An Empirical Study on the Exchange Rate Volatility of Shanghai Cooperation Organization Countries Based on Computer Software Analysis

Xiaodong Huang$^{1,*}$
$^1$School of Economics and Management, Shanghai University of Political Science and Law, China, 201701
*Corresponding author e-mail: huangxd@shupl.edu.cn

Abstract. With the rapid development of our economy, the market of economic exchange rates between our country and other countries has also fluctuated. This paper analyzes the volatility of exchange rates among members of the Shanghai Cooperation Organization. The result shows that the economic volatility and exchange rate volatility among its members have strengthened gradually, and the courseware Shanghai Cooperation Organization has been developing steadily.

Keywords: Shanghai Cooperation Organization, Economic Fluctuations, Coordination

1. Introduction
The Shanghai Cooperation Organization was established on June 15, 2001. After it was established, our prime minister will meet regularly. With the attention of our country, the development of the Shanghai Cooperation Organization is getting better and better. With the rapid development of our country’s economy, trade exchanges between organizations have become more frequent. Therefore, it is imperative to investigate and analyze the volatility of the exchange rate in the Shanghai Cooperation Organization.

2. A review of the correlation research on economic fluctuation comobility
International economic fluctuation coordination refers to the synchronization of output fluctuations between countries and the similarity of business cycles. Economic coordination among member countries of economic organizations is the economic basis for policy coordination. Mitchel (1927) and a large number of subsequent studies (such as David K. Backus, 1993) found that the world economic cycle exists objectively and is an endogenous form of economic movement under the conditions of an open economy. The combined effect of various shocks and the cross-border transmission of international trade and financial transactions in the economic cycle of a specific country or region have created the world economic cycle [1].

The New Open Economic Macroeconomics (NOEM), as a successful example of the Neoclassical Synthesis (NNS) framework that emerged in the 1990s, integrates the theoretical resources of both the
real business cycle (RBC) theory and the New Keynesian macroeconomics. The groundbreaking paper by Kydland and Prescott (1982) laid the foundation for the actual business cycle theory. After the development of King and Rebelo (2000), a relatively complete theory with explanatory power for real-world economic cycle fluctuations has gradually formed. Chen Kunting, Zhou Yan, and Gong Liutang (2004) proposed that “there is an approximate sympathetic relationship between developed economies; the developing economy is led by a leading economy, and there is a lagging sympathetic response; a small economy relies on a large economy and has a lagging Sympathetic; the surrounding economies often have sympathetic responses.”

Traditional theory believes that the synchronization of the international business cycle will be further strengthened with the advancement of global economic integration and is currently in a highly relevant state (Doyle and Faust, 2005), but other scholars (D. Harding and A. Pagan, 2006). In the empirical test, it is found that although the correlation coefficients of the total economic output of various countries are mostly positive, the synchronization of industrial production is low and the synchronization of economic cycles between developing countries is lower than people's expectations [2].

The generation mechanism of the world economic cycle and the transmission mechanism are closely connected, and the transmission mechanism is, in a large part, the generation mechanism. The same cyclicality of economic fluctuations is mainly due to the international transmission of economic fluctuations. The trade density theory (Baxter, 1995, 2005) has confirmed the existence and rationality of the two most important transmission channels of international trade and finance. It is believed that the synchronization of economic fluctuations in various countries has a close positive relationship with trade, mainly due to Dependence on imports from other countries includes price shocks, demand shocks (Ariel Burstein, 2008), and other trade-related shocks [3].

3. The measurement of the comobility of business cycles

3.1. HP filtering method

Time series data business cycle research generally uses trend elimination to obtain cycle components. There are many specific methods for trend elimination. Huang Meibo and Lu Chaofeng (2010) made a comparative analysis and pointed out that “even for countries that have suffered from natural conditions and technological innovation, the production function method, HP filter method, and potential growth rate Law also has synchronization in trends." The HP (Hodrick, Prescott, 1990, 1997) filtering method overcomes to a certain extent the shortcomings of the linear regression method, such as forcing the trend of the variable as a straight line. This paper uses EV iews7 software to decompose the actual GDP data based on 2000 in the trend item and cyclical fluctuation item (the smoothing factor λ is 100) [4]. The results show that the trend correlation between Russia and the four Central Asian countries (0.96) is higher than that of China (0.87), and the CIS effect is obvious. According to the size of their economies, the six member states of the SCO are basically divided into three groups: large, medium and small (Abu Lait Yiming, 2010). Under normal circumstances, the economic fluctuations of small countries are relatively large and are caused by the economic fluctuations of large countries, and SCO members are no exception. The economic powers of Russia and China in the organization exhibited "countercyclical" characteristics, and the four members of Central Asia basically fluctuated simultaneously. The reason is that Russia and Kazakhstan, as energy exporting countries, their economic fluctuations mainly reflect trends in the international energy market. Standardized data within the group of economic fluctuations and trends in various countries, as shown in Figure 1.
3.2. Synchronization index
Judging from the existing research literature, the bilateral correlation between the actual economic activities of the two countries after removing the trend is usually used to measure the economic cycle coordination. This paper draws on the synchronization index method of Cerqueira and Martins (2009) to calculate the actual economic cycle co-movement among SCO member countries. The larger the index value, the higher the degree of economic cycle coordination between the two countries. The calculation formula of synchronization index is shown in formula (1):

$$CI_{ij,t} = 1 - \frac{1}{2} \left( \frac{g_{j,t} - \mu_{gi}}{\sigma_{gi}} - \frac{g_{i,t} - \mu_{gi}}{\sigma_{gi}} \right)$$

Among them $CI_{ij,t}$ represents the actual economic synchronization index between country i and country j in period t, $g_i$ and $g_j$ are the actual GDP growth rates of countries i and j and their mean and standard deviation respectively. Statistics show that the CIS countries experienced severe economic recession and instability due to lack of institutional systems, social turmoil and even civil wars in the early 1990s, and then experienced greater crises and impacts in 1999 and 2009. Volatility, China is growing steadily and rapidly. As shown in Figure 2 for the synchronization index display between China and the other five countries, the overall volatility difference tends to shrink.

In addition to safeguarding regional security, the Shanghai Cooperation Organization has also made outstanding contributions to the political, economic, and cultural fields. As the most powerful countries in the organization, China and Russia, their policies have an important and far-reaching impact on the development of the SCO. There are many similar demands in the policies of China and Russia, and it is these policy demands that determine the development of the Shanghai Cooperation Organization. Russia, Belarus and Kazakhstan established a customs union on January 1, 2010. In this context, Russia should play its due role more actively and promote the integration process of the Shanghai Cooperation Organization.
infrastructure construction, can non-governmental trade and investment follow up and prosper [7]. Economic cooperation can cultivate a higher level of economic integration cooperation mode. Here, giving full play to Xinjiang's role as a bridgehead for opening to the west is conducive to the development of China's western region and will certainly inject new impetus into Asia-Europe cooperation.

4. Network technology for calculating exchange rate models

4.1. Hypothesis of the model
From the definition of the network model, a specific network G is composed of a non-empty point set V(G) and a finite edge set E(G), where each actor is regarded as a node, and each edge represents the relationship between nodes. Therefore, a social network graph contains two sets of information: One group is point N={n₁, n₂, ..., nₙ}, N is the number of nodes (or order), denoted as V(G); One group is the line L={l₁, l₂, ..., lₖ}, L is the number of sides, denoted as E(G). Each edge in E has a pair of nodes in V corresponding to it. After this abstraction, according to whether the edges in the graph have directed rights, there can be four types of network graph representation: weighted directed graphs, weighted undirected graphs, unweighted directed graphs, and unweighted undirected graphs. For an unauthorised and undirected exchange rate network, make the following assumptions: There is no heavy edge in the network, that is, there is at most one edge between any two nodes; There is no self-loop in the network, that is, there is no edge starting and ending at the same node [8].

4.2. Data acquisition and preprocessing
This article refers to Yao et al. (2015) on the measurement method of exchange rate volatility, and defines exchange rate volatility V as the relative rate of change of exchange rate price series, namely \( V = \frac{P_{t+1} - P_{t}}{P_{t}} \), where \( P_{t} \) is the dollar value at time t exchange rate. Since the U.S. dollar occupies a dominant position in the global monetary system, the measurement of a currency’s depreciation or appreciation is based on the U.S. dollar. Therefore, this article selects 34 major currencies against the U.S. dollar from January 1, 2008 to December 31, 2016. Daily exchange rate data, a total of 3288 transaction data. These 34 major currencies are non-US currencies selected according to the currency rankings in the global foreign exchange market volume survey report conducted by the Bank for International Settlements every three years. The research range covers both the global financial crisis and the new trends in world politics. Effectively reveal the fluctuation laws of global currency exchange rates [9].

4.3. Exchange rate network construction algorithm
Denote the volatility series of 34 exchange rates as VEUR, VJPY, ..., VPEN. The Pearson correlation coefficient is used to measure the relevance of exchange rate fluctuations. The calculation is shown in formula (2):

\[
\rho_{ij} = \frac{\text{cov}(V_i, V_j)}{\sqrt{D(V_i)D(V_j)}}
\]  

(2)

Among them, \( V_i \) is the exchange rate fluctuation of currency i against the U.S. dollar, \( V_j \) is the exchange rate fluctuation of currency j against the U.S. dollar, \( \text{cov}(V_i, V_j) \) is the covariance of the two, and \( D(V_i) \) is the variance of the exchange rate fluctuation of currency i against the U.S. dollar. The correlation coefficient matrix is transformed into the adjacency matrix \( A=(a_{ij}) \) through the threshold method, and the transformation rules are as follows: If \( \rho_{ij} \geq 0.5 \) and pass the test, \( a_{ij} = 1 \); otherwise, \( a_{ij} = 0 \). In this way, the adjacency matrix \( A=(a_{ij}) \) of the graph G containing 34 currency nodes is obtained, which is a 34×34 matrix. From this matrix, we can see whether there is a relationship between the exchange rate fluctuations of the two currencies, 1 means there is a relationship, and 0 means no relationship. According to the network adjacency matrix \( A=(a_{ij}) \), an unweighted undirected network with 34 nodes is constructed. This article studies the current situation and structural characteristics of exchange rate volatility from two perspectives: cohesion subgroup and location analysis [10].
5. Conclusion
In summary, this paper mainly uses network technology to build a model for calculating exchange rates. It also uses HP filtering and assimilation index calculation methods to calculate and analyze the exchange rate volatility of the Shanghai Cooperation Organization. The result shows that our country's economic development is very rapid, and the stability of its economic development is getting higher and higher.

Acknowledgement

References
This project is supported by the research fund of China National Institute for SCO International Exchange and Judicial Cooperation, No.18SHJD042.

[1] Pang Bo, Zhang Qinglong. Exchange Rate Volatility Analysis with Conditional High-order Moment Risk [J]. China Logistics & Purchases, 2020: 39-40.
[2] Ma Rongjiu. On China's State Role in the "Shanghai Cooperation Organization" [J]. Contemporary World Socialist Issues, 2016: 34.
[3] Zhang Ning. Analysis on the Possibility of the Shanghai Cooperation Organization Free Trade Zone [J]. Journal of Liaoning University (Philosophy and Social Sciences Edition), 2017
[4] Abulaidi Yiming, Gulige Gupur. Research on the co-dynamics of economic fluctuations among SCO members [J]. China Economic and Trade Guide, 2012: 77-78.
[5] Zhang Jing. Exchange Rate Determination of Asian Countries: Analysis Based on the Feasibility of Exchange Rate Linkage [J]. Shanghai Finance, 2012: 11-19+118.
[6] Wu, X. X. An Analysis of Exchange Rate Volatility in China's Foreign Exchange Market Based on ARCH Model [J]. Eastern Corporate Culture, 2013: 212.
[7] Xiang Xiao Yang. An Empirical Analysis of the Impact of Exchange Rate Fluctuation on Financial Financing of "One Belt And One Road" Countries [J]. New Business Week, 2018: 127, 129.
[8] Yang Lifan. Analysis of the Influence of RMB Exchange Rate Volatility on China's Import and Export [J]. Business Management, 2012: 57+156.
[9] GeMing, Nie Pingping. The Logic of Collective Action in Cooperation of Regional International Organizations: A Case Study of the Shanghai Cooperation Organization [J]. Journal of Shanghai Institute of Administration, 2017: 101-110.
[10] Wang Jieqiong. Empirical Analysis of RMB Exchange Rate Volatility [J]. Fortune Today: China Intellectual Property, 2017: 121.