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RMB/USD exchange rate

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by

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ABSTRACT

This original purpose of this paper is to figure out why the RMB exchange rate fluctuated sharply, and how it would go. As the research goes on, several opinions showed up, some people believe the fluctuation was in order to offset the influence of American 25% tariff on Chinese export, but some experts fight against, such as Xing Yuqing, he said Chinese export has large proportion of high third-party added value and low technology goods, which result in the RMB depreciation was only offset a small part of 25% tariff. One more opinion, they believe the result of the fluctuation of the RMB exchange rate was manipulated by the Chinese government. So far, the most reliable opinion is to offset the influence of the American 25% tariff. Moreover, as observed, the exchange rate is stable at 7.08 RMB per USD.

Introduction

From the perspective of exchange rate changes, in August this year, with the fermentation of trade friction, the exchange rate of RMB against the US dollar came under pressure and fell below the "7" mark on the morning of August 5. The exchange rate of RMB against the US dollar in August was as low as around 7.15, a monthly decline of more than 3%. However, despite the depreciation trend of the RMB in August, the foreign exchange market transactions were relatively stable. The balance of foreign exchange reserves in August increased by 3.5 billion us dollars compared with the month before, while the foreign exchange deficit contracted by 12% compared with the month before, down 64% compared with the year before.

To figure out the reason for the fluctuation of the RMB exchange rate, and predict how it will go, started this research. Primarily, finding out the data that show what kinds of products on Chinese export, and trying to answer whether the large proportion of the products are high third-party added value and low technology goods, which is in order to figure out it is true or not that American 25% tariff on Chinese export can really influence the exchange rate. Moreover, the research also shows the factors that can influence the exchange rate are the interest rate, inflation rate, trade balance, currency policies, and the expectation of the market. So the first thing I should do is to find out the information and data related to the factors as many as possible. The data is easy to find, the fluctuation of the exchange rate is showed in Sina

Finance, the fluctuation of interest rate can be found on yinhang123.net, the fluctuation of inflation rate and trade balance can be found on tradingeconomics.com, the attitude and policies about the exchange rate will be shown on the PBC official website and fx678.com, and the expectation of market was implied in the tendency of the speed of the exchange rate changing.

After finding all of the data, a result was calculated by Ming Zhenyi, Sun Ruize, Hou Yunhan, and Wang Hao (2017) showed from 1990 to 2014, relevant factors such as RMB exchange rate against us dollar, import and export balance and foreign exchange reserve were selected for empirical analysis. The analysis results showed that: every 1% increase in GDP would lead to an RMB appreciation of 5.559%. A 1% increase in the money supply (M2) will lead to a 3.425% depreciation of the renminbi. A 1% increase in the U.S. federal benchmark interest rate would lead to a 0.186% depreciation of the yuan. Every 1 unit increase in CPI will lead to a 0.027 unit depreciation of the RMB. Combining this result with the influence of American 25% tariff on Chinese export, an equation can be created:

$$R2=R1+\Delta GDP\% \times 5.559\% - \Delta M2\% \times 3.425\% - \Delta USrf\% \times 0.186\% - \Delta CPI\% \times 0.027\% - T$$

In this formula, R2 is the future USD/RMB and R1 is the original USD/RMB. respectively are the percent of GDP, RMB supply, The federal benchmark interest rate, and CPI changes. T is the influence of the 25% tariff.

After created this equation, it will be tested by the real exchange rate of September and October. According to this test, the bias between the predicted rates with the real rates can be calculated, after based on the bias to revise the predicted rates.

In short, primarily this paper will show the popular opinions about the question of whether the depreciation of RMB is to offset the tariff limitation. Then showing the main reasons that influence the exchange rate in August, at the same time, interpreting the deal tails why it will change the exchange rate and how it will change it. At last, according to a multiple linear regression model and the influence of the 25% tariff policy to predict how the exchange rate will change under the 25% tariff limitation.

Literature review

Since 2008, the exchange rate of Chinese RMB to USD never broke or adversely broke 7 until August 5th, 2019. In fact, according to the volatility of USD/RMB after June of 2018, the tendency of depreciating RMB has increased, and it almost broke 7. At the same time, June 2018 is the first time the US adjusted the tariffs to China. According to the article of Peng Wensheng (2019), the logic of RMB devaluation, he mentioned tariffs are American president Trump's tool and objective and the exchange rate is the carrier and result of transmission. As for the first perspective, Trump tried to

stimulate the internal supply and reverse trade deficit by adding tariffs, but it's not always good for the US. If the exchange rate between RMB and USD didn't change, the tariffs will increase the price directly which will afford by American buyers, as a result, the American investment and consumption will transfer into internal. As for the second perspective, if the increased price could be afforded by the suppliers of China, in other words, the RMB depreciates to USD. In this kind of situation, the USD increase in value led to the American consumers will transfer their need to outside of other countries (not China), because the depreciation of RMB also could result in other currencies depreciation related to USD.

The author explained why other countries' currencies will depreciate following the devaluation of RMB. If supposing other countries' currencies remain the value, RMB needs to devalue 5% to offset the influence of tariffs. However, RMB has been depreciated 8% to USD and appreciate 1% to a basket of currencies. That the evidence shows if USD increased in value to RMB, the buyers will choose other countries' products because it is cheaper than Americans. Increase the tariffs is neither good for the US, nor China. This article revealed the trade balance will influence the exchange rate, and the main reason for RMB's recent depreciation is related to Trump's tariffs policy. These results show a way to calculate the future exchange rate.

Recently, the result of RMB depreciation seemly is trying to offset 25% tariffs on Chinese export, however, a professor of national relationship, Xing

Yuqing (2018) suspected the depreciation is hard to offset the effect of 25% tariffs. He outlined the products Chinese export to the US include a large number of third-country value-added components so that the depreciation may not have too much effect on offsetting the tariffs.

To explain the reason why this happens, Xing uses an example of the first version of the iPhone. He said every iPhone exported to China is sold at 179 dollars, and the added valued from China only has 6.5 dollars, so if RMB appreciates just influence the 6.5 dollars that created in China. According to this example, he explained information and communication technology products, which have high third countries added value about 58%, is the largest category of Chinese exports to the United States by far, if the Trump tried to increase tariffs on these kinds of goods, the depreciation of RMB will not offset the influence of Trump's tariffs policy.

Moreover, due to the influence after the depreciation cannot offset the tariffs, if some third countries can allocate or manufacture for sale to the United States, 10% of tariffs may transfer the original orders of China to them. Therefore, in the world dominated by value chains, the potential impact of tariffs on Chinese exporters is not simply a few percentage points of decline in price elasticity, but a risk that Chinese exporters who accept orders will completely lose their export orders. What's worse, some foreign companies in the United States assembling and processing in China may relocate to other countries, such as India, Vietnam, Indonesia, and other countries.

He also pointed out some analysts like to compare the US-China trade war to the Japan-US trade frictions of the 1980s. But there was a fundamental difference between Japanese exporters to the United States and Chinese exporters today. When Japanese companies sold cars and appliances in the U.S. in the 1980s, they owned the core technology and brands for those products, and they paid for their advertising to get a market. Today, Chinese enterprises export products to the United States, relying on the core technology of the United States and other developed countries to rely on the brand, these enterprises do little marketing in foreign markets. Their affiliation with the value chain makes them more vulnerable to U.S. tariffs. Finally, this article shows some ideas about why the depreciation of RMB cannot perfectly offset the 25% tariffs. And it may help to complete the assumption of exchange rate predicting.

The factors influence the exchange rate is not only trade balance such as GDP, inflation rate, and M2, etc. According to the article, Analysis of the Factors Affecting RMB Exchange Rate, written by Ming Zhenyi, Sun Ruize, Hou Yunhan, and Wang Hao (2017), which was trying to find out the factors that may affect exchange rate and the correlation between these factor and exchange rate. The authors created an RMB exchange rate-multiple regression model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \mu$$

Where Y represents the exchange rate between RMB and us dollar, X1

represents the import and export balance, X2 represents foreign exchange reserves, X3 represents the total national product (GDP), X5 represents the average annual interest rate in the U.S., X6 represents the growth rate of fob West Texas crude oil, and X7 represents the average annual CPI. Beta zero is the constant term, beta one, beta two...Beta seven is the regression coefficient.

After creating the model, they tested it by Test of economic significance, multicollinearity test, autocorrelation test and test for heteroscedasticity. Finally, they found the change of GDP is the most important factor affecting the RMB exchange rate, and the change of money supply (M2) is also a key factor. Secondly, the impact of the US federal benchmark interest rate and CPI on the RMB exchange rate should not be underestimated by using empirical analysis. If using the USD/RMB from 1990 to 2014, the analysis shows: A 1% increase in GDP would lead to a 5.559% appreciation of the yuan. A 1% increase in the money supply (M2) will lead to a 3.425% depreciation of the RMB. A 1% increase in the U.S. federal benchmark interest rate would lead to a 0.186% depreciation of the yuan. Every 1 unit increase in CPI will lead to a 0.027 unit depreciation of the RMB. These analyses outlined some other factors will significantly affect USD/RMB, and also supplemented the whole idea of the factors.

Methodology

Historical analysis

To predict the future exchange rate change, a historical analysis will be used in the equation of prediction,

$$R2 = R1 + \Delta GDP\% \times 5.559\% - \Delta M2\% \times 3.425\% - \Delta rf\% \times 0.186\% \\ - \Delta CPI\% \times 0.027\% - T$$

And this research method combines the study of sources with critical thinking. It involves extensive study of relevant written records, data, artifacts, visits and participation in excavations of historical sites and other sources, and concluding this evidence, rather than blindly accepting conclusions drawn by other historians. Revisionist history is the result of this process. In the application of historical analysis, one must take care to avoid looking at past events with a "modern eye". To draw accurate conclusions, historians must consider and interpret the cultural changes in societies they study, such as values, morals, traditions, and other social factors that have occurred since the time they analyze.

Case study

The research has talked about some opinions that come from some experts, so try to easily interpret their views, there will be some simple but actual happened cases to help readers understand the key ideas. Such as an example of the first version of the iPhone shows every iPhone exported to

China is sold at 179 dollars, and the added valued from China only has 6.5 dollars, so if RMB appreciates just influence the 6.5 dollars created in China.

Dependent Variable

The dependent variable of this research is the RMB/USD exchange rate because it can reveal many aspects of factors that have changed, such as according to the forward parity, it can show the relationship between the interest rate and exchange rate. On the other hand, the data of RMB/USD is easy to acquire, which also will help the process of research.

Independent variable

As mentioned before, there are four negative factors and one positive factor can significantly influence the exchange rate.

Negative factors

CPI

The Consumer Price Index, or CPI, is a measure of the Price of a fixed basket of Consumer goods. It mainly reflects the changes in the prices consumers pay for goods and services. It is also a measure of the level of inflation, expressed as a percentage change. In the United States, there are seven main categories of goods that make up the index, including food, alcohol and beverage housing; Clothes; Traffic; Medical health;

Entertainment; Other goods and services. In the United States, the consumer price index is published monthly by the bureau of labor statistics. There are two different consumer price indexes. One is the consumer price index for workers and employees or CPW. The second is the consumer price index for urban consumers or CPIU.

When the CPI of a country increases, it indicates that the inflation rate of the country increases, which also means that the purchasing power of the currency weakens and the exchange rate declines. According to the theory of purchasing power parity, the currency of the country should weaken. On the contrary, when the consumer price index of a country declines, it indicates that the inflation rate of the country declines, that is, the purchasing power of the currency increases. According to the theory of purchasing power parity, the currency of the country should strengthen. However, since controlling inflation is the primary task of every country, the rise of inflation also brings the opportunity of an interest rate rise, which is beneficial to the rise of the national currency exchange rate. If inflation falls under control, interest rates also tend to fall, undermining the currency's rise.

M2

According to the report of Hai Huishi (2018), the relationship between money supply and exchange rate fluctuations, the Money supply is an important indicator of people's long-term confidence in money, as anyone with

a little historical knowledge knows. However, there is no universally recognized measure index and critical value to what extent the money supply is large enough to significantly affect people's confidence, and even if there is a measure index, the critical value is bound to be greatly different under the influence of different economic structure, social culture, political environment and other factors in different countries.

In addition, in addition to the money supply, there are many factors influencing the exchange rate, growth potential, the efficiency of capital controls, residents education level (public understanding of the financial market depth), the degree of residents varieties of investment, the government macroeconomic regulation and control ability, etc., these factors will directly affect the yuan into the actual size of the foreign exchange market, money supply is just one of many factors. Therefore, the increase in the money supply does not mean the increase of the trading scale in the foreign exchange market, and the decrease of the money supply does not necessarily lead to the contraction of the trading scale in the foreign exchange market.

US federal fund rate

This rate is a kind of interest rate, so the relationship between the benchmark interest rate and the exchange rate is the same as the relationship between the US federal fund rate and the exchange rate. When the interest rate rises, bank deposits increase and the amount of bank loans increases,

which is conducive to the development of enterprises. The increase in investment costs caused by the rise in interest rates will inevitably cause investors with lower investment returns to withdraw from the investment field, thus reducing the investment demand. By encouraging saving, it discourages consumption. As interest rates rise, domestic prices will fall. The increase of domestic interest rate, the rise of the domestic exchange rate, the appreciation of the domestic currency, and the decline of foreign exchange rates are conducive to imports. It is advantageous to the debtor, is not advantageous to the creditor, the foreign loan recovers the value to decline. But the target of this paper is RMB, the foreign interest rate will have a negative value on the domestic currency.

Tariff

According to the article by Peng Wensheng(2019), he believes the exchange rate is the carrier of transmission and the result of the tariff. First, look at the changes in trade since the us first imposed tariffs on Chinese imports in June last year. Us imports from China fell while imports from other countries rose, but the cumulative value of our trade deficit with China now seems to have returned to the original point (figure 1-2), which intuitively conforms to theoretical expectations. After the trade war of the 1930s, economics rethought the question of tariffs. In 1936, Lerner, an American economist, put forward the symmetry hypothesis, believing that the tax on

imports was equal to the tax on exports, and the trade volume would decline, but the balance of trade would remain unchanged.

Figure 1: U.S. trade in goods with China (2018)

Month	Exports	Imports	Balance
January 2018	9,902.6	45,765.6	-35,863.1
February 2018	9,759.9	39,020.6	-29,260.7
March 2018	12,652.1	38,327.6	-25,675.5
April 2018	10,503.8	38,303.9	-27,800.1
May 2018	10,428.2	43,965.7	-33,537.5
June 2018	10,860.1	44,612.1	-33,752.0
July 2018	10,134.6	47,120.6	-36,986.0
August 2018	9,285.9	47,869.2	-38,583.3
September 2018	9,730.0	50,015.0	-40,285.0
October 2018	9,139.9	52,202.3	-43,062.5
November 2018	8,606.2	46,500.8	-37,894.6
December 2018	9,144.9	45,972.1	-36,827.2
TOTAL 2018	120,148.1	539,675.6	-419,527.4

Figure 2: U.S. trade in goods with China (2019)

Month	Exports	Imports	Balance
January 2019	7,134.3	41,603.8	-34,469.5
February 2019	8,433.6	33,194.4	-24,760.8
March 2019	10,426.5	31,175.7	-20,749.1
April 2019	7,896.3	34,798.9	-26,902.6
May 2019	9,074.5	39,269.1	-30,194.6
June 2019	9,034.7	39,002.3	-29,967.6
July 2019	8,733.7	41,508.7	-32,775.0
August 2019	9,430.6	41,187.3	-31,756.6
TOTAL 2019	70,164.3	301,740.3	-231,576.0

Of course, the balance of trade depends on other factors such as the state of the economy, but the exchange rate is the key. Let's look at how import tariffs affect economic growth and jobs in the United States. If the

exchange rate stays the same, tariffs will lead to higher prices for imported goods, and American consumption and investment demand will shift to domestic substitutes. This is the logic of some people in the United States that higher tariffs are good for economic growth and employment. But if the dollar rises and American goods become more expensive, demand will shift to foreign output, offsetting the effect of tariffs. The key depends on the extent to which the dollar appreciation is partially offset, completely offset or even overshoot.

Positive factors

GDP

In general, the gross domestic product consists of four distinct components, including consumption, private investment, government spending, and net exports, expressed as $GDP=C+I+G+X$. Where: C is consumption; I is a private investment; G is government expenditure; X is the net export value. From the perspective of economics, there are three forms of GDP, namely value-form, income form and product form. From the perspective of the value-form, it is the difference between the value of all goods and services produced by all resident units in a certain period and the value of goods and services invested by all non-fixed assets in the same period, namely the sum of the added value of all resident units. From the perspective of income form, it is the sum of income directly generated by all

resident units in a certain period; In product form, it is the final use of goods and services minus the import of goods and services.

Due to gross domestic product (GDP) is the production of goods and services by a certain time multiplied by the total "currency price" or "market price" and get the Numbers, the nominal GDP (nominal GDP growth rate is equal to the sum of real gross domestic product (GDP) growth rate and inflation rate), as a result, the total output even if did not increase, just price level rises, nominal GDP is still rising, but in the case of rising prices, rising gross domestic product (GDP) is a kind of illusion. What matters is the rate of change in real GDP, so the GDP measure must also be adjusted for nominal GDP through the GDP deflator to accurately reflect actual changes in output. Thus, an increase in the GDP deflator in one quarter is enough to indicate inflation in the current quarter. A large increase in the GDP deflator would have a negative impact on the economy and would be a harbinger of tighter money supply, higher interest rates, and thus higher foreign exchange rates

A country's gross domestic product (GDP) has risen sharply, reflecting the country's booming economy, rising national income, and rising consumption power. In that scenario, the central bank would likely raise interest rates and tighten the money supply, while the country's economic performance and rising interest rates would make the currency more attractive. Conversely, if a country shows negative GDP growth, indicating that the economy is in recession and less spending power, the central bank will likely cut interest

rates to stimulate growth again. Lower interest rates coupled with weak economic performance make the currency less attractive. As a result, high economic growth rates generally push up the exchange rate, while low economic growth rates cause the exchange rate to fall.

Results

Adjusted model

USD/RMB	2018/1/1		
	0.1537		
GDP	2017-2018	2018-2019	The percentage of Change
	12143.4900	13608.1500	0.1206
CPI	2018/1/1	2019/1/1	The percentage of Change
	101.5000	101.7000	0.0020
M2	2018/1/1	2019/1/1	The percentage of Change
	1720814.4600	1865900.0000	0.0843
US Federal funds rate	2017-2018	2018-2019	The percentage of Change
	0.0130	0.0270	1.0769
The exchange rate (2019/1/1)	0.1555		
	6.4299		

According to the formula, $R_0 = R_1 + \Delta GDP\% \times 5.559\% - \Delta M2\% \times 3.425\% - \Delta USrf\% \times 0.186\% - \Delta CPI\% \times 0.027\%$, we can calculate the theoretical value of the exchange rate of January 1st, 2019 without the effect of the tariff policy. The result is equal to 0.1555 \$/¥ (6.4299 ¥/\$)

	2018	2019
Total Chinese exports to US	\$539 billion	N/A

Tariffs on \$200 billion	10%	25%
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Chinese export on 2018 (10% tariff)	USD/RMB	USD needs
3506.6316	0.1537	539.0000
Chinese export on 2018 (25% tariff)	USD/RMB	USD needs
3766.8640	0.1431	539.0000

The USD needs mean how much the US is willing to pay for Chinese goods. If the depreciation of RMB can offset all of the influence of the tariff results in the USD needs constant. We can according to this logic to calculate the theoretical value of the exchange rate with the influence of the tariff by $539/3766.8640=0.1431\$/\text{¥}$. The value of 3766.8640 is calculated from the increased 15% tariff on \$200 billion Chinese exports.

Then influence of the tariff is $0.1555-0.1431=0.0124\$/$. So the total function can be written:

$$R2=R1+\Delta\text{GDP}\% \times 5.559\% - \Delta\text{M2}\% \times 3.425\% - \Delta\text{USr}\% \times 0.186\% - \Delta\text{CPI}\% \times 0.027\% - 0.0124$$

Hypothesis test

Null hypothesis (n_0)=6.9886

Alternative hypothesis (n_1) \neq 6.9886

Avarage	6.9113
Standard Deviation	0.1588
Test Statistics	-0.0689

I have transformed the exchange rate to ¥/\$. For the Hypothesis testing, I randomly selected 50 days exchange rate from January 1 to November 12, 2019. Then I calculated the test statistics is -0.0689 which is within a 95% confidence level (-1.96 to 1.96), we cannot reject the Null hypothesis.

Conclusion

In the end, the survey successfully predicted that the RMB exchange rate would be around 7 ¥/\$if the 25% tariff was completely offset. But at the same time, this does not mean that the trend of the exchange rate is necessarily like this because in this paper, in order to simplify the calculation, many hard-to-reach assumptions are put forward and a large number of historical data are used. This research has used the result that concluded by Ming Zhenyi, Sun Ruize, Hou Yunhan, and Wang Hao, so the same as the model they created in their research, this research also has the limitation on data selection, because they just use the data from 1990-2014, which can't reflect real-time fluctuation. Moreover, this research is based on historical analysis and mathematical statistics, which uses the past to deduce the future, but it is not possible to control the variable in the future, so the result is not precise. The assumptions are not easy to reach, such as no transfer of Chinese export and all the export goods are elastic.

References

- Hai, Huishi. (2018). The relationship between money supply and exchange rate fluctuations. <https://house.focus.cn/zixun/06313d14c6decab6.html>
- Ming, Zhengyi. Sun, Ruize. Hou, Yunhan.& Wang, Hao. (2017). Analysis of the Factors Affecting RMB Exchange Rate. 72-74.
- Peng, Wensheng. (2019). Peng wensheng: the logic of RMB devaluation. <http://forex.jrj.com.cn/2019/08/05134627930228.shtml>
- Xing, Yuqing. (2018). A weaker renminbi would hardly hedge against Mr Trump's tariffs. <http://www.chinavalue.net/Investment/Blog/2018-8-9/1570716.aspx>