Article

Implicit Interpretation of Indonesian Export Bans on LME Nickel Prices: Evidence from the Announcement Effect

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Abstract: Forecasting of LME (London Metal Exchange) nickel prices remains an interesting topic but lacks consensus. This study aims to fill knowledge gaps by demonstrating the announcement effect of export bans by the Indonesian government. This article focuses on Indonesia because Indonesia produces more than 60% of global nickel ore. We identified the sequence of two episodes in which Indonesian export bans of nickel ore appeared to increase LME nickel prices. The impact of the Indonesian export ban in 2014 is somewhat larger than that of 2019. The shock on the LME nickel market in 2014 was sustained for a while after the ban was implemented. We believe that this is the first export ban that has had unexpected effects within the market.

1. Introduction

Nickel prices have fluctuated dramatically in response to news from Indonesia, including an earthquake, which caused damage that impacted nickel ore production in mines. Serious events such as earthquakes and typhoons, and even Indonesian government regulations, have affected LME nickel prices, because Indonesia produces more than 60% of global nickel ore. A recent example took place on 4 January 2021. LME nickel prices rose by 4.8%, seemingly based on news from Indonesia of an earthquake taking place near the Morowali Industrial Park. LME nickel price forecasts of spot nickel prices were found to exhibit biases, because the financialization of commodities had been growing (Park and Lim 2018).

The Indonesian ore export ban of nickel has been an issue since July 2014, when Joko Widodo was elected. He was the first president not to come from an elite political or military background. His political direction for natural resources in Indonesia is resource nationalism. On the foreign policy front, he has emphasized protecting Indonesia's sovereignty. The Indonesian ore export ban helps to preserve Indonesia's nickel ore resource base for its rapidly growing NPI (nickel pig iron) and stainless-steel melting industries. We suppose that the Indonesian government introduced this 2014 export ban on unprocessed minerals with the implicit purpose of forcing global miners to build local processing capacities.

Going forward, nickel highlights considerations from the perspectives of environmental, social and governance (ESG) (Lim et al. 2020). The sales of electric vehicles have been held up since the start of the COVID-19 pandemic, mainly due to global environment issues, unlike traditional gasoline cars. Notably, the production of electric vehicle (EV) batteries has a strong demand for nickel as a raw material. As global governments are tackling climate change, vehicles with alternative power sources should become more and more sought after. This is a key argument behind the long-term bullish nickel narrative as a market consensus. Battery technology has continued to evolve from NCM111 ($LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$) to NCM811 ($LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$) batteries, implying an increase in nickel content; an exception is LFP (Lithium Iron Phosphate: $LiFePO_4$) batteries, which do not contain nickel but are popular in China (Hu et al. 2020). As the nickel element is

essential, this can contribute to specific power with manganese and cobalt ion. However, the increase in nickel content may sacrifice the structural stability and safety performance of NCM111 (Hu et al. 2020). Given the EV industry is relatively young, it is not a surprise that the demand for nickel is growing continuously.

Considering the strong expectations of the long-term bullish views on nickel price, the question may arise as to what the relationship is between Indonesian regulations of nickel ore export and fluctuations in LME nickel price. We develop our hypothesis as follows:

Hypothesis 1. *The export ban on nickel ore by the Indonesian government is associated with a higher nickel price.*

We consider the variable of daily LME nickel price returns. There are two focal episodes of Indonesian nickel export bans. The first was on 10 January 2014 (this was continued until 2016) and the second was on 8 July 2019 based on Reuters. The second export ban would stop the export of unprocessed nickel ore in 2022. There are many news articles reporting the increase in nickel price after the Indonesian government announced these bans. However, there are no previous studies in terms of rigorous empirical analysis of the relationship between Indonesian export bans of nickel ore and nickel price to the best of our knowledge. Notice that there have only been two Indonesian export bans; therefore, formal event study methodologies such as by Brown and Warner (1980) and Corrado (1989) cannot be applied to this issue, mainly due to limited data. Hence, we introduce an alternative analysis called the announcement effect. This paper tests the above hypothesis using the announcement effect through Romer and Romer (1989) research framework. Their paper used a "narrative approach" to provide evidence about the effects of monetary shocks to the FRB (Federal Reserve Board). We consider the "narrative approach" as the appropriate methodology to identify the effects of Indonesian export bans on LME nickel prices. Through the narrative approach of Romer and Romer (1989), we found that LME nickel prices related to the Indonesian export bans seem to be majorly the results of current developments, which supports the above hypothesis. The novelty of this study is that it empirically shows that the Indonesian export bans caused LME nickel prices to be higher. This is an important scientific contribution and is in line with UNCTAD (2017). The impact of the Indonesian export ban in 2014 is somewhat larger than that of 2019. The shock on the LME nickel market in 2014 is sustained afterwards. It seems that the 2014 case is the first export ban unexpected within the market. To check the robustness of the results, we analyze the AR (abnormal returns) data measured against the LMEX (LME Index). Based on the LME homepage, the LMEX value is calculated as the sum of the prices for the three qualifying months multiplied by the corresponding weights. This robustness result exhibits values similar to the main results, which satisfies the robustness check of the results.

Our paper is organized as follows. Section 2 describes the background of the Indonesian nickel ore ban through a review of the literature and explains the announcement effect. Section 3 presents detailed empirical evidence of the announcement effects of two episodes of nickel ore export bans by the Indonesian government. Section 4 summarizes our main findings.

2. Background and Literature Review

Djuric et al. (2015) analyzed how the Serbian exports ban impacted local wheat price. They analyzed how the market interventions of the Serbian government affected the domestic wheat market during the global commodity price peak in 2007–2008. Their results showed that the wheat price transmission regime was not changed by the export ban. However, there is no direct previous study of the effects of Indonesian export bans on nickel prices. In 2014, the Indonesian government implemented a regulation banning the export of nickel ore; in Indonesia's 2009 Mining Law, the government sought to compel miners to build smelters within Indonesia in order to increase the country's share of the

value added to its nickel ore. This was a comprehensive quantitative prohibition of the export of nickel ores. According to the export ban, only companies that undertook the construction of a smelter were granted an export license. In fact, the use of restrictions on the export increased during the commodity price boom period over 2000–2011. The OECD (2014) found that the export restrictions by commodity-led emerging countries rose rapidly during the commodity super cycle. This motivated commodity-led development to reinvest revenue from the commodity sector to derive economic growth in other sectors, and to achieve structural transformation of the national economy.

This section reviews UNCTAD (2017) research, where the nickel ore ban of Indonesia is discussed. UNCTAD (2017) argued that commodity-dependent developing countries such as Indonesia claimed their natural resources as national wealth. This paper studied Indonesia's mineral export ban over 2014–2017 and found that the nickel ore export ban would achieve its dual objectives of increasing value addition and reducing the extraction rate of its nickel resources. Note that the Indonesian government announced relaxing of the ban in early 2017. They pointed out that Indonesia's nickel export ban represented a significant gamble in terms of export value, value added, job creation and government revenues. UNCTAD (2017) found that nickel ore exports of Indonesia declined from 64.8 million tons in 2013 to only 4.1 million in 2014. As a result of the ban, many suspended their mining operations and development, and, in turn, laid off their employees. UNCTAD (2017) concluded that the riskiness of the nickel ore ban gamble by the Indonesian government was underlined by the mixed results in terms of value addition and jobs.

In their seminal paper within the 'announcement effect' subject, Waud (1970) found that there was an announcement effect on the expectations associated with discount rate changes by the FRB, and that there seemed to be a consensus as to the content of the inferred information. Demiralp and Jorda (2002) provided a good discussion on the announcement effect. The way we investigate the announcement effect of the Indonesian government differs from Waud (1970), mainly due to limited observations. Romer and Romer (1989) proposed a narrative approach for announcement effect analysis. Our analysis of Friedman and Schwartz's identification following Romer and Romer (1989) suggests the narrative approach is a robust method. We propose that their method is appropriate for analysis of the Indonesian nickel ore export bans, because it involves using historical records to identify the two episodes when there were large shifts in events (Romer and Romer 1989; Romer and Romer 1994).

3. Research Methodology and Results

3.1. Research Design and Steps

To examine the announcement effect of Indonesia's ban on nickel exports, we developed a simple empirical framework (Romer and Romer 1989). The estimated equation is:

$$nr_{i,t} = \alpha + \sum_{j=1}^{m} \sum_{i=1}^{t} \beta_j nr_{t-i} + \varepsilon_t \tag{1}$$

where $nr_{i,t}$ is the natural logarithm of the spot nickel price return against the previous day; ε_t is the independent, identically distributed (*i.i.d.*) errors of the $nr_{i,t}$; and m is the optimal lag level, which is determined by the AIC (Akaike Information Criterion) and the SBC (Schwarz–Bayesian Information Criterion). Forecast errors of the univariate autoregressive model for the daily LME nickel price returns follow the shock of the Indonesian export ban.

To formally test whether there is a significant statistical relationship between the Indonesian export bans and LME nickel prices, we employ the following test. With the simple univariate forecasting equation above (1), we calculate the cumulative forecast errors of the univariate autoregressive model after the focal episode.

$$CFE_i = \sum_{i=1}^{t} (nr_i - \hat{nr}_i) \tag{2}$$

Here, nr_i is the actual value observed in period i; and $\hat{nr_i}$ is the forecast via Equation (1) for period i. The forecasting equations are estimated after the focal episode, i.e., the announcement day of Indonesian export bans for the next 200 days.

The basic idea is to determine the univariate forecasting (Equation (1)) in the 200 days before the focal episode. Then, we project the next 200 days' LME nickel returns using Equation (1) and compare the actual figures. This is the Romer and Romer (1989) approach for analyzing the announcement effect.

3.2. Data

Daily data relating to the period of 26 March 2013 to 9 January 2014 and 20 September 2018 to 5 July 2019 are used for estimating Equation (1), providing both N = 200 observations, respectively, through *Bloomberg*. Daily data are the natural logarithm of the LME spot nickel price return. Based on projection figures ($\hat{nr_i}$), we can compare the actual figures, then find cumulative forecast errors up to the 200 days after the announcement day.

Table 1 presents the descriptive statistics of the daily returns of the two focal episodes. The skewness and kurtosis measures show that the returns distributions are asymmetric and fat-tailed, which is known as excess kurtosis. The Jarque–Bera statistics in Table 1 are for checking normal distribution, revealing no normally distributed data within considered the dataset. It is found that the returns data are strongly leptokurtic. The conclusion for the data finds that the distributions for the returns data are skewed and fat-tailed.

Table 1. Summary statistics.

Variables	Mean	SD	Skewness	Max	Min	Kurtosis	Jarque–Bera
nr_i(2014)	0.0003	0.0162	−0.3311	0.0549	−0.0660	4.9688	35.95 (0.00)
nr_i(2019)	−0.0002	0.0189	0.4475	0.0844	−0.0586	5.1760	46.13 (0.00)

The total observation contains 200 obs. (26 March 2013~9 January 2014, daily data; and 20 September 2018~5 July 2019, daily data), where nr_i is the daily natural log returns. We see that the distributions for returns are skewed and fat-tailed, as indicated by the high significance of the Jarque–Bera test for normality. The SD is standard deviation. The parenthesis figures are the *p*-value.

3.3. Unit Root Tests

Before implementing the univariate forecasting procedure, we check whether the data are stationary. For that purpose, we used unit root tests: ADF (Augmented Dickey Fuller) test and Phillips–Perron (PP) test. The null hypothesis for the tests is that data have a unit root, which is presented in Table 2. Table 2 shows the unit root tests results for the variables, which have no unit root. Therefore, converting them to stationary by taking the first difference is not necessary. All the data employ this level.

**Table 2.** Unit root tests: stationary check.

Variables	ADF	PP	Order of Integration
nr_i(2014)	−10.3629 ***	−11.6677 ***	I(0)
nr_i(2019)	−14.2408 ***	−14.3381 ***	I(0)

The total observation contains 200 obs. (26 March 2013~9 January 2014, daily data; and 20 September 2018~5 July 2019, daily data), where nr_i is the daily natural log returns. The reported numbers represent test statistics. *** indicates rejection of the null hypothesis (there is a unit root) at a 1% level of significance.

3.4. Empirical Results

The objective of this study is to identify whether the Indonesian export ban on nickel ore causes the LME nickel price to be higher. The implementation of the export ban by the Indonesian government indicates LME nickel price levels for producers, demanders and even speculative investors such as major hedge funds and CTAs (Commodity Trading Advisors) through the boosting of speculative buying interest. In particular, Park (2019) found that significant causality from the levels of net future positions of speculative managers on LME future prices changes using weekly COTR (commitments of traders' report) data.

Figure 1 exhibits the LME nickel prices of two focal episodes (announcement days: 10 January 2014 and 8 July 2019). Both nickel ore export bans have a positive effect on LME nickel prices. The positive effect in terms of LME nickel price itself increases up to the 84th observation, which is 21,000 USD/ton on 13 May 2014 and equivalently rises by 51.5%. In the case of the 2019 episode, the positive effect in terms of LME nickel price itself increases only up to the 44th observation, which is 18,050 USD/ton on 9 September 2019 and equivalently rises by 41.9%. The visualized impact of the Indonesian export ban in 2014 is somewhat larger in terms of LME nickel price itself than that of in 2019. The LME nickel prices related to the nickel ore export ban by the Indonesian government appear to be largely the result of current developments. Then, the shock to the LME nickel market eventually died out.

(a)

(b)
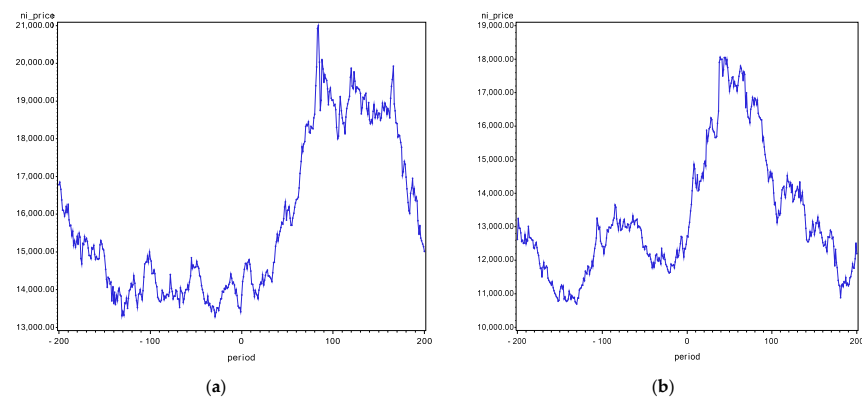
Figure 1. LME nickel prices. The period 0 means the day of the focal episode, i.e., the announcement day. (**a**) The first focal episode on 10 January 2014; (**b**) the second focal episode on 8 July 2019. Figures imply that such a big shift in Indonesian government action in response to LME nickel prices represents a significant shock.

Daily data relating to two focal episodes by the Indonesian government are used for estimating Equation (1) through MLE (Maximum Likelihood Estimation). The optimal autoregressive lag terms are one for the 2014 market event, while they are four for the 2019 market event using AIC and SBC. We run the MLE procedure first using the 200 observations before the focal episode. We know the actual figure already after the focal episode. Then, we can calculate CFE (Cumulative Forecast Errors). Figure 2 shows the cumulative error at each point so that one can more readily identify the impact of the shock on the LME nickel prices (Romer and Romer 1989).
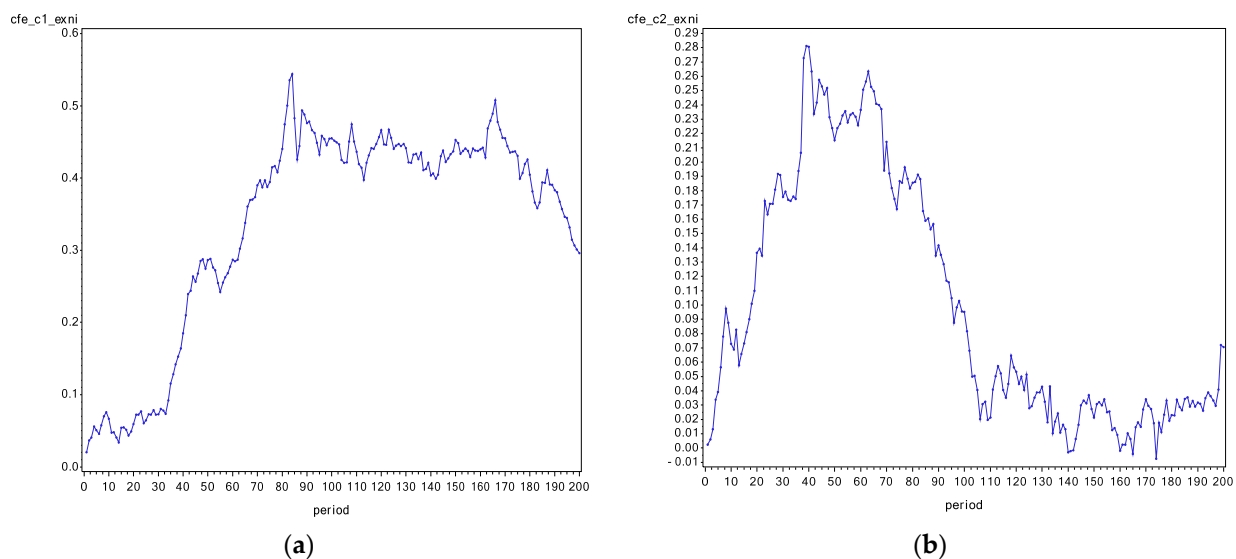

(a)

(b)
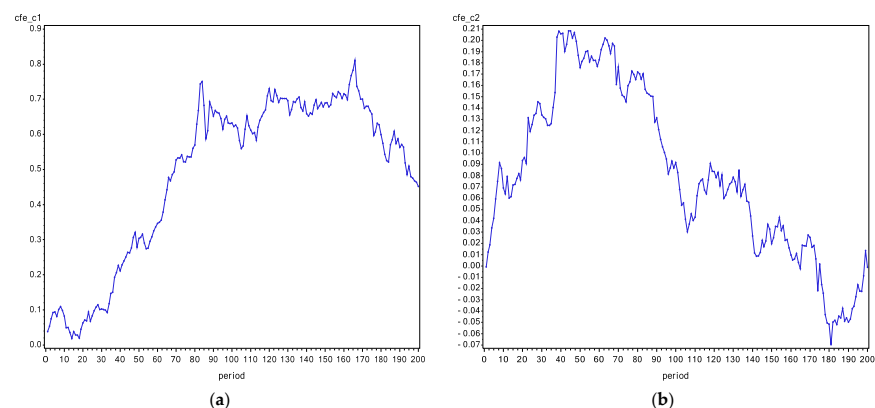
Figure 2. Calculated CFE graph. The actual figures after the focal episode are subtracted by the forecasts via the MLE procedure. (**a**) The first focal episode on 10 January 2014; (**b**) the second focal episode on 8 July 2019. Figures imply that the impact of the Indonesian export ban in 2014 is relatively larger than that of in 2019.

Figure 2 shows the results of the narrative approach by Romer and Romer (1989). From these graphs, it appears that LME nickel prices increase substantially after each of the Indonesian export bans. The positive effect in terms of CFE increases up to the 83rd observation, which is 0.7503 on 13 May 2014. The positive effect in terms of CFE increases only up to the 44th observation in the case of the 2019 episode, which is 0.2083 on 9 September 2019. The impact of the Indonesian export ban in terms of CFE in 2014 is somewhat larger than that of in 2019. In particular, unlike in the case of the episode in 2019, the shock on the LME nickel market in 2014 is sustained for a while. We suggest that this is the first export ban that was unexpected within the market. However, the shock on the LME nickel market in 2019 died out after the 160th day and even goes to the negative range around the 170th day.

3.5. Robustness Checks

We analyze AR data considering different aspects in order to check their robustness in Figure 3. The AR data were found to be stationary through ADF and PP. The optimal autoregressive lag terms are one for the 2014 event, while they are three for the 2019 event. Similarly, we run the MLE procedure using the 200 observations before the event and then calculate CFE. It is found that the results are very similar to previous results on spot price returns. Hence, the robustness checks appear to be satisfied.

Figure 3. CFE graph for AR; cfe_c1_exni means CFE for AR in 2014 and cfe_c2_exni means CFE for AR in 2019. The actual figures after the focal episode are subtracted from the forecasts via the MLE procedure. (**a**) The first focal episode on 10 January 2014; (**b**) the second focal episode on 8 July 2019. Figures imply that the impact of the Indonesian export ban in terms of AR in 2014 is relatively larger than that of in 2019.

Much of the bullishness surrounding LME nickel price caused by the Indonesian nickel ore ban is spreading out to the market. This issue accounts for short-term negative fundamentals such as weaker demand from stainless steel and batteries. The two episodes showed that LME nickel prices were driven higher by speculative demand related to a ban on exports of nickel ore from Indonesia potentially being brought forward. While nickel is currently linked to the stainless-steel sector, it is pricing upwardly in a premium for its future usage in the EV revolution. This is reason why nickel is firmly on the speculative radar, going into lithium-ion batteries.

Looking at the EV market, production and sales of EVs in China hit a new record high. Going forward, we think that the positive outlook in EV sales and batteries can continue to boost demand for battery metals such as nickel and cobalt. The confidence in EV market growth rate can be attributed to potential LME nickel as bullish for the long run.

4. Conclusions and Further Study

Much of this study presents a history of the "Indonesian export ban of nickel ore". This paper has no preceding studies to draw on. It briefly documents the Indonesian government's attempt and the actions that the Indonesian government has taken predictably as a function of shock and price impact.

This study is based on assumptions that the narrative approach (Romer and Romer 1989) is the method that is most likely to convincingly answer the question of whether Indonesian export bans have significant effects on LME nickel prices. We identified the sequence of two episodes in which the Indonesian export ban of nickel ore appears to have tried to increase LME nickel prices. The impact of the Indonesian export ban in terms of CFE in 2014 is somewhat larger than that of in 2019. The shock on the LME nickel market in 2014 is sustained after the event. We suggest that this is the first export ban that was unexpected within the market. We show that this result is robust through AR data analysis.

The limitation of this research is the limited number of cases of Indonesian export bans. Further studies regarding this issue should consider a formal event study such as Brown and Warner (1980) when the Indonesian government has implemented export bans more times. A nonparametric rank test for event studies can also apply for comparison (Corrado 1989).

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