Study on the Structure Optimization of China's Foreign Exchange Reserve

Ningya Mao

The Graduate School of the University of the Chinese Academy of Social Sciences, Beijing 100000, China

Abstract

With the continuous expansion of the scale of foreign exchange reserves, the structure of reserve assets and risk management are becoming more and more important. Selecting the daily yield data of eight representative reserve assets from January 2016 to December 2020, such as US dollar, euro, Japanese yen, British pound, Australian dollar, Canadian dollar and oil and gold, we can further optimize the structure of China's foreign exchange reserve assets by using the twice absolute deviation model (MAD model) to calculate the optimal allocation of assets and the VaR-GARCH model to manage the risk of asset allocation, Meet the safety principle of foreign exchange reserve management.

Keywords

Foreign Exchange Reserves; Mad Model; GARCH Model; Reserve Currency; Foreign Exchange Portfolio Risk; Foreign Exchange Reserve Structure.

1. Introduction

Over the past 30 years of reform and opening up, China's economy has developed rapidly, of which foreign trade has contributed greatly. Especially since China's accession to the WTO, a large amount of capital has entered China because international investors are optimistic about China's economic situation. The double surplus of trade and capital makes China's foreign exchange reserves accumulate for a long time and occupy the first position in the world. By the end of 2020, China's foreign exchange balance had reached US $3.84 trillion. Huge foreign exchange reserves have played an important role in the stable development of China's open economy. At the same time, the investment risk of managing huge foreign exchange reserves is also facing great challenges.

The International Monetary Fund (IMF) announced the foreign exchange reserve structure of developing countries in the fourth quarter of 2020: the US dollar was 62.25%, the euro was 21.48%, the Japanese yen was 3.16%, the British pound was 4.48%, the Canadian dollar was 2.23%, the Australian dollar was 2.07%, and other currencies accounted for a total of 3.93%. As the scale of China's foreign exchange reserves accounts for a large proportion in developing countries, it is speculated from the above data that about 60% of China's foreign exchange reserves are invested in US dollar assets, and the euro also accounts for about 20%. Recent research shows that under the background of long-term turbulence in the international financial environment, how to balance the relationship between risk and return and reasonably determine the foreign exchange reserve structure has become a hot spot in academic research[1].

On the structure of foreign exchange reserves, foreign scholars have carried out relevant research for a long time. The famous theories include Markowitz's portfolio selection model, Heller and knowledge model and Dooley model. By constructing a Markowitz's (1952) portfolio selection model for foreign exchange reserve currencies, the risks and benefits of VaRious reserve currencies can be optimized and analyzed. Heller and Knight (1978) studied a country's

foreign exchange management by establishing an econometric model and paying attention to a country's trade balance structure and exchange rate system. Dooley (1989) and others supplemented the Heller Knight model and pointed out that the structure of foreign exchange assets is the result of the joint influence of trade flow, foreign currency payment flow and exchange rate system.

Another research direction of foreign exchange reserve structure is to use VaR method and other models to optimize the foreign exchange currency structure from the perspective of reducing foreign exchange risk.

Looking at domestic and foreign studies, it can be seen that although scholars have made in-depth research on the currency structure of foreign exchange reserves from different angles, there are still some deficiencies: first, from the perspective of "don't put eggs in one basket", most studies still choose less types of reserve assets, resulting in the lack of good dispersion of foreign exchange portfolio risk; Secondly, using the mean VaRiance model to study the structure of foreign exchange reserves, we need to assume the normality of the yield distribution. However, the actual situation is that the yield distribution of foreign exchange assets generally does not obey the normal distribution[2]; Finally, although the use of absolute deviation model avoids the problem of normality assumption, it obviously does not consider the risk factor.

In view of the shortcomings in the above research, this paper makes innovations from two aspects: the selection of foreign exchange assets and the selection of optimization methods. Firstly, in the selection of foreign exchange reserve assets, eight assets are selected: US dollar, euro, Japanese yen, British pound, Australian dollar, Canadian dollar, oil and gold; Secondly, in the selection of optimization methods, the absolute deviation model is used twice, especially when the absolute deviation model is used for the second time, not only the rigid constraints such as trade direction and foreign debt structure are considered, but also the constraints of foreign exchange reserve risk value calculated by GARCH model are considered, which solves some deficiencies in the above literature research and realizes a new balance between income and risk.

2. An Empirical Analysis on the Structural Optimization of China's Foreign Exchange Reserves

2.1. Selection of China's Foreign Exchange Reserve Assets and Data Collection

On November 19, 2012, Australian dollar and Canadian dollar were recognized as official reserve currencies by the International Monetary Fund. At the same time, after 2013, the holdings of the two currencies in each member state have also been independently announced, indicating that the Australian dollar and Canadian dollar will be more and more widely used in international settlement. In addition, gold reserves have become an indicator of the wealth and hard power of countries around the world. Having more gold reserves means that countries have a stronger ability to deal with financial risks in the world trading system. As one of the lifeline resources of China's industrial economy, the storage of oil is insufficient compared with sufficient coal resources. In addition to further developing domestic oil resources, it is urgent to use foreign exchange reserves to solve the problem of long-term oil shortage. Based on the above reasons, considering China's foreign trade structure and foreign debt currency structure, this paper selects US dollar, euro, Japanese yen, British pound, Australian dollar, Canadian dollar, gold and oil as China's foreign exchange reserve assets[3].

According to the needs of demonstration, this paper selects the daily exchange rate under the indirect pricing method of US dollar, euro, Japanese yen, British pound, Australian dollar and Canadian dollar, the daily price of gold and oil, and the daily yield of five-year treasury bonds of the United States, the European Union, Japan, the United Kingdom, Australia and Canada. The

data comes from the wind database, and the daily data from January 2016 to December 2020 are selected.

2.2. Descriptive Statistical Analysis of Return on Assets

As can be seen from table 1, the largest average is the Australian dollar, followed by the Canadian dollar and sterling. It can be seen that the yields of the Australian dollar, Canadian dollar and Sterling have been high and performed well in recent years. Analyzing the risk of eight assets from the perspective of VaRiance and standard deviation, it can be seen that the standard deviation of US dollar is the smallest, followed by Japanese yen, Canadian dollar, British pound, euro, gold and Australian dollar, and the largest standard deviation is oil.

Analyze whether the return on eight assets conforms to the normal distribution. From the descriptive statistics, it can be seen that the skewness coefficient is significantly not equal to 0, and the kurtosis coefficient does not meet the normal condition. By using Shapiro Wilk statistical test method to test the normality of the return distribution of eight assets, we get that the W-Test statistics of eight assets are greater than 0.95, so the return of eight assets does not conform to the normal distribution.

2.3. China's Foreign Exchange Reserve Structure under Mad Model

The traditional mean VaRiance model needs to assume that the rate of return of money meets the condition of normal distribution, but the condition in the previous analysis does not meet. Therefore, this paper uses the absolute deviation model proposed by yamakaz and komno (1991) to calculate the optimal allocation proportion of foreign exchange reserves.

The daily income of eight assets, the proportion of import trade and the proportion of foreign debt structure are substituted into the mad model and calculated with MATLAB software. On the premise of meeting the payment of short-term foreign debt and import trade, it is concluded that when the absolute deviation is the smallest.

Considering China's trade structure and foreign debt structure, combined with the risk situation of VaRious assets, the largest proportion of China's foreign exchange reserves is 36.9% in yen, followed by 35.1% in US dollars. This is because both Japan and the United States are important trade importers of China, and they also play an important role in China's foreign debt. From the calculation results of absolute deviation model, yen and US dollar play an important role in China's foreign exchange reserves. Although the EU has been China's largest importer in recent years, the European debt crisis since 2016 has led to the continuous depreciation of the euro, so the euro accounts for only 3.69% of foreign exchange reserves. From the absolute deviation model, the proportion of US dollar and euro held by China is too high and should be lowered appropriately[4]; The proportion of Japanese yen should be appropriately increased.

In addition, the Australian dollar, whose mean and standard deviation are not optimistic, accounts for 1.42% of China's foreign exchange reserves. This is due to China's trade structure constraints. In China's foreign trade system, Australia has close trade relations with China, and due to its unique geographical location and natural resource advantages, Australia has become the most important trade importer of China. Therefore, the Australian dollar should become one of China's strategic foreign exchange reserves.

The proportion of sterling in China's foreign exchange reserves of 0.28% seems incredible at first. However, after careful analysis, it can be found that Britain, like Canada, is not a major trade importer of China. At same time, pound sterling does not occupy a place in foreign debt currencies, so foreign debt structure constraints do not exist.

In the previous statistical description and analysis, gold and oil, which are not optimistic, also occupy a place in foreign exchange reserves. Gold accounts for 13.09% of foreign exchange reserves, ranking third; Oil accounts for 4.42%, ranking fifth. Although gold prices have continued to fall recently, they have performed poorly. In view of the fact that gold prices are

easily affected by international speculation, the risk will rise with the instability of prices. But in comparison, gold fluctuates much less over a period of time than underperforming currencies. At the same time, as a real asset recognized by countries all over the world, and there are few political risks, it is necessary to increase gold holdings. As China's scarce energy, oil plays an important role in China's economic development. Even if the oil price has great volatility, it is necessary for China to reserve oil.

Through the above analysis, it can be seen that the foreign exchange asset structure calculated by the absolute deviation model is reasonable. The model estimates the optimal structure of domestic and foreign exchange in a long period of time, but the disadvantage is that it does not consider the risk measurement. Next, we use VaR method to further optimize China's foreign exchange structure.

2.4. Statistical Characteristics of China's Foreign Exchange Reserve Portfolio Return

By using the mad model to calculate the proportion of each asset in China's foreign exchange reserves, the yield of China's foreign exchange reserve portfolio can be calculated and statistically analyzed.

As can be seen from table 3, the average rate of return of foreign exchange reserve portfolio is 0.009 0 and the standard deviation is 0.004 6. From the analysis of standard deviation, it is obvious that the standard deviation of foreign exchange portfolio is 0.004 6, which is less than the standard deviation of eight kinds of assets, indicating that China's foreign exchange reserve investment in a VaRiety of assets can well reduce risks.

2.5. Optimization of China's Foreign Exchange Reserve Structure - Marginal Var

Marginal VaR refers to the change of Portfolio VaR caused by the change of asset position. Using marginal VaR to measure the impact of small changes in position on portfolio risk can help us reduce portfolio risk[5]. The weight ratio calculated by mad model and the asset volatility estimated by garch-n model are substituted into the marginal VaR calculation formula. The SAS software is used to obtain the marginal value of each asset at 99% confidence level, and the sum of marginal VaR is 0.144 9.

In order to reduce portfolio risk, we should reduce the position with the maximum marginal VaR value and increase the position with the lowest marginal VaR value. According to the above analysis, the marginal VaR values of AUD, EUR and GBP are large, and their proportion in the combination should be reduced. However, as the proportion of the three currencies has reached the lower limit of trade constraints, it cannot be adjusted. Therefore, this paper readjusts the proportional constraint between Canadian dollar and oil according to the marginal VaR value, and sets the lower limit of Canadian dollar constraint to 0.05 and the upper limit of oil constraint to 0.04. The new marginal VaR value constraint is substituted into the absolute deviation model for the second optimization.

In the process of the second optimization, the sum of marginal VaR is 0.143 2 and the standard deviation of the combination is 0.004 6259, while the sum of marginal VaR of the original combination is 0.144 9 and the standard deviation is 0.004 6405, which indicates that the portfolio risk after the second optimization has decreased. At the same time, it can be found that under the new constraints, the structure of China's foreign exchange reserves should be 37.58% of yen, 34.21% of US dollar, 13.31% of gold, 5.5% of Canadian dollar, 4% of oil, 3.69% of euro, 1.42% of Australian dollar and 0.28% of British pound.

3. Conclusion

This paper calculates the optimal allocation proportion of foreign exchange reserve assets by using the absolute deviation model twice, and uses the VaR-GARCH model to manage the risk

of asset allocation, which further optimizes the structure of China's foreign exchange reserve assets and meets the safety principle of foreign exchange reserve management.

Under the background of one belt, one road, the European and American debt crisis is constantly fermented and the international financial environment continues to be turbulent, China's future international political and economic strategy and major economic cooperation will inevitably shift. This paper empirically gives other options for the diversification of China's foreign exchange reserves, such as the Canadian dollar with good currency stability, gold with international payment function and strategic reserve resource oil.

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