行政院國家科學委員會專題研究計畫 成果報告

使用高頻率外匯交易資料之實證分析
研究成果報告(精簡版)

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計畫參與人員：助理教授-主持人(含共同主持人)：山本竜市

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My original research plan for the year 96 was to explore empirical characteristics in foreign exchange markets by using high-frequency data at the Electronic Brokerage Service (EBS). This project has two goals. First, I planed to ask if there is long-memory of the order signs and the market is efficient. Then I analyze how the relations on the long-memory (or no long-memory) and market efficiency (or inefficiency) can be explained with theories of currency market microstructure. The second goal was to investigate a following hypothesis: fluctuations in trading volume are the proximate cause of clustered volatility and fat tail distribution of price returns.

The first agenda studies a relation between order flows and exchange rates. In particular, the paper empirically investigates a hypothesis that the signs of orders obey a long-memory process, but the market is efficient. The market efficiency is simply measured with its autocorrelations of returns. If returns have significantly positive autocorrelations with really long lags, it is the evidence of long-memory. If not, it implies the market efficiency. Long-memory properties of the order signs and returns are first investigated with simple plots of autocorrelation functions and then with the Lo's modified "rescaled range" or "range over standard deviation" (R/S) tests (Lo (1991)). In addition, I will explain the relation between signs of order flows and exchange rates based on theories of currency market microstructure.

The second research agenda investigates a hypothesis that fluctuations in trading volume are the proximate cause of clustered volatility and fat tailed distribution of price returns. I will empirically examine if the price variations can be explained by fluctuations in trading volume or number of transactions. In particular, we examine if we can detect the clustered volatility and the fat tails even if price changes are recorded at intervals containing equal numbers of trading volume or transactions. If trading volume or transaction frequency matters for these features, the clustered volatility and the fat tails should disappear with the intervals of equal numbers of trading volume or transactions.

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This is a project with Professor Blake LeBaron. However, this year, immediately after we had an suggestion from Professor Barkley Rosser, James Madison University on our Physica A paper (LeBaron and Yamamoto (2007)), we started extending the results of our 2007 paper to explore the impact of varying amounts of imitation and agent learning in a simple order driven market. LeBaron & Yamamoto (2007) added a form of evolutionary learning to the model of Chiarella and Iori (2002) and examined various properties of the high frequency market's time series like long-memories of volume, volatility, and order signs, but yet the market is still informationally efficient. We conjectured that many time series features were related to the levels of imitation in the market. Our most recent paper performs experiments which directly support this conjecture. The paper, titled "The Impact of Imitation on Long-Memory in an Order-Driven Market", will be published to *Eastern Economic Journal* in 2008.

In 2007, although we spend most of the time for publishing this paper to Eastern Economic Journal, we made some progress on the EBS project this year. In particular, we found that in the EBS dataset there is no long-memory in order signs. This finding totally contradicts to properties found in order-driven markets. We conjecture some possible hypotheses to our finding, and have started thinking which one of these better explains and how we can test it.

First, the sings of order flows are not persistent in FX (brokered) interdealer market because dealers do not split their orders so that they do not submit small pieces incrementally. The first explanation on why dealers do not break up their orders into small pieces in FX markets is as follows. The dealers do not split their orders because price impacts from order flows would be very low (small transaction costs). Dealers would know that it is because there are so many liquidities in markets so that large orders do not move price much. The second explanation is that dealers just want to eliminate an inventory imbalance (an inventory risk) so quickly so that they do not split orders. If they split them, it would take more time to eliminate it. According to Mende, Menkhoff, and Osler (2005), on average, dealers at large (small) banks brings inventories halfway back to zero within 0.7 to 3.7 (19) minutes.

The third possible explanation is based on an idea that dealers in the system can observe the last trade prices. EBS contains huge amounts of liquidity so that the price response to any deals is quite small. Dealers who join the system do not expect large changes of the rates, meaning that it is rare for them to capture large price differences to make profits. Then, dealers take actions to capture really small changes. Any increase (decrease) in rates cause dealers to sell (buy) to make a profit. It implies that any pressure to buy (sell) are just cancelled out with the opposite signs of orders. This explains the non-persistence of the order signs. Buyer-initiated deals tend to increase the rates, but putting sell orders gives resistance on price to reverse the trend, making FX markets informationally efficient. This implies that we would observe some impact on price (buy pressure push up the price), but the price impact would be really short-lived as found in Ito et al. (2006).

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出席國際學術會議心得報告

計畫編號	96-2415-H-004-006-
計畫名稱	使用高頻率外匯交易資料之實證分析
出國人員姓名 服務機關及職稱	山本竜市 (Ryuichi Yamamoto), National Chengchi University, Department of International Business
會議時間地點	9/27-29, 2007, Ancona, Italy
會議名稱	Econophysics Colloquium and beyond 2007 conference
發表論文題目	Transparency in a Dealership Market

一、參加會議經過

I attended a conference, which was taken place in Ancona, Italy from September 27 through 29, 2007. The program covered all areas dealing with the computational aspects (broadly defined) of economics, finance, computer science, and physics. The conference focused on topics covered by the field of Econophysics which applies methods from statistical physics and non-linear dynamics to macro/micro-economic modeling, agent based models, financial market analysis and social problems. and so on. The conference is interested in research topics like Agent-based models: Theory and Simulations, Econophysics, Socio-Economic Networks, Information, Bounded Rationality and Learning in Economics, Markets as Complex Adaptive Systems, Evolutionary Economics, Multiscale analysis and modeling, Non-linear Dynamics and Econometrics, Physics of Risk, Statistical and probabilistic methods in Economics and Finance, and Complexity.

This is a great conferences to attend. Many well-known professors attended the conferences and presented the latest results of a wide variety of research. The conferences brought together researchers and practitioners from diverse fields, such as computer science, economics, physics, and complex system theory for understanding emergent and collective phenomena in economic, organizational, and social systems, and to discuss on effectiveness and limitations of computational models and methods in social sciences.

Since I am doing research about the agent-based modeling for finance, it was really a good conferences to attend and great opportunities for improving the quality of my paper. Moreover, I had many opportunities to talk with many professors in my field. Discussions with such professors further improved my research. I made oral presentations of my paper, Transparency in a Dealership Market, at the conference.

二、與會心得

I had opportunities to present my paper to many audiences there and had many chances to talk with

people with the same interests of mine and actually learned a lot from them. Based on the discussion with them, after I came back to Taipei, I have mainly revised my paper as follows. Originally, I was supposed to compare the trading volume and trading frequency with different degrees of transparency net interdealer order flows in foreign exchange markets. However, my recent version investigates how different levels of transparency scheme on net interdealer order flows influence the wealth of dealers in a multiple-dealership market. I argue this issue with an application to foreign exchange markets, and show the average wealth of dealers will grow in the market but their wealth difference will shrink as we increase the degree of transparency.

Currently, FX markets do not have any disclosure requirements so that the public normally do not observe most order-flow information. However, some order flow information is available when dealers choose brokered interdealer trades, which consist of about 20-40% of the total trades in the major trading centers (BIS (1996)). Therefore, currently the level of transparency in FX markets is somehow determined by the dealers, and it seems dealers currently prefer to choose the middle of the complete transparency and non-transparency because they trade directly with other dealers, which means non-transparent, and indirectly through brokers, which means more transparent. However, we are not sure the mechanism on why dealers choose such a transparency level. In addition, it is unclear whether the current low level of transparency of the multiple-dealership markets produces the highest profits for dealers. If the current transparency level hinders all dealers from gaining the possible profits, we can suggest that dealers may be currently making a wrong choice on transparency levels. My paper addresses these issues from dealers' viewpoint.

I would like to argue whether transparency is good or bad for FX dealers. So, as professors I discussed in that conference suggested, it would be better to compare dealers' wealth, not trading volume. It is hard to say whether larger or smaller volume is good or bad for FX dealers.

The paper I found interesting is: Intra-day Prediction of FX Price by Means of Technical Indicators by Dr. Mieko Tanaka-Yamawaki and Dr. Seiji Tokuoka. Their paper tries to find the rules of price formation. They assume agents there switch between different strategies in order to make a good prediction, and many investors try to pinpoint the timing of trend turnover. Their agents automatically select the optimal combination of the appropriate indicators as well as their parameters simultaneously by learning the performance of various candidate combinations from the data, in order to predict the trend of intra-day price movements. They show their system gave a good performance on foreign exchange rates. This is related to my research in a sense that agents in my paper also try to learn from the past performance in order to show better performance in the future. Their paper made me think over whether we really see those agents in actual foreign exchange markets. I would like to try to do some survey on actual FX dealers and investigate whether they actually behave as agents in their and my papers do. This is very important and should be one of my future research agenda.

Anyway, since I learned a lot there, I am grateful to NSC for funding me to have such great opportunities there. I believe the things I learned there have made my research ideas much better.