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Antipersistent Markov behavior in foreign exchange markets

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Abstract

A quantitative check of efficiency in US dollar/Deutsche mark exchange rates is developed using high-frequency (tick by tick) data. The antipersistent Markov behavior of log-price fluctuations of given size implies, in principle, the possibility of a statistical forecast. We introduce and measure the *available* information of the quote sequence, and we show how it can be profitable following a particular trading rule. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

A challenging question in financial markets is whether there exist correlations which provide useful information for a speculator. We show that an elementary Markov model can grasp some essential features of foreign exchange markets and how this is related to a profitable strategy.

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Since the celebrated work of Fama [1] a big effort has been made to empirically test markets' efficiency. The debate is still open: on one side, academics mostly believe in market efficiency, at least in the weak form, on the other, chartists are convinced of the feasibility of financial series forecast. In particular, currency exchange markets seem to be the natural subject for an efficiency test. Their large liquidity should imply efficiency; however, practitioners widely use chartist techniques as documented by Allen and Taylor [2].

In this paper we show how, in an even simpler framework, a Markov model can be an useful tool in forecasting FX fluctuations of given size.

First, to obtain statistical significant results and estimations which are stable over time, we analyze a 1 year high-frequency dataset of the US dollar/Deutsche mark exchange, the most liquid market. Our data, made available by Olsen and Associates, contains all worldwide 1,472,241 bid–ask US dollar/Deutsche mark exchange rate quotes registered by the inter-bank Reuters network over the period October 1, 1992–September 30, 1993. In fact, FX markets have changed significantly over 15 years: the BIS [3] reports a change even in the micro-structure of the FX market. In the eighties transactions occurred only by telephone. However, since 1992 three electronic broking systems have been operating in London, the most important FX exchange, and automated dealing systems have been mostly used in the second half of the nineties. A 1-year lag should allow the stationarity of the essential features of the market, avoiding most of these problems.

Second, one cannot be sure that considering today's information for tomorrow's forecast (as in a Markov model of order 1) one has included all the relevant information. For example, it should be checked that the information on yesterday's prices does not add anything in tomorrow's forecast. A natural question is then: how far in the past one has to go to get all the relevant information?

Finally, we link the forecast to profits. In particular, we show how the speculator can exploit this information in an optimal trading strategy if correlations are present.

For these reasons, in order to quantify the degree of (eventual) inefficiency of the market, we define and measure the *available* information of the returns' time series. This *available* information is related to the Shannon entropy of a symbolic sequence associated to the time series. We also discuss the relation with the growth rate of the capital of a speculator which follows an optimal trading rule, i.e., a trading rule which makes the largest profit in the long run using the *available* information. *Available* information reminds ε entropy introduced by Kolmogorov [4] in the context of information theory.

The *available* information is not uniquely defined since there are different ways of associating a symbolic dynamics to a time series. In this paper, we propose a simple but very reasonable strategy which consists in fixing the resolution Δ for the return in spite of the time lag. Before trading again the speculator waits that prices vary of a given amount Δ and then he rebalances his position.

The paper is organized as follows. First, in Section 2, we define the *available* information. In Section 3, we compute this quantity for our prescription for any fixed resolution Δ and measure it in Section 4. In Section 5, we relate the *available*