International Journal of Economics and Financial Issues
Vol. 4, No. 4, 2014, pp.726-734
ISSN: 2146-4138
www.econjournals.com

London Metal Exchange: Causality Relationship between the Price Series of Non-Ferrous Metal Contracts

Mustafa Serdar Basoglu
Bulent Ecevit University, Institute of Social Sciences
Graduate School of Business, 67100 Zonguldak, Turkey.
Email: sbasoglu@erdemir.com.tr

Turhan Korkmaz
(Corresponding Author)
Mersin University, Faculty of Economics and Administrative Sciences
Department of Business Administration, 33343, Mersin, Turkey.
Email: korktur@gmail.com

Emrah Ismail Cevik
Bulent Ecevit University, Faculty of Economics and Administrative Sciences
Department of Business Administration, 67100 Zonguldak, Turkey.
Email: emrahic@yahoo.com

ABSTRACT: Fluctuations in raw material and product prices have caused manufacturers and consumers to experience serious losses in steel sector as well as in all other sectors. As the number of manufacturers of commodities like coking coal, iron ore and scrap- the main raw materials of steel manufacturing- is less worldwide and their manufacturers do not want to disclose price in an organized market, their future transaction volumes have not developed sufficiently yet. However, future transaction volumes of non-ferrous metals like aluminum, tin etc. that are used as auxiliary raw materials in steel manufacturing have increased fast in organized markets and such style of future transactions have become important in steel manufacturing in terms of cost management. The London Metal Exchange, one of the leading future commodity markets of world, has an important place in management of price risk in steel manufacturing and consumption of derivative transaction contracts. In this study, causality relationship between the price series of non-ferrous metals used as raw materials in steel manufacturing is examined by using Toda and Yamamoto (1995) causality test procedure. Empirical results suggest that aluminum is Granger cause of the other non-ferrous metals.

Keywords: causality relationship; LME; metal contracts; price risk.
JEL Classifications: G13; L61

1. Introduction

The steel sector, one of the keystones of economic development, is a sector that has a direct relation with economic developments in the world and economic power of countries. The steel sector plays an important role by providing an input to all industrial branches for development of countries.

Observed raw steel consumption per person is deemed as an indicator of development level of countries and communities. Steel sector, requiring high investment besides qualified manpower, has begun to be restructured by private sector especially since the beginning of 2000's and an increase in efficiency has been provided.

Because of China, a country that is under rapid growth and development possesses the most important share in the world in terms of both consumption and manufacturing process. This situation causes it to establish unilateral pressure on raw material and product prices. With liberalization of economies at great speed, decreasing of commercial restrictions between countries, increasing of transferability of capital and development of communication technology, it is inevitable that economic developments in the world will affect all the countries in a short time.

Fluctuations in steel manufacturing and prices occur because of reasons such as similar manufacturing processes and manufacturing technologies in countries, scarcity of raw material sources and they are provided from relatively definite countries and demand remains below manufacturing capacity and such affects are seen almost on all countries. For this reason, in the study, importance of price risk in steel industry which is sensitive to economic fluctuations has been taken into consideration and causality relationship between price series of non - ferrous metals transacted at London Metal Exchange has been explained.

In this study, it is aimed to contribute to management of price risk of raw materials used in steel sector. Under this scope, future transaction prices of non - ferrous metals that are recently transacted at future transaction market in great volumes are examined. Causality relation between price series of aluminum, aluminum alloy, copper, lead, nickel, tin and zinc that are transacted at London Metal Exchange and include in the non - ferrous metals category are analyzed. Determination of causality relations between these variables will provide great benefits both to investors and manufactures that use such metals as they will be able to see the future values of these variables better.

2. Steel Industry and Price Risk

Steel Industry is one of the primary industries of world's industry. It covers manufacturing of products like flat steel, long steel and plates by means of hot and cold shaping methods under structure of many facilities such as integrated plants, rolling mills, arc furnaces. Steel manufacturing can be grouped into two basic headings in terms of manufacturing methods. Manufacturing of steel at integrated plants: it covers the process the raw materials like iron ore, coke and lime are melted at high furnaces or basic oxygen furnaces. Melting of scrap covers the process of manufacturing of steel at electric arc furnaces (EAF).

Steel industry is one of the sectors that determines development levels of countries and establishes keystones of economic development. Fundamentals of economic development are to have a powerful steel sector. Steel sector is very important for developed and developing countries as it provides input to all industrial sectors. Flat and long products manufactured with melting of raw materials like scrap and iron ore at arc furnaces or integrated plants provide inputs to many sectors such as construction, automotive, railway, ship constriction, agricultural machines and equipment, white furniture, packing, defense industry and other sectors. The steel sector forms the foundation of industrialization and developments occur in this sector play a role in shaping of socio-economic structures of countries throughout the history.

In globalizing world, competition ability in international level is very important for both developed and developing countries. The most important subject for policy makers is; to develop an economy with competitive conditions and manage global risks with prudent and rationalist approach. With increasing concern of private capital in steel sector, the main purpose of manufacturers in the sector has been to maximize the market values. The enterprise managers have paid attention to protection measures against price risk in order to maximize market values. Serious fluctuations occurred in raw material and product prices have forced manufacturers and consumers to take various measures against price risk for sustainable and predictable profit amounts. The most import of such measures is to make transaction at future commodity markets.

To make transaction at future commodity markets provide various benefits for users. Basic benefits provided to processors are as listed below (LME, 2012: 16-17):

1. Protection of physical product stock against price fall risk
2. Protection of physical raw material stock against price risk
3. Protection against price risk in future sales with long-term fixed sale price
4. Management of price risk in physical purchases
5. Fixation of future purchase/sale price
6. Fixation of profit margin with long-term fixed sale price opportunity
7. Hedging of time difference between raw material supply and product sales.

3. Data and Methodology

In the study, the presence of causality relations among price series of aluminium, aluminium alloy, copper, lead, nickel, tin and zinc that are transacted at London Metal Exchange (LME) are examined by using Toda-Yamamoto causality test. In this context, daily price series for the periods of 2000 and 2013 were obtained from Bloomberg database and logarithmic price series were considered in the empirical analysis. The determination of causality relations among these variables can provide benefits for investors and manufactures who use these metals price in terms of to better predict the future values of these variables. Note that we do not consider log steel contract price series in this study because there are abnormal differences between spot and future market prices.

Causality Analysis: Clive W. Granger who was given Nobel Prize in Economy field in 2003 together with Robert F. Engle proposed causality tests that have been widely used today not only in economy and econometrics field but also basic sciences, engineering and medical sciences. Granger causality can be defined as if the past value of a random X variable ensures better prediction of other random Y variable after other factors and non-random information are taken into consideration, it can be said that X variable is Granger-cause of Y. Nowadays; Granger-causality tests are different from their original shape in 1969 in practice and theory. Both developments in time series analysis and decrease in data-process cost have added new dimensions to Granger-causality tests (Atukeren, 2011:138).

Although the Granger causality analysis is commonly used in the literature, some studies in the literature show that the test methodology has some drawbacks (Alimi ve Ofenyolu, 2013:131). For instance, bivariate Granger causality test has model speciation error because it does not consider the effects of third or common variables. In this context, Gujarati (1995) showed that causality test results are very sensitive to model form and choosing of lag lengths. Furthermore, time series are not generally stationary in level and this lead to find spurious regression results. Gujarati (2006) indicated that even if variables are cointegrated, F test used in testing of causality is not valid because the test statistic does not have standard distribution.

When testing methodologies for causality relation among variables are evaluated, it can be seen that the causality test proposed by Granger (1969) is generally employed for stationary series in the literature. On the other hand; if there exist a cointegration relation among variables, the presence of causality relation is examined by using error correction model proposed by Engle and Granger (1987). In this context, a causality test can be employed by using F statistics in the Vector Error Correction Model (VECM) that is a restricted VAR model but F statistics cannot be valid because the distribution of the test statistics does not have standard distribution (Toda and Yamamoto, 1995; Giles and Mirza, 1998; Giles and Williams, 1999). Recently, Toda and Yamamoto (1995) proposed a causality test that depends on lag augmented VAR model in which the presence of cointegration relation between series is not important in the testing methodology. Toda and Yamamoto (1995) indicated that the correct determination of model form and maximum lag lengths of the variables is adequate for the causality testing (Erbaykal and Okuyan, 2007:81).

Toda and Yamamoto (1995) suggested that pre-tests for the series (such as unit root and cointegration tests) cause to impose too many restrictions and these restrictions lead to size distortions in the causality testing procedure. For this reason, Toda and Yamamoto (1995) show that the causality test that relies on lag augmented VAR (k+d_{mak}) model outperforms than standard causality testing procedure due to Monte Carlo simulations.

Toda and Yamamoto (1995) causality testing methodology consists of three steps. In the first step, it is determined the maximum order of integration (d_{max}) for the series in the system via unit root tests. In the second step, optimal lag lengths (k) for VAR model is determined by means of model information criterions such as Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Finally, VAR model is estimated with (k+d_{mak}) lag lengths and causality relation between variables is examined by using Wald test. The formula of causality test suggested by Toda and Yamamoto (1995) is as follows.

$$\begin{aligned} X_t &= \delta + \sum_{i=1}^{k+d_{mak}} \alpha_i Y_{t-i} + \sum_{j=1}^{k+d_{mak}} \beta_j X_{t-j} + u_{1t} \\ Y_t &= \nu + \sum_{i=1}^{k+d_{mak}} \lambda_i Y_{t-i} + \sum_{j=1}^{k+d_{mak}} \delta_j X_{t-j} + u_{2t} \end{aligned} \tag{1}$$

In the Equation (1), k is optimal lag lengths, (d_{max}) is maximum order of integration for the variables in the system and it is assumed that the disturbance u_{1t} and u_{2t} are uncorrelated and the errors terms are assumed to be white noise with zero mean, constant variance and no autocorrelation. In the Equation (1), the presence of causality relation between Y and X can be examined by using modified

Wald test. Toda and Yamamoto (1995) showed that the test statistic which null hypothesis is no causality has an asymptotic chi-square (χ^2) distribution with k degrees of freedom.

Finally, Hatemi-J and Irandoust (2006) show that if the error terms in Equation (1) are not white noise, the test statistic does not asymptotic standard χ^2 distribution. This finding is very important specifically for financial time series because it is well known that ht distribution of financial time series exhibits non-normality and heteroskedasticity properties. Hence, we employ bootstrap methodology with 10000 repetitions to calculate critical values for the test statistic.

4. Empirical Results

We first test for the stationarity of the log of prices series by means of ADF, and PP unit root tests. We employ the all unit root test with a constant term and trend and select the lag specification according to the Schwarz Bayesian information criterion (BIC). The unit root test results are presented in Table 1.

Results in Table 1 show that the null hypothesis of nonstationarity could not be rejected for all price indices in levels according to ADF and PP unit root tests. On the other hand, ADF and PP unit root tests results suggest that the null hypothesis of nonstationarity can be rejected for all price indices in first difference levels. These findings are important for Toda-Yamamoto causality test because the testing procedure is rely on maximum order of integration of the variables in the systems. Hence, it can be said that maximum order of integration of the variables in the systems is one for all price series.

Table 1. Unit Root Test Results

Variables	Level Values		First Differences	
	ADF	PP	ADF	PP
Aluminum	-1.747 [0.406]	-1.679 [0.441]	-60.322*** [0.000]	-60.347*** [0.000]
Aluminum Alloy	-1.396 [0.585]	-1.562 [0.501]	-64.977*** [0.000]	-64.545*** [0.000]
Copper	-1.528 [0.820]	-1.573 [0.803]	-61.230*** [0.000]	-61.193*** [0.000]
Lead	-2.173 [0.503]	-2.108 [0.540]	-54.623*** [0.000]	-54.581*** [0.000]
Nickel	-1.526 [0.520]	-1.526 [0.520]	-57.500*** [0.000]	-57.500*** [0.000]
Tin	-2.708 [0.233]	-2.681 [0.244]	-56.212*** [0.000]	-56.193*** [0.000]
Zinc	-1.201 [0.675]	-1.155 [0.695]	-59.022*** [0.000]	-59.065*** [0.000]

Note: The optimal number of lags is selected according to the Schwarz BIC. The figures in square brackets show the probability (p-values) of rejecting the null hypothesis non-stationarity. ***, ** and * indicate that the series in question is stationary at the 1%, 5% and 10% significance level, respectively.

Next, we employ bivariate VAR model and then optimal lag lengths are determined according to model information criterions. It should be noted that because seven metal price series are considered in the empirical analysis, we estimate 21 bivariate VAR models. As mentioned above; because causality tests results are sensitive to model form, we considered both the Akaike model information criterion (AIC) and Schwarz Bayesian model information criterion (BIC) in this study. Optimal lag lengths that are determined by AIC and BIC are reported in Table 2.

According to results in Table 2, the optimal lag lengths that are determined due to the AIC generally exceed the optimal lag lengths estimated by the BIC and these results are consistent with a priori expectations. For instance, while the AIC indicates 3 lags for bivariate VAR model with aluminium and aluminium alloy variables; the BIC suggests 2 lags. On the other hand, both AIC and BIC suggest the same lag lengths for bivariate VAR model with aluminium and lead, aluminium alloy and copper, aluminium alloy and lead, aluminium alloy and nickel and copper and lead.

Table 2. Optimal Lag Lengths for Bivariate VAR Models

Bivariate VAR Models	AIC	BIC
Aluminum and Aluminum Alloy	3	2
Aluminum and Copper	2	1
Aluminum and Lead	2	2
Aluminum and Nickel	2	1
Aluminum and Tin	4	1
Aluminum and Zinc	2	1
Aluminum Alloy and Copper	2	2
Aluminum Alloy and Lead	2	2
Aluminum Alloy and Nickel	2	2
Aluminum Alloy and Tin	4	2
Aluminum Alloy and Zinc	2	1
Copper and Lead	2	2
Copper and Nickel	4	1
Copper and Tin	3	1
Copper and Zinc	2	1
Lead and Nickel	2	1
Lead and Tin	2	1
Lead and Zinc	3	1
Nickel and Tin	8	1
Nickel and Zinc	8	1
Tin and Zinc	4	1

We present Toda-Yamamoto causality test results in Table 3 and Table 4. It should be noted that because we consider both AIC and BIC for optimal lag lengths in bivariate VAR models, we employed two different causality tests. We show causality test results in Table 3 in which optimal lag lengths are determined via AIC. According to these results, bidirectional causality relation between aluminium and aluminium alloy price series is determined at 1% significance level. Additionally, aluminium price series is determined as a Granger cause of copper, lead, nickel price series at 5% significance level. On the other hand, the null hypothesis of no causality relation running from aluminium alloy to copper, lead and nickel price series can be rejected at 5% significance level. While copper price series is found to be Granger cause of lead and nickel price series, there is a causality relation going from nickel to tin and from zinc to nickel.

We reemploy Toda-Yamamoto causality test but in this case optimal lag lengths are determined by BIC to avoid model misspecification error due to selection of optimal lag length and we present test results in Table 4. It should be noted that although the results in Table 3 and Table 4 are generally same, there are some differences between results in Table 3 and Table 4. While we show the presence of causality relation running from zinc to aluminium and aluminium alloy at 10% significance level in Table 3, the presence of causality relation between these variables is determined at 5% significance level in Table 4. Similarly, although lead is found to be Granger cause of nickel at 10% significance level according to results in Table 3; the presence of causality relation can be determined at 5% significance level in Table 4 when optimal lag lengths are determined according to BIC. Finally, we show that the zinc price series is Granger cause of tin price series in Table 3; however the presence of causality relation between these variables cannot be determined in Table 4.

Table 3. Toda-Yamamoto Causality Test Results According to AIC

Causality Relationship	Test Value	Bootstrapped Critical Values		
		%1	%5	%10
Aluminum → Aluminum Al.	**56.731*****	12.404	7.854	6.256
Aluminum Al. → Aluminum	**16.288*****	10.810	7.633	6.088
Aluminum → Copper	**9.688*****	9.160	6.169	4.531
Copper → Aluminum	4.868*	9.651	6.085	4.440
Aluminum → Lead	**11.878*****	9.426	5.797	4.522
Lead → Aluminum	3.385	9.188	5.735	4.598
Aluminum → Nickel	**6.783****	10.236	6.282	4.715
Nickel → Aluminum	0.181	9.147	6.157	4.547
Aluminum → Tin	3.723	14.911	9.559	7.987
Tin → Aluminum	5.838	12.803	9.931	8.188
Aluminum → Zinc	3.794	9.135	5.952	4.754
Zinc → Aluminum	4.651*	9.682	6.041	4.580
Aluminum Al. → Copper	**8.068*****	6.759	3.756	2.573
Copper → Aluminum Al.	2.229	5.247	3.185	2.460
Aluminum Al. → Lead	**11.878*****	9.426	5.797	4.522
Lead → Aluminum Al.	3.385	9.188	5.735	4.598
Aluminum Al. → Nickel	**6.783****	10.236	6.282	4.715
Nickel → Aluminum Al.	0.181	9.147	6.157	4.547
Aluminum Al. → Tin	3.723	14.911	9.559	7.987
Tin → Aluminum Al.	5.838	12.803	9.931	8.188
Aluminum Al. → Zinc	3.794	4.754	5.952	4.754
Zinc → Aluminum Al.	4.651*	9.682	6.041	4.580
Copper → Lead	**6.376****	9.136	6.167	4.753
Lead → Copper	1.261	8.643	6.180	4.601
Copper → Nickel	**13.687****	13.687	9.702	7.841
Nickel → Copper	5.273	12.882	9.104	7.515
Copper → Tin	4.763	10.680	7.350	6.095
Tin → Copper	5.497	11.632	8.083	6.164
Copper → Zinc	5.618*	8.995	5.988	4.793
Zinc → Copper	3.437	9.151	6.036	4.411
Lead → Nickel	5.396*	9.508	6.099	4.448
Nickel → Lead	0.885	9.492	6.151	7.731
Lead → Tin	0.853	9.227	5.816	4.538
Tin → Lead	0.955	9.154	6.025	4.429
Lead → Zinc	3.390	11.116	7.948	6.191
Zinc → Lead	3.978	11.442	7.923	6.393
Nickel → Tin	**25.131*****	20.482	15.075	13.172
Tin → Nickel	14.869*	19.037	16.146	13.878
Nickel → Zinc	11.441	21.193	15.121	13.002
Zinc → Nickel	**21.390*****	20.368	16.316	14.159
Tin → Zinc	3.314	13.149	9.538	8.015
Zinc → Tin	5.170	13.114	9.537	7.701

Note: *, ** and *** indicates the presence of causality relation at %10, %5 and %1 significance level respectively.

We summarize causality test results that are obtained from Table 3 and Table 4 according to 5% significance level and the results are presented in Table 5. According to these results, aluminium price series is the Granger cause of aluminium alloy, copper, lead and nickel price series. Similarly, aluminium alloy price series is the Granger cause of aluminium, copper, lead and nickel price series. While the copper price series is determined to be Granger cause of lead and nickel price series; nickel price series is found to be Granger cause of tin price series. Lead, tin and zinc price series cannot be found to be Granger cause of other metals series.

Table 4. Toda-Yamamoto Causality Test Results According to BIC

Causality Relationship	Test Value	Bootstrapped Critical Values		
		%1	%5	%10
Aluminum → Aluminum Al.	**56.576*****	8.691	6.009	4.544
Aluminum Al. → Aluminum	**13.682*****	8.254	6.004	4.545
Aluminum → Copper	**8.068*****	6.759	3.756	2.573
Copper → Aluminum	2.229	5.247	3.185	2.460
Aluminum → Lead	**11.878*****	9.426	5.797	4.522
Lead → Aluminum	3.385	9.188	5.735	4.598
Aluminum → Nickel	**6.391****	7.042	3.786	2.587
Nickel → Aluminum	0.021	6.443	3.670	2.687
Aluminum → Tin	0.685	6.614	4.127	2.872
Tin → Aluminum	0.948	7.293	3.853	2.830
Aluminum → Zinc	3.390*	7.037	3.532	2.484
Zinc → Aluminum	**4.517****	5.948	3.391	2.438
Aluminum Al. → Copper	**8.068*****	6.759	3.756	2.573
Copper → Aluminum Al.	2.229	5.247	3.185	2.460
Aluminum Al. → Lead	**11.878*****	9.426	5.797	4.522
Lead → Aluminum Al.	3.385	9.188	5.735	4.598
Aluminum Al. → Nickel	**6.391****	7.042	3.786	2.587
Nickel → Aluminum Al.	0.021	6.443	3.670	2.687
Aluminum Al. → Tin	0.685	6.614	4.127	2.872
Tin → Aluminum Al.	0.948	7.293	3.853	2.830
Aluminum Al. → Zinc	3.390*	7.037	3.532	2.484
Zinc → Aluminum Al.	**4.517****	5.948	3.391	2.438
Copper → Lead	**6.376****	9.136	6.167	4.753
Lead → Copper	1.261	8.643	6.180	4.601
Copper → Nickel	**4.922****	7.288	3.902	2.550
Nickel → Copper	0.028	5.826	3.220	2.225
Copper → Tin	0.378	6.373	4.028	2.829
Tin → Copper	0.046	6.859	4.202	2.961
Copper → Zinc	2.567*	6.134	3.371	2.396
Zinc → Copper	2.175	6.245	3.683	2.651
Lead → Nickel	**4.665****	6.903	3.951	2.727
Nickel → Lead	0.606	6.487	3.819	2.752
Lead → Tin	0.734	7.257	4.022	2.977
Tin → Lead	0.006	6.458	4.293	2.610
Lead → Zinc	0.004	6.451	3.659	2.617
Zinc → Lead	3.023*	6.288	3.956	2.793
Nickel → Tin	**10.442*****	7.765	3.863	2.646
Tin → Nickel	0.266	6.829	4.290	2.892
Nickel → Zinc	1.185	6.583	3.343	2.483
Zinc → Nickel	2.191	7.052	3.796	2.683
Tin → Zinc	1.039	6.906	3.741	2.583
Zinc → Tin	0.380	7.218	3.926	2.587

Note: *, ** and *** indicates the presence of causality relation at %10, %5 and %1 significance level respectively.

Table 5. Causality Relationship among Metal Price Series

Causality Relationship →	**Aluminum**	**Aluminum Alloy**	**Copper**	**Lead**	**Nickel**	**Tin**	**Zinc**
Aluminum	-	Exist	Exist	Exist	Exist	Absent	Absent
Aluminum Alloy	Exist	-	Exist	Exist	Exist	Absent	Absent
Copper	Absent	Absent	-	Exist	Exist	Absent	Absent
Lead	Absent	Absent	Absent	-	Absent	Absent	Absent
Nickel	Absent	Absent	Absent	Absent	-	Exist	Absent
Tin	Absent	Absent	Absent	Absent	Absent	-	Absent
Zinc	Absent	Absent	Absent	Absent	Absent	Absent	-

6. Conclusions

Although development of steel sector varies depending on countries and time, problems experienced today are common for many manufacturers. These problems are surplus capacity, insufficient domestic and foreign demand, technological modernization and need for management of price movements.

Steel sector that is chancing radically since beginning of 2000s has entered into a rapid growing process with increasing demand especially in China and other developing countries and it has also taken attention of private equity. Through purchases and mergers in the sector, profitability and productivity of sector has increased. Countries have been affected from such changes in many aspects because of productivity and employment policies of private capital.

It has been thought that “steel cycle” experienced in previous years and caused great problems to manufacturers may be experienced again because of rapid increase in investment demands, rapid growth of China by taking place in the biggest exporter position and serious increases in raw material costs. Because of the economic crisis in 2008, the steel sector was unexpectedly involved in this steel cycle and manufacturers faced with high stock costs and bad market conditions.

Steel manufacturers had to deal with serious value losses both in their product stocks and raw material stocks and many companies that could not manage bankrupted process. Economic crisis in 2008 which effects have continued until today showed clearly to steel manufacturers even though the highest quality, most efficient and most cost effective manufacturing are one of the most important factors may not prevent from prospect damages.

For this reason, derivative products of which use began in very old days took attention both manufacturers and consumers more than before. Especially, derivative products that are effectively used for purpose of investment or arbitrage, in order to be protected from risk in foreign exchange and interest markets are also increasingly used in commodity markets.

London Metal Exchange mediates the future metal transactions of steel sector since its establishment date. The market has reached levels that satisfy processors in terms of both volume and transaction contracts.

In this study, we examine the presence of causal link between non-ferrous metal price series via Toda-Yamamoto causality test. Our empirical findings generally suggest the existence of causal relation running from price series of aluminum and aluminum alloy to other metal prices series because only 11 of the possible 42 pair-wise directional causal relationships are found to be significant. Consequently, in order for the parties who make transactions at LME to better predict future values of the metals they will work with, studying the causality relation of price series of metals will support the decisions to be made and make a contribution in protection from the price risk or increasing of profitability.

References

Alimi, S.R., Chris C. Ofenyolu (2013), Toda-Yamamoto Causality Test between Money Market Interest Rate and Expected Inflation: The Fischer Hypothesis Revisited, *European Scientific Journal,* 7, 125-142.

Atukeren, E. (2011), Granger – Nedensellik Sınamalarına Yeni Yaklaşımlar, *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi,* 25, 137-153.

Başoğlu, M.S. (2013), *“Metal Sektöründe Emtia Fiyat Riski: Londra Metal Borsasında Bir Uygulama,”* Yayınlanmamış Yüksek Lisans Tezi, Bülent Ecevit Üniversitesi Sosyal Bilimler Enstitüsü, Zonguldak.

Dickey, D.A., Fuller, W.A. (1979), Distribution of the Estimators for Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association,* 74, 427-431.

Engle, R.F., Granger, C.W.J. (1987), Co-Integration and Error Correction: Representation, Estimation, and Testing, *Econometrica,* 55(2), 251-276.

Erbaykal, E., Okuyan, H.A. (2007), Hisse Senedi Fiyatları ile Döviz Kuru İlişkisi: Gelişmekte Olan Ülkeler Üzerine Ampirik Bir Uygulama, BDDK Bankacılık ve Finansal Piyasalar Dergisi, 1(1), 77-89.

Giles, J.A., Mirza, S. (1998), Some Ptetesting Issues on Testing for Granger Non-Causality, *Econometric Working Papers,* Department of Economics, University of Victoria, Canada.

Giles, J.A., Williams, C.L. (1999), Export-led Growth: A Survey of the Empirical Literature and Some Non-Causality Results, *Econometric Working Paper,* Department of Economics, University of Victoria, Canada.

Granger, C.W.J. (1969), Investigating Causal Relations by Econometric Models and Cross-Spectral Methods, *Econometrica,* 37(3), 424-438.

Granger, C.W.J. (1986), Developments in the Study of Cointegrated Economic Variables, *Oxford Bulletin of Economics and Statistics,* 48, 213-228.

Granger, C.W.J. (1988), Recent Developments in the Concept of Causality, *Journal of Econometrics,* 37, 199-211.

Gujarati, N.D. (1995), *Basic Econometrics*, International Edition, McGraw-Hill, Inc., USA.

Hacker, R.S., Hatemi-J, A. (2006), Tests for Causality between Integrated Variables Using Asymptotic and Bootstrap Distributions: Theory and Application, *Applied Economics,* Volume 38(13), 1489-1500.

Hatemi-J, A., Irandoust, M. (2006), A Bootstrap-corrected Causality Test: Another Look at the Money-Income Relationship, *Empirical Economics,* Springer, 31(1), 207-216.

Hull, J.C. (1989), *Options, Futures, and Other Derivative Securities*, Prentice-Hall, Inc., New Jersey.

LME (2012), *Introduction to Hedging with Futures and LMEswaps*, London Metal Exchange, London.

Phillips, P.C.B., Perron, P. (1988), Testing for a Unit Root in Time Series Regression, *Biometrika,* 75, 335–346.

Stock, J.H., Watson, M.W. (2001), Vector Autoregressions, *Journal of Economic Perspectives,* 15, 101-115.

Toda, H.Y., Yamamoto, T. (1995), Statistical Inference in Vector Autoregressions with Possibly Integrated Processes, *Journal of Econometrics,* 66, 225-250.