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An Empirical Analysis of a Settlement Currency in the "Silk Road Economic Belt"

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Abstract: ***The regions and countries have begun to seek deeper cooperation actively, especially cooperation in the monetary area, after the Asian crisis and the global financial crisis. Strategic Concept "Silk Road economic belt" is raised against this background trend. This paper studies the possible forms of the national currency cooperation along the "Silk Road economic belt". First , construct Currency Basket Index by study on the relationship between the exchange rate. And then, choose the weight for the currency with the smallest fluctuations to build the "currency basket" as the settlement currency in trade. Finally, the weights for the "currency basket" of some countries along the "Silk Road economic belt" are simulated to provide policy recommendations for monetary cooperation.***

Keywords: "Silk Road economic belt", settlement currency, currency basket

1. Introduction

The "Silk Road Economic Belt" is a new economic development area formed on the basis of the ancient Silk Road. It is an important conception of China's economic development and foreign affairs. The "Silk Road Economic Belt" strategy not only strengthens the interconnection and trade between China and Central Asia, but also provides an open channel for the western region of China. With the "Silk Road Economic Belt" cooperation deepening, the issues such as the determination of trade settlement currency, promoting financial integration have been put on the agenda gradually.

2. Literature Review

The study of the Settlement Currency of "Silk Road Economic Belt" is relatively rare, most of which are theoretical research, there is little empirical analysis, and more of the study focused on the aspects of RMB regionalization and internationalization. However, according to the theory of optimal currency area proposed by Mundell (1961), to achieve the "single currency" in the monetary union of the "Silk Road Economic Belt" countries and regions needs to have four conditions—labor mobility, economic openness, economic scale, commodity diversification, commodity integration and financial integration [1]. According to research, China and the five Central Asian countries do not meet the requirements. Therefore, the realization of RMB regionalization is a long-term development goal, can not be achieved in the short term. Therefore, according to the existing conditions, this paper proposes a "basket of currencies" model to solve the problem that transition from "basket currency" to "single currency" gradually [2].

Most of the research in the field of "basket currency" is focused on the choice of exchange rate system, but less on the choice of monetary cooperation. Robert Mundell (1961) explored the issue of monetary cooperation among countries, which laid the theoretical foundation for the later European monetary integration. Hovanov (2004) proposed a minimum variance monetary basket method, using the weighted geometric mean exchange rate to construct the currency basket of minimum volatility.

This paper mainly provides the choice for monetary cooperation in the "Silk Road Economic Belt", and serves as a trade settlement currency by building a stable basket currency, and providing services for the trade and investment between countries in the Silk Road Economic Zone. The core areas of the "Silk Road Economic Belt" mainly include China and five Central Asian countries (Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, Kyrgyzstan). Therefore, this paper is to build China-Central Asia "basket currency" by simulating the data of China and the five Central Asian countries.

3. Build the Model

In the "basket currency" model, the common currency is not a tangible currency, does not participate in market circulation, not a country's currency as the base currency, but the "basket currency" as the base currency. In establishing the "basket of currencies" model, first we should determine the composition of the basket of currency types, the base period of the basket currency index and the weight of different currencies, the most important is the determination of monetary weight. The optimal weight of "basket currency" is determined to meet specific policy objectives. In this paper, the weights of "basket currency" are chosen to optimize the stability of currency.

3.1The Construction of "Basket Currency" Model

This paper uses the weighted average exchange rate to construct the Currency Basket Index to measure the currency value of the basket. According to the minimum variance currency basket method of Hovon (2004)[3]. The equation is as follows:

$$CBI = \sum_{i=1}^{n} w_i \frac{EEI_i(t)}{EEI_i(t_0)}$$

w_i represents the weight of currency i in the "basket

currency", $\sum_{i=1}^{n} w_i = 1$. $EEI_i(t)$ represents the weighted geometric average exchange rate of the currency i in period t, and EEIi (t_0) represents the weighted geometric average exchange rate of the base currency i in the base period. To stabilize the value of the "basket currency", ie, the smallest fluctuation of the currency, it is necessary to minimize the variance of CBI, as follows:

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$$VAR(CBI) = \sum_{i,j=1}^{n} w_i w_j \operatorname{cov}(i,j) = \sum_{i=1}^{n} w_i^2 s_i^2 + 2\sum_{n} w_i w_j \operatorname{cov}(i,j) \}$$

$\sum_{i=1}^{n} w_i = 1$, and $w_i \geq 0$, i = 1,2, ..., n; s_i^2 is the variance of $\frac{EEI_i(t)}{EEI_i(t_0)}$, $\operatorname{cov}(i,j)$ is the covariance of $\frac{EEI_i(t)}{EEI_i(t_0)}$ and $\frac{EEI_j(t)}{EEI_j(t_0)}$. According to the data of variance and covariance, using the optimal method to determine w_i can minimize the variance of CBI.

3.2 Calculation of Weighted Geometric Average Exchange Rate (EEI)

The weighted geometric mean exchange rate for any currency i is EEIi, which represents the actual monetary value of the currency i represented by the weighted geometric mean. In the calculation of weighted geometric average exchange rate, this paper assumes that there are A, B, C three different currencies, the exchange relationship between them are: $1A=S_{12}B$, $1B=S_{23}C$, $1C=S_{31}A$. According to the principle of trigonometry, only when $S_{12}\times S_{23}\times S_{13}=1$, there will be no speculative arbitrage between the various currencies. The same applies to the n-type currency, assuming $S_{12}\times S_{23}\times S_{34}\times\ldots\times S_{n-1,n}n=1$for the currencies from 1 to n. The real exchange rate = nominal exchange rate × foreign price level / domestic price level, that is $r_{ij}=S_{ij}\times P_j/P_i$. From $S_{12}\times S_{23}\times S_{34}\times\ldots\times S_{n-1,n}=1$, we can deduce $r_{12}\times r_{23}\times r_{34}\times\ldots\times r_{n-1,n}=1$. We can express the relationship between the real exchange rates of the three currencies in the form of matrices, as shown below:

	A	B	C
A	r_{11}	r_{12}	r_{13}
B	r_{21}	r_{22}	r_{23}
C	r_{31}	r_{32}	r_{33}

r_{ij} is the real exchange rate between i and j, that is, 1 unit currency j = r_{ij} unit currency i, $r_{ii}=1$, $r_{ij}=1/r_{ji}$. As can be seen from the above, $1A= r_{11}A= r_{21}B= r_{31}C$, the use of different currencies to express, the specific currency value of A is different.

Therefore, this paper defines the weighted geometric mean of A, B, C currencies as:

A：$(r_{11})^{a_1}\times(1/r_{12})^{a_2}\times(1/r_{13})^{a_3}$

B：$(1/r_{21})^{a_1}\times(r_{22})^{a_2}\times(1/r_{23})^{a_3}$

C：$(1/r_{31})^{a_1}\times(1/r_{32})^{a_2}\times(r_{33})^{a_3}$

$a_1+a_2+a_3=1$. There are three different representations of A currency:

$1A= r_{11}A= r_{11}\times(r_{11})^{a_1}\times(1/r_{12})^{a_2}\times(1/r_{13})^{a_3}$(Weighted average of the currency A)

$1A= r_{21}B= r_{21}\times(1/r_{21})^{a_1}\times(r_{22})^{a_2}\times(1/r_{23})^{a_3}$(Weighted average of the currency B)

$1A= r_{31}C= r_{31}\times(1/r_{31})^{a_1}\times(1/r_{32})^{a_2}\times(r_{33})^{a_3}$(Weighted average of the currency C)

To extend this conclusion to n kinds of currencies, we can get $r_{ji}\prod_{k=1}^{n}(\frac{1}{r_{jk}})^{a_k}$ (i = 1,2, ..., n) are equal, and $\sum_{1}^{n} a_k = 1$.

From the above inference we can know that $\prod_{k=1}^{n}(\frac{1}{r_{jk}})^{a_k}$ (I = 1,2, ..., n) is the weighted geometric mean of the i-th currency, then EEIi = $\prod_{k=1}^{n}(\frac{1}{r_{jk}})^{a_k}$ (i = 1,2, ..., n).

3.3 Determination of the amount of money

This paper use the currency index to calculate the "basket currency", can further determine the amount of each currency in the basket to restore into a specific currency basket.

In the first step, assume that the currency basket consists of n kinds of currencies, each of which is $x_1, x_2, \ldots, x_n$, ie, the number of currencies in the basket $N= x_1+x_2+\ldots+x_n$.

The second step, express each currency in the currency basket with one of the currency i, then in the t period of N (t) = $x_1r_{i1}+x_2r_{i2}+\ldots+x_nr_{in}$, both sides of the equation multiplied by $\prod_{k=1}^{n}(\frac{1}{r_{ik}})^{a_k}$:

$$\prod_{k=1}^{n}(\frac{1}{r_{ik}(t)})^{a_k} N(t) = [x_1 r_{i1}\prod_{k=1}^{n}(\frac{1}{r_{ik}(t)})^{a_k} + x_2 r_{i2}\prod_{k=1}^{n}(\frac{1}{r_{ik}(t)})^{a_k} + \cdots\cdots + x_n r_{in}\prod_{k=1}^{n}(\frac{1}{r_{ik}(t)})^{a_k}]$$

$$= x_1 EEI_1(t) + x_2 EEI_2(t) + \cdots + x_n EEI_n(t)$$

$EEI_i= \prod_{k=1}^{n}(\frac{1}{r_{jk}})^{a_k}$ (i = 1, 2, ..., n). Therefore, $\prod_{k=1}^{n}(\frac{1}{r_{ik}(t)})^{a_k} N(t) = \sum_{i=1}^{n} x_i EEI_i(t)$.

Finally, let $CBI = \frac{\prod_{k=1}^{n}(\frac{1}{r_{ik}(t)})^{a_k} N(t)}{\prod_{k=1}^{n}(\frac{1}{r_{ik}(t_0)})^{a_k} N(t_0)}$, then combined it with $CBI = \sum_{i=1}^{n} w_i \frac{EEI_i(t)}{EEI_i(t_0)}$ which we established earlier to derive the relationship between w_i and x_i,

$w_i = \frac{x_i EEI_i(t_o)}{\sum_{k=1}^{n} x_k EEI_k(t_o)}$, which reflects the relationship between the optimal monetary weight w_i and the amount of money in the specific currency basket x_i. Thus, we can calculate the specific amount of various currencies in "basket currency", respectively.

4. Empirical Analysis

This section will be an empirical analysis of a basket of settlement currencies in the Silk Road Economic Belt to build a suitable currency basket based on the CBI model. Considering the availability of data and the degree of openness to foreign trade, we have chosen the currencies of Kazakhstan, Kyrgyzstan and Tajikistan that have joined the WTO to form "basket currency" in the five Central Asian countries. Therefore, in the "basket currency" contains four currencies: RMB, Kennedy coins, Somme, Somo Ni.

4.1 Parameter selection and data sources

For China - the five Central Asian countries, to determine the "basket currency" as the settlement currency, first we must determine the weight of geometric weighted average of each currency. The general method of determining the "basket of currencies" by using the ratio of the gross domestic product of countries is not suitable for China-the five Central Asian countries. The main reason is the difference of the national economic development level along the "Silk Road Economic Belt" is too large. If we choose GDP as the weight, it is not conducive to the enthusiasm of the economic cooperation among the countries of "Silk Road Economic Belt". Therefore, we use the proportion of foreign trade as the weight to calculate the geometric average exchange rate, and then calculate the proportion of each currency in the "basket currency".

The data of import and export volume, exchange rate and CPI index of the major economies (China, Kazakhstan, Kyrgyzstan and Tajikistan) during the period from 2010 to 2014 in the "Silk Road Economic Belt" were used in the study.

4.2 The Calculation of Weighted Geometric Average Exchange Rate

Since this paper is studying the composition of the "basket currency" in the "Silk Road Economic Belt", we mainly use the sum of imports and exports of countries in Central Asia and Europe to calculate the weighted geometric mean weights of each currency. First of all, calculate the average value of total imports and exports in Central Asia and Europe for each country from 2010 to 2014, and then add the total of the average of the import and export of the four countries, finally obtained the ratio of the average value of total imports and exports of each country to total imports and exports, which is taken as the weight of each country's currency in weighted geometric averages. Assuming that the weight of the Yuan a_1, Kennedy coin a_2, Somme a_3, Somo a_4, after calculation can get $a_1 = 0.845$, $a_2 = 0.119$, $a_3 = 0.023$, $a_4 = 0.013$.

The second step, we have to calculate the actual exchange rate between the various countries. Assuming that the RMB is 1, the Kennedy Coin is 2, the Somali is 3 and the Somo is 4, then the real exchange rates between them are expressed as:

	RMB	Kennedy	Som	Somoni
RMB	r_{11}	r_{12}	r_{13}	r_{14}
Kennedy	r_{21}	r_{22}	r_{23}	r_{24}
Som	r_{31}	r_{32}	r_{33}	r_{34}
Somoni	r_{41}	r_{42}	r_{43}	r_{44}

Take 2010 as the base period, respectively, to calculate the real exchange rate rij. Thus, we can compute the weighted average geometrical exchange rate EEIi = $\prod_{k=1}^{n} (\frac{1}{r_{jk}})^{a_k}$ (i = 1,2, ..., n) for different currencies, as shown in the following table:

Weighted average geometric average exchange rate of the four currencies in 2010-2014

Years / Currency	RMB	Kennedy	Som	Somoni
2010	0.667014	14.51757	4.528448	0.43142
2011	0.657866	15.34407	5.192141	0.500643
2012	0.651563	16.19975	5.363857	0.537752
2013	0.644519	17.17673	5.786365	0.557613
2014	0.625014	20.70452	6.608991	0.587633

Source: calculated by the World Bank data

4.3The Calculation of Currency Weights in "Basket Currency"

In the calculation of monetary weights, the paper takes the optimization method to calculate. It is known that the variance of CBI is:

$$VAR(CBI) = \sum_{i,j=1}^{n} w_i w_j cov(i,j)$$

And $\sum_{i=1}^{n} w_i = 1$. To find the optimal solution, the first step is to construct the Lagrangian equation:

$$L = \sum_{i,j=1}^{n} w_i w_j cov(i,j) - \lambda(\sum_{i=1}^{n} w_i - 1)$$

Then, both sides of the formula on the derivative w_i at the same time:

$$\frac{\partial L}{\partial w_i} = \sum_{i=1}^{n} w_j \mathrm{cov}(i,j) - \lambda = 0$$

Which $\mathrm{cov}(i,j)$ is the covariance of $\frac{EEI_i(t)}{EEI_i(t_0)}$ and $\frac{EEI_j(t)}{EEI_j(t_0)}$.

Finally, calculate the weights of different currencies based on the 2010 base year (t_0). The following matrix equation can be derived:

$$\begin{pmatrix} \mathrm{cov}(1,1) & \mathrm{cov}(1,2) & \mathrm{cov}(1,3) & \mathrm{cov}(1,4) \\ \mathrm{cov}(2,1) & \mathrm{cov}(2,2) & \mathrm{cov}(2,3) & \mathrm{cov}(2,4) \\ \mathrm{cov}(3,1) & \mathrm{cov}(3,2) & \mathrm{cov}(3,3) & \mathrm{cov}(3,4) \\ \mathrm{cov}(4,1) & \mathrm{cov}(4,2) & \mathrm{cov}(4,3) & \mathrm{cov}(4,4) \end{pmatrix} \begin{pmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \end{pmatrix} - \lambda = 0$$

Has $\sum_{i=1}^{n} w_i = 1$. Through the matrix calculation can be drawn: $w_1 = 0.865363$, $w_2 = 0.05507$, $w_3 = 0.054138$, $w_4 = 0.02543$.

From the above calculation results can be seen, the weight of China's RMB is the most important, the weight of Somali coins in Tajikistan is the lowest. It can be concluded that the RMB is an absolute advantage in the "basket currency". However, the weight is not fixed, and can be adjusted according to specific circumstances cyclical.

4.4Determination of the amount of money in "Basket Currency"

According to the above calculation, we get the "basket currency" constructed by the monetary index, and we can further calculate the amount of money corresponding to each currency to construct the specific "basket currency".

The relationship between w_i and x_i has been deduced as $w_i = \frac{x_i EEI_i(t_o)}{\sum_{k=1}^{n} x_k EEI_k(t_o)}$. From which the number of relationships, orders $\sum_{k=1}^{n} x_i EEI_k(t_0) = 1$, $x_i = \frac{w_i}{EEI_i(t_0)}$ available. Therefore, it can be calculated: $x_1 = 1.297368$, $x_2 = 0.003793$, $x_3 = 0.011955$, $x_4 = 0.058944$.

From the above calculation, we can build a specific "basket currency" N = 1.297368 (RMB) +0.003793 (Kennedy Coin) +0.011955 (SOM) +0.058944 (Somoney coins). The weight of money in the basket of currencies is, in fact, geometrically weighted by the specific amount of each currency, translating it into the proportion of the combined currency in the basket of currencies. The weight of currencies reflect the importance of different currencies in the basket, while the specific amount of money due to the impact of exchange rate, does not reflect the importance of money.

5. Practical Significance

Taking China and the five countries of Central Asia as examples, this paper constructs the basket currency index by weighted geometric average exchange rate, and then constructs the stable "basket currency". The results show that the RMB in the "basket currency" is a large proportion of possession. As the study is limited to the scope of China and the five countries of Central Asia, and cannot effectively represent the form of basket currency for the entire "Silk Road Economic Belt", so the scope can be further expanded to build the new basket currency, which is more applicable to the "Silk Road economic belt". With the trade cooperation, financial cooperation and monetary cooperation of the "Silk Road Economic Belt" become closer and closer, building a reasonable "basket currency" has important practical significance.

5.1 The "basket currency" has advantages over "single currency"

"Basket currency" is different from the "single currency" for settlement measurement, which has the following advantages: First, The "basket currency" is the currency of the countries along the "Silk Road Economic Belt" and is more capable of reflecting the fundamental changes in the economies of the economic belt; Second, the "basket currency" is a compound currency, using the geometric mean weighted exchange rate on behalf of the currency, better reflect the characteristics of the currency change, as a valuation standard is more reasonable [4]; Third, the "basket currency" currency is more stable, can effectively prevent the risk caused by a certain currency instability.

5.2 Promote the national trade, financial and monetary cooperation along "Silk Road Economic Belt"

After the strategy of "Silk Road Economic Belt" was put forward, the economic and trade relations between the countries along the line have been constantly strengthened, and the interrelationships between economic and policy have been constantly strengthened. It is urgent to formulate a reasonable monetary cooperation strategy to promote economic and trade cooperation and development. "Basket currency" as the new currency cooperation, is conducive to promoting the national trade, financial and monetary cooperation to further deepen along the Silk Road.

The construction of the "basket currency" strengthens the coordination and cooperation between the policies of national monetary and exchange rate along the "Silk Road Economic Belt", and facilitates the development of its trade and investment. The construction of "basket money" adapts to the requirements of economic development and the trend of monetary integration and regional development. As the

intermediate stage, it not only benefits economic and trade cooperation, but also promotes the process of monetary cooperation.

5.3 Promote the formation of a diversified international monetary system

The construction of the "basket currency" has a certain mitigation effect on the phenomenon that the US dollar occupies the hegemonic position, which can reduce the reliance of the countries along the Silk Road on the US dollar and the Euro, while reducing the spillover effects of the macroeconomic policies of the US dollar and the Euro on economies of the "Silk Road Economic Belt ".

On the other hand, the RMB holds a large proportion in the in the "basket currency", the use of "basket currency" can gradually increase the influence of the RMB on the Central Asian countries, weakening the influence of the US dollar on the national economic and political along "Silk Road Economic Belt", and then open the road for the RMB regionalization. And changing the status quo of the dollar dominance gradually, play a catalytic role on the formation of a diversified international monetary system.

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