Effect of Interest, Moving Average, and Historical Volatility in Forecasting Exchange Prices of Major International Currencies

Marwan Mohammad Abu Orabi

Dept. of Finance and Business, The World Islamic Science University

E-mail: drmarwan1974@yahoo.com

Abdul Aziz F. AA. Saymeh

Dept. of Finance and Banking, Petra University

E-mail: Abdul_Aziz48@hotmail.com

Abstract

Forecasting foreign exchange prices drives the concerns of financial investors and occupies the minds of financial analysts as well. Most Current forecasting formulas used to employ individual financial factors, either fundamental or technical. The purpose of this study is to test the effect of combined financial factors in forecasting future exchange prices of world currencies. This study used one fundamental factor and two technical factors merged in one mathematical formula. Researchers have merged interest rate, historical volatility, and moving average in one formula. Empirical tests included correlation, Covariance tests to measure the magnitude of the linear relation between historical and computed exchange rates; F.Test aimed to show whether the two sets of historical and computed data have the same standard deviation at the specified confidence levels. Data included historical and computed sets of exchange prices of Swiss Franc, Sterling Pound, European Euro, and Japanese Yen against U.S.Dollar.Study period extended for ten years, i.e. 2000-2008.Results reflected high correlation and low covariance and accepted F.test; there were some biases due to extraneous factors which had affected the exchange rates for certain times during the testing period.

Keywords: Interest rate parity, Historical volatility, Exchange rates

JEL Classification Codes: E43, E52, G14, WP\07\03

1. Introduction

Until the recent past, foreign exchange markets were confined to meet the demands of exporters and importers of goods and services. But these markets have flourished and diversified to include financial and investment companies, as well as individuals. (Ewing &Ascarelli, 2000).

Many efforts were done to study the basis under which the future exchange rates of currencies can be forecasted. Several financial theories aimed to develop financial models to understand the movements of exchange rates and their vulnerability to financial and economic developments, as well as the behaviors of investors.(Brigham et al., 2002).Financial analysts and researchers are keen to develop financial models that will give more comprehensive explanations for the foreign exchange rates movements ;However, there are gaps between the actual market prices and forecasted rates resulting from the use of mathematical models. A room for improvement still exists through introducing multi- factor models. Models composed of technical and fundamental factors are becoming of interest to researchers. Given the importance of these factors, the purpose of this study is to test a mathematical model composed of interest rate, historical volatility, and moving average, combined, to forecast the future foreign exchange rates.

2. Literature Review

2.1 Emergence of Capital Markets (Historical Review)

The exchange of currencies goes back to the reign of Egyptian Pharaohs, i.e., more than five thousand years BC, where the traders in the Middle East used to exchange coins in ancient times. Since that time and until recently currency markets were stable and were not shrouded in any speculation to remember. In 1944, i.e. aftermath World War II an international agreement was reached to govern monetary policy among nations in Bretton Woods, USA, in which U.S.

dollar was pegged with gold at $ 35 per ounce, and most major global currencies were pegged with either gold or U.S. dollar; this agreement has made a bid to prevent any fluctuations in the prices of world major currencies. In 1971, The Bretton Woods system collapsed, partially due to economic expansion in excess of the gold standard's funding abilities on the part of the United States and other member nations. Consequently, several agreements were made between European alliances to protect their currencies, such as Snake Tunnel model aiming at limiting fluctuations between different European currencies. It was an attempt at creating a single currency band for the European Economic Community (EEC), essentially pegging all the EEC currencies to one another. The tunnel collapsed in 1973 when the US dollar floated freely. This has ushered a new era, were currencies are liberated and their exchange prices were subjected to market supply and demand forces (Abuaf & Schoess,, 1988).

2.2 The Importance of a Sound Global Financial System

Good Financial system supports global economic developments; Its basic role is to act as mediator between the surplus and deficit units; it increases the confidence of depositors and taxpayers of surplus money and the world's international bodies, both public and private; this will benefit individuals, groups and communities altogether to achieve well-being. Any defect affecting the international financial system will adversely affect the monetary policies of countries and thus slows investment operations, the result will be recession in the economies of these countries. The recession is rampant in any country as it will spread like an epidemic in countries that have business or financial interrelationship. The safety of the financial system is the basis for safety of related economies (Rose, 2003).

The system also offers a range of financial instruments to stimulate the surplus units to choose what suits them of financial investments depending on their nature. Financial markets act as the mechanism of distributing wealth and sources of production. The good performance of global financial markets is the most important element of a developed economy. Developed markets result in upgrading the efficiency of working capital for industrial and service establishments, and thus increase their productivity and development. Globalization has increased the reliance of World Trade on financial markets. As well, the Banking System had a key role in supporting governments and policy-makers and organizers of the economies of countries to finance their projects, while the private sector had a big role in absorbing the technology and the use of modern optimization. (Hilbers, 2000).

2.3 IMF's Role in the Development of the Global Financial System

The International Monetary Fund (IMF) is an international organization that was conceived on July 22, 1944, The IMF works to improve the economies of its member countries.

IMF role is to activate the financial control at the bilateral and collective levels among the members the Fund, including assistance in providing technical advice to members. Details of such role are as follows:

- Bilateral control: it is a bilateral cooperation program between the Fund and individual countries, and is this regard, the Directors of the Fund have the right to monitor and asses the financial performance in terms of showing the strengths and weaknesses in their performance and how to overcome all the obstacles that may hinder the work of these institutions properly and effectively.

– Collective Control: It is to find programs of cooperation between the institutions of a group of countries with the same nature and the management of the Fund, aiming at exchange of information about customers and regional areas of joint interest.

- Technical support programs for financial institutions: to identify and diagnose problems of bank facilities, also to help in restructuring of banks in accordance to the economic conditions of countries and their financial policies.

- Technical assistance: it is the Fund's contribution to help its members in applying procedures and policies that serve and strengthen the infrastructure of the financial system.

2.4 Development of Currency Markets

For many years financial markets were monopolized by central banks and major financial institutions, after the liberalization of global trade currencies in the late seventies, it became possible for any institution or individual to engage in this trade, currency has become the most active trading instrument to reach $ 5 billion per day in 1977, jumped to 600 billion per day in 1987, and one trillion dollars a day in 1992, and more than three trillion dollars in 2009.Information technology development and emergence of the Internet have the major impact on the evolution of trading. Investors are now able to perform direct buying and selling of global currencies, it can be launched without barrier or over the counter (OTC); this means that transactions are done without the need for actual trading halls (Singh, 1997).

Integration and Globalization of the World's Currency Markets: That the essence of globalization is to create integration between the global financial markets, based on the financial relations and multilateral trade. The processes

of globalization and financial market integration are linked together. Globalization of markets, acknowledges the free flow of money, commodities, and information between all world states without barriers and with low costs. Integration of markets is the process of consolidating markets and returns and minimizes risks among all financial markets (González, 2010).

2.5 Foreign Exchange Markets

Created in 1971-1976, they started as an interbank "tool" used for operating huge monetary assets between the countries. At that time the rate of one currency to another was defined by mutually agreed exchange rate. In quite a few years Foreign Exchange markets turned into the major income sources for the banks. Such renowned banking institutions as Citibank, Chase Manhattan Bank report to get their biggest revenue from currency operations.

Modern technologies made Foreign Exchange accessible to all investors. Acceleration in transfer of monetary assets and supersonic informational exchange combined with latest technological inventions made it possible to trade on Foreign Exchange even with large and small capitals (starting from $100). So Foreign Exchange attracted a wide wave of small and big investors and this has increased the liquidity of this market (Ross, 2003).

2.6 Technical and Fundamental Analysis

2.6.1 Fundamental analysis

Analysis of economic indicators, social factors and government policy of a business cycle. It can forecast price movement and trends of the market. The fundamentals of any country, multinational industry, or trading bloc lie in the combination of factors like social, political, and economic influences. However, it is rather hard to stay aside from all these variable factors. Therefore, the sphere of complicated and subtle market fundamental lets the explorer know and understand more details of a dynamic global market during the analyzing. Fundamental analysts use economic data that are usually separate from the security or currency

2.6.2 Technical Analysis

The development of technical trading rules from observations of past price movements of the security or currency market and the individual security or currency. Technical analysis involves the examination of past market data such as prices and volumes traded which leads to an estimate of future price trends. Technical analysts believe that using data from the market itself is a good idea as market is its own best predictor (Reily & Brown, 2003)

The practice of sound operations of financial investment is a primary factor to expand the work of capital markets and increase their efficiency; as well as building sound strategies for investment, by avoiding dangers caused by the fluctuations of world currencies.

2.6.3 Importance of Fundamental and Technical Analysis

Fundamental analysis in currency trading provides information of the economic situation of concerned countries along with the statistics on how big the economic and political events of a certain country influence its currency and currency market as well. Currency specialists keep a track on the reports and the statements given by the economists, experts and politicians on the currency market moves. Technical analysis is considered as the pivot of currency trading and is important for a person to trade in successfully. The analysis has to be set on the basis of certain common parameters throughout the world. There are three arenas which need to be considered for technical analysis which are market discount, trend movement of price and the tendency of trends repetition.

The importances of these indicators are summarized as follows:

- Their impact on predicting exchange rates of world currencies.

- Enhance investors' understanding the impact of fundamental factors on currency price fluctuations.

- Ability to develop new advanced investment strategies thru using amalgamated fundamental and technical indicators.

- Improve investment efficiency and earn higher profits by using financial indicators in forecasting currency prices.

- Increase the confidence of investors in global financial markets. (Kahevci & Sayilgan, 2006).

2.7 Previous Studies

Malabika et al(2007), have empirically tested an implied volatility function for a selected call option from the Indian Stock Market for the period Jan.-Dec. 2006.they found that implied volatility for the in – the –money options are higher than the out of – the money options . They concluded that higher prices translate into higher implied volatility and it structure a U shape smile (Malabika et al, 2007).

Ferreira(2008) has tested an ex ante uncovered interest parity(UIP) by using a survey data of exchange rates expectations from 2001 to 2007, at the Brazilian Central Bank; he used the least square method .he found that the estimated UIP parameter is less than1,which is a common finding of his literature(Ferreira,2008).

Grenade & Moore (2007) have tested the interest rate parity hypothesis for the case of the Easter Caribbean Currency Union (ECCU) &U.S.Dollar; their test exploit the Univar ate and Multivariate tests of the interest rate hypothesis. They concluded that the main policy implication of their findings is that small open economies of the ECCU are susceptible to exogenous changes in the U.S. Monetary policy (Grenade & Moore, 2007).

Oberlechner (2001) in his study of foreign currency traders in Frankfort, London, Vienna, and Zürich, he found that that most traders use charts and conduct fundamental and technical analysis to forecast for European currencies; this supports the belief that investors use technical and fundamental analysis to help them in the forecast of foreign currency prices (Oberlechner,2001).

Aysoy & Balaban (1996) have compared between realized and implied volatility. They studied the Turkish currency prices against the U.S. dollar and German mark, for the period from 1981-1995.Study has proven that the volatility increases by less than the square root of the time factor for short periods, and increases by more than the square root of the time factor for long periods. This result is inconsistent with the random walk hypothesis, and is considered as a rejection of the model of weak market efficiency (Aysoy & Balaban ,1996)

Lui & Mole(1998) studied the use of fundamental and technical analyses by foreign exchange dealers in Hong Kong, study showed that 85% of dealers rely on both the fundamental and technical analysis, for both mid and medium terms. Also Study showed that there is reliance by dealers on technical analysis over fundamental for the short term, while this reliance disappears in the medium and long terms. The study proved that the interest rate is important in predicting future currency prices (Lui & Mole, 1998).

Doran, (2009), studied the structural relationship between implied volatility world currency prices and their currency options. Study showed that the rate of change of implied volatility of options for the short term is higher than the rate of change of implied volatility for the long term for these options (Doran, (2009).

Dumitrescu, and Dumitrescu, (2009) studied the relationship between exchange rates and interest rate differences, using the model of uncovered interest parity ("UIP"), by taking degrees of volatility of currency exchange markets and capital markets. Researchers found that the interest rate parity is not an absolute factor for the entire study period. They found that exchange rates follow the model of interest parity, and found that the relationship between interest parity rate. Research also revealed that high the degree of market volatility raises the exchange rates of low-yielding currencies and lowers the exchange rates of the high yielding currencies (Dumitrescu, H. and Dumitrescu, D.2009).

2.8 Importance of Study

Study the combined effect of fundamental and technical factors combined, the factors are: interest rate, historical volatility, and moving average combined. An empirical test had been conducted to test the validity of these factors.

3. Methodology

3.1 Sample

Many studies on financial factors aimed to explore their effect on future prices of currencies and other financial instruments; this study is a complementary to these studies. Researchers have used and compiled data of historical exchange prices for four world currencies against U.S.Dollar, these currencies were: Swiss Franc (CH), Sterling Pound (GBP), European Euro (EUR), and Japanese Yen (JPY) for the period 2000- 2008.Exchange rates and interest rates were retrieved from Bank of Canada files. Data were compiled and segregated into four sub groups; first subgroup was of 30 day period, second subgroup was of 90 days, third subgroup was of 182 days, and the last subgroup of 365 days. These subgroups were used to calculate expected exchange rates. Sub groups of historical and calculated data were paired and empirically tested; correlation coefficient; covariance factor and F.test were measured.

3.2 Test Hypotheses

Ho-1: There is no significant statistical relationship between moving average and forecasted exchange rates of international currencies.

Ho-2: There is no significant statistical relationship between interest parity and forecasted exchange rates of international currencies.

Ho-3: There is no significant statistical relationship between historical volatility and forecasted exchange rates of international currencies.

Ho-4: There is no significant statistical relationship between the factors: historical volatility, moving average and interest rate parity, combined, and forecasted exchange rates of international currencies.

3.3 Variables: Two Sets of Variables Are Used

3.3.1 Independent Variables

- Interest rate parity:

It is interest rate differential between two countries; it is equal to the difference between forward exchange rate and spot exchange rate. It plays an essential role in foreign exchange markets; it connects interest rates, spot exchange rates and foreign exchange rates.

The interest rate parity describes how the market compensates for arbitrage, which is investors' ability to take advantage of price differences of the same things in different markets. In this case, it refers to the different prices of currency and different exchange rates. Interest parity is two types:

Covered interest parity: It refers to a condition where the relationship between interest rates and the spot and forward currency values of two countries are in equilibrium. As a result, there are no interest rate arbitrage opportunities between those two currencies.

Uncovered interest parity: A parity condition stating that the difference in interest rates between two countries is equal to the expected change in exchange rates between the countries' currencies. If this parity does not exist, there is an opportunity to make a profit.

The interrelationship between currency exchange forward rates and spot rates that result from interest rate differentials. It is given by the formula:

$$F = (1+ i_b)/ (1+i_o) * S, \tag{1}$$

Where:

F: Future exchange rate; i_b: Interest rate for base currency; i_o: Interest rate for other currency

S: Current exchange rate (Wei, 1991).

- Volatility

It is defined as the standard deviation of the continuously compounded return of the financial instrument, it is an unobservable variable. Volatility can help sort through the layers of analysis and guidance that pundits, proffer with regard to foreign exchange markets.

- Historical volatility is a method of measuring volatility of an underlying asset price, or relative value for a currency pair. Its estimate is based on the assumption that the volatility that prevailed over the recent past will continue to hold in the future (Chance, 2004).

It is calculated by determining the average deviation from the mean price of a financial instrument in the given time period. Standard deviation is the most common method to calculate historical volatility. It is given by the formula:

$$F = S * (1 \pm S.D/M), \tag{2}$$

Where S.D. is the standard deviation; M is the mean (Malabika et al, 2008).

- Moving Average:

It is a technical indicator used to measure the average price or exchange rate of a currency pair over a specific time frame. Moving average is used to emphasize the direction of a trend and to smooth out price and volume fluctuations that can confuse interpretation. A moving average (MA) is an average of data for a certain number of time periods. It "moves" because for each calculation, we use the latest x number of time periods' data. There are two major types of Moving Averages: "Simple" and "Exponential". For this study, simple moving average has been used; it is given by the following equation:

$$M = (S_1 + S_2 + \ldots\ldots.. + S_n) \div n, \tag{3}$$

Where: $S_1, S_2 \ldots S_n$, are exchange rates for time n.

It is worth to note that the length of time calculated in a moving average is very important. Moving averages with shorter time periods normally fluctuate and are likely to give more trading signals. Slower moving averages use longer time periods and display a smoother moving average. The slower averages, however, may be too slow to enable you to establish a long or short position effectively.

- Combined Formula (Proposed):

$$F = S * \{1 \pm \sigma/M\} * (1+ ib)/ (1+io), \qquad (4)$$

Where: S: is the price of base currency (U.S.Dollar)

σ: is the standard deviation, it measures implied volatility.

M: is the moving average for the set of currency prices for the interval n.

ib: Interest rate for base currency.

io: Interest rate for other currency

F: is the forecasted exchange rate for other currency.

3.2.2 Dependent Variables: Sets of exchange prices of world currencies evaluated in U.S.Dollar, computed by using formula number (4).

4. Tests

4.1 Test Results

4.1.1 Data Analysis

Following is a set of tables of prices of the world's currencies against the U.S. dollar, these tables show the results of using the combined model proposed, the researchers tested the average prices for periods: 360 days, 180 days, 90 days, and 30 days.

4.1.1.1 Swiss Franc

Study of the Swiss franc prices of the period 30 days (CH30),90 days(CH-90),182 days(CH-182,365 days(CH-365):

Table below shows prices of Swiss franc, columns show the movement of prices of Swiss Franc against the U.S. dollar, we notice the price changes with the change in moving average factor:

Insert Table 1 Here

As shown Table 1, the impact of factors, historical volatility, and interest rate factors combined on price movements of world currencies. We notice that the impact of these factors in the third period was matching what is expected, as they have improved the degree of convergence, i.e. least covariance (CH-182); Also F.Test has advocated that the third period has the highest effect of forecasted prices.

4.1.1.2 Euro Currency

Study of the Euro prices for the periods 30(EUR-30, 90(EUR-90), 182(EUR-182), and 365 days (EUR-365), Table (2) shows the movement of prices of EU against the U.S. dollar.

Insert Table 2 Here

As shown in table 2, we notice the impact of historical volatility and the interest rate in the price movements of the Euro currency, the degree of historical currency rates are close to those calculated. Table down shows close correlations for corresponding periods; Covariance measures show the degree of deviation from the real prices and calculated ones. For the F.Test, results show significant results except for EUR-182, so it is most probably that there were certain setbacks in this period which caused historical prices to be skewed due to certain financial instabilities or extraneous factors. There were certain swings in the degree of convergence and divergence for the four periods. Researchers think that this swing is due to the effect of extraneous factors that had negatively affected the momentum of subject factors. In reviewing the degree of correlation and co variation, two sets of prices we find that the impact of these extraneous factors had minimized the effect of the prime factors under study. Table above shows that longer periods have more coherent prices and less deviated ones which indicates that the influence of extraneous factors is minimized.

4.1.1.3 GBP

Study of GBP prices for the periods 30(GBP-30), 90(GBP-90), 182(GBP-182), and 365 (GBP-365)

Insert Table 3 Here

Table 3, shows the movement of prices of GBP against the U.S. dollar. Table shows correlation coefficients, ranging from 0.99412 to 0.989138; we find that the correlation for GBP-90 is the highest, while GBP-365 is the lowest. F. test also shows significant results except for GBP-365 which has low F.test result; it is most probably that there were certain setbacks in this period which caused historical prices to be skewed due to certain financial instabilities, setbacks, or some extraneous factors.

4.1.1.4 JPY

Study of the JPY prices for the periods 30(JPY-30), 90(JPY-90), 182(JPY-182), and 365(JPY-365):
Table 4.shows movement of prices of JPY against the U.S.

Insert Table 4 Here

Table 4, shows a degree of convergence for the groups of historical and calculated prices. It is evident that correlation coefficient of sub-periods is higher than the full period, the same for the covariance; table shows higher readings in sub-periods more than for the full period. By comparing the degree of convergence in the above table, we can demonstrate the impact of the factors, historical volatility and the interest rate, in the price movements of world currencies, and we found that the degree of historical currency rates are close to those calculated. Above readings are likely to be more random than being ordered;i.e. the degrees of convergence and degrees of deviation fluctuate up and down in no system, we think that some extraneous factors had effected the result, it is worth mentioning that these measures were not affected by moving average factor as it is an independent factor.

5. Conclusions

The analyses of the study had shown a general relation between historical and calculated exchange rates of currencies: Swiss Franc, Euro, Pound Sterling and Japanese Yen against U.S. Dollar. However, there were some variations in some sub groups, i.e. moving average periods had shown more significant results than others.   Tests results of were positive for most time periods, however, results included some abnormalities of covariance and correlation coefficients due to certain financial or political conditions in the countries concerned, or the   intrusion of some extraneous factors that had affected the results. Examples are: F.test result for GBP-365 and EUR-182, correlation coefficient for JPY-365. Researchers noticed that the impact of financial factors included the study did not have the same impact in forecasting future currency prices; this has been noticed in some parts of study period.

References

Abuaf, N., & Schoess, S. (1988). *Foreign-Exchange Exposure Management*, (6th Ed.)The Columbia Electronic Encyclopedia, Copyright © 2007.

Aysoy, & Balaban. (1996). Daily Volatility in the Turkish Foreign Exchange Market, *Discussion Paper,* No: 9625, Research Department, The Central Bank of The Republic of Turkey.

Backe,P., & Scardax, F. (2009).European and Non-European Emerging Market Currencies: Forward Premium Puzzle and Fundamentals. *Focus on European Economic Integration Journal, 2009*(2), 56-66.

Brigham, et al. (2002). T*heory and Practice*, (10th Ed.).Mason Ohio, Thomson, South-Western

Doran et al. (2009). Seasonal Patterns in the Information Content of Implied Volatility, *Research Paper, College of Business*, Florida State University.

Ewing, & Ascarelli. (2000). One World, How Many Stock Exchange? *WALL ST. J.*, May 15, 2000, at C1 (explaining the push toward global stock market consolidation).

FerreiraA.L. (2008).The Simultaneity Bias of Uncovered Interest Parity: Evidence for Brazil, Economics Dept. University of SaoPaulo, FEARP, Brazil.

Grenade, K.I., & Moore, W. (2007).Research,Co-MovementBetween Foreign and Domestic Interest Rate in a Fixed Exchange Rate Regime: Case of Easter Caribbean Currency Union,ECCB, Staff Research paper. *Euro-American Association of Economic Development*, *8*(1), 119-130.

Jin Wei, S. (1991). Anticipation of foreign exchange volatility and Bid-ask spreads. *International discussion papers*, 409, Board of Governors of Federal Reserve Systems, USA

Kahved, E., & Sayilgan G. (2006). Globalization of Financial Markets and its Effects on Central Banks and Money PolicyStrategies:Canada,NewZealand and UK Case With InflationTargeting,Journal of Finance and Economics,ISSN 1450-2887,Issue 6 ,Euro Journal Publishing Inc. *Wall Street Journal*, 15 May, 2000, C1

Lui,Y.H., & Mole, D. (1998).*The use of fundamental and technical analyses by foreign exchange dealers: Hong Kong evidence*, Asia-Pacific Financial and Forecasting Research Center, City University of Hong Kong, 535-545.

Malabika et al. (2008). An Empirical Analysis of Implied Volatility in Indian Options Market. *International Research Journal of Finance and Economics*, 18, ISSN 1450-2887, Euro Journals Publishing, Inc.

Mc Kinnon R., & H. Pill. (1997). Credible Economic Liberalizations and Over borrowing. *American Economic Review*, *87*(2), 93-189

Oberlechner. (2001). Importance of Technical and Fundamental Analysis in the European Foreign Exchange Market. *International Journal of Finance and Economics*, *6*(1), 81-93.

Paul Hilbers. (2000). European Economic Integration – Challenges and Consequences on Romanian Financial systems Soundness, *IMF*.

Reilly, F., & Brown, K. (2003). *Investment Analysis and Portfolio Management*, (7th Ed.).Mason, Ohio, Thomson-South-Western

Rose, P. (2003). *Money and Capital Markets*, (10th Ed.). New York, NY: McGraw-Hill,

Sinh, A. (1997). Asian Capitalism and the Financial Crisis. *The Economic Journal*, *107*(442), 771-782.

Table 1. Aggregate factors for CH-30, 90,182,365

	CH-30	CH-90	CH-182	CH-365
Correlation	0.97823	0.9897	0.99101	0.97203
Covariance	0.040588	0.03995	0.03835	0.03306
F.Test	0.22315	0.00747	0.78936	0.30179

Source: these tables were compiled by the researcher using Excel program

Table 2. Aggregate factors for EUR-30, 90,182,365

	EUR-30	EUR-90	EUR-182	EUR-365
Correlation	0.9997	0.99457	0.99637	0.99177
Covariance	0.022461	0.02318	0.022272	0.019091
F.Test	0.035842	0.02819	0.0005651	0.861147

Source: these tables were compiled by the researcher using Excel program

Table 3. Aggregate factors for GBP-30, 90,182,365:

	GBP-30	GBP-90	GBP-182	GBP-365
Correlation	0.99267	0.99412	0.99191	0.989138
Covariance	0.00491	0.004892	0.00461	0.000395
F.Test	0.06623	0.02308	0.39172	0.004398

Source: these tables were compiled by the researcher using Excel program

Table 4. Aggregate factors for JPY-30, 90,182,365

	JPY-30	JPY-90	JPY-180	JPY-365
Correlation	0.96881	0.96323	0.95252	0.6184
Covariance	51.815	51.208	48.968	34.423
F.Test	0.64768	0.51779	0.108055	0.40586

Source: these tables were compiled by the researcher using Excel program