〔論説〕

Fundamental and Chartist Analysis for Exchange Rates and Stock Prices

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Abstract

This paper analyzes the deterministic elements of exchange rates and stock prices. Fundamental and chartist analysis has been adopted when analyzing these asset prices. Taking one of them into account while ignoring the other is inappropriate. This paper uses a 'bounded' rational expectation model. It shows that the bound rational-fundamentalist-chartist mixed model can account for movements in these prices. Also, economic agents rely on fundamental approach when asset prices depart from fundamental prices ; on the other hand, they rely on chartist analysis when the departure is small.

1. Introduction

The 1970s marked the beginning of rational expectations hypotheses in economic analysis, which has dominated in the field of economics. Countless papers have been presented and cited. Using this theory, many theories have been developed and many empirical analyses have been presented. It cannot be denied the fact that the theory of rational expectations has contributed to the development of economics in both macro-

and microeconomics. However, recent problems have occurred from a real-world perspective. Above all, many economists feel that the observation of information in economy is extremely variable and complex such that no single agent can understand the situation of the entire economy.Storing and processing information is extremely difficult. Moreover, it seems to be natural to think that people form a different forecasting approach[1].

In the 1980s, exchange rate theory developed rapidly. The introduction of a flexible exchange rate system promoted discussion all over the world. Along with traditional purchasing power parity approach, monetary approach, and balance of payments approach, the portfolio approach was presented and analyzed from theoretical and empirical aspects. Use of this approach has shed light on fundamental elements and has been applied to various analyses.

This paper also analyzes another important asset: stock. Stock prices have been assumed to be determined by dividends of enterprises, expectations, and other factors. Future prospects of a firm are the most important factor in determining its stock prices. Also, macroeconomic variables have influenced stock prices (Kurihara and Nezu, 2006). This paper focuses on fundamental prices reflecting these elements.

On the other hand, agents in the business world have taken other approaches to analyzing and forecasting exchange rates and stock prices. Chartist analysis is a typical example. Economists in academic fields have seemed to be scornful about such analysis in general. However, most daily trading has been based on this chartist analysis.

This paper takes these aspects into account. However, some other important ideas are incorporated in the analysis. One of the important points is that although agents do not have the ability to understand the economic real world, at the same time, they are not fools. People can store and process information that is relevant to them, even if only a tiny part of the information. Agents rely on this information as much as they can. They are not perfectly rational but rather are bounded rational.

This paper is structured as follows. Section 2 introduces a structural model for asset price

determination using a fundamentalist and chartist mixed model.Section 3 uses this model as a basic for empirical analysis. Finally this paper ends with a brief summary.

2. Theoretical Model

The model here is the bounded rational model. Agents cannot fully acquire and process information, but they use as much information as possible and act based on a bounded rational rule. Agents act as follows : they check the profitability of the rule and compare it to other available rules. If they find out that the rule is less profitable, they consider switching to a better rule. If they find otherwise, they stick to the initial rule.

In general, economic agents in the real world emphasize the chartist analysis whereas academics emphasize the fundamental elements. Economists in academic fields have not evaluated the chartist model, but the evidence shows that many agents make forecasts based on it. There is no strong theoretical reason to dismiss or disregard the chartist rule. The model for exchange rates as chosen by agents is as follows.

The fundamental model assumes that agents know the fundamental exchange rate. They compare the present market exchange rate with the fundamental one and forecast the future exchange rate to move toward the fundamental exchange rate. This leads us to specify the following rule :

$$E_t = (\Delta s_{t+1}) = -\alpha\ (s_t - s^*_t) \qquad (1)$$

where E_t is the forecast made in period t by the fundamentalists using information up to time, s_t is the exchange rate (the price of the domestic currency in units of the foreign currency) in period t, Δs_{t+1} is the change in the exchange rate between the period t to t + 1, s^*_t is the fundamental exchange rate in period t, and $\alpha > 0$ measures the speed with which the fundamentalists expect the exchange rate to return to the fundamental exchange rate.

Chartists, on the other hand, are assumed to follow a feedback rule. This paper assumes

Chartists, on the other hand, are assumed to follow a feedback rule. This paper assumes that chartists extrapolate the last period's exchange rate into the future [2]. Although agents are rational, they are not perfectly rational. In the real world, this assumption seems to be very realistic. The chartists' forecast rule is as follows :

$$Et = (\Delta s_{t+1}) = \beta\ (\Delta s_t) \tag{2}$$

where E_t is the forecast made in period t by the chartists using information up to t, and β is the coefficient that measures the degree with which chartists extrapolate the past change in the exchange rate. This paper assumes that $0 < \beta < 1$ [3].

The general idea is that agents seem to follow one of the two rules, compare their profitability, and decide whether to keep the rule or switch to the other one. This means that the fraction of the total population of agents using chartist and fundamentalist rules are a function of the relative profitability of these rules. Procedures (3) and (4) are specified [4].

$$Population_f = E_t\ (\pi_f)\ /\ (E_t\ (\pi_f)\ + E_t\ (\pi_c)) \tag{3}$$

$$Population_c = E_t\ (\pi_c)\ /\ (E_t\ (\pi_f)\ + E_t\ (\pi_c)) \tag{4}$$

where $Population_f$ and $Population_c$ are the fractions of the population that use fundamental and chartist rules. Of course $Population_f + Population_c = 1$. The variables π_f and π_c are the risk-adjusted profits realized by the use of chartists' and fundamentals' forecasting rules in period t. Each variable is profits made in forecasting minus $\mu\sigma^2$. μ is the coefficient of risk aversion. σ^2 is the variance of the forecast error, $\sigma^2 = [E_{t-1}(s_t) - s_t]^2$.

Equations (3) and (4) can be interpreted as follows. When the risk-adjusted profits of the chartist trader's rule increase relative to the risk-adjusted profits of the fundamentalists' rule, the share of agents who use chartist trader rules increases and vice versa.

Profits are defined as the 1-period earnings of investing foreign currency or domestic currency. More formally,

$$\pi_{i,\,t} = [s_t\ (1 + r^*)\ / s_{t-1} - (1 + r)]\ PM\ [E_{t-1}(s_t)\ (1 + r^*)\ / s_{t-1} - (1 + r)] \quad (5)$$

where i = f (fundamentalist) or c (chartist). PM [x] = 1 (for x > 0), 0 (for x = 0), or -1 (for x < 0).

Finally, I can assume that agents aggregate these forecasts to obtain market forecasts. The market forecast of exchange rate change can be written as a weighted average of the expectation of chartists and fundamentalists.

$$E_t\ (\Delta s_{t+1}) = - Population_f\ \alpha\ (s_t - s^*_t) + Population_c\ \beta\ (\Delta s_t) \quad (6)$$

The realized change in the market exchange rate in period t+1 equals the market forecast made at time t plus white-noise errors, ε_{t+1}, occurring in period t+1 [5]. The equation (6) can be written as follows :

$$\Delta s_{t+1} = - Population_f\ \alpha\ (s_t - s^*_t) + Population_c\ \beta\ (\Delta s_t) + \varepsilon_{t+1} \quad (7)$$

Empirical analysis is conducted in the next section. The analysis mainly checks which rule is adopted. When the exchange rate moves much or frequently, checking which rule is used in the market is important not only for market agents but also for policymakers. Analyzing the deterministic rule in the foreign exchange markets is an important issue for policymakers.

For stock prices, the model is almost the same with for foreign exchange rates. The basic model is explained in the following section.

The fundamental model here assumes that agents know fundamental stock prices. Agents in the markets compare the present market stock price with the fundamental one and they forecast the future stock price to move toward the fundamental stock price. This leads us to specify the rule as noted in equation (1). Chartists are assumed to follow a feedback rule. This paper assumes that chartists use the previous period' s stock price information to predict the future. This is written as in equation (2).

The fraction of the total population of agents using chartist and fundamentalist rules is a function of the relative profitability of these rules. Procedures (3) and (4) apply. Profits in the stock markets are defined as the 1-period earnings of investing stocks. More

formally,

$$\pi_{i,\,t} = (s_t - s_{t-1})\ \ PM\ \ [E_{t-1}(s_t) - s_{t-1}] \tag{8}$$

where i = f (fundamentalist) or c (chartist). PM [x] = 1 (for x > 0), 0 (for x = 0), or -1 (for x < 0).

Finally, I can assume that agents aggregate these forecasts to obtain market forecasts. The market forecast for stock prices change can be written as a weighted average of the expectations of chartists and fundamentalists as in equation (6), with equation (7) accounting for the realized change in the stock price. Analyzing the deterministic rule in the stock market is an important issue not only for stock traders but also for policymakers.

3. Empirical Analysis

This section 3 provides empirical analysis. Generally speaking, economists have been generally scornful about chartist analysis. Chartists do not emphasize the extrapolation of past information. However, there is a lot of empirical evidence that chartist analysis or technical analysis is appropriate, and in reality, agents forecast based on this approach. Taylor and Allen (1992), Menkhoff (1997,1998), Cheng and Chinn (2001) provide examples. Too much dependence on fundamental analysis seems to be dangerous when analyzing exchange rates in reality.

First, the fundamental exchange rate should be determined. The Hodrick-Prescott Filter method is used [6]. The sample periods are from 1999 to 2006. In 1999, the Euro started. Next, α and β should be computed. The estimated equations (1) and (2) are as follows. This is the case of the Euro/U. S. Dollar

$$Et = (\Delta s_{t+1}) = -0.1302\ (s_t - s^*_t) \tag{9}$$

adj. R^2: 0.056 ; D.W. : 1.784

$$E_t = (\Delta s_{t+1}) = 0.0416\ (\Delta s_t) \tag{10}$$

adj. R^2: 0.209 ; D. W. : 2.166

Fundamental stock prices are also computed using the Hodrick-Prescott Filter method. μ is also set to be one. The sample periods are from 1986 to 2006.

The estimated equations (1) and (2) for the U. S. stock price are as follows.

$$Et = (\Delta s_{t+1}) = -0.1904\ (s_t - s^*_t) \quad (11)$$

adj. R^2: 0.090 ; D.W. : 1.850

$$Et = (\Delta s_{t+1}) = 0.010\ (\Delta s_t) \quad (12)$$

adj. R^2: 0.023 ; D.W. : 1.998

All of the coefficients are significant at 1% or 5% level.

Figure 1 is the case of the U. S. dollar-Euro. Sample periods are long, so only a short period in 2006 is shown. The upper part shows the simulated exchange rates obtained in the simulation run and the exchange rate in reality. The lower part of this figure reveals the fundamental's and chartist's weight.

Figure 2 is the DOW Jones. The upper part shows the simulated stock price obtained in the simulation run and the stock price rate in reality.

The results are interesting and almost common. The most striking features of these simulations are the following. First, it appears that the movement of simulated exchange rates and stock prices is similar to the ones of reality. They fit well. However, simulated exchange rates and stock prices are very often disconnected from those of reality. Second, non-fundamental periods are characterized by situations in which the chartists' weights are far from 1 and are fluctuating significantly. In this case, the fundamental approach is used. On the other hand, if the differences between the simulated and the reality are small, agents use the chartist model.

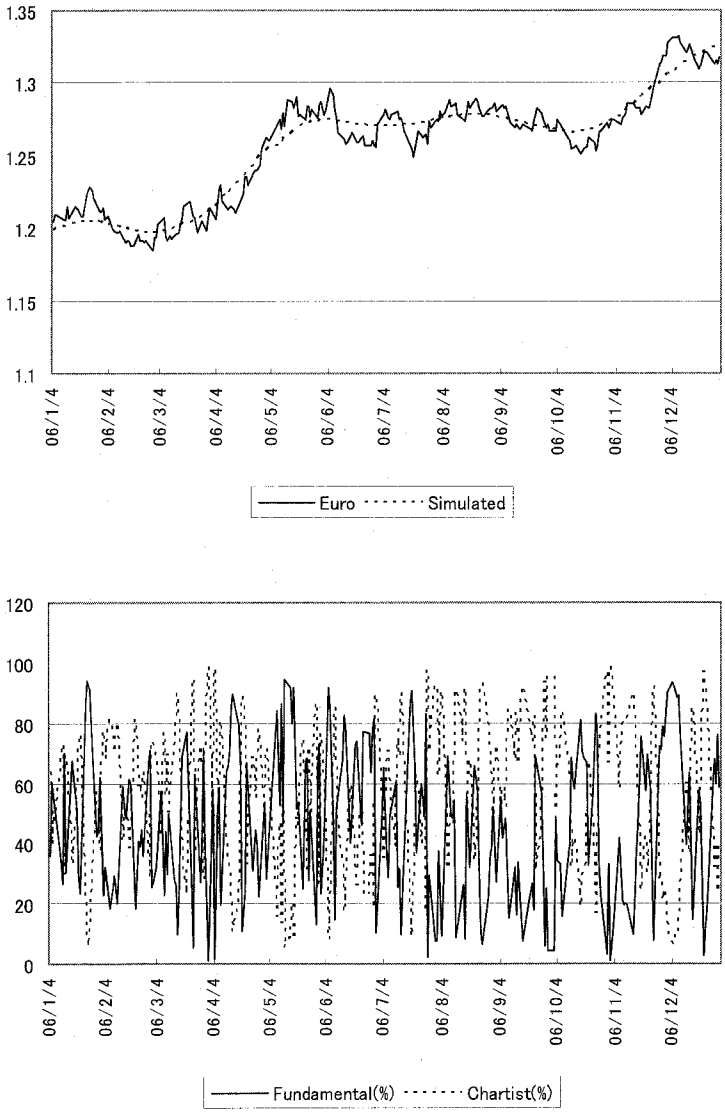

Figure 1 Simulated exchange rates and the exchange rate in the real market (U. S. dollar-Euro).

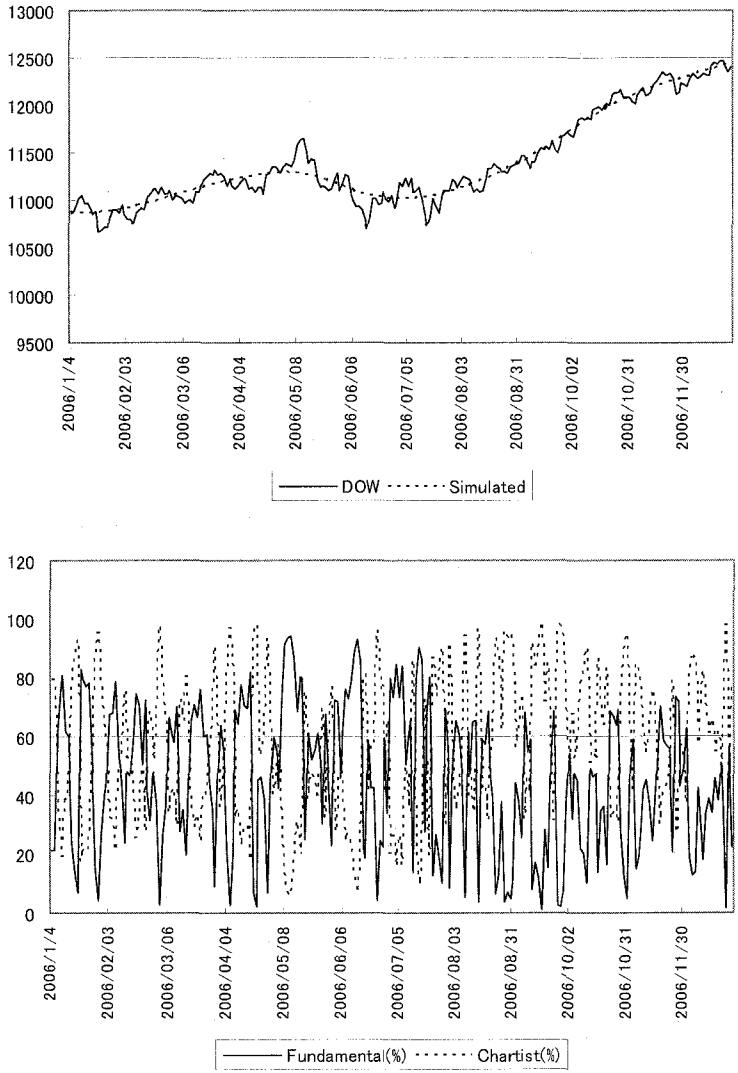

Figure 2 Simulated stock price and the stock price in the real market（DOW：U. S.）.

4. Conclusion

This paper analyzed the deterministic elements of exchange rates and stock prices from a realistic point of view incorporating some important issues. When we analyze asset price movements, both fundamental and chartist analysis need to be performed. Taking into account only one of them is insufficient. Both analyses should be used to forecast asset prices. The movement of these market prices in reality and as simulated are very similar. Also, agents rely on the fundamental approach when exchange rates and stock prices depart from the fundamental ones ; on the other hand, agents rely on the chartist approach when the departure is small.

One important drawback of this paper is that I cannot draw general conclusions. Moreover, there are a lot of specific situations in this long sample periods. Taking these factors into account is important and interesting.

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Notes

1. The rational expectation approach also does not perform well in the empirical approach. See De Grauwe (2006).
2. This assumption seems to be very realistic. Most chartists do not extrapolate past (very old) period's information but extrapolate only from the recent period's information. However, the chartists are not rational but rather bounded rational.
3. This ensures dynamic stability.
4. See De Grauwe (2006). One of the objections to this switching rule could be that when one of the

two rules is more profitable, all agents will use that rule. However, some psychological literature says that there is a status quo bias in decision-making. Agents need time to change a decision rule that has been used for some time.

5. The εt is assumed to be normally distributed with means equal to 0.
6. AR (1) was applied ; however, the results are similar to those shown below.

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