Tin commodity exchange: granger causality test

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Abstract

Indonesian government established tin commodity exchange as a reference for world's tin price. Currently, there are three commodity exchanges in the world. This research aims to analyze relationship of tin commodity exchanges between London Metal Exchange (LME), Kuala Lumpur Tin Market (KLTM) and Indonesian Tin Exchange (INATIN). Daily data were obtained since August 23rd, 2013 to December 31st, 2015. We utilized Granger Causality and verified through interviews with tin's experts. The result indicates that price alterations in INATIN influence the price in other commodity exchanges and not vice versa. The experts consider it yet to be optimized in influencing other commodity exchanges, especially with regard to Alternative Delivery Procedure system in Indonesia Commodity and Derivatives Exchanges (ICDX).

Keywords: Commodities Exchanges; Granger Causality; Tin

1. Introduction

Tin price movements prior to 1985 had influenced by ITC (International Tin Council) which is an intergovernmental body that governs the global tin (Hilman, 2010). The formation of this institution began in 1927 before eventually collapse which caused by smuggling and oversupply of the non-ITC countries (Hilman, 2010). Tin price movements were more volatile compared with before the end of the ITC. High volatility was allegedly influenced the production of tin from Indonesia as the largest exporter in the world. The result is in line with Vivian and Wohar (2012), indicates the supply or demand factors are important factors that led to the price volatility of certain commodities. Chen (2010) state that estimated to average 34% volatility of commodity prices is influenced by global macroeconomic factors in the period of 1972-2007.

Volatility and movements of tin commodity price can be observed in the LME market, the physical market of KLTM and the physical market of INATIN. LME is a commodity market which trades tin from Indonesia and the world. Estimated around 80% of global tin stock is supplied from Indonesia (ITRI 2013; Irawan 2014). Indonesia began to form INATIN that trades physically (physical contracts) in 2012. The formation of the exchange refers to the Ministry of Trade Regulation No. 78/M-DAG/PER/12/2012 concerning export provision. Tin exports requirement through INATIN exchange is one of the government's efforts and Indonesian tin producers in order to control the price of the commodity at a price that benefits all parties, moreover to reduce price fluctuations (Irawan, 2014).

The formation of INATIN exchange by the government aimed to be a world reference and control of tin price. Research involves the influence of inter-exchanges has never been done by any researchers. The previous study ever conducted on the oil market and the gold market (Zhang and Wei, 2010), the market price of agricultural

(Capelle-Blancard and Coulibaly, 2011) and the market price of electricity (Gissey et al., 2014). Benefit from the influence of inter-exchanges is to determine market driven so that become price reference for investors, traders, users and producers.

2. Literature Review

Granger causality is employed to test the causality between two different variables. Granger causality applications are diverse and has been used broadly by researchers to examine causality relationship in stock markets (Vyrost et al, 2015; Gooijer and Sivarajasingham, 2008), spot and futures prices of West Texas Intermediate crude oil (Bekiros and Diks, 2008), agriculture and energy market prices (Saghain, 2010), crude oil and gold market prices (Zhang and Wei, 2010), world oil and agriculture commodity prices (Nazlioglu and Soytas, 2011), wheat, cattle and agricultural commodity prices with index-based trading activity (Capelle-Blancard and Coulibaly, 2011), electricity and commodity prices (Moutingo et al., 2011), oil and metals prices; such as gold, silver and cooper (Bildirici and Turkmen, 2015), crude oil, biofuel and agriculture commodity prices (Katrakilidis et al., 2015).

Furthermore, granger causality test also utilized for researches involved the same commodity in different market. For instance, the prices of crude oil in several countries (Candelon et al., 2013), global crude oil prices between world crude oil producers (Lu et al., 2014), also physical and futures price for natural gas in US (Ghodussi., 2016). There is no research ever conduct to test the causality relationship for tin price in different market. Previous studies were more focused on oil, precious metals and agricultural commodities. This research became important to the Indonesian government's efforts to make the exchange of INATIN as the world reference tin prices and controlling tin commodity prices from price speculators.

Tin commodity currently traded on various commodity markets with different types of contract. There are three active tin commodity exchanges; LME, KLTM and INATIN. Comparison of the three markets can be seen in Table 1. Famous tin commodity markets that has been widely known is the LME which built in 1886. Transactions in LME guaranteed by a clearing house named LME Clear Limited. LME Clear guarantee the financial settlement of all trades that occur in the event of counterparty default. In these conditions the LME Clear enable to act as a seller for every buyer and a buyer for every seller. When financial settlement has been fulfilled through the clearing house, the next process through the designated metal exchange warehouses.

The next tin commodities market in Malaysia is at the KLTM. The market has been established since 1984 which is the first physical contract market in Asia. The physical contract market used to accommodate the needs of the world's tin producers mainly located in Malaysia. In addition, the physical contract market to meet the needs of Malaysia as one of the world's tin producers and also to keep tin prices at a reasonable level. Tin latest commodity exchanges were in Indonesia. INATIN registered under ICDX. INATIN is a collection of tin sellers, buyers and trader which was established on February 1, 2012. The exchange gain positive response from the government to issue Minister of Trade Regulation No.32/M-DAG/PER/6/2013 concerning Tin Export Provision which required tin trading to go through the tin exchange in Indonesia.

Table 1. Comparison of the three world tin markets

Information	LME	KLTM	INATIN
Year of build	1886	1984	2003
Location	London	Kuala Lumpur	Jakarta
Contract type	Physical (spot), Futures, Options	Physical	Physical
Form	Bar	Bar	Bar
1 Lot	5 ton	1 ton	5 ton
Price	USD/ton	USD/ton	USD/ton
Tin bar standard	BS EN 610:1996	ASTM B 339.93	BS EN 610:1996; Permendag 33/2015
Warehouse	650 locations	2 locations	2 locations
Membership	98 members under 5 types of membership	11 members	41 members

The existence of commodity exchange market requires that the general provisions of specific commodities and transparent in assigning commodity prices. Based on individual transactions, it will be difficult to determine a fair price for a particular commodity. The difference in the three world's tin exchanges become important to investigate the relationship between the commodity markets. It is currently unknown price set on the LME provides the basis for the majority of commercial transactions in the non-ferrous metal (Schofiled, 2007). Following INATIN established in 2013, it may influence the relationship between the tin markets.

3. Data and Method

Granger's Causality is used to examine the causal relationship between two variables. The predictive power of the foregoing information may indicate a causal relationship between the two variables in the long term. This study tested the causality of tin prices in the three (3) different commodity exchanges namely INATIN, KLTM and LME. We used daily data of tin prices tin commodity prices obtained in INATIN, KLTM and LME. The collected data are daily data of tin commodity prices Sn 99.85% from August 2013 to December 2015 under the commodity markets. Expected results of Granger's Causality can deliver results that indicate the direction of causality and effect between the tin prices in the three different commodities market. The model granger causality is as follows:

$$\Delta Y_t^{LME} = \sum_{i=1}^{n} \alpha_i \Delta X_{t-1}^{INA} + + \sum_{j=1}^{n} \beta_j \Delta Y_{t-j}^{LME} + \mu_{1t}$$

$$\Delta X_t^{INA} = \sum_{i=1}^{n} \lambda_i \Delta X_{t-1}^{INA} + + \sum_{j=1}^{n} \delta_j \Delta Y_{t-j}^{LME} + \mu_{2t}$$

With hypothesis:

H_0: There is no causality between the LME price (Y_t^{LME}) at a price of INATIN (X_t^{INA})

H_1: There is a causality

Where:

ΔY_t^{LME}	: LME price at time t
ΔY_{t-j}^{LME}	: LME price at time t-j
ΔX_t^{INA}	: INATIN price at time t
ΔX_{t-1}^{INA}	: INATIN price at time t-1
μ_{2t}, μ_{1t}	: Error term
$\alpha_i, \beta_j, \lambda_i, \delta_j$	: Coefficient variable

The same equation is also used to examine the relationship between KLTM with INATIN also KLTM and LME. The first testing phase to unit root test to see stationary variables tested. After Granger Causality test results obtained, next is the verification and confirmation of the quantitative research result with tin experts. The method used to interview four (4) tin experts in Indonesia. Tin experts interviewed are people who are competent in their field.

4. Result and Discussion

Descriptive analysis of tin commodity prices in all three exchanges shown in Table 2. Table 2 explain the distribution of commodity price data in KLTM, INATIN and LME. The highest tin commodity prices was 23,905 USD per ton occurred on April 24, 2014 and the lowest was 13,700 USD per ton on June 8, 2015 within the interval of observation at tin commodity exchanges. The distribution of tin commodity prices fluctuate quite high with a coefficient of variation more than 16% from the exchanges. It shows a fairly high daily volatility in tin ingot commodity prices. Table 2 also indicate the average price of INATIN was greater than the LME price and KLTM price. INATIN price was higher around 300 USD per ton compared to the others. Similarly, the average price on

the KLTM was lower than the LME price. The quite high difference made it difficult of arbitrage to occur in tin commodity exchanges. This is possible because the INATIN exchange consists of more manufacturers than users (end-user), only a small amount and would prefer to buy at the LME.

Table 2. Descriptive statistics of tin commodity price exchanges

Variable	LME Spot Price	KLTM Price	INATIN Price
Mean	19,548.77	19,518.43	19,829.27
Median	20,220.00	20,200.00	20,720.00
Maximum	23,905.00	23,800.00	23,875.00
Minimum	13,895.00	13,700.00	13,800.00
Std Dev.	3,313.25	3,313.27	3,335.51
Skewness	-0.302229	-0.313920	-0.367978
Kurtosis	1.468918	1.468917	1.479057
Jarque-Bera	63.56229	64.23828	66.97057
Observation	563	563	563

Schofiled (2007) states storable commodity prices are influenced by the amount of stock available. Based on the tin stocks data in the LME within the period of 2003 to 2015, warehouse stocks of tin was in the fluctuating patterns and emerges a downward trend. The highest stock revealed in 2009 amounted to 26,800 tonnes and the lowest stocks in 2015 amounted to 6,100 tons with an average of 12,954 tonnes per year. Meanwhile, the average volume of transactions in the KLTM around 727 tons per annum. The highest volume of transactions occurred in 2001 amounted to 1,052 tones and the lowest volume of transactions in 2013 amounted to 466 tons with declining trend of transaction volume. The low volume of transactions since 2013 because of the establishment of INATIN in Indonesia. One of the major players listed in both KLTM and INATIN is PT Timah Tbk. Meanwhile, INATIN has a large volume of transactions. If compared with KLTM, KLTM's transactions in a year almost equivalent to a month in INATIN's transactions. The average volume of INATIN transactions amounted to 524 tons with the largest volume took place in December 2013 with amount was 1,411 tons and the lowest volume was in September 2013. The high INATIN transaction was due to Indonesian tin producers' obligations to trade tin ingot through the INATIN by Regulation of the Minister of Trade No.32/ M-DAG/PER/6/2013. The high transaction also caused by the considerable number of INATIN's members as many as 41 members with 26 tin manufacturers from Indonesia.

The relationship between the tin commodity exchanges tested by using Granger Causality. Granger Causality test conducted when data is stationary. The unit root test is performed to determine stationer data. The unit root test results that the price of tin has a unit root (non-stationary) at level and does not have roots units (stationary) in the first differencing. The LME, KLTM, INATIN price is stationary in first difference. After the data were stationer then Granger Causality Test carried between the LME, KLTM and INATIN. In testing with Granger Causality requires the selection of optimum lag models. Selection of the optimum lag intend to see the minimum of indicator value of Akaike Info Criterion (AIC) and Schwarz Criterion (SC) among the results of several lag selection VAR models. Optimum lag selection was found that optimum lag occurs at 4 in each Granger Causality test.

Granger Causality Test results showed a first difference of INATIN affect the first difference of KLTM and first difference of LME. It is also similar with KLTM price changes which affect the LME price shown in Table 3. These results also show that the price changes on the INATIN is a market driven to the price changes on other exchanges. Table 3 also reveal the physical stock market influence the non-physical. Stock of INATIN had a great influence due to it owns a physical market (tin ingot) with a large quantity. Based on the policies by the Indonesian government tin ingot exports should go through INATIN. Unlike the KLTM exchange which does not have large amount of physical tin, as well as LME which has contracts based on underlying tin in the existing warehouse.

Table 3. Granger Causality Test Result at Tin Commodity Exchanges

Granger Causality Test	Lag Optimum	Prob Value*	Information
D(INATIN) → D(LME)	4	0.7187	Granger (+)
D(LME) → D(INATIN)		0.0000	No granger
D(INATIN) → D(KLTM)	4	0.1278	Granger (+)
D(KLTM) → D(INATIN)		0.0000	No granger
D(KLTM) → D(LME)	4	0.4692	Granger (+)
D(LME) → D(KLTM)		0.0000	No granger

*critical value level at α = 5%

The study results also denote the existence of INATIN in accordance with the original purpose for the establishment of controlling world tin price and in line with the study from Irawan (2014). The INATIN establishment began in February 2012 by Pemendag 78/M-DAG/PER/12/2012 but still has flaws for its provisions is voluntary and does not set conditions for tin in other forms and weakness was exploited by the manufacturer by exporting not through exchanges and exports in other forms (Irawan, 2014). Experts agree that the presence of tin exchange help to influence the world tin price control. The existence of trading in INATIN also provide benefits to the Indonesian government in the form of sale price transparency for 3% royalty, the certainty of the goods origin which traded within the exchange, moreover traded tin ingot product standardization and certainty Net Results Export (DHE) which entered Indonesia.

There are various advantages with the INATIN, meanwhile according to the experts, the flaws in the INATIN exchange remain exist upon the operation of INATIN. Other weakness INATIN is the existing transaction settlement system for tin ingot outside the exchange, known as Alternative Delivery Procedure (ADP) is governed by the Physical Contract of Tin Ingot in chapter 24 clauses 2418. On the other hand, no outside futures settlement process occurs in LME and KLTM. All the process of tin ingot payment and delivery through the clearing house.

5. Conclusion

Ganger Causality test results showed tin price changes in INATIN exchange influence the price changes in LME and KLTM, but do not apply vice versa. Likewise KLTM price changes affect the LME price changes, but do not apply vice versa. It shows the physical contracts market are controlling the market price. Indonesia as an exporter of tin may control the tin price and the price reference. In line with the original purpose of INATIN formation as a price reference, yet still has weaknesses in the implementation of the provisions. Experts agreed to reorganize ICDX-INATIN in accordance with its original purpose. The flaw need to be improved by eliminating exchange transactions in Indonesia through ADP. Depth study of the improvement in ICDX trading system by involving various stakeholders need to be done as a continuation of this research. In addition, a study on how much influence of INATIN exchange to the LME and KLTM is an interesting topic for future study

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References

Bekiros, S and Diks, C. (2008) 'The relationship between crude oil spot and futures prices: cointegration, linear and nonlinear causality', *Energy Economics*. Vol.30, pp.2673 - 2685.

Bildirici, M and Turkmen, C. (2015) 'Nonlinear causality betwen oil and precious metals', *Resources Policy*, Vol.46, pp.202 – 211.

Candelon, B., Joets, M., and Tokpavi, S. (2013) 'Testing for granger causality in distribution tails: an application to oil markets integration', *Economic Modeling*, Vol.31, pp.276 - 285

Capelle-Blancard, G., and Coulibaly, D. (2011) 'Index trading and agricultural commodity prices: a panel granger causality analysis', *International Economics*, Vol.126-127, pp.51 - 72

Ghoddusi, H. (2016) 'Integration of physical and futures prices in the US natural gas market', *Energy Economics,* Vol.56, pp.229 - 238.

Gissey, G., Chavez, M., and Fallani, F. (2014) 'Dynamic granger causal networks of electricity spot prices: a novel approach to market integration', *Energy Economics*, Vol.44, pp.442 - 432.

Gooijer, J., and Sivarajasingham, S. (2008) 'Parametric and nonparametric granger causality testing: linkages between international stock markets', *Physica A*, Vol.387, pp.2547 - 2560.

Hilman, J. (2010) *The International Tin Cartel,* Routledge, London.

Hegerty, S. (2016) 'Commodity-price volatility and macroeconomic spillovers: evidence from nine emerging markets', *North American Journal of Economic and Finance*, Vol.35, pp.23 - 37.

Irawan, R. (2014) *Model Bisnis Industri Tambang Timah di Indonesia Studi Kasus Provinsi Bangka Belitung*. Published PhD thesis, Bogor Agricultural University, Bogor, Indonesia.

International Tin Research Institute. (2013) *Global Tin Outlook*, London: ITRI.

Katrakilidis, C., Sidiropoulos, M., and Tabakis, N. (2015) 'An empirical investigation of the price linkages between oil, biofuels and selected agricultural commodities', *Procedia Economics and Finance*, Vol.33, pp.313 - 320.

Lu, F., Hong, Y., Wang, S., Lai K., and Liu, J. (2014) 'Time-varing granger causality test for applications in global crude oil markets', *Energy Economics*, Vol.42, pp.289 - 298.

Moutinho, V., Vieira, J., and Moreira, A. (2011) 'The crucial relationship among energy commodity prices: evidence from the Spanish electricity market', *Energy Policy,* Vol.39, pp.5898 - 5908.

Nazlioglu, S., Soytas, U. (2011) 'World oil prices and agricultural commodity prices: evidence from an emerging market', *Energy Economics*, Vol.33, pp.488 - 496.

Saghaian, S. (2010) 'The impact of the oil sector on commodity prices: correlation or causation?', *Journal of Agricultural and Applied Economics*, Vo.42 No.3, pp.477 - 485.

Schofield, N. (2007) *Commodity Derivates Markets and Application*, Wiley & Son Inc, West Sussex.

Vivian, A., and Wohar, M. (20120 'Commodity volatility breaks', *Journal of International Financial Markets, Institutions & Money*, Vol.22, pp.395 – 442.

Vyrost, T., Lyocsa, S., and Baumohl, E. (2015) 'Granger causality stock market networks: temporal proximity and prefential attachment', *Physica A*, Vol.427, pp.262 - 276.

Zhang, Y., and Wei, Y. (2010) 'The crude oil market and the gold market: evidence for cointegration causality and price discovery', *Resources Policy,* Vol.35, pp.168 – 177.