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# Exploring the relationship between the price of Chinese imported iron ore and the exchange rate of each country

1. **Business Background**

In order to be able to analyze and forecast the iron ore market more accurately, the internship unit sent two researchers from the Steel Industry Research Institute to explore the factors influencing the price changes of imported iron ore, in order to seek a better analysis of the iron ore market and help the group leaders to better give reasonable orders. The researchers found that the price of imported iron ore is often inextricably linked to factors such as futures market prices, the US dollar price index, and the supply and demand pattern of strong demand and insufficient supply. However, due to the research volume of the researchers, there is no opportunity to take out a separate study about the relationship between the price change of imported iron ore and the exchange rate between the U.S. dollar and national currencies, so I would like to take this opportunity to use my knowledge of multivariate statistics and the use of SPSS that I learned in school, as well as my own learning of R language to do a statistical analysis.

This study will allow me to better grasp what I have learned in class by applying statistical knowledge and statistical software to real-world problems. In addition, this project will also allow me to improve my statistical skills, because I need to be proficient in a series of processes from data acquisition, data organization, statistical description, problem identification to model construction, software operation, and result analysis, which will be helpful for me to complete my thesis and even to work in the future.

1. **Status Survey**

In the last six months, the futures prices in the steel market have all risen sharply due to the positive macroeconomic impact of China, with iron ore prices hitting new highs again during the year. According to the data on the Platts Iron and Steel Ore Price Index provided to me by the internship, it can be observed through the 2019-2020 Iron Ore Platts line graph (Figure 1) that after May 2020, the Platts price index for imported iron ore has seen a a significant increase. At the same time, the import volume of iron ore has likewise reached a new high during the year. Iron ore is in an overall tight supply/demand balance. On the supply side, iron ore production and transportation were affected by the hurricane and berth maintenance in Australia and the spread of the epidemic in Vale, Brazil, and the shipment volume from Australia and Brazil has picked up since the end of March, but is still on the low side. On the demand side, the downstream industry accelerated the rush to work to make steel demand concentrated, stimulating a significant increase in crude steel production and a large marginal increment in iron ore demand in the short term, and iron ore demand is strong. On the inventory side, iron ore port inventories have continued to fall since February and have dropped to 106 million tons by the end of June, a new low since 2017, with a structural gap in inventories. With such a tight supply pattern, China's steel enterprises have a high dependence on imported iron ore. Therefore, it is important to study the relationship between the price of imported iron ore and the exchange rate of the US dollar against national currencies. It can help us pay attention to the impact of exchange rate changes on iron ore prices, so that we can be more comfortable to face the changes in the steel market to make reasonable policy adjustments.

Figure 1 2019-2020 Iron Ore Platts Folding Chart

1. **Problem Analysis**

**3.1 Sample selection**

Iron ore prices are obtained from the Iron Ore Platts data provided by the internship unit for 2010-2020. Since the data are available for each working day, monthly data of iron ore prices are selected for better statistical analysis in the next step. Therefore, the exchange rate of U.S. dollar against each country's currency should also be selected as monthly data, and the monthly exchange rate of U.S. dollar against Australian dollar (AUD), Brazilian real (BRL), Chinese yuan (CNY), Indian rupee (INR) and Japanese yen (JPY) from 2010-2020 is selected as the sample, and the exchange rate data of this paper is obtained from Yingwei Finance.

**3.2 Multiple regression modeling**

Since the price of imported iron ore can be influenced by a variety of factors, a multiple regression model is chosen to conduct the analysis.

**3.2.1 Preliminary analysis by line graph of independent and dependent variables**

To investigate whether the price of imported iron ore changes with the appreciation and depreciation of national currencies. Through the 2010-2020 imported iron ore Platts price folding chart (Figure 2) and 2010-2020 U.S. dollar against each country's currency folding chart (Figure 3) comparison observation guessed that the yen and rupee have a negative correlation with iron ore prices, the currency value of the yuan is stable but imported iron ore prices still fluctuate, guessed that the influence of the yuan on the change of imported iron ore prices is small.

Figure 2 2010-2020 imported iron ore Platts price folding chart

Figure 3 Folding line chart of the exchange rate of the U.S. dollar against national currencies, 2010-2020

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| Table 1 Correlation matrix of imported iron ore prices with the exchange rate of the US dollar against each country's currency | | | | | | | |
|  | | Monthly Average Platts Iron Ore Price Index | USD\_AUD | USD\_BRL | USD\_CNY | USD\_INR | USD\_JPY |
| Pearson Correlation | Monthly average Platts iron  Ore Price Index | 1.000 | -.766 | -.738 | -.163 | -.798 | -.856 |
| USD\_AUD | -.766 | 1.000 | .943 | .603 | .868 | .812 |
| USD\_BRL | -.738 | .943 | 1.000 | .542 | .914 | .748 |
| USD\_CNY | -.163 | .603 | .542 | 1.000 | .329 | .164 |
| USD\_INR | -.798 | .868 | .914 | .329 | 1.000 | .806 |
| USD\_JPY | -.856 | .812 | .748 | .164 | .806 | 1.000 |

**3.2.2 Multiple linear regression analysis**

Multiple linear regression analysis of iron ore and US dollar exchange rates against national currencies using SPSS.

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| Table 2 Summary of the model with all independent variables entered | | | | |
| Models | R | R Square | Adjusted R-squared | Error in standard estimation |
| 1 | .879a | .773 | .764 | 19.200077490000000 |
| a. Forecast variables: (constant), USD\_JPY, USD\_CNY, USD\_INR, USD\_BRL, USD\_AUD | | | | |
| b. Dependent variable: Monthly average Platts iron ore price index | | | | |

The correlation matrix (Table 1) is obtained, and it can be seen that the exchange rates of all four currencies except the RMB have a very high correlation with the Platts iron ore price index.

At this point, let all independent variables enter the model first, so there is only one model here, and the R-squared represents the goodness of fit, and the closer the R-squared is to 1, the better the effect of the goodness of fit of this model is represented. The adjusted R-square represents the goodness of fit, and the closer the R-square is to 1, the better the model fits. The adjusted R-square is the adjusted value when the sample is small. We can see that the R-squared and the adjusted R-squared are both greater than 0.7, which means that the model has a better fit.

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| Table 3 t-test with all independent variables entered | | | |
| Models | | t | Significance |
| 1 | (Constant) | 3.420 | .001 |
| USD\_AUD | -1.458 | .147 |
| USD\_BRL | .085 | .932 |
| USD\_CNY | 1.952 | .053 |
| USD\_INR | -1.801 | .074 |
| USD\_JPY | -4.276 | .000 |
| a. Dependent variable: Monthly average Platts iron ore price index | | | |

The result of the t-test is to determine whether this independent variable has a linear relationship with the dependent variable. It can be seen that the p-value of the t-test is greater than 0.05 for all but the Japanese yen. this indicates that not all variables should enter the equation and that variable screening is required.

The independent variable input process in SPSS linear regression was changed to stepwise, and the optimal model was selected by stepwise regression.

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| Table 4 Stepwise regression results | | | |
| Models | Input variables | Variables to be removed | Method |
| 1 | USD\_JPY | . | Step (condition: probability of F to be entered <= .050, probability of F to be removed >= .100). |
| 2 | USD\_INR | . | Step (condition: probability of F to be entered <= .050, probability of F to be removed >= .100). |
| a. Dependent variable: Monthly average Platts iron ore price index | | | |

**3.2.3 Goodness-of-fit test**

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| Table 5 Summary of stepwise regression models | | | | |
| Models | R | R Square | Adjusted R-squared | Error in standard estimation |
| 1 | .856a | .732 | .730 | 20.532341090000000 |
| 2 | .875b | .766 | .762 | 19.267805870000000 |
| a. Forecast variables: (constant), USD\_JPY | | | | |
| b. Forecast variables: (constant), USD\_JPY, USD\_INR | | | | |
| c. Dependent variable: Monthly average Platts iron ore price index | | | | |

From the stepwise regression results (Table 4) and the summary of stepwise regression models (Table 5), it can be seen that SPSS screened out two groups of models through stepwise regression, model one yen and model two yen and rupee, respectively. r-square is the goodness of fit, and the larger the R, the closer to 1 means the better the model fits. The R-squared and the adjusted R-squared show that the second model is better.

**3.2.4 F-test**

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| Table 6 Stepwise regression model F-test | | | | | | |
| Models | | Square and | Degree of freedom | Mean Square | F | Significance |
| 1 | Return to | 142989.970 | 1 | 142989.970 | 339.179 | .000b |
| Residuals | 52275.552 | 124 | 421.577 |  |  |
| Total | 195265.522 | 125 |  |  |  |
| 2 | Return to | 149601.976 | 2 | 74800.988 | 201.485 | .000c |
| Residuals | 45663.546 | 123 | 371.248 |  |  |
| Total | 195265.522 | 125 |  |  |  |
| a. Dependent variable: Monthly average Platts iron ore price index | | | | | | |
| b. Forecast Variable: (Constant), USD\_JPY | | | | | | |
| c. Forecast variables: (constant), USD\_JPY, USD\_INR | | | | | | |

The original hypothesis of the F-test is

 (1)

The stepwise regression model F-test (Table 6) shows that the p-value of the F-test is less than 0.05, indicating that the regression equation is linear and significant.

**3.2.5 t-test**

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| Table 7 Stepwise regression model coefficients | | | | | | |
| Models | | Unstandardized coefficient | | Standardization factor | t | Significance |
| B | Standard Error | Beta |
| 1 | (Constant) | 348.289 | 13.492 |  | 25.814 | .000 |
| USD\_JPY | -2.423 | .132 | -.856 | -18.417 | .000 |
| 2 | (Constant) | 359.222 | 12.924 |  | 27.796 | .000 |
| USD\_JPY | -1.715 | .208 | -.605 | -8.224 | .000 |
| USD\_INR | -1.365 | .323 | -311 | -4.220 | .000 |
| a. Dependent variable: Monthly average Platts iron ore price index | | | | | | |

The null hypothesis for the t-test was . The stepwise regression model coefficients (Table 7) show that the p-values of the t-test are less than 0.05, rejecting the original hypothesis. The results reflect the significance of the linear effect of the independent variable on the dependent variable, and the variables in both models have a significant linear effect on the dependent variable. beta coefficient reflects the degree of influence of the independent variable on the dependent variable, and it can be seen that the influence of the yen on the price of imported iron ore is greater than that of the rupee, and the beta coefficient, the correlation coefficient and the partial correlation coefficient of the yen are also greater than that of the rupee. The beta coefficient, the correlation coefficient and the partial correlation coefficient of the yen are also greater than that of the rupee.

**3.2.6 Regression equation**

Regression equations were constructed from the regression coefficients in the stepwise regression model coefficients (Table 7): (2)

**3.3 Conclusions and Recommendations**

The results of multiple regressions on the impact of currency exchange rates of major iron ore importing and exporting countries on international iron ore prices show that international iron ore prices are significantly influenced by the exchange rate of the US dollar against the Indian rupee and the Japanese yen.

As one of the major importers of iron ore, China must pay attention to the impact of exchange rate changes on iron ore prices and adjust its policies in a timely manner, and this paper makes the following recommendations.

First, pay attention to the changes in international iron ore prices and related currency exchange rates, adjust economic policies in a timely manner, and strengthen risk management.

Second, the international iron ore prices and the U.S. dollar to rupee exchange rate and the U.S. dollar to yen exchange rate is negatively correlated, can be appropriate to buy India, Japan foreign exchange contracts to avoid the international iron ore prices rise, due to the appreciation of the currency in hand, reducing the loss due to price increases.

Third, actively participate in the construction of the international iron ore price system. The existing system is vulnerable to the restrictions of the U.S. dollar exchange rate, with the RMB gradually become an international currency, China needs to continue to participate in the construction of the international iron ore price system, increase international cooperation to achieve mutual benefit and win-win, and gradually improve China's ability to negotiate in international iron ore pricing.

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