Chinese Yuan (CNY) vs. United States Dollar (USD)

Currency Report

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Overview

- The CNY reached a 16-month high of 7.03 against the USD in September 2024, driven by U.S. monetary policy changes and China's economic measures.
- The Federal Reserve's dovish stance and China's interest rate cuts supported CNY appreciation.
- Long-term pressures such as demographic challenges, high debt levels, and limited internationalization suggest potential CNY depreciation over long term, which aligns with regression and UIRP long-term results.

1. Recent RMB Appreciation Against the USD

In late September 2024, the RMB reached a 16-month high of around 7.03 against the USD, driven by changes in U.S. monetary policy, China's domestic measures, and global market dynamics.

1.1. U.S. Dollar Weakness and Interest Rate Differential

The weakening of the U.S. dollar, caused by the Federal Reserve's shift to a more dovish stance since mid-2023, has been a key factor in the RMB's appreciation. As the Fed eased rates, the dollar index declined, leading to capital outflows from the U.S. Additionally, the narrowing interest rate differential between the U.S. and China has made Chinese assets more attractive, mitigating depreciation pressure on the RMB and supporting its appreciation.

1.2. Chinese Domestic Economic Policies

China's economic measures, such as lowering the reserve requirement ratio and policy interest rates, have contributed to the RMB's strength. The government's efforts to stimulate demand, especially in the real estate sector, and the PBOC's focus on a stable exchange rate have reassured markets, boosting confidence in the RMB.

1.3. Global Market Conditions

Geopolitical uncertainties, including U.S. elections and global market volatility, have led investors to seek stability. China's recovering economy and strong trade performance have made it an attractive destination for capital, further supporting the demand for RMB.

1.4. Outlook

Analysts expect the RMB to continue strengthening, potentially trading between 6.8 and 7.1 against the dollar, depending on U.S. monetary policy, China's economic recovery, and global developments.

2. Long-Term RMB Depreciation

Despite recent gains, the RMB faces long-term depreciation pressures due to structural challenges in China's economy and shifting global trends.

2.1. Economic and Demographic Challenges

China's transition from an investment-driven to a consumption-based economy is slowing its growth. Demographic headwinds, including an aging population and shrinking workforce, are likely to exacerbate this slowdown, increasing fiscal burdens and weakening economic competitiveness, leading to long-term depreciation pressure on the RMB.

2.2. Debt Levels and Capital Outflows

High corporate and local government debt pose risks to financial stability. If China loosens capital controls in the future, potential capital outflows could reduce demand for the RMB. This would further contribute to depreciation pressure, especially if China's foreign exchange reserves are insufficient to offset large outflows.

2.3. Global Trade and Limited RMB Internationalization

Geopolitical tensions and the diversification of global trade away from China may weaken the country's export sector, reducing the global demand for RMB. Additionally, the RMB's limited use as a global reserve currency due to capital controls and financial transparency concerns continues to restrict its internationalization, further supporting long-term depreciation.

2.4. Conclusion

Long-term depreciation of the RMB against the USD is expected due to slowing economic growth, demographic challenges, high debt levels, potential capital outflows, and limited internationalization. While short-term fluctuations may occur, the structural factors suggest the RMB is likely to depreciate over the long term.

3. Macro Index Analysis

3.1. GDP

3.1.1. China

China's real GDP growth reached 5.0% year-on-year in H1 2024. The cumulative GDP deflator declined by 0.9% year-on-year, worsening from -0.5% in December 2023. Demand was driven by policy support and a rebound in external demand; however, slow policy advancement, coupled with supply outstripping demand in traditional sectors, led to nominal GDP growth of only 4.0% year-on-year in the first quarter and a further decline in the GDP deflator.

3.1.2. United States

In the first quarter of 2024, U.S. real GDP grew at an annualized rate of 1.6% and a year-on-year growth rate of 3.0%, exceeding expectations. Core PCEPI grew at an annualized rate of 3.7%, continuing to reflect inflationary pressures and sparking market divergence on economic resilience. The US Dollar Index swung sharply as a result, approaching a high of 106. Second-quarter GDP grew 2.8% annualized, higher than the expected 2%, but overall economic downward pressure remains, and the dollar has limited room to rebound.

3.1.3. U.S.-China Economic Comparison

Compared with 2020-2021, GDP growth in China and the U.S. is slowing down, the trend is converging, and both are facing growth challenges. China needs to accelerate policy implementation and stimulate domestic demand, while the U.S. needs to deal with inflation and a tight labor market to maintain economic resilience.

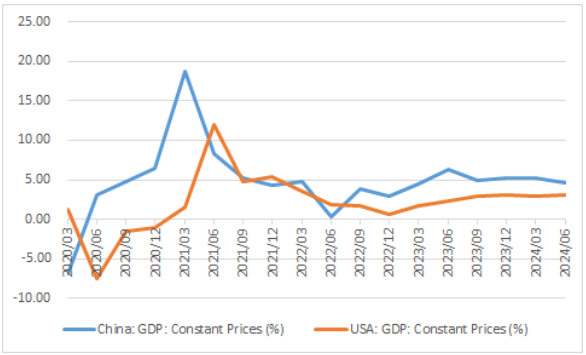

Figure 1: China and US GDP growth rate: 2020-2024

3.2. CPI

3.2.1. China

In the first half of 2024, China's CPI rose 0.3% year-on-year, indicating a relatively stable price level. Structurally, food prices declined by 2.0%, while non-food prices rose by 0.8%. Changes in CPI will have a direct impact on market expectations and investor confidence, and a stable CPI will help enhance market confidence and promote the stable development of the capital market. If the market expects prices to continue to rise, it may lead investors to lay out their positions in advance, thus further pushing up asset prices.

3.2.2. United Sates

In the first half of 2024, the year-on-year CPI growth rate in the US declined, indicating easing inflationary pressures. However, core CPI (net of food and energy prices) remained at a high level, reflecting the rising trend in service prices. Fluctuations in energy prices have a greater impact on the U.S. CPI, with geopolitical tensions and supply disruptions in the global oil market likely to lead to a spike in energy prices, pushing up the CPI.Meanwhile, the rapid development of the U.S. service sector has become an important factor in pushing up the CPI, driven mainly by rising labor costs and strong demand.

3.2.3. U.S.-China CPI Comparison

The CPI data of China and the US reflect the different characteristics and development trends of their respective economies. In China, the combination of declining food prices and rising non-food prices has resulted in a relatively stable price level, while the US is facing a persistently high core CPI, although overall inflationary pressures have eased.

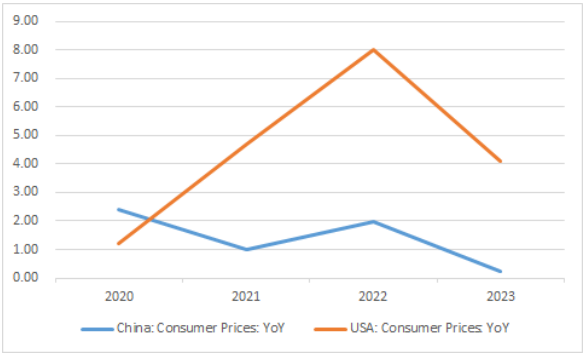

Figure 2: China and US CPI growth rate: 2020-2023

4. Financial market impact

Analyzing from Bonds, Stocks, and Commodities

4.1. The Impact of Government Bonds

In the first half of 2024, U.S. Treasury yields continued to rise, with the 10-year Treasury yield increasing by approximately 52 basis points, reaching 4.4% (source: Nasdaq). The Federal Reserve's

tightening policy made U.S. bonds more attractive to investors, leading to a significant inflow of international capital into the U.S., which in turn boosted demand for the dollar. This strengthened the dollar further, exerting greater depreciation pressure on the Chinese yuan. In contrast, China adopted a relatively loose monetary policy in the first half of 2024 to support economic recovery. As a result, China's bond yields remained comparatively low, widening the yield gap between China and the U.S., and intensifying capital outflows from China, which exacerbated the depreciation pressure on the yuan against the dollar.

Figure 3: 10-year China and US bond yields in 2024

4.2. The Impact of stock

In 2024, the U.S. stock market showed strong performance, with the technology sector leading the rally. Fueled by the booming artificial intelligence and semiconductor industries, the technology sector grew by approximately 8.8% in the second quarter, driven primarily by tech giants such as Apple and Nvidia. Overall, the S&P 500 index surged by over 28% in the first half of the year, attracting significant international capital inflows into the U.S. market. This influx of capital increased demand for the U.S. dollar, further strengthening its position, while placing substantial depreciation pressure on the Chinese yuan.

In contrast, the Chinese stock market showed weaker performance. Despite government stimulus measures, key sectors such as real estate and consumer industries underperformed, with economic recovery progressing slowly. The CSI 300 index remained flat or experienced slight declines in the first half of the year. The sluggish performance of China's stock market exacerbated capital outflows, further weakening the yuan's exchange rate. In stark contrast to the robust U.S. stock market, investors were more inclined to pursue higher returns in the U.S., widening the demand gap between the dollar and the yuan, which intensified the depreciation pressure on the Chinese currency.

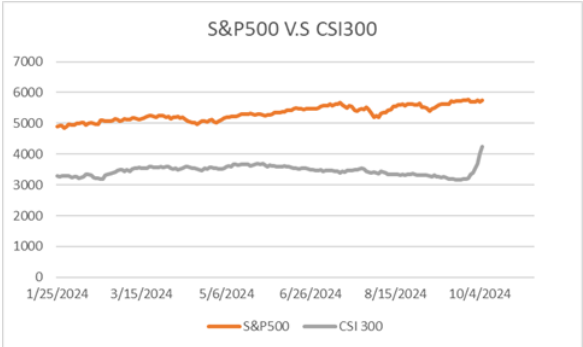

Figure 4: S&P500 and CSI300 Index in 2024

5. Global risk factors

5.1. Tech Competition

The technological competition between the U.S. and China, especially in semiconductors, AI, and 5G, has directly affected the CNY-USD exchange rate. In 2022, the U.S. passed the CHIPS and Science Act, imposing export controls that limited China's access to advanced technologies. These restrictions continued into 2024, worsening trade tensions and affecting investment.

As Chinese companies struggled to acquire key components, market uncertainty grew. Investors sought safer assets, like the U.S. dollar, causing the yuan to weaken, especially in late 2023, when it passed the "7" mark due to concerns over geopolitical risks and U.S. sanctions(China News). Additionally, U.S. fears over the growth of Chinese tech firms like Huawei led to stricter controls on AI and semiconductor exports, causing capital outflows from China and further weakening the yuan.

5.2. Ukraine War

The Ukraine war has significantly impacted the CNY-USD exchange rate, primarily through rising global energy prices and supply chain disruptions. From 2022 to 2023, the conflict led to a sharp increase in oil and natural gas prices, resulting in global inflation and supply chain pressures. As Europe reduced its reliance on Russian energy, the demand for alternative energy sources surged, placing greater pressure on the market. As a major energy importer, China's demand for foreign exchange increased, affecting its foreign reserves and consequently leading to a depreciation of the yuan.

Moreover, the war triggered a global risk-averse sentiment, driving capital into safe assets like U.S. Treasury bonds, which further strengthened the dollar and pressured the yuan. According to data from the International Monetary Fund (IMF), this

trend has persisted from 2022 to 2024, weakening the yuan's competitiveness in the international market.

In summary, the technological competition between the U.S. and China, along with the Ukraine war, has heightened exchange rate volatility, increased geopolitical risks, and influenced capital flows.

6. Prediction

6.1. Ordinary Least Squares (OLS) regression model

Several key economic indicators were chosen as explanatory variables based on their historical impact on exchange rate fluctuations. The dependent variable in this model is the CNYUSD exchange rate, and the variables include: Consumer Price Index (CPI); Unemployment Rate (UR); Interest Rate (INT); Foreign Reserves (FR); Current Account (CA).

The regression results suggest that the CPI differential and Foreign Reserve differential have the most significant impact on the CNYUSD exchange rate. Using the estimated regression coefficients and forecasted values for the variables, the following exchange rates were predicted over the next 1, 3, and 5 years:

Table 1: Regression Forecast

	1-Year	3-Year	5-Year
Forecast Rate (CNYUSD)	7.2060	7.2151	7.2276

6.2. Uncovered Interest Rate Parity (UIRP)

The UIRP method was also applied to forecast the future exchange rate of CNYUSD over 1-year, 3-year, and 5-year horizons. The interest rates on China Treasuries for the 3 periods are all lower than those of comparable US securities. This difference in interest rates suggests a probable future appreciation in the value of the CNY, as shown in the table below:

Table 2: UIRP Forecast

	Sep-24	1-Year	3-Year	5-Year
Spot Rate (CNYUSD)	7.0845			
United States		3.96%	3.52%	3.51%
China		1.49%	1.67%	1.85%
UIRP Rate (CNYUSD)	N/A	6.9163	6.9579	6.9713

6.3. Prediction Summary

The regression and UIRP forecasts present contrasting views on the future trajectory of the CNYUSD exchange rate. The regression analysis suggests a gradual depreciation of the yuan over the 1-year, 3-year, and 5-year horizons, reflecting the impact of CPI differentials and potential economic pressures. On the other hand, the UIRP model forecasts a potential appreciation of the yuan. The model indicates that the yuan could strengthen against the U.S. dollar as capital inflows seek higher returns abroad. Overall, both models foresee a slight trend of depreciation of the yuan over longer periods–3-year and 5-year.

7. Conclusion – Short-term RMB depreciation, with potential long-term stability

In the short term, we expect that the RMB will depreciate against the USD, with a 1-year forecasted exchange rate of approximately 7.2060. This prediction is driven by factors such as a widening interest rate differential between the U.S. and China, stronger U.S. economic performance, and a slower-than-expected recovery in China's economy.

In the medium term (3 years), the RMB is projected to stabilize around 7.2151, as China adjusts its economic policies and global conditions evolve. For the long term (5 years), while the RMB may face structural pressures such as demographic challenges and rising debt levels, it is expected to remain relatively stable at around 7.2276. However, depreciation pressures will persist due to these ongoing structural issues. This aligns with long-term trends observed in previous forecasts.

Appendix A. Prediction Methodology

Appendix A.1. Data Sources

The data used in the regression model and UIRP were collected from the following sources:

- **World Bank**: For data on GDP, inflation, and current account balances.
- **International Monetary Fund (IMF)**: For data on foreign reserves and macroeconomic indicators.
- **People's Bank of China (PBOC)** and **Federal Reserve**: For interest rates and monetary policies.
- **National Bureau of Statistics of China**: For domestic economic data such as CPI and unemployment rate.

Appendix A.2. Regression Model

Assumptions:

- Linear relationships between the exchange rate and the selected economic indicators.
- Stability of economic policies in China and the US over the forecast period.

Limitations:

- Unexpected global events or political shifts may impact the accuracy of the predictions.
- The model does not account for short-term market sentiment or speculative factors.

We initially considered the following factors: Consumer Price Index (CPI), Unemployment Rate (UR), Current Account Balance (CA), Producer Price Index (PPI), Industrial Production (IP), Foreign Reserves (FR), and Interest Rate Differential (INT).

Due to the significant data gaps in China before 2010 and the availability of the Current Account Balance only on a quarterly basis, the data for all factors was selected from Q1 2010 to Q1 2024, totaling 57 data points. For the original data, since there were many negative values in the U.S. Current Account Balance, which made logarithmic transformation impossible, Min-Max scaling was applied while preserving the dimensional consistency, projecting all U.S. CA data to positive values. Therefore, the original regression model was:

$$\ln\left(\frac{\text{CNY/USD}_{t+1}}{\text{CNY/USD}_t}\right) = \beta_0 + \beta_1\left[\ln\left(\frac{\text{CPI}^{\text{CHN}}_{t+1}}{\text{CPI}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{CPI}^{\text{USA}}_{t+1}}{\text{CPI}^{\text{USA}}_t}\right)\right] + \beta_2\left[\ln\left(\frac{\text{UR}^{\text{CHN}}_{t+1}}{\text{UR}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{UR}^{\text{USA}}_{t+1}}{\text{UR}^{\text{USA}}_t}\right)\right] + \beta_3\left[\ln\left(\frac{\text{CA}^{\text{CHN}}_{t+1}}{\text{CA}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{CA}^{\text{USA}}_{t+1}}{\text{CA}^{\text{USA}}_t}\right)\right] + \beta_4\left[\ln\left(\frac{\text{PPI}^{\text{CHN}}_{t+1}}{\text{PPI}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{PPI}^{\text{USA}}_{t+1}}{\text{PPI}^{\text{USA}}_t}\right)\right] + \beta_5\left[\ln\left(\frac{\text{IP}^{\text{CHN}}_{t+1}}{\text{IP}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{IP}^{\text{USA}}_{t+1}}{\text{IP}^{\text{USA}}_t}\right)\right] + \beta_6\left[\ln\left(\frac{\text{FR}^{\text{CHN}}_{t+1}}{\text{FR}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{FR}^{\text{USA}}_{t+1}}{\text{FR}^{\text{USA}}_t}\right)\right] + \beta_7\left[\ln\left(\frac{\text{INT}^{\text{CHN}}_{t+1}}{\text{INT}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{INT}^{\text{USA}}_{t+1}}{\text{INT}^{\text{USA}}_t}\right)\right] + \epsilon_t \tag{A.1}$$

(A.2)

Based on the regression model and a 10% significance level, we selected the most statistically significant factors that impact the CNYUSD exchange rate. These factors include Consumer Price Index (CPI), Unemployment Rate (UR), Foreign Reserves (FR), Interest Rate Differential (INT), and Current Account Balance (CA).

The resulting regression equation is as follows:

$$\ln\left(\frac{\text{CNY/USD}_{t+1}}{\text{CNY/USD}_t}\right) = -0.002 - 0.5928\left[\ln\left(\frac{\text{CPI}^{\text{CHN}}_{t+1}}{\text{CPI}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{CPI}^{\text{USA}}_{t+1}}{\text{CPI}^{\text{USA}}_t}\right)\right] - 0.0323\left[\ln\left(\frac{\text{UR}^{\text{CHN}}_{t+1}}{\text{UR}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{UR}^{\text{USA}}_{t+1}}{\text{UR}^{\text{USA}}_t}\right)\right] - 0.0013\left[\ln\left(\frac{\text{CA}^{\text{CHN}}_{t+1}}{\text{CA}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{CA}^{\text{USA}}_{t+1}}{\text{CA}^{\text{USA}}_t}\right)\right] + 0.1698\left[\ln\left(\frac{\text{FR}^{\text{CHN}}_{t+1}}{\text{FR}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{FR}^{\text{USA}}_{t+1}}{\text{FR}^{\text{USA}}_t}\right)\right] - 0.0148\left[\ln\left(\frac{\text{INT}^{\text{CHN}}_{t+1}}{\text{INT}^{\text{CHN}}_t}\right) - \ln\left(\frac{\text{INT}^{\text{USA}}_{t+1}}{\text{INT}^{\text{USA}}_t}\right)\right] \tag{A.3}$$

(A.4)

Although the constant term was not significant, removing it resulted in a decrease in the model's R-squared score. Therefore, the constant term was retained in the new model. Moreover, the new model's AIC and BIC values were both lower than those of the original model, indicating that the new

model performs better in terms of the balance between explanatory power and overfitting.
The model's coefficients indicate that: A higher CPI differential (China vs. U.S.) results in the appreciation of the Chinese yuan, suggesting inflationary pressure is a critical factor in maintaining competitiveness. An increasing interest rate differential (U.S. rates higher than China's) tends to weaken the yuan due to capital outflows seeking higher returns in U.S.-denominated assets.

Appendix A.3. Monte Carlo Simulation

Prediction:

After constructing the final OLS prediction model, we applied the Monte Carlo method to forecast the values of the five explanatory variables over 1, 3, and 5 years.

First, we calculated the mean, standard deviation, and correlation matrix for each variable. To account for market volatility between China and the U.S., as well as international political changes, a volatility factor (`volatility_factor = 2`) was introduced, adjusting the standard deviations accordingly. Since the original correlation matrix was not positive definite, a small perturbation ϵ was added to the diagonal to ensure that the correlation matrix could be decomposed via Cholesky decomposition. This step preserves the correlation between the variables, allowing for proper linear relationships during the random number generation process.

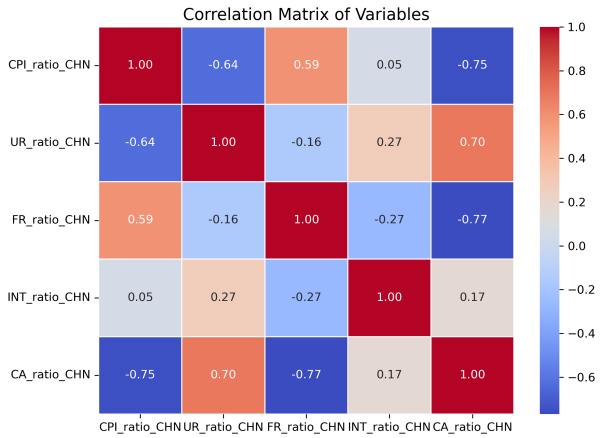

Figure A.5: Correlation Matrix Heatmap

Next, we defined a general Monte Carlo simulation function, `monte_carlo_simulation`. This function generates possible future exchange rate (CNY/USD) paths over multiple time steps (quarterly) with 20,000 simulations. Random numbers are drawn from a standard normal distribution and then adjusted based on the Cholesky decomposition result to maintain correlations between variables. Each variable's simulation begins from its last known value in the historical data and projects forward into the future.

The primary goal of the Monte Carlo simulation is to predict exchange rates over different time periods: 1 year (7 time steps starting from 2024 Q1), 3 years (15 time steps starting from 2024Q1), and 5 years (23 time steps starting from 2024Q1). In each simulation, the mean values of the economic variables and the predetermined regression coefficients are used to calculate the log of the predicted value $\ln(Y)$, which is then converted into the actual predicted exchange rate Y through an exponential function. The simulated paths accumulate step by step, generating forecasted exchange rates for each year.

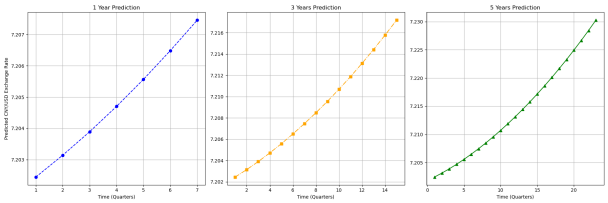

Figure A.6: Predicted CNY/USD Exchange Rate for Different Time Horizons: 1 Year, 3 Years, and 5 Years.

After the simulation is complete, the exchange rates for the last 4 time steps are extracted, and the mean of these values is calculated. This produces the average exchange rate forecasts for 1, 3, and 5 years, with the specific results detailed in the main text.

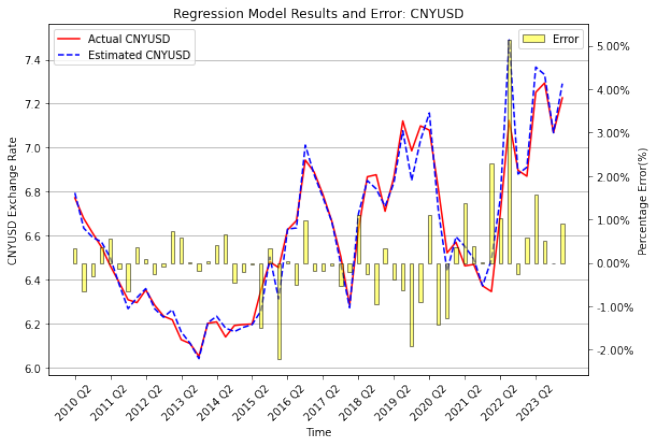

Figure A.7: Regression Results and Error

Appendix A.4. UIRP

The theory of UIRP relates the difference in interest rates between two countries to the expected changes in their exchange rates. According to UIRP, if one country has a higher interest rate than another, its currency is expected to depreciate against the lower-interest-rate country's currency over time, to prevent arbitrage opportunities. Mathematically, it can be expressed as:

$$E(S_{t+k}) = S_t \left(\frac{1 + i^{\text{CNY}}_{t,t+k}}{1 + i^{\text{USD}}_{t,t+k}} \right) \tag{A.5}$$

Appendix A.5. Comparison

The future CNYUSD exchange rates predicted by the regression model and the UIRP method display distinct patterns over different time horizons. In the short term, the forecasts diverge significantly, with the regression model suggesting a gradual depreciation of the CNY against the USD, while the UIRP model predicts a potential appreciation driven by the interest rate differential favoring China.

In the medium and long-term outlooks, both models project a similar trend towards a slight depreciation of the CNY. The regression model attributes this to factors such as inflation differentials and structural economic challenges in China, including high debt levels and demographic headwinds. Meanwhile, the UIRP model's expectations of a reversion to long-term trends support a modest depreciation scenario.

While the regression model may better capture the impact of economic fundamentals, the UIRP model aligns with the anticipated effects of interest rate parity over extended periods, providing complementary perspectives for assessing future exchange rate movements.

Appendix B. Other Plots

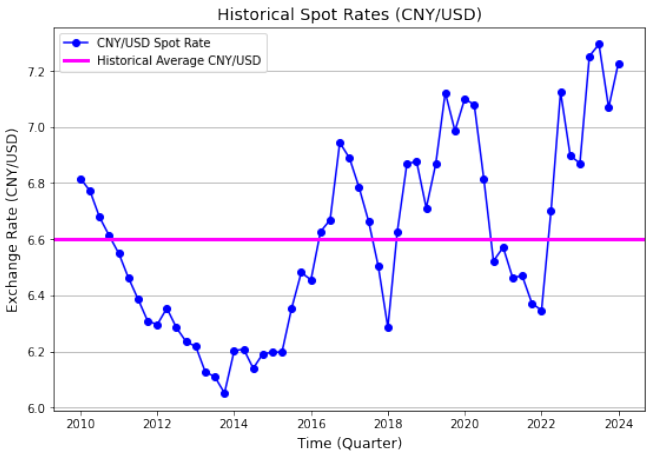

Figure B.8: Historical Spot Rate

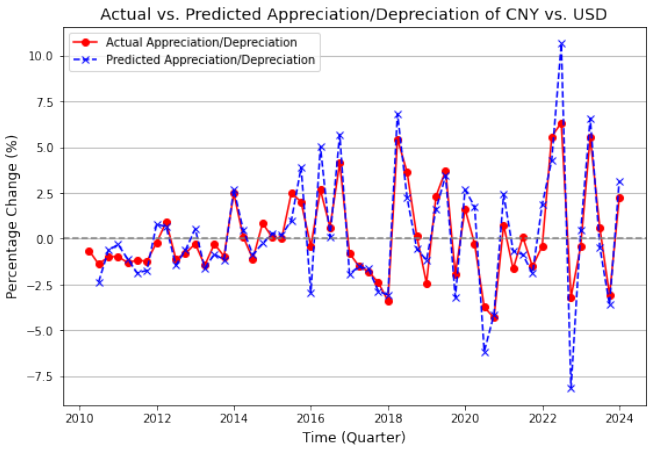

Figure B.9: Actual and Predicted Rates of CNYUSD Appreciation/Depreciation by Regression