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False Euro (FEUR) exchange rate correlated behaviors and investment strategy

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Abstract. We have searched for correlations and anticorrelations with respect to currencies as CHF, DKK, JPY, and USD in order to understand the EUR behavior. In order to do so we have invented a *false euro* (FEUR) dating back to 1993 and have derived simulated exchange rates of the FEUR. Within the *Detrended Fluctuation Analysis* (DFA) statistical method we have obtained the power law behavior describing the rms. deviation of the fluctuations as a function of time. We have compared the time-dependent exponent for these four exchange rates, and observe the role of the DEM, and the other currencies forming the EUR. A simple investment strategy based on the *local* DFA technique shows one can obtain appreciable gains, even taking into account some modest transaction fee. We compare the time dependent α exponent of the DFA for various exchange rates as in a correlation matrix for estimating respective influences.

PACS. 05.45.Tp Time series analysis – 05.45.Gg Control of chaos, applications of chaos – 74.40.+k Fluctuations (noise, chaos, nonequilibrium superconductivity, localization, etc.)

1 Introduction

The Euro is a new currency which will replace 11 European currencies in 2002, *i.e.* Austrian Schilling (ATS), Belgian Franc (BEF), Finnish Markka (FIM), German Mark (DEM), French Franc (FRF), Irish Pound (IEP), Italian Lira (ITL), Luxembourg Franc (LUF), Dutch Guilder (NLG), Portuguese Escudo (PTE), Spanish Peseta (ESP). It is already used for psychological purposes during the present 'transition period', and its exchange rate is already quoted [1]. The 11 currencies (BEF=LUF) and their exchange rates with respect to the EUR are shown in Table 1 of reference [2].

A data series can be artificially constructed for the EUR exchange rate toward other currencies, *e.g.* the Swiss Franc (EUR/CHF) following the artificial rule:

$$1\text{EUR/CHF} = \sum_{i=1}^{11} \frac{\gamma_i}{11} C_i/\text{CHF} \tag{1}$$

where the γ_i's are the conversion rates and the C_i's denote the respective currencies.

The same may hold true for EUR/DKK, EUR/JPY, and EUR/USD which are the only ones considered here below. The normalized evolution of ten (since LUF = BEF) currency (forming EUR) exchange rates *vs.* USD, – assuming an exchange rate = 1 on January 01, 1993 has been shown in Figure 1 in reference [2]. The other EUR/DKK, EUR/CHF, and EUR/JPY cases are similarly obtained. Such data is not shown here for lack of space. The number of data points has been equalized, as done in reference [2] and is equal to $N = 1902$, spanning the interval time from January 1, 1993 till June 30, 2000. The fluctuations can be as large as 30% for ESP, FIM, and PTE and 20% for the others.

The DFA technique [3] has often been described and is not recalled here. It leads to investigating whether the function $\langle F^2(\tau)\rangle$ has a scaling behavior, *i.e.*

$$\langle \frac{1}{\tau} \sum_{n=k\tau+1}^{(k+1)\tau} [y(n) - z(n)]^2 \rangle \sim \tau^{2\alpha} \tag{2}$$

where $y(n)$ is the investigated time series and $z(n)$ is hereby a linear function fitting at best the data in the τ interval which is considered. Let it be recalled that in reference [2] two different scaling ranges were found for the EUR/DKK; one, from four to 25 days (5 weeks) with $\alpha = 0.37 \pm 0.01$, and another, after that for up to 300 days (61 weeks) with more Brownian-like correlations, *i.e.* $\alpha = 0.48 \pm 0.03$. The time scale invariance for EUR/CHF, EUR/USD, and EUR/JPY holds from 5 days (one week) to about 300 days (one year) showing Brownian types of correlations.

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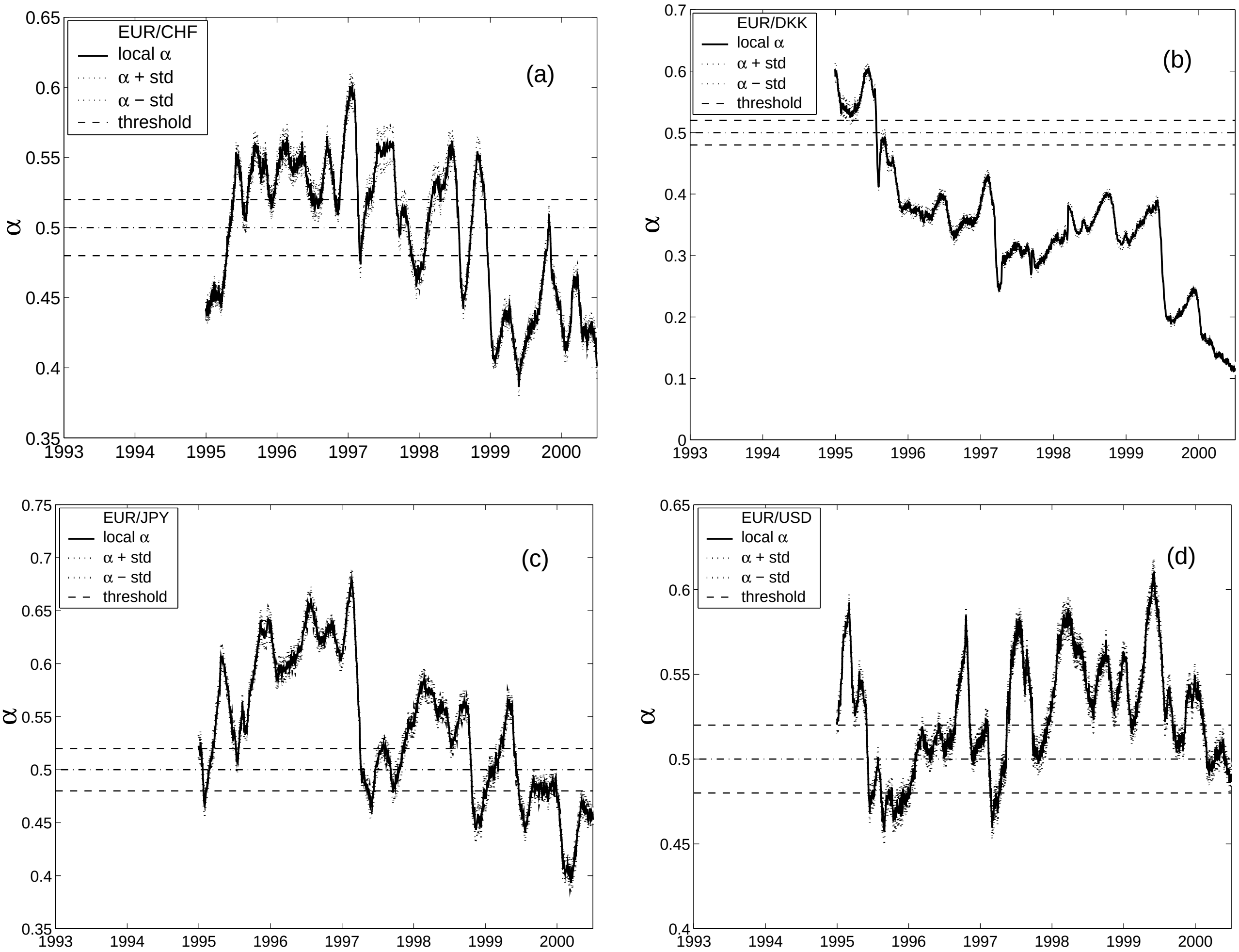

Fig. 1. Time dependent evolution of the α exponent of the DFA applied to (a–d) EUR/CHF, EUR/DKK, EUR/JPY, and EUR/USD.

Next, in order to probe the existence of *locally correlated or not* sequences, a so-called observation box is constructed, *i.e.* a $w = 2$ years (513 days) wide window probe is placed at the beginning of the data, and the α exponent is recalculated for the data in that box. A time dependent value of α is thereby obtained. The four cases of interest are shown in Figure 1a–d.

2 Investment strategy

The most simple investment strategy has been presented in reference [4]. It consists of predicting the sign of the exchange rate fluctuation the next day according to the value of the α exponent up to the previous day. If we predict correctly the sign of the fluctuation in the rate the increase/decrease absolute value of the $y(n)$ change is added to the initial investment; it is subtracted if the prediction has the wrong sign. In so doing the daily gain (or loss) evolves with time. There is no bid on the next day fluctuation if the rate does not change from one day to the next. There is no bidding either when the day α error bar extremities are in the interval $[0.48, 0.52]$. In Figure 2a–d the result of such a strategy is shown for the four cases of interest, either when there is no exchange fee taken into account, or when there is a 5% fixed fee. Even though the strategy could be further improved, the present one indicates appreciable gains. Constraints on the amplitude of the fluctuation and the local trend seem to be also relevant.

3 Discussion on correlations

The local α exponent has been indicated to reflect some entropy dimension, as defined in reference [5] and to reflect information input in the system [4]. Therefore, it is of interest to observe whether the various exchange rates are correlated. Moreover, it is an theoretical question whether DEM is the strongest currency among the 11 forming the EUR, and whether DEM truly controls the market. In order to do so we construct a correlation matrix of the time-dependent α exponent for the various exchange rates of interest. Not all can be displayed here. In Figure 3a–d, the correlation matrix is displayed

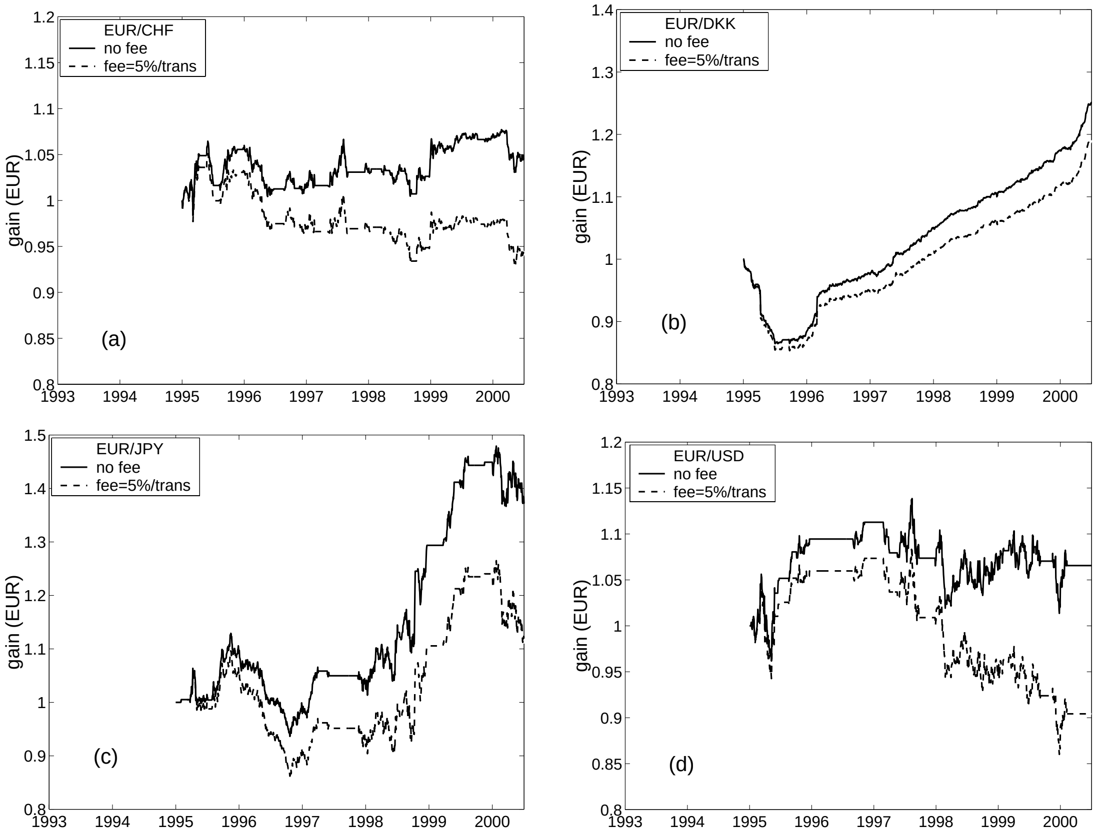

Fig. 2. Gains resulting from the simple investment strategy as described in the text for (a–d) EUR/CHF, EUR/DKK, EUR/JPY, and EUR/USD markets; full line, no fee; dotted line, 5% fee.

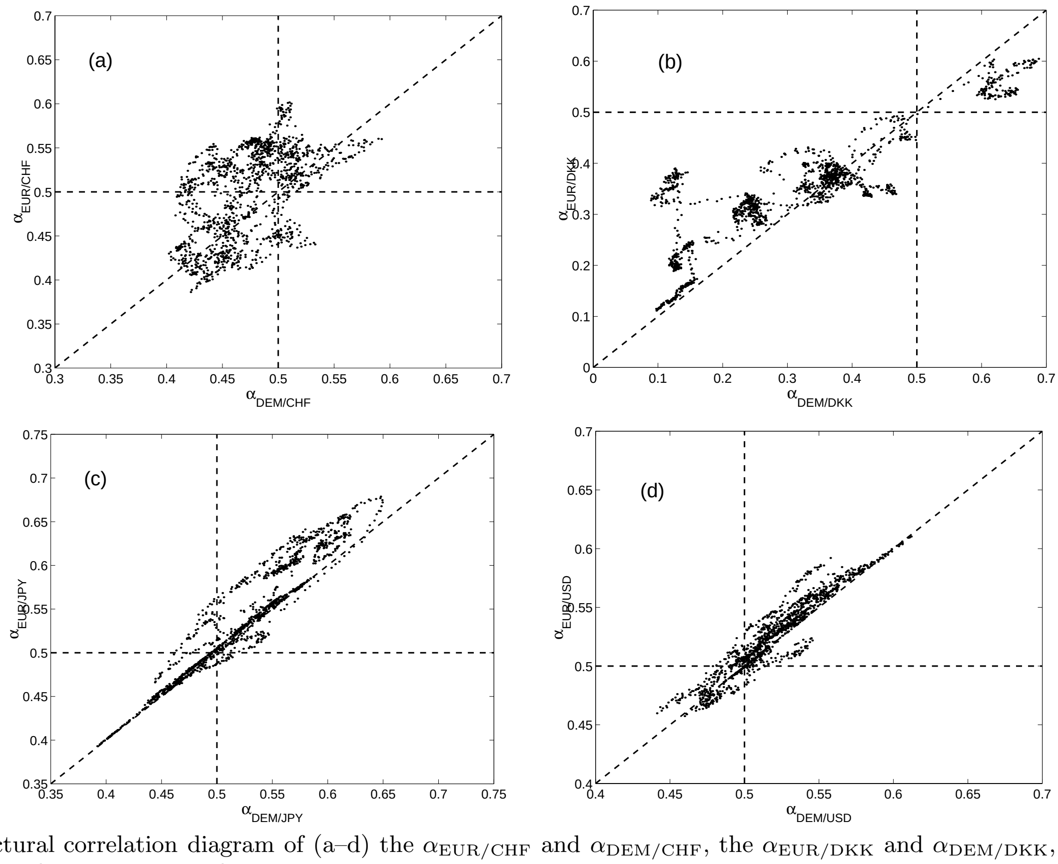

Fig. 3. Structural correlation diagram of (a–d) the $\alpha_{\mathrm{EUR/CHF}}$ and $\alpha_{\mathrm{DEM/CHF}}$, the $\alpha_{\mathrm{EUR/DKK}}$ and $\alpha_{\mathrm{DEM/DKK}}$, the $\alpha_{\mathrm{EUR/JPY}}$ and $\alpha_{\mathrm{DEM/JPY}}$, the $\alpha_{\mathrm{EUR/USD}}$ and $\alpha_{\mathrm{DEM/USD}}$ exponents.

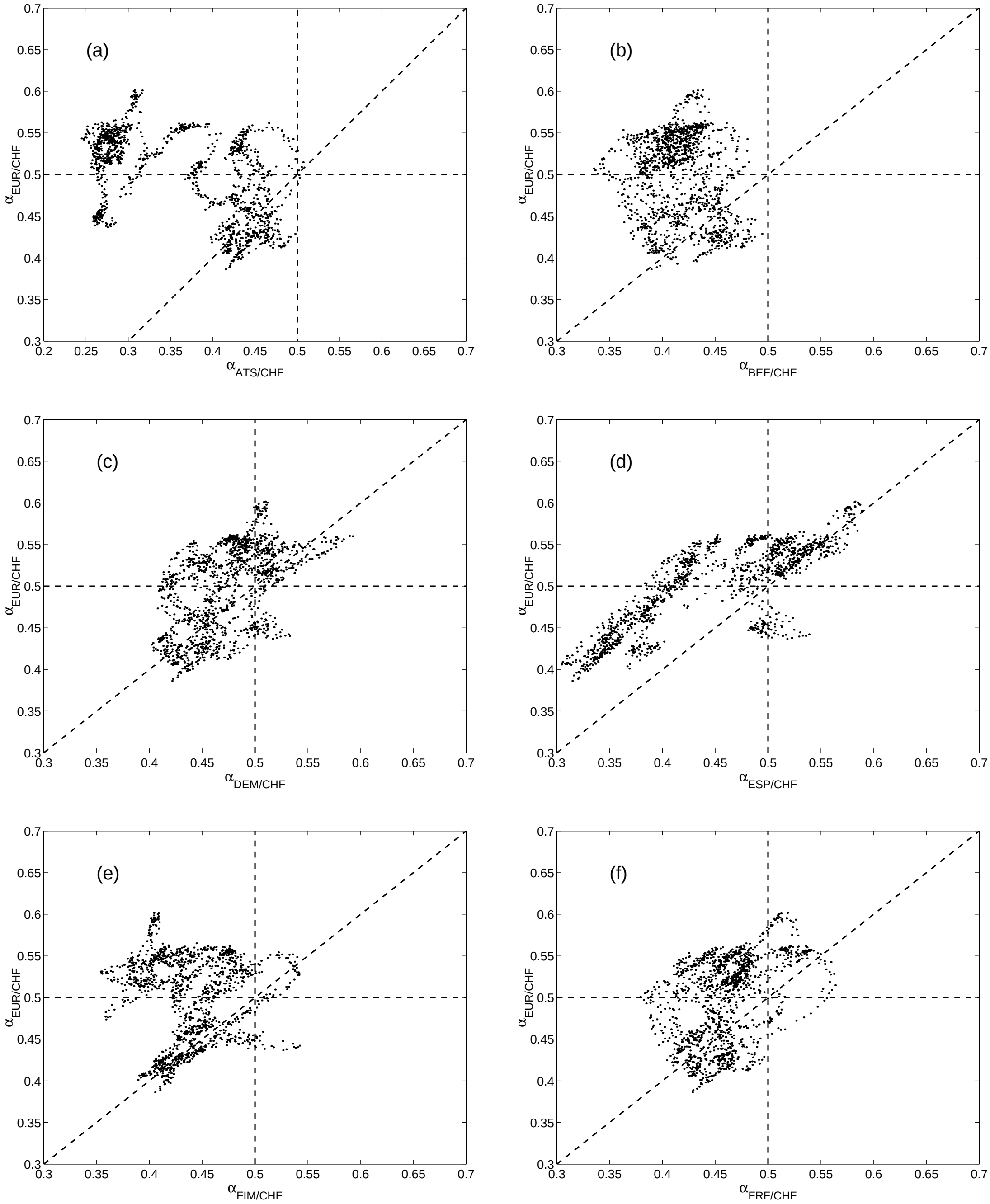

Fig. 4. Same as Figure 3, but for the correlation between the exchange rate α exponent of DFA for (a–j) the EUR and the 11 currencies forming EUR with respect to CHF; (BEF=LUF).

for the time interval hereby considered for $\alpha_{\mathrm{EUR}/B_i}$ *vs.* $\alpha_{\mathrm{DEM}/B_i}$, where B_i stands for CHF, DKK, JPY, and USD. Such a diagram can be divided into eight main sectors through a horizontal, a vertical and two perpendicular diagonal lines crossing at (0.5, 0.5). If the correlation is strong the cloud of points should fall along the slope = 1 line. Clusters of points indicate highly correlated data as well. Let it be noticed that parallel stripes occur for the correlations with respect to the USD, with interestingly $\alpha_{\mathrm{EUR/USD}}$ always greater than $\alpha_{\mathrm{DEM/USD}}$. Therefore the correlations are highly persistent ones. The $\alpha_{\mathrm{EUR/JPY}}$ and $\alpha_{\mathrm{DEM/JPY}}$ show very strong correlations with a cluster on the +1 line. The distribution of points indicate that the fluctuation correlations are more persistent for the EUR/JPY than for the DEM/JPY. Strong correlations between $\alpha_{\mathrm{EUR/CHF}}$ and $\alpha_{\mathrm{DEM/CHF}}$ are observed due to the wide stripe, with an interesting set of missing points *below* the +1 line slope in the vicinity of the *Brownian*

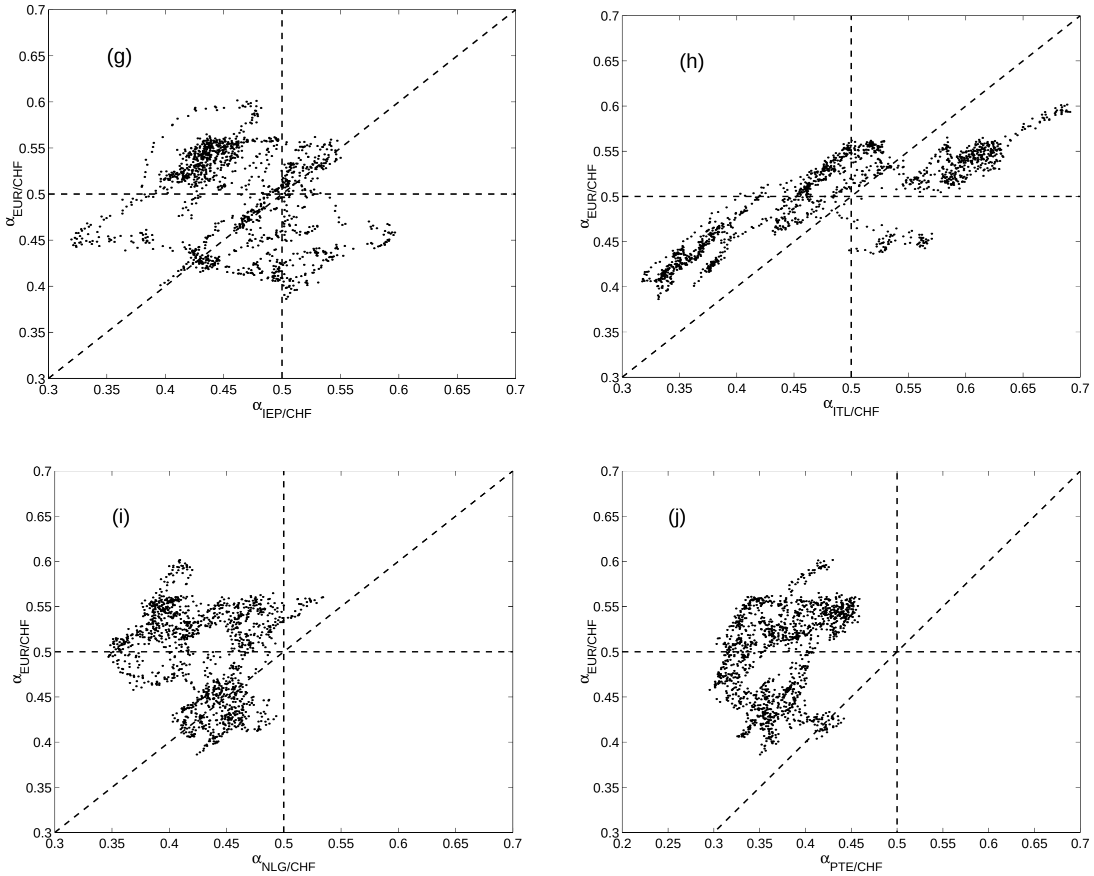

Fig. 4. continued

point at (0.5, 0.5), points which are found in the upper left hand triangle, with a few far below in the lower right hand triangle. Finally the case of $\alpha_{\mathrm{EUR/DKK}}$ *vs.* $\alpha_{\mathrm{DEM/DKK}}$ indicates a set of blobs, showing consistent 'anti-persistence-antipersistence' or 'persistence-persistence' correlations. From a DKK point of view, the EUR and DEM are entirely identical currencies.

Such a diagram can also be thought of for the eleven currencies forming EUR with respect to the four selected non Euroland currencies. The 44 diagrams cannot be shown here. For illustration we give in Figure 4 the corresponding diagrams of EUR and the currencies forming EUR for their exchange rate with respect to CHF.

Stripes and clouds can be observed. Most of them indicate a large variety of behaviors. Notice that a risk evaluation can be made by observing the local rms. deviations in the stripe or cloud regions.

4 Conclusion

The Euro (EUR) exchange rate is very puzzling and its strength currently is questioned. Correlations and anticorrelations of EUR exchange rates with respect to currencies as CHF, DKK, JPY and USD indicate a very complex behavior. Nevertheless, let us notice that a *local* DFA method can lead to different investment strategies, and correlations between currencies could be analyzed for improving the gains. In particular, some better investment strategy could be done by deducing some risk condition from the correlation matrix.

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