# Is Renminbi a (Truly) International Currency? An Evaluation Based on Offshore Foreign Exchange Market Trading Patterns

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*Abstract*

*This article provides a new framework to evaluate the status of Renminbi internationalization. It proposes that the trading patterns of a currency in global foreign exchange market embody the currency's position in the international monetary system. Based on foreign exchange trading data provided by CLS Group, the article constructs a ranking of major international currencies including Renminbi. It finds that Renminbi shares more similarities in foreign exchange trading patterns with the established global currencies like US dollar and Euro than with those regional currencies. The article also explores the policy implications that the new evaluation approach provides.*

Keywords: *Renminbi; Foreign Exchange Market; Trading Pattern*

JEL classification: F33; F37; G15

Renminbi (RMB) internationalization has become an important target in China's international economic policy[1]. Naturally, how to assess the progress of RMB internationalization become a hot topic for government, academics, and market participants, both inside and outside China. For example, the People's Bank of China (PBoC), China's central bank, started its annual release of *RMB Internationalization Report* in 2015. The report focused on the policy measures taken by the central bank to facilitate RMB internationalization, but it also quoted SWIFT's data to show RMB's market share in global payment currencies. A more direct attempt to assess the role of RMB in international monetary system is the RMB internationalization Index (RII)

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[1] RMB Internationalization was adopted by Chinese government as an official policy at the 2014 Central Economic Working Conference. But before that, People's Bank of China (PBoC), China's central bank, had been encouraging the "overseas use of RMB" for several years.

compiled by the International Monetary Institute (IMI), Renmin University of China. The RII is a comprehensive measure of RMB's functions as an international currency and takes into account the share of RMB in the denomination of international trade and international finance and in the official foreign reserves. Some financial institutions also launched their own indexes of RMB internationalization according to business need, among which the Bank of China Cross-border RMB Index (CRI) and Standard Chartered Renminbi Globalisation Index (RGI) are quite typical. Different from the RII, both CRI and RGI are based on the scale of business activity instead of the market share of RMB in specific sectors. Besides the explicit indexes of RMB internationalization, there are also many researches exploring the evaluation framework of RMB internationalization (e.g. Chen and Hu, 2013; Qiu and He, 2013) or involving the judgement of the status of RMB in global monetary system (e.g. Li and Liu, 2010; Lee, 2010; Islam and Bashar, 2012; Burdekin, 2014; Batten and Szilagyi, 2016).

While the above measures of RMB internationalization differ in their forms and results, they share a commonality with other existing methods for assessing the level of internationalization of currencies: consisting of the volumes or market shares of the specific currency in the areas reflecting their international currency functions such as foreign reserves, trade settlement, international payment, international security issuance, foreign exchange (FX) market, foreign deposit, etc. However, for a new comer of international monetary club with severely unbalanced performance in the above areas like RMB, it's very difficult to achieve a consensus on the composition of a volumes or market shares-based measure. Moreover, in some occasions the results of this type of evaluation methods have ambiguous policy implication and can be misleading.

In this article, we try to contribute to the topic from a new perspective, trading patterns of currencies in FX market. Based on the microstructural data of global FX market provided by CLS, we find that the currencies sharing similar trading patterns have close positions in the international monetary hierarchy. With the structure-oriented approach, we achieve a ranking of major international currencies that well fits the acknowledged order of international monetary system. After comparing the trading patterns of RMB in offshore FX market with those of the CLS settled currencies, we identify the position of RMB in the ranking of international currencies. We also explore the policy implications that the new evaluation approach provides us.

This article is closely linked to the literature on financial market microstructure. While the majority of studies in this strand focus on price dynamics and market performance, there has been attempts in applying network analysis to identify the characters of market participants based on market microstructure data (e.g. Cetorelli and Peristiani, 2013; Schreiber, 2014). Our study makes a further step in this direction.

To the authors' knowledge, the article is the first empirical study to rank currencies according to their level of internationalization based on FX trading patterns. In this aspect, the article also contributes to the pluralism of topics and methodologies in the field of financial market microstructure.

The article proceeds as follows. Section 1 briefly describes the policy background of the study. Section 2 presents the concept foundation. Section 3 explains the methodology and the data. Section 4 presents the empirical results. Section 5 explores the policy implications of the empirical results. Section 6 concludes this article and discusses future work.

## 1. Policy Background

Many researches recognize the development of the RMB offshore market as one of the core components to internationalize the Chinese currency (e.g. He and McCauley, 2010; Subacchi, 2010; Cheung, 2014). The offshore market is one of the most important innovations in the development of the modern financial industry as a market where nonresidents engage in international currency transactions (Zoromé, 2007). For the internationalization of currency, the development of offshore markets will help facilitate the expansion of currency circulation and increase investment and financing channels (Cheung, 2014). For a currency with a home country that doesn't fully open her financial sector yet, the offshore market can potentially build the channel for the circulation of the currency between residents and nonresidents and form an initial liquidity and pricing system for the overseas use of the currency (He and McCauley, 2010). Thus, the development of RMB offshore markets became a critical part in the strategy to promote RMB internationalization.

Although offshore RMB business has seen significant growth in FX turnover and in trade payments in the last decade, there are still controversies on the real driving force behind the achievement. Many scholars believe that the emergence of Hong Kong, Taiwan and other RMB offshore centers is actually a result of arbitrage based on RMB appreciation expectation and the interest rate spread between the offshore market and the onshore market, so the blooming of RMB offshore market is fragile and misleading (e.g. He, et al., 2011; Yu, 2014). With the fading of RMB appreciation expectation in 2015, the growth of offshore RMB business seemed to lose its momentum (Figure 1). So a question here is if RMB offshore market has fostered "real" demand for RMB instead of being a result of pure speculation. The study tries to answer the question with an exploration into the trading patterns in the RMB offshore market.

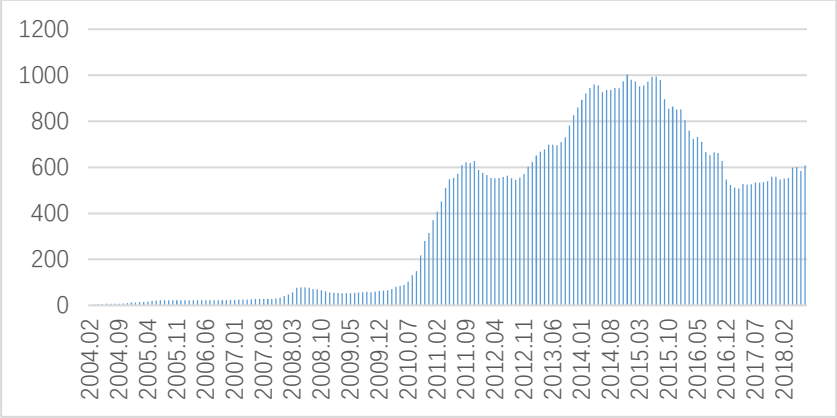


**Figure 1 Total Outstanding of RMB Deposits in Hong Kong (RMB billion)**

**Data Source: Hong Kong Monetary Authority.**

## 2. Conceptual Foundation

While the attempts to evaluate RMB internationalization proliferate, most of them are based on the theoretic framework on the functions of international currency. Kenen (1983) argues that currency internationalization refers to the use of a currency beyond its national borders and may be used and held outside its territory by its own residents or nonresidents. Chinn and Frankel (2005) develop a list of the international functions of internationalized currencies. According to this list, an international currency can provide residents or nonresidents with the functions of value storage, exchange medium and accounting units of the function. It can be used for currency substitution, investment pricing and trade and financial transactions for private purposes, as well as for official reserves, currency carriers for foreign exchange intervention, and anchor currencies for pegging the exchange rate.

**Table 1 Basic functions of International currencies**

| | **Private Use** | **Official Use** |
|---|---|---|
| **Medium of Exchange** | vehicle currency: invoicing trade and financial transactions, settlement currency | vehicle currency: intervention currency in the foreign exchange market |
| **Unit of Account** | quote currency (denominating trade and financial transactions) | anchor of the other currency's exchange rate |
| **Store of Value** | investment currency (portfolio allocation) or currency substitution (private dollarization) | reserve currency (international reserves) |

**Source: Hartmann (1998)**

Chinn and Frankel's list of the functions of internationalized currencies provide an intuitive strategy to measure the degree of internationalization of a currency by combining the indicators corresponding to the functions. Actually, many existent "RMB internationalization indexes" are essentially weighted sum of some indicators of these functions, e.g. the RII (Table 2) and the RGI. The difference is only in the choice of indicators and the determination of weights. For example, in the RII the weights of the three categories of third-class indicators are equal, while in the RGI the weight of each sub-indicator is inversely proportional to the variance of the sub-indicator's value. But the simplicity of the approach is not without its costs. The straightforwardness in its construction makes its quality or accuracy as a measure of currency internalization critically relies on the relevance of the sub-indicators with the corresponding currency functions, which is not always guaranteed. To some extent, each measure of currency internationalization under this approach is actually a specific definition of the concept of "internationalization".

**Table 2 Indicator System of RMB Internationalization Index by IMI, Renmin University of China**

| First-class indicators | Second-class indicators | Third-class indicators |
|---|---|---|
| International Pricing and Payment Function | Trade | ● Proportion of RMB settlement in world trade |
| | Capital and Finance | ● Proportion of RMB credit in global foreign credit<br>● Proportion of RMB security in global issuance of international bonds and bills<br>● Proportion of RMB security in global remaining sum of international bonds and bills<br>● Proportion of RMB direct investment in global foreign direct investment |
| International Reserve Function | Official Foreign Exchange Reserves | ● Proportion of RMB foreign exchange reserves in global foreign exchange reserves |

**Source: International Monetary Institute: *RMB Internationalization Report 2015*, July, 2015.**

Obviously, in this situation the "correctness" (or usefulness) of a measure for international currency evaluation depends on the specific scenario and the purpose of its user. The problem is, for a relative newcomer of the game field like RMB, which are

often severely imbalanced in their international currency functions, the subtleness in the above approach might lead to a difficulty in translating the policy implications of the evaluation results. As an extreme case, if all the trade settled in RMB were China's exports, the increase of the indicators corresponding to its proportion in world trade could mean nothing for the promotion of nonresidents' use of RMB, even though the latter seems to be more relevant to the essence of RMB internationalization. Moreover, this approach is vulnerable to manipulation as the index compilers can easily skew the results in their favor by changing the weights of sub-indicators. Furthermore, this type of index system can be highly sensitive to short-term economic or financial shocks and so to be volatile. Either the expansion of international trade or the speculative fever to hold (but not to trade) RMB-denominated assets can lead to a deceptive upswing of the internationalization index. Also the mixture of private use and official use of RMB in the index might be confusing for the commercial institutions hesitant on participating in RMB business, as an increase of RMB's role in official foreign reserves might not change its acceptability and liquidity in the financial market.

Our evaluation framework in this article tries to mitigate the potential pitfalls of the traditional approach by focusing on the behavior of economic agents in the FX market, an often-neglected aspect for a currency to carry out its international functions. As observed by some researches (e.g. Moore and Payne, 2011; Menkhoff, et al., 2013; Schreiber, 2014), traders in the FX market with different motives, information, and market liquidity conditions conduct their transactions in different ways. For a specific currency traded in the FX market, the characteristics of its traders (e.g. motive, information, financial capability, counterparty network) and market conditions (e.g. liquidity, transparency, trading costs) is closely linked with its level of internationalization in term of both functions and market perception (the latter is also important as it may influence the acceptability of the currency in the market). This association implies that the currency's position in the international monetary hierarchy gets its reflection in its trading patterns in the FX market. Here the "trading pattern" is a broad concept. It not only includes the characteristics of the trading itself such as time, location, institution type, but also includes the structural features of the complex network comprising of the institutions participating in the trading of specific currencies and the transactions between them.

A reasonable further assumption is that the currencies having close position in the international monetary hierarchy share some similarities in their trading patterns. So if we can identify the specific characteristics of currencies' trading patterns relevant to their status of internationalization, we will be able to fix the position of a new newcomer of the intentional monetary system by comparing its trading patterns with those of the established international currencies. This approach relies more on the market consensus

on the ranking of some reference currencies and thus avoids an explicit definition of "currency internationalization".

A feature of this evaluation framework is the relative stableness of its results. Due to the network effect among the trading parties in the FX market and the fixed cost required for a market participant to start the trading of a new currency or got a new counterparty, the trading patterns of a currency is much more stable than its trading volumes. For a currency with intensely fluctuant market expectation like RMB around 2015, the feature is certainly an advantage. Moreover, for potential overseas RMB business participants, the status of RMB internationalization measured based on its trading patterns in the global financial market is more relevant to their concerns.

## 3. Methodology Framework

Based on the above idea, this study seeks to determine the indicators characterizing the features of trading patterns for international currencies and identify their relationship with the role of the related currencies in global monetary hierarchy.

### 3.1 Data sources

The data for the study are from two sources:

1. CLS-settled FX trades in Q2 2015, comprised of 17 currencies[2].

2. A survey of CLS settlement members FX trading for currencies not settled by CLS in Q2 2015, which includes the offshore RMB.

The first source provides trading data of CLS settled currencies in Q2 2015. We use the data to build and help calibrate our international currency ranking system. The second source provides data of 17 CLS settled currencies and CNH traded by CLS members in Q2 2015. We use the data to identify the position of RMB in our international currency ranking system.

### 3.2 Indicators

Since each FX transaction involves two currencies, the indicators are currency pair-based. We use three categories of indicators:

[2] Specifically AUD, CAD, CHF, DKK, EUR, GBP, ILS, HKD, JPY, KRW, MXN, NOK, NZD, SEK, SGD, USD, ZAR. The HUF was added as an 18th currency in Q4 2015 and is not included in the analysis.

1. Trading volume and value (on a weekly basis)

(1) Mean, variance, max, min of total trading volume and trading value

(2) Mean, variance, max, min of the number of institutions participating the trading of the currency-pair

(3) Mean, variance of trading volume and trading value categorized by institutions

(4) Mean, variance, max, min of trading volume and trading value categorized by regions

2. Market concentration (on a weekly basis)

(1) Mean, variance, max, min of market concentration (with both trading volume and trading value) by trading institutions (CR(5) and Herfindahl index)

(2) Mean, variance, max, min of the number of counterparties of institutions who have ever participated the trading of the currency-pair

3. Trading network

(1) Distribution function of trading institutions with various number of trading partners

(2) Topological rich-club coefficient of the trading network

(3) Weighted rich-club coefficient of the trading network

(4) Topological clustering coefficient of the trading network

(5) Weighted clustering coefficient of the trading network

(6) Proportion of transactions between high volume trading institutions.

### 3.3 Procedures

As our framework focuses on the structural features of currency trading, we first eliminate the scale difference in the values of indicators by data standardization. After that we use Principal Component Analysis (PCA) to reduce the dimension of the parameter space to a manageable number. Then we represent the difference in trading patterns between currency pairs with Euclidean distance in the parameter space.

1. Data standardization

Rescaling the values of indicators to remove the differences in unit and scale.

$$\hat{x}_{ij} = \frac{x_{ij} - \mu_j}{\sigma_j}$$

2. Dimensionality reduction

We use PCA to derive 2 trading pattern parameters from the first category of

indicators, 4 parameters from the second category, and 7 parameters from the third category.

3. Cluster analysis

Assuming that the vector of trading pattern parameters for currency pair AB after dimensionality reduction is

$$x^{AB} = x_1^{AB}, ..., x_k^{AB}.$$

And that for currency pair CD is

$$x^{CD} = x_1^{CD}, ..., x_k^{CD}.$$

Then the distance between AB and CD is

$$d_{AB}^{CD} = \sqrt{(x_1^{AB} - x_1^{CD})^2 + ... + (x_k^{AB} - x_k^{CD})^2}.$$

Based on this definition of distance, we apply multidimensional scaling (MDS) to project all the currency pairs into a two-dimension plane. Then we use connectivity based clustering to group the currency pairs according to the similarity in their trading patterns.

4. Ranking

Different from some researches also focusing on structural characteristics in FX trading patterns (e.g. Schreiber, 2014), we don't make any presumption on the relationship between trading pattern parameters and the status of currency internationalization. Instead, we try to derive the relationship by fitting the parameters to some accepted ranking of international currencies and currency pairs.

Since the US dollar is acknowledged as the most "globalized" currency by being the largest adopted and traded currency globally according to the BIS Triennial surveys and SWIFT's trade payments, we take USD as the reference point in international currency ranking system and measure the level of internationalization of a currency by the distance between it and USD in the abstract space of trading pattern indicators. Similarly, we take EURUSD as the reference point in currency-pair system.

For a specific currency C, the distance is calculated based on three parameters.

(1) *dist.*1: the diversification of the trading counterparties, i.e. the number of currency pairs which include currency C.

(2) *dist.*2: the distance between the currency pair C-USD and EURUSD.

(3) *dist.*3: the average distance between each currency pair consisting of C and a third currency and the corresponding currency pair consisting of USD and the third currency.

Then the distance between currency C and USD is

$$dist = \lambda * dist.1 + dist.2 + dist.3$$

where λ is a penalty factor.

To determine the value of λ, we consider the feature parameter vector $x^{ij} = \{x_1^{ij}, x_2^{ij}, ..., x_p^{ij}\}$ for a currency pair $A_iA_j$. There are $k$ currencies. So the Euclidean distance between the currency $A_i$ and $A_j$ in the space of trading pattern is

$$d_{ij} = \sqrt{\sum_{l=1}^{k} (d_{il}^{jl})^2}$$

$$d_{il}^{jl} = \sqrt{\sum_{k=1}^{p} (x_k^{jl} - x_k^{il})^2}$$

If for a third party currency $A_l$, there is no trading between $A_i$ and $A_l$ or between $A_j$ and $A_l$, then $d_{il}^{jl} = 0$. Based on the data, $\bar{d}_{ij} = \sum d_{ij}/N = 3.6$, so we set the value of λ to be the multiples of 3.6, separately 3.6*1, 3.6*2, 3.6*3.

The currencies are then ranked according to the distances between them and USD. After we calibrate the procedure against the generally acknowledged hierarchy of international monetary system, we use trading data including CNH to get its position among the currencies.

## 4. Analysis and Results

### 4.1 Trading pattern of CLS settled currencies

This part of analysis is based on the CLS-settled trading data of 17 currencies in Q2 2015 (4/5/15 – 6/27/15). There are 77 trading currency pairs as shown in Table 3.

**Table 3 Trading relationship between CLS settled currencies**

| Currency Code | USD | AUD | CAD | CHF | DKK | EUR | GBP | HKD | ILS |
|---|---|---|---|---|---|---|---|---|---|
| USD | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| AUD | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| CAD | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| CHF | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| DKK | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| EUR | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| GBP | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| HKD | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ILS | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| JPY | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| KRW | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MXN | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| NOK | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| NZD | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| SEK | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| SGD | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| ZAR | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |

Note: a "1" indicates a currency pair.

After dimensionality reduction on feature parameters with PCA, we get the location of the currency pairs in the plane of trading pattern with MDS (Figure 2). We can see clearly that EURUSD is special in the graph and has the longest average distance with all the other CLS settled currencies.

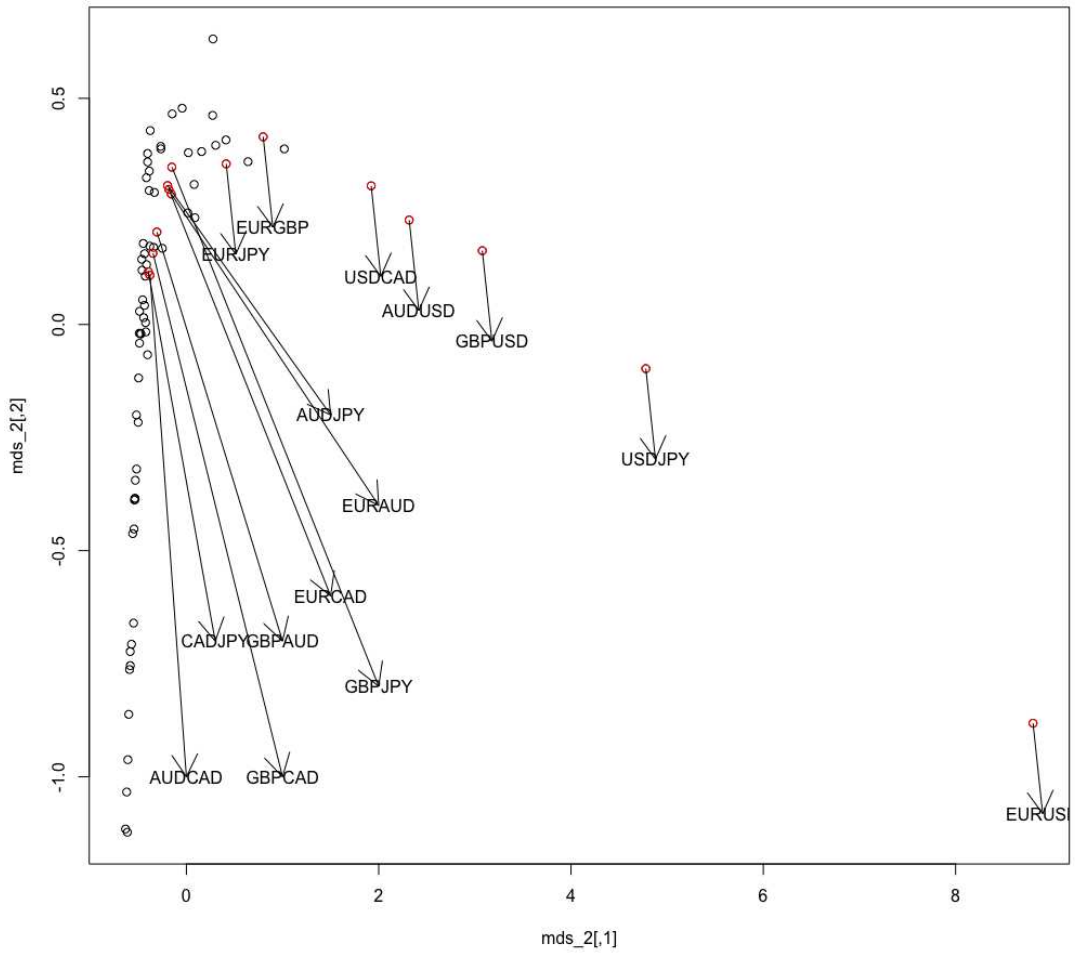


**Figure 2 Location of CLS settled currency pairs in the trading pattern parameter space**

We calculate the location of each CLS settled currency as the gravitational center of all the currency pairs containing the currency (Figure 3). Apparently USD is most different in location from other CLS settled currencies. Also other considered well established international currencies such as EUR, GBP, JPY, are closer to USD than remaining CLS settled currencies.

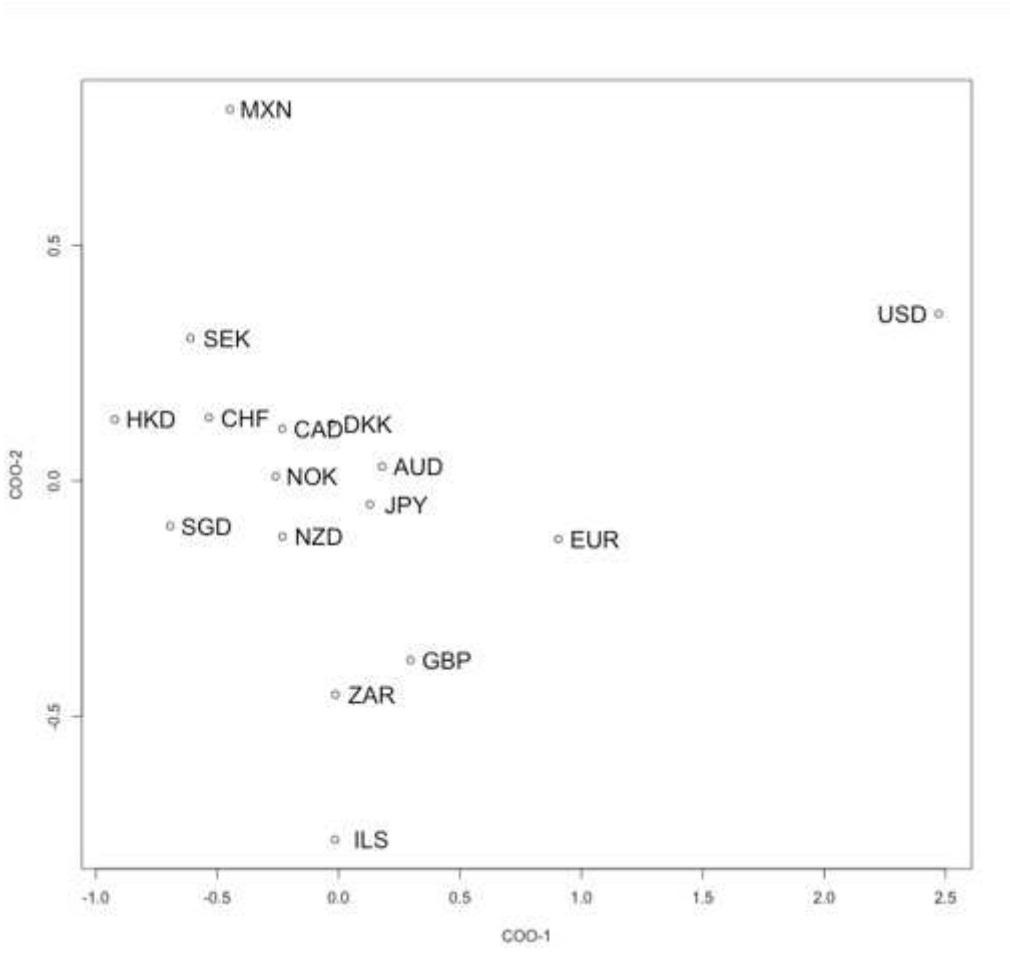


**Figure 3 Location of CLS settled currencies in the trading pattern parameter space**

Then we calculate the distance between the CLS settled currencies and USD with different value of $\lambda$ (Table 4).

**Table 4 Distance between CLS settled currencies and USD**

| Currency Code | dist.1 | dist.2 | dist.3 | $\lambda = 3.6*1$ | $\lambda = 3.6*2$ | $\lambda = 3.6*3$ |
|---|---|---|---|---|---|---|
| USD | 0 | 0 | 0 | 0 | 0 | 0 |
| EUR | 1 | 0 | 44.6611 | 52.8479 | 61.0347 | 69.2214 |
| GBP | 2 | 39.5152 | 72.5989 | 128.4876 | 144.8612 | 161.2347 |
| JPY | 3 | 33.8875 | 70.5493 | 128.9972 | 153.5575 | 178.1178 |
| CAD | 4 | 47.5049 | 81.8983 | 162.1503 | 194.8974 | 227.6445 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CHF | 4 | 53.4423 | 79.1097 | 165.2991 | 198.0462 | 230.7932 |
| AUD | 5 | 46.2524 | 79.1344 | 166.3206 | 207.2545 | 248.1883 |
| NZD | 6 | 56.3867 | 82.9781 | 188.4854 | 237.6061 | 286.7267 |
| SEK | 6 | 59.2378 | 81.5388 | 189.8972 | 239.0179 | 288.1385 |
| NOK | 8 | 60.1627 | 79.0302 | 204.6871 | 270.1813 | 335.6754 |
| SGD | 8 | 58.5515 | 83.2592 | 207.3048 | 272.799 | 338.2932 |
| HKD | 9 | 58.9248 | 82.7756 | 215.3813 | 289.0623 | 362.7432 |
| DKK | 10 | 61.3806 | 78.3269 | 221.5752 | 303.4429 | 385.3106 |
| KRW | 15 | 61.5003 | 0 | 184.3019 | 307.1034 | 429.905 |
| ZAR | 11 | 59.7614 | 80.7614 | 230.5772 | 320.6317 | 410.6862 |
| MXN | 12 | 57.628 | 69.9565 | 225.8257 | 324.067 | 422.3082 |
| ILS | 14 | 62.1171 | 63.1959 | 239.9278 | 354.5425 | 469.1573 |

Based on the above parameters, we get the ranking of the17 CLS settled currencies with regard to their level of internationalization (Table 5).

**Table 5 International currency ranking based on trading patterns determined from CLS settled FX trades**

| Rank | Currency Name | Currency Code | SWIFT Rank in the same period |
|---|---|---|---|
| 1 | United States Dollar | USD | 1 |
| 2 | Euro | EUR | 2 |
| 3 | British Pound | GBP | 3 |
| 4 | Japanese Yen | JPY | 4 |
| 5 | Canadian Dollar | CAD | 6 |
| 6 | Swiss Franc | CHF | 8 |
| 7 | Australia Dollar | AUD | 7 |
| 8 | New Zealand Dollar | NZD | 18 |
| 9 | Swedish Krona | SEK | 11 |
| 10 | Norwegian Krone | NOK | 13 |
| 11 | Singapore Dollar | SGD | 12 |
| 12 | Hong Kong Dollar | HKD | 9 |
| 13 | Danish Krone | DKK | 17 |
| 14 | South African Rand | ZAR | 15 |
| 15 | Mexican Peso | MXN | 16 |
| 16 | Israeli New Shekel | ILS | None* |
| 17 | South Korean Won | KRW | None* |

Data source: the SWIFT rank is from SWIFT RMB Tracker, ILS and KRW are not in the SWIFT ranking list.

*: Not provided in SWIFT RMB Tracker.

Compared with the SWIFT rank in the same period based on the currencies' share

in global payment, the ranking seems reasonable except for maybe some currencies in low positions.

### 4.2 Internationalization level of RMB

With the parameters calibrated, we apply the procedures to trading data including CNH. Figure 4 shows the location of CNH-currency pairs in the trading pattern parameter space. In the figure CNH-currency pairs are located at the periphery of currency-pair cluster. It implies that the trading patterns of CNH-currency pairs are different from those of other currency pairs, which excludes the mixing of all the currency pairs in the figure.

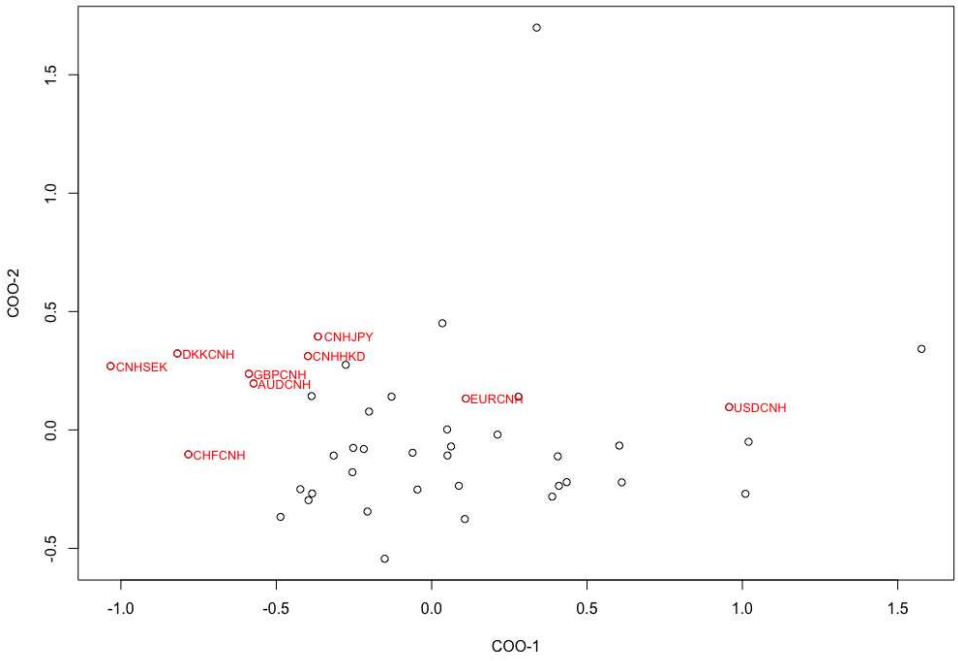


**Figure 4 Location of CNH-currency pairs in the trading pattern parameter space**

With the clustering analysis (Figure 5), we can see the relationship between CNH-currency pairs and other currency pairs more clearly. Interestingly, although CNH-currency pairs seem different from CLS settled currency pairs in Figure 4, they are not clustering together. There are some points worth notice. First, USDCNH is very close to the USD-currency pairs involving other high ranking international currency, such as GBPUSD, USDCAD and EURUSD. Second, EURCNH is close to EURGBP, while both of them are far from EURUSD. Third, CNH-currency pairs involving China's neighbor regions' currencies (CNHHKD, CNHJPY) and British Commonwealth currencies (AUDCNH, GBPCNH) are very close, but they are far from other CNH-currency pairs. Four, CNH-currency pairs involving Scandinavian currencies

(CNHSEK, DKKCNH) are far from almost all the other currency pairs. So it seems that CNH-currency pairs as a whole don't share much similarity.


**Figure 5 Clustering Analysis of Currency pairs including CNH**

Although it's not so easy to identify the specific sources of the difference in the trading patterns of CNH-currency pairs. We can still find the sign of divergence in the trading network indexes. Take the weighted rich-club coefficient of the trading network in FX market for example. The graphs of the index value of CNH-currency pairs other than USDCNH and EURCNH show a sharp contrast against the graphs of most CLS settled currency pairs (Figure 6). The irregular zigzag curves imply that not only the population of the traders on these CNH-currency pairs is small but also the business links between them is sparse.

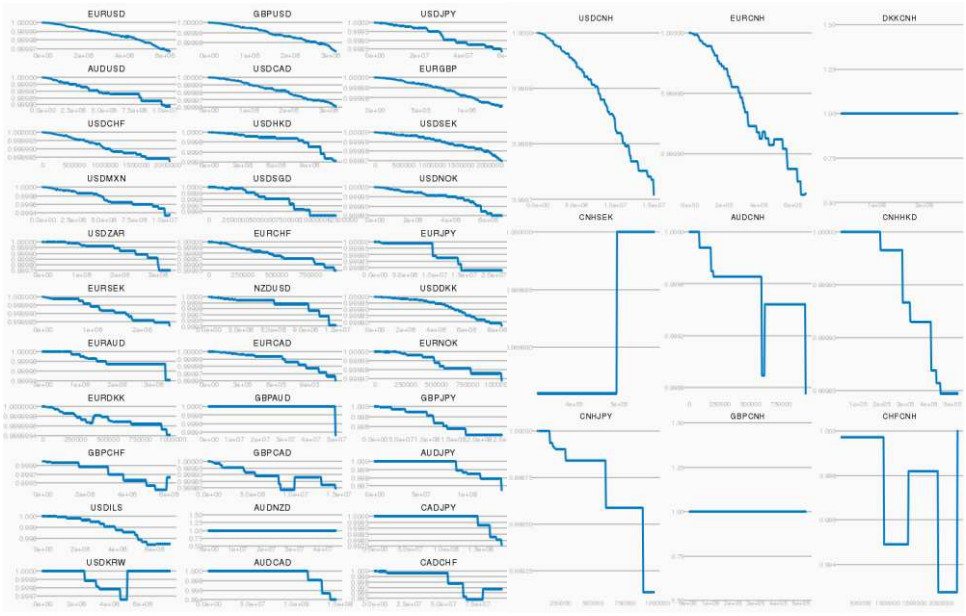


**Figure 6 Graph of weighted rich-club coefficient for CLS settled currency pairs and CNH-currency pairs**

But if we focus on only the USD-related currency pairs, we find that the USD-CNH pair is very close to EUR-USD pair (Figure 7). Actually, it's the closest among all the currency pairs. It means that the trading pattern between CNH and USD is very similar to that between EUR and USD.

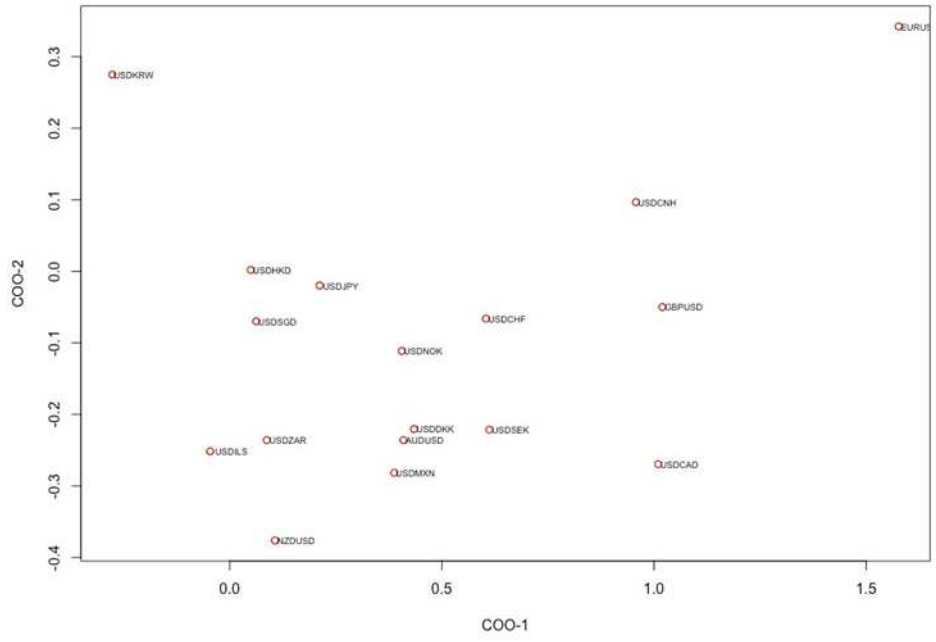


**Figure 7 Location of USDCNH Pair in the trading pattern parameter space**

We calculate the location of CNH as the gravitational center of all the currency

pairs containing the currency (Figure 8). Again in the chart CNH is located far from the CLS settled currencies.

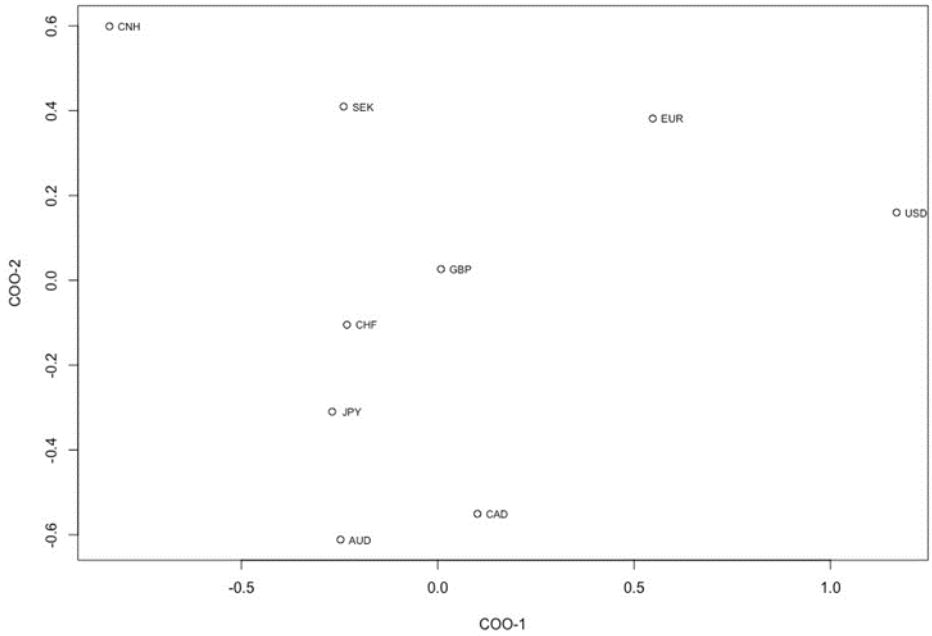


**Figure 8 Location of CNH in the trading pattern parameter space**

Based on the distance between CNH and USD, we get the ranking of CNH with regard to their level of internationalization (Table 6). With regard to the similarity with USD trading patterns, RMB ranks relatively high. From this perspective, RMB could be considered a global currency like Euro or Pound rather than a regional currency like the Hong Kong Dollar in relative terms.

**Table 6 International Currency Ranking Based on Trading Patterns**

| Rank | Currency Name | Currency Code | SWIFT Rank in the same period |
|---|---|---|---|
| 1 | United States Dollar | USD | 1 |
| 2 | Euro | EUR | 2 |
| 3 | British Pound | GBP | 3 |
| 4 | Chinese Offshore Renminbi | CNH | 5 |
| 5 | Australia Dollar | AUD | 7 |
| 6 | Canadian Dollar | CAD | 6 |
| 7 | Japanese Yen | JPY | 4 |
| 8 | Swiss Franc | CHF | 8 |
| 9 | Swedish Krona | SEK | 11 |
| 10 | Norwegian Krone | NOK | 13 |
| 11 | New Zealand Dollar | NZD | 18 |

| | | | |
|---|---|---|---|
| 12 | Mexican Peso | MXN | 16 |
| 13 | Danish Krone | DKK | 17 |
| 14 | South African Rand | ZAR | 15 |
| 15 | Singapore Dollar | SGD | 12 |
| 16 | Hong Kong Dollar | HKD | 9 |
| 17 | Israeli New Shekel | ILS | None* |
| 18 | South Korean Won | KRW | None* |

Data source: the SWIFT rank is from SWIFT RMB Tracker, ILS and KRW are not in the SWIFT ranking list.

*: Not provided in SWIFT RMB Tracker.

A way to understand the high ranking of RMB lies in the fact that CNH trading pattern in FX market shows a strong trend of diversification. We use the concept "Average Distance between Currency Pairs (ADBCP)" to capture the phenomenon. ADBCP measures the closeness of the currency pairs containing a specific currency in the space of trading pattern. CNH owns a very large ADBCP, smaller only than EUR and USD (Table 7). The large ADBCP implies that CNH is trading with many currencies with quite different characteristics – a feature of highly internationalized currencies that play a role of hub in FX market.

**Table 7 Average distance between currency pairs**

| Currency code | Average distance between currency pairs |
|---|---|
| EUR | 15.64 |
| USD | 12.96 |
| CNH | 12.7939 |
| CHF | 8.8394 |
| GBP | 8.6277 |
| SEK | 8.2447 |
| CAD | 7.995 |
| AUD | 7.0519 |
| JPY | 6.5875 |

As a conclusion, the analysis based on FX market trading patterns tends to support the view that RMB is already a real international currency. At the same time, RMB shows quite large difference with most CLS settled currencies in trading patterns. This paradox can be attributed to two reasons: (1) RMB is not a CLS settled currency; (2) the sparseness of RMB trading data. The fact that RMB doesn't join an international multilateral PvP settlement mechanism like CLS not only limits its trading efficiency, but also twists its trading patterns to some extent. The sparseness of RMB trading data is another side of the same issue. Since RMB is not a member of

CLS settled currencies, we can't get systematic RMB trading data through the platform and have to use survey data for our research. The latter is incomparable with the former in both richness and accuracy. This problem also threatens the robustness of our results.

## 5. Policy Implication

Despite the uncertainty in its future, the development of the RMB offshore market so far is of great importance to RMB internationalization. The RMB offshore market allows overseas investors to learn RMB and the RMB business. This is a critical step for the RMB to compete for the position of global currency in a world dominated by network externalities. Now the development of RMB offshore market has reached a turning point. When the excess return to RMB holders vanishes with the RMB appreciation expectation, the competition of RMB with other currencies will critically rely on its efficiency as an international medium of exchange, which, in turn, highly depends on the accessibility of international financial infrastructure, especially payment system.

However, at least in the FX market, the situation is not optimistic. RMB is not eligible for PvP settlement through a global settlement system. This fact leaves RMB trading in the global FX market vulnerable to counterparty settlement risk and subjected to counterparty credit limits, which clearly doesn't help encouraging financial institutions to participate in RMB business. As our analysis on FX trading patterns implies, the most impeded is the trading between RMB and those regional currencies with low position in international ranking list. But if the target for RMB internationalization is to become a global currency, RMB must assume the function of international medium of exchange in the global FX market, which requires safe and efficient settlement between RMB and not only the established global currencies like USD and Euro, but also those less illustrious regional currencies. The cooperation in international payment system has already become a critical link for RMB internationalization.

## 6. Future Work

This article provides a preliminary exploration on the connection between currencies' positions in international monetary system and their trading patterns in the FX market. The revealed relationship is applied to the evaluation of the status of

RMB internationalization. Although the results are encouraging, there is still a lot of work to achieve a reliable ranking of international currencies.

We notice some differences between the ranking of international currencies derived from the CLS-settled FX trades data and that derived from survey data. For some currencies such as Japanese yen and New Zealand dollar the change of ranking is quite significant. Although these discrepancies can be partly explained by the difference in data quality, they still remind us the necessity of further robust test. We will check the stability of our results with the CLS-settled FX trades data in other periods and also FX trades data from other sources.

Another potential improvement is to use more sophisticated tools to identify the FX trading patterns related to our topic. As PCA itself can't guarantee the relevance of the components derived in the context of our study, we will screen the variables and calibrate the parameters with different clustering methods (e.g. SVM). Moreover, so far our method to depict FX trading patterns is still indicator-based. In future we will also explore the possibility to capture the trading patterns directly from the raw trading data with deep learning technique.

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