Studying the Currency Exchange Markets with models of Undercooled Fluids and Glasses

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The principle of corresponding states indicates that different fluids are in the same state if the reduced temperature and pressure are the same. This principle can be extended also to colloidal fluids, making the length scale irrelevant [1]. Furthermore, a similar principle can be invoked for the dynamics. In particular, slow dynamics is observed in many different systems, such as colloidal and molecular glasses, granular matter, and polymer gels, among others. All of them are featured by a clear separation between microscopic dynamics and long-time, structural, relaxation. Another hallmark of these systems is that the particle displacement distribution deviates from a Gaussian at large displacements [2].

A completely different system that can be in principle ascribed to this category of slow systems is financial markets, and in particular, the currency exchange market. For instance, the Euro-U.S. Dollar exchange rate has moved in more than 15 years in a range of $\pm 50\%$ the mean value.

In this work, we analyse the data from the Euro-U.S. Dollar (EURUSD) exchange rate market over many years using the typical concepts of glasses, such as caging, hopping, or two-step relaxation. In particular, we borrow a model from structural glasses, proposed by Chaudri, Berthier and Kob based on hopping [2], to rationalize the behaviour of the EURUSD market.

We present the price change distribution functions (pdf) for different time intervals in the upper panel of Fig. 1. These can be fitted with the model using an Ornstein-Uhlenbeck process for the short time dynamics and a single set of parameters for all time intervals. Despite the non-Gaussian tails in the pdf, the corresponding mean squared displacement averaged over all years is linear with time, apparently indicating free diffusion [3].

However, when the data is deaggregated appropriately (using the starting time), the typical behaviour of undercooled fluids, with a separation between microscopic dynamics and structural relaxation is observed (as shown in the lower panel of Fig. 1). Similarly, the price correlation functions show the typical two-step decay, and the non-Gaussian parameter develops a peak in the time range when the price is caged [3]. These phenomenology is similar to that shown by physical glasses, posing an interesting analogy between these two far appart fields.

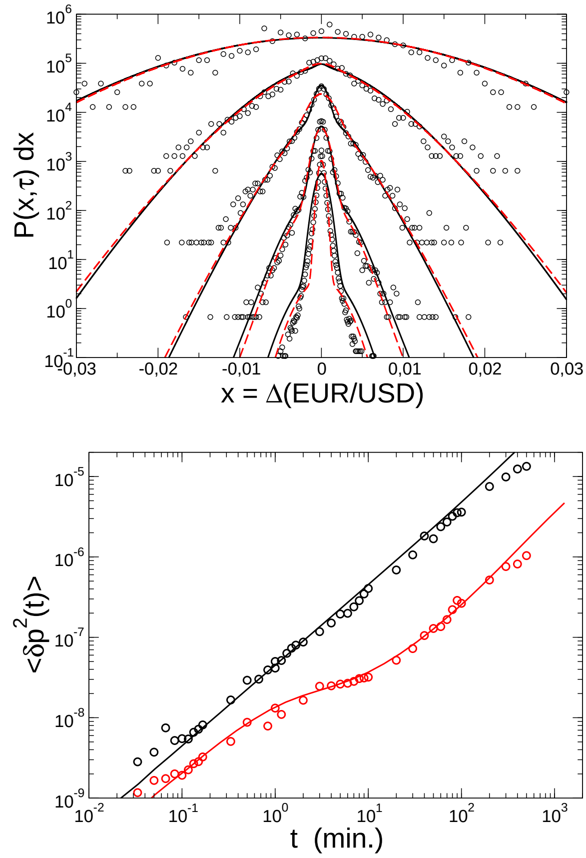

Figure 1: Upper panel: Price change distributions of the EURUSD for time intervals $\tau = 5, 25, 125, 625$ and 3125 minutes, from bottom to top, shifted vertically for clarity. The data is taken from the period 2010-2015. The lines are two models used to fit the data.

Lower panel: Mean squared price displacements for different time origins: 9.30 am ET (black circles) and 6 pm ET (red circles). The lines are the fittings with the model.

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