Can we predict financial markets?

— Scenario analysis by an artificial market approach

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1. Introduction

Are you surprised if the performance of financial specialists' forecasts is lower than that of randomly generated forecasts? Meese and Rogoff[4] conducted forecast tests and got the above mentioned results.

Prediction in financial markets is very difficult because markets have *structural changes* caused by *micro-macro relation*. The micro-macro relation here means that dynamic patterns at the macro (market) level emerge from the interaction of behavior at the micro (dealer) level.

This paper proposes new agent-based approach, an *artificial market approach*[1,2,3], to examine the micro-macro relation in markets and to construct a decision support system. The artificial market approach consists of three steps: (1) fieldwork, (2) construction of multi-agent model, and (3) scenario analysis by computer simulation.

2. Fieldwork

In order to examine an actual market participant's feature, we gathered field data by interviews and questionnaires with professional dealers and experimental markets (Fig.1).

Fig.1 Experimental markets

About ten participants made the virtual exchange dealing using the experiment market system on a Network. The participant of an experiment receives news irregularly in the window of an experiment market system. Experiment participants interpret news, predict the rate of the future, and in order to make profits they trade in a currency using broker dealings or interbank dealings. Moreover, they can refer to past news, their active capital position, and estimated profit and loss.

The following data can be obtained by experiment: (1) rate log, (2) transaction logs, (3) conversation log at the time of dealings, (4) data reference time, (5) expectation questionnaire. The structure about a strategy decision and a learning of an agent in an artificial market was determined using these data.

3. Construction of an Artificial Market Model

Based on the result of fieldwork, we constructed multi-agent model (AGEDASI TOF) of a foreign exchange market. This model is an artificial market on the computer that consists of 100 virtual dealers.

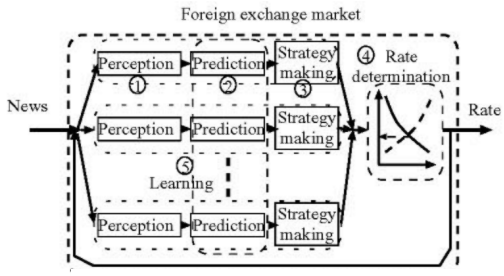

Fig.2 Framework of AGEDASI TOF

Each week of the model consists of 5 steps: (1) Each dealer receives 17 data items of economic and political news (*Perception step*), (2) predicts the future rate using the weighted average of news data with her own weights (*Prediction step*), and (3) determines her trading strategy (to buy or sell dollars) in order to maximize her utility function (*Strategy Making step*) every week. Then, (4) the equilibrium rate is determined from the supply and demand in the market (*Rate Determination step*). Finally, (5) each agent improves her weights by copying from the other successful agents using GA operators (*Adaptation step*). After the Adaptation step, our model proceeds to the next week's Perception step.

An example of the data obtained by the artificial market is shown in Fig.3.

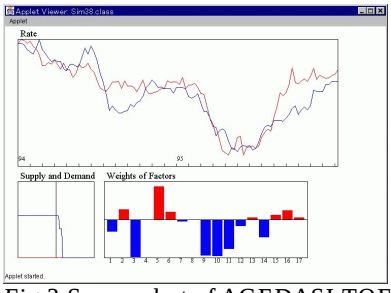

Fig.3 Screenshot of AGEDASI TOF

4. Scenario Analysis by Computer Simulation

Using our artificial market model, we try to construct a decision-making support system about exchange rate policy in 1998. Decision-making using our model consists of two steps: selection of important factors and comparison of strategic scenarios.

4.1 Selection of important factors

First, we trained the agents in our artificial market using sample data until 1997, by repeating the following procedure a hundred times; initialization and a training period.

The results of training showed that the agents are sensitive to the *Economic activities* and *Deutschemark* factors among the uncontrollable factors, as illustrated in Fig. 4. Hence we selected these 2 factors as ``important factors".

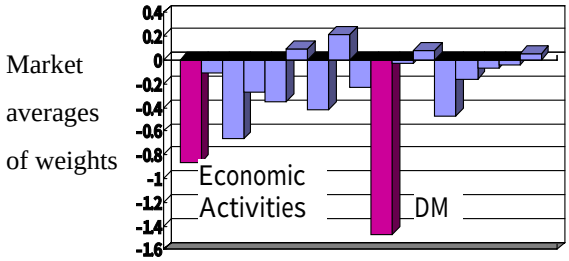

Fig.4 Market averages of the weights of factors (the mean of 100 simulations).

We thought of the following three scenarios:

When there are continuous large news about the important factors,

Scenario (a): control the interest rates against the news (*interest rate scenario*),

Scenario (b): intervene to the markets against the news (*intervention scenario*),

Scenario (c): make announcements about rate policies against the news (*announcement scenario*).

4.2 Comparison of strategic scenarios

Using the strategic scenarios (a)-(c) and the actual scenario as input data, results of computer simulations were compared. We generated 100 simulation paths for each scenario by repeating the following procedure a hundred times, initialization, a training period, and a test period.

Actual scenario

We carried out computer simulations using the real-world scenario of the controllable factors, in order to compare the ``strategic scenarios" to the actual scenario as a standard. As a result, the 100 simulation paths are clearly divided into 4 groups in Fig. 5: Upward, Bubble, Flat, Downward groups. The rate path in the real world is classified into the bubble group, which has the highest probability in the simulation.

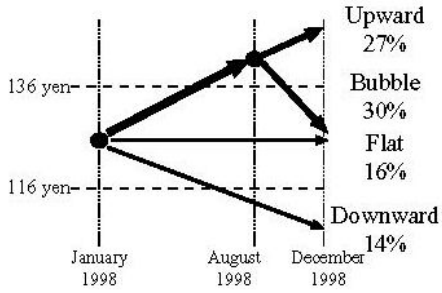

Fig.5 Categorization of simulation paths

Strategic scenarios

Based on the results of computer simulation, effects on rate paths in each scenario can be analyzed. The most desirable scenario is one where the ratio of the Flat group is the highest.

The results showed that the intervention scenario had the highest ratio of the Flat group (Fig. 6).

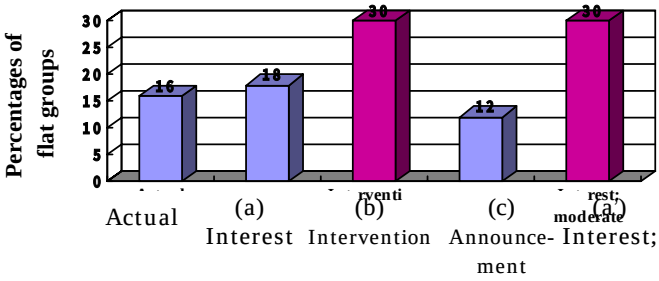

Fig.6 Percentages of Flat groups.

Considering the fact that effects of interest rates were so large, we made a new scenario (a') where change value of interest rates is smaller. This scenario (a') has the same probability of the Flat group as (b). Therefore also the moderate control by interest rates was effective.

5. Conclusions

In this study, we took an artificial market approach to decision-making about exchange rate policies. As a result, it is found that intervention and the control of interest rates is effective on the he stabilization of yen-dollar rates in 1998.

References

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