developed by Bai and Perron [24]. In this study, the author preferred the version of Global Information Criteria that determines the possible break dates in the series through the Schwarz (Sic) and Lagrange Multiplier-Wald-Zhao (LWZ), which is the modified version of the Schwarz [26]. In this method, it is recommended to use a consistent covariance estimator against heteroscedasticity or serial correlation. Therefore, the heteroskedasticity and autocorrelation consistent (HAC) [27] estimator can be used. In this estimator, Quadratic Spectral Kernel and Andrew's bandwidth options can be preferred. Analysis was performed using the EViews econometric software. The null hypothesis of this test is that there is no break in the series.

4. Results

In this study, it was decided to apply tests to both the raw order data and the order trend data to detect the break in LNG ship orders. This is because in some months no ships are ordered, and the value is 0 in those months. To reduce the possible negative effect of this situation on the results, the series was separated into its components using the STL decomposition method, and analyses were applied to the trend of the data as well.

For the application of the Bai and Perron [24] test, the series is first estimated by a single regressor (constant) as the series is a dependent variable, as shown in Equation 1. Then, multiple structural break tests are applied.

$$Y_t=\beta_0+u_t \quad (1)$$

Since the break in LNG ship order amount will be tested in the research, the order amount has been estimated as a dependent variable by a constant, as in Equation 2. Also, the analysis was applied to the trend of the series as shown in Equation 3. The ordinary least squares method was used to estimate the regression equations.

$$Order_t=\beta_0+u_t \quad (2)$$

$$OrderTrend_t=\beta_0+u_t \quad (3)$$

The estimated regression models for LNG order and LNG order trend variables are presented in Table 2. HAC was chosen for the covariance method because it was desired to allow serial correlation of errors while estimating the model. Quadratic-spectral and Andrew Bandwidth were selected from kernel settings in HAC. Since the frequency of data is monthly, it was decided to automatically determine the lag number in the HAC settings by minimizing the Akaike Information Criterion (Aic). Aic was selected because it is asymptotically efficient and better in larger samples [28]. The model that minimizes the information criterion value is determined to be the most effective one. As a result, constant terms are significant at the 1% and 5% levels. However, the model has no explanatory power because independent variables are not included in the equation. This does not matter because the test that will give the real result is the structural break test.

Table 2. *Regression estimation results*

	Order	Order Trend
C	482096.5 [0.00]	317416.8 [0.03]
Adjusted R-Squared	0.00	0.00
Durbin-Watson	1.16	0.006649
Aic	29.98	28.82
Sic	29.90	28.83
(1) Probabilities are shown in square brackets, (2) the HAC (Newey-West) Covariance method was applied		

After the regression model was estimated, the multiple break test was applied. While applying the test, the Global Information Criterion was chosen as the method. This method compares the information criteria for structural breaks from 0 to M. The information criteria used were Schwarz (Sic) and LWZ. While performing the analysis, the maximum number of breaks was determined as 5. In addition, the trimming rate was chosen as 5% because a high trimming rate may lead to data loss in the series.

The results obtained for the raw LNG order variable are presented in Table 3. Values that minimize the information criteria show the number of breaks in the series. According to the analysis, Sic indicates four breaks, while Lwz indicates 1 break since their values are the minimum in these break numbers. The dates of the breaks are presented in Table 4.

Table 3. *Structural break test for order*

Breaks	# of Coefs.	Log-L	Sic Criterion	Lwz Criterion
0	1	-5036.407	27.06905	27.09059
1	3	-4970.426	26.71201	26.77667$^{\alpha}$
2	5	-4959.314	26.68060	26.78841
3	7	-4954.362	26.68576	26.83675
4	9	-4946.169	26.67168*	26.86589
5	11	-4943.733	26.69176	26.92924
(1) The number of breaks that minimize the information criterion is shown by * for Sic and $^{\alpha}$ for Lwz (2) Sic: Schwarz, Lwz: Lagrange Multiplier-Wald-Zhao				

Table 4. *Break dates considering the number of breaks*

1[α]	2	3	4*	5
2021M06	2003M09	2004M04	2004M04	2004M04
	2021M06	2006M07	2006M07	2006M07
		2021M06	2011M04	2011M04
			2021M06	2015M02
				2021M06
Suggested structural break dates by *Sic and [α]Lwz				

The Sic suggested 4 break dates, while Lwz suggested only 1 break date. The common date for both Sic and Lwz is June 2021. On the other hand, other break dates suggested by Sic are April 2004, July 2006, and April 2011.

The results of the structural break test applied to the trend of LNG order amount are presented in Table 5. In this case, both Sic and Lwz point to 5 structural breaks. The structural break dates are presented in Table 6.

Table 5. *Structural break test for the order trend*

Breaks	# of Coefs.	Log-L	Sic Criterion	Lwz Criterion
0	1	-4855.827	25.99736	26.01890
1	3	-4568.404	24.32613	24.39078
2	5	-4513.804	24.03663	24.14444
3	7	-4498.066	23.97777	24.12876
4	9	-4472.735	23.86198	24.05619
5	11	-4458.271	23.81068*	24.04815[α]
(1) The number of breaks that minimize the information criterion is shown by * for Sic and [α] for Lwz (2) Sic: Schwarz, Lwz: Lagrange Multiplier-Wald-Zhao				

Table 6. *Break dates considering the number of breaks*

1	2	3	4	5 *α
2021M08	2011M04	2000M01	2003M08	2003M08
	2021M09	2011M04	2006M02	2006M02
		2021M09	2011M04	2011M03
			2021M09	2018M01
				2021M09
Suggested structural break dates by *Sic and [α]Lwz				

Both information criteria suggested 5 break dates: August 2003, February 2006, March 2011, January 2018, and September 2021. Although the break dates are close to those in the previous analysis, there are some differences.

The dates determined after the structural break tests are presented in Figure 2. The dates of the 4 breaks are very close to each other. Apart from that, trend data indicates one more break at the beginning of 2018 as well. The effects of the war between Russia and Ukraine can be clearly seen in the figure. According to the raw and trend variables, after the war, order quantities reached all-time highs monthly. When the data is analyzed annually, the highest LNG ship order of all time was given in 2022 with 27.4 million cbm, and even 16% of the total orders in the sample were given in that year. In 2021, the highest ship order after 2022 was given with a total of 14.5 million cbm. In addition, while the number of ships ordered in 2022 was 163, it was 89 in 2021. Considering that the annual average ship order in the period under consideration was 36, it can be understood how unusual these order quantities are [23].

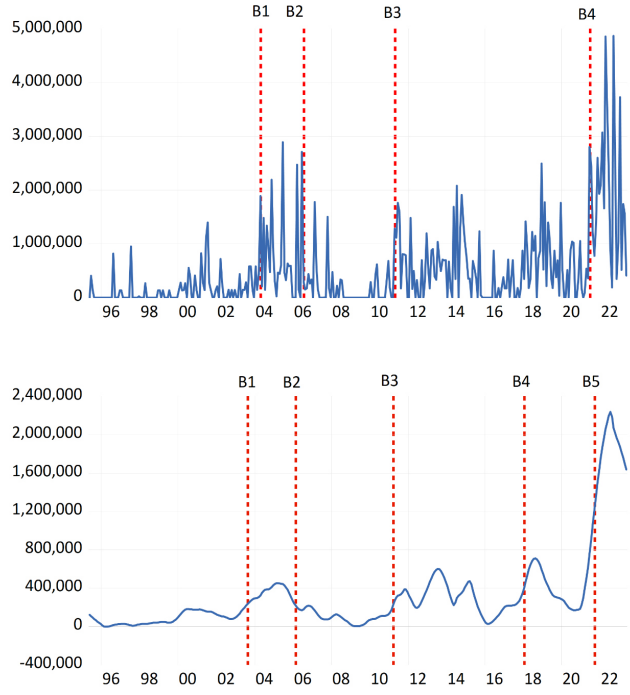

Figure 2. *Positions of break dates in the dataset*

Before February 2022, the date when the war officially started, it is seen that orders entered an upward trend and there was a break in orders in June 2021 according to raw data and in September 2021 according to trend data. This situation can be interpreted as countries and companies evaluated this war probability months before the war started actively and increased their LNG ship orders due to energy security concerns. Also, just before the war, on November 10, 2021, the US detected abnormal military activity on the Ukrainian border. On November 28, Ukraine informed the world that Russia was preparing to attack the border with 92,000 soldiers [29]. Such news has also been events that increase tension and worry countries in terms of energy security. They have probably also caused the demand for LNG ships to rise.

Apart from the war period, there are some periods in which there is an increase in LNG ship orders. For instance, the positive structural break in late 2003 and early 2004 was probably due to Chinese influence. Between 2000 and 2004, energy consumption in China increased by an average of 16% annually, and during this period, China alone accounted for more than half of global energy consumption [30]. In 2006, however, there was a negative structural break this time, and order quantities remained low for a while, probably due to a lower-than-expected demand in China, resulting in an oversupply of LNG ships.

Figure 2 shows an increase in orders after March 2014, when Russia invaded Crimea. However, this situation was not reflected in the series as a break. It is even argued that the rich natural gas reserves around Crimea played a role among the factors causing this invasion [31]. Therefore, countries may have increased their order quantities to diversify their energy security.

The increase seen in 2018 is probably due to the Kerch Strait Incident event, which increased the tension in the region [32]. There may have been an increase in LNG ship orders in response to the possibility that the problem between Ukraine and Russia could generate a problem in the flow of natural gas through Ukraine or EU countries that may impose sanctions on Russia. Because there is an annual gas flow capacity of 40 billion cbm to Europe via Ukraine, this constitutes a very significant amount of the total flow capacity [33].

5. Conclusion

The war between Russia and Ukraine greatly affected the natural gas market and forced the countries to produce new policies regarding the supply of natural gas. In particular, the European region has been the area most affected by the natural gas problems due to the war. In particular, the overall EU natural gas dependency rate is 97% in 2022 [34]. This great dependency can make the European economy fragile. In 2021, 54% of the total European natural gas imports were from Russia [2]. The disruption of natural gas flow through Ukraine, sanctions against Russia, and sabotage of the Nord Streamline due to the war made other suppliers mandatory for Europe. Since it is possible to supply natural gas by pipeline only from North Africa, it has had to supply its needs mostly with LNG ships from countries such as the US, Qatar, Algeria, and Nigeria. Therefore, the demand for LNG transportation has increased, which can be expected to cause an explosion in orders for new LNG ships. Of course, the structure of the LNG market should also be considered to make healthier inferences about this issue.

The LNG market can be defined as having an oligopoly market structure. While a certain number of companies manage the market, there are barriers to entry, such as large capital and knowledge accumulation. As LNG company owners make long-term contracts with buyers, a stable market trend occurs. In addition, because there are a limited number of players, they can easily cooperate with each other. Therefore, it can be said that the LNG market has an oligopoly structure, especially in the short term. Since LNG ships are complex in structure and require high technology, their prices are much higher than those of other ships [35]. This situation is also reflected in global fleet statistics. While LNG ships constitute only 3.7% of the world fleet in number [36], they constitute 8.3% in monetary value [37]. In addition, according to a monthly shipbuilding report, the average value of the ships ordered in January 2023, according to their types, were $34.7 million for bulkers, $57 million for tankers, $64.6 million for LPG ships, $83.1 million for container ships, $97.1 million for car carriers, $223 million for LNG ships [38]. These values are also sufficient to understand the capital barrier required to enter this market. However, there may still be a structural break in LNG orders due to the increasing demand and because the energy needs of countries are strategic and security issues.

According to the results of the analyses applied, the periods when orders increased and the dates of various structural breaks were determined in the data range discussed. If the China boom period is excluded in general, these breaks coincide with periods of military and political tension between Russia and Ukraine. As Russia is one of the most important natural gas suppliers in the world, the increase in LNG ship orders shows that countries are trying to diversify their energy supplies. Especially during the Russian-Ukrainian war, the highest LNG ship orders of all time were given. In this regard, when the studies in the literature are examined, policies and projects are being carried out to diversify energy resources with LNG both before [16-18] and after [15,19] the Russia-Ukraine crisis. This situation has increased the importance of suppliers in Africa and the Middle East, generating a need for more LNG ships [20]. In addition, environmental concerns and policies regarding emission reduction have encouraged countries such as Saudi Arabia to switch from oil-fired power plants to environmentally friendly natural gas power plants. Such countries, whose infrastructures are not yet suitable for processing their own natural gas, have turned to LNG for a rapid transition and aim to have a say in this market in the near future [21]. Finally, the possibility of the NEP route becoming more functional in the near future may also contribute to Russia's easier access to the Asian market [22]. All these diversification policies, climatic events, environmental policies, and geopolitical events increased the demand for LNG ships and caused a positive trend-break in the tonnage in the order book. Our

findings constitute scientific evidence as a concrete result of developments in this direction. Although it is a capital-intensive sector and gas supplied with LNG is expensive, countries cannot give up on this energy source in the near future. Existing infrastructure and industry are highly dependent on this gas.

Because the cost of supplying gas with LNG is higher, the cost to the European economy will likely be somewhat higher, adding to the inflationary effects in the region. Perhaps countries may consider entering this oligopoly market with the power of the state to reduce costs in the future, as it is a very important issue that affects energy security and costs. On the other hand, the increase in the number of LNG ships ordered will cause a large increase on the supply side after a few years. The effects of this situation on the LNG freight market can be examined. In addition, since which companies place orders will affect future market concentration and competition levels, a possible oligopoly structure may cause an increase in LNG supply prices and new energy security crises. Such possible situations can be analyzed using simulation and general equilibrium modeling, and proactive policies can be developed. Finally, the situation in the FSRU order book can be analyzed with a similar approach because the construction of physically fixed facilities is a process that can take a long time and requires know-how. The effect of the sudden energy shock may also have caused disruptions in the orders of such mobile vehicles that offer such quick solutions. These issues may also be important for further research.

The inability to access ship size-based order book data can be shown as a limitation of the study. Since ship sizes may vary depending on factors such as distance, value of cargo, commercial trends, and market competition structure, a distinction based on size would have made it possible to analyze the future market better.

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