

The Impact of Russia-Ukraine Conflict on Chinese Transportation Industry Index: Evidence from ARIMA Model

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Abstract. This paper examines the short-term (5 months) impact of Russian Invasion of Ukraine, occurred in February 24, 2022, to Chinese transportation industry. Setting the closing prices of Chinese Transportation Securities as the index of evaluating Chinese transportation industry and utilizing the ARIMA model, this paper makes use of the historical data of closing prices of Chinese Transportation Securities before February 24, 2022 to forecast the securities prices without the occurrence of the war. Comparing the actual and fitted values of the prices of securities, this paper concludes that the Russia-Ukraine war was a shock to Chinese transportation industry in a relatively short period. From the results of the model, the transportation industry in China had about one week lag correspondence to the occurrence of the war. Although there was a plummet in the prices of Transportation Securities from the first to the fifth weeks after the war, the market recovers soon from the bad news in two to three months. Suggestions from this essay includes encouraging green energy resources exports and improving international relationships with other countries from the government's side and reducing sensitivity to sudden market changes from the investors' side.

Keywords: Russia Invasion of Ukraine 2022, Russia-Ukraine War, China, Transportation Industry.

1. Introduction

The complex tapestry of international relations often weaves unexpected connections between seemingly distant nations, fostering ripple effects that extend far beyond their immediate borders. One such intricate nexus has emerged with the Russia-Ukraine conflict, a geopolitical confrontation that has reverberated across global landscapes, including the realm of transportation.

This paper will use quantitative analysis to analyze the impact of the Russian-Ukrainian war, which officially broke out in 2022, on China's transportation industry. The historical data on China's transportation industry securities will be used in the ARIMA model. This article will use historical data from 2012 to February 2022 to predict the closing price trend of China's transportation industry securities without the impact factor of the Russian-Ukrainian conflict and compare them with their actual closing prices.

2. Literature Review

2.1. Russo-Ukraine Conflict

In 2014, the Donbass war broke out between Ukraine and pro-Russian forces.

In February 2022, Russia recognized the two republics established in the Udon region by pro-Russian armed forces in eastern Ukraine in 2014 as independent countries and established diplomatic relations with them.

On February 24, 2022, Russia used missiles and air strikes to attack the entire Ukraine, and the war broke out in full swing.

At present, this war has caused the casualties of more than 30,000 civilians and the death of more than 30,000 soldiers [1].

As the war progresses and countries around the world attack Russia from a humanitarian perspective, the European Union and the United States have successively announced economic sanctions against Russia. Its actions include, but are not limited to, closing stores in Russia and suspending imports of energy and goods from Russia.

2.2. Sanction Imposed to Russia

China and Russia are geographical neighbors. Russia is an indispensable crude oil and natural gas supplier to China.

The connection between China and Ukraine is based on the Belt and Road Initiative (BRI). BRI is a Chinese project to promote trade exchanges with the world and has 6 main routes, among which the New Eurasian Land Bridge (NELB) is closely related to Ukraine because Ukraine is the bridge connecting China and Europe.

China's loan to Ukraine is estimated at 7 billion US dollars, mostly for building infrastructure. China may regard the three countries of Ukraine, Belarus and Russia as a whole in terms of disclosing information on lending [2].

From China's perspective, the Russo-Ukrainian war is seen as a reference point for the cost of a war in China. On the one hand, China compulsively encourages exports to reduce the impact of sanctions Russia has received, and on the other hand, encourages exports to stimulate the economy [3].

2.3. International Conditions of China and Energy

In 2021, 68% of westbound traffic and 82% of eastbound traffic in China-Europe overland trade will pass through Russia [4]. In regard of Russian Invasion of Ukraine, China's attitude is to oppose any illegal unilateral sanctions. In the implementation of economic sanctions against Russia, Russia's net export trade will inevitably be affected, which will affect the construction and development of China's NELB along the Belt and Road. By early April 2022, freight volumes from China to Europe have dropped by about 50% compared to pre-war levels [5].

At the same time, China's abstention in the United Nations General Assembly's resolution condemning Russia's aggression against Ukraine led to the international perception that China's stance on the Russia-Ukraine war is biased towards Russia.

Therefore, some countries that originally cooperated with the Belt and Road Initiative will reduce their trade interactions with China because of China's position [6]. At the same time, it will also reduce the investment of countries and organizations that support Ukraine in the construction of the Belt and Road Initiatives.

In conclusion, the current impact of the Russia-Ukraine conflict on China focuses on the analysis of China's political stance on the war and the changes in China's international relations with European countries. Most studies only focus on the short-term negative impact of the weakening of the Belt and Road Initiatives on the transportation industry and list short-term data. However, the data are more like the data support of quantitative analysis, rather than pure quantitative analysis. Moreover, it has been more than a year since Russia invaded Ukraine, and there is little discussion of the long-term impact of this war on China's overall transportation industry.

Therefore, this article will use the closing price data of China's transportation industry securities from 2012 to conduct a quantitative analysis of the impact of the Russo-Ukrainian War on China's transportation industry, compare forecasts and real data, find a reasonable explanation, and provide suggestions to investors and government.

3. Research Design

3.1. Data Source

In order to assess the impact of the Russian Invasion of Ukraine, which officially occurred on February 24, 2022, on China's transportation industry, this paper utilizes the data of closing prices of Transportation Securities (Code 801021) from July 2012 to 2023 from Choice, a financial bond database operated by China Oriental Fortune Corporation.

In order to avoid the impact of regular fluctuations in the securities market and to carry out accurate data analysis, this paper uses three types of data on the closing price of Transportation Securities-

daily data, weekly data, and monthly data. They will serve as three different time series in the analysis. February 24, 2022, is set as the t_0 , the starting point of forecasts.

3.2. ARMA and Stationarity

ARMA models, abbreviated for autoregressive-moving-average models, are used in statistics and economics to forecast the future from historical data and its volatility.

ARMA model (p, q) , where p refers to the order of the autoregressive model and q refers to the order of the moving average model of order, can be written as:

$$R = \epsilon_t + \sum_{i=1}^p \varphi_i X_{t-i} + \sum_{i=1}^q \theta_i \epsilon_{t-i} \quad (1)$$

R is return; ϵ_t is white noise; φ_i is the random variable; θ_i is parameter of the model; ϵ_{t-i} is white noise error terms.

ARMA models are based on the stationarity of the time series—only stationary time series is applicable for the ARMA model. A time series is said to be stationary with two properties:

$$\gamma_0 = \text{Var}(X_t) \quad (2)$$

$$\gamma_{-k} = \gamma_k \quad (3)$$

γ is covariance; Var is variance; X_t represents the time series. Equation (3) refers that the covariance of itself and the covariance of lag k only depend on the time interval k .

3.3. Weak Stationarity Test

To test the stationarity of the three time series, ADF (Augmented Dickey-Fuller) test in STATA is applied. The test is based on the formula:

$$y_t = c + \beta t + \alpha y_{t-1} + \sum_{i=1}^p \phi_i \Delta Y_{t-i} + e_t \quad (4)$$

The null hypothesis (H_0) of the test is the that the time series is not stationary. The table (Table 1) below is the result of ADF test of the three time series—daily data, weekly data, and monthly data of closing prices of Transportation Securities in China. All raw data, first order difference of the raw data, and second order difference of the raw data are tested of stationarity using STATA.

Table 1. Weak stationarity test

		t	p
	Daily		
Raw		-1.759	0.7242
1st order difference		-33.474	0.0000
2nd order difference		-56.995	0.0000
	Weekly		
Raw		-1.754	0.7265
1st order difference		-14.805	0.0000
2nd order difference		-25.844	0.0000
	Monthly		
Raw		-2.118	0.5359
1st order difference		-7.177	0.0000
2nd order difference		-11.954	0.0000

From the results, the p-values of the raw data of the three different time series is greater than the significance level 0.05. The H_0 cannot be rejected so that the raw data of the three time series are not stationary. It shows that the closing prices of Transportation Securities in China from 2012 to 2022 are not stable, making it not applicable for ARMA model to provide reliable forecast of future prices.

On the other hand, the p-values of first and second order differences of the three time series is infinitely closer to zero, showing that the first and second order differences of the time series is stationary, leading the direction of this paper to utilizing ARIMA model.

3.4. ARIMA Model

ARIMA model, abbreviated for autoregressive-integrated-moving-average model, is an improved form of ARMA model for non-stationary time series.

ARIMA model has three parameters. Besides p and q from ARMA, the added parameter d refers to the degree of differencing, the number of times the past data have subtracted to make the data fit.

From Table 1, both the first and second order difference of the raw data of three time series are stable. The table set the d of the weekly data to be 1 and the d of both the weekly and monthly data to be 2.

4. Outcome of Estimation and Data analysis

4.1. ARMA (p , q) Identification

The order of the autoregressive model (p) and the order of the moving average model (q) are determined by the PACF (Partial Auto-Correlation Function) graph and the ACF (Auto-Correlation Function) graph, respectively, generated by STATA using the time series data.

Below is the figure (Figure 1) of the PACF and ACF graphs for the first order difference of the daily data, second order difference of the monthly data, and second order difference of the monthly data, respectively.

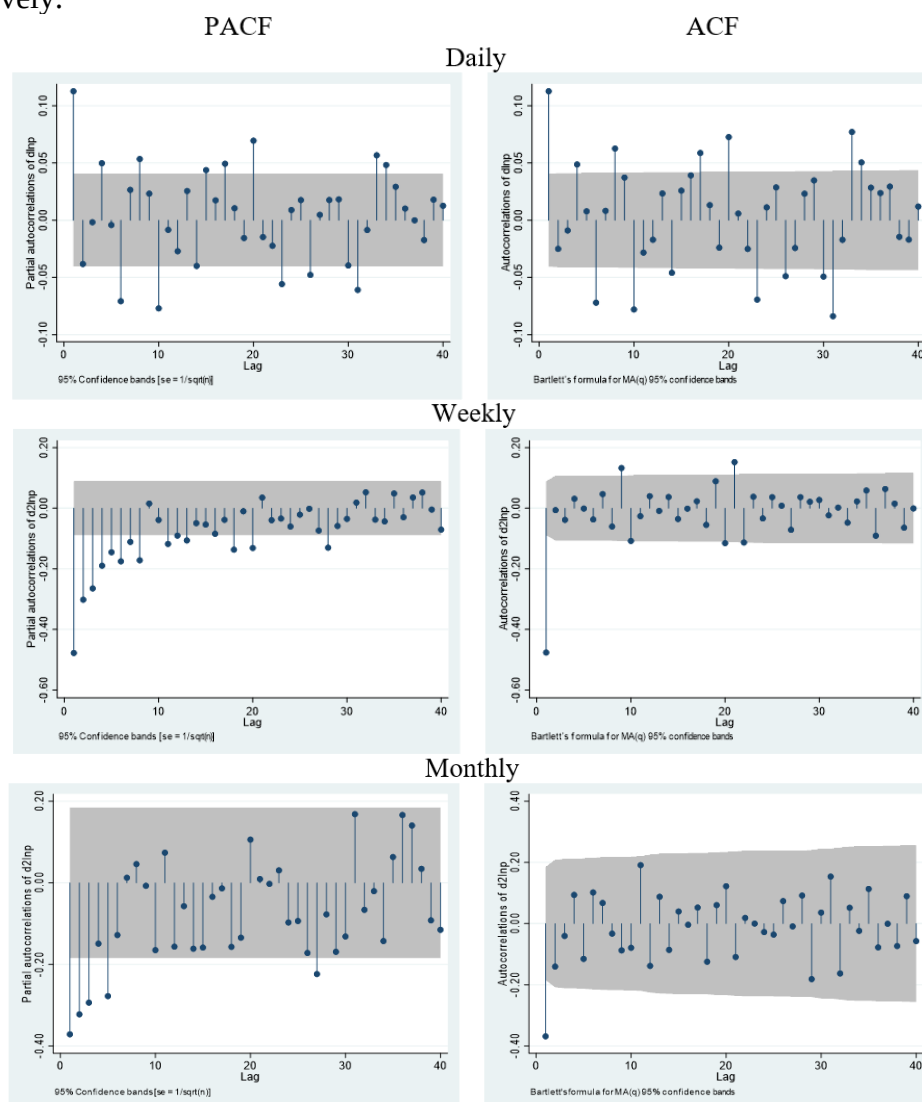


Figure 1. ARMA (p , q) identification, Photo credit: Original

Figure 1 represents the relationships between the confidence interval and the values of p and q . The grey area is the cut-off area for the identification of p and q —the values whose blue dot is not within the range of the grey are accepted for the parameters, p and q . Also, usually the p and q who are greater than 10 will not be selected for the ARMA model since the greater the p and q are, the less accurate the forecast are.

From Figure 1, the p and q of the first order difference of the daily data of closing prices of Transportation Securities are set to be 10 and 10; the p and q of the second order difference of the weekly data are set to be 8 and 1; the p and q of the first order difference of the monthly data are set to be 5 and 1.

4.2. Residual Test

After determining the parameters (p , d , q) of the ARIMA models of all daily, weekly, and monthly data, it is important to test the validity of the models. The residual test using STATA is being used to test the validity.

A time series X_t is said to be white noise if X_t is sequence of identically distributed random variables with limited average and covariance. The null hypothesis of the residual test is that the residual is white noise, meaning the model is qualified. The table below (Table 2) is the results of the residual tests of all daily, weekly, and monthly data.

Table 2. Residual test

Model	Portmanteau (Q) statistic	Prob > chi2
Daily-ARIMA(10,1,10)	52.6115	0.0874
Weekly-ARIMA(8,2,1)	50.7342	0.119
Monthly-ARIMA(5,2,1)	35.0041	0.6944

From Table 2, the p-values of the three time series are all greater than 0.05. The null hypothesis cannot be rejected so that the validities of the ARIMA models of the three time series are qualified. The models with the set parameters are valid to forecast the future prices of China's Transportation Securities.

4.3. Results Presentation and Explanation

Using the ARIMA model, the results using the historical data of the closing prices of Transportation Securities in China to forecast the future prices of Transportation Securities can be generated by STATA.

The figure below (Figure 2) shows the comparison between the actual value and the fitted (predicted) value of the daily data of China's Transportation Securities.

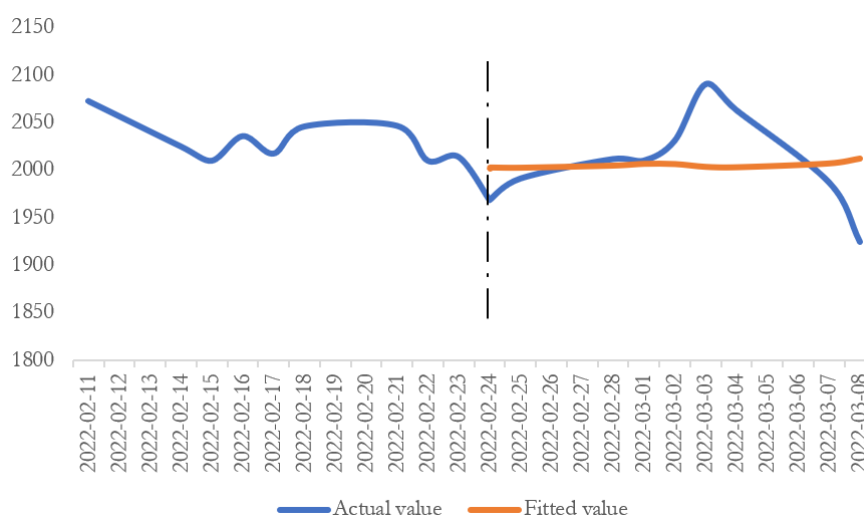


Figure 2. Actual value and fitted value, daily, Photo credit: Original

In Figure 2, the horizontal axis represents the date; the vertical axis represents the price of China's Transportation Securities (unit: Chinese Yuan); the blue line and orange line represent the actual price and predicted price of China's Transportation Securities. The p of the daily model is 10, so the model is able to predict the prices 10 days after February 24, 2022.

The percentage of difference, the average of 10 days' differences between the actual and predicted prices divided by the average of the fitted values, is -0.03%.

From Figure 2, there is no huge difference between the actual and predicted prices of China's Transportation Securities. It means that within a short period (about 1 week), China's transportation industry has not been greatly affected by Russia Invasion of Ukraine occurred in February 24, 2022.

The figure below (Figure 3) shows the comparison between the actual and predicted prices of the weekly data of China's Transportation Securities. The p of the weekly model is 8, so the model is able to predict the prices 8 weeks after February 24, 2022.



Figure 3. Actual value and fitted value, weekly, Photo credit: Original

The percentage of difference is -6.90%.

From Figure 3, it shows a plummet of the actual price of China's Transportation Securities in March 2022 and a remarkable difference between the actual and predicted prices. The results from the weekly model indicates that Russian Invasion of Ukraine has a negatively huge impact on China's transportation industry in 1-month period.

The figure below (Figure 4) shows the comparison between the actual and predicted prices of the monthly data of China's Transportation Securities. The p of the monthly model is 5, so the model is able to predict the prices 5 months after February 24, 2022.

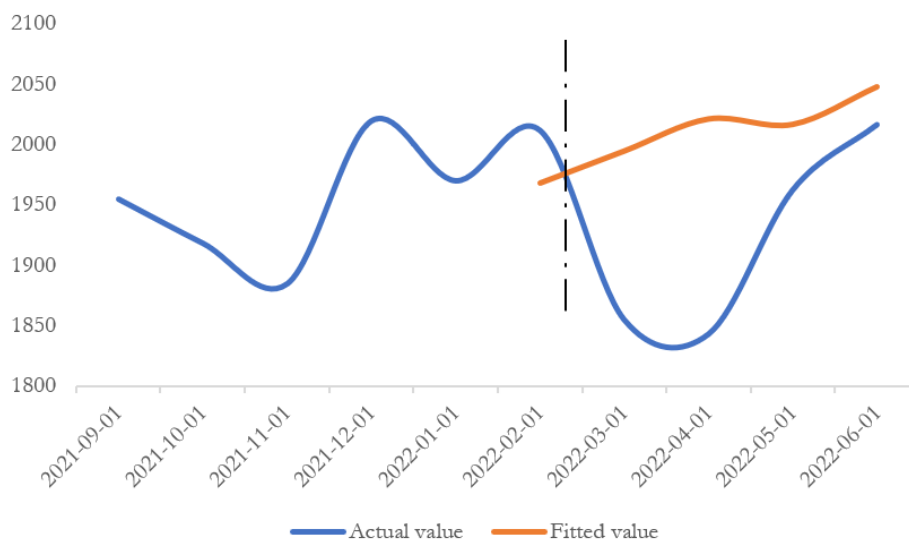


Figure 4. Actual value and fitted value, monthly, Photo credit: Original

The percentage of difference is -3.59%.

From Figure 4, it displays a narrowing gap between the actual and predicted prices of China's transportation industry in May and June 2022. The monthly model illustrates that although there is remarkable plummet of the prices of Transportation Securities in a short period, the impact of Russian Invasion of China has diminished about 2 months after the war occurred. The difference between the actual price and predicted prices in June is small and there is a trend of the converging gap.

In conclusion, the impact of Russian Invasion of Ukraine to China's transportation industry has not shown in a very short period (about 1 week). The market does not react corresponded to the war until 1 weeks after the war occurred. After a huge drop of the prices of China's Transportation Securities in a relatively short period (about 8 weeks), the transportation industry recovers from the war and shows a re-flourishing trend.

5. Discussion

From the results of the models, Russian Invasion of Ukraine is a shock to Chinese transportation industry. There is a one-week lag in the transportation industry's reflection of the negative impact of the war. The reason accounts for the negative impact might be that the increased prices of gasoline due to the war and Russia's terminating oil supply increases the cost of transportation and possibly decreases the demand. On the other hand, the price of transportation from the suppliers' side cannot be increased in a short period, thus the war is the bad news to the transportation market.

The reason accounts for the lag response of decreasing prices might be that dependence of Chinese transportation industry to Russian oil is not heavy since China has its own oil supply and many other oil imports countries. Transportation oil consumption accounts for about 25% of yearly total oil consumption [7]. China has nearly 200 million tons of crude oil production, and China's crude oil self-sufficiency rate is 27.8% in 2022 [8]. Not only is China relatively self-sufficient in oil supply, but China's dependence on Russian oil imports is also not heavy. The Middle East has always been the main region for China's crude oil imports, accounting for 50.84% of the total imports, while Russia's oil imports accounted for 17% [7].

The delay and quick recovery in the decline in the prices of securities in the transportation sector demonstrates the importance of national energy self-sufficiency in the tense moments of war.

When European and American countries-imposed sanctions on Russia, a major energy exporter, countries around the world also realized the importance of reducing energy dependence on Russia. Among them, the use of clean energy instead of oil and other energy is an important way. For example, national renewable energy generation increases by 9 percent in 2022, with half of the new capacity coming from China [9].

China is rich in mineral resources, important minerals for the green industry. China is a top five producer of aluminum, steel, lithium, silicon, and titanium [10]. These are China's advantage in this turmoil in international relations. However, the disadvantage is that China's unstable international relations with the United States and various regions will limit China's energy exports [11]. For example, 80% of REE used in the United States is imported from China [12], and due to the occurrence of the Sino-US trade war, the export of REE may be restricted [11].

Therefore, China can use its rich mine resources to try its best to develop new energy sources and further increase the national energy self-sufficiency rate. At the same time, the government can further optimize international relations with other countries and promote the export of new energy raw materials.

The result from the model shows that the negative impact of the war does not maintain a long time, although there was a remarkable drop in securities prices. When facing bad news and shock to the market, investors can be deliberate and not overly panicked by sudden short-term changes.

6. Conclusion

Using the prices of China's Transportation Securities as the index of assessing the Chinese transportation industry, this paper uses ARIMA model to forecast the prices of Transportation Securities after the occurrence of Russian Invasion of Ukraine, from the historical data and volatility. The model uses three types of data-daily data, weekly data, and monthly data- and is able to forecast the prices 5 months after the war. From the results of estimation and the comparison between the actual and fitted values of securities price, it is safe and sound to conclude that the war is a short-term shock (from 1 week to 8 weeks after the war) to the transportation industry. On the other hand, the market re-flourished soon because of the low correlation between the war and Chinese transportation industry. China is relatively sufficient with its own oil supply. The imports oil does not mainly come from Russia and only a quarter of it is used in the transportation industry. This result shows the importance of abundant energy supply in a country. Suggestions to Chinese government include promoting green energy sources exports and improving international relationships; suggestions to investors include investing green energy and do not overreact confronted with short-term bad news in the market.

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