



Mining the co-movement between foreign exchange rates and category stock indexes in the Taiwan financial capital market

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ABSTRACT

The foreign exchange market is one of the biggest markets in the global financial capital market. With current trends toward financial capital globalization, it is becoming more important to understand the co-movement of foreign exchange. Investors always want to get all kinds of messages to make decisions about investing. Moreover, they always look forward to making a profit. This study investigates financial investment issues related to Taiwan's financial capital. Thus, this study implements the association rules as a data mining approach to explore the co-movement between foreign exchange rates and category stock indexes in Taiwan. Transaction data, such as foreign exchange rates and stock indexes, were collected to construct a database; the Apriori algorithm was then used to generate the association rules. By doing so, this study proposes several possible portfolio alternatives in the Taiwan financial capital market including foreign exchange currencies and stock investment under different circumstances.

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1. Introduction

According to the 2007 survey of the Bank for International Settlements (BIS), the average daily turnover of the global foreign exchange market is \$3.2 trillion. According to the Central Bank of the Republic of China (Taiwan), the average daily turnover of the foreign exchange market in Taiwan is \$21.08 billion. The foreign exchange market has the world's largest trading volume for a single market. Operating 24 h, the international financial market has a pivotal position. Its influence in 1997 by the Asian financial crisis shows that when a large number of the withdrawals of international capital can enable a single country, or can even be a serious threat to a region as a whole. In financial and market globalization, with trends toward liberalization, traders, investors, speculators, bankers and other participants in the foreign exchange market make repeated daily transactions, such as arbitrage and hedging actions, so as to active the countries' stock market and capital flows. Through globalization in finance and trade, all countries are increasing their dependence on foreign trade. This kind of trade relationship will be a dependent response in the foreign exchange market. Such relationships should be further to explored if the exchange rate between countries is also co-movement. Thus, integration of co-movement and portfolio analysis in financial capital markets in terms of investment and risk management, has become a critical research issue (Chiarella, Dieci, & He, 2007; Ilhan, Mitchell, & Gulser, 2008).

In addition, there are three degrees of financial capital market efficiency. The first degree is the strong form of the efficient market hypothesis, which states that all information that is knowable is immediately factored into the market's price for security. If this is true, then all price predictors are definitely wasting their time, even if they have access to private information. The second degree is the semi-strong form of the efficient market hypothesis, in which all public information is considered to possess private information, which can be used for profit. The third degree is the weak form, which holds only that any information gained from examining a security's past trading history is reflected in price. Indeed, past trading history is public information implying that the weak form is a specialization of the semi-strong form, which itself is a specialization of the strong form of the efficient market hypothesis.

Due to the different degrees of market efficiency, academic researchers investigate the efficient market hypothesis by exploring unknown and valuable knowledge from historical data, using techniques such as data mining. Enke and Thawornwong (2005) introduce an information gaining technique used in machine learning for data mining to evaluate the predictive relationships of numerous financial and economic variables. Neural network models for level estimation and classification are then examined for their ability to provide an effective forecast of future values. Boginski, Butenko, and Pardalos (2006) propose a network representation of stock market data referred to as a market graph, which is constructed by calculating cross correlations between pairs of stocks based on opening price data over a certain period of time. Chun and Park (2005) propose a learning technique, which extracts new case vectors using Dynamic Adaptive Ensemble CBR (DAE

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CBR). The main idea of DAE CBR originates from finding combinations of parameters and updating and applying an optimal CBR model to an application or domain area. These concepts are investigated against the backdrop of a practical application involving the prediction of a stock market index. In addition, Rapach and Wohar (2006) implement an analysis of in-sample and out-of-sample tests of stock return predictability in an effort to better understand the nature of the empirical evidence in return predictability. Their study finds that certain financial variables display significant in-sample and out-of-sample predictive ability with respect to stock returns. Overall, most studies consider stock market analysis as a time series problem, and there have been few studies using stock market efficiency to explore the possible cause-and-effect relationships among different stock categories or the influence of outside factors (Liao, Ho, & Lin, 2008).

Accordingly, this study investigates the following research issues related to the co-movement between exchange rates and categorical stock indexes in the Taiwan financial capital market. They include: (1) the study of the changes of 13 foreign currency exchange rates indexes by association rules to find a similar trend in foreign currency change, and but also to identify the co-movement of foreign currency; (2) the use association rules to understand the co-movement between 13 international exchange rates and 30 categorical stock indexes in Taiwan; (3) the 13 subjects of this study will be stalls in foreign currency in accordance with their national and regional classification. Compared to exploring the same geographical area, the financial trading environment of countries is similar to changes foreign currency exchange rates; (4) to provide an opportunity for the foreign exchange market and stock market investors to invest in the Taiwan market with a different direction and a new way of thinking. The rest of this study is organized as follows. In Section 2, we present the background of foreign exchange market management and the stock market in Taiwan. Section 3 describes the methodology, including the research framework, data sources, and database design. Section 4 presents the data mining approach, association rules, and data mining tool – SPSS Clementine and discusses research findings. Section 5 illustrates the data mining results and Section 6 describes research findings and managerial implications. Finally, Section 7 presents a brief conclusion.

2. Taiwan financial capital market

2.1. Taiwan foreign exchange market

Prior to February 1979, management of foreign exchange in the Republic of China was characterized by a central clearing and settlement system. Following the establishment of the Taipei Foreign Exchange Market in February 1979, a flexible exchange rate system was formally implemented. Since then, the NT dollar exchange rate has been determined by the market. However, when seasonal or irregular factors disrupt the market, the Central Bank of China (CBC) will step in to maintain an orderly foreign exchange market. However, the CBC has continued to promote financial liberalization and internationalization. The management of capital movements is market based. In general, capital can flow freely in and out of Taiwan. The CBC's management philosophy of its foreign exchange reserves centers around liquidity, security, and profitability. The foreign exchange reserves have also been used to promote economic development and industrial upgrading.

On the other hand, as the domestic financial market opens further to foreigners after Taiwan's entrance in the World Trade Organization (WTO), the volume of capital flowing in and out of the country and the number of market participants will significantly increase. The depth and scope of Taiwan's foreign exchange market will be broadened as a result, and the market scale will rise as well.

Also, in response to mounting foreign exchange transactions, new financial products related to foreign exchange will be further diversified. In particular, associated hedge instruments will rapidly increase. Moreover, regulations governing trading procedures will conform to international practices. The Central Bank of China will also emphasize discipline of financial institutions and allow the NT dollar exchange rates to reflect underlying economic fundamentals (<http://www.cbc.gov.tw/np.asp?ctNode=444&mp=2>).

2.2. Taiwan stock market

TSEC, Taiwan Stock Exchange Corporation, maintains stock price indices to allow investors to conveniently grasp both overall market movement and the performances of different industrial sectors. The indices may be grouped into market value indices and price average indices. The former are similar to the Standard and Poor's Index, which is weighted by the number of outstanding shares, and the latter are similar to the Dow Jones Industrial Average and the Nikkei Stock Average. The Taiwan Stock Exchange Capitalization Weighted Stock Index ("TAIEX") is the most widely quoted of all TSEC indices. The base year value as of 1966 was set at 100. TAIEX is adjusted in the event of new listings, de-listings and new share offerings to offset the influence on TAIEX owing to non-trading activities. TAIEX covers all listed stocks excluding preferred stocks, full-delivery stocks and newly listed stocks that are listed for less than one calendar month. The other market value indices are calculated and adjusted similarly to that of the TAIEX, but with different groupings of stocks included for calculation. Out of the TAIEX Component Stocks, the non-Finance Sub-Index, Non-Electronics Sub-Index, and Non-Finance Non-Electronics Sub-Index include stocks not in the financial sector, not in the electronics sector, and not in either sector. Similarly, the Industrial Sub-Indices are calculated for different industrial sectors. In 1986, eight Industrial Sub-Indices were introduced, i.e. Cement/Glass/Ceramics, Textiles, Foods, Plastics/Chemicals/Rubber, Electric Machinery/Electric Appliance/Cable/Electronics, Paper/Pulp, Construction, Finance. In 1995, the TSEC introduced an additional 14 Industrial Sub-Indices, i.e. Cement, Plastics, Electric machinery, Electric appliance/cable, Automobile, Chemicals, Glass/ceramics, Iron/steel, Rubber, Electronics, Transportation, Tourism, Retail and others. This expansion was intent to give a broader perspective of industrial performance and a more comprehensive comparison with overall market trends. Total Return Indices add back cash dividends to the index calculations, and are published at the end of each trading day. This expansion can serve as a better indicator to measure the performance of funds.

In addition, the Industrial Price Average Index and the Composite Price Average Index contain 20 and 30 issues, respectively. The samples are chosen based on their representation in the market as a whole and are adjusted every year by considering profitability, operational efficiency and trading liquidity of the shares, so that the indices can mirror the market trend. All of the TSEC indices (excluding Total Return Indices) are constantly computed and broadcast every minute during the trading hours through the TSEC MIS system and information vendors' networks. This information can be easily accessed on the systems of local and international information vendors, such as Reuters, Bridge, Quick, Bloomberg, Primark, etc. Monthly summaries of all the TSEC indices data are also available on the TSEC website (<http://www.tse.com.tw/en/>).

3. Research design

3.1. Research framework

The research framework of this study is shown in Fig. 1. It involves collecting 13 exchange rates and the concentrated Market's

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