温州肯恩大学
WENZHOU-KEAN UNIVERSITY

The impact of economic policy uncertainty on Chinese nonferrous metal futures

In Partial Fulfillment of the Requirements

for the Bachelor of Science in Finance

by

CHEN Yian

1098802

May, 2022

The impact of economic policy uncertainty on Chinese nonferrous metals futures

December 4, 2021

Yian Chen[a,*]

[a] *School of Accounting and Finance, College of Business and Public Management, Wenzhou-Kean University, Wenzhou 325060, China.*

Abstract

This article studies the impact of economic policy uncertainty in China and the United States on China's non-ferrous metal futures prices. We use Chinese and American data from 2011 to 2020 for regression analysis. According to the control variable method, we take industrial value-added, China's crude oil market prices, the exchange rate of USD to RMB, nonferrous metal inventory, and Chinese real interest rate as the control variables, and then take the economic policy uncertainty as the only variable to influence. According to the unit root test, we discovered that using the closing price as an indicator of futures price movements has randomness. Instead, we use the daily cumulative rise and fall of Chinese nonferrous metal futures to measure price influence. Other independent variables are transformed to the return data appropriate to them. Comparing two sets of data according to the regression method, our empirical results show that the increase of index of economic policies uncertainty in China and the United States increases the price change of non-ferrous metal futures. And according to the Quadratic test, we found that the relationship between variables is indeed linear. And we make sure that our previous findings

* Corresponding author. Email address: 1098802@wku.edu.cn

remain robust by adding control variables and changing response variables. In general, subsequent research and investment on non-ferrous metal futures need to consider the uncertainty of the economic policies of China and the United States to improve the prediction accuracy.

JEL Classification: E44, G14, Q31

Keywords: Economic policy uncertainty, nonferrous metals futures

1. Introduction

Due to the uncertainty of national economic policies and regulatory frameworks, many companies invest and operate more cautiously (Huseyin and Mihai, 2016). Baker et al. (2016) used newspaper and journal data, Congressional Budget Office reports, and Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters to create each country's economic policy uncertainty index. This index can help us to measure the economic policy uncertainty.

Because of China's rapid development, urbanization and industrialization have accelerated China's demand for metal resources. 71% of China's copper resources come from overseas markets (Yue et al., 2015).[1] In addition, China has become the world's leading importer and producer in the aluminum and copper industry, with the domestic market as the mainstay and increasing export volume. Therefore, whether for investment gains or for hedging when metal resources are introduced, there have been many participants and trading activities in metal market futures in recent decades.

The import and export, cooperation, and conflicts of interest between the Chinese market and the U.S. market make the uncertainty of U.S. economic policy also affect the changes in China's nonferrous metals futures market. For example, the two countries are promoting new energy vehicles, which makes the battle for upstream mineral resources more intense because it involves company profits and the country's energy security. In June 2021, the U.S. Department of Energy, the Department of Defense, the Department of Commerce, and the State Department

[1] “Price linkage between Chinese and international nonferrous metals commodity markets based on VAR-DCC-GARCH models”March 2015 (source: https://www.sciencedirect.com/science/article/pii/S1003632615636937)

jointly issued the "National Lithium Battery Blueprint (2021-2030)".[2] And in 2020, China released the "New Energy Automobile Industry Development Plan (2021-2035)".[3]

The growth of policy uncertainty brings policy risks, which can affect or restrict economic activities. Before this, many studies emphasized the importance of economic policy uncertainty for different markets and investments in different countries. For example, Zhang et al. (2021) find that the China-US Economic Policy Uncertainty Index has a significant positive impact on the long-term volatility of Chinese government bond futures. Dejuan-Bitria and Ghirelli (2021) analyze that increased uncertainty in Spain's economic policy reduces investment. As for the nonferrous metal market analysis, most of the research is based on the internal futures market. For example, Kang et al. (2019) inspect the London nonferrous metals futures market overall leading the Shanghai market. But in the long run, the Shanghai market leads the London market in aluminum and zinc. Ma and Xiong (2021) analyze the characteristics and influencing factors of high volatility in nonferrous metal futures markets.

The new finding of this article is that economic policy uncertainty is one of the factors that affect the price of nonferrous metal futures. This research aims to solve the essential questions– whether economic policy uncertainty impacts nonferrous metal futures prices. Specifically, we find that the uncertainty of economic policy has increased the demand for nonferrous metal futures by companies, which has led to an increase in prices. Of course, since the price change of nonferrous metal futures is composed of many factors, we need to consider the influence of these factors, such as economic growth rate, industrial production growth rate, report inventory, relevant market factors, exchange rate, capital Factor-Open interest (Bo and Feng, 2011). Therefore, when

---

[2] Retrieved from https://www.energy.gov/sites/default/files/202106/FCAB%20National%20Blueprint%20Lithium%20Batteries%200621_0.pdf

[3] Retrieved from http://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm

analyzing the price of nonferrous metal futures, we prepare two sets of factors. One set includes economic policy uncertainty, and the other does not. According to the unit root test, we find that it is impossible to directly use the closing price as an indicator of futures price changes. So we use the cumulative daily rise and fall of Chinese non-ferrous metal futures instead. And other independent variables are converted to the corresponding return of data. Then we use the regression method to get two sets of data and then compare the results to get a conclusion that the increase of economic policy uncertainty in China and the United States increase the price change of non-ferrous metal futures.

This research result is vital for two reasons. On the one hand, due to the outbreak of the epidemic, the transportation time of metal commodities has increased, so the related futures market has increased investment, and more people are buying futures to reduce risks. And different from other commodity futures, metal futures can be used not only for investment and risk hedging but also for the enormous industrial market. On the other hand, the return on futures is different from the return on traditional investment. In other words, people can form a low-risk portfolio of futures, stocks, and funds. This makes people pay more attention to the futures market when the stock market is down (Kang et al., 2019).

This research makes two contributions. Firstly, it verifies that the uncertainty of economic policies contributes to the future development of non-metal futures and helps develop China's follow-up related industries. Secondly, this article provides consideration for future research on nonferrous metals futures, which requires subsequent research on nonferrous metals futures to consider economic policy uncertainty as a variable that needs to be controlled.

Our next layout will be as follows. Section 2 We will conduct a literature review and hypothesis development. We divide the literature review into economic policy uncertainty related literature, research based on nonferrous metal futures, and related papers on the relationship between economic policy uncertainty and non-ferrous metal futures. In section 3 we will describe the data and the linear regression methodology I used. The research results will be reflected in section 4. We use the unit root test to measure whether the variable is a random walk, and then use linear regression to get the main results, and then use robust check to determine whether the previously obtained results are remaining robust. Finally, we will summarize the whole article in section 5.

2. Literature Review and Hypotheses Development

Economic policy uncertainty can affect supply and demand. Thus it can affect many factors in financial markets. Nonferrous metal futures' price changes are affected by several market factors or economic events as a category of futures. We review the relevant theoretical and empirical evidence of economic policy uncertainty, nonferrous metal futures, and their relationship in the following content.

2.1 Economic Policy Uncertainty

Economic policy uncertainty is highly related to financial market events, or even it can be influenced by it. Duca and Saving (2018) point out that economic policy uncertainty is affected by many factors, such as inflation, unemployment, and media fragmentation caused by economic development. And Liu and Zhang (2021) reveal many factors influencing policy uncertainty, including the uncertainty of policy-related macroeconomic variables such as the consumer price index, government budget, and federal spending. The content contained in this data includes a large number of changes in the economic market. Furthermore, Olanipekun et al. (2019) recognize that oil price change can lead to shortly high economic policy uncertainty. As an energy source, oil as a financial product is related to many other industrial chains, and sometimes the pricing of oil is related to politics. As a result, fluctuations in oil prices increase economic policy uncertainty.

Many scholars have tried to find the relationship between economic policy uncertainty and different financial markets in the last several decades. Like in the bond futures market, Zhang et al. (2021) explored that economic policy uncertainty is highly related to the volatility of Treasury bond futures in China and the United States. There is a positive correlation between the two. And policy uncertainty increases foreign exchange market pressure. However, if the overall policy environment is stable, economic policy uncertainty reduces economic activities such as investment, which eases the stress on the foreign exchange market (Olanipekun et al., 2019). Inthefuturemarket, Zhang et al. (2021) explored that Economic policy uncertainty is highly related to the volatility of Treasury bond futures in China and the United States, and there is a positive correlation between the two. Jones and Olson (2013) find that the relationship between economic policy uncertainty and inflation has gradually changed from negative to positive before ten years. But the negative relationship between the output and economic policy uncertainty still exists. Asforthecompanyinvestment, Gulen and Ion argue that (2016) increased economic policy uncertainty in the first few years reduces or delays company investment. And this impact takes more than two years to alleviate.

However, long-term investment delays may lead to greater losses in the company's economy. Economic policy uncertainty negatively affects some companies' investments and weakens after about a year. Inthefurtherstep, Goel et al. (2021) point out that if people invest in hedging portfolios in an environment of unstable economic policies, especially when short positions are dominant in the portfolio, then the profit from the investment decreases. Besides, another reason why investments may be affected is that their funds are concerned. Barraza and Civelli (2020) support this version because most companies believe that economic policy uncertainty negatively impacts investment uncertainty, and the demand for funds is reduced. And the bank itself provides liquidity insurance by reducing lending. Increased economic policy uncertainty decreases its financing sources so that some companies grow their loan business (Zhang et al., 2015). Although several U.S. banks find that a high degree of positive economic uncertainty does reduce the overall credit of the banking industry, this negative impact is relatively small for banks with significant capital (Bordo et al., 2016).

Zhang et al. (2019) emphasize that the U.S. economic policy uncertainty index still dominates the major global brokerage markets. Although China's financial status is rising, Chinese investors must invest in domestic and foreign markets to earn more profit. U.S. economic policy factors are taken into consideration. Liu et al. (2019) supplement that the economic policy uncertainty of different countries has different effects on China's inflation. Uncertainty in Europe and Japan causes inflation in China to rise, but the United States makes it fall. Krol (2014) shows that China's domestic foreign exchange market pressure and global economic policy uncertainty interact with each other. But looking at the domestic economic policy uncertainty data alone, there is no such relationship with the domestic currency market pressure.

Based on the above discussions, Economic policy uncertainty is influenced by economic shocks and politics and can react to different markets.

2.2 Nonferrous Metal Futures

China's nonferrous metal futures are considered the most active ones in the world market. However, Siklos et al. (2020) find that Chinese futures contracts are receivers of price shock. Thus, the Chinese market is relatively passive and is greatly affected by external countries' markets. The domestic nonferrous metal futures market be affected by foreign markets. However, Li and Zhang (2014) find that as the Chinese market expands, the impact of LME copper futures prices on SFE copper futures prices is declining, and in turn, the influence of SFE on LME is strengthened. Kang and Yoon (2016) use aluminum, copper, and zinc as test objects and find that the trading of metal futures on the Shanghai Futures Exchange (SFE) is affected by the London Metal Exchange (LME). As a different investment method from stocks and bonds, the correlation between futures and the stock market is relatively low. Indriawan et al. (2019) find when the prices of copper futures and aluminum futures change, the Chinese stock market doesn't cause excessive market price fluctuations. Based on the data of Shanghai zinc and aluminum futures, Kang et al. (2019) find that China's nonferrous metal futures have relatively low-risk resistance.

The risks arising from changes in economic market trends cause price changes, and it takes a long time to recover. Metal futures such as silver, copper, and gold have rapid price fluctuations in response to the emergence of macroeconomic news (Elder et al., 2012). Based on model research for nonferrous metal futures, several factors affect investment costs and commodity supply and lead to changes in nonferrous metal futures prices, like Changes in interest rates and exchange rates (Ma and Xiong, 2021; Zou et al., 2017). Yin and Han (2014) examine that supply and demand and investment banks are considered factors in the price volatility of metal futures. And the U.S. dollar is the settlement unit for most futures, so the exchange rate impacts commodity futures prices (Zhu et al., 2015). Besides, as an energy source, changes in oil prices change investors' decisions on production, so it also changes nonferrous metal futures prices (Reboredo and Ugolini, 2016).

Based on the above discussions, foreign markets affect China's metal futures. The price changes of nonferrous metal futures include exchange rates, interest rates, oil prices, and the relationship between supply and demand.

2.3 Effects of Economic Policy Uncertainty on Non-ferrous Metal Futures

Until now, few relevant pieces of literature describe the correlation between the price of nonferrous metal futures and the uncertainty coefficient of economic policy. However, it is learned from the literature that the commodity futures market reacts differently to the uncertainty of domestic and foreign economic policies under different market trends. Zhu et al. (2020) find that domestic economic policy uncertainty does not significantly impact metal futures returns. Still, in a bull market, the increase in U.S. economic policy uncertainty has a positive and significant impact on futures returns. Also, as part of economic policy, Gospodinov and Jamali (2018) state that increased uncertainty in negative monetary policy lowers the future prices of metal commodities and reduces speculation. A large part of commodity price volatility is due to economic policy uncertainty, because some investors become hesitant to make decisions, and the response of commodity prices to fundamental shocks also be affected by uncertainty (Yin and Han, 2014). And Yu et al. (2021) research the relationship between the gold futures market and economic policy uncertainty is different before and after the economic recession. Before the recession, the two were positively correlated, but the relationship became less clear during the financial recovery period.

When the high preventive demand for oil causes oil prices to change, the government issues policies quickly, undoubtedly bringing a high degree of economic policy uncertainty (Kang and Ratti, 2015). Zhu et al. (2021) examine that the impact of oil prices on China's nonferrous metals industry is positive. Still, increased economic policy uncertainty has a negative effect on the nonferrous metals industry. Galán and Martín (2021) cast the analysis on copper, which is the nonferrous metal with the highest degree of financialization. And gain a result that when political events occur, short-term supply decreases. This means that forward futures prices fall while spot prices rise. This means that the emergence of uncertainty affects investors. The investment decision affects the price of metal commodities from supply and demand, thus affecting the price of nonferrous metal futures.

Liu and Zhang (2015) use the economic policy uncertainty coefficient as the only variable to compare the prediction accuracy of the volatility model within the same time and space and find that in a variety of models, the economic policy uncertainty coefficient is included. The error of the model's answer is smaller than that of the model that is not considered. This is because the consideration of economic policy uncertainty can take into account some out-of-sample data. The application and the uncertainty coefficient of economic policy affect the price changes of metal futures.

Based on the above discussions, I believe that the impact of the economic policy uncertainty coefficient on nonferrous metal futures needs to be discussed separately from the country and futures market trends. And it can be tested whether the uncertainty coefficient of economic policy is added as the only variable to conclude the correlation between the two under the same other conditions.

Hypothesis: Higher economic policy uncertainty can lead to the increase of nonferrous metal futures.

The discussion mentioned above on economic policy uncertainty and nonferrous metal futures has multiple directions. However, there is still no clear explanation of the impact of the overall nonferrous metal futures market on the economic policy uncertainty. My research aims to fill the gap by studying the effect of the uncertainty of Sino-US economic policies on China's nonferrous metal futures prices.

3. Data and Methodology

This study used two data sources: 1) Wind Financial Terminal 2) Economic Policy Uncertainty Database.

We obtain the closing price, daily rise and fall of futures prices and trading volume of China's non-ferrous metal futures for each trading day from January 2011 to December 2020 from the Wind Financial Terminal. These data come from the daily data of Wind Information Technology Co., Ltd. The non-ferrous metals include silver, international copper, gold, aluminum, nickel, lead, tin, zinc, and copper cathode. These data are calculated in real-time according to the weighted average of the variety index holdings based on the latest price of the index of each category under the Wind Nonferrous Metals Futures Index with 1000 units on April 17, 1995. And we obtain data on China's monthly industrial value-added from 2011 to December 2020 from the Wind Financial Terminal. These percentage data are all from the National Bureau of Statistics. And we obtain China's crude oil market prices from National Development and Reform Commission from Wind, the unit is RMB per ton, the frequency is daily. We also download the average annual exchange rate of USD to RMB from the China Money Net for the same period from the Wind financial terminal, the frequency is every day. And we obtain China's actual interest rate provided by the World Bank, with a monthly frequency. As for the non-ferrous metal futures inventory, we obtain China's non-ferrous metal futures inventory from 2011 to 2020 from the Shanghai Futures Exchange with a weekly frequency and a unit of a ton. And we download from

Wind the import and export volume of China's non-ferrous metals from the General Administration of Customs from 2011 to 2020. The unit is 10,000 tons and the frequency is monthly. The monthly output data of China's non-ferrous metals for the same ten years comes from the National Bureau of Statistics, and the unit is also 10,000 tons. We get this information from Wind.

In addition, we find the uncertainty coefficients of economic policies in China and the United States from the Economic Policy Uncertainty database. According to the algorithm of Baker et al. (2016), the relevant vocabulary and time are used as retrieval conditions in 10 major U.S. newspapers. China's data is based on "People's Daily" and "Guangming Daily" as benchmarks. To solve the impact of the change in the number of articles, the article data is used as a percentage in the same year and the same month. Finally, the standard deviation and average are obtained. The second component draws on the report of the Congressional Budget Office (CBO), which is the future consideration of the economic policy uncertainty caused by temporary taxation. The third factor affecting conditions is the survey of professional forecasters by the Federal Reserve Bank of Philadelphia, which includes changes in fiscal and monetary policies. The economic policy uncertainty coefficient covers the monthly economic policy uncertainty coefficient from January 2011 to September 2020.

Table 1 shows a sample of non-ferrous metal futures and descriptive statistics of 7 influencing factors. Table 1 reports the summary statistics of the non-ferrous metals futures database and other related variable databases. Our sample includes 2,631-day non-ferrous metal futures trading records from 2010 to 2020. $CP_{i,t}$ represents the closing price of China's non-ferrous metal futures from the Wind Financial Terminal, with an average value of approximately 1368.88 yuan per subject. $CEPU_{i,t}$ represents the uncertainty of China's economic policy, with an average value of approximately 241.7, and $AEPU_{i,t}$ represents the uncertainty ratio of US economic policy and its average value is approximately 138.24. They all come from the economic policy uncertainty database. $IVA_{i,t}$ stands for industrial added value. Using data collected by the National Bureau of Statistics, the kurtosis data is relatively large, indicating the existence of extreme differences greater than or less than the average value. $OP_{i,t}$ represents China's crude oil market price and comes from the National Development and Reform Commission. The exchange rate behavior on $ER_{i,t}$ is the exchange rate of USD to RMB obtained from Chinamoney.com. $IR_{i,t}$ stands for China's real interest rate and comes from the People's Bank of China. $NMI_{i,t}$ is the non-ferrous metal inventory data from the Shanghai Futures Exchange, including aluminum, nickel, lead, tin, zinc, and copper cathode.

First, we determine that the factors that affect the price of non-ferrous metal futures include interest rates, exchange rates, industrial production growth rate, and report inventory. The linear regression model can assume that there are other factors besides the explanatory factor that affects the price of explained factor (Seber and Lee, 2012). Thus, we regard explanatory factors as economic policy uncertainty that can affect nonferrous metal futures, but many other aspects affect the nonferrous metal futures. So we use a linear regression model to calculate that the price of non-ferrous metal futures is affected by economic policy uncertainty, as shown below:

$$\begin{aligned} CP_{i,t} = {} & \beta_0 + \beta_1 CEPU_{i,t} + \beta_2 IVA_{i,t} + \beta_3 OP_{i,t} + \beta_4 ER_{i,t} + \beta_5 IR_{i,t} \\ & + \beta_6 NMI_{i,t} + \beta_7 AEPU_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

For the formula, $CP_{i,t}$ stands for the closing price of Chinese non-ferrous metal futures, which is the affected factor. $IVA_{i,t}$ stands for Industrial value-added, $OP_{i,t}$ stands for Chinese crude oil market prices, $ER_{i,t}$ stands for the exchange rate, $IR_{i,t}$ stands for the real interest rate in China, and $NMI_{i,t}$ stands for nonferrous metal inventory. These factors are all control variables. For formula, it is separated into two situations. Firstly, $AEPU_{i,t}$ and $CEPU_{i,t}$ stand for economic policy uncertainties that are included, while another does not include the influence of EPU. In the two situations, $CP_{i,t}$ is affected by the price of non-ferrous metal futures, and the right side of the equation is affected by other factors. $\varepsilon_{i,t}$ is the error term, representing other unknown effects.

RA Fisher (1992) introduces the analysis of variance into the analysis of multiple samples. R-square is the coefficient of determination, mainly using R-squared to assess whether there is a correlation between factors. When R-square tends to be one, it shows that the two are very relevant. We use the R-square values in two different situations to compare the impact of economic policy uncertainty on non-ferrous metal futures prices.

4. Results and Discussions

4.1. Main Results

The correlation table 2 shows the correlations between our daily variables, using ten-year data from January 2011 to December 2020. It shows that the closing price of China's non-ferrous metals futures and economic policy uncertainty in China have a negative correlation. This shows that the greater the volatility of China's economic policies, the lower China's non-ferrous metal futures prices follow. However, the U.S. economic policy uncertainty coefficient and Closing Price's correlation data show that the two have similar amounts of influence with the previous China correlation, but in different directions. In the correlation coefficient of closing price, the values of industrial value-added and Chinese crude oil market prices are both greater than 0.50, which indicates that the two have a largely positive relationship with China's non-ferrous metal futures prices and must be used as control variables to prevent The impact of our research results. Both Exchange rate and Chinese real interest are negative numbers, which indicates that these two control variables have a negative correlation with our dependent variables. The correlation coefficient between nonferrous metal inventory and closing price is 0.26, which indicates that there is a small amount of positive correlation between the two variables.

Table 3 shows the results of the Augmented Dickey-Fuller (ADF) unit root and Phillips–Perron (PP) unit root of variables. We perform a unit root test to test the smoothness of this time series. This table tests the unit root hypothesis in which the regression contains constant and no deterministic components. Where delta (Δ) is the first-order difference operator. We present the test statistic before and after the difference of each variable. The data results generated by the two tests are slightly different, but the inference on integration based on test statistics all show that the original series of the variables of $CP_{i,t}$, $OP_{i,t}$, $ER_{i,t}$, $NMI_{i,t}$, $CEPU_{i,t}$, $AEPU_{i,t}$, $MO_{i,t}$ and $IP_{i,t}$ are non-stationary time series and are all after first-order difference It becomes a stationary time series, while $IVA_{i,t}$, $IR_{i,t}$, $TO_{i,t}$ and $EP_{i,t}$ show that the original data presents a stationary time series. This shows that we need to process the data of the original series that is a non-stationary time series, so that the data of the original random walk becomes stationary time-series statistics.

Since the results in table 3 show that many variables are random walks, in order to avoid false correlations, we changed the dependent variable to $DCRF_{i,t}$ which is on behalf of the cumulative daily rise and fall of Chinese non-ferrous metal futures that comes from China non-ferrous metals futures data from Wind Financial Terminal. This variable is the return of China's non-ferrous metals futures daily price. And other variables are transformed into return variables. This change can help change the data into stationary time-series statistics, to avoid the occurrence of uncorrelated variables and data changes in the same direction are defined as interrelated.

Our first regression is

$$
\begin{aligned}
DCRF_{i,t} = \beta_0 + \beta_1 RCEPU_{i,t} + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} \\
+ \beta_5 RIR_{i,t} + \beta_6 RNMI_{i,t} + \beta_7 RAEPU_{i,\mathrm{t}} + \varepsilon_{i,t}
\end{aligned} \tag{2}
$$

Which is shown in Table 4

Panel A includes the economic policy uncertainty of China and the United States and five other influencing factors, while Panel B does not include economic policy uncertainty but only studies the correlation between the five control variables and the closing price of non-ferrous metal futures data. For Panel A, R square is 40.32%, which means 40.32% variation of closing price can be fully explained by the variations. It means that the data fits well with the model. In Panel A, statistical significance exists in several variables. For example, $RIVA_{i,t}$ are statistically significant at 5% level and $RNMI_{i,t}$ are statistically significant at 10%. Besides, $ROP_{i,t}$, $RER_{i,t}$, $RIR_{i,t}$,and $RCEPU_{i,t}$ are statistically significant at 1% level. It shows that these variables have a significant impact on the cumulative daily rise and fall of futures prices.

While for Panel B, R square is 40.04%, which means 40.04% variation of closing price can be explained by the variations. Except for $RNMI_{i,t}$, the significance of other variables is at 1% level. It seems that the statistical significance of $RNMI_{i,t}$ is reduced, but the significance of RIVA_{i2} increases.

Compared with the R-squared of the regression analysis of Panel A including economic policy uncertainty, the R-squared of Panel B does not include the regression analysis of economic policy uncertainty, an increase of 0.28%. This means that economic policy uncertainty has a certain positive impact on non-ferrous metal futures prices. In addition, we can find that in addition to being statistically significant, the data is also economically significant. For example, the coefficient on $RER_{i,t}$ in panels A and B are -312.60 and -320.21.39 respectively. This shows that when the $RER_{i,t}$ changes, the $DCRF_{i,t}$ changes significantly. And $ROP_{i,t}$ and $RIR_{i,t}$ coefficient statistics are both show economical significance

4.2. Additional Results

4.2.1 Test Results

In the previous, we used linear regression to find the impact of economic policy uncertainty on the cumulative daily rise and fall of non-ferrous metal futures prices. In table 5, we examine the impact of the square of economic policy uncertainty on the outcome to find if there exists a quadratic nonlinear relationship. We use ${RCEPU_{i,t}}^2$ and ${RAEPU_{i,t}}^2$ to represent independent variables and keep other variables unchanged. In order to separate the research, we divide it into panel A and panel B to show the results. Panel A shows the result of formulation including the square of economic policy uncertainty of China and considers economic policy uncertainty of the USA and economic policy uncertainty of USA as controlled variables, while Panel B contains the square of economic policy uncertainty of America. In these two panels, we consider the squares of the two economic policy uncertainty as dependent variables. We find that in panel A, expect $RIVA_{i,t}$, $RNMI_{i,t}$ and $RAEPU_{i,t}$, all variables are statistically significant at 1% level. And we can learn from that the coefficients of $ROP_{i,t}$, $RER_{i,t}$ and $RIR_{i,t}$, that are returns of oil price, exchange rate and Chinese real interest rate are separately 85.26, -324.12 and 59.95, which are all economically significant. While in panel B, expect $RAEPU_{i,t}$, $RNMI_{i,t}$ are statistically significant at 10% level and other variables are all statistically significant at 1% level. Otherwise, the coefficient of $RER_{i,t}$ in panel B shows the economical significance. But we can compare table

4 panel A and table 5, the coefficient of ${RCEPU_{i,t}}^2$ in panel A and ${RAEPU_{i,t}}^2$ in panel B are both smaller than the coefficient in table 4.

4.2.2 Robustness Check Results

In the previous content, we all use cumulative daily rise and fall of non-ferrous metal futures prices as the dependent variable. In table 6, in order to avoid the random walk of turnover, we use the return of turnover of Chinese metal futures in the same period instead of the cumulative daily rise and fall for regression analysis between variables, and represented by $RTO_{i,t}$. In the eighth row of table 6, we can see that the p-value of $\varepsilon_{i,t}$ is low and owns three stars, which is the lowest value of p-value in this table, and other all coefficients are not statistically significant. And according to the second column, it can be found that the economically significant exist in some variables like $RER_{i,t}$. But different from table 4, the coefficient of $CEPU_{i,t}$ and $RAEPU_{i,t}$ are smaller. And *R-square* decreased from 40.32% to 0.12%, which shows that the variation of closing price can be explained by the variations decreased a lot.

In Table 7, we examine the ability of the economic policy uncertainty coefficient to affect the price of non-ferrous metal futures in the presence of the three additional control variables of non-ferrous metal production and import and export volume (Wang, 2010). From this table, we can see from the second column that except $RAEPU_{i,t}$, $RIVA_{i,t}$ is statistically significant at 10% level and other all variables are statistically significant as all p-values are less than 1%. However, there are differences in the coefficients in the second column. For $RAEPU_{i,t}$, the coefficient is small and it means to have less economic significance. And variables like $ROP_{i,t}$, $RER_{i,t}$ and $RIR_{i,t}$ owns relatively high coefficients that represent at high economically significant. In order to understand the impact of metal output and import and export quantities on our previous results, we compare Table 7 with Table 4. In panel A of Table 4 and the second column of Table 7, we can see that coefficients of $ROP_{i,t}$, $RER_{i,t}$ and $RIR_{i,t}$ decrease, and coefficient of $RCEPU_{i,t}$ increases. Thus, the quantities of metal output and imports and exports increase the economic significance of economic policy uncertainty, but do not have an extremely high impact on statistical significance. And we can also find that from panel A of Table 4 to the second column of Table 7, the economical significance of $RIVA_{i,t}$ is reduced and the economical significance of $RNMI_{i,t}$ is increased.

5. Conclusion

In the past few years, China's non-ferrous metal industry has continued to develop and the volatility of futures prices has also been an area of research by many people. However, when studying the factors related to China's metal futures prices, existing research often ignores the uncertainty of domestic and US economic policies. This study uses the ten-year period from 2021 to 2020 as a sample to investigate the impact of the increase or decrease in economic policy uncertainty in China and the United States on China's non-ferrous metal futures prices.

This article uses regression to consider the specific relationship between the uncertain changes in the economic policies of the two countries and the cumulative daily rise and fall of China's non-ferrous metal futures. First of all, from the perspective of the closing price of futures and policy uncertainty, an increase in the US economic policy uncertainty coefficient leads to an increase in the closing price. The intensity becomes greater. Second, when we look at the daily rise and fall of futures prices and the return of economic policy uncertainty, the increase in economic policy uncertainty in China and the United States leads to a greater increase in futures. This shows that futures prices reveal an upward trend when economic policies are unstable. The reasons may include changes in supply and profit and demand, or people are more inclined to buy futures to hedge risk. Third, the empirical results show that economic policy uncertainty can also improve prediction accuracy. The presence or absence of economic policy uncertainty in the two countries has an impact on the daily rise and fall of futures prices by approximately 0.28%. Therefore, for the follow-up research on the price of non-ferrous metal futures, the uncertainty of economic policy may be taken into consideration to reduce data errors.

In past papers, Changes in interest rates and exchange rates were found to affect non-ferrous metal prices. And the relationship between supply and demand was also found to be related to non-ferrous metal futures prices. But they did not find the impact of the uncertain economic policies of China and the United States on non-ferrous metal futures prices. In addition, scholars reveal that negative monetary policy has a negative impact on metal futures. Scholars discover the relationship between the gold futures market and the uncertainty of China's economic policy. But our paper found on the other hand that China's non-ferrous metal futures market will be affected by uncertain changes in the economic policies of China and the United States. Our paper fills this gap. And for futures market researchers, in subsequent non-ferrous metal related research, they need to consider whether the economic policy uncertainty of China and the United States needs to be considered as a control variable to prevent errors in the research results. For futures companies, they need to pay attention to changes in the economic policies of China and the United States to help make futures bullish or bearish decisions.

References

Baker, S.R., Bloom, N., Davis, S. J., 2016. Measuring economic policy uncertainty. The quarterly journal of economics 131, 1593–1636.

Barraza, S., Civelli, A., 2020. Economic policy uncertainty and the supply of business loans. Journal of Banking and Finance121, 105983.

Bo, X., Feng, D., 2011. An analysis of the factors affecting the price of China's metal futures: Taking SHFE copper as an example. Economic Research Guide 10, 78–80.

Bordo, M.D., Duca, J.V., Koch, C., 2016. Economic policy uncertainty and the credit channel: Aggregate and bank level U.S. evidence over several decades. Journal of Financial Stability 26, 90–106.

Dejuan-Bitria, D., Ghirelli, C., 2021. Economic policy uncertainty and investment in Spain. Journal of the Spanish Economic Association 12, 351–388.

Elder, J., Miao, H., Ramchander, S., 2012. Impact of macroeconomic news on metal futures. Journal of Banking and Finance 36, 51–65.

Fang, L., Yu, H., Li, L., 2017. The effect of economic policy uncertainty on the long-term correlation between U.S. stock and bond markets. Economic Modelling 66, 139–145.

Fisher, R.A., 1992. Statistical methods for research workers. Springer, New York.

Galán-Gutiérrez, J.A., Martín-García, R., 2021. Cointegration between the structure of copper futures prices and Brexit. Resources Policy 71, 101998.

Goel, G., Dash, S.R., Mata, M.N., Caleiro, A.B., Xavier, R.J., Filipe, J.A., 2021. Economic Policy Uncertainty and Stock Return Momentum. Journal of Risk and Financial Management14, 141.

Gospodinov, N. and Jamali, I., 2018. Monetary policy uncertainty, positions of traders and changes in commodity futures prices. European Financial Management 24, 239–260.

Gulen, H., Ion, M., 2016. Policy uncertainty and corporate investment. The Review of Financial Studies 29, 523–564.

Huseyin, G., Mihai, I., 2016. Policy Uncertainty and Corporate Investment. The Review of Financial Studies 29, 523–564.

Indriawan, I., Liu, Q., Tse, Y., 2019. Market quality and the connectedness of steel rebar and other industrial metal futures in China. Journal of Futures Markets 39, 1383–1393.

Jones, P.M., Olson, E., 2013. The time-varying correlation between uncertainty, output, and inflation: Evidence from a DCC-GARCH model. Economics Letters 118, 33–37.

Kang, S.H., Tiwari, A.K., Albulescu, C.T., Yoon, S.M., 2019. Time-frequency co-movements between the largest nonferrous metal futures markets. Resources Policy 61, 393–398.

Kang, S.H., Yoon, S.M., 2016. Dynamic spillovers between Shanghai and London nonferrous metal futures markets. Finance Research Letters 19, 181–188.

Kang, W., Ratti, R.A., 2015. Oil shocks, policy uncertainty and stock returns in China. Economics of Transition 23, 657–676.

Krol, R., 2014. Economic policy uncertainty and exchange rate volatility. International Finance17, 241–256.

Li, Z., Zhang, L.H., 2013. An empirical study of international linkages of the Shanghai copper futures market. Chinese economy 46, 61–74.

Liu, L., Zhang, T., 2015. Economic policy uncertainty and stock market volatility. Finance Research Letters 15, 99–105.

Ma, R.R., Xiong, T., 2021. Price explosiveness in nonferrous metal futures markets. Economic Modelling 94, 75–90.

Reboredo, J.C., Ugolini, A., 2016. The impact of downward/upward oil price movements on metal prices. Resources Policy 49, 129–141.

Schneider, A., Hommel, G., Blettner, M., 2010. Linear regression analysis: part 14 of a series on evaluation of scientific publications. Deutsches Ärzteblatt International 107, 776.

Seber, G.A., Lee, A.J., 2012. Linear regression analysis. John Wiley and Sons, New York.

Siming, L., Mengxin, W., Yong, T., 2019. Stabilizing inflation expectations in China: Does economic policy uncertainty matter?. Green Finance 1, 429–441.

Siklos, P.L., Stefan, M., Wellenreuther, C., 2020. Metal prices made in China? A network analysis of industrial metal futures, Journal Of Futures Markets 40, 1354–1374

Wang, L. 2010. An Empirical Study on the Price Formation Mechanism of China's Nonferrous Metal Futures. MS thesis. Zhejiang Gongshang University.

Yue,Y., Liu,D., S. Xu.,2015. Price linkage between Chinese and international nonferrous metals commodity markets based on VAR-DCC-GARCH modelsTrans. Transactions of Nonferrous Metals Society of China 25, 1020–1026

Yu-Xin, C.A.I., Yun-Lu, G.O.N.G., Sheng, G.Y., 2021. The Gold Price And The Economic Policy Uncertainty Dynamics Relationship: The Continuous Wavelet Analysis. Economic Computation and Economic Cybernetics Studies and Research 55.

Zhang, M., Zhao, Y., Nan, J., 2021. Economic policy uncertainty and volatility of treasury futures. Review of Derivatives Research 1, 1–15.

Zhang, D., Lei, L., Ji, Q., Kutan, A. M., 2019. Economic policy uncertainty in the U.S. and China and their impact on the global markets. Economic Modelling 79, 47–56.

Zhang, G., Han, J., Pan, Z., Huang, H.,2015. Economic policy uncertainty and capital structure choice: Evidence from China. Economic Systems 39, 439–457.

Zhu, H., Huang, R., Wang, N., Hau, L., 2020. Does economic policy uncertainty matter for commodity market in China? Evidence from quantile regression. Applied Economics 52, 2292–2308.

Zhu, X.H., Chen, J.Y., Zhong, M.R., 2015. Dynamic interacting relationships among international oil prices, macroeconomic variables and precious metal prices. Transactions of Nonferrous Metals Society of China 25, 669–676.

Zhu, X., Liao, J., Chen, Y., 2021. Time-varying effects of oil price shocks and economic policy uncertainty on the nonferrous metals industry: From the perspective of industrial security. Energy Economics 97, 105192.

Zou, L., Zheng, B., Li, X., 2017. The commodity price and exchange rate dynamics.Theoretical Economics Letters7, 1–24

Table 1: Sample Statistics of influencing factors of non-ferrous metal futures

The table reports descriptive statistics for the sample of nonferrous metal futures and 7 influencing factors. $CP_{i,t}$ stands for the closing price of China's non-ferrous metal futures which come from the Wind Financial Terminal. $CEPU_{i,t}$ stands for economic policy uncertainty in China and $AEPU_{i,t}$ stands for economic policy uncertainty in the United States that are from the Economic Policy Uncertainty database. $IVA_{i,t}$ represents industrial value-added that uses data collected by the National Bureau of Statistics. $OP_{i,t}$ represents China's crude oil market prices that come from National Development and Reform Commission. $ER_{i,t}$ on behave of the exchange rate that is the exchange rate of the US dollar against the name currency obtained from the China Money Net. $IR_{i,t}$ stands for Chinese real interest rate comes from thePeople's Bank of China. $NMI_{i,t}$ is the nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode that come from the Shanghai Futures Exchange.

	N	Mean	Std. Dev.	min	max	skewness	kurtosis
CP	2432	1,362.57	186.60	958.96	1,976.84	0.80	4.13
IVA	2432	7.50	4.64	-25.87	21.30	-2.70	23.87
OP	2432	7,685.93	955.41	5,965	9180	-0.37	1.81
ER	2432	6.52	0.31	6.04	7.18	0.34	1.86
IR	2432	0.30	0.93	-17.6	0.50	-14.74	233.74
NMI *(thousand)*	2.432	812.71	227.08	399.41	1,497.99	0.50	3.02
CEPU	2432	243.72	278.37	0	1,425.16	1.80	6.33
AEPU	2432	138.67	51.52	71.26	350.46	1.47	5.31

Table 2: Correlation

The table shows the correlations between our daily variables, using ten-year data from January 2011 to December 2020. $CP_{i,t}$ is the daily closing price that comes from China non-ferrous metals futures data from Wind Financial Terminal. $CEPU_{i,t}$ is the index of China's economic policy uncertainty in the past decade, $AEPU_{i,t}$ is economic policy uncertainty in the United States, these data are from the Economic Policy Uncertainty database. $IVA_{i,t}$ is the industrial value-added that uses data collected by the National Bureau of Statistics. $OP_{i,t}$ is Chinese crude oil market prices that come from National Development and Reform Commission. $ER_{i,t}$ represents the exchange rate that is the exchange rate of the US dollar against the name currency obtained from the China Money Net. $IR_{i,t}$ is the Chinese real interest rate that comes from the People's Bank of China. $NMI_{i,t}$ represents the nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode inventory information that come from the Shanghai Futures Exchange. *- state. sign. at smaller than 10% level, stands for weakly significant. ** state. sign. at smaller than 5% level, stands for significant coefficient. *** state. sign. at smaller than 1% level, represents that the coefficient is most significantly different from zero.

Variables	CP	IVA	OP	ER	IR	NMI	CEPU	UEPU
CP	1.000							
IVA	0.523***	1.000						
OP	0.655***	0.372***	1.000					
ER	-0.231***	-0.408***	-0.470***	1.000				
IR	-0.001	-0.010	-0.032	0.030	1.000			
NMI	0.259***	0.071***	0.285***	-0.114***	-0.002	1.000		
$CEPU$	-0.159***	-0.183***	-0.141***	0.610***	0.008	0.001	1.000	
$AEPU$	0.152***	0.006	-0.218***	0.374***	-0.070***	-0.158***	0.256***	1.000

Table 3: Unit Root Results

The table shows results of Augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) unit root of variables. This table tests the unit root hypothesis in which the regression contains constant and no deterministic components. $CEPU_{i,t}$ is the index of China's economic policy uncertainty in the past decade, $AEPU_{i,t}$ is economic policy uncertainty in the United States, these data come from the Economic Policy Uncertainty database. $CP_{i,t}$ is the daily closing price that comes from China non-ferrous metals futures data from Wind Financial Terminal. $IVA_{i,t}$ is the industrial value-added that uses data collected by the National Bureau of Statistics. $OP_{i,t}$ is Chinese crude oil market prices that come from National Development and Reform Commission. $ER_{i,t}$ represents the exchange rate that is the exchange rate of the US dollar against the Chinese Yuan obtained from the China Money Net. $IR_{i,t}$ is the Chinese real interest rate that comes from the People's Bank of China. $NMI_{i,t}$ represents the nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode inventory information that come from the Shanghai Futures Exchange. $TO_{i,t}$ is the Turnover of Chinese metal futures. $MO_{i,t}$ is the cumulative value output of ten non-ferrous metals from the National Bureau of Statistics. $EP_{i,t}$ is the number of non-ferrous metals exported from the General Administration of Customs. $IP_{i,t}$ is the import quantity of non-ferrous metals from the General Administration of Customs. Δ means the first difference of variables. *- state. sign. at smaller than 10% level, stands for weakly significant. ** state. sign. at smaller than 5% level, stands for significant coefficient. *** state. sign. at smaller than 1% level, represents that the coefficient is most significantly different from zero. The sample period is from January 2011 to December 2020, daily frequency.

Variables	ADF test statistics	PP test statistics
	Constant	Constant
CP	-2.753*	-2.741*
ΔCP	-38.929***	-38.944***
IVA	-4.441***	-4.445***
ΔIVA	-31.873***	-31.872***
OP	-1.295	-1.297**
ΔOP	-35.066***	-35.066***
ER	-0.591	-0.601
ΔER	-38.461***	-38.449***
IR	-8.029***	-8.066 ***
ΔIR	-0.538	-0.502
NMI	0.191	0.191
ΔNMI	-39.494***	-39.495***
$CEPU$	-1.707	-1.709
$\Delta CEPU$	-38.023***	-38.024***
$AEPU$	-1.741	-1.744
$\Delta AEPU$	-30.523***	-30.520***
TO	-10.417***	-9.244***
ΔTO	-55.912***	-56.886***
MO	-1.055	-1.047
ΔMO	-36.139***	-36.136***
EP	-3.683***	-3.685***
ΔEP	-30.787***	-30.787***
IP	-2.516	-2.520
ΔIP	-39.953***	-39.950***
Inference on integration based on the above tests		
CP	I (1)	I (1)
IVA	I (0)	I (0)
OP	I (1)	I (1)
ER	I (1)	I (1)
IR	I (0)	I (0)
NMI	I (1)	I (1)
$CEPU$	I (1)	I (1)
$AEPU$	I (1)	I (1)
TO	I (0)	I (0)
MO	I (1)	I (1)
EP	I (0)	I (0)
IP	I (1)	I (1)

Table 4: Main Regression Results

The table shows results for the in-sample regressions:

$$DCRF_{i,t} = \beta_0 + \beta_1 RCEPU_{i,t} + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} + \beta_5 RIR_{i,t} + \beta_6 RNMI_{i,t} + \beta_7 RAEPU_{i,t} + \varepsilon_{i,t}$$

$$DCRF_{i,t} = \beta_0 + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} + \beta_5 RIR_{i,t} + \beta_6 RNMI_{i,t} + \varepsilon_{i,t}$$

Panel A shows the result of formulation including economic policy uncertainty, while Panel B only contains control variables. $RCEPU_{i,t}$ is the return of the index of China's economic policy uncertainty in the past decade, $RAEPU_{i,t}$ is the return of the economic policy uncertainty in the United States, these data come from the Economic Policy Uncertainty database. $DCRF_{i,t}$ on behalf of the cumulative daily rise and fall of Chinese non-ferrous metal futures that come from China non-ferrous metals futures data from Wind Financial Terminal. $RIVA_{i,t}$ is the return of the industrial value-added that uses data collected by the National Bureau of Statistics. $ROP_{i,t}$ is the return of Chinese crude oil market prices that come from the National Development and Reform Commission. $RER_{i,t}$ represents the return of the exchange rate that is the exchange rate of the US dollar against the Chinese Yuan obtained from the China Money Net. $RIR_{i,t}$ is the return of the Chinese real interest rate that comes from the People's Bank of China. $RNMI_{i,t}$ represents the return of nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode inventory information that comes from the Shanghai Futures Exchange. The *t*-statistics based on adjusted standard errors are reported in parentheses below the estimated coefficients. *- state. sign. at smaller than 10% level, stands for weakly significant. ** state. sign. at smaller than 5% level, stands for a significant coefficient. *** state. sign. at smaller than 1% level, represents that the coefficient is most significantly different from zero. The sample period is from January 2011 to December 2020, daily frequency.

DCRF	*10 years*	*DCRF*	*10 years*
	Panel A: Includeing EPU		*Panel B: No EPU*
RIVA	-0.002**	*RIVA*	-0.002***
	(-2.33)		(-3.01)
ROP	87.693***	*ROP*	86.800***
	(22.11)		(22.41)
RER	-312.600***	*RER*	-320.207***
	(-4.36)		(-4.46)
RIR	63.090***	*RIR*	-63.423 ***
	(28.25)		(28.04)
RNMI	-0.003*	*RNMI*	-0.018
	(-0.09)		(-0.54)
RCEPU	0.004***	*RCEPU*	
	(2.60)		
RAEPU	0.011	*RAEPU*	
	(1.41)		
Constant	-19.167***	*Constant*	18.966***
	(-95.89)		(-94.53)
R-square	40.320%	*R-square*	40.040%

Table 5: Quadratic Form Regression Results

The table shows results for the in-sample regressions：

$$DCRF_{i,t} = \beta_0 + \beta_1 RCEPU_{i,t} + \beta_8 \left(RCEPU_{i,t}\right)^2 + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} + \beta_5 RIR_{i,t} + \beta_6 RNMI_{i,t} + \beta_7 RAEPU_{i,t} + \varepsilon_{i,t}$$

$$DCRF_{i,t} = \beta_0 + \beta_7 RAEPU_{i,t} + \beta_8 \left(RAEPU_{i,t}\right)^2 + \beta_1 RCEPU_{i,t} + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} + \beta_5 RIR_{i,t} + \beta_6 RNMI_{i,t} + \varepsilon_{i,t}$$

Panel A shows the result of formulation including economic policy uncertainty of China, while Panel B contains economic policy uncertainty of America. $DCRF_{i,t}$ on behalf of the cumulative daily rise and fall of Chinese non-ferrous metal futures that come from Wind Financial Terminal. ${CEPU_{i,t}}^2$ is the square of the index of China's economic policy uncertainty, ${AEPU_{i,t}}^2$ is the square of economic policy uncertainty in the United States. $CEPU_{i,t}$ is the index of China's economic policy uncertainty, $AEPU_{i,t}$ is economic policy uncertainty in the United States, these data come from the Economic Policy Uncertainty database. $RIVA_{i,t}$ is the return of the industrial value-added that uses data collected by the National Bureau of Statistics. $ROP_{i,t}$ is the return of the Chinese crude oil market prices that come from the National Development and Reform Commission. $RER_{i,t}$ represents the return of the exchange rate that is the exchange rate of the US dollar against the Chinese Yuan obtained from the China Money Net. $RIR_{i,t}$ is the return of the Chinese real interest rate that comes from the People's Bank of China. $RNMI_{i,t}$ represents the return of the nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode inventory information that come from the Shanghai Futures Exchange. The *t*-statistics based on adjusted standard errors are reported in parentheses below the estimated coefficients. *, ** and *** represent the coefficient significant at 10%, 5% and 1% respectively. The sample period is from January 2011 to December 2020, daily frequency.

$DCRF$	*10 years*	$DCRF$	*10 years*
	Panel A: Includeing CEPU square		*Panel B: Includeing AEPU square*
$RCEPU$	-0.010***	$RAEPU$	0.03***
	(-0.53)		(4.56)
$RCEPU^2$	0.000***	$RAEPU^2$	-0.001***
	(5.78)		(-7.39)
$RIVA$	-0.001	$RIVA$	0.983***
	(-3.08)		(11.45)
ROP	85.261***	ROP	0.006***
	(-1.26)		(27.76)
RER	-324.124***	RER	7.562***
	(21.17)		(13.28)
RIR	59.950***	RIR	0.226***
	(-4.50)		(4.10)
$RNMI$	-0.018	$RNMI$	0.001*
	(26.96)		(1.93)
$RAEPU$	0.008	$RCEPU$	0.001
	(1.02)		(0.72)
$Constant$	-19.277***	$Constant$	-123.342***
	(-96.94)		(-26.20)
R-square	41.090%	*R-square*	50.650%

Table 6: Turnover Regression Results

The table shows results for the in-sample regression：

$$\mathrm{TO}_{i,t} = \beta_0 + \beta_1 RCEPU_{i,t} + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} + \beta_5 RIR_{i,t}$$
$$+ \beta_6 RNMI_{i,t} + \beta_7 RAEPU_{i,t} + \varepsilon_{i,t}$$

The table shows the result of formulation including turnover instead of cumulative daily rise and fall of Chinese non-ferrous metal futures. $RTO_{i,t}$ is the return of the turnover of Chinese metal futures. $CEPU_{i,t}$ is the index of China's economic policy uncertainty in the past decade, $AEPU_{i,t}$ is the economic policy uncertainty in the United States, these data come from the Economic Policy Uncertainty database. $RIVA_{i,t}$ is the return of the industrial value-added that uses data collected by the National Bureau of Statistics. $ROP_{i,t}$ is the return of Chinese crude oil market prices that come from the National Development and Reform Commission. $RER_{i,t}$ represents the return of the exchange rate that is the exchange rate of the US dollar against the Chinese Yuan obtained from the China Money Net. $RIR_{i,t}$ is the return of the Chinese real interest rate that comes from the People's Bank of China. $RNMI_{i6,t}$ represents the return of nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode inventory information that comes from the Shanghai Futures Exchange. The t-statistics based on adjusted standard errors are reported in parentheses below the estimated coefficients. *- state. sign. at smaller than 10% level, stands for weakly significant. ** state. sign. at smaller than 5% level, stands for significant coefficient. *** state. sign. at smaller than 1% level, represents that the coefficient is most significantly different from zero. The sample period is from January 2011 to December 2020, daily frequency.

RTO	*10 years*
$RIVA$	0.001
	(0.56)
ROP	0.049
	(0.39)
RER	-1.626
	(-0.60)
RIR	-0.052
	(-0.90)
$RNMI$	-0.001
	(-1.05)
$RCEPU$	0.001
	(0.32)
$RAEPU$	0.001
	(0.75)
$Contant$	0.032***
	(5.39)
R-square	0.120%

Table 7: Add Control Variables Regression Results

The table shows results for the in-sample regression：

$$DCRF_{i,t} = \beta_0 + \beta_1 RCEPU_{i,t} + \beta_2 RIVA_{i,t} + \beta_3 ROP_{i,t} + \beta_4 RER_{i,t} + \beta_5 RIR_{i,t} + \beta_6 RNMI_{i,t}$$
$$+ \beta_7 RAEPU_{i,t} + \beta_8 RMO_{i,t} + \beta_9 REP_{i,t} + \beta_{10} RIP_{i,t} + \varepsilon_{i,t}$$

The table shows the result of formulation including economic policy uncertainty of China and economic policy uncertainty of America with three more control variables. $DCRF_{i,t}$ on behalf of the cumulative daily rise and fall of Chinese non-ferrous metal futures that come from Wind Financial Terminal. $CEPU_{i,t}$ is the index of China's economic policy uncertainty in the past decade, $AEPU_{i,t}$ is the economic policy uncertainty in the United States, these data come from the Economic Policy Uncertainty database. $RIVA_{i,t}$ is the return of the industrial value-added that uses data collected by the National Bureau of Statistics. $ROP_{i,t}$ is the return of Chinese crude oil market prices that come from the National Development and Reform Commission. $RER_{i,t}$ represents the return of the exchange rate that is the exchange rate of the US dollar against the Chinese Yuan obtained from the China Money Net. $RIR_{i,t}$ is the return of the Chinese real interest rate that comes from the People's Bank of China. $RNMI_{i,t}$ represents the return of nonferrous metal inventory data including aluminum, nickel, lead, tin, zinc, and copper cathode inventory information that comes from the Shanghai Futures Exchange. $RMO_{i,t}$ is return of the cumulative value output of ten non-ferrous metals from the National Bureau of Statistics. $REP_{i,t}$ is the return of number of non-ferrous metals exported from the General Administration of Customs. $RIP_{i,t}$ is the return of import quantity of non-ferrous metals from the General Administration of Customs. The t-statistics based on adjusted standard errors are reported in parentheses below the estimated coefficients. *, ** and *** represent the coefficient significant at 10%, 5% and 1% respectively. The sample period is from January 2011 to December 2020, daily frequency.

$DCRF$	*10 years*
RMO	6.213***
	(8.90)
REP	1.152***
	(10.11)
RIP	-10.459***
	(-7.97)
$RIVA$	0.002*
	(1.93)
ROP	79.797***
	(21.54)
RER	-308.806***
	(-4.45)
RIR	59.700***
	(27.92)
$RNMI$	0.105***
	(2.73)
$RCEPU$	0.001***
	(3.68)
$RAEPU$	0.010
	(1.30)
Constant	-20.138***
	(-98.80)
R-square	45.460%