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Empirical Valuation of Relationship between Freight Index and Economic Performance

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Abstract

The index method is significant among the individual methods of scientific research. This work intends to develop ways to analyze the usage of transport indices as indicators of the character of market activity in logistical infrastructure at different levels. Transport indices only developed in the past decade; nevertheless, they have already developed a large degree of diversity. This makes systematization, classification, and identification of their distinguishing features all necessary.

By their nature, freight indices are largely similar to stock market indices, in that they both show the average changes in some observed phenomenon, and that they both aim to describe the general changes in a process involving many factors. The authors propose a transport index classification with freight indices set aside in a separate group, depending on their intended applications and possible uses.

As a result, based on the empirical analysis of the transport index and the stock market index, the level of interconnection between logistical infrastructure and market activity in the Russian economy has been defined, by applying the GARCH model. On the other hand, applying this methodology to the USA's statistical transport index and stock market index gave no results. This once again confirms the necessity of setting freight indices aside in a separate group, as well as the futility of performing analytical procedures with statistically heterogeneous indexes.

Key words: transport logistic infrastructure, freight index, economic performance, GARCH-model

Introduction

This article aims to research the nature of transport indices, revealing the limits of using such indices in analytical operations when studying the distinctive correlations between logistical infrastructure and the infrastructure of the national economy at large, using Russia's example as the basis of study. The empirical results have shown that contradictory results can come about when analyzing the interconnectedness of quasi-freight indices and statistical indices. We use the term "quasi-freight" indices to indicate indices of a cost-based nature, but which do not form in the process of market trading. This article also attempts to explain these kinds of contradictions in the case of Russian and American indices.

Although the topic of transport indices is relatively new in recent years (2011-2013), there is a noticeable surge of interest in it; in the case of a drop in profitability in the field of transport (Lee, Lun, Yan, 2013), transport indices are seen as a universal mechanism for hedging risks (Drobetz, Richter, Wambach, 2013; Angelidis & Skiadopoulos, 2008). A number of modern authors' works concern the issue of predicting transport indices as a basic indicator for the field of transport (Goulielmos & Psifia 2011). The work of Kavussanos & Dimitrakopoulos (2011) is especially noteworthy for using the GARCH model (Bollerslev, 1986; Engle, 2002) in their research of freight indices. This is the same methodology we have used in our research.. Erdogan, Tata, Karahasan, Sengoz, (2013) have also studied the interactions between transport and stock indices and found evidence of correlation.

It must also be noted that, despite the wide variety of indices, most of this work has been devoted to the Baltic Dry Index and other indices of the London-based Baltic Exchange. This aside, no other territorial indicators (from which country the index originates and how this influences its interaction with stock market indices and other indices around the world) have been taken into account.

The second section of this article examines different types of transport indices, classifies them, assigns quasi-freight indices to a separate group, discusses their distinct formation, and examines an econometric methodology for analyzing them. The third section provides and discusses the statistical results of the research. The fourth section analyzes the results and the contradictions which arose, and makes an attempt to explain them.

Methods

Classification of Indices

The index method is significant among the individual methods of scientific research. Today, a multitude of indices have developed which characterize the various aspects of economic activity on the macro level as well as the micro level. This article is devoted to developing a way to use transport indices

analytically, as indicators of the state of market activity in the logistical infrastructure of various levels of economic system.

An index is defined as a general relative indicator which characterizes changes in the level of social activity across time, as compared to a plan, prediction, or program of development. Correspondingly, a transport index is a relative indicator which characterizes the level of market activity in logistic infrastructure.

Transport indices have only developed in the past decade; nevertheless, they have already developed a large degree of diversity. This makes systematization, classification, and identification of their identifying features all necessary.

By their nature, freight indices are largely similar to stock market indices, in that they both show the average changes in some observed phenomenon, and that they both aim to describe the general changes in a process involving many factors. In addition, there are indices which represent both a transport and a stock market index at the same time; for example, DJ Transportation is considered to be a stock market index of the cost of a transport enterprise's shares. Another argument for the similar nature of transport and stock market indices is that a number of transport indices are calculated based on the price of a freight transport contract. The contract is fixed as a result of stock market trading, and, subsequently, the indices are determined together. Therefore, a number of transport as well as stock market indices can be used as assets for financial derivatives. Keeping this in mind, transport indices can be divided into three groups: statistical indices, which play a considerable role in state statistics; stock market indices; and freight transport indices, which are calculated according to market values and volume of freight. A summary of this classification is given in Table 1.

In addition, freight indices can be further divided into proper freight (indices which form as a result of stock market trading and which are based on freight rates) and quasi-freight, which form are based on freight transport cost indicators. The Russian Cargo Index examined in this article is an example of a quasi-freight index. In Russia, there is no freight market, and no proper freight index can form. The Cargo Index is the first transport index in the country. It is calculated according to railway transport, since this is the main mode of transporting freight in the country.

The cargo index is based on data about the loading of nine freights. These nine freights make up 75% of Russian railway transport. To switch from indicators of volume to indicators of cost, the loading data is weighed on a coefficient reflecting the freight enterprise's revenue in relation to non-financial sectors of the economy.

Table 1. *Classification of Transport Indices*

№ п/п	Transport Indices			
1.	Category of Index	Indices of Official Statistics	Stock Market Indices	Indices of Freight Transport
2.	Information Recorded	Official statistic information about freight transports	Value of a transport enterprise's shares and capital	Price and volume of freight transport depending on mode of transport, distinctive features of freight, route
3.	Distinctive Features of Calculation	Calculated in relation to GDP or on the basis of official state freight statistics	Calculated based on a synthetic portfolio of a transport enterprise's shares	Calculated based on volume of freight weighed according to market value
4.	Goals of Utilization	Evaluate a transport enterprise's contribution to the national GDP	Evaluate the profitability of investment in a transport enterprise	Evaluate market activity in the transport service market; analyze costs of managing logistical systems; satisfy demand for derivatives, where the underlying asset is the spot rate; provide transport companies the opportunity to hedge risks
5.	Example	Transportation Service Index (USA); Index of Inland Freight Transport Volume Relative to GDP (EU); Indice de production de services de transports (France); Welsh Index of Transport, Storage and Communication (UK); Index figures traffic density (Netherlands)	DJ Transportation (USA)	Baltic Dry Index (UK) China (export) containerized freight index (China) Canadian General Freight Index (Canada) Cass Freight Index (USA) Cargo Index (Russia)

Methodology of Empirical Analysis

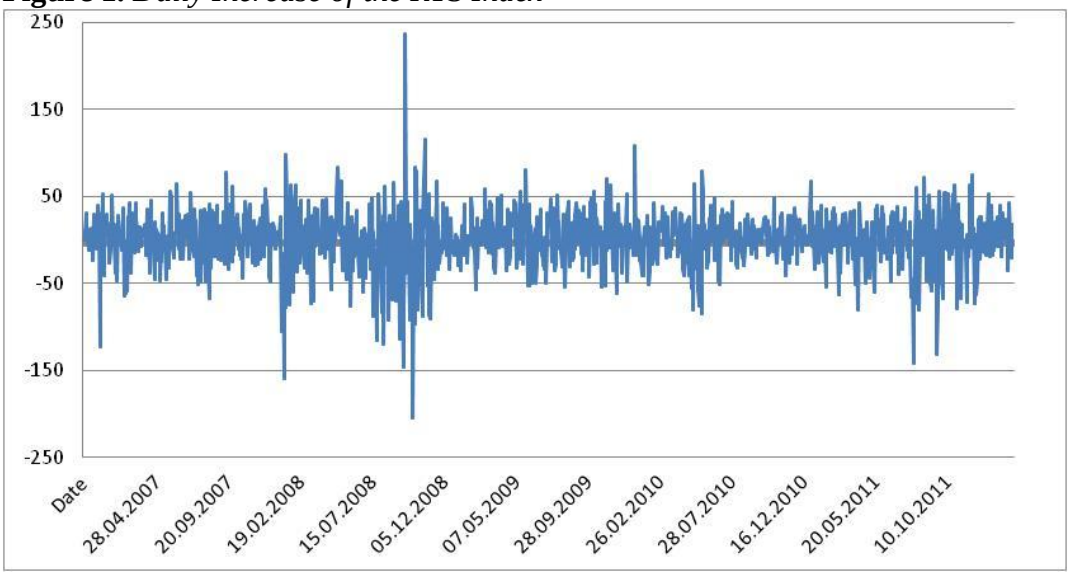
As Table 1 shows, freight transport indices and stock market indices are most similar in an economical sense; they can thus be compared and used to analyze the extent of correlation between the market activity of logistic infrastructure and the national economy at large. To measure the extent of correlation, we looked at data from the RTS (Russian Trading System) index as an indicator of Russian market activity; we also looked at data from the Cargo Index as the only Russian transport index and, therefore, the indicator of Russian logistical infrastructure's market activity. Based on these indices, we constructed a generalized autoregressive conditional heteroskedasticity model (GARCH(1,1)). GARCH models have dominated economic literature since the second half of the 1980s, and are widely used for empirical evaluations of correlations between economical processes expressed by means of a time series.

In essence, the model is as follows. Let y_t be a regression function of one time series in relation to other time series, where every series is assumed to meet the stationary condition:

$$y_t = x_t'\beta + u_t \quad . \tag{1}$$

This means that observations with large and small deviations from the average will have a noticeable tendency of clustering (Figure 1). In other words, the time series (RTS) oscillates between periods of calm and turbulence.

Figure 1. *Daily Increase of the RTS Index*



The model expresses the clustering of turbulent moments by having the error variance u_t be dependent on previous occurrences:

$$\sigma_t^2 = \alpha_0 + \alpha_t u_{t-1}^2 + \cdots + \alpha_p u_{t-p}^2. \quad (2)$$

A more generalized model for an equation of error variance was proposed in (Bollerslev, 1986):

$$\sigma_t^2 = \alpha_0 + \alpha_t u_{t-1}^2 + \cdots + \alpha_p u_{t-p}^2 + \gamma_1 \sigma_{t-1}^2 + \cdots + \gamma_p \sigma_{t-p}^2. \quad (3)$$

Now, we will look at the connection between the RTS index (Figure 2) and the Cargo Index (Figure 3). Remember that the RTS index is our indicator of market activity in the Russian economy and the Cargo Index is our indicator of transport market activity.

Figure 2. *Monthly values of the RTS index from January 2006 to November 2011*

Figure 3. *Monthly values of the Cargo Index From January 2006 to November 2011*

Since the starting time series of both indices is not stationary, we must make a logarithm of the growth rate of the RTS and the Cargo Index in order to fulfill the stationary condition. Let X_t be the difference of the two indicators' natural growth-rate logarithms:

$$X_t = ln\frac{IRTS_t}{IRTS_{t-1}} - ln\frac{CI_t}{CI_{t-1}}, \quad (4)$$

where $IRTS_t$ is the value of the RTS index at t point in time, and
CI_t is the value of the Cargo Index at t point in time.

Then, the model aligning the growth rates of the two indicators will be:

$$\Delta X_t = const + \mu X_{t-1} + \varepsilon_t\ , \quad (5)$$

where $\Delta X_t = X_t - X_{t-1}$. (6)

The parameter μ signifies the speed at which the growth rates of the RTS index and Cargo Index align, and also indicate the extent of integration of the two time series.

Results

The GARCH (1,1) model evaluation of RTS and Cargo Indices was performed on the interval from January 2006 to November 2011, and gave the results displayed in Table 2.

Table 2. *Results of GARCH(1,1) model evaluation of the RTS index and Cargo Index*

	Value	Standard Error
Const	0	0,0071
μ	-0,8386	0,0583
R-squared	0,7579	-
Instances Observed	68	-

The value μ gives evidence for the interconnectedness between the market activities of logistic infrastructure and the Russian economy. In addition, during a change in market tendencies, this connection is inversed for a short-term period. This means that, when market activity decreases in the economy at large, market activity in logistic infrastructure begins to decrease as well, with a lag of about 1 month.

To avoid being limited to a regional aspect, and see how the proposed methodology works with other indices, we decided to study the correlation between American indices: Dow Jones Industrial and Transportation Services Index, monthly data from January 2004 to June 2011. Complicating the task by using a statistical index, the results are given in Table 3.

Table 3. *Results of GARCH(1,1) model evaluation of the Dow Jones Industrial Index and Transportation Services Index*

	Value	Standard Error
Const	0	0,0011
μ	0	0,0273
R-squared	0,04	-
Instances Observed	88	-

The results can not be considered satisfactory. Research has shown an absence of correlation between indices. In the authors' opinion, this is somehow connected with the statistical nature of the data. Stock market indices and statistical indices are formed by fundamentally different processes based on characteristically different kinds of information. Stock market indices are formed based on stock market trading. Meanwhile, statistical indices are comparatively relative quantities which characterize changes in complex socio-economic statistical indicators in time, space, and comparison to the norm. The heterogeneous nature of the indices researched is the reason for such contradictory results.

Discussion

The results we have achieved add to the body of work focusing on the interactions of freight and stock market indices. Similar research has been carried out by Erdogan, Tata, Karahasan, Sengoz, (2013). The difference is that the above-mentioned authors were studying correlations between stock market indices and proper freight indices formed by different financial institutes in different countries. Nevertheless, Erdogan, Tata, Karahasan, Sengoz, (2013) found evidence of a positive correlation between those indices.

We also studied a stock market and quasi-freight index and found evidence of a positive correlation. In addition, the interaction of the stock market and statistical indices was studied, and we found no evidence of correlation at all. Certainly, nobody could claim that there is no connection between the functions of logistic infrastructure and economic performance in the national economy; we believe that the whole problem is due to the heterogeneous nature of the indices used in our calculations.

We have determined that, when performing analysis, it is necessary to consider the economical and statistical basis of the indices being used. When using fundamentally heterogeneous indices, the final result is predictably unsound.

One may also note that the most logical and objective empirical result can be achieved through comparing stock market indices and proper freight indices. Researchers may find themselves limited here. There exist an incredibly limited amount of freight markets in the world. They don't exist in several developed countries, not to mention the developing world. In particular, the authors themselves encountered this limitation, and were forced to use a

quasi-freight index. Nevertheless, it was this circumstance that provided the opportunity to correct the classification of transport indices and reveal a new subcategory: quasi-freight index.

Conclusion

We have classified transport indices, bringing them together into three groups, and we have introduced a new subcategory, the quasi-freight index. We further demonstrated the importance of using statistically homogeneous indices in empirical analysis. We also found a positive correlation between stock market and quasi-freight indices in Russia.

In the future, we plan to research the possibility of using quasi-freight indices in portfolio performance evaluation and determine if there are any connections between the different kinds of freight indices.

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