



The long-run dynamic relationship between exchange rate and its attention index: Based on DCCA and TOP method

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HIGHLIGHTS

- An attention index of CNY/USD exchange rate is constructed based on search engine.
- DCCA and TOP methods are used to explore the relation between the two time series.
- The time lead–lag structure between exchange rate and attention index is studied.

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ABSTRACT

The behavior information of financial market plays a more and more important role in modern economic system. The behavior information reflected in INTERNET search data has already been used in short-term prediction for exchange rate, stock market return, house price and so on. However, the long-run relationship between behavior information and financial market fluctuation has not been studied systematically. Further, most traditional statistic methods and econometric models could not catch the dynamic and non-linear relationship. An attention index of CNY/USD exchange rate is constructed based on search data from 360 search engine of China in this paper. Then the DCCA and Thermal Optimal Path methods are used to explore the long-run dynamic relationship between CNY/USD exchange rate and the corresponding attention index. The results show that the significant interdependency exists and the change of exchange rate is 1–2 days lag behind the attention index.

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1. Introduction

As the CNY exchange rate mechanism becomes more market-oriented, the risk faced by China's foreign exchange management department, enterprises, financial institutions and international investors is growing rapidly, such as translation risk, transaction risk and economic risk. For the foreign exchange management department, an accurate grasp of the situation of exchange rate fluctuations will contribute to maintaining exchange rate stability, maintaining the internal and external balance, and promoting the healthy development of the foreign exchange market. For import and export enterprises, grasping the short-term trend of exchange rate can be beneficial to their costs controlling, increasing revenue, and reducing the risk of foreign currency translation. For international investors, short-term exchange rate prediction is

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favorable to take hedging measures to avoid exchange rate risk and increase investment return. However, the traditional models such as ARMA, GARCH only rely on historical data to explain the change of exchange rate, and cannot reflect other impact factors like investors' expectations and their emotions. So in the latest research, scholars have tried to integrate people's expectations and emotions into exchange rate analysis by the attention index using web-searching data. The reason is that people use search engine to inquire information to satisfy their requirements [1], and this behavior is the response to the environment changes [2]. Therefore, Internet users' keywords searching on search engine inevitably have close and natural links to external conditions and the environment changes [3]. That is why lots of scholars use web-searching data to forecast economic issues. Find out the leading indicators of exchange rate is critical and necessary to analyze the change of exchange rate. But there is almost no research to examining whether the attention index and the exchange rate have steady and dynamical relationship in each time point.

Based on the INTERNET searching data, NLPPIR Chinese word segmentation system and TextRank keyword extraction algorithm technology are used firstly to find the keywords which are highly related to the CNY/USD exchange rate fluctuations. Further, the attention index of CNY/USD exchange rate is constructed. Then some statistic methods employed from physics are used in this paper to detect the long-run dynamic relationship between exchange rate and its attention index. The Detrended Cross-Correlation Analysis (DCCA) is first used to examine the long-run relationship between CNY/USD exchange rate and the corresponding attention index. Then the Thermal Optimal Path (TOP) method is employed to do the dynamic lead-lag analysis.

2. The construction of attention index

There are five steps to construct the attention index of RMB/USD exchange rate: (1) the construction of corpus, which contains huge amount of text information related with exchange rates; (2) segmentation of Chinese words; (3) keywords screening based on TextRank algorithm; (4) obtaining keywords web-searching index; and (5) the construction of comprehensive attention index.

2.1. The construction of corpus

In this paper, we research on the CNY/USD exchange rates. We collect large amount of text materials from financial reports, financial columns, forums and weibo of financial commentators. The time span is from 2011 to 2014. We get tens of thousands words in the corpus after filtering and duplicate removal.

2.2. Segmentation of Chinese words

Then, we do semantic segmentation of the corpus by employing NLPPIR Chinese words segmented system. Based on Chinese semantics and tones, we split large amounts of text information into the separate words using computer programs, which is named Chinese segmentation. For instance, if we do semantic segmentation for a sentence "The exchange rate of the CNY to US dollars has appreciated", we would get these words: "CNY", "US dollars" and "appreciated". Chinese segmentation system NLPPIR (former ICTCLAS) was designed by Huaping Zhang, a doctor in the department of computer science and technology, Chinese Academy of Sciences, in 2000. Based on Chinese lexical analysis, the system can accomplish complete and semantic analyses of documents, including names, places, institution names, article authors, published media, keywords and abstracts. Therefore, we use the open-source NLPIC Chinese segmentation system to do word splitting work.¹

2.3. Keywords screening based on TextRank algorithm

Mihalcea [4] proposed TextRank² model in 2004. They firstly applied PageRank algorithm to the keywords screening work, and named the model TextRank by segmentation, we decompose the corpus and get preliminary vocabularies. Then we screen the keywords, which are closely related to exchange rate fluctuations, from a large number of vocabularies by TextRank algorithm. Finally, we get 281 keywords, including "CNY exchange rates", "investments", "capital flows", "trading" and "US dollars". After removing the keywords without web-searching index, we get 88 effective keywords. These keywords not only contain the words which are closely related with CNY to US dollars exchange rates such as "the CNY", "US dollars" and "exchange rates", but also contain some unrelated words like "markets", "programs", "space", "stocks", "data" and "processing". But these seemingly unrelated vocabularies are screened by statistical analysis, and may have some hidden relationship with exchange rates. We keep these words in this research.

¹ The introduction of the NLPIC Chinese segmentation system is from "NLPPIR natural language processing and information retrieval platform", <http://ictclas.nlpir.org/>.

² The idea of TextRank model is from PageRank. It thinks that any text is a complexity network combined by groups of words. The central node of the network is the keywords we are looking for. Those nodes adjacent to the central node, although they have very low frequencies of appearance, they may still be the candidates of keywords.

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