

Prediction of Changes in the Exchange Rate between the USD and the CNY and Analysis of Influencing Factors

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Abstract. As one of the important indicators of the global financial market, the fluctuation of the US dollar to Chinese yuan exchange rate not only directly affects the economic development of China and the United States, but also has important significance for analyzing the global economic situation. Analyzing the factors influencing the exchange rate between the United States dollar (USD) and the Chinese yuan (CNY) is one of the key research topics today. Researchers have found that exchange rates are influenced by factors such as national policies and the global political situation. However, there is still a certain gap in the comprehensive and objective analysis of these influencing factors. Therefore, the research topic of this article is to predict the trend of the exchange rate between the USD and the CNY and analyze the influencing factors. This study collected exchange rate data from January 2000 to November 2023 and used the ARIMA model to predict exchange rate changes. This study explores the trend of exchange rate changes by visualizing these data. Research has found that significant changes in exchange rates over the past two decades have also occurred during times of global instability and policy adjustments. The economic development level of China and the United States also directly affects the changes in exchange rates. In addition, the model used in this study also predicted the exchange rate between the USD and the CNY in 2024, providing a scientific direction for predicting the economic development trend in 2024.

Keywords: USD to CNY exchange rates; Exchange rate prediction; Monetary policy; Global political situation; Trade relations.

1. Introduction

The exchange rate was the rate at which the money of one country could be changed for the Money of another country [1]. The exchange rate can also be seen as the value of one currency against another. Exchange rate fluctuations have a direct regulatory effect on a country's import and export trade. Exchange rate fluctuations are crucial in analyzing the economic development situation, among which the fluctuation of the United States dollar (USD) to Chinese yuan (CNY) exchange rate has a profound impact on the economic landscape of China and the United States. Since China opened up its economy, the exchange rate between the USD and the CNY has always been a concern for economists or citizens of both countries, and its changes will affect trade and investment between China and the United States. Over the past few decades, the exchange rate between the USD and the CNY has experienced multiple fluctuations. In the long run, the main factors affecting the exchange rate of the USD against the CNY are the interest rate hikes by the US Federal Reserve and changes in national policies. The increase in interest rates by the US Federal Reserve will push up the yield of US treasury bond bonds, which will further strengthen the US dollar index, leading to changes in the exchange rate [2]. Changes in relevant national policies or government intervention in exchange rates will directly affect the exchange rate [3]. In the short term, the global political situation will affect changes in exchange rates. At present, the conflict between Russia-Ukraine conflict and the conflict between Palestine and Israel is not over. International capital flows to the United States based on the demand for risk aversion. The massive purchase of US dollars has rapidly pushed up the dollar index, which has also led to the depreciation of the CNY against the dollar [2]. However, exchange rate changes will be influenced by many factors, and the above factors cannot comprehensively predict the exchange rate changes between the USD and the CNY in 2024. In addition, foreign exchange reserves will also have an impact on the exchange rate between the USD and the CNY. A negative relationship

implied that as foreign exchange reserves increased between the United States of America and China the exchange rates between them decreased in the countries that carried out the exchange [4].

In summary, many factors affect the exchange rate of the US dollar against the Chinese yuan. However, there is currently a lack of objective and comprehensive analysis of these factors in previous researches. Therefore, this article uses the ARIMA model to predict the US dollar to Chinese yuan exchange rate from December 2023 to November 2024. This research aims to comprehensively analyze the influencing factors of the exchange rate changes between the US dollar and the Chinese yuan.

2. Method

This study uses the R language to analyze and forecast the exchange rate of the US dollar against the Chinese yuan. When analyzing the trend of the USD to CNY exchange rate in previous years, this study mainly uses the ggplot2 package in the R language for plotting to visualize the yearly trend more intuitively. When forecasting the USD to CNY exchange rate, the Auto-regressive Integrated Moving Average (ARIMA) model is an effective method.

2.1. Data Collection

Firstly, to analyze the exchange rate changes, this study intercepts the monthly USD to CNY exchange rate from January 2000 to November 2023 from the exchange rate statement in the annual data of the Statistics and Analysis Department of the People's Bank of China as the data for analysis. These data use the average exchange rate of each month as the exchange rate data for that month. This ensures that the data used is accurate, complete, trustworthy, and covers a sufficiently long period to capture the trends and periodicity of exchange rate changes.

2.2. Modeling

After the data collection was completed, this study used the ARIMA model to forecast the exchange rate in 2024. The full name of the ARIMA model is the Auto-regressive Integrated Moving Average Model. The ARIMA model is a forecasting model based on time-series data, which combines the components of auto-regression (AR), difference (I), and moving average (MA) [5]. Before establishing the model, the research conducts preliminary exploratory analysis of the collected data, such as observing the trends of the data. Then, the research used the model recognition function `arima()` to select the most suitable ARIMA model structure based on the characteristics of the data and the results of existing research, including the parameter selection of ARIMA (p, d, q).

2.3. Forecasting

After completing the model establishment and parameter estimation, this study used the trained ARIMA model to predict the US dollar to Chinese yuan exchange rate from December 2023 to November 2024. The results will display the specific predicted values and confidence intervals. At the same time, the research also evaluates the predictive performance of the model, such as using root mean square error (RMSE) or other appropriate evaluation metrics to verify the accuracy and reliability of the model.

2.4. Consideration of Influencing Factors

In the analysis process, this study will consider various factors that affect the exchange rate between the US dollar and the Chinese yuan, especially events that occur at certain time points with significant exchange rate changes, such as changes in economic policy, international trade conditions, interest rate policies, inflation rates, macroeconomic indicators, trade data, etc., which may have a significant impact on the exchange rate.

In summary, this study uses the ARIMA model as the main method for analyzing and forecasting the changes in the exchange rate between the US dollar and the Chinese yuan and will give full

consideration to the historical data, model parameter estimation, forecasting results, and factors affecting the exchange rate changes, to provide accurate and reliable forecasting and analyze results.

3. Results

This section will explain and analyze the results of the experiment. Firstly, Figure 1 shows the trend of the average monthly exchange rate between the US dollar and the Chinese yuan from 2000 to 2023. According to the graph, it can be seen that the exchange rate from 2000 to early 2005 was unchanged. Starting from July 2005, the exchange rate continued to decline significantly until July 2008, a decrease of approximately 17.39%. Afterward, the exchange rate continued to fluctuate slightly until 2010. Starting from September 2010, the exchange rate continued to decline until reaching its lowest point in recent years, around 6.1, in 2014. Then, the exchange rate remained low until August 2015. Since August 2015, the exchange rate has fluctuated significantly, but overall it has shown an upward trend.

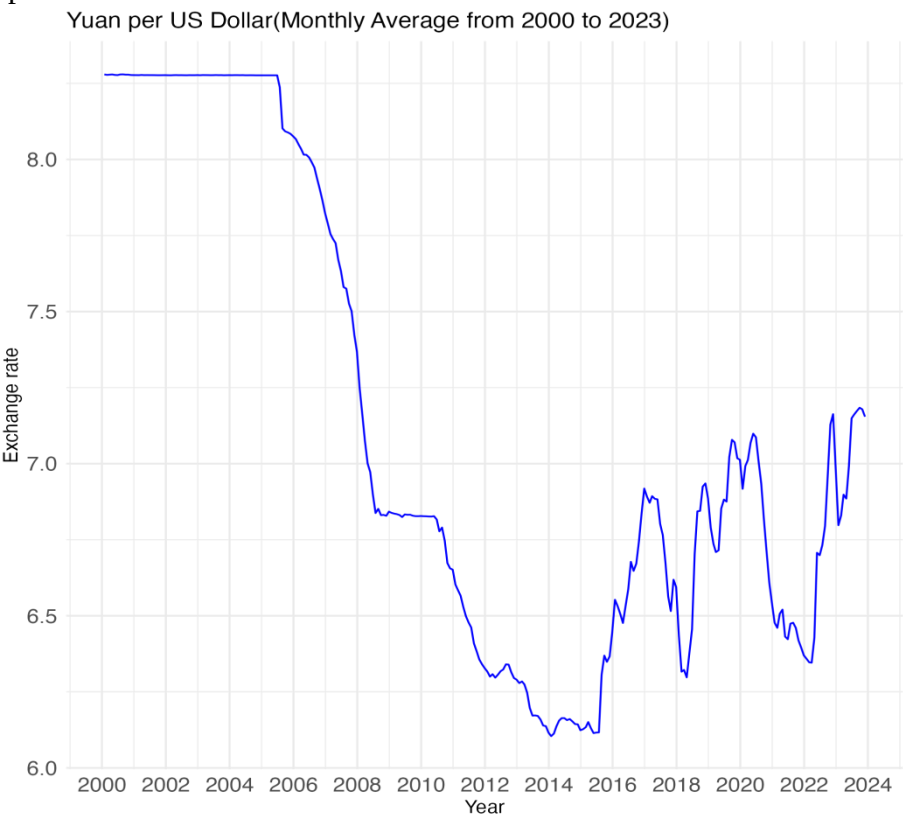


Fig. 1 Trend of exchange rate changes from 2000 to 2023 (Photo/Picture credit: Original).

The ARIMA model is used to forecast the USD/CNY exchange rate from December 2023 to November 2024, and the specific prediction results are shown in Table 1. Among them, Point Forecast is the predicted value based on the model, representing the central estimate of the prediction, which is the average or expected value of future observations that the model considers. The results indicate that the exchange rate predicted by the model from December 2023 to November 2024 is between 7.1453 and 7.1565. Lo 80 (Lo 95) represents the lower limit of the prediction result, usually the lower limit of the confidence interval with a confidence level of 80% (95%). This value indicates that in the prediction, there is an 80% (95%) confidence level that future observations will be above this lower limit. Similarly, Hi 80 (Hi 95) represents the upper limit of the prediction result, which is the upper limit of the confidence interval with a confidence level of 80% (95%). This value indicates that in the prediction, there is an 80% (95%) confidence level that future observations will be below this upper limit.

Table 1. Three Scheme comparing

Point.Forecast	Lo.80	Hi.80	Lo.95	Hi.95
7.156472124	7.098966086	7.213978162	7.068524229	7.244420019
7.1552029	7.048377679	7.262028122	6.991827822	7.318577979
7.145382613	6.996971694	7.293793532	6.9184077	7.372357526
7.152281484	6.971117312	7.333445655	6.875214793	7.429348175
7.152334274	6.940155426	7.364513121	6.827834729	7.476833818
7.145301967	6.905591707	7.385012228	6.77869676	7.511907175
7.151956791	6.888907507	7.415006074	6.749657628	7.554255954
7.151414848	6.865422402	7.437407294	6.714027146	7.58880255
7.145931676	6.838818574	7.453044777	6.676242719	7.615620633
7.151889164	6.8259865	7.477791828	6.653464051	7.650314277
7.150804427	6.806077417	7.495531437	6.623589961	7.678018892
7.146554102	6.784189697	7.508918507	6.592365568	7.700742635

4. Discussion

Based on Figure 1, the research selected several important time points, namely the time when the exchange rate began to undergo significant changes, such as July 2005, September 2010, August 2015, January 2017, April 2018, May 2020, and May 2022. By reviewing economic news from these times, this study concludes that:

July 2005: The People's Bank of China announced the abandonment of the fixed exchange rate system between the Chinese yuan and the US dollar, and instead adjusted based on a basket of currencies.

September 2010: The sustained high-speed growth of the Chinese economy has triggered pressure from the international community to appreciate the Chinese yuan. To alleviate the pressure, the Chinese government has gradually relaxed the control of the Chinese yuan exchange rate and allowed the renminbi to gradually appreciate.

August 2015: The slowdown in China's economic growth and global market turbulence led to a significant depreciation of the CNY exchange rate.

January 2017: At the end of 2016, the Federal Reserve of the United States raised interest rates and adjusted interest rate policies to raise the federal funds rate. This may lead to some international investors flowing their funds out of the United States, seeking higher interest rates or more attractive investment opportunities. This capital outflow may lead to a depreciation of the US dollar, which will result in a decrease in the exchange rate between the US dollar and the Chinese yuan.

April 2018: In early 2018, the trade tensions between China and the United States gradually escalated, with the two countries imposing tariffs on each other, causing market concerns about the uncertainty of the global trade situation. This uncertainty often leads to an increase in investor demand for safe-haven assets such as the US dollar, thereby pushing up the exchange rate of the US dollar against other currencies.

May 2020: The exchange rate decline in this stage was mainly affected by the COVID-19 epidemic, which had different impacts on the global economy. At this time, the global economy is full of uncertainty.

May 2022: After the pandemic, the global political situation was slightly unstable, and the US economic data turned out well. At the same time, the US Federal Reserve continued to raise interest rates, which also triggered investor demand for the haven asset of the US dollar, leading to an increase in the exchange rate [6].

The research results indicate that the economic development level, national policy adjustments, and global political situation of China and the United States have a significant impact on the exchange rate of the US dollar against the Chinese yuan. These findings help to understand the driving factors behind exchange rate fluctuations and provide important references for future forecasting and

decision-making. Through calculation, the RMSE of the model is about 3.8%. Although the model has shown good accuracy in prediction, there are also some limitations, such as the complex and non-linear trend of exchange rate changes, which may limit the model's ability to make predictions and may require the introduction of other models to better capture these features.

In the future, the research will collect more data, such as detailed daily exchange rates, to further improve the accuracy of predictions. In addition, the research will also consider more complex time series models, such as SARIMA and machine learning models, to better handle nonlinear relationships in data and improve the reliability of the models. This study fills the gap in the analysis of the fluctuation of the US dollar to the Chinese yuan exchange rate and provides important insights for related research.

5. Conclusion

Through in-depth research and analysis of the exchange rate changes between the US dollar and the Chinese yuan, this study confirms that exchange rate changes not only reflect the economic dynamics of China and the United States but also directly affect the stability of international economic trade and financial markets. This study found that the factors affecting the exchange rate between the US dollar and the Chinese yuan exist in the following aspects:

Basic economic factors: The economic conditions of China and the United States will directly affect the exchange rate of the US dollar against the Chinese yuan. Economic growth, inflation, interest policies, and other factors will affect the trend of exchange rates to varying degrees.

National monetary policy: The policies of the People's Bank of China and the US Federal Reserve will also directly affect exchange rate fluctuations, especially the US Federal Reserve's adjustments to interest rates.

Geopolitical factors: The relationship between China and the United States, the international political situation, and the geopolitical situation will all have a serious impact on the exchange rate.

This study fully analyzed the factors that have a significant impact on exchange rates through the trend chart of exchange rate changes. In addition, the model used in this study also predicted the exchange rate between the US dollar and the Chinese yuan in 2024, providing a scientific direction for predicting the economic development trend in 2024. However, there are still shortcomings in this study, as the model's generalization is not very good and other factors cannot be considered. In the future, the research will make improvements to this, such as continuing to optimize the model or considering regression analysis of exchange rates and other influencing factors, such as gold prices, oil prices, etc.

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