Are Pound and Euro the Same Currency?

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Abstract

Relying on a fictitious euro some physicists have claimed that the pound and the euro have been locked together for years despite daily changes in their respective exchange rates. They then conclude that pound and euro are in practice the same currency. We employ a novel technique based on time-varying Hurst exponents to assess efficiency and find that, in this respect, the pound and the euro are unambiguously distinct. While the pound is becoming more efficient, this is not the case for the euro.

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1. Introduction

Some physicists have suggested that the pound is redundant in that it behaves like the euro [1, 6]. This claim has received reasonable media coverage in the financial press. The authors devise a fictitious (false) euro to get the euro's short time series extended. And they find that before 1999, the pound fluctuated against the Deutschemark, the French franc, Finnish markka, Dutch guilder, and Austrian schilling in the same way as it fluctuated against the false euro. After 1999, the same matching pattern was seen between the pound and the euro itself. The correlation coefficients of the pound, Deutschemark and French franc were all similar to that of the actual euro. (Yet the Italian lira followed a different pattern.) According to the two physicists the results show that the pound and the euro have been locked together for years despite daily changes in their respective exchange rates.

We revisit the issue to take financial efficiency into account. We employ a novel technique based on time-varying Hurst exponents [2] and find that while the pound-dollar exchange rate is getting more efficient as time goes by, the false (and actual) euro-dollar rate is not evolving toward efficiency. What is more, the pound-dollar rate seems to depart from efficiency more recently. At present one cannot say whether this is a permanent trend. What is remarkable is that it coincides with the introduction of the euro itself.

The rest of this paper is organized as follows. Section 2 presents actual data, the false euro, and the correlation finding. Section 3 evaluates efficiency of pound and euro's dollar values reckoning Hurst exponents over time. Section 4 concludes.

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2. **Data, False Euro, and Correlation**

We take daily data for the actual exchange rates from the Federal Reserve website. The data set for the British pound ranges from 2 January 1973 to 31 March 2005 (8073 data points). The false euro is built on data of the euro itself, which are also taken from the Federal Reserve. The data set ranges from 2 January 1973 to 31 March 2005 (8073 data points as well).

Conversion rates at the launching of the euro stand in Table 1. Here 1 euro can be represented as an unweighted sum of the 11 currencies C_i, i = 1, 11, i.e.

$$1euro = \sum_{i=1}^{11} \frac{\gamma_i}{11} C_i \tag{1}$$

where γ_i is a conversion rate.

To get the false euro, equation (1) is extended backward [1]. The series of the false euro-US dollar rate is built according to

$$\frac{1euro}{USD} = \frac{\sum_{i=1}^{11} \frac{\gamma_i}{11} C_i}{USD} \tag{2}$$

From 1 January 1999 on, the false euro-dollar rate matches that of the actual euro-dollar rate. We follow Ausloos and Ivanova [1] and insert artificial data points wherever needed to cope with the problem of different official, national, and bank holidays, when banks are closed and official exchange rates are not defined in a country.

Figure 1 shows that the pound-dollar rate and the false euro-dollar rate are indeed correlated. The linear correlation coefficient is of 0.875. This is in line with Ivanova and Ausloos [6]' claim. But this finding seems to be related to first-moment correlation between the exchange rates. Yet Figure 1 suggests that we can go beyond this. If we link points, we are able to realize that the path changes direction and loops around. Thus second-moment correlation might play a role. This might be long-range correlation that can be tracked by Hurst exponents. Next section will consider these in connection with the analysis of efficiency. We will find that, in this respect, the exchange rates are not the same.

3. Efficiency

The Hurst exponent [3, 4, 5] is related to how the value of a stochastic variable moves away from its initial position. A Hurst exponent of 1/2 provides an indication of a random walk even if a series is not normally distributed, whereas a value of between 1/2 and 1 suggests a persistent, trend-reinforcing series. And a value short of 1/2 means that past trends tend to reverse in future. Generally Hurst exponent's values departing from 1/2 means that data points are not independent, regardless of Gaussianity. Here a data point conveys information from the precedent points. And this is not short- but long-range memory that can in theory last forever.

Table 2 shows that the average Hurst exponent (over time) for the false euro is of 0.603 (standard deviation of 0.063). And Table 3 shows that the normality hypothesis for the Hurst is rejected for the false euro. In turn, Table 4 shows that the average Hurst exponent for the pound is of 0.5762 (standard deviation of 0.085). And Table 5 shows that

the normality hypothesis is rejected for the pound as well. At first glance all this suggests that there are slight departures from efficiency for both exchange rates.

Hurst exponents are usually calculated by rescaled range (R/S) analysis. Yet R/S analysis has been criticized for not properly distinguishing between short- and long-range memory [7]. Suggested modifications [7], however, bias against the hypothesis of long-range dependence [8, 9]. A recent alternative is for the Hurst exponents calculated by R/S analysis to be filtered by an AR(1)–GARCH(1,1) process [2]. We adopt such a procedure in here.

We focus on time windows (subsets of the entire time series) of 1008 data points each (four-year size), as in Cajueiro and Tabak [2]. We filter the first time window with an AR(1)–GARCH(1,1) model, and then reckon the Hurst exponent using R/S analysis for the standardized residuals. We then move over to the next time window, which is built by discarding the first element of the previous one and inserting (at the end of the window) the subsequent point from the whole time series. This routine is repeated successively.

Hurst exponents over time can be used to evaluate whether a series is getting more or less efficient [2]. After all, long-range correlations are at odds with random walks and the efficient market hypothesis. Calculations of the Hurst over time should in addition be accompanied by histograms of the exponent plots. If these are normally distributed, exponent variations could be ascribed to measurement errors.

Figures 2 and 3 show that while the pound-dollar exchange rate is getting more efficient as time goes by, the false (and actual) euro is not evolving toward efficiency. What is more, the pound's recent departure from its efficient trend (if permanent) coincides with the introduction of the euro itself. (Vertical bars in Figures 2 and 3 indicate the date of launching of the euro.)

We check the cross correlations between returns of the pound and the false euro as well as their Hurst exponents'. The greatest correlation between returns (0.42) is found between the pound at time period t and the false euro at $t - 23$. The remaining cross correlations stand short of 0.08 or are practically zero. As for the cross correlation between Hurst exponents, we find the greatest one (0.29331) between the Hurst of the pound at t and the Hurst of the false euro at $t - 21$. All this suggests that the pound does respond to false euro movements with a lag of one trading month. And thus it makes sense our interpretation that the launching of the euro may have driven the pound away from its road to efficiency.

4. Conclusion

We assess how the dollar prices of the pound and a false euro are evolving in time, as far as financial efficiency is concerned. Using Hurst exponents over time, we find that while the pound is becoming more efficient as time goes by, the false (and actual) euro is not approaching efficiency. And we also find that the pound's recent departure from its efficient trend (if permanent) coincides with the introduction of the euro itself. We think this strengthens the case for Britain to delay the euro's E-Day.

Despite the fact that the pound-dollar and false euro-dollar rates are indeed correlated (Ivanova and Ausloos' claim), this finding seems to be related to first-moment correlation only. As we take second-moment correlation into account and calculate Hurst exponents to evaluating efficiency, we find that the two currencies are moving apart.

We thus provide a counterexample for the proposition that the euro and the pound are in practice the same currency. As for efficiency, evidence of distinct behavior is clear-cut.

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Table 1 Euro conversion rates as in 31 December 1998

Currency	**1 euro =**
Austrian schilling	13.7603
Belgian franc	40.3399
Finnish markka	5.94573
Deutschemark	1.95583
French franc	6.55957
Irish pound	0.787564
Italian lira	1936.27
Luxembourg franc	40.3399
Dutch guilder	2.20371
Portuguese escudo	200.482
Spanish peseta	166.386

Table 2 False Euro-Dollar Rate: Statistics for the Hurst Exponents Over Time

Moments			
N	7065	Sum Weights	7065
Mean	0.60168322	Sum Observations	4250.89197
Std Deviation	0.06305779	Variance	0.00397628
Skewness	-0.2124829	Kurtosis	0.34232464
Uncorrected SS	2585.77885	Corrected SS	28.0884767
Coeff Variation	10.4802308	Std Error Mean	0.00075021

Table 3 False Euro-Dollar Rate: Goodness-of-Fit Tests for Normal Distribution of the Hurst Exponents Over Time

Test	---Statistic----		-----p Value-----	
Kolmogorov-Smirnov	D	0.0304151	Pr > D	<0.010
Cramer-von Mises	W-Sq	1.9716524	Pr > W-Sq	<0.005
Anderson-Darling	A-Sq	11.7103875	Pr > A-Sq	<0.005

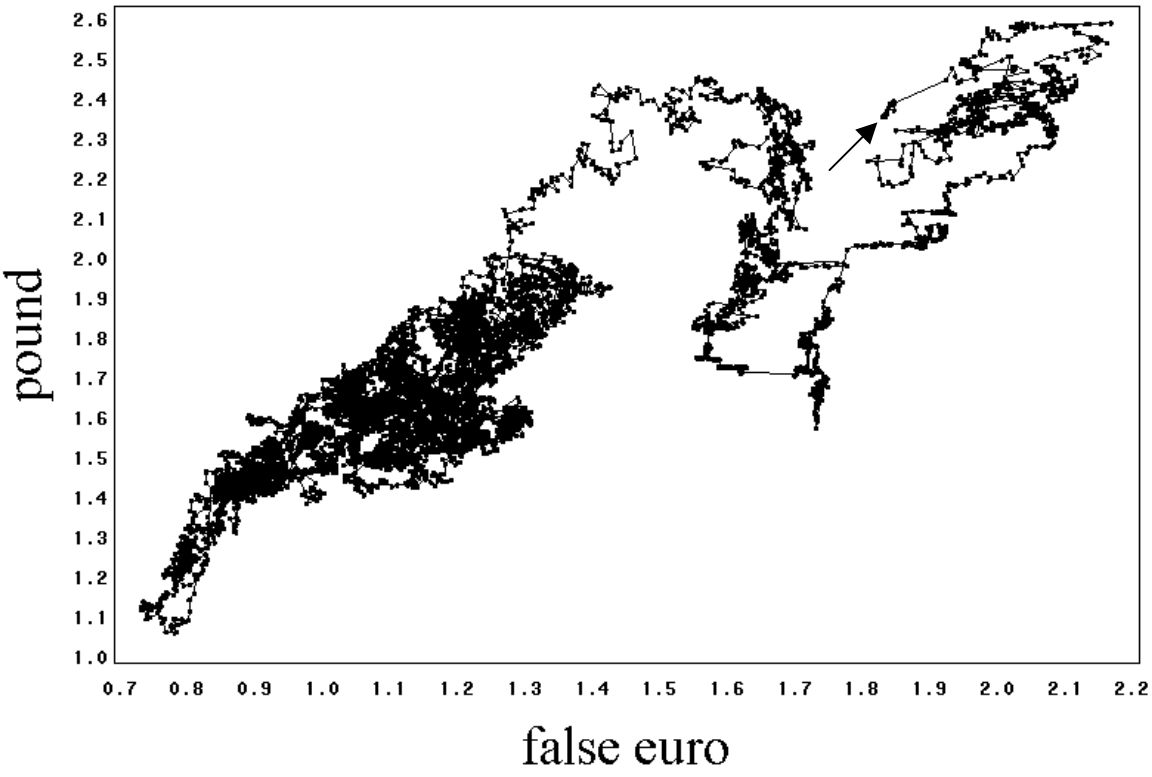
Table 4 Pound-Dollar Rate: Statistics for the Hurst Exponents Over Time

Moments			
N	7065	Sum Weights	7065
Mean	0.57230393	Sum Observations	4043.32729
Std Deviation	0.0857316	Variance	0.00734991
Skewness	0.63011846	Kurtosis	0.40037903
Uncorrected SS	2365.93186	Corrected SS	51.91974
Coeff Variation	14.9800816	Std Error Mean	0.00101996

Table 5 Pound-Dollar Rate: Goodness-of-Fit Tests for Normal Distribution of the Hurst Exponents Over Time

Test	---Statistic----		-----p Value-----	
Kolmogorov-Smirnov	D	0.0747199	Pr > D	<0.010
Cramer-von Mises	W-Sq	9.3463101	Pr > W-Sq	<0.005
Anderson-Darling	A-Sq	57.9638150	Pr > A-Sq	<0.005

Figure 1 Pound-Dollar and False Euro-Dollar Correlation



Note
The arrow indicates the starting point at 2 January 1973, and the continuous line links consecutive points.

Figure 2 False Euro-Dollar Rate: Hurst Exponents Over Time

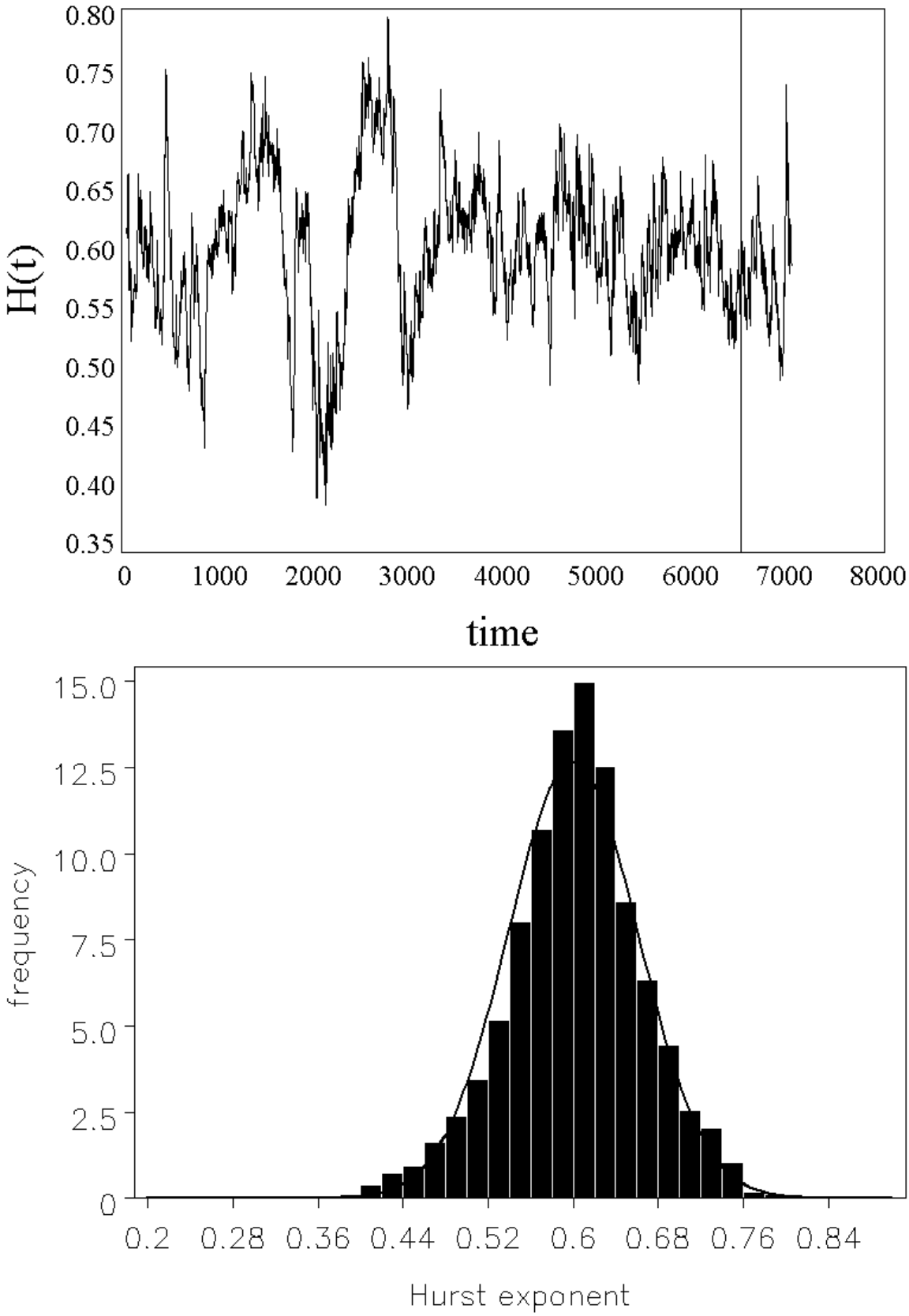
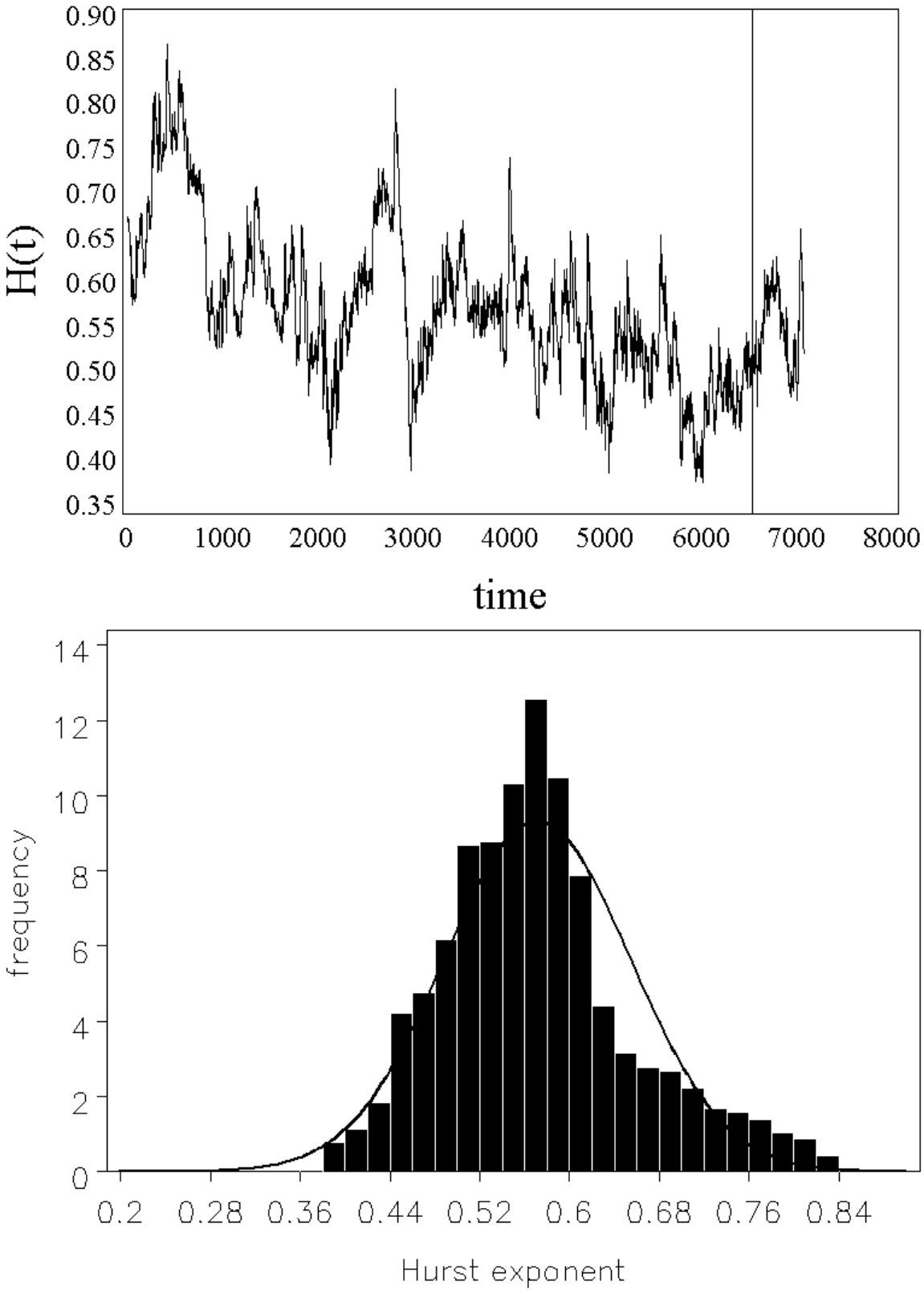


Figure 3 Pound-Dollar Rate: Hurst Exponents Over Time



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