THE ROLE OF TECHNICAL ANALYSIS IN THE FOREIGN EXCHANGE MARKET

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ABSTRACT

This paper provides evidence that currency spot prices are autocorrelated, which indicates that technical analysis in foreign exchange trading can and should take a leading role for analyzing expected exchange rate movements. The Augmented Dickey-Fuller test was used to test the Random Walk Hypothesis on the USD/CHF exchange rate prices in a one minute frequency timeline for 10 randomly selected Fridays. Under the Extreme Values Method, calculations were based on the High-Low ask price spread and not on the volatility of closing prices. The main contribution of this paper is that new evidence is generated providing reasonable basis to discard the Efficient Markets Hypothesis in its weak form. The findings lead to embracing the Dow Theory, rather than the Random Walk approach, and conclude that markets are not efficient in their weak form.

JEL: F31; G14; G15

KEYWORDS: price range, volatility, Dow Theory, random walk, foreign exchange, weak form market efficiency

INTRODUCTION

Ever since prices have been put in graphic form, trends and patterns have been presented in a way that investors could more easily understand. When Charles H. Dow first published his theory, the big picture came into view, allowing traders to find sense in a seemingly senseless Wall Street market. During the first half of the 20th century, Dow Theory became a well known set of rules for understanding market mechanics. Later, in the middle of the century, the Random Walk approach (Osborne, 1952; Fama, 1965) seemed a plausible explanation to the frustration of speculators who, counting on the charts, suffered mounting losses at the hands of a market that did not seem to follow the rules. The Efficient Markets Hypothesis (Fama, 1970) followed as a manner of justifying that no one can systematically obtain abnormal returns, and thus beat the market. Much research effort went into developing and reinforcing the view that any attempt to beat the market would be unsuccessful due to a high level of market efficiency, erasing any opportunity to win in a systematic manner.

There may not be solid ground, though, to build such thinking. If it can be shown that markets are predictable, with a repeating pattern or continuous trend that replicates itself with a certain frequency, then Dow Theory should not be discarded. Still, it is studied in such a way that new evidence may arise and new postulates may be settled. In this regard, new trading technologies that make high frequency graphing possible rely on the possibility to redefine our understanding of the cognitive-behavioral nature of a financial market. Due to a man-made common area, as well as the inclusion of the best of technology in operations performance, the foreign exchange market is, over all other financial markets, the best field to understand the express and disguised nature of market prices. The objective of this paper is to uncover the underlying essence hidden from academics and practiced by traders, even when traders themselves may not be able to explain it. Our conclusion in this sense is that price ranges are dependent between them. But neither academics nor practitioners seem to notice this phenomenon. Perhaps, the reason is that advances in technology had been gradually penetrating the trading sphere delaying the revelation of the nature. However, the reason could be that the explanations of the Efficient Market Hypothesis still resound in many minds and a sense of fatalism surrounds the sector.

A Unit Root test was conducted to demonstrate dependence among price ranges. A *price range* is defined as the spread between the high and the low market ask price for a given currency pair in a given time frame. This model has been applied to a dataset of high frequency data, - minute based timeline - that consists of 10 randomly selected Fridays in the USD/CHF foreign exchange market. This research sought to demonstrate that market prices show dependence from one time period to the next. The paper is structured as follows. After the introduction a review of the relevant literature is provided. Section 3 focuses on the data employed and the methodology used. Section 4 provides a discussion of the results, and the paper concludes in section 5 with a summary.

LITERATURE REVIEW

Microstructure theory studies the mechanics of a financial free market (Flood, 1991). The meaning of spreads, the geographic location of exchange centers, the interaction between market makers and individual investors, and the seasonality of volatility, impact of news, trade volume, and transaction costs among other aspects are used to explain the functioning of the market. Within this theoretical framework, volatility behavior has been studied by Beillie and Bollerslev (1991), Bollerslev and Domowitz (1993), and Fang (2000), among others. These authors have uncovered evidence of seasonal patterns in volatility among different market locations, enlightening the understanding of global spot financial markets.

In a seminal paper, Beillie and Bollerslev (1991) identified high volatility levels during the opening of trading in the principal foreign exchange markets of Tokyo, London, and New York, with New York having the highest intraday volatility of the three. The reason is said to be the junction of the afternoon London session with the New York morning session. A lesser volatility is observed in the junction of the London morning and the Tokyo afternoon sessions. Volatility information is useful to traders because it provides a measure of activity, giving indications of both trading volume and trade frequency. According to the liquidity theory proffered by Admati and Pfleiderer (1989), traders tend to gather in the most liquid part of the session, and this is precisely the moment of the highest volatility. But even when they detect a statistically significant negative first order serial correlation, Beillie and Bollerslev concluded in their paper that their findings appear largely consistent with the efficient markets hypothesis.

Contrary to Beillie and Bollerslev, Longworth (1981) concluded that markets are not efficient. He used spot and forward rates for USD and Canadian dollars during the period from July of 1970 to October of 1976, and found that spot rates could be used as predictors of forward rates. He concluded that a speculator looking at economic variables during that time could have made extraordinary profits thorough trading the Canadian dollar.Extreme high-low spreads, rather than currency prices, give deeper insight to the speculative nature of financial markets when it comes to volatility measures (Parkinson, 1980). The variance is the distance of prices to their mean and gives a measure of volatility. Meanwhile, the High-Low price spread carries more information because it captures the extension of the price movement for any specific point in time. Parkinson shows that the extreme values method provides a much better estimate of a diffusion constant than does the traditional method. Little attention has been given to this aspect of price behavior in the foreign exchange markets. We state that the high-low price range provides better information than the price itself. The high-low price range explains the behavior of traders when it comes to watching the spot price in the charts.

Taylor and Allen (1992) report the use by traders of technical analysis as the best tool when trading currencies. They show that analysts rely on the fundamentals of the economy for the long run or overall picture, and utilize technical analysis for short-term trades and entry/exit signals. Levy (1966) shared the view that technical analysis serves as a supplement to fundamental analysis. He observed that technical analysis may be as good, or perhaps more satisfactory than fundamental analysis in supporting trading decisions. However, trading based solely on technical analysis entails a careful study and close watch on price charts. The high-low range carries more information than the daily closing price.

DATA AND METHODOLOGY

This paper uses intraday USD/CHF ask price ranges from the following randomly selected Fridays: January 9, 2009; September 4, 2009; November 13, 2009; February 19, 2010; April 8, 2010; June 25, 2010; August 20, 2010; October 15, 2010; December 10, 2010; and March 18, 2011. The intraday price ranges are defined as follows:

$$Price\ Range = High_{price} - Low_{Price} \quad (1)$$

Since the main scope in this paper is to test for the market efficiency hypothesis on the USD/CHF exchange rate, price ranges are transformed into serial differences as follows:

$$\Delta(Price\ range)_t = Price\ range_t - Price\ range_{t-1} \quad (2)$$

The descriptive statistics for the price ranges differences are shown in Table 1, in which can be observed from skewness that there have been more positive changes than negative ones within each Friday and across all Fridays selected. As a whole, price ranges can be described as a fat-tailed distribution time series which means the presence of extreme values explained by the stylized fact in financial time series as conditional volatility. Nevertheless, in some cases the kurtosis value is quite low as compared to the other dates. In turn the Jarque-Bera value for Normality test decreases significantly and would explain that in some cases price ranges first differences can be approximated by a Gaussian distribution.

Table 1: Descriptive statistics USD/CHF in price ranges differences.

	Jan 9, 2009	Sep 4, 2009	Nov 13, 2009	Feb 19, 2010	Apr 8, 2010	Jun 25, 2010	Aug 20, 2010	Oct 15, 2010	Dec 10, 2010	Mar 18, 2011
Mean	-0.004	-0.000	0.000	-0.002	0.000	-0.001	-0.002	-0.000	0.000	-0.001
Median	-0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.100
Maximum	44.8	17.3	7.1	35.9	6.8	18.1	12.3	21.2	7.6	28.7
Minimum	-20.6	-16.7	-6.5	-21.4	-8.0	-17.6	-12.3	-11.7	-5.7	-17.4
Std. Dev.	4.046	1.869	1.400	2.483	1.398	2.289	1.989	2.055	1.504	2.574
Skewness	1.299	0.346	-0.003	1.808	0.103	0.300	0.111	1.449	0.176	0.850
Kurtosis	17.54	20.26	5.94	39.14	5.88	11.10	8.26	22.16	4.75	20.97
Jarque-Bera	12441.46	17119.97	509.79	81827.91	497.69	3949.40	1660.02	22273.78	189.34	19483.90
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	-5.60	-0.40	0.20	-2.70	0.60	-1.10	-2.10	-0.30	0.50	-1.30
Sum Sq. Dev.	22374.46	4807.08	2775.16	9174.27	2804.42	7520.93	5677.35	6005.73	3220.05	9503.47
Observations	1368	1377	1416	1489	1437	1436	1436	1423	1425	1435

Descriptive statistics for the range price differences in USD/CHF for different randomly selected Fridays. The price range is given by ($High_{price}$ – Low_{price}) x 10,000 and the Price Range Differences are given by Δ(Price Range)$_t$ =Price Range$_t$ – Price Range$_{t-1}$.

The random walk model states that a change in the stock price from one period to another is completely random. The representation of the random walk hypothesis is described as

$$y_t = y_{t-1} + \varepsilon_t \quad (3)$$

Then it is supposed that $\Delta y_t = \varepsilon_t$ in such a way to accept the market efficiency hypothesis at least in its weak form. A variation of (3) relates to a random walk model with a deterministic component such as

$$y_t = y_{t-1} + a_0 + \varepsilon_t \quad (4)$$

Testing the market efficiency hypothesis is to testing for $a_1 = 1$ or the presence of a unit root as in the following model

$$y_t = a_1 y_{t-1} + \varepsilon_t \quad (5)$$

In this sense as described by Dickey and Fuller (1979), it should be the same to testing for $\gamma = 0$, where $\gamma = a_1 - 1$, in the following equations

$$\Delta y_t = \gamma y_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + \varepsilon_t \quad (8)$$

A generalized expression of (8) would be an autoregressive process as

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1}\, \varepsilon_t \quad (9)$$

This paper performs the Augmented Dickey-Fuller test on equation (9) to test for the presence of a unit root in USD/CHF price ranges; if it exists then it is not possible to reject for the random walk model and consequently not possible to reject the market efficiency hypothesis in its weak form.

RESULTS

Table 2 shows the Dickey-Fuller (DF) unit root test results based on equation (8), in which the coefficients' statistical values are compared with those of DF critical ones. Since the scope is to determine whether the exchange rate market is efficient or not on its weak form, attention is paid on the γ's coefficient value. Given the ten Fridays selected, it is observed that γ's statistical t-values are greater than the DF critical ones except for October 15, 2010.

Table 2: Unit Root Test

Friday	Jan 9, 2009	Sep 4, 2009	Nov 13, 2009	Feb 19, 2010	Apr 8, 2010	Jun 25, 2010	Aug 20, 2010	Oct 15, 2010	Dec 10, 2010	Mar 18, 2011
a_0	0.386	0.155	0.324	0.782	0.267	0.614	0.370	0.105	0.531	0.957
	(2.004)	(1.769)	(4.401)	(5.374)	(3.404)	(5.353)	(3.599)	(1.109)	(6.294)	(6.601)
a_2	0.0006	0.0003	0.0003	-0.0001	0.0001	0.0005	0.0001	0.0001	0.0001	-0.0002
	(2.461)	(2.394)	(3.552)	(-1.206)	(1.267)	(4.076)	(1.039)	(1.165)	(1.677)	(-1.137)
γ	-0.177 ***	-0.160 ***	-0.294 ***	-0.226 ***	-0.176***	-0.410 ***	-0.203 ***	-0.093 *	-0.324 ***	-0.318 ***
	(-6.014)	(-5.219)	(-7.435)	(-7.695)	(-4.551)	(-9.298)	(-6.187)	(-3.402)	(-9.633)	(-10.449)

Null Hypothesis: γ has a unit root, Dickey-Fuller Test critical values: 10% level -3.128485, 5% level -3.412976, 1% level -3.964516.

As the unit root null hypothesis states, $\gamma = a_1 - 1$, this one can be rejected for the ten Fridays selected at the given three confidence levels. The exception as stated above is observed in October 15, 2010 where the unit root null hypothesis cannot be rejected at 5% and 1%. Since γ is not rejected to be different from cero, then a_1 is different from the unit. Hence, the USD/CHF exchange rate process is not completely random in the statistical sense and the efficiency market hypothesis at least on its weak form can be rejected. Also, Table 2 shows the statistical significance of a trend (a_2) effect in the USD/CHF process. At the given confidence levels or DF critical values, in most of the cases the trend coefficient statistical t-values are less than those of the DF values meaning that there is no trend effect. The only two exceptions are in November 3, 2009 and June 25, 2010, where in the former the trend effect is not rejected at the 1% significance level and in the latter the trend effect cannot be rejected at any of the three confidence levels.

These results, however, do not lead to the assertion that a technical strategy will in fact generate abnormal results. This is up to the trader and not to the market. What we are saying is that the market is inherently inefficient at some level, and the trader will have to construct his or her own set of rules to find trades that take advantage of the fact. A successful trade may not be possible every day; there will be days with good opportunities and others without such opportunities. It may happen that a trading day brings good trading opportunities but the trader is unable to capture them.

CONCLUSION

The purpose of this research work was to provide new evidence as to accept or reject the Efficient Markets Hypothesis. Based on the foreign exchange market, ten randomly selected Fridays were used in a minute by minute timeline. A Unit Root test then was conducted in order to identify the autocorrelation of the price ranges. The principal contribution of this paper is that using the extreme value method we may stand for Dow Theory and defend Technical Analysis. Focusing attention on the high-low ask price spread rather than closing prices, a better information set is captured that may provide information on the nature of the foreign exchange market. In this sense, it is shown that price ranges have dependencies, reaffirming the use of chart observation in currency trading activity. Hence, Technical Analysis takes its prominent role in the foreign exchange market.Even when the results confirm an absence of efficiency, it must be considered that the tests were made on just one currency pair, that is, the Swiss Franc per US Dollar. Additionally, the tests were made on data collected in a different time frame. That is, data is collected in the 21st century when technology and the knowledge of the market is greater. Contrary to the stock market, where the efficient market hypothesis surged, this research relies in the foreign exchange market. Researchers must take these limitations into account.

These findings open a wide new field in financial markets research and challenge researchers to further develop historic tests employing price ranges rather than closing price quotes. Based on these results, the study of volatility should be further studied. In particular, a full market study of this phenomenon should be conducted to replicate the results of this study.

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