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Just another day in the inter-bank foreign exchange market☆

Rajesh Chakrabarti*

Faculty of Business, University of Alberta, 2-32E Business Building, Edmonton, Alberta, Canada T6G 2R6

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Abstract

In this paper, I develop a theory of bid–ask quotes provided by foreign exchange dealers in the inter-bank market based on their beliefs and their inventory positions. I then build an agent-based model of the inter-dealer market where dealers learn in a Bayesian manner from quotes from other dealers. Using simulations, I find that the resulting intra-day spreads and between-quote returns largely conform to the empirically observed intra-day U-shaped pattern – a feature that has not been satisfactorily explained in the literature. I also study the factors that determine this U-shape.

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Keywords: Agent based model; Foreign exchange; Microstructure

1. Introduction

Bid–ask quotes and their spreads in stock markets have been the subject of considerable inquiry in the market microstructure literature. However, as Flood

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* Tel.: 780-492-7987; fax: 780-492-3325.

E-mail address: rajesh.chakrabarti@ualberta.ca (R. Chakrabarti)

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(1991) points out, 'little attention has been paid to the particular microstructure of the foreign exchange market'. Since the institutional arrangements of the NYSE and the foreign exchange market are significantly different, the theories of bid–ask spreads developed in one setting do not automatically carry over to the other. The most important distinction between the two markets is that, while the NYSE is a centralized market, a large part of the foreign exchange market – the direct inter-bank foreign exchange market – is a decentralized one. Biais (1993) and Perraudin and Vitale (1995) point out how the difference between these two market forms can lead to some important differences in efficiency and other market characteristics. This paper views the decentralized foreign exchange market as a complex system, and builds a model of intra-day quotes offered by traders. Then it demonstrates, using simulation, that when dealers with heterogeneous price expectations trade according to this model and update their beliefs in a Bayesian fashion, their actions lead to the empirically observed U-shaped pattern in intra-day spreads, spread volatility, and quote-to-quote return volatility.

Direct inter-dealer trading constitutes the most important part of the foreign exchange market. In the Deutsche mark-to-dollar spot market, the largest of all foreign exchange markets, nearly 85% of the trading is between dealers and about two-thirds of this trade is direct (as opposed to brokered) (see Lyons, 1995). The direct market has been characterized as a 'decentralized, bilateral, continuous, open-bid, double-auction market' (Flood, 1991). Bilateral direct trading, using either electronic or voice-based options, involve communication between the counter-parties only. With systems like the Reuters Dealing 2000-1, it is possible to get simultaneous quotes from more than one dealer, but the decentralized nature of the market persists. This decentralized nature is crucial to the way information circulates in this market.

This paper views the foreign exchange market as a complex system of interactions among traders. In the foreign exchange market, the evolution of quotes is determined by more than only the initial beliefs of the participating agents and their subsequent updating. Quotes evolve based on the path of interaction between dealers, and depend on the exact sequence of which trader gets quotes from which other trader. Consequently, even when the initial values of the relevant state variables – priors and inventory – follow well-known probability distributions, modeling and tracking the evolution of quotes between dealers becomes an overwhelming task, even for a reasonable number of agents. The appropriate technique for studying such a market is agent-based modeling. Here the decision making of a single agent is modeled explicitly and then several such agents are allowed to interact in a simulated environment. In the simulations, all agents begin with initial values of state variables which follow specified probability distributions and then interact with one another through their quotes. The resulting sequence of intra-day quotes is then analyzed. When this experiment is repeated several times, we get a distribution for