

The Influence of Currency Exchange Rate Fluctuations on China's Medical Stock Market

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Abstract—After the COVID-19 in 2020, the development of medical stocks has been expected. At the same time, the continuous impact of the epidemic will affect the change of Chinese exchange rate. The impact of exchange rate on the change of Chinese medical stock price is usually negative, and this impact also occurs immediately. For investors, it is necessary to choose a suitable medical stock to resist the change of exchange rate. This paper mainly describes the impact of RMB's exchange rate on the US dollar on China's medical market in the year (2021) after the outbreak of COVID-19. Through ADF test and correlation coefficient, this paper analyzes the changes of capital return and exchange rate of China's medical industry, explores the Mudell-Fleming Model to see the impact of the unique reform trend of China's exchange rate and the regulation mode of the central bank on China's medical market. The paper finds that the RMB will appreciate against the US dollar in 21 years. Medical stocks with large assets will be more stable than the overall medical commercial market in 2021, which means that medical enterprises with relatively large investment will avoid risks in the West. The floating rate of exchange rate has a negative impact on the return of medical stock, although this impact is relatively stable.

Keyword-COVID-19; Chinese medical stock; Chinese exchange rate; mudell Fleming Model

1 INTRODUCTION

Since the outbreak of the epidemic in the past 20 years, medical stocks have attracted much attention, but many countries have adjusted interest rates, resulting in a floating exchange rate on a certain basis, and the floating currency exchange rate will also affect the medical stock market. As not that many paper focus on this side in detail, this paper mainly describes the impact of RMB's exchange rate on the US dollar on China's medical market in the year (2021) after the outbreak of COVID-19. Through ADF test and correlation coefficient, this paper analyzes the changes of capital return and exchange rate of China's medical industry, explores the Mudell-Fleming Model to see the impact of the unique reform trend of China's exchange rate and the regulation mode of the central bank on China's medical market. Such a result will help investors better judge the changes of China's medical stocks for exchange rate fluctuations, support the economic development of China's medical sector through the adjustment of exchange rate, and select a medical stock to join the portfolio.

2 MUDELL MODEL TO ILLUSTRATE THE DIFFERENCE OF FOREIGN EXCHANGE ADJUSTMENT MECHANISM BETWEEN THE UNITED STATES AND CHINA

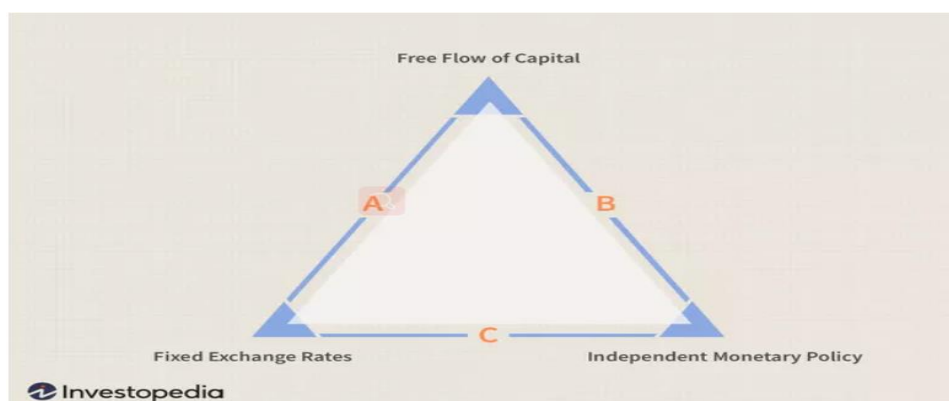


Figure 1. Trilemma [4]

In trilemma, triangles have three sides, side A, B, and C. Trilemma is a development model proposed by Maurice Obstfeld in 1997. This model is based on the theory of the policy trilemma proposed by Robert Mundell and Marcus Fleming [1]. All governments can only choose two sides to control, and it is impossible to achieve trilateral control. A-side countries usually choose fix exchange rates against currency and have a free flow of capital, which is often used in emerging markets from 1980 to 1990[6]. Developed countries, such as the United States, are on side B. China is unique, which uses side C, including independent monetary policy and fixed exchange rate. For example, China's independent monetary policy will cut interest rates to stimulate the economy during the economic recession. However, China's unique fixed exchange rate allows a slight floating within a certain range. In the future, China tries to move to side B from C.

3 ADJUSTMENT HISTORY OF CHINA'S EXCHANGE RATE POLICY

China's unique fixed exchange rate system is called the "managed floating exchange rate system." From 1994 to 1999, the exchange rate was adjusted through the balance of payments and foreign exchange reserves [5]. From 1999 to 2005, China adopted a fixed exchange rate between its own currency and one single currency (the dollar), also known as the "traditional pegged exchange rate pegged to a single currency" [5]. After 2005, China's monetary policy changed again. The RMB exchange rate was no longer adjusted according to the change of the single currency (dollar), but selected several major currencies to form a currency basket, and calculated the change of the RMB multilateral exchange rate index with a currency basket. However, after the economic and financial crisis in 2008, China adjusted its exchange rate policy to "closing exchange rate plus exchange rate change of a basket of currencies". The change of the "closing exchange rate + exchange rate change of a basket of currencies" not only

reflects the exchange rate change of a basket of currencies, but also reflects market supply and demand. The "closing exchange rate" refers to the closing exchange rate of RMB against the US dollar in the interbank foreign exchange market at 16:30 on the previous day, which primarily reflects the supply and demand in the foreign exchange market. rate change of a basket of currencies" refers to the adjustment range required to maintain the basic stability of the exchange rate of RMB against a basket of currencies. For the free flow of capital, China has not achieved it at present. It has only opened some markets (Hong Kong), making it difficult for investors to enter the market. After China entered the WTO in 2001, it gradually opened some of its markets. For example, medical opened drug distribution services in 2003, and foreign banks were allowed to fully enter the market in 2006 [9].

3.1 Differences in exchange rate policies between China and the United States

China's exchange rate can be adjusted through government policies, and the foreign exchange market cannot get rid of government intervention. The structure of China's exchange rate adjustment is very special. The main responsibilities of China's foreign exchange administration are to maintain the balance of payments and stabilize the RMB exchange rate. The foreign exchange administrations of the United States and many countries are for price stability, among which the U.S. foreign exchange administration is to maintain price stability and employment rate stability.

The Chinese government usually uses international reserves to intervene in the foreign exchange market, including gold, foreign exchange reserves, and special drawing rights. The largest amount of China's foreign exchange reserves is US dollars. By 2021, China's reserves had reached \$3.25 trillion [2]. Therefore, it is important to study the differences between China and the United States in the methods of intervening in the foreign exchange market.

3.2 Short-term and long-term factors affect the exchange rate

The long-term factors affecting the exchange rate are production capacity, domestic and foreign commodity preferences, and trade barriers. The short-term factors are investment and holding products to be appreciated. This study focuses on the exchange rate changes in 2021 years. In the short term, the interest rate and expectation will affect the investment and currency holding behavior to be appreciated for the trend of RMB, resulting in the supply-demand curve and affecting the foreign exchange market.

4 OBSERVATION OF THE CHANGE OF RMB AGAINST THE US DOLLAR FROM THE DEMAND CURVE

Through the above theories, the prediction contributes to a research conclusion. As shown in the table below, the RMB will appreciate in 2020, which is related to the development of the medical industry. The rise in China's interest rate will cause the RMB to rise against the US dollar. The overall appreciation of the RMB is expected, which will lead to a rise in the RMB exchange rate against the US dollar. The expected appreciation of the RMB includes the expectation that the Chinese medical industry exports will increase and the productivity of China's medical industry will increase in 2021. High productivity will lead to high income

growth, which in turn will lead to high exchange rates. Because of the epidemic, China's productivity will recover.

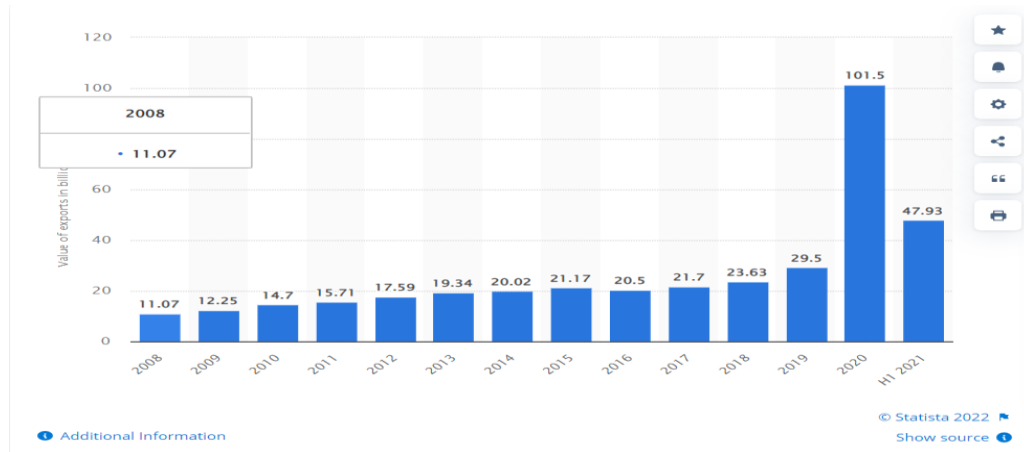


Figure 2. Value of medical equipment exports from China from 2008 to 1st half of 2021(in billion U.S. dollars) [7]

According to the table, Chinese exports are expected to decrease in 2021.



Figure 3. The exchange rate of RMB against the US dollar in 2021 [3]

By studying the exchange rate of RMB against the US dollar in 2021, it shows that the exchange rate is rising, indicating the appreciation of RMB.

Table 1 Demand of RMB against US dollar

factor	demand curve	the exchange rate of the yuan against the dollar
1.Yuan interest rate rises	Moves to the right	appreciation
2.Expected RMB appreciation	Moves to the right	appreciation
2.1Chinese imports are expected to increase	Moves to the left	devaluation
2.2Chinese exports are expected to decrease	Moves to the left	devaluation
2.3Expect China to increase trade barriers against the United States	Moves to the right	appreciation
2.4China's productivity is expected to increase	Moves to the right	appreciation

There are two factors affecting the exchange rate. One is the interest rate, the other is the expected interest rate. It is expected that the interest rate will affect the behavior of investors and thus the exchange rate. Among them, expected interest rates include import and export, productivity and trade barriers. China's production capacity increased in 2021, reaching a GDP growth rate of 8.1% [10]. Both imports and exports of the medical industry decreased [7][8]. The exchange rate of RMB against the US dollar increased. China expects to increase trade barriers against the United States, because the United States adjusts the exchange rate based on the unemployment rate, and the epidemic will cause most people to lose their jobs. The United States will also increase barriers to stimulate domestic production.

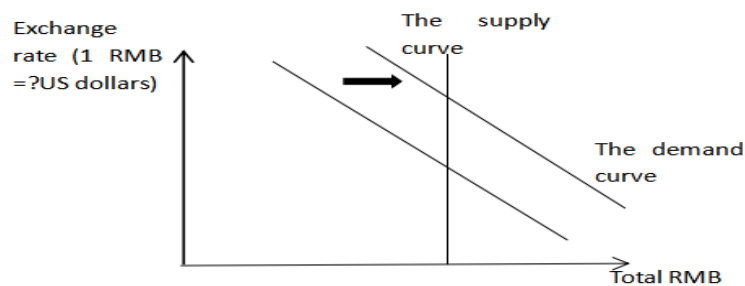


Figure 4. The demand curve

By combining yuan interest rate risks and expected RMB approval, the whole demand line should move to the right. At the same time, the RMB will exchange for more US dollars and the RMB will appreciate. This is a general monetary environment predicted by macroeconomics when the total amount of RMB remains unchanged.

5 DESCRIPTIVE TEST USED TO PLOT THE PRICE FLUCTUATION OF 20 SELECTED CHINESE LISTED MEDICAL STOCK COMPANIES

This experiment will study the 20 Chinese medical commercial companies with the largest total market value and their performance every day in the whole year of 2021, through the price and exchange rate and the performance of the whole medical stock.

Shanghai Pharmaceuticals Holding Co.,Ltd	Yunnan Baiyao	Zhejiang Huahai Pharmaceutical Co.,Ltd.	Changchun High and New Technology	Hualan Biological Engineering	Huadong Medicine	Topchoice Medical Co., Inc.
Shanghai RAAS Blood Products	Kangmei Pharmaceutical Co.,Ltd	Jiangsu permanent auspicious medicine	Zhangzhou Pientzhuang Pharmaceutical	Guangzhou Baiyunshan Pharmaceutical Holdings	Beijing Tiantan Biological Products	Shijiazhuang Yiling Pharmaceutical Co.,Ltd.
Hangzhou Tigermed Consulting	Lepu Medical Technology (Beijing)	Walvax Biotechnology	Chongqing Zhifei Biological Products	Aier Eye Hospital Group	Tongrentang	

Figure 5. The 20 Chinese medical commercial companies

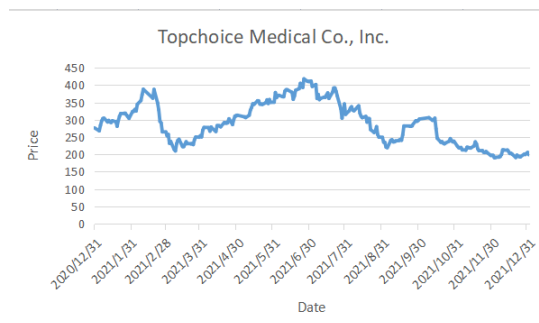


Figure 6. The price of Topchoice Medical Co., Inc.

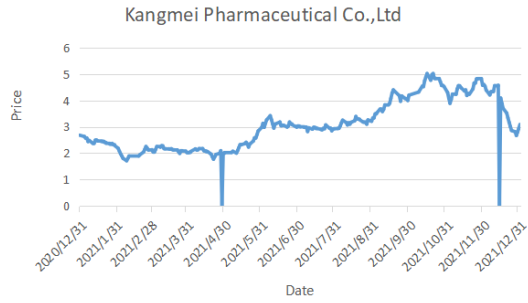


Figure 7. The price of Kangmei Pharmaceutical Co.,Ltd

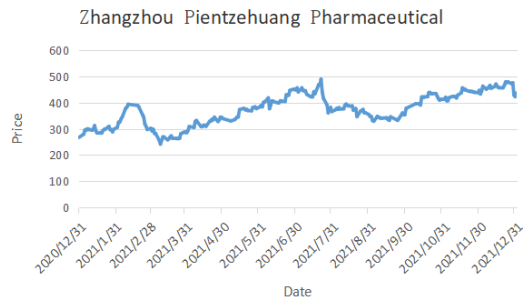


Figure 8. The price of Zhangzhou Pientzhuang Pharmaceutical

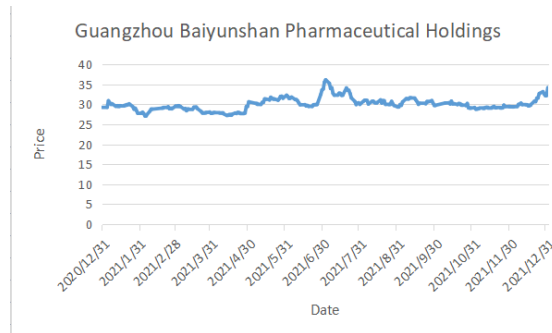


Figure 9. The price of Guangzhou Baiyunshan Pharmaceutical Holdings

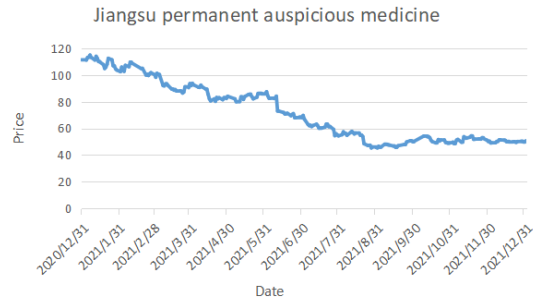


Figure 10. The price of Jiangsu permanent auspicious medicine

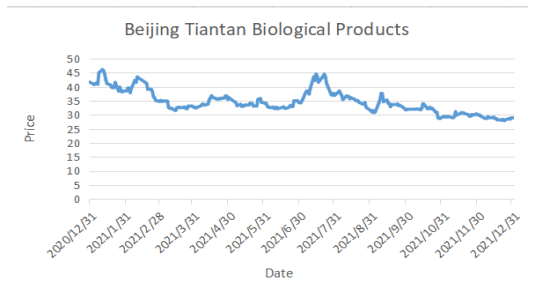


Figure 11. The price of Beijing Tiantan Biological Products

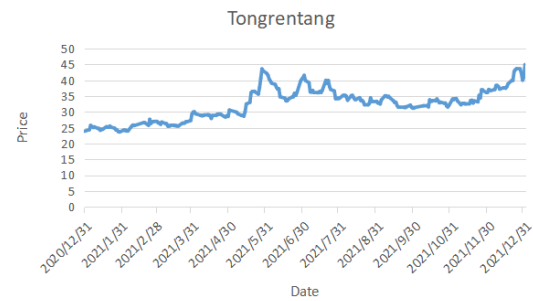


Figure 12. The price of Beijing Tiantan Biological Products



Figure 13. The price of Hangzhou Tigermed Consulting

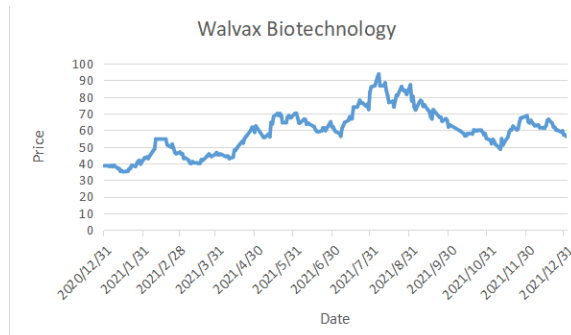


Figure 14. The price of Walvax Biotechnology

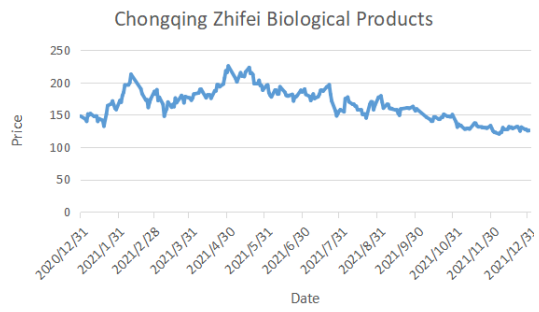


Figure 15. The price of Chongqing Zhifei Biological Products

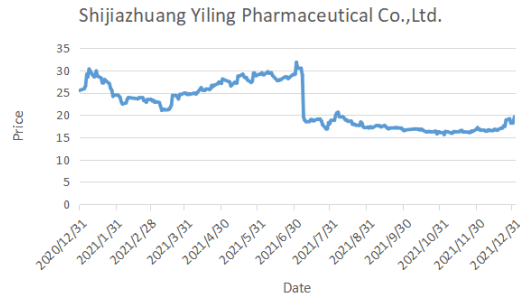


Figure 16. The price of Shijiazhuang Yiling Pharmaceutical Co.,Ltd.

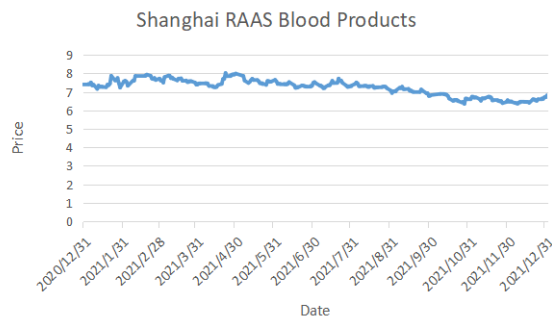


Figure 17. The price of Shanghai RAAS Blood Products

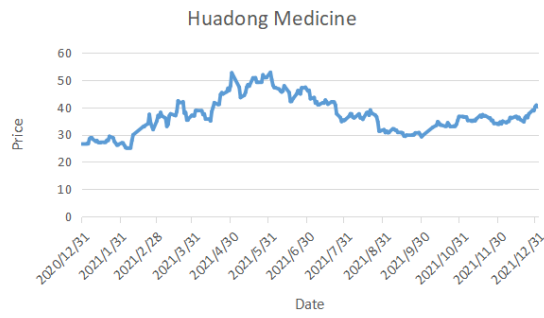


Figure 18. The price of Huadong Medicine

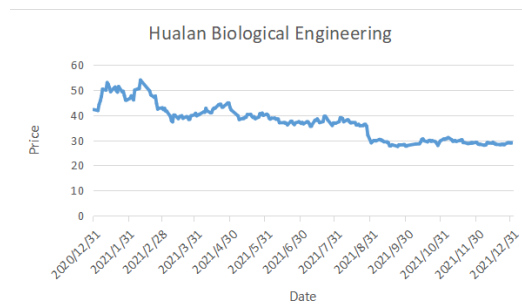


Figure 19. The price of Hualan Biological Engineering

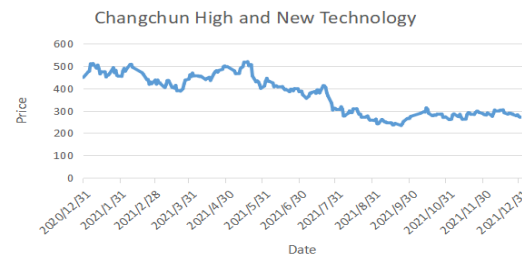


Figure 20. The price of Changchun High and New Technology

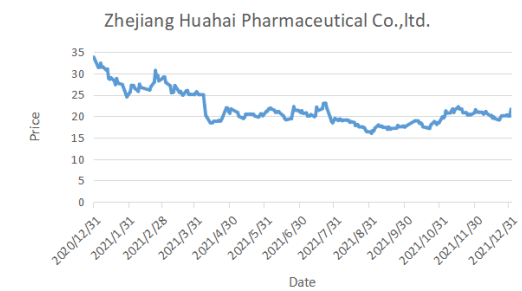


Figure 21. The price of Zhejiang Huahai Pharmaceutical Co.,Ltd.



Figure 22. Shanghai Pharmaceuticals Holding Co.,Ltd.

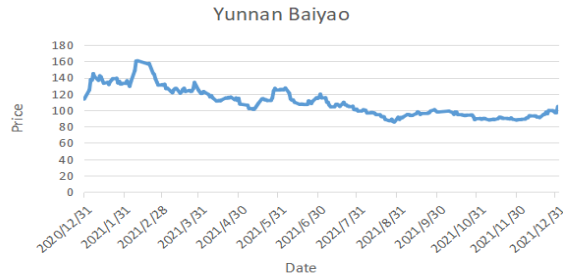


Figure 23. The price Yunnan Baiyao

As can be seen from this price trend chart, among China's largest medical stocks, Guangzhou Baiyunshan Pharmaceutical Holdings, Shanghai RAAS blood products and Shanghai Pharmaceutical Holdings Co., Ltd. are relatively stable.

5.1 Fluctuation curve of RMB exchange rate

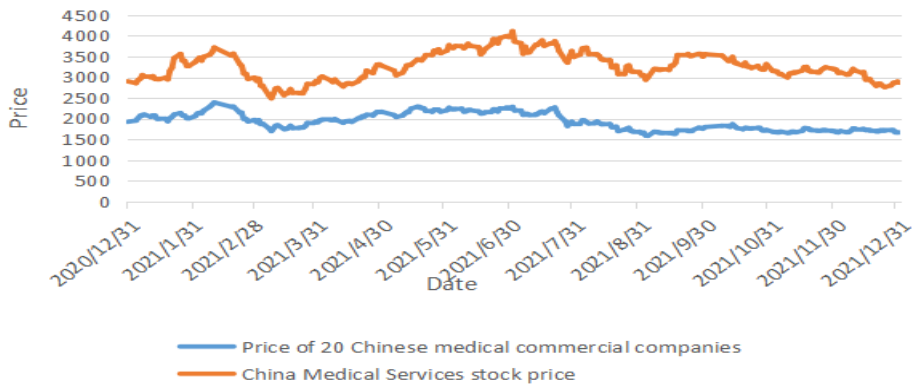


Figure 24. Price curve of the 20 Chinese medical commercial companies and medical services.

Table 2 Standard deviation and average value

	Price of 20 Chinese medical commercial companies	China Medical Services
Standard Deviation	206.6523423	343.1482664
Average Value	1925.384303	3261.609877

The overall trend of the 20 largest asset stocks selected (the sum of the 20 stock prices) is similar to that of China's medical services. At the same time, the stock prices of the 20 largest assets fluctuate less.

5.2 Return rate of China Medical Services stock, return rate of 20 Chinese medical commercial companies, exchange rate volatility

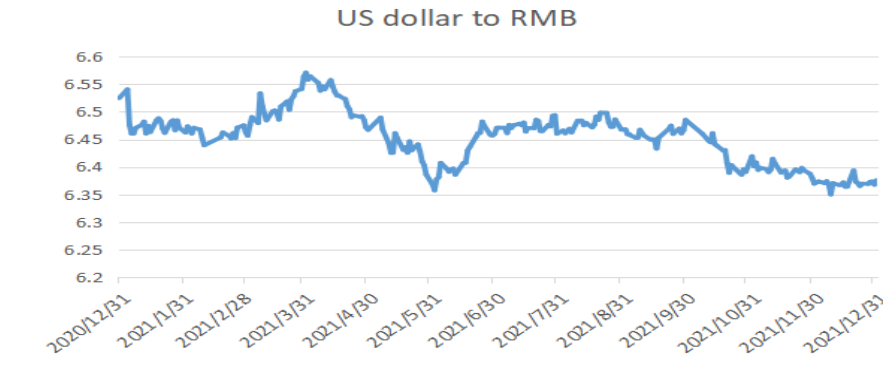


Figure 25. The exchange rate of US dollar to RMB

Then it calculates the exchange rate volatility $Ret1$, $Ret1=LN(et/e(t-1))$, et represents the exchange rate of US dollar to RMB at time t , and $e(t-1)$ is the exchange rate of US dollar to RMB at time $t-1$. Through logarithmic calculation, it can get their changes in 2021 years.

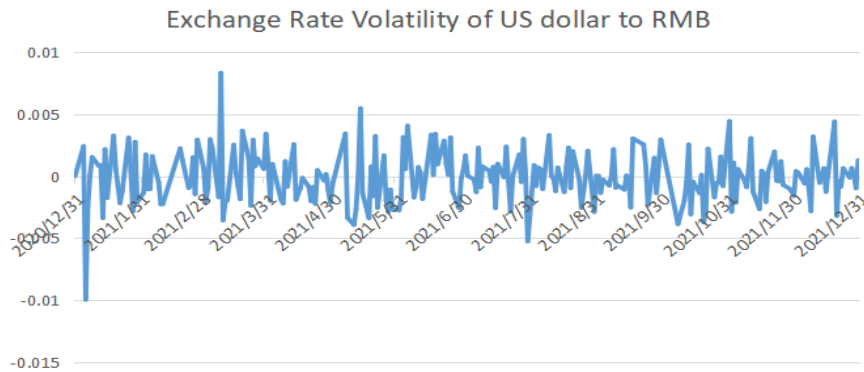


Figure 26. The exchange rate volatility of US dollar to RMB

Return Rate of 20 Chinese medical commercial companies is $Ret2$. $Ret2=LN(pt/p(t-1))$, pt represents the price sum of 20 Chinese medical commercial companies at time t , and $p(t-1)$ is the price sum of 20 Chinese medical commercial companies at time $t-1$. Through logarithmic calculation, it can get their return rate in 2021 years.

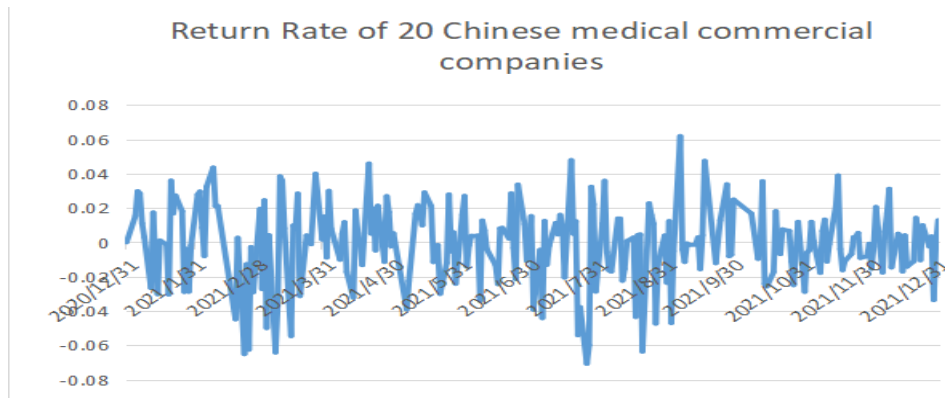


Figure 27. Return rate of 20 Chinese medical commercial companies

Return rate of China Medical Services stock is Ret_3 . $Ret_3 = \ln(p_t/p_{t-1})$, p_t represents the price sum of China Medical Services stock at time t , and p_{t-1} is the price sum of China Medical Services stock at time $t-1$. Through logarithmic calculation, it can get return Rate of China Medical Services stock in 2021 years.

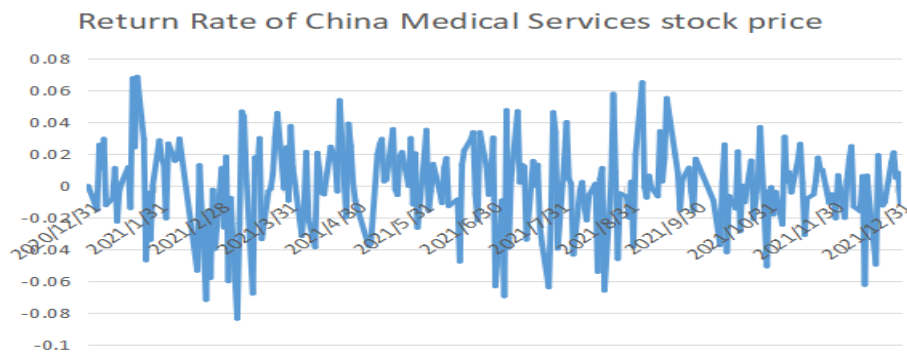


Figure 28. Return rate of China medical services stock price

According to the efficient market hypothesis, the stock market is not completely transparent and will be affected by transaction costs, taxes and information, considering the lag factor of the impact of exchange rate on stocks. Exchange rate is an independent variable and stock is a dependent variable. ADF test is used to calculate the number of stages of stationarity and lag.

5.3 ADF test

Table 3 ADF test of exchange rate volatility and return rate of 20 Chinese medical commercial companies.

variable	ADF Test						
	Lag stage number	t	p	AIC	Critical value		
					1%	5%	10%
Exchange Rate Volatility US dollar to RMB(Ret1)	0	-13.293	0.000***	-2188.795	-3.458	-2.874	-2.573
Return Rate of 20 Chinese medical commercial companies(Ret2)	0	-7.161	0.000***	-1066.811	-3.458	-2.874	-2.573

In ADF test, the T value of ret1 (exchange rate volatility) is -13.293, which is less than 1%, 5% and 10%, and the T value of ret2 (stock return) is -7.161, which is less than 1%, 5% and 10%. And the p value is 0, less than 0.01. It shows that the two time series can reject the original hypothesis, and there is no unit root. They are both stationary time series, and the lag order is 0.

5.4 Correlation test

Table 4 Correlation test of exchange rate volatility and return rate of the 20 Chinese medical commercial companies.

Correlation test	Ret1 (P value)	Ret2 (P value)
Ret1 (P value)	1.000(0.000***)	0.156(0.015**)
Ret2 (P value)	0.156(0.015**)	1.000(0.000***)

Through the correlation test, it can be concluded that the p value is 0.015, less than 0.01, which is significant. And there is a negative impact between exchange rate volatility (Ret1) and Return Rate(Ret2) (- 0.156).

The paper calculates the return rate of a medical stock individually. That means, $\text{return}(n) = \ln(P(t) / P(t-1))$, return (n) is the return rate of a medical stock; P (t) is the price of the stock at time t; P (t-1) is the price of the stock at time t-1 and the logarithm of the value of P (t) / P (t-1). Finally it gets the return rate.

When the exchange rate changes, the change of Guangzhou Baiyunshan Pharmaceutical Holdings is smaller, which may be due to the greater impact of other factors (tax). Chongqing Zhifei biological products are affected greatly by the floating rate of the exchange rate.

Table 5 Correlation test of return rate of each company and exchange rate volatility

Correlation test (P value)	Ret1 (P value)	Shanghai Pharmaceuticals Holding Co.,Ltd	Yunnan Baiyao	Zhejiang Huahai Pharmaceutical Co.,Ltd.	Changchun High and New Technology	Hualan Biological Engineering	Huadong Medicine	Topchoice Medical Co., Inc.
Ret1 (P value)	1.000(0.000***)	-0.078(0.231)	-0.092(0.156)	-0.092(0.155)	-0.104(0.108)	-0.062(0.341)	0.209(0.001***)	0.111(0.086*)
Ret1 (P value)	-0.016(0.811)	-0.019(0.771)	-0.058(0.371)	0.115(0.077*)	0.007(0.911)	-0.033(0.610)	0.054(0.403)	0.056(0.390)
Ret1 (P value)	-0.076(0.240)	-0.094(0.148)	0.102(0.117)	0.228(0.000***)	0.195(0.003***)			

6 CONCLUSION

In conclusion, the RMB will appreciate against the US dollar in 21 years. Medical stocks with large assets will be more stable than the overall medical commercial market in 2021, which means that medical enterprises with relatively large investments will avoid risks in the West. The floating rate of exchange rate has a negative impact (p value is 0.015, significant) on the return of medical stocks, although this impact is relatively stable. The exchange rate of Guangzhou (correlation = 0.007) will be more resistant to the change in the exchange rate in 2021. This study focuses on the factors affecting the exchange rate and the impact of China's medical stocks on exchange rate fluctuations, but does not study the impact of each factor (such as interest rate) on the return rate of medical stocks. The study of those factors will help investors further reduce losses and risks. Moreover, the study is based on the average stock price per week, which lacks the rejection of heresy index (the number of weeks with an abnormal price), so these points can be refined in further studies.

REFERENCES

- [1] Christina, M. Trilemma Definition. Investopedia. 2020. <https://www.investopedia.com/terms/t/trilemma.asp#:~:text=Trilemma%20often%20is%20synonymous%20with,its%20international%20monetary%20policy%20agreements.>
- [2] Global Times. China's foreign exchange reserves reach \$3.25 trillion, hitting 6-year high. Global Times. 2022. <https://www.globaltimes.cn/page/202201/1245389.shtml#:~:text=China's%20foreign%20exchange%20reserves%20stood,of%20Foreign%20Exchange%20on%20Friday.>
- [3] Finance.sina.com. yuan against the dollar [Infographic]. Finance.sina.com. 2021. <https://finance.sina.com.cn/money/forex/hq/CNYUSD.shtml>

- [4] Julie, B. Trilemma Definition [Photograph]. Investopedia. 2019. <https://www.investopedia.com/terms/t/trilemma.asp>
- [5] Jinglaiguwang. A detailed explanation of China's exchange rate regime. 2016. Souhu. https://www.sohu.com/a/110272643_180545
- [6] Kenneth, S. R., Aasim, M.H., Ashoka, M., Robin, B., & Nienke, O. Evolution and Performance of Exchange Rate Regimes. 2003. International Monetary Fund. <https://www.imf.org/external/pubs/ft/wp/2003/wp03243.pdf>
- [7] Statista.com. Value of medical equipment exports from China from 2008 to 1st half of 2021 [Infographic]. Statista.com. 2021. <https://www.statista.com/statistics/436834/china-medtech-export-value/>
- [8] Statista.com. Value of medical equipment imports to China from 2008 to 1st half of 2021 [Infographic]. 2021. <https://www.statista.com/statistics/436823/china-medtech-import-value/#:~:text=In%20the%20first%20half%20of,period%20in%20the%20previous%20year.>
- [9] The east of finance and economics. Enlightenment of China's changes in the past 20 years after China's entry into WTO. Baijiahao. 2021. <https://baijiahao.baidu.com/s?id=1720175464793976497&wfr=spider&for=pc>
- [10] Tianyu, W. China's foreign exchange reserves reach \$3.25 trillion, hitting 6-year high. CGTN. 2022. <https://news.cgtn.com/news/2022-01-17/China-s-GDP-tops-114-36-trillion-yuan-in-2021-16T64Jt0na8/index.html>