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Examining the Impact of Movements of the Commodity Price on the Value of the Baltic Dry Index during Covid19 Pandemic

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Abstract

The Baltic Dry Index (BDI) is one of the most well-known indices, as it is perceived as a leading indicator of economic activity. Reductions in the movement of people, commodities, and capital in the conditions of economic crises, such as the one in 2008 and 2009, as well as the current economic crisis generated by the COVID-19 pandemic, were affected by the reduction of economic activities. It is interesting to point out that the analysis of the basic trend of the BDI movements in the period before the economic crisis shows that the index fell to near record lows just before the derivatives and credit crisis hit stocks full force. This is a clear signal that the index can be used as a tool for stock market forecasting. The paper aims to examine whether the changes in these raw materials affect the changes in the value of BDI. For these purposes in the paper was use GMM and 2SLS estimator. The results show that different raw materials have a different impact on the value of the BDI, which indicates that based on individual movements value of raw materials which composes the BDI cannot forecast its movement.

Keywords: The baltic dry index, COVID-19 pandemic, Economic crises, Commodities, GMM and 2SLS estimator.
JEL Classification: C01, C22, C24, G01

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Contribution of this paper to the literature
This study contributes to the existing literature by revealing that different raw materials have a different impact on the value of the BDI, which indicates that based on individual movements the value of raw materials which composes the BDI cannot forecast its movement.

1. Introduction

The Baltic Dry Index (BDI) is one of the most well-known indexes, as it is perceived as a leading indicator of economic activity. The reason for this lies in the fact that it reflects changes in supply and demand for imported raw materials used in manufacturing. For that reason, the prevailing view in professional and academic circles is that changes in values of this index are a good indicator of future global economic activities (Faqin & Sim, 2013). Although it should be noted that the BDI is not the only dry bulk index available; it derives its popularity from the fact that is the most comprehensive index (for details see Precision trading systems, 2013). Additionally, it derives its popularity from the fact that real-time indicator that is difficult to manipulate, since it is driven by clear forces of supply and demand (Hassan, Sanchez, & Yu, 2011).

The BDI is defined as a daily weighted average freight price to ship raw materials across the globe to be used in the production process. Therefore, it incorporates aspects of the future economic activity and thus has the characteristics of a leading economic indicator (Papailias, Thomakos, & Liu, 2017).

More precisely, the BDI is a benchmark for the price of moving the major raw materials by sea. In other words, it is an index that measures changes in the cost of transporting various raw materials, which is transported by sea. The creator of the index, the Baltic Stock Exchange based in London, describes it as the index of average prices paid for the transport of dry bulk materials for 26 different shipping routes carrying coal, iron ore, grains, and many other commodities. It consists of three sub-indices: Capesize, Panamax and Supramax. They measure different sizes of dry bulk carriers or merchant ships.

Given the above, it is not surprising that this index is often referred to as a shipping and trade index. The basic characteristic of the index is reflected in high volatility. Numerous researches testify to this. There are several reasons for this. The first is that the supply of large carriers by sea is quite small with long lead times and high production costs, while on the other hand, the demand for the transport of raw materials is determined by the level of economic activity, which is ultimately determined by the price of raw materials and their supply and demand. Hence, the volatility of the raw material market also affects the volatility of this index.

Reductions in the movement of people, goods and capital in the conditions of economic crises, such as the one in 2008 and 2009, as well as the current economic crisis generated by the COVID-19 pandemic, were affected by the reduction of economic activities. It is interesting to point out that the analysis of the basic trend of the BDI movements in the period before the economic crisis shows that the index fell to near record lows just before the derivatives and credit crisis hit stocks full force (see UNCTAD (2009)). This is a clear signal that the index can be used as a tool for stock market forecasting. The decrease in economic activity affects the increase in price volatility in the commodity market. Price volatility is the main characteristic of commodity markets. The reasons for commodity price volatility differ by commodity and may change over the course of time. But in general, low short-term elasticities of supply and demand cause any shock to production or consumption to translate into significant price fluctuations (Mayer, 2010). The outbreak of COVID-19 has been accompanied by widespread declines in global commodity prices (Bank, 2020). In such conditions, it is expected that these changes affect the decrease in the value of BDI. In order to examine whether the changes in these raw materials affect the changes in the value of BDI, and to what extent they affect, the paper analyzes the impact of changes in the value of basic raw materials on the change in the value of the BDI. In other words, the aim of the paper is to examine the relationship between the BDI and the major raw materials, whose freight price enters the calculation of the BDI.

The paper is structured as follows. The first part of the paper is of introductory character. The second part of the paper gives an overview of the most significant empirical researches which deal whit this issue and presents the results of previous research in this field. The third part of the paper provides a brief description of the analyzed data and the methodology used. In the next sector, the results were presented, analyzed and discussed. The final part of the paper is of a concluding character, and it summarizes the findings and outlines the conclusions of this study.

2. Literature Review

In literature there is an abundance of papers dealing with the BDI, that can be classified into two groups: the first group consists of papers which are focusing on the development of more reliable procedures and models to predict changes in freight rates. The development of various models is caused by fact that risk and uncertainty in the shipping market have increased dramatically. It is interesting to note that maritime freight rates fell on average by 50% while global trade increased 400% from 1870 to 1913 (Jacks & Pendakur, 2010). The first one who tries to design a good model for forecasting freight rates was Driehuis (1970). Similar attempts were made by Marlow and Gardner (1980) and (Beenstock & Vergottis, 1989a; Beenstock & Vergottis, 1989b). Cullinane, Mason, and Cape (1999) apply the Box-Jenkins approach to forecast the movements of the Baltic Freight Index (BFI). More recently, Makridakis, Merikas, Merika, Tsionas, and Izzeldin (2020) presented a new model for predict changes in freight rates and apply it to the BDI. The findings were reported by them to show that the new model was very successful in forecasting the BDI movement. Thalassinos, Hanias, Curtis, and Thalassinos (2013) use the False Nearest Neighbors (FNN) method to forecast the BDI. While Tsioumas, Papadimitriou, Smirlis, and Zahran (2017) used a multivariate Vector Autoregressive model with exogenous variables (VARX). Zeng, Qu, Ng, and Zhao (2016) developed a new forecasting approach, in literature knows as the Empirical Mode Decomposition (EMD). Their approach is based on Artificial neural networks (ANN). Geman and Smith (2012) investigated the BDI and suggested several diffusion models able to capture the unique features of its trajectories, such as large swings and high volatility.

The second group includes the papers which are examining the relationship between the BDI and various microeconomic, macroeconomic indicators and commodities. Tsioumas and Papadimitriou (2015) investigate the lead-lag relationship between China's steel output and various Baltic Exchange indices and conclude that there is a significant causality effect of Chinese steel production on the dry bulk freight market. Similar results were presented by Tsioumas and Papadimitriou (2016). Their results provide evidence in favour exist significant causality between certain commodity prices and the freight rates of bulk carriers.

A significant part of these papers focuses on testing the hypothesis that the BDI functions as a signal that promptly responds to crisis effects. These papers focus to analyze the BDI as a supply and demand signal on the stock market. So, Faqin and Sim (2013) examined the link between the BDI, as a proxy for trade and income improvements for the 48 least developed countries. Since the trade is endogenous in the determination of income levels, they used the BDI as a proxy for trade and developed a new measure of trade cost as an external source of variation in trade, which in turn is used to construct the within-country estimate of the causal effect that trade has on the income of the least developed countries. They found that a reduction in the BDI has a positive effect on the income of least developed countries through the trade channel. 1% expansion in trade raises GDP per capita by approximately 0.5 percent on average. This estimate is much larger than previously found in the literature and its quantitative significance emphasizes the importance of trade towards the economic development of low income countries (Faqin & Sim, 2013). Papailias et al. (2017) found that variations in BDI are strongly associated with fluctuations in commodity markets, such as coal, steel, iron, corn, and wheat markets. They also showed that it is possible, by applying trigonometric regression, to improve forecasting in BDI movements, and thus movements at commodity markets. Similar studies were conducted by Adland and Cullinane (2005); Koekebakker, Adland, and Sødal (2006) and Batchelor, Alizadeh, and Visvikis (2007). They studied the BDI series as a whole rather than analysing the spot or forward rates separately. Lin and Sim (2013) examined the relationship between the BDI and trade in Sub-Saharan countries. Also, they investigated the impact of the BDI on the transitory negative income shocks. They found that there is a strong relationship between the BDI and trade and the impact of the BDI on the transitory negative income shocks. The seasonal properties and forecasting in the dry bulk shipping sector were the subject of researches in the studies were conducted by Cullinane et al. (1999); Kavussanos and Alizadeh-M (2001) and Kavussanos and Alizadeh-M (2002). The results of these authors imply that a considerable proportion of the BDI variation can be predicted by a combination of explanatory factors and the cyclical pattern that exists in the series. Kavussanos and Nomikos (1999); Kavussanos and Visvikis (2004) studied the relationship between freight futures and spot prices. In the study, they used the VAR and the VECM models. Kavussanos and Visvikis (2004) and Kavussanos, Visvikis, and Menachof (2004) utilize co-integration analysis to examine the Forward Freight Agreements (FFA) predictability in the Panamax freight market.

Jurun, Ratković, and Moro (2015) examined the relationship between the BDI, as the key indicator of economic and business activities, and the business results of companies, who deal whit sea transport (shipping companies). They have studied the relationship between the BDI and performance excellence of the representative shipping companies. The results of their study show that there is a strong relationship between average annual BDI values, as an indicator of the cyclical nature of the maritime market and results of the business of the representative shipping companies. They studied the business performances of the selected shipping companies. Jurun et al. (2015) used the adjusted Altman Z-score to measure business results. The conclusion of their study is that the BDI represents a good buying or selling signal for certain shares. In other words, it provides a reliable basis for making decisions. They came to this conclusion based on the discovery that it exists a high correlation between short-term (quarterly) average BDI values and a company's business excellence.

All the mentioned papers suggest to possible of endogenous problem.

3. Data and Methodology

As already mentioned, the aim of the paper is to examine the relationship between the BDI and the major raw materials, whose freight price enters into calculation the BDI, such as corn, coal crude oil, iron ore, soybeans, copper, tin, wheat, aluminium, zinc, nickel, gold, rice and lead. The row materials are selected from the aforementioned empirical studies that tend to confirm the link between the BDI and the major raw materials. Data are collected from the official sites Federal Reserve Bank of St. Louis and Bloomberg, for the period between November 1999 and September 2020. For purpose of this study were used monthly data.

For the purpose of this study, it is estimated multiple linear regression model, by using a set of explanatory variables as mentioned above. The econometric model is expressed as the following, to notice that BDI is a dependent variable.

$$BDI = \beta_0 + \beta_1 Cor + \beta_2 Coa + \beta_3 Cru + \beta_4 Iro + \beta_5 Soy + \beta_6 Lea + \beta_7 Cop + \beta_8 Tin + \beta_9 Whe + \beta_{10} Alu + \beta_{11} Znc + \beta_{12} Nil + \beta_{13} Gol + \beta_{14} Ric + \varepsilon \qquad (1)$$

Where *BDI* is the Baltic Dry Index; *Cor* denotes corn pirce; *Coa* expresses the Coal price; Cru is crude oil price; Iro is iron ore; Soy represents Soybeans; Lea is Lead, Cop represents Cooper, Tin represents tin; Whe represents wheat, Alu is aluminum, Znc is zinc, Nil is nickel, Gol represents gold and Ric represents rice; ε is model error.

According to Wooldridge (2003) and Radivojevic and Jovovic (2017) the OLS represents the most efficient estimator. However, it is true if and only if all the assumptions on which it is based are met. Otherwise, it will generate biased/unbiased and consistent/inconsistent estimates (some of these combinations), depending on which assumptions are not met. From the literature review on this subject, we observe that researchers have concluded that this topic might run the risk of endogeneity. The problem of the possible endogeneity of one or more independent variables may be solved using the two-stage Least Square (2SLS) method but have to be a satisfying condition that instrumental variables are not weak. For that reason in the paper, we have employed the 2SLS method. Mladenovic and Pavlovic (2003) warn that the 2SLS generates biased and consistent estimates, usually. In addition, we have used the Generalized Method of Moments (GMM). Unlike other estimators, the main advantage of GMM is that it can be used even when the assumptions of other estimators are not satisfied. Generally speaking, GMM can be viewed as a generalization of many other methods, and as a result, it is less likely to be misspecified (Chaussé, 2010). The GMM generates correct standard errors and p-values, provided that the specified moment conditions are valid. It is based on a simple idea that the estimations of parameters are done by solving a set of moment conditions. For the purpose of this study we are used one-step[1] IV-GMM. Since GMM depends only on moment conditions, it is a reliable estimation procedure for many models in economics and finance, especially for models which suffer from endogeneity problems, because it provides the efficient estimations of instrumental variables, under "orthogonality condition", instrumental variables and error term being orthogonal in the expectation sense (Radivojević et al., 2019).

4. Empirical Analysis and Discussion of Results

Table 1 are shown the results of descriptive statistics of the data set. As can be seen from Table 1, BDI ranges from 306.9 to 10843.65, which indicates a very high disparity between minimum and maximum index values. The very high value of the standard deviation of the BDI testifies to a large fluctuation in the value of this index. It is similar in the case of the value of all commodities. The excess kurtosis is ranging from 4.84, in the case of the BDI index to -1.09, in the case of the cooper. This indicates that the BDI index has a significant leptokurtosis. The skewness of all the commodities and the index is different from zero, which indicates that they have asymmetric distribution. To identify a potential problem of multicollinearity in the next step was conducted an analysis of matrix correlation was. The matrix correlation is presented in Table 2. As can be seen from Table 2,

Table-1. Descriptive statistic of selected variables.

	BDI	**Cor**	**Coa**	**Cru**	**Iro**	**Soy**	**Cop**	**Lea**
Mean	2268.77	164.72	73.21	60.62	67.44	336.30	5332.50	1621.46
Standard Deviation	2027.69	63.74	33.92	26.22	48.01	115.60	2353.37	753.00
Excess Kurtosis	4.84	0.13	0.02	-0.70	-0.61	-0.74	-1.09	-0.86
Skewness	2.14	0.89	0.52	0.43	0.63	0.30	-0.35	-0.23
Minimum	306.90	75.06	24.00	16.55	11.93	158.61	1377.38	412.61
Maximum	10843.65	333.00	195.19	133.88	187.18	622.91	9880.94	3722.61
No. obs.	251	251	251	251	251	251	251	251
	Tin	Whe	Alu	Zin	Nic	Gol	Ric	
Mean	14726.08	184.20	1902.17	1944.61	15341.74	958.33	391.55	
Standard Deviation	7022.54	64.56	414.70	798.11	7751.67	482.84	153.35	
Excess Kurtosis	-1.07	0.08	-0.07	-0.23	4.30	-1.31	1.04	
Skewness	-0.10	0.82	0.77	0.39	1.74	-0.06	0.69	
Minimum	3698.37	90.44	1283.53	748.81	4830.78	260.75	162.10	
Maximum	32347.69	403.81	3067.46	4381.45	51783.33	1971.17	1015.21	
No. obs.	251	251	251	251	251	251	251	

To identify a potential problem of multicollinearity in the next step was conducted an analysis of matrix correlation. The matrix correlation is presented in Table 2.

Table-2. Matrix correlation.

	BDI	**Cor**	**Coa**	**Cru**	**Iro**	**Soy**	**Cop**	**Tin**	**Whe**	**Alu**	**Zin**	**Nic**	**Gol**	**Ric**	**Lea**
BDI	1.00														
Cor	-0.03	1.00													
Coa	0.18	0.76	1.00												
Cru	0.29	0.80	0.79	1.00											
Iro	-0.23	0.82	0.71	0.70	1.00										
Soy	0.01	0.93	0.77	0.81	0.80	1.00									
Cop	0.15	0.80	0.81	0.85	0.79	0.78	1.00								
Tin	-0.09	0.83	0.85	0.75	0.86	0.87	0.88	1.00							
Whe	0.27	0.86	0.71	0.84	0.64	0.85	0.78	0.72	1.00						
Alu	0.55	0.46	0.63	0.69	0.33	0.38	0.76	0.48	0.57	1.00					
Zin	0.15	0.35	0.49	0.45	0.37	0.34	0.76	0.58	0.35	0.73	1.00				
Nic	0.58	0.40	0.40	0.58	0.30	0.33	0.66	0.37	0.52	0.84	0.64	1.00			
Gol	-0.31	0.78	0.67	0.56	0.86	0.79	0.78	0.88	0.59	0.26	0.51	0.19	1.00		
Ric	0.13	0.79	0.81	0.75	0.73	0.81	0.75	0.76	0.72	0.48	0.35	0.35	0.72	1.00	
Lea	0.17	0.70	0.78	0.72	0.70	0.76	0.90	0.88	0.71	0.62	0.75	0.55	0.78	0.69	1.00

As can be seen from Table 2, there is a strong correlation (above 0.800) between certain commodities.

For this reason, eight variables were excluded from further analysis (Cor, Coa, Cru, Iro, Soy, Cop, Tin, Gol and Alu).By using the two different methods of estimation, two different results are illustrated in Table 3.

As it can be seen in Table 3, the results obtained from the 2TLS show that there are: 1) a positive and significant relationship between the BDI and the Nic– every increase in the Nic of 1% causes an increase of 0,217% in the BDI; 2) a positive and significant correlation between the Ric rate and the BDI - for every 1% increase in the value of rice, the NPLs rate will rise approximately for 4,17%; 3) a positive and significant relationship between the Lea and the BDI - every rise the Lea of 1% conducts to increase in value of the BDI approximately for 1,61%. This result is in line whit (Papailias et al., 2017; Tsioumas & Papadimitriou, 2015; Tsioumas & Papadimitriou, 2016).

The results obtained from the 2TLS, also, show that there are: 1) a negative and significant relationship between the Iro, as one of the main commodities for international trade, and the DBI index - for every rise of 1% in the Iro, the value of DBI will decrease for 35,95% and 2) a negative and significant correlation between Zin and the BDI - every increase in the Zin of 1% will impact to decrease of the BDI for 1.501%.

[1] Of the available two-step and one-step GMM, one-step GMM estimator is chosen due to the fact that in smaller sample sizes it tends to be less biased. (see Arellano and Bond (1991)).

Table-3. 2STLS and one-step GMM method results.

2 SLS					
Regessors	**Coefficient**	**Std. Error**	**t-ratio**	**p-value**	
const	525.294	289.874	1.812	0.071	*
Iro	−35.952	2.378	−15.12	<0.0001	***
Whe	−2.633	2.246	−1.173	0.242	
Zin	−1.501	0.179	−8.386	<0.0001	***
Nic	0.217	0.014	15.610	<0.0001	***
Ric	4.178	0.791	5.280	<0.0001	***
Lea	1.610	0.240	6.695	<0.0001	***
R-squared 0.71		Adjusted R-squared 0.70			
Hausman test -Chi-square(1) = 4.41037 p-value = 0.035					
Weak instrument test - F-statistic (1, 243) = 1110.79					
One -step GMM					
Regessors	Coefficient	Std. Error	z-ratio	p-value	
const	300.320	381.020	0.790	0.431	
Iro	−36.24	3.550	-10.090	<0.0001	***
Whe	0.450	2.819	0.160	0.872	
Zin	-1.385	0.183	-7.560	<0.0001	***
Nic	0.207	0.021	9.570	<0.0001	***
Ric	3.800	1.344	2.830	<0.005	***
Lea	1.451	0.295	4.930	<0.0001	***

Note: ***, **, * indicate significance on 1%, 5% and 10% respectively.

The one-step GMM method is given similar results: 1) there is a positive and significant relationship between the BDI and the Nic – every increase in the Nic of 1% causes an increase of 0,207% in the BDI; 2) a positive and significant correlation between the Ric rate and the BDI - for every 1% increase in the value of rice, the NPLs rate will rise approximately for 3,8%; 3) a positive and significant relationship between the Lea and the BDI - every rise the Lea of 1% conducts to increase in value of the BDI approximately for 1,45%.

The results obtained from the one-step GMM, also, show that there are: 1) a negative and significant relationship between the Iro and the DBI index - for every rise of 1% in the Iro, the value of DBI will decrease for 36,24% and 2) a negative and significant correlation between Zin and the BDI - every increase in the Zic of 1% will impact to decrease of the BDI for 1.385%.

Both methods suggest that there is no significant relationship between the Whe and the BDI index.

5. Conclusion

In this paper, we have examined the relationship between the BDI and major raw materials, whose freight enters the calculation of the value of the BDI index. The aim of the paper was to examine whether the changes in the value of these raw materials affect the changes in the value of BDI, and to what extent they affect it. For purpose of the studies, we have used a multiple linear regression model. To estimation of the model parameters, we have used the 2SLS and GMM estimator. The survey covers the period from the day the indexes were created to the present day. This period includes two major economic crises: the great economic crisis of 2008 and the current crisis caused by the Covid-19 pandemic.

The findings of this research suggest that iron ore has a crucial deterministic role for the BDI unveiling that the value of this raw material is opposite linked to the value of the index. Also, the findings of this research suggest that there is a negative and significant correlation between zinc and the BDI.

The results of the paper imply that there is a positive and significant relationship between Lean and the index and between index and nickel, and index and rice. We did not find that there is a significant relationship between the BDI index and wheat. This result is not in line with mentioned studies.

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