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Country-Level Indicators and Foreign Exchange Returns

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Abstract

This study uses daily foreign exchange (FX) rate changes in China, Japan, and Brazil from 2000 to 2022 to examine the predictability of FX returns. I observe multiple Bloomberg signals with statistically significant return-forecasting power to the FX returns. These signals can be divided into three groups: macroeconomic, investor sentiment, and stock market related. This study adds to the empirical understanding of how country-level economic indicators can forecast FX returns.

Keywords

Foreign Exchange, Global Macro, Return Forecasting, Portfolio Management, China, Japan, Brazil

1. Introduction

Perennial questions in finance include whether exchange rate movements are predictable and exchange rate returns are predictable. According to Samuelson's (1965) efficient market hypothesis (EMH), asset prices fully and instantly reflect all available relevant information. According to this hypothesis, returns are unpredictable because price adjustments resulting from new information are immediate and accurate since prices in efficient markets follow a random walk. Therefore, returns in the foreign exchange market are completely unpredictable based on past price and return information.

Many studies are still devoted to revealing the empirical laws of exchange rate changes. Lo (2004) proposed the adaptive markets hypothesis (AMH), which provides a framework that reconciles the efficient market hypothesis with bounded rationality. An important implication of AMH is that predictability in foreign exchange returns may sometimes occur due to changes in market conditions and

institutional factors.

Regarding the volatility of the foreign exchange market, multiple studies have found that coordinated intervention by central banks, the Asian financial crisis, and the global financial crisis can affect market characteristics such as market efficiency (LeBaron, 1999; Jeon & Seo, 2003; Ahmad et al., 2011). These events can significantly impact the psychological mood of market participants and how they use the new integrated information, which can produce temporal changes in the serial correlation of foreign exchange returns. According to Lo's (2005) AMH, the degree of predictability of foreign exchange returns may primarily driven by such dynamic market conditions.

Ederington and Lee (1993), Andersen and Bollerslev (1998), and Melvin and Yin (2000) all find the impact of macroeconomic announcements on exchange rate volatility. Faust et al. (2007) show that drastic and unexpected macroeconomic announcements may increase exchange rate appreciation. Mueller et al. (2017) state that monetary policy uncertainty affects foreign exchange returns. Ghironi and Ozhan (2019) show that interest rate uncertainty reduces returns and increases currency risk. These literatures show the impact of macroeconomic and monetary policies on exchange rate changes. The data used in my research is also the national-level signal index, and many aspects of signal data have been processed and analyzed. My research results more specifically enumerate the signal factors that reasonably impact foreign exchange returns in historical data.

The currencies used in my empirical applications include the Chinese Yuan, the Japanese Yen, and the Brazilian Real. I chose these currencies because each one has unique characteristics as an investment. The CNY's influence and transactions in international currencies are gradually increasing while the Japanese Yen has always been considered a safe asset. Brazilian Real is the representative currency of emerging countries, and its depreciation is more sensitive to regional shocks and changes in global economic factors.

The choice of country can also be divided into developed, developing, and underdeveloped countries. This allocation choice allows for a more comprehensive analysis of the macroeconomic factors faced by countries with different levels of development and the differences in their political stability. Japan and China have stable politics and policies to stabilize their exchange rates, but China's solid economic strength provides more support for the exchange rate. Compared with the former, although Brazil also has good economic momentum, its political factors tend to be turbulent. In this way, the choice of country can directly see the influence of political factors and economic momentum on foreign exchange.

China has long run on trade surplus, which has helped keep RMB relatively stable. Rapid GDP growth generally supports the RMB exchange rate, and its large foreign exchange reserves provide additional stability. The Chinese government maintains exchange rate stability through currency manipulation and

capital controls. The Yen is often seen as a "safe haven" when global risks increase; Japan's long-term low interest rate environment usually drives capital outflows and affects the exchange rate. Due to its high reliance on imported energy, price fluctuations may affect the Japanese Yen; Japan's monetary policies, such as quantitative easing, have been used to stimulate the economy and influence the exchange rate. In Brazil, an important exporter of commodities like iron ore and agricultural products, commodity price fluctuations affect the real. Often, so do political instability and economic policy uncertainty. However, as an emerging market, Brazil usually relies on foreign direct investment, and these capital flows can affect the exchange rate. Brazil's high inflation and interest rate environment will lead to high exchange rate volatility.

The profit margin signal is most important for the return of the RMB exchange rate, illustrating the impact of China's international solid trade status on the exchange rate. The most significant signal index for the Japanese yen is holding sentiment, consistent with investors viewing it as an essential safe-haven currency. Brazil has an occupied purchasing power parity signal, which is also due to Brazil's long-term high inflation rate. Notably, as an international trade supporting the stability of China's exchange rate, its historical data reflects a negative impact on foreign exchange returns when the profit margin increases. I will analyze this in detail in the following parts. Similarly, for the safe-haven Japanese yen, the result reflects the negative impact on foreign exchange returns when holding sentiment signal rises among all investors. Real's foreign exchange returns increase when the Brazilian purchasing power parities signal increases, possibly due to Brazil's long-term high inflation.

The novelty of my contribution is that it compares random fluctuations of a large number of signal indices with exchange rate fluctuations to reflect which signals are relevant and may have predictive power in foreign exchange return data. This study contributes to empirical research examining the determinants of exchange rates. Fama (1984) used the GARCH model to estimate conditional exchange rate volatility, but its ability to predict exchange rate changes needed to be stronger. Based on the time series method, I chose to find the predictive signal factors for exchange rate changes through comparative analysis of historical data. The main focus of Chinn (2006) is on basic macroeconomic indicators to determine the equilibrium exchange rate. I used the signal data of Bloomberg macroeconomic indicators to conduct regression analysis and verified which Bloomberg signals would affect foreign exchange returns by analyzing the correlation of the results.

A large amount of literature shows the role of basic macroeconomic indicators such as terms of trade, government expenditure, foreign currency exchange rates, and central bank monetary policy in determining the equilibrium exchange rate. Chinn (2006), Bacchetta and van Wincoop (2006), Ederington and Lee (1993), Mueller, Tahbaz-Salehi and Vedolin (2017), and Melvin and Yin (2000) indicate that unexpected macroeconomic events can affect exchange rates. My data anal-

ysis does reflect that macroeconomic indicators are the most effective signals. I pay more attention to the correlation between data fluctuations of different signals and exchange rate price changes. Then, I analyze whether the signal predicts exchange rate fluctuations through literature support and correlation. When analyzing the reasons for changes in signal index, I emphasized the economic reasons that may accompany changes in the signal index and the possible monetary policy adjustments to remind exchange rate fluctuations. Overall, Foreign exchange rate return forecasts are helpful for traders in the foreign exchange market. This research could help traders optimize profits through information from Bloomberg data and measurement of geopolitical risk.

The rest of the paper is organized as follows. Section 2 explains my data methodology and analysis process. Section 3 offers potential interpretations of the results from data analysis. Section 4 concludes and discusses research extensions.

2. Data and Methodology

I use monthly exchange rates to test my hypothesis. I extracted 3 countries from the data Bloomberg Financial Terminal set, China, Japan, and Brazil, as the primary research objects. The sample range I am using is from January 2000 to October 2020. Exchange rate quotes are daily direct quotes in units of one U.S. dollar per local currency. I use closing prices, where an increase in the exchange rate means the domestic currency depreciates against the U.S. dollar, and a decrease in the exchange rate means the domestic currency appreciates against the U.S. dollar. The second data also comes from Bloomberg Financial Terminal. I extracted all signal index changes related to the above three countries to verify which signal indexes effectively predict exchange rate return changes.

The monthly exchange rate and return chart show that the RMB has experienced significant depreciation since May 2022 (**Figure 1**), which has also led to the most extended continuous negative return in the monthly return of the RMB. This phenomenon is also shown in the charts of the Japanese Yen and the Brazilian Real. In late 2021, the post-COVID period, Japanese Yen experienced a substantial and sustained depreciation (**Figure 2**). Relative to the substantial depreciation of the RMB and the Japanese yen, the Brazilian real has depreciated to a great extent since the early days of COVID-19 in 2020 and has shown extreme volatility throughout the COVID period (**Figure 3**). Economies around the world are in the doldrums and growing slowly. When irresistible pressure occurs, the economies of various countries will be affected. The development momentum of macroeconomics is expressed as a signal indicator, and the impact is a change in the exchange rate.

After the global COVID-19 crisis begins in 2022, the world economy will gradually begin to recover. In response to the economic downturn caused by the prolonged epidemic, various countries have actively introduced monetary policies to stimulate the economy. As the U.S. economic recovery stabilizes and global trade resumes, investors' demand for the U.S. dollar has increased significantly. As the world's primary currency, the U.S. dollar continues to strengthen,

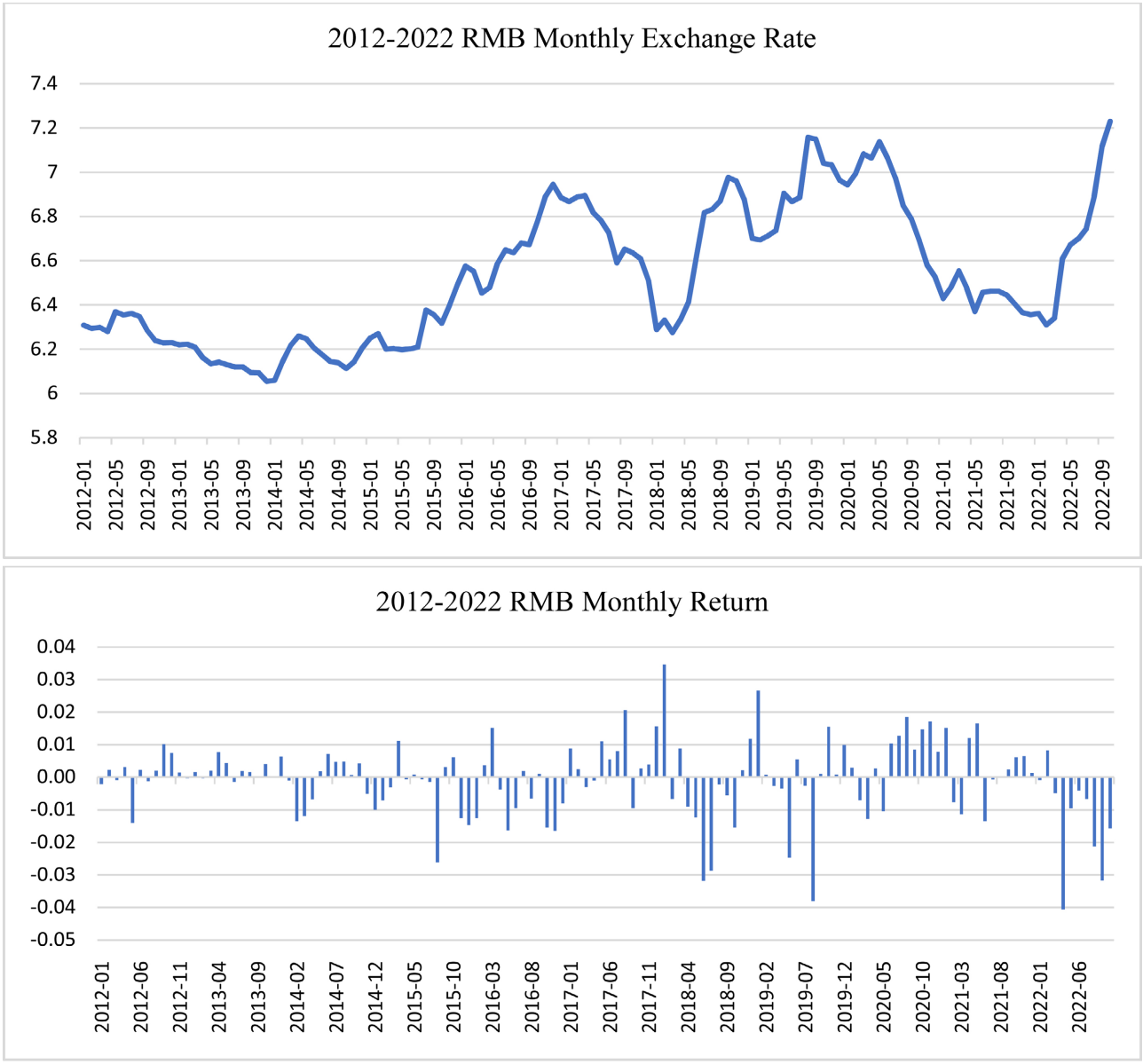

Figure 1. 2012-2022 RMB exchange rate and monthly return. The monthly exchange rate of RMB from 2000 to 2022, and the monthly return. Both tables have the same time series. Because the early Chinese foreign exchange data trend contains too much external intervention. Through the observation and query of the data, we decided to use the data from 2012-2022 for calculation.

and many currencies are facing depreciation pressure. Uncertain factors in the global market, such as the escalation of China-US trade friction and uncertainty in the global economy, affect investor confidence and concerns. As expectations of U.S. interest rate hikes increase, many investors' funds flow into U.S. dollar assets, exacerbating the depreciation pressure on other currencies. In the chart, China, Japan, and Brazil currencies have experienced substantial depreciation and fluctuations, and investor negative sentiment has increased. Based on the transmission effect of market sentiment, investors generally choose to transfer funds to other relatively stable assets, further exacerbating the currency's downward trend.

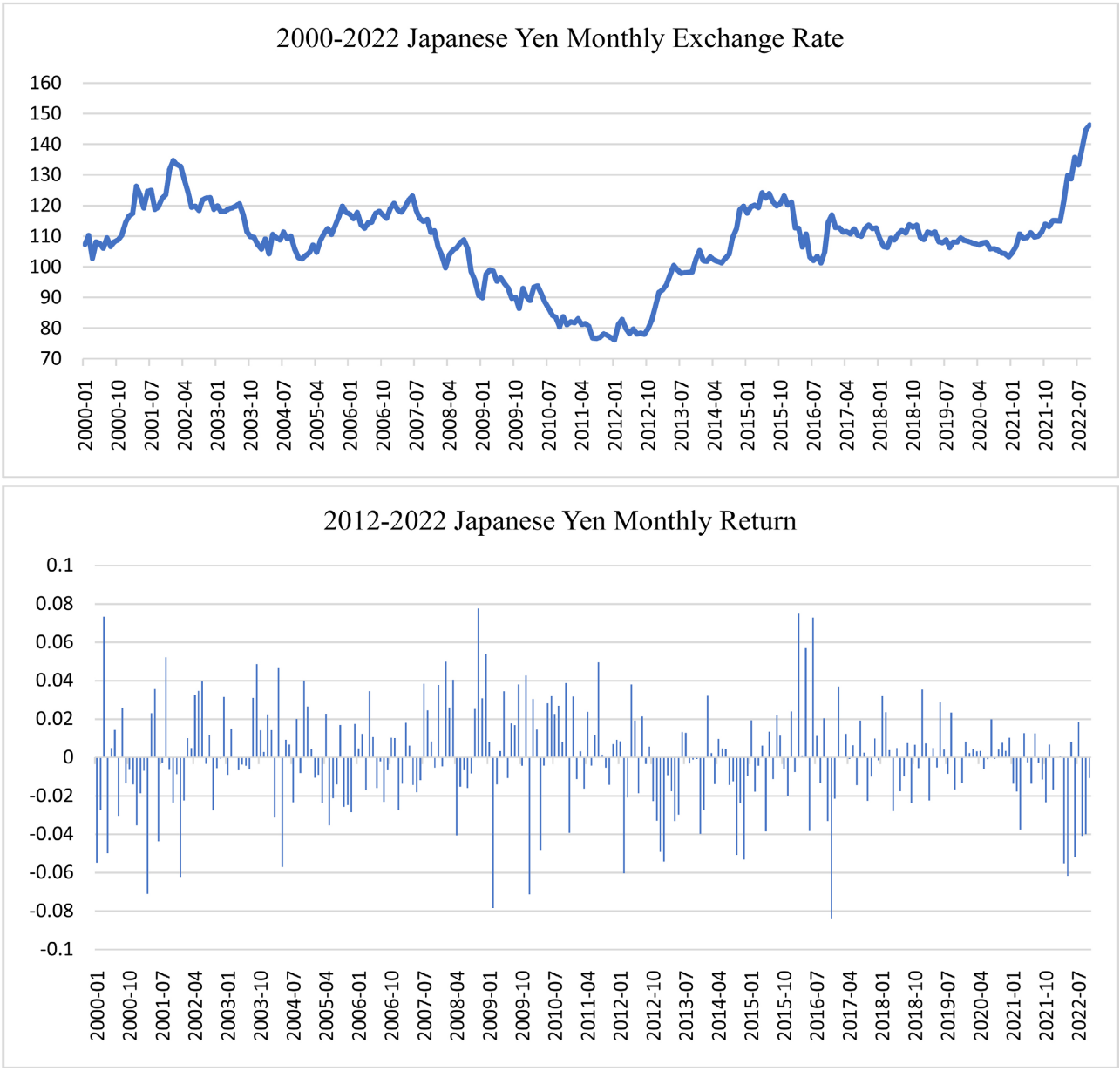

Figure 2. 2000-2022 Japanese yen exchange rate and monthly return. The monthly exchange rate of Japanese Yen from 2000 to 2022. Both tables have the same time series.

2.1. The Exchange Rate of China, Japan and Brazil from 2000 to 2022 and the Calculation Method of Return

Due to the slight fluctuation of daily data, I use monthly returns to represent the return generated by the natural changes in the exchange rate every month. I calculate the exchange rate return as (EXR_t), t is written as the value at the end of each month, and t-1 is the value at the end of the previous month. since the currency is quoted as national currency per USD. An increase in the exchange rate is a depreciation of the domestic currency relative to the U.S. dollar. That is to say, the following formula is generated to express the monthly foreign exchange return.

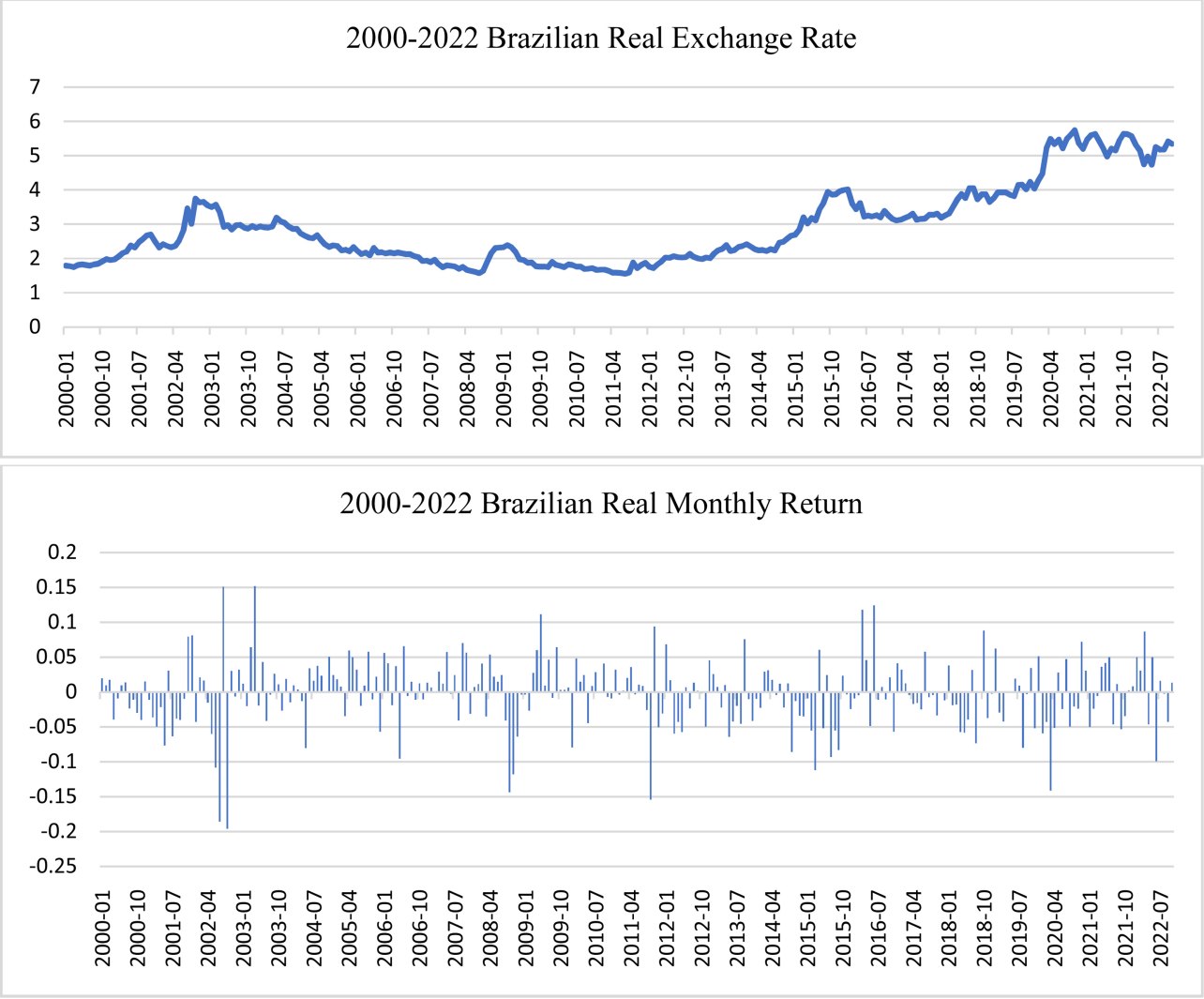

Figure 3. 2000-2022 Brazil real exchange rate and monthly return. The monthly exchange rate of Brazilian real from 2000 to 2022. Both tables have the same time series.

$$EXR_t CNY = \frac{CNY_{t-1} - CNY_t}{CNY_{t-1}}$$

$$EXR_t JPY = \frac{JPY_{t-1} - JYP_t}{JPY_{t-1}}$$

$$EXR_t BRL = \frac{BRL_{t-1} - BRL_t}{CNY_{t-1}}$$

2.2. Signal Data Collation and Use

I want to predict the future trend by analyzing the past state of the time series, that is, predict the impact of different signals on the future return. Since the measurement value of each signal data is different, when sorting the signal data, all the signal data should be normalized first to obtain the actual change of each signal. The stationarity of the data is the prerequisite for forecasting the time se-

ries model, so I performed ADF Test on all the signal data to ensure the validity of the data. I sequentially perform first- and second-order differences for non-stationary signals to ensure that all ADF Test results are stable. I have listed all the Bloomberg signals used in this study in Table 1 and marked the signals after using the first-order difference and the second-order difference to be stationary.

2.3. Use Each Signal in Turn to Perform Regression Analysis on Return

Use 5% and 10% significance to filter out effective signals and analyze regression results. In data collation, the total number of signal data in China is 49, and 10 effective signals are filtered out by significance. The total number of signal data in Japan is 60, with only six being effective. For Brazil, only five out of 53 signal indexes are effective. Table 1 shows the list of all Bloomberg signals I used. Tables 2-4 are effective signals filtered by significance. In the appendix, I list the definition of each effective signal abbreviation.

I use regression analysis to calculate the correlation between each signal data and return. Use the previous month's signal and the current month's return data to perform regression, which can show the impact of the signal on the next month's return. I regress the current exchange rate return (EXR_t) on past signal data ($Signal_{t-1}$). α and β are the model parameters, and ε_t is the error term at time t.

$$EXR_t = \alpha + \beta * Signal_{t-1} + \varepsilon_t$$

3. Empirical Results

In this section, I examine within-sample predictability using all available data from January 2000 to October 2020. Since the RMB exchange rate in previous years was under a hard peg system, I used data from 2012 onwards to make adjustments for analysis. Observe the exchange rate fluctuation chart. The results show that the signaling index predicts exchange rate returns. These signals are concentrated on the macroeconomic side, further supporting my hypothesis that macroeconomic strategies directly affect exchange rate returns. Julio and Yook (2016) found that increasing a country's political risk may decrease capital inflows, as foreign investors are more worried about potential losses from expropriation risks and economic recession. This shows that macroeconomic performance and the government's economic control strategies will affect exchange rate returns and negatively impact investor sentiment. This further proves that fluctuations in economic indicators and changes in investor sentiment signals hint at changes in investor confidence in the country's currency to a certain extent, and changes in the actual signal index also hint at the appreciation/depreciation of the country's exchange rate.

In particular, Chaieb and Mazzotta (2013) analyze the temporal variation of foreign exchange rate risk and relate this variation to macroeconomic state variables. Its extended robustness check also uses GDP, industrial production,

Table 1. Bloomberg signals index.

China	Japan	Brazil
TradeBalance	TradeBalance_First-order difference*	TradeBalance_First-order difference*
EconSurprise	EconSurprise	EconSurprise
TermsTrade_First-order difference*	TermsTrade_First-order difference*	TermsTrade_First-order difference*
InfSurprise_First-order difference*	InfSurprise	InfSurprise
InfConsensusChg_First-order difference*	InfConsensusChg	InfConsensusChg
OECD.PPP_Second-order difference**	CitiBroadREER_First-order difference*	CitiBroadREER_First-order difference*
BigMac_First-order difference*	CitiNarrowREER_First-order difference*	CitiNarrowREER_First-order difference*
JPM_CPI_REER_First-order difference*	OECD.PPP_First-order difference*	OECD.PPP_First-order difference*
JPM_PPI_REER_First-order difference*	BigMac_First-order difference*	BigMac
1mFwdYield	JPM_CPI_REER	JPM_CPI_REER_First-order difference*
BudgetBalanceFcast_First-order difference*	JPM_PPI_REER	JPM_PPI_REER_First-order difference*
GDPFcast_First-order difference*	1mFwdYield	1mFwdYield_First-order difference*
CurrentAcctFcast_First-order difference*	BudgetBalanceFcast_First-order difference*	BudgetBalanceFcast
InfFcast_Second-order difference**s	CurrentAcctFcast_First-order difference*	GDPFcast_First-order difference*
UnempFcast_First-order difference*	InfFcast	CurrentAcctFcast_Second-order difference**
Fixed Income Uncertainty	UnempFcast	InfFcast_First-order difference*
Fixed Income Total Positioning	Fixed Income Uncertainty	UnempFcast
Fixed Income Leveraged Positioning	Fixed Income Uncertainty.1	Fixed Income Uncertainty
Fixed Income Real Money Positioning	Equity Index Uncertainty	Fixed Income Leveraged Positioning
AGGR Sentiment	Equity Index Total Positioning	Fixed Income Total Positioning
BEST_EPS_First-order difference*	Equity Index Leveraged Positioning	Fixed Income Real Money Positioning
BEST_PX_BPS_RATIO	Equity Index Real Money Positioning	AGGR Sentiment
BEST_PX_CPS_RATIO_First-order difference*	Equity Index Retail Positioning	BEST_EPS_Second-order difference**
BEST_PX_SALES_RATIO	HOLD Sentiment	BEST_PX_BPS_RATIO
CUR_RATIO_First-order difference*	HOLD Sentiment.1	BEST_PX_CPS_RATIO
EST_PX_CASHFLOW_FY3_AGGTE	BUY Sentiment	BEST_PX_SALES_RATIO
EST_PX_EBITDA_FY3_AGGTE	SELL Sentiment	CUR_RATIO
EV_EST_EBITDA_NEXT_YR_AGGTE_First-order difference*	SELL Sentiment.1_First-order difference*	EST_PX_CASHFLOW_FY3_AGGTE_First-order difference*
IDX_EST_DVD_YLD	BEST_EPS_First-order difference*	EST_PX_EBITDA_FY3_AGGTE
INDX_ADV_VOL	BEST_PX_BPS_RATIO	EV_EST_EBITDA_NEXT_YR_AGGTE
LONG_TERM_PRICE_EARNINGS_RATIO	BEST_PX_CPS_RATIO	IDX_EST_DVD_YLD_First-order difference*
OPER_MARGIN_First-order difference*	BEST_PX_SALES_RATIO	INDX_ADV_VOL
PCT_MEMB_MACD_GT_BASE_LINE_0	CUR_RATIO	LONG_TERM_PRICE_EARNINGS_RATIO_ First-order difference*

Continued

PROF_MARGIN	EST_PX_CASHFLOW_FY3_AGGTE_First-order difference*	OPER_MARGIN
PX_TO_CASH_FLOW	EST_PX_EBITDA_FY3_AGGTE_First-order difference*	PCT_MEMB_MACD_GT_BASE_LINE_0
PX_TO_TANG_BV_PER_SH_First-order difference*	EV_EST_EBITDA_NEXT_YR_AGGTE_First-order difference*	PROF_MARGIN
RSI_30D	IDX_EST_DVD_YLD	PX_TO_CASH_FLOW
TOT_DEBT_TO_EBITDA_First-order difference*	INDX_ADV_VOL	PX_TO_TANG_BV_PER_SH_First-order difference*
1m FX MOM	LONG_TERM_PRICE_EARNINGS_RATIO_ First-order difference*	RSI_30D
3y FX MOM_First-order difference*	OPER_MARGIN_First-order difference*	TOT_DEBT_TO_EBITDA
vol-adj carry	PROF_MARGIN	1m FX MOM
ETF Sharpe	PX_TO_CASH_FLOW	3y FX MOM_First-order difference*
PPP Z-score_First-order difference*	PX_TO_TANG_BV_PER_SH_First-order difference*	vol-adj carry
JPM-CPI-REER/ToT Z-score	RSI_30D	ETF Sharpe
JPM-PPI-REER/ToT Z-score	TOT_DEBT_TO_EBITDA	PPP Z-score
FX seasonality	1m FX MOM	Citi-Broad-REER/ToT Z-score
	3y FX MOM	Citi-Narrow-REER/ToT Z-score
	vol-adjcarry_First-order difference*	JPM-CPI-REER/ToT Z-score
	ETF Sharpe	JPM-PPI-REER/ToT Z-score
	PPP Z-score	FX seasonality
	Citi-Broad-REER/ToT Z-score	
	Citi-Narrow-REER/ToT Z-score	
	JPM-CPI-REER/ToT Z-score	
	JPM-PPI-REER/ToT Z-score	
	FX seasonality	

This table is the Bloomberg signals dataset. I used * and ** to denote the signals for first-order and second-order differences.

money supply, trade, and inflation variables. They found that macroeconomic variables are the main drivers of currency risk. Caldara and Iacoviello (2018) found that increased geopolitical risks in emerging markets led to a shift in foreign sourcing away from these developed markets. As geopolitical risks increase, large amounts of capital move away from a country, causing foreign investors to lose interest and causing the country's currency to become unstable relative to other currencies. It can be seen that countries with lower economic and political risks are more stable and more conducive to investment. Because these countries are less susceptible to reversals in capital flows, their exchange rates are less affected by economic and political risks. The stable development of China's economy and the stability of the Japanese yen both illustrate that a stable political environment and monetary policy positively impact the currency. Brazil has

Table 2. Regression analysis of signals and return in China.

	Coefficient	T-stat	P-value	R-square
PROF_MARGIN	−0.0043	−4.15	0.00006**	11.94%
JPM-CPI-REER/ToT Z-score	−0.0036	−3.56	0.00052**	9.08%
JPM-PPI-REER/ToT Z-score	−0.0035	−3.45	0.00077**	8.55%
TradeBalance	0.0034	3.36	0.001**	8.18%
1mFwdYield	−0.0032	−2.99	0.0033**	6.58%
AGGR Sentiment	−0.0036	−2.09	0.04**	6.22%
TermsTrade	0.0021	2.01	0.047**	3.10%
1m FX MOM	0.0020	1.87	0.064*	2.84%
BEST_PX_BPS_RATIO	−0.0019	−1.80	0.075*	2.48%
JPM_PPI_REER	0.0019	1.79	0.075*	2.49%

This table is a regression analysis of monthly returns and all signal data in China. Then filter through the 5% and 10% significant to obtain the regression data of the effective signal. The table contains the coefficient, t-stat, p-value, and r-square. I used ***, ** and * to denote significance at the 1%, 5%, and 10% level, respectively.

Table 3. Regression analysis of signals and return in Japan.

	Coefficient	T-stat	P-value	R-square
HOLD Sentiment	−0.0063	−2.81	0.0065**	10.54%
INDX_ADV_VOL	−0.0037	−2.28	0.023**	1.9%
EST_PX_CASHFLOW_FY3_AGGTE	−0.0038	−2.09	0.038**	2.12%
JPM_PPI_REER	0.0037	1.88	0.062*	1.85%
Fixed Income Uncertainty	0.0030	1.87	0.063*	1.27%
PX_TO_TANG_BV_PER_SH	−0.0034	−1.68	0.095*	1.62%

This table is a regression analysis of monthly returns and all signal data in China. Then filter through the 5% and 10% significant to obtain the regression data of the effective signal. The table contains the coefficient, t-stat, p-value, and r-square. I used ***, ** and * to denote significance at the 1%, 5%, and 10% level, respectively.

Table 4. Regression analysis of signals and return in Brazil.

	Coefficient	T-stat	P-value	R-square
OECD.PPP	0.0071	2.41	0.017**	2.1%
EST_PX_CASHFLOW_FY3_AGGTE	0.0069	2.07	0.04**	2.21%
JPM_CPI_REER	0.0056	1.91	0.057*	1.33%
Fixed Income Total Positioning	−0.0079	−1.75	0.083*	2.89%
BEST_EPS	0.0056	1.71	0.089*	1.47%

This table is a regression analysis of monthly returns and all signal data in China. Then filter through the 5% and 10% significant to obtain the regression data of the effective signal. The table contains the coefficient, t-stat, p-value, and r-square. I used ***, ** and * to denote significance at the 1%, 5%, and 10% level, respectively.

higher political risks than China and Japan. At the same time, the Brazilian real is a new currency and is more likely to experience sudden changes in monetary policy. Emerging currencies often depreciate during high financial market tensions (Ranaldo & Söderlind, 2010). These sources propose and demonstrate the real impact of macroeconomics on exchange rate changes. My research will also specifically focus on these macroeconomic signal indices, analyze which signal indices in historical data affect foreign exchange returns, and analyze the impact and predictability of these indices.

3.1. Analysis of China's Effective Signal on RMB Return

The profit margin signal is negatively related to returns; the results show that a one standard deviation increase in the signal causes a 0.43% decrease in returns over the next month. The appreciation of currency will lead to a decrease in profit margins, and changes in exchange rates will directly affect profit margins. On the other hand, if the profit rate increases to a certain extent, it also reflects the possible depreciation of the RMB. In my return calculations, a weaker currency means lower FX returns. The rise in profit margins represents the strengthening of domestic exports and increased demand for exports. As a major trading country, when the yuan depreciates, other countries will increase their import demand for Chinese products because the same expenditure can buy more products. Therefore, when the profit rate signal shows a strengthening trend, it can be used as one of the factors to predict the decline of the RMB exchange rate.

The J.P. Morgan Data consumer price index, real effective exchange rate, and terms of trade z-score calculation index increased by one standard deviation, a signal that caused returns to fall by 0.36% over the next month. A higher z-score for the CPI compared to historical data could mean inflation is unusually high. High inflation will increase the price of domestic goods and services, lose competitiveness in the international market, lead to reduced exports and increased imports, and depreciate the RMB. A high REER z-score may indicate that RMB is strong relative to its trading partners. It will reduce export competitiveness and further promote the depreciation of the RMB. Likewise, a stronger REER trend will lead to lower exports and higher imports. The impact of this index on foreign exchange returns depends more on the central bank's monetary policy. It is challenging to produce reasonable predictions through changes in the index alone. It needs to be analyzed in conjunction with corresponding policy changes; however, excessive changes in the index will inevitably cause the government to Regulation can be taken into consideration.

One standard deviation increase in the J.P. Morgan data producer price index, real effective exchange rate, and terms of trade Z-score calculation index led to a 0.35% decrease in returns over the next month. It means that these indicators are at higher levels in their historical distribution. The rising PPI z-score means that production costs are higher than historical data, leading to an increase in the price of domestic goods, weakening exports, and increasing demand for im-

ported goods, further promoting the depreciation of the RMB. The real effective exchange rate has increased significantly compared with historical levels, which is unfavorable for countries that need to import from China and will affect China's commodity exports to a certain extent. Like the previous signal, this index depends more on monetary policy, government regulation, and international factors. The index can be used as a factor in forecasting, but it needs to be analyzed with more information.

The trade balance positively correlates with the return; the results show that a one standard deviation increase in this signal leads to a 0.34% increase in return in the next month. When China's trade surplus increases, it will attract more foreign currency inflows, and the growth of exports will increase foreign exchange earnings, thereby increasing the value of the domestic currency and exchange rate returns. A strong trade balance typically attracts more foreign investment, which is seen as an indicator of economic health and increases investor confidence. Changes in exchange rates will affect the international competitiveness and trade balance of domestic products, affecting the current and future cash flows and profitability of enterprises due to their impact on imports and exports (Dornbusch & Fischer, 1980). It illustrates that when export demand increases, the country's trade surplus increases because domestic goods are considered cheaper than foreign goods; more export demand drives the RMB exchange rate to strengthen, bringing higher foreign exchange returns. The actual results of the data do reflect this phenomenon. The strengthening of the trade balance signal led to the appreciation of the RMB and the increase in foreign exchange earnings. This result suggests that changes in trade balance signals can predict foreign exchange returns.

One standard deviation increase of the One-month forward yield signal will lead to a 0.32% decrease in return in the next month. The market has expected a rise in forward yields reflected in the current exchange rate, and the actual return may be lower than expected. High forward yields will attract short-term hot money inflows and increase the risk of sudden capital outflows in the future. Suppose the rise in forward yields is due to an expected increase in interest rates. In that case, when it rises, it will lead to higher returns on domestic assets, reducing the attractiveness of the foreign exchange market. High forward yields also represent higher economic or political risks, which can lead to exchange rate volatility. If forward yields rise due to short-term swings in market sentiment, exchange rate returns will be negatively affected once sentiment stabilizes. Clarida and Taylor (1997) successfully exploited the information content of the term structure of forward rates and high-accuracy forecasting of out-of-sample spot exchange rates via a dynamic VECM approach. Therefore, forward yield is predictable for exchange rate returns.

One standard deviation increase in aggregate sentiment will cause the return to decrease by 0.36%. High levels of positive sentiment can lead to excessive optimism in the market, making the currency overvalued. If market sentiment is

buoyant but subsequent economic data fails to meet expectations, the currency report will be lowered. Investors may move funds from the currency market to assets with higher potential returns, reducing the currency's value. Due to investor sentiment, the noise trader theory (Black, 1986) holds that market prices may deviate from their fundamental values even without fundamental risks. Hopper (1997) showed in his literature review that exchange rates are influenced by market sentiment rather than economic fundamentals, at least in the short term. Aggregate sentiment is effective in predicting foreign exchange returns.

When the terms of trade increase one standard deviation, the return will increase by 0.21%. The literature that currently exists on developing markets has reported the contribution of the terms of trade as 49% in Mendoza's study from 1995 and approximately 13% of real exchange rate volatility in pegged exchange rate regimes in Broda's research from 2002. In Broda's classification system, the contribution of the terms of trade is found to be between 31% and 43% for floating regimes. When global demand or other factors cause export commodity prices to rise, China, as a major exporting country, has a good trade environment, and the increase in export commodity prices will drive the RMB to strengthen. At the same time, tariffs and trade agreements continue to improve and improve, which is evidence of improving terms of trade and will positively impact FX returns. Therefore, the terms of trade signal effectively predict foreign exchange returns.

One standard deviation increase in 1-month forward exchange rate momentum signal leads to next month return increase by 0.2%. An upward momentum in the 1-month forward exchange rate could signal that the market expects the domestic currency to depreciate relative to a foreign currency. The forward market may offer investors opportunities to hedge against expected currency movements, effectively locking in the current forward rate for transactions that will occur in the future. A rising 1-month forward exchange rate could indicate that market sentiment expects the domestic currency to weaken. It could attract speculative capital flows. Investors will arbitrage transactions based on interest rate differences to obtain higher foreign exchange returns. Menkhoff, Sarno, Schmeling and Schrimpf (2012) find that the currency momentum (CMOM) strategy, which involves purchasing foreign currencies with higher historical returns and selling foreign currencies with lower historical returns, achieves an average annual return of 10%. The CMOM strategy's profitability surpasses that of other strategies in emerging currency markets and has the potential to generate profits of 1% - 3% per annum (Tajaddini & Crack, 2012). It proves the effective prediction of one-month forward exchange momentum signal.

One standard deviation increase in the Bloomberg estimates price/book ratio will lead to next month's return decrease by 0.19%. A high P/B ratio is a sign of an asset bubble. If foreign investors believe the Chinese market is overvalued, they may reduce their investment, affecting foreign exchange returns. Suppose a high P/B ratio is caused by investors anticipating unfavorable factors in the fu-

ture (such as policy tightening or economic slowdown). In that case, it may trigger capital outflows, depressing foreign exchange returns. A high P/B ratio may cause investors to divert funds from the Chinese market to other more attractive. In a strong market, such capital flows may reduce demand for the renminbi. A high P/B ratio may also make governments and central banks more inclined to take measures to curb overinvestment and bubbles. Such policies may include raising interest rates or imposing capital controls, which may have a negative impact on FX returns. High P/B ratios can sometimes be caused by increased macroeconomic instability (such as high inflation or fiscal deficits), which can reduce foreign investment and lower foreign exchange returns.

J.P. Morgan data China's producer price indices and real effective exchange rate increase by one standard deviation will lead to a 0.19% return increase in the next month. A rise in the producer price index (PPI) typically signals a likely rise in inflation ahead, which could prompt China's central bank to raise interest rates. High-interest rates can attract foreign capital inflows, thereby increasing the value of the RMB and foreign exchange returns. An increase in REER means the yuan is stronger relative to its major trading partners. It often reflects a strong performance in China's economy or weakness in other countries' economies, which attracts more foreign investment and thus improves foreign exchange returns. The improvement of PPI and REER may enhance investors' confidence in China's economy and also mean that the RMB is relatively more valuable, attracting more foreign investment and thus improving foreign exchange returns. This signal is directly affected by macroeconomic policies and is also one of the factors affecting foreign exchange return forecasts.

3.2. Analysis of Japan's Effective Signal on Yen Return

One standard deviation change in the hold sentiment for the Yen will lower 0.63% of the following month's return. Rising holding sentiment reduces trading activity in the market, resulting in reduced liquidity and greater susceptibility to unexpected events and large transactions. High holding sentiment also reflects the uncertainty and lack of direction in the market, which will reduce investor participation, the lack of new funds entering the market, and the decline in trading volume. It also reflects investors' reluctance to take more risks and willingness to buy will reduce the currency's value, thereby reducing exchange rate returns. There is evidence in the empirical literature showing how investor sentiment partly drives outcomes in capital markets such as foreign exchange markets (Hopper, 1997).

One standard deviation rise of the advance volume index will have a −0.37% negative impact on next month's return. When the transaction volume rises, more capital flows to other asset markets, causing other assets to rise, and the central bank may adjust interest rate policies, affecting currency values and exchange rate returns. The increase in trading volume is based on certain specific economic expectations. Investors turn to high-risk and high-return assets, lead-

ing to asset price bubbles. Once the bubble bursts will trigger market panic, lead to capital outflows, and affect exchange rate returns.

Estimated cashflow fiscal year three aggregate indexes increase one standard deviation will lead to next month's return decrease by 0.38%. Increased cash flow means a fiscal surplus and the government's ability to repay accumulated debt, and Japan has long had a high fiscal deficit. The increase in this signal may be due to the government's overly optimistic baseline fiscal forecasts. Governments raise fiscal surpluses in response to increases in the value of debt caused by past deficits and rising actual interest rates. However, they do not respond to changes in the value of debt caused by unexpected inflation. The surplus, in turn, responds to all changes in the value of the debt, resulting in passive fiscal policy. Active fiscal policy may have a negative impact on the domestic economy. Although the data results show that signal changes will negatively impact foreign exchange returns, the specific impact and predictability need to be analyzed in conjunction with more factors.

J.P. Morgan Japanese producer price index and real effective exchange rate increase of one standard deviation will lead to the next month's return increase of 0.37%. The increase in the index reflects Japan's inflation and will directly prompt the central bank to adjust its monetary policy to deal with inflation. For the Japanese Yen, which has been a safe-haven currency for many years, the Bank of Japan's interest rate hike policy is more attractive to investors. Large capital inflows will gradually push the Yen higher, resulting in higher foreign exchange return.

Fixed Income Uncertainty signal increase of one standard deviation will lead to next month's return increase of 0.3%. If there is increased uncertainty in Japanese fixed-income markets—perhaps due to economic volatility, political instability, or changes in interest rates—investors may seek to diversify their holdings or find safer assets. The Japanese Yen is often considered a "safe-haven" currency, meaning that investors may choose to buy Yen or Yen-denominated assets in times of market stress or uncertainty. It increased demand for the Yen can lead to an appreciation of its value against other currencies, thereby increasing its foreign exchange returns. So, indirectly, uncertainty in Japanese fixed income could result in a stronger Yen and higher forex returns for those holding the currency.

One standard deviation rise in price to tangible book value per share leads to next month's return decrease of 0.34%. An increase in the index could reflect good trends in Japan's tangible assets. However, the depreciation of the Yen and the massive exodus of overseas investors in recent years have shown that investors prefer low-risk investments. A rise in the index could alert investors to profit and risk trade-offs. The epidemic has depressed the global economy, and investors will exit the market due to excessive fluctuations. Capital outflows would put downward pressure on the exchange rate, reducing the Yen's foreign exchange returns. Forecasting foreign exchange returns also needs to be analyzed with the fluctuations of more tangible assets.

3.3. Analysis of Brazil's Effective Signal on Real Return

OCED Rising purchasing power parities signal an increase of one standard deviation will cause the next month's return to increase by 0.71%. It will make domestic goods and services more expensive, affect export competitiveness, and reduce foreign exchange earnings. It also increases demand for foreign goods and services, potentially creating a trade deficit. Higher domestic prices make the domestic investment environment less attractive than other countries, affecting capital flows. Hakkio (1992) and Grossmann et al. (2014) show how deviations from PPP-based relative models can provide valuable information on future dollar movement. It does not mean that PPP can predict the Real trend; more research and analysis are still needed.

Signal index estimated cashflow fiscal year three increase of one standard deviation will lead the next month's return increase by 0.69%. Signal index estimated cashflow fiscal year three increase of one standard deviation will lead the next month's return increase by 0.69%. Contrary to the situation in Japan, the data shows that increased fiscal cash flow in Brazil positively impacts foreign exchange returns. Brazil has a large fiscal deficit due to reduced tax revenue, reduced investment, and increased spending, and the real devaluation continues. Brazil's multi-party federal presidential system gives the president greater power, so elections will also significantly impact Brazil's fiscal policy. Its high financial expenditure is also due to the president's large-scale welfare subsidies to his supporters. For Brazil, increased cash flow strengthens the real, improving foreign exchange returns. Of course, this signal is closely related to political and fiscal policies, and my calculation data alone cannot prove its predictive ability. Analysis needs to be combined with more political and economic information.

Each standard deviation of the J.P. Morgan data consumer price index and real effective exchange rate signal increase will lead to the next month's return increase of 0.56%. Inflation could be indicative of strong consumer demand and a growing economy. If investors perceive this positively, it could attract capital inflows. A rising REER indicates that the Brazilian Real is appreciating against other currencies, adjusted for inflation. It can reflect economic strength and competitiveness and attract foreign investment. When foreign capital flows into Brazil, investors have to convert their currencies into the Brazilian Real, thus increasing demand for the Real. Higher demand often leads to currency appreciation, increasing forex returns for those holding the currency.

Fixed Income Total Positioning signal increase of one standard deviation will lead the next month's return to decrease by 0.79%. The increase in fixed-income positioning may be driven by local factors, such as high-interest rates, so it may not necessarily attract foreign capital. Instead, it could crowd out other investments, putting downward pressure on the currency. An increase in domestic fixed-income positioning might coincide with a decrease in foreign exchange returns due to global factors, such as changes in risk sentiment, geopolitical tensions, or shifts in commodity prices that affect the Brazilian economy and its

currency.

When one standard deviation increases in Bloomberg estimates, the earnings per share signal will increase the next month's return by 0.56%. When foreign investors buy Brazilian assets, they usually need to convert their currency to Brazilian real, creating demand for the currency and potentially increasing its value. This process can result in higher foreign exchange returns for the Brazilian real. The monetary model (Gavin, 1989) predicts a positive relationship; stock market growth increases domestic investor returns and wealth. Portfolio balance models (Branson, 1983; Frankel, 1983) predict a negative link by emphasizing the role of investor risk aversion and international diversification. Higher stock prices make the country more attractive to investors, who will move their investments to these countries, putting upward pressure on currency demand and increasing currency appreciation. Raising the exchange rate will lead to higher foreign exchange returns. It reflects that this signal has a particular impact on foreign exchange returns.

4. Conclusion & Research Extension

The results of this study focus on predicting foreign exchange returns due to economic changes within a country. Although there are very few effective signals in each country, the effective signals in the three countries are very similar. Therefore, it can be believed to a certain extent that the index changes in Bloomberg data on endogenous factors and macroeconomic strategies can provide some ideas for investors to adjust their foreign exchange investment strategies.

Regarding the limitations of the research, although the analysis of excessive data set samples can better show the correlation between signal and exchange rate, excessively long time series will dilute the impact of some sudden events on exchange rates, such as the impact of short-term major political and economic factors on exchange rate fluctuations.

For future research, a natural extension would be to conduct multi-variate time-series regression analysis. For each country of interest, we can build country-specific time-series models to incorporate the return-forecasting powers of multiple signals simultaneously. Another potentially interesting research direction is to incorporate regime-switches into the analysis. In different regimes (e.g., as marked by a country's Central Bank monetary policy), models may incorporate different sets of signals.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix

Variable Definition

Variable	Description
PROF_MARGIN	Profit margin
JPM-CPI-REER/ToT Z-score	JPMorgan data consumer price index, real effective exchange rate and terms of trade z-score calculate
JPM-PPI-REER/ToT Z-score	JPMorgan data producer price index, real effective exchange rate and terms of trade z-score calculate
TradeBalance	Balance of trade
1mFwdYield	One-month forward yield
AGGR Sentiment	Aggregate sentiment
TermsTrade	Terms of trade
1m FX MOM	One-month forward exchange momentum
BEST_PX_BPS_RATIO	Bloomberg estimates price/book ratio
JPM_PPI_REER	JPMorgan China's producer price indices and real effective exchange rate
HOLD Sentiment	Investors' hold sentiment
INDX_ADV_VOL	Advance volume index
EST_PX_CASHFLOW_FY3_AGGTE	Estimated cashflow fiscal year three aggregate indexes
Fixed Income Uncertainty	Fixed Income Uncertainty
PX_TO_TANG_BV_PER_SH	Price to tangible book value per share
OECD.PPP	OCED purchasing power parities
Fixed Income Total Positioning	Fixed Income Total Positioning
BEST_EPS	Bloomberg estimates, the earnings per share