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An Investigation into Forex Market Efficiency Based on Detrended Fluctuation Analysis

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Abstract

The efficient market hypothesis states that asset prices fully reflect all available information. As a result, speculators cannot predict the future behaviour of asset prices and earn excess profits at least after adjusting for risk. Although initial tests of the EMH were performed on stock market data, the EMH was soon applied to other markets including foreign exchange (FX). This study uses the detrended fluctuation analysis technique to test forex rate time series data to see if it can be explained by the weak form of the EMH. Moreover, to determine changes in the degree of inefficiency over time. Countless theories have been developed by both researchers and financial analyst in an attempt to explain the fluctuation of forex price. By obtaining an intimate understanding of the forex market, traders will hopefully be able to forecast and react to forex price oscillations on-the-fly towards making a profitable investment. In this paper, an investigation into the underlying theory that there exist repeating patterns within the time series data which forms the basis of technical analysis is conducted. The assumption that certain patterns do develop over time and the forex market does not fluctuate in a random manner is used to establish the fact that history repeats itself in forex trading. The patterns and repetitions unveiled within the forex historical data would be an important element for forex forecasting. The findings suggest that profitable risk-adjusted trades could be made using past data.

Keywords: *Foreign Exchange, Forex Market, Detrended Fluctuation Analysis, Investigation into Forex Market*

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1. Introduction

A general notion about financial markets is that price manipulation is not possible when the market is very liquid. Instead, it is very easy to manipulate an illiquid market.

This means that the foreign exchange market, where $5 trillion worth of currencies is traded every day, is not susceptible to manipulation. Such preconceived notions were blown away when several banks (Bank of America, Barclays, Citigroup, HSBC, JPMorgan, RBS, and UBS AG) were fined billions of dollars by the US and European regulators for price rigging between the periods December 2007 and January 2013. So, a retail trader may certainly wish to know whether the Forex market can be manipulated presently? Additionally, if the currency market can be manipulated, then how far will a retail trader be affected by the price manipulation? This guide will try to answer these questions.

Of $5 trillion total daily volume, about half is traded by the large banks. Nearly 80% of that volume is contributed by the ten biggest banks. For example, in 2017, Citi topped the list of major players in the interbank FX market with a share of 10.7%. JP Morgan followed closely with a market share of 10.3%. So, on any given day, we can expect Citi and JP Morgan to trade $500 billion worth of currencies. If both banks open opposite positions in a counter, then the net movement will be dependent on the positions taken by the rest of the big players. However, if the top players collude and place order in the same direction, then the market can be manipulated. This is what precisely happened between 2007 and 2013.

Big banks take fix orders from their clients (usually large multi-national corporations). Before we go further into this, let us explain what a fix means in the foreign exchange market. It is the reference or benchmark rate used by Forex dealers, multinational companies, and central banks to evaluate the behavior of a currency. It enables big companies and other market participants to assess their business or portfolio risk.

The fix is set based on two timed benchmark rates. The first one is the European Central Bank fix, which occurs every day at 14:15 CET. The second one is the World Markets/Reuters fix, which occurs every day at 16:00 UTC. During fix, the exchange rate is frozen. Until recently, the fix was based on currency deals that took place in a window 30 seconds before and 30 seconds after the designated time. This was used as the benchmark rate until the next day for various business activities.

When a bank executes a trade below (or above) the fix order (a large buy or sell order placed at fix rate) placed by a client, then the difference between the fix rate and the rate at which the order is completed will be pocketed as profit. So, there is a benefit if a bank can manipulate the fix rate. Imagine pushing the price upwards or downwards half-an-hour before the start of the fixing window. This would create a false impression among companies about the actual demand and supply. The banks can capitalize by selling to the client at a higher rate and buying the currency later at a lower rate from the market.

2. Foreign exchange market

The foreign exchange market (Forex, FX, or currency market) is a global decentralized or over-the-counter (OTC) market for the trading of currencies. This

market determines foreign exchange rates for every currency. It includes all aspects of buying, selling and exchanging currencies at current or determined prices. In terms of trading volume, it is by far the largest market in the world, followed by the credit market.

The main participants in this market are the larger international banks. Financial centres around the world function as anchors of trading between a wide range of multiple types of buyers and sellers around the clock, with the exception of weekends. Since currencies are always traded in pairs, the foreign exchange market does not set a currency's absolute value but rather determines its relative value by setting the market price of one currency if paid for with another. Ex: US$1 is worth X CAD, or CHF, or JPY, etc.

The foreign exchange market works through financial institutions and operates on several levels. Behind the scenes, banks turn to a smaller number of financial firms known as "dealers", who are involved in large quantities of foreign exchange trading. Most foreign exchange dealers are banks, so this behind-the-scenes market is sometimes called the "interbank market" (although a few insurance companies and other kinds of financial firms are involved). Trades between foreign exchange dealers can be very large, involving hundreds of millions of dollars. Because of the sovereignty issue when involving two currencies, Forex has little (if any) supervisory entity regulating its actions, see Figure 1.

Figure 1 Forex Market

The foreign exchange market assists international trade and investments by enabling currency conversion. For example, it permits a business in the United States to import goods from European Union member states, especially Eurozone members, and pay Euros, even though its income is in United States dollars. It also supports direct speculation and evaluation relative to the value of currencies and the carry trade speculation, based on the differential interest rate between two currencies.

In a typical foreign exchange transaction, a party purchases some quantity of one currency by paying with some quantity of another currency.

The modern foreign exchange market began forming during the 1970s. This followed three decades of government restrictions on foreign exchange transactions under the Bretton Woods system of monetary management, which set out the rules for commercial and financial relations among the world's major industrial states after World War II. Countries gradually switched to floating exchange rates from the previous exchange rate regime, which remained fixed per the Bretton Woods system.

Forex is a real global marketplace, with buyers and sellers from all corners of the globe participating in trillions of dollars of trades each day. The fact that foreign exchange trading has become such a global activity means that macroeconomic events everywhere play a greater role in forex than ever before. Traders don't have to stick to popular currencies anymore, but they are a good place to start. Below, we'll discuss some economic trends and events that will help those who are new to the market to become successful forex traders.

3. The foreign exchange market characteristics

The foreign exchange market is unique because of the following characteristics:

- Its huge trading volume, representing the largest asset class in the world leading to high liquidity;
- Its geographical dispersion;
- Its continuous operation: 24 hours a day except for weekends, i.e., trading from 22:00 gmt on sunday (sydney) until 22:00 gmt friday (new york);
- The variety of factors that affect exchange rates;
- The low margins of relative profit compared with other markets of fixed income; and
- The use of leverage to enhance profit and loss margins and with respect to account size.

As such, it has been referred to as the market closest to the ideal of perfect competition, notwithstanding currency intervention by central banks.

According to the Bank for International Settlements, the preliminary global results from the 2019 Triennial Central Bank Survey of Foreign Exchange and OTC Derivatives Markets Activity show that trading in foreign exchange markets averaged

$6.6 trillion per day in April 2019. This is up from $5.1 trillion in April 2016. Measured by value, foreign exchange swaps were traded more than any other instrument in April 2019, at $3.2 trillion per day, followed by spot trading at $2 trillion.

The $6.6 trillion break-down is as follows:

- $2 trillion in spot transactions
- $1 trillion in outright forwards
- $3.2 trillion in foreign exchange swaps
- $108 billion currency swaps
- $294 billion in options and other products.

4. Forex market manipulation

4.1 Manipulation by brokers

A retail trader places orders with the hope that the Forex broker, who acts as a market maker, really offers a competitive bid/ask quote. A scam broker would often widen the spread and create artificial spikes so that a trader loses capital quickly. For a trader, who totally depends on the broker's price feed, this would look as price tampering done by big players in the Forex market. This kind of manipulation is often seen in the currency market. It is quite easy for a retail broker to alter the price feed provided to clients.

By manipulating the price feed, a scam Forex broker will also resort to stop hunting. A scam broker will tune its software to create spikes near major support and resistance levels irrespective of what happens in the actual market. A trader who has placed a stop-loss order above (or below) a resistance (or support) level will be forced out of the trade when it should not be the case. Shady brokers often indulge in such price manipulation to rip away innocent traders.

4.2 Manipulation by central banks

The exchange rate of a currency reflects the economic stability of a country. A stable and strong exchange rate is generally preferred by investors across the globe. However, there may be situations where the exchange rate becomes too strong or weak according to the assessment made by the country's central bank. An extremely strong currency would affect exports and encourage imports, thereby leading to a trade deficit. Likewise, an extremely weak currency would increase the cost of imported goods, which may include raw materials as well. This would weaken the economy further. Therefore, in order to bring the exchange rate of a currency to a desired level, central banks manipulate the currencies by three ways. If the deviation is only small, strongly worded statements would shift the market's sentiment towards the currency in favor of the central bank's expectation. If that does not work out, then central bank's usually hike or lower the prevailing interest rates.

A currency becomes more attractive to investors when there is a hike in interest rates and vice versa. Therefore, a hike in interest rates generally propels the exchange rate of a currency upwards. The value of a currency falls when a central bank slashes the benchmark interest rates. If these two methods do not work, then central banks intervene in the market and bring the exchange rate of a currency to the desired level. However, this would work only when there is economic stability in the country. The central bank of a country with a strong economy will have practically unlimited financial strength.

The Swiss National Bank is a classic example of this case. The Swiss National Bank held the exchange rate of the franc against the euro at or below 1.20 for a period of over three years ended 2015. Having failed to weaken the exchange rates through the implementation of negative interest rates, the SNB actively intervenes in the market to ensure the franc does not strengthen further. In such cases, a retail trader should avoid trading against the objective of the bank as it would end in a loss. If the economy is not strong, then the central bank will not be able to manipulate the currency as its buying power will be very much limited.

4.3 Solutions

To prevent manipulation of the fix rates, the window time has already been increased to five minutes. This makes it difficult for even big players to manipulate the market. Region wise, central banks in some countries have started using a different methodology to arrive at reference rates for the domestic currency. For example, in India, the exchange rate for US dollar against Indian rupee is polled from the select list of contributing banks at a randomly chosen five-minute window between 11:30 and 12:30 IST every weekday (excluding bank holidays in Mumbai). The new system came into existence from 2014. China has also changed the manner in which the yuan's exchange rate is calculated. Therefore, manipulating the fix rate is no longer attractive, compared to the risk. The entire process of manipulating the fix rate was done in a confident manner because banks shared their order book with each other. If a huge order, which offsets the order placed by banks, is executed by a large individual trader or institution, then the whole plan will break apart quickly. Since the time window for calculating the fix rate has been increased, banks will be extremely hesitant to venture into such activities again.

We should also remember that banks changed the exchange rate of a currency pair by about 30 pips during the period of manipulation discussed here. So, a retail trader who is playing by the book will hardly lose anything. Since banks trade hundreds of millions of dollars, such a small difference in fix rate would make a huge difference in their net profits.

The manipulation done by brokers can be avoided by doing adequate background checks before opening a trading account. Furthermore, to avoid dealing with a Forex broker who is involved in stop hunting, a trader can use multiple demo accounts to compare exchange rates quoted during volatile hours or when major economic data is released. This would enable a trader to assess the Forex broker and also understand the

spread offered. To judge a broker, traders can also compare the price shown by the company's terminal with the price feed of Reuters and Bloomberg.

5. Forex probe and investigation

The forex scandal (also known as the forex probe) is a 2013 financial scandal that involves the revelation, and subsequent investigation, that banks colluded for at least a decade to manipulate exchange rates on the forex market for their own financial gain. Market regulators in Asia, Switzerland, the United Kingdom, and the United States began to investigate the $4.7 trillion per day foreign exchange market (forex) after Bloomberg News reported in June 2013 that currency dealers said they had been front-running client orders and rigging the foreign exchange benchmark WM/Reuters rates by colluding with counterparts and pushing through trades before and during the 60-second windows when the benchmark rates are set. The behaviour occurred daily in the spot foreign-exchange market and went on for at least a decade according to currency traders [1].

At the centre of the investigation were the transcripts of electronic chatrooms in which senior currency traders discussed with their competitors at other banks the types and volume of the trades they planned to place. The chatrooms had names such as "The Cartel", "The Bandits' Club", "One Team, One Dream" and "The Mafia".[5][6][7] The discussions in the chatrooms were interspersed with jokes about manipulating the forex market and repeated references to alcohol, drugs, and women.[8] Regulators were particularly focusing in on one small exclusive chatroom which was variously called The Cartel or The Mafia. The chatroom was used by some of the most influential traders in London and membership in the chatroom was highly sought after. Among The Cartel's members were Richard Usher, a former Royal Bank of Scotland (RBS) senior trader who went to JPMorgan as head of spot foreign exchange trading in 2010, Rohan Ramchandani, Citigroup's head of European spot trading, Matt Gardiner, who joined Standard Chartered after working at UBS and Barclays, and Chris Ashton, head of voice spot trading at Barclays. Two of these senior traders, Richard Usher and Rohan Ramchandani, were members of the 13-member Bank of England Joint Standing Committee's chief dealers' group.[9]

At least 15 banks including Barclays, HSBC, and Goldman Sachs disclosed investigations by regulators. Barclays, Citigroup, and JPMorgan Chase all suspended or placed on leave senior currency traders. Deutsche Bank, continental Europe's largest lender, was also cooperating with requests for information from regulators.[9][10] Barclays, Citigroup, Deutsche Bank, HSBC, JPMorgan Chase, Lloyds, RBS, Standard Chartered, UBS and the Bank of England as of June 2014 had suspended, placed on leave, or fired some 40 forex employees.[7][11][12][13] Citigroup had also fired its head of European spot foreign exchange trading, Rohan Ramchandani.[14] Reuters reported hundreds of traders around the world could be implicated in the scandal.[15].

On 12 November 2014, the United Kingdom's Financial Conduct Authority (FCA) imposed fines totaling $1.7 billion on five banks for failing to control business practices

in their G10 spot foreign exchange trading operations, specifically: Citibank $358 million, HSBC $343 million, JPMorgan $352 million, RBS $344 million and UBS $371 million. The FCA determined that between 1 January 2008 and 15 October 2013 the five banks failed to manage risks around client confidentiality, conflict of interest, and trading conduct. The banks used confidential customer order information to collude with other banks to manipulate the G10 foreign exchange currency rates and profit illegally at the expense of their customers and the market.[20], see Table 1. On the same day the United States Commodity Futures Trading Commission (CFTC) in coordination with the FCA imposed collective fines of $1.4 billion against the same five banks for attempted manipulation of, and for aiding and abetting other banks' attempts to manipulate, global foreign exchange benchmark rates to benefit the positions of certain traders. The CFTC specifically fined: $310 million each for Citibank and JPMorgan, $290 million each for RBS and UBS, and $275 million for HSBC.[27].

Bank	CFTC[18]	DFS	DOJ[19]	FCA[20]	Fed[21]	FINMA[22]	OCC[23]	Total
Barclays[24][25][26]	400	635	650	441	342			**2,468**
BofA					205		250	**455**
Citibank	310		925	358	342		350	**2,285**
HSBC	275			343				**618**
JPMorgan	310		550	352	342		350	**1,904**
RBS	290		395	344	274			**1,303**
UBS	290			371	342	145		**1,148**
Total	**1,875**	**635**	**2,520**	**2,209**	**1,847**	**145**	**950**	**10,181**

Table 1: Fines imposed by UK, US, and Swiss authorities in Forex Scandal (US$ millions)

The CFTC found that currency traders at the five banks coordinated their trading with traders at other banks in order to manipulate the foreign exchange benchmark rates, including the 16:00 WM/Reuters rates. Currency traders at the banks used private chatrooms to communicate and plan their attempts to manipulate the foreign exchange benchmark rates. In these chatrooms, traders at the banks disclosed confidential customer order information and trading positions, changed trading positions to accommodate the interests of the collective group, and agreed on trading strategies as part of an effort by the group to manipulate different foreign exchange benchmark rates. These chatrooms were often exclusive and invitation only.[27]

On 20 May 2015, the five banks pleaded guilty to felony charges by the United States Department of Justice and agreed to pay fines totaling more than $5.7 billion. Four of the banks, including Barclays, Citigroup, JP Morgan, and Royal Bank of Scotland pleaded guilty to manipulation of the foreign markets; while the others had already been fined in settlements from the November 2014 investigation, Barclays had not been involved and was fined $2.4 billion. UBS also pleaded guilty to committing wire fraud and agreed to a $203 million fine. A sixth bank, Bank of America, while not found guilty, agreed to a fine of $204 million for unsafe practices in foreign markets.[28][29]

On 18 November 2015 Barclays was fined an additional $150m for automated electronic foreign exchange misconduct.[26]

As of November 2014, respective authorities announced remediation programmes aimed at repairing trust in their banking systems and the wider foreign exchange market place. In the United Kingdom, the FCA has stated that the changes to be made at each firm will depend on a number of factors, including the size of the firm, its market share, impact, remedial work already undertaken, and the role the firm plays in the market.[20] The remediation programme was to require firms to review their IT systems in relation to their spot FX business, as the banks relied on legacy technologies that allow for the existence of dark-data silos within which manipulation is able to occur unnoticed by compliance systems.[32]

In Switzerland, the Swiss Financial Market Supervisory Authority announced in December 2014, that for a period of two years UBS would be limited to a maximum annual variable compensation to 200% of the basic salary for foreign exchange and precious metals employees globally. UBS was instructed to automate at least 95% of its global foreign exchange trading, while effective measures must be taken to manage conflicts of interest with a particular focus on organisational separation of client and proprietary trading.[33]

As of May 2015, the window in which the daily 4pm fix is calculated was extended to five minutes as recommended by the Financial Stability Board, a watchdog advising the G20 finance ministers and the Bank for International Settlements tried to get banks to agree a unified code of conduct [34].

6. Detrended fluctuation analysis

In stochastic processes, chaos theory and time series analysis, detrended fluctuation analysis (DFA) is a method for determining the statistical self-affinity of a signal. It is useful for analysing time series that appear to be long-memory processes (diverging correlation time, e.g., power-law decaying autocorrelation function) or 1/f noise.

The obtained exponent is similar to the Hurst exponent, except that DFA may also be applied to signals whose underlying statistics (such as mean and variance) or dynamics are non-stationary (changing with time). It is related to measures based upon spectral techniques such as autocorrelation and Fourier transform.

Peng et al. introduced DFA in 1994 in a paper that has been cited over 3,000 times as of 2022[35] and represents an extension of the (ordinary) fluctuation analysis (FA), which is affected by non-stationarities, see Figure 2.

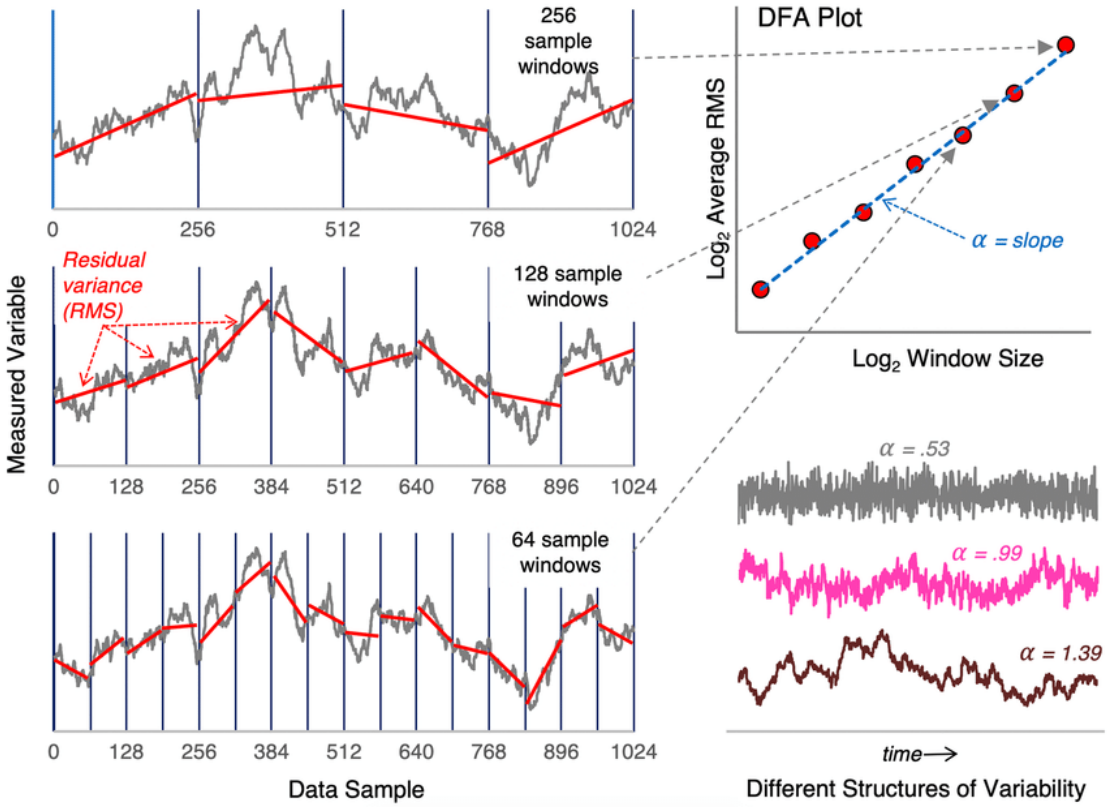

Figure 2 Detrended Fluctuation Analysis (DFA) and example

Illustration of Detrended Fluctuation Analysis (DFA) and example behavioural time series with different structures of variability. DFA determines the degree of random or persistent (deterministic) structure within a behavioural time series from the slope, α (alpha), of a log-log plot of the average residual variance (root mean-square; RMS) as a function of the window size used to calculate the residual variance estimates. The bottom right time series are representative examples of white (random), pink (fractal, long-range correlated, slightly persistent), and brown (highly persistent) structures of variability.

7. Forex trading using detrended fluctuation analysis

We define a currency index CIa for the currency a as an average out of cumulative log-returns for all exchange rates that have a as a base currency.

The CIa could be cast in the following form [36]:

$$CI_a(t) = 1 + \frac{1}{N-1} \sum_{b \neq a} r(b/a, t),$$

The currency index given by Eq. indicates performance of any given currency in terms of exchange rates to other currencies in our data sets. With such a single averaged characteristic, one may have a general overview of a global temporal behaviour and performance of any currency in the Forex market.

In Figure 3 [37], currency indexes time variation is shown for all the currencies in our data set for the considered period 2010–2018. For this plot, we take logarithmic returns arising from average bid and ask exchange rates. In the figure, we have indicated some political or economic events on the timescale (with dotted vertical line) which in principle could have impact on the Forex market performance during that period of time. These labels may serve as an intuitive explanation of features observed on the curves related to the currency indexes. We have included some sudden events: the US stock market flash crash on May 6, 2010, Fukushima Daiichi (Japan) nuclear disaster unfolding during several days in the aftermath of the earthquake which took place on March 11, 2011, the Swiss National Bank (SNB) interventions (on September 6, 2011, and January 15, 2015), the US futures flash crash on August 24, 2015, the Brexit referendum on June 23, 2016, GBP pound sterling's flash crash on October 7, 2016, (GBP/USD exchange rate briefly dropped overnight by 6 per cent), the US Presidential elections (on November 9, 2016) and the general elections in the UK (on January 8, 2017), and increase in overnight rate target to 1 per cent by the Bank of Canada (on September 6, 2017) [38].

In general, one observes significant variations of considered currency indexes over the period of 8 years. Worth noting in this timeline are Swiss National Bank (SNB) interventions in 2011 and in 2015 as well as the Brexit referendum in 2016. In the following, we will explore in some more detail's statistical properties of the Forex market data in the vicinity of these events. We will discuss to what extent our proposed statistical analysis corroborates these features, when looking from the hindsight with the help of historical data from the Forex market.

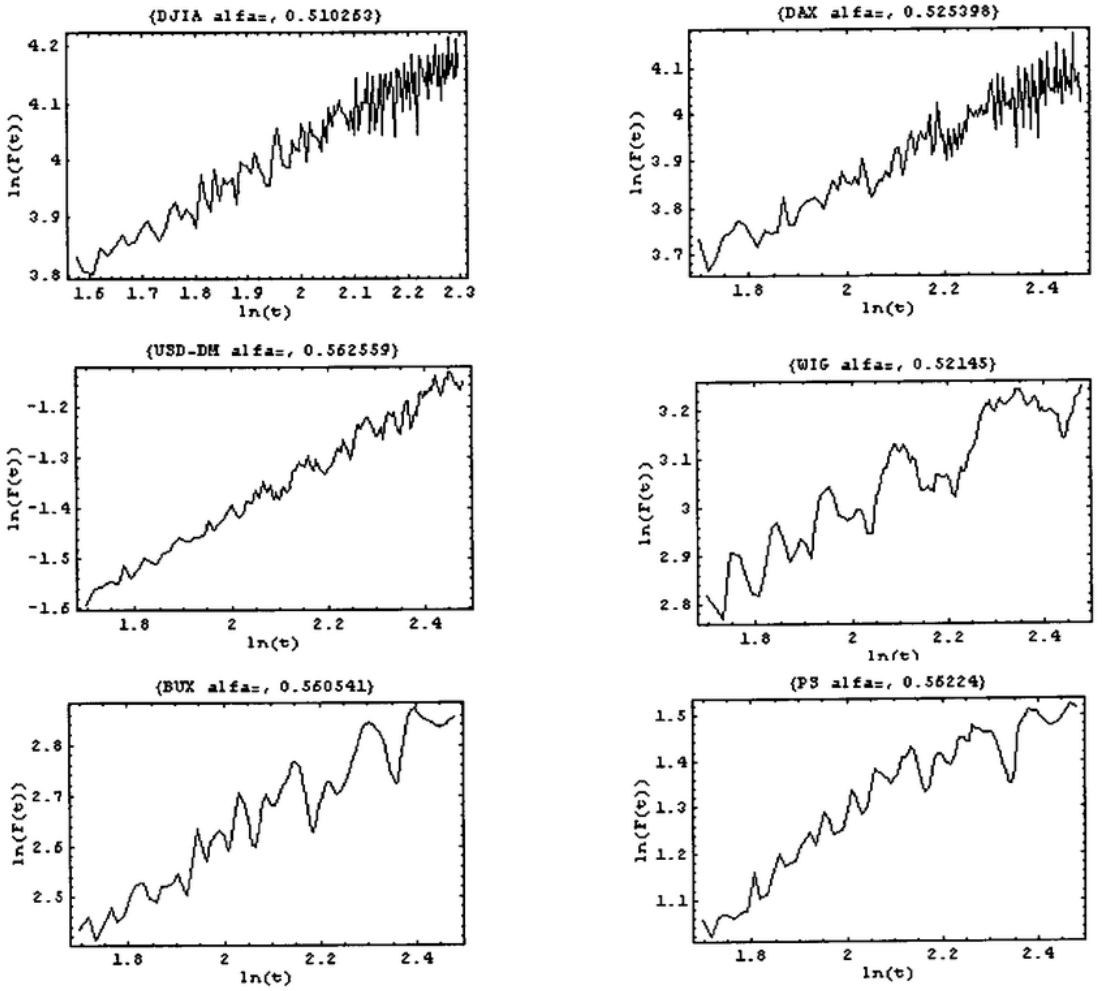

Figure 3 Illustration of Detrended Fluctuation Analysis (DFA) in Forex Market as Example

As a more quantitative extension of this analysis, we consider therefore some examples of the detrended cross-correlation q-coefficient ρq(s) results for exchange rate series. Two examples of the cross-correlation between two series of returns for exchange rates are shown in Figure 4: the top panel presents a pair of EUR/JPY and GBP/JPY, whereas the bottom panel illustrates the results of ρq(s) for EUR/JPY and GBP/USD.

From the data shown in Figure 4, it follows that the return rates for exchange rates EUR/JPY are markedly more correlated with the returns for exchange rates GBP/JPY than with the GBP/USD rate. This seems to be expected as in the former case there is a common (base) currency (JPY). In such a way, a pair of returns is intrinsically correlated by JPY currency performance due to the triangular constraint in the exchange rates. This is an example of cross-correlations among 3 currencies. In this case, the cross-correlations are in the triangular relation (the top panel of Figure 4) [39]. In the

case shown in the bottom panel of Figure 4 illustrating a pair of returns for exchange rates EUR/JPY vs GBP/USD which includes 4 different currencies, there is no triangular relation among them.

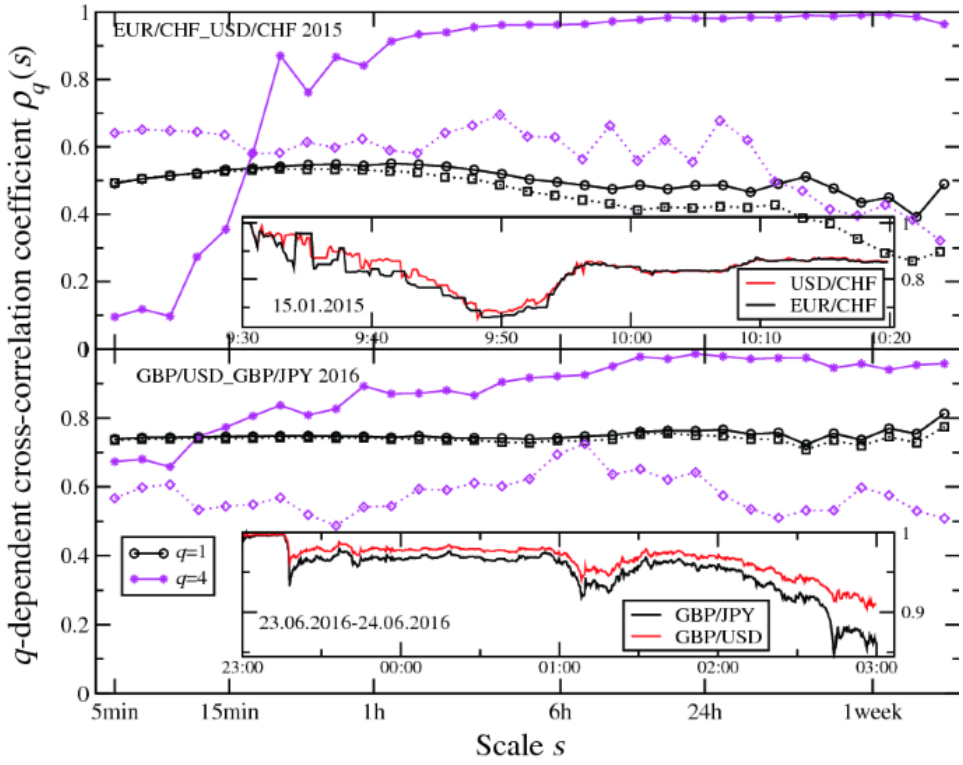

Figure 4 A Pair of Returns for Exchange Rates EUR/JPY Vs GBP/USD

However, for both pairs of exchange rates (one of them pertains to the triangular relation, whereas the other one does not in the shown example) we observe that the larger size fluctuations are considered (the greater q value is taken), the smaller cross-correlation in terms of the detrended cross-correlation q-coefficient ρq(s) is observed over the timescale considered [40]. The magnitude of this cross-correlation measure is weakly dependent on the timescale and only slightly grows with time. Its growth is more pronounced for larger fluctuations (cf. data for q=4) than this is the case for smaller fluctuations (cf. q=1).

Let us investigate in some more detail the cross-correlations between relatively small and large fluctuations of two exchange rate return series. The results for all ρq(s) cross-correlations (378 pairs in total) over the whole period 2010–2018 in the case of q=1 and q=4 averaged over all scales s are shown in Fig. 5. Note that the cross-correlation pairs are grouped into two classes. One class of exchange rate pairs (in black, left top and bottom panels) which pertain to the triangular relation and the second class, where cross-correlated pairs are outside the triangular relation (in red, right top and bottom

panels). On the top-left (in black) and top-right (in red) panels, the results for ρq(s) with q=1 are sorted in decreasing order. This ordering is unchanged for the purpose of the presentation of results with q=4.

This gives an idea about the range of obtained values of cross-correlation coefficient distributions for the currency pairs which are in or out the triangular relation. One can easily verify that at the level of smaller fluctuations (q=1) many pairs of logarithmic exchange rate returns, which are not linked by the triangular relation, could have a higher averaged cross-correlation coefficient than many pairs which have such property [41]. The black dotted horizontal line on the top-left panel shows the average cross-correlation of different pairs pertaining to the triangular relation. The value of that overall average is about 0.6.

Note that in the case of cross-correlations with no triangular relations between pairs of currencies including AUD and NZD we observe stronger correlations than in the case of pairs pertaining to the triangular relations (the top panel for q=1). It indicates a possibility of observing stronger correlations in exchange rates among four currencies in comparison with what we would expect on average in the case of exchange rates linked with the triangular relations. This somewhat unexpected result could be ascribed to mechanisms coupling economies of these two countries, see Figure 5 [42].

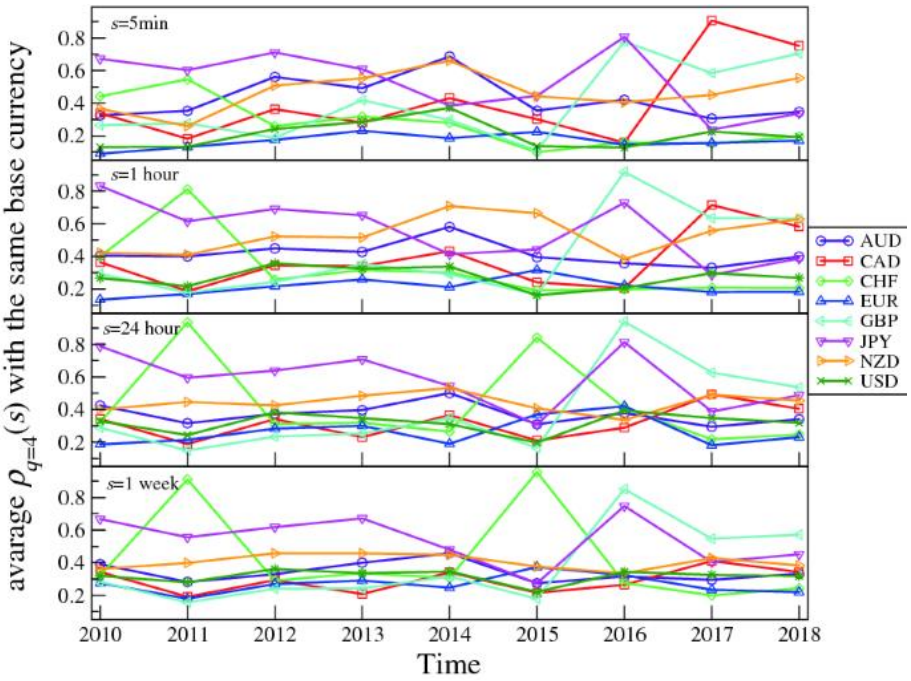

Figure 5 Detecting correlations and triangular arbitrage opportunities in the Forex by means of multifractal detrended cross-correlations analysis

Hence, from our study it follows that indeed some cross-correlations of the pairs, which are not linked by a common currency and are traded on the Forex market, may reach that overall average cross-correlation of exchange rates with a common base. This

seems to be a surprising conclusion, since typically we would expect stronger correlations between explicitly correlated two series (by means of a common, base currency) rather than in a case where there is no such common base [43]-[49]. However, we have to appreciate the fact that cross-correlations between any pair of exchange rates will have some impact on the cross-correlations of other pairs through mutual connections arising from different combinations of currencies being exchanged.

8. Conclusion

Big banks still have the capability to manipulate the foreign exchange market. However, the net impact on the exchange rate will be a matter of only 20-30 pips. Furthermore, regulators have plugged most of the loopholes to avoid a repeat of such incidents. Top banks have realized that they can no longer afford such misadventures. So, retail traders have nothing to worry about it. However, selecting a proper Forex broker is a must to avoid price manipulation that may cost dearly soon.

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