Chapter III.

Theory and Review of literature

3.1 Theory

3.1.1 Efficient Market Hypothesis (EMH)

The Efficient Market Hypothesis (EMH) has been proved to be a powerful intellectual tool for understanding and investigating financial market. Efficient Market in terms of economics is the market that does not have any abnormal profit from trading. Asset prices and returns are determined by the outcome of the mechanism of supply and demand in a competitive market. Traders are rational and quickly assimilate any information, which is relevant to the determination of asset prices and returns. Following this, one does not have advantage over the other in prices adjustment. So, one cannot make abnormal profit excess from a fair payment of the riskiness of that security. In this study, the securities are spot and forward in foreign exchange market.

Current and past information is immediately incorporated into current prices. Hence, if current and past information is immediately incorporate into current prices then only new information or "news" is able to cause changes in prices. Current and past information does not help to forecast which would improve return or reduce forecast error. Since news is unforecastable, price changes should be unforecastable, or we can say that return is unforecastable. This independence of forecast error from previous information is known as the orthogonality property and it is a widely used concept in testing the efficient market hypothesis.

$$\varepsilon_{t+1} = P_{t+1} - E_t P_{t+1}$$

ε_{t+1} = forecast error at time t+1

P_{t+1} = price of exchange rate or rate of exchange at time t+1

E_tP_{t+1} = expected rate of exchange at time t+1

Or we can rewrite this as the rational expectation (RE) element of the EMH.

$$P_{t+1} = E_tP_{t+1} + \varepsilon_{t+1}$$

The forecast error is expected to be zero on average. Because "News" the only factor that is able to make prices change, is a random variable (sometimes positive and sometimes negative and thus offset each other). Hence, in efficient markets "news" will not influence the exchange rate over a long horizon.

$$\varepsilon_{t+1} = P_{t+1} - E_tP_{t+1}$$

$$E\varepsilon_{t+1} = E(P_{t+1} - E_tP_{t+1})$$

$$E\varepsilon_{t+1} = EP_{t+1} - E_tP_{t+1} = 0$$

This means the forecast of P_{t+1} is unbiased. On average actual exchange rate equal expected exchange rate. Unexpected profit or loss (ε_{t+1}) on average from time t to t+1 is zero. In other word, there is no supernormal profit in an efficient market. Under EMH investors make profit only to cover their costs in order to stay in the business. The hypothesis also applies to the return on exchange rate which give better understand in concept of supernormal profit.

$$\varepsilon_{t+1} = R_{t+1} - E_tR_{t+1}$$

$$E\varepsilon_{t+1} = E_tR_{t+1} - E_tR_{t+1} = 0$$

ε_{t+1} = forecast error at time t+1

R_{t+1} = return of exchange rate at time t+1

E_tR_{t+1} = expected return of exchange rate at time t+1

However, inefficient markets, exchange rate is subject to longer-term "irrational-swings" which make stock price volatility in this market greater than that in efficient market. For this reason financial institutions are forced to reserve enough resources. Which means if there are systematic risks, financial institutions should reserve not only for private costs but should reserve for social cost as well. This will help financial institution to have adequate capital to cover its situation.

Thus, in an efficient market, investors know the true economic model that generates future returns and use all relevant information to form their bests forecast of the expected return. This is the rational expectation element of the EMH.

The basic ideas, which constitute the Efficient Market Hypothesis (EMH) are:

1. All agents act as if they have an equilibrium model of price determination.
2. Agents process all relevant information in the same way to determine their equilibrium returns. Forecast errors are unforecastable from the information available at the time the forecast is made due to the definition of news, which cannot be predicted. This is called the test of information efficiency.
3. Agents cannot repeatedly make excess profits. A market is efficient with respect to an information set. It is impossible to make abnormal profit, which profit or rate of return in economic is adjusted by risk.

Nowadays the foreign exchange (FOREX) market is not the market of the formally organized type with a specified place for face-to-face meeting of buyers and sellers. Instead, it is computer, telephone, and Internet based, known as "on-line trading". The need of the efficient system came from high volume of trade and is supported by high technology. There are two main types on the foreign exchange market that will be focused on in this study on. The first is the spot rate, which is the exchange rate quoted for immediate delivery of the currency to the buyer (actually, delivery two working days later, which is called "value date"). The second is the forward currency at some future period. Normally, the contract matures within one to six months. Other than forward contract, there are futures and options contracts in foreign exchange market. However, we do not have futures market in Thailand and futures contract is basically similar to forward contract except futures contract is more formal than forward contract. In other countries, futures contracts are less flexible than forward contract because it is available only on specified day in March, June, September, or December. Options are contract giving the purchaser the right to buy or sell a currency at some specified data in the future, with the price specified at the time the contract is entered into. But options have premium, the charge for purchasing the option. In the early stage of introducing derivatives, the one that has no cost would be much more attractive than the one that has cost. Therefore, we will focus on only spot rates and forward rates.

3.1.2 Forward Rate Unbiasedness (FRU)

The theory of the forward Rate Unbiasedness is widely used as a base to test the efficient of the forward exchange rate market. The concept of the theory is to check whether the forward rate is a good predictor of the spot rate or exchange rate.

First, test to see whether the forward exchange rate systematically over or under predicts the future spot exchange rate. If it were to do so then this would be indicative of foreign exchange market inefficiency. In short, the forward exchange rate should be an unbiased predictor of the future spot rate. The efficient market implies that there are no unexploited profit opportunities. Market participants use all costlessly available information correctly in assessing the probability distribution of future exchange rates. This condition will hold if foreign exchange market participants are rational, in the sense that they do not make systematic forecasting errors, and there are no transaction costs or risk premium.

If the foreign exchange market is rational and speculators' risk neutral, the supply of speculative funds will be infinitely elastic at the forward price equal to the expected future spot price. Thus, the forward exchange rate should be an unbiased predictor of the corresponding future spot exchange rate. The forward premium/discount will be the market's best predictor of the change in the spot exchange rate.

Hypothesis of this theory is:

$$E_tS_{t+1} = f_t$$

Where;

E_tS_{t+1} is the expected spot rate at period t+1

f_t is the forward rate at period of t

In forward market, there are events when the short beat the long and the long beat the short. Ultimately there must be an equilibrium reached in which neither the longs nor the shorts consistently beat the other side. Neither side wins at the expense of

the other. There is no risk premium in this kind of market. The futures price is the market's expectation of the future spot price. In economics, futures prices are unbiased expectations of future spot prices. The FRU is a particular example of a very general concept of market efficiency. The forward rate is the expected spot rate in the next one period. If the expected spot rate is equal to the forward rate, the forecast error is equal to zero. The expected spot rate to forward rate is unbiased.

The efficient market is conventionally defined as one 'in which prices always 'fully reflect' available information" as mentioned above. In the specific application for the foreign exchange market this implies that market participants use all relevant available information bearing on the appropriate value of the exchange rate, to produce a set of exchange rates (spot and forward) that do not provide an opportunity for unusual ex-ante profit opportunities. In other words, speculators who make exchange rate forecasts on a similar information set cannot make unusual profits.

The FRU is a special case of market efficiency. It implicitly assumes a particular market model, one where the following model applies:

1. There are an adequate number of well-funded and well-informed agents in the currency markets. Market prices are well defined.
2. There are no barrier to trade in the markets and no costs to dealing.
3. Investors are risk neutral.

3.1.3 Uncovered Interest Parity (UIP)

For better understand, the study will discuss from the theory of Real Interest Parity (RIP) before going to the Covered Interest Parity (CIP) and Uncovered Interest Parity (UIP).

Real Interest Parity (RIP)

$$r_t - \Delta p^e_t = r_t^* - \Delta p^e_t{}^*$$

Where;

r_t	is the domestic interest rate.
r_t^*	is the foreign interest rate.
Δp^e_t	is expected domestic price change.
$\Delta p^e_t{}^*$	is expected foreign price change.

Arbitrage methodology initiates interest rate parity. Arbitrage happens because of human behavior. Suppose in foreign exchange markets one finds a round-trip sequence of transactions that generates a sure profit with out requiring any capital. One will make as large a transaction as possible. So will everyone, who might also find this transactions. Thus, the profit will be fast eliminated. This is the process of parity.

The concept of interest rate parity provide some understanding of the way in which interest rates are linked between different countries through the flow of capital. The interest rate parity condition implies that the expected rates of return on domestic and foreign investment are equal through arbitrage. With perfect substitutability between domestic and foreign financial assets, exchange rate movements immediately eliminate any return differential between the two types of assets. The interest rate parity reveals that the expected rate of depreciation of the exchange rate is equal to the interest rate

differential between two countries. The immediate reactions of the current exchange rate cancel the return differential so that the expected rates of return on domestic and foreign financial assets are equalized.

Suppose that we have an amount of money equal to "A" Baht and we want to invest this money for one year in either the U.S. or domestic (Thailand market).

The return from investing in Thailand will be equal to

$$A(1+r_t)$$

Where;

r_t is the rate of interest in Thailand (domestic)

The return from investing in U.S. will be equal to

$$(A/S_t)(1+r_t^*)S^e_{t+1}$$

Where;

S_t is a spot rate of exchange at time t

S^e_{t+1} is an expected spot rate at time t+1

r_t^* is the rate of interest in U.S. (foreign)

A/S is an amount of investment "A" convert from U.S. dollars to Baht. After one year of investment, it will increase to $(A/S)(1+r^*)$. We will be able to expect the amount of return of our investment in terms of Baht from the expected exchange rate at the end of one-year investment. The return is equal to $(A/S)(1+r^*)S^e_{t+1}$.

If we are a risk neutral investors*, we will be concerned only with the expected return form the two alternative investments (invest in Thailand or invest in U.S.) and will continue to invest in the country which has higher return until the expected returns are equalized.

$$A(1+r_t) = (A/S_t)(1+r_t^*)S^e_{t+1}$$

When amounts of investment are equal in both sides of the equation, they cancel out each other.

$$(1+r_t) = (S^e_{t+1}/S_t)(1+r_t^*)$$

Which becomes:

$$S^e_{t+1}/S_t = 1+r_t/1+r_t^*$$

Or approximately:

$$S^e_{t+1} - S_t = r_t - r_t^*$$

Where;

S^e_{t+1} = In (S^e_{t+1})
S_t = In (S_t)
r_t = In $(1+ r_t)$
r_t^* = In $(1+ r^*_t)$

Log 1 is very small. It is close to zero so that we can consider only r where r is measured as a dicimal.

* The assumption of the Uncovered Interest Parity (UIP) will be presented next.

This is the equation of "Uncovered Interest Parity" (UIP). If UIP does not hold then there are forces that will restore the equation to equilibrium.

If the domestic interest rate is higher than the foreign interest rate, the price of the domestic securities will be pushed up by excess demand of the domestic securities and drive down the domestic interest rate. This was because security proprietors are able to reduce their expense by reducing the rate of interest or the rate of return. There is excess demand in securities. While the price of the foreign securities will be lower and urge the foreign interest rate to be higher. Or vice versa in a case that the foreign interest rate is higher than the domestic interest rate. This process will automatically restore equilibrium.

In reality, the agents in the foreign exchange market can be specified in to three groups, which are hedgers, speculators and arbitrageurs. The last two groups now play an important role in the world trading. These two groups take the advantage from the price differential between markets, therefore their transactions are one-way transactions. In other words, covering forward is a form of insurance. It suits those who need the price of a particular installation or raw material or sale of goods not to be affected adversely by a change in the exchange rate. Hence, this explains why Uncovered Interest Parity (UIP) is better than Covered Interest Parity (CIP) in describing the world situation.

Uncovered Interest Parity (UIP)

Hypothesis of the Uncovered Interest Parity (UIP) theory is:

$$E(S_{t+m} - S_t) = (r - r^*)_t$$

Where;

$E(S_{t+m} - S_t)$	is the expected of the differential between spot rate at period t+m and t; m is a period of foreign exchange rate in the future, which can be one month, two months, three months, etc.
S_t	is the spot rate at period t
$(r - r^*)_t$	is the interest rate differential
r	is the domestic interest rate
r^*	is the foreign interest rate

The condition of UIP assumes that risk neutral speculators dominate the market and that neither risk averse "rational speculators" nor noise traders have a perceptible influence on market prices. The investors know that they are taking a risk when they enter into transactions because the exchange rate always fluctuates. However, they ignore this risk and undertake it when they make transactions.

Hypothesis of the Cover Interest Parity (CIP) theory is:

$$f_t - S_t = (r - r^*)_t$$

Where;

f_t	is the forward rate at period of t delivery within one period, which can be one month, two months, three months, etc. But it has to be consistent with period of interest rate.
S_t	is the spot rate at period t
$(r - r^*)_t$	is the interest rate differential
r	is the domestic interest rate
r^*	is the foreign interest rate

The UIP or the Fisher hypothesis differs from the CIP. In the case of CIP, foreign exchange risk is removed by arbitrageurs entering into a forward contract. The nominal interest differential between financial centers is known as premium/discount on forward rate and this is in principle riskless. In the case of UIP, a forward contract is not entered into and hence the investor assumes the foreign exchange risk. The UIP means that the investor does not protect himself in the forward market against the exchange rate risk as he does in the case of CIP. We would expect it to hold if the path of the exchange rate is known with certainty or if arbitrageurs are risk neutral. In other words, they do not seek an extra return for taking on foreign exchange risk. Critically for the UIP to hold continuously, it is required that capital is perfectly mobile so that investors can instantly alter the composition of their international investments. Perfect capital mobility can be defined as involving assets, which are identical in every respect except their currency of denomination (i.e. same maturity, etc.). In addition, there is equal risk between investing in domestic and foreign country. So, investors who are risk averse could not require a higher expected return on the riskier asset. This means investing in domestic or in foreign markets are perfect substitutes. The two conditions are equivalent only when the forward rate is equal to the expected future spot rate or the forward rate is an unbiased predictor of future spot rate. The interrelationship of these three theories can be presented as following:

Covered Interest Parity (CIP)

$$f_t - S_t = (r - r^*)_t$$

Uncovered Interest Parity (UIP)

$$E(S_{t+1}) - S_t = (r - r^*)_t$$

Forward Rate Unbiasedness (FRU)

$$f_t = E(S_{t+1})$$

From the equation of Uncovered Interest Parity (UIP), we substitute the equation of Covered Interest Parity (CIP) in to the equation. We will get the equation of Forward Rate Unbiasedness (FRU).

$$f_t - S_t = (r - r^*)_t$$
$$E(S_{t+1}) - S_t = (r - r^*)_t$$

Therefore,

$$f_t - S_t = E(S_{t+1}) - S_t$$
$$f_t = E(S_{t+1})$$

To better understand the concept of CIP, imagine the case of a Thai investor who has the option of investing his money in Thai bonds or US bonds of similar risk and maturity. There will be two factors that investors will bear in mind when considering whether to purchase Thai bonds or US bonds. There are the rates of interest on Thai bonds and US bonds and what they expect to happen to the baht-dollar exchange rate. For example, if the interest rate in Thailand is 10 percent per annum, while the interest rate in the US is 4 percent per annum, then on average, investors expect the baht to depreciate by 6 percent per annum. This is driven by the arbitrage mechanism.

3.2 Review of Literature

The Efficient Market Hypothesis (EMH) has been the dominant paradigm in financial economics since the mid-1960s. The test of asset market efficiency, focusing on domestic equity and bond markets, began in the 1960s and became significance during the 1990s. Fama[1] (1970) was the first economist who initiated the empirical studies to test efficiency of capital market. His definition of capital market efficiency is a market, in which prices provide accurate signals for resource allocation and therefore firms can make production-investment decisions and investors can choose among the securities that represent their productivity. The market efficiency is derived from the role of prices as aggregators of structural information. In short, prices will insure an efficient allocation of resources under the assumption that security prices at any time "fully reflect" all available information. Thus, the investors are not able to gain abnormal profit.

The test of market efficiency is a test of joint hypotheses. First, the hypothesis that defines market equilibrium prices or expected returns as some function of the information set. Second, the hypothesis that economic agents can set actual prices or returns to conform to their expected values or agents use information rationally. Therefore, a number of plausible hypotheses about equilibrium pricing or returns have been incorporated into efficient market tests for equities. Following the EMH economists believe that price is the ultimate result of the market equilibrium that incorporates a vast amount of information or all the relevant information and factor affecting the demand and supply of assets are incorporated in prices. In short, price is the ultimate indicator of the market's status.

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[1] Fama, E.F. (1970) "Efficient Capital Matkets: A Review of Theory and Empirical Work", *Journal of Finance*, Vol. 25, No. 2, 383-423.

Under the assumptions of EMH, information is available with no cost. This is not a case in reality because the way to acquire information always cost something. Therefore, price cannot perfectly reflect the information available. As you can see that the speculator can make smart money by being faster in acquisition and correct interpretation of new information over others in the real situation. To be compatible with the world situation and for empirical testing a definition is needed of what constitutes "all relevant information" and three broad categories of information types for testing the market efficiency have been distinguished.

Weak Form	– the current price is considered from all the information in past price.
Semi-strong Form	– the current price is considered from all publicly available information (including past price).
Strong Form	– the current price is considered from all information that can possibly be known, including insider information.

These three forms are distinguished upon the assumption made about the information set available to individual agents. Firstly, there is weak form efficiency. A market is weakly efficient if a trader cannot make abnormal profits using past values of the price in that market. In other word, the information set in the case of foreign exchange market is restricted to past values of the foreign exchange rate. Secondly, a market is said to be semi-strong efficient if a trader cannot make abnormal profits by making use of past values of the variable in question (the forward exchange rate) or any publicly available information that might be of some use in predicting the future value of the variable. Thirdly, the market is considered the strong form efficient if traders cannot make abnormal profits by using all information, which can possibly be known. Including past price,

public available information, and other information such as insider information. Insider information is information that is not published to public such as a pending announcement of a merger or acquisition.

Reilly[2] (1979) stated that market efficiency under the definition of Fama is too straightforward to be practical. To make it more general and able to apply for the situation, he added more assumptions to the market efficient conditions as following:

1. There are a large number of investors, who want to maximize their profit. These investors have to analyze and estimate security's prices independently.
2. News, which is related to security, will be randomly stored and that news does not depend on others.
3. Investors will quickly adjust security's price follow the news. From the fact that news is random so price change is also random or unforecastable.
4. Security's prices at all time are the unbiased news reflection.

From the above four assumptions, Reilly concluded that capital market efficiency is the market where security's price will rapidly adjust follow the effect from news. The price of a security will fully represent both news and risk at that time.

The foreign exchange market became more active with high volume, has many traders with billions of dollars of liquid assets and is open 24 hours a day around the world. This was due to the closer link between countries, more transaction of trading and investment. While test of efficient asset market gained increasing popularity, the test of efficient foreign exchange market also became more important.

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[2] Reilly Frank K. (1979) *Investment Analysis and Portfolio Management.* Illinois: Dryden Press : 162-164.

With the establishment of floating exchange rates in the early 1970s, it was natural to begin investigation of foreign exchange market efficiency. Many economists started to pay attention to this topic and some applied the Fama efficient concept and model with foreign exchange market.

In the case of the foreign exchange market, such information could include past values of forward exchange rates in our and other foreign exchange markets for different currencies or information that might be expected to influence exchange rates such as interest rates, money supply figures, inflation rates, etc. Thus in the case of semi-strong efficiency, the information set is expanded to include all publicly available information. This is much closer to what is usually meant by assuming that agents form their expectations rationally. They use all publicly available information to do so. Therefore, the test of the EMH following Fama three classified forms is usually considered to be test of the semi-strong form in foreign exchange market.

The efficiency general concept can be put into mathematical form for testing if investors use all available relevant information to forecast returns thus eliminating abnormal profits. This concept is then applied to mathematics form. The first model to test of market efficiency is the Expected Return Model also known as the Fair Game Model, proposed by Fama. Other models are Martingale and Random Walk.

1. Expected Return or Fair Game Model

Fama defined that in an efficient market prices "fully reflect" available information. But the words "fully reflect" are so general and too broad that it has no empirically testable implications. The way to make the model testable is to posit that equilibrium prices are

generated. The assumption that the conditions of market equilibrium can be stated in term of expected returns and that equilibrium expected returns is formed on the basis of the information set, Φt. The information set rules out the possibility of trading systems that have expected profits or returns in excess of equilibrium expected profits or returns. Hence, the equilibrium prices in term of expected return can be written as:

$$E(P_{j,t+1} \mid \Phi_t) = [1+E(r_{j,t+1} \mid \Phi_t)]P_{jt} \quad (1)$$

Where;

E is the expected value operator.

P_{jt} is the price of security j at time t.

$P_{j,t+1}$ is its price at t+1.

$r_{j,t+1}$ is the one-period percentage return $(P_{j,t+1}/P_{jt})/P_{jt}$.

Φ_t is a general symbol for whatever set of information is assumed to be "fully reflected" in the price at t.

$P_{j,t+1}$ and $r_{j,t+1}$ are random variables at t.

In the foreign exchange market, security price in this market is exchange rate or $S_{j,t}$. Thus, replace $P_{j,t+1}$ with $S_{j,t+1}$.

$$E(S_{t+1} \mid \Phi_t) = [1+E(r_{t+1} \mid \Phi_t)]S_t \quad (2)$$

From the expectation of available information at time t or present, the exchange rate at time t+1 will equal to the current rate of exchange plus expected return in the future. The expected return in the future is also based on the same available information at time t. The available information, information at time t, includes all kinds of situations that are now happening and the situation that occurred in the past. In addition, the change in variables that effect the exchange rate also has to be taken in to account. Therefore, the current and past information is counted in the rate of exchange. The change in the

rate of exchange will happen only when there is news. News is a random variable. No one will be able to forecast what might happen. Hence, if there is news, the exchange rate in the future will not be equal to the expected exchange rate that is expected at time t. There is a differential between future exchange rate and expected future exchange rate. In other words, there is an excess exchange rate over the expected exchange rate, or the difference between the observed price expected and the expected value of the price that was projected at t on the basis of the information Φ_t.

$$X_{t+1} = S_{t+1} - E(S_{t+1} | \Phi_t) \quad (3)$$

It is different if considering the expected excess exchange rate at present because it will equal zero. There is still no effect from news.

$$E(X_{t+1} | \Phi_t) = 0 \quad (4)$$

This, by definition, say that the sequence (Xt+1) is a "Fair Game" with respect to the information sequence (Φt). This condition can be presented in the form of return as follows:

$$Z_{t+1} = r_{t+1} - E(r_{t+1} | \Phi_t) \quad (5)$$

The expected excess return from the exchange rate when considered at present is equal to zero.

$$E(Z_{t+1} | \Phi_t) = 0 \quad (6)$$

Where;

X_{t+1} is the excess market value of security j at time t+1.

Z_{t+1} is the return at t+1 in excess of the equilibrium expected return projected at t.

Therefore, sequence of excess return from the exchange rate, Z_t, is fair game, which is also effected from information sequence.

The fair game model is the important basis for other models that are used to test the efficient market such as the Martingale, Submartingale and the Random Walk Model.

2. Martingale and Submaringale Model

From equation (2) above the expected return is equal to zero.

$$E(r_{t+1} \mid \Phi_t) = 0$$

The expected value of next period's price, as projected on the basis of the information, Φ_t, is equal to the current price.

$$E(S_{t+1} \mid \Phi_t) = S_t \text{ or } E[(S_{t+1} - S_t) \mid \Phi_t] = 0$$

The current exchange rate is the best predictor of the future exchange rate. In other words, the current exchange rate is the Martingale, which include all information that relates to the future exchange rate in the current exchange rate.

In the case that the expected return is more than zero.

$$E(r_{t+1} \mid \Phi_t) \geq 0$$

The expected value of next period's price, as projected on the basis of the information, Φ_t, is equal to or more than the current price. More general, the expected change in exchange rate is more than or equal to zero.

$$E(S_{t+1} \mid \Phi_t) \geq 0 \text{ or } E[(S_{t+1} - S_t) \mid \Phi_t] \geq 0$$

The current exchange rate is not the best predictor of the future exchange rate. There are still some other factors that have influence on the future exchange rate other from the current exchange rate. Therefore, the current exchange rate is the Submartingale.

3. Random Walk Model

The efficient market model was assumed to imply that successive price changes are independent. In addition, it was usually assumed that successive changes are identically distributed. These two hypotheses constitute the random walk model.

$$f(r_{t+1} \mid \Phi_t) = f(r_{t+1})$$

This is the usual statement that the conditional and marginal probability distributions of an independent random variable are identical. In addition, the density function f must be the same at all t.

From above, the Martingale and Random Walk are very much the same. Both models are able to use current exchange rate as a good predictor of future exchange rate.

$$S_{t+1} = S_t + \varepsilon_{t+1}$$

The difference is in the error term. In the Martingale, the error term is expected to be zero on average and constant variance. The covariance is equal to zero or having no relationship rather than independent from others ($\varepsilon_{t+1} \sim (0,\sigma^2)$). The only difference between the random walk model and the Martingale is that in the random walk model the distribution is independent from others ($\varepsilon_{t+1} \sim iid(0,\sigma^2)$) while in the Matingale it has no relationship.

Moreover, the Martingale assumes that the expected return is constant over time.

$$E(r_{t+j} | \Phi_t) = E(r_{t+j}) \quad \text{for} \quad \forall_j$$

The mean of the distribution of r_{t+j} is independent of the information available at t, Φ_t, whereas the random walk model notes that the entire distribution is independent of Φ_t.

From all the above, we can conclude that the random walk model is an extension of the general expected return or "Fair Game" efficient markets model in the sense of making a more detailed statement about the economic environment. The fair game model just states that the conditions of market equilibrium can be noted in terms of expected returns. Thus it says little about the details of the stochastic process generating returns. A random walks arises within the context of a model when the environment is the evolution of investor tastes and the process of generating new information combined to produce equilibrium in which return distributions repeat themselves through time. Hence, the theory of efficient markets can be perceived as stated in terms of random walks but usually implying some more general "Fair Game' model.

Therefore, the Martingale Model is a subset of the Random Walk Model because the Maringale analyzes movement of the exchange rate only for certain periods of time while the Random Walk Model analyzes the movement of the exchange rate all the time. These two models are used to test the weakly efficient foreign exchange market. If the movement of the exchange rate is random then the market is efficient because investors cannot gain abnormal profit.

Thus, all the empirical work on efficient markets can be considered within the context of the general expected return (fair game

model) or random walk model. The initial empirical research was concerned with weak form tests. Most of the results from the random walk literature supported the efficiency hypothesis at this level, therefore economists moved to test in semi-strong form, which concerns the speed of price adjustment from available public information. Finally the economists moved to strong form test, which has just started recently.

There were many empirical works in the test of efficient markets, which the empirical work itself can be divided into three categories, defined by Fama, depending on the nature of the information subset of interest. The weak form tests the information subset is just historical price or return sequences. The weak form tests of efficient market model are the most voluminous and the results strongly supported the hypothesis of market efficiency. In other words, the evidences of weak form tests followed the fair game and the random walk model. Fama (1965)[3], Alexander (1961) and Fama and Blume (1966)[4] found the evidences of positive dependence in day-to-day price changes and returns and this dependence is of a form that can be used as the basis of marginally profitable trading rules. Under a less than completely strict interpretation of market efficiency, this positive dependence was not sufficient to reject the market efficiency. For the periods longer than a single day, Cootner (1962)[5], Moore (1962)[6], and Fama (1965) have no indication that whatever dependence exists in weekly returns can be used as the

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[3] Eugene F. Fama.(1995) "The Behavior of Stock Market Prices" *Journal of Business*, 38, January 1965, 34-105

[4] Eugene F. Fama and Marshall Blume.(1996) "Filter Rules and Stock Market Trading Profits." *Journal of Business*, 39 Special Supplement, January, 1966, 226-241.

[5] Paul Cootner (ed.)(1962). "Stock Prices: Random vs. Systematic Changes." *Industrial Management Review*, 3, Spring 1962, 24-45.

[6] Arnold Moore (1962) "A Statistical Analysis of Common Stock Prices" Unpublished Ph.D. thesis, Graduate School of Business University of Chicago.

basis of profitable trading rules. It means that they accepted that the market was efficient.

Semi-strong form tests, in which prices are assumed to fully reflect all public available information, have also supported the efficient markets hypothesis. The same conclusion of the above was obtained from the empirical studies of Fama, Fisher, Jansen and Roll (1969)[7], Ball and Brown (1968)[8] and Scholes (1969)[9].

The strong-form efficient markets model, in which prices are assumed to fully reflect all available information, is probably best viewed as a benchmark against which deviations from market efficiency can be judged because one would not expect such an extreme model to be an exact description of the world. Niederhoffer and Osborne (1966)[10] noted that specialists on major security exchanges have monopolistic access to information on unexecuted limit order and they use that information to generate trading profit while, Scholes (1969) found that corporate insiders often have monopolistic access to information about their firm. At this moment, only corporate insiders and specialists who are able to access information have been studied. The results of these two studies supported the hypothesis of efficient markets.

There are several ways to test whether or not the foreign exchange market is efficient. For example, tests of whether excess

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[7] Eugene F. Fama, Lawrence Fisher, Michael Jansen and Richard Roll (1969) "The Adjustment of Stock Prices to New Information." *International Economic Review*, 10, February 1969, 1-21.

[8] Ray Ball and Phillip Brown (1968) "An Empirical Evaluation of Accounting Income Numbers." *Journal of Accounting Research*, 6, Autumn 1968, 159-178.

[9] Myron Scholes (1969) "A Test of the Competitive Hypothesis: The Market for New Issues and Secondary Offerings." Unpublished Ph.D. thesis, Graduate School of Business, University of Chicargo.

[10] Victor Niederhoffer and M. F. M.Osborne (1966) "Market Making and Reverse on the Stock Exchange." *Journal of the American Statistical Association*, 61, December 1966, 897-916.

returns are independent of the information available at time t or earlier is the first one. If price is considered from all information at time t so that only news that occurs during time t and t+1 will able to make price changes, then the market is efficient. If not, it means that information at time t helped to make abnormal returns and thus the market is inefficient. Second, test of whether actual "trading rules", buy when the price is low, and sell when the price is high, can earn supernormal profit after taking account of transaction costs and an amount to cover the systematic riskiness of the assets. The market will be considered efficient if the return from trading transactions is enough for traders to stay in business. This means only their cost and systematic risk is covered. Third, is a test of whether market prices are always equal to fundamental value, or whether price reflects the fundamental value. The answer is "yes" if the variation in actual prices is consistent with that dictated by the variability in fundamentals over time.

To concentrate only on our objectives, this study focuses on those empirical studies based on international finance relations. This is due to the test of market efficiency being a joint test hypotheses. One needs to state the market equilibrium price when one wants to test for efficient markets and those international finance relation theories serve this requirement.

The international financial relations under the models of the risk premium that have been applied to foreign currency are interest rate parity (IRP), purchasing power parity (PPP), the Fisher real interest equation and the forward rate unbisedness (FRU).

In this study, we will concentrate in CIP, UIP and FRU. The interrelationships between CIP, UIP and FRU is that when CIP and UIP hold simultaneously then the forward rate is an unbiased predictor of the future spot rate. In short, FRU also holds. General

speaking, if any two of the relationships of the set of CIP, UIP and FRU are true then the third will also be true.

Under the test of Efficient Market Hypothesis, the main feature is that there is no opportunity for traders to gain abnormal profit. If FRU does not hold, it implies that there is an opportunity for traders to speculate in the forward market. However, in the efficient market those unexploited profitable opportunites will be instantaneously eliminated so that FRU will hold at all times. FRU will hold in two cases. First from the active speculation as mentioned above. Second, FRU will hold if CIP holds. If both FRU and CIP hold, this implies that UIP will also hold.

The condition can also state that if UIP and FRU hold simultaneously, CIP will also hold. However, this study cannot directly test from CIP because of the data availability and quality of data. Under CIP, every transaction is assumed to be no risk, but in reality most of the transaction nowadays are arbitrage and speculation, which involve risk. The data acquired from the real world is closer to the definition of UIP than CIP.

The test of efficient markets in the prior studies in foreign exchange market, based on the theories of UIP and FRU, can be separated in to two groups. One is the empirical study based on UIP and the other is the empirical study based their study on FRU.

3.2.1 Test Under the Hypothesis of Forward Rate Unbiasedness

Hakkio[11] (1981) suggested a more efficient econometric technique for testing market efficiency that allowed the use of overlapping observations without inducing serial correlation in the

[11]Hakkio, C.S. (1981) "Expectations and the forward exchange rate", *International Economic Review*, 22, 663-78.

residuals. Former studies, Hodrick (1980) and Hakkio (1979), used OLS to estimate market efficiency and were faced with several obstacles. This study is different as the analysis was based on time series analysis of the spot and one month forward rate using a bivariate autoregression approach and notes that the efficient markets hypothesis implies certain nonlinear restrictions on the coefficient. The study also exploited the time series properties of the forecast errors. Using weekly data from 24 April 1973 to 5 May 1977 for the dollar relative to the Dutch guilder, the Deutschmark, the Canadian dollar, the Swiss franc and the Sterling, he concluded that the restriction implied by the efficient market hypothesis are not accepted. This study is a joint test of efficiency and the equilibrium model because test efficiency of the market requires an equilibrium model of pricing in the foreign exchange market which including specifying an information set. Hence, the rejection of the empirical test might be due to either a rejection of market efficiency or a rejection of the model being used, or both. In this study, it was shown that the rejection came from the model because the model proposed is not compatible with the data. The possible reason of rejection by the discrepant model might come from pure econometrics, theory, or both. From an econometric position, the cause of the rejection might come from a vector autoregression, which possessed few lagged terms and resulted in biased test statistics. From the theory portion, the theory used to develop the hypotheses was taken from the theory of efficient markets in finance, which is a theory that initiated from US stock market basis. There are many differences between the US stock market and the foreign exchange market. The vital difference is that the US stock market is much more regulated that the foreign exchange market. Second, the assumption of constant risk premium might not exist. Third, the model did not include irrational behavior from oil shocks. Any of these reasons could explain the finding that the market was inefficient with respect to the model imposed.

Baillie et al[12] (1983) also used the bivariate approach. In this study, 30-day forward rate and spot exchange rate are modelled as an unrestricted bivariate autoregression from weekly data on the New York foreign exchange market for June 1973 to April 1980. This test for efficiency is also a joint hypothesis that concluded the assumption of rational expectations and the assumption of zero forward risk premium. They estimated equation by using OLS and then used a nonlinear Wald test to test the restrictions implied by the efficient market hypothesis. Again the null hypothesis that the forward rate is an unbiased predictor of the future rate is rejected for all six currencies considered, which were the currencies of the U.K., West Germany, Italy, Switzerland, Canada and France. Those currencies were recorded in term of their value against the US dollar. The rejection of joint hypothesis can be interpreted either as the assumption of rational expectations is inappropriate or the assumption of risk neutrality is invalid, or both. The interpretation of hypothesis rejection in this study is different from that of Hakkio (1981), which indicated that it results from an inadequate alternative model specification. In this study, they believe that it is a result from a biased forward rate. In other words, the assumption that the forward rate contains all relevant information necessary to forecast the future spot rate is inappropriate.

MacDonald[13] (1983) stated that the reason that the forward rate is inaccurate to forecast future spot rate might caused by "news" which is unpredictable and happens during that period and/or using OLS might be inefficient to estimate the equation for the following reason. The OLS technique fails to take account of the probable joint distribution of the error terms. Usually in those empirical studies sets

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[12] Balie, R.J., Lippens, R.E. and McMahon, P.L. (1983) "Testing rational expectations and efficiency in the foreign exchange rate market", *Econometrica*, 51, 553-63.

[13] MacDonald, R. (1983) "Some test of rational expectations hypothesis in the foreign exchange market", *Scottish Journal of Political Economy*, 30:3, 235-50.

of exchange rates relative to the dollar are used. However, given that we would expect that shocks emanating form the US would affect all exchange rates used, then similar correlation could result from the operation the European Monetary System which tied European currencies together. Such contemporaneous correlation across regression implies that the coefficients might not be efficient and that using Zellner's[14] (1962) SURE method of estimation could derive more efficient estimates. He used quarterly data from 1972 quarter I to 1979 quarter IV to test of the rational expectations in six foreign exchange market. Those markets are Canada, Germany, Switzerland, France, U.K., and Australia. The test of impact of news the SURE results indicate that the null of efficiency can be rejected for four out of the six currencies, Australia, Switzerland, Canada, and France, while the OLS estimates reject only three currencies not including France from those of SURE. The way which he interpreted his result was the same as other two economists, Hakkio[15] (1981) and Baillie et al[16] (1983), that the rejection of joint hypothesis may came from one of the two hypotheses. In this case, the joint hypothesis is the tests of expectation are rational and the test of forward rate is the mean value of individual expectation distribution. So the rejection may come form an incorrect expectation specification or individuals were inefficient information processors. He noted that it is caused by the later reason.

Ito[17] (1995) examined survey data of exchange rate forecasts to test the extent to which individual forecasters would have made

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[14] Zellner, A. (1962) "An efficient method of estimating seemingly unrelated regressions and tests of aggregation bias", *Journal of the American Statistic Association*, 57: 348-368.

[15] Hakkio, C.S. (1981) "Expectations and the forward exchange rate", *International Economic Review*,22,663-78.

[16] Balie, R.J., Lippens, R.E. and McMahon, P.L. (1983) "Testing rational expectations and efficiency in the foreign exchange rate market", *Econometrica*, 51, 553-63.

[17] Ito, Takaposhi and Elliott, Graham (1995) "*Heterogeneous Expectations and Tests of Efficiency in the Yen/Dollar Forward Foreign Exchange Rate Market*" NBER working paper series No. 5376. National Bureau of Economic Research, Inc.

profits by assuming that a trading rule dependent on a sign relationship between the forward rate and the expected exchange rate. Since betting on the forward would produce profit, there is a case that the forward rate is biased from the ex post spot rate. In short, forward rate is a bias predictor of spot rate. The data was obtained from May 1985 until the end of May 1995, which were composed of forecasts of the future spot yen/dollar exchange rate for one, three and six months. The survey data was gained from 44 companies and the conclusion from the survey was that the firms had made statistically significant profits following a simple trading rule using their perspective forecast. Such profits are small in magnitude and highly valuable. Generally, many firms had earned excess profit when they based their forecast on the relative position of the subjective forecast to the forward rate. The study showed that the market is inefficient.

Lin Wu[18] (1997) investigated the efficiency in Taiwan's foreign exchange market using the method of Gregory and Hansen (1996)[19] that allows for a one-time break in the linear long-run relationship between spot and forward exchange rates and method of Stock and Watson (1993)[20], which examines the significance of cointegrating coefficients. The test assumed that if the foreign exchange market was efficient, the expectations concerning future exchange rates should be incorporated and rapidly reflected in forward rate. The unbiased property implicit in market efficiency and the test of the efficiency hypothesis can be written in the form of cointegrating regression as:

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[18] Lin Wu, Jyh (1997) " Foreign Exchange Market Efficiency and Structural Instability: Evidence from Taiwan" *Journal of Macroeconomics*, Vol. 19, No. 3: 591-607.

[19] Gregory, Allan W.,and Bruce E. Hansen. "Residual Based Tests for Cointegration in Models with Regime Shifts." *Journal of Econometrics* 70 (January 1996) 99-126.

[20] Stock, James, and Mark W. Watson. "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems." *Econometrica* 61 (July 1993) 783-820.

$$S_{t+k} = \alpha + \alpha_1 D_t + \beta F_{t,k} + \beta_1 F_{t,k} D_t + \varepsilon_{t,k}$$

Where;

D	is the dummy variable, $D_t = 0$ if $t \leq \tau$ and $D_t = 1$ if $t > \tau$.
τ	is the timing of the change point.
α and β	are the cointegrating intercept and slope coefficients before the regime shift.
α_1 and β_1	are the change in the intercep, and slope coefficients at the time of the shift.

The monthly data run from March 1980 to March 1989. The study applied Johansen's multivariate cointegration technique to test for cointegration between spot and the forward rates. The study noted that the structural inability of forward market led to the rejection of market efficiency. This means the outcome of the study showed that the market was inefficient and the hypothesis of market efficiency is uniformly supported when we restrict the sample to a period without regime changes.

In a case of Thailand, Thongkhundam[21] (1996) tested the efficiency of the future market in Thailand useing cointegration and error correction model. The result from this study concluded that Thailand's foreign exchange market is not efficient, that is, the joint hypothesis of rational expectation and risk neutral is rejected. The inefficiency of Thailand forward foreign exchange market can be explained by some factors such as a small size market, irrational expectation of investors and risk premium.

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[21] Parichat Thongkhundam (1996) "*Efficiency in Thailand forward foreign exchange market: cointegrattion and error correction model*" Master of Economics, Chulalongkorn University (in Thai).

3.2.2 Test Under the Hypothesis of Uncovered Interest Parity

Cumby et al[22] (1981) tested the Fisher hypothesis* that nominal interest differentials between similar assets denominated in different currencies can be explained entirely by the expected change in the exchange rate over the holding period. The tests are joint tests of Fisher hypothesis and a weak form of foreign exchange market informational efficiency. They used weekly observations on exchange rates and interest rates. Interest rate differential was obtained from one-week yield on seven-day London Eurodollar price of foreign currency and seven-day London Euro-deposits denominated in the foreign currency. They tested for Fisher parity between US dollar deposits and deposits denominated in Canadian dollars, French francs, Deutsche marks, Dutch guilders, Swiss francs, and Pounds sterling. The data are obtained from 5 July 1974 to 27 June 1980. They performed two statistical tests, which were the standard Q test and the likelihood ration test. They first performed the standard Q test as

$$Q(k) = n\sum_{i=1}^{k} \hat{c}_i^2$$

Where;

$\hat{c}_i = \sum \varepsilon_t \varepsilon_{t-i} / \sum \varepsilon^2_t$

n is the sample size.

k is an increasing function of n.

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[22] Cumby, Robert F. and Obstfeld, Mourice (1981) "A Note of Exchange Rate Expectation and Norminal Interest Differentials: The test of Fisher's Hypothesis." *The Journal of Finance*, 81,8, June 1981, 697-703.

* The Fisher parity or Uncovered Interest Parity (UIP) stated that the norminal interest differentials between similar asset denominated in differential currencies could be explained entirely by the expected change in the exchange rate over the holding period. The Fisher parity is different from Covered Interest Parity that it involves risk in the essential way.

Q(k) is asymptotically distributed as χ^2 with k degree of freedom.

The null hypothesis is that ε_t are serially uncorrelated.

$$\Lambda(L)\varepsilon_t = \zeta_t$$

Where;

$$\Lambda(L) = \sum_{i=0}^{\alpha} \rho_i L_i$$

and is a polynomial the lag operator, $\rho_0 = 1$.

ξ is white noise process.

The null hypothesis is $\Lambda(L) = 1$.

The result showed that both two statistical procedures yield essentially the same conclusion. Both suggested that Fisher-parity relationship does not hold. This means the foreign exchange market efficiency is consistent with the existence of risk premium at equilibrium. The evidence against the hypothesis of perfect asset substitutability is weakest in the case of the United Kingdom. They stated that deviations from Fisher Parity appeared to be highly autocorrelated and so they did not behave as expectational errors. They believed that it came from the inefficiency of the market.

McCurdy and Morgan[23] (1991) used the alternative to the Martingale process, which was provided by the Intertemporal Asset Pricing Model (IAPM). They used foreign currency spot prices and Eurocurrency interest rates to construct a time series of weekly excess

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[23] McCurdy, H. Thomas and Morgan, Ieuan G. (1991) "Tests for a Systematic Risk Component in Deviations From Uncovered Interest Rate Parity" *Review of Economic Studies*, 58, 587-602.

returns on an uncovered foreign currency position, which they refer to as deviations from UIP. They predicted interdependence between the conditional mean of deviations from UIP and the relevant conditional covariance with the benchmark portfolio by using GARCH formulation.

They used an average interest rate differential as an instrument for predicting the benchmark portfolio excess return under the following equation.

$$E_{t-1}\left[R^{*}_{st}\right] = \frac{\mathrm{cov}_{t-1}\left[R^{*}_{bt}, R^{*}_{st}\right]}{\mathrm{var}_{t-1}\left[R^{*}_{bt}\right]} E_{t-1} R^{*}_{bt}$$

Where;

R^{*} indicates a return in excess of the riskless rate.

They used daily observations on foreign currency spot prices and Euro currency 7-day interest rates were used to construct a time series of weekly deviations from Uncovered Interest Parity (UIP). The range of data was from 1980 to 1988 inclusive.

The result was in favour of the conditional beta measure of time varying risk premia for all five currencies: pound sterling, Canadian dollars, Deutsche marks, Japanese Yen and Swiss francs. In other words, the outcome indicated significant conditional systematic risk. The result deviated from Uncovered Interest Parity (UIP) and that implied an inefficient market.

Flood and Rose[24] (1996) tested the efficiency in foreign exchange markets based on the Uncovered Interest Parity (UIP) with floating

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[24] Flood, Robert P. and Rose, Andrew K. (1996) "Fixes: of the Forward Discount Puzzle" *The Review of Economics and Statistics*, Vol. 50, The MIT Press.

exchange rate currencies and the European Monetary System (EMS) realignments, to see their differences. Assuming ration expectations, the equation that used to test is

$$S_{t+\Delta} - S_t = \alpha + \beta(i-i^*)_t + \varepsilon_t$$

Where;

S	is the natural logarithm of s.
$(i-i^*)_t$	is the interest rate differential between domestic and foreign interest rates at time t.
ε_t	is the forecasting error realized at $t+\Delta$ from a forecast of the exchange rate made at time t.
α and β	are regression coefficients.

They used OLS to estimate β because they wanted to focus attention on the data rather than the estimation technique. Even though OLS is not fully efficient estimator, it is a standard choice.

The null hypothesis is

$$H_0 = \alpha = 0, \beta = 1$$

They estimated two different data sets: one for flexible exchanges vis-à-vis the US dollar, one for fix exchange rate: Australia, Canada, France, Germany, Japan, Switzerland and the United Kingdom. Both data sets consisted of daily observations on exchange and interest rates from 1981 through early October 1994. The result came out that Uncovered Interest Parity (UIP) was much better under fixed exchange rate system than under floating exchange rate system, even though both data sets exhibited significant deviation from Uncovered Interest Parity (UIP). In short, both foreign exchange markets where they obtained data sets were inefficient.

Meredith and Chinn[25] (1998) tested Uncovered Interest Parity (UIP) using interest rates on longer-maturity bonds for the G-7 countries. Their test was performed in a way different to others. This was due to the others having been tested by using financial instruments with relatively short maturity – 12 months or less. Under Uncovered Interest Parity (UIP) hypothesis, the equation was

$$\Delta S_{t,t-k} = \alpha + \beta(i-i^*)_{t,k} + \varepsilon_{t,t-k}$$

Where;

$\Delta S_{t,t-k}$ is the forecast error of the price of foreign currency in units of domestic currency at time t-k, equal to $S_{t,t-k} - \Delta S^e_{t,t-k}$

$(i-i^*)_{t,k}$ is the corresponding yield on the foreign instrument differential, interest rate differential for a contract expiring k from now, t.

They used data from the benchmark government bond yields 10-year maturity. After 10-year lags, the available data was from first quarter of 1983 until first quarter of 1998.

The result of regression was that the Canadian dollar, Deutsche mark and the franc were statistically rejected by the hypothesis. The result suggested that risk premium shocks are capable of explaining the main factors regarding Uncovered Interest Parity (UIP). All of the coefficients of the long run maturity instruments had the correct sign. Furthermore, almost all of the coefficients on interest rates were closer to the Uncovered Interest Parity (UIP) value of unity than to a zero coefficient implied by random walk hypothesis.

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[25] Meredith, Guy and Chinn, Menzie D. (1998) "*Long-horizon Uncovered Interest Rate Parity*" NBER working paper 6797, National Bureau of Economic Research, Inc.

In conclusion, the result of long run exchange rate movement were driven by the fundamentals leading to a relationship between interest rates and exchange rates that is more consistent with Uncovered Interest Parity (UIP) far more than the outcome of short run empirical studies. This is the result of risk premium shock from endogenous monetary policy.

Nuchpong[26] (1997) considers the topic of the relation between exchange rate and the differential of real interest rate. She used OLS and cointegration (Engle-granger) method to study. The result of her study found that there is only one case that accepted the hypothesis. The case showed the relationship between Thailand and US. Other cases rejected the hypothesis using OLS. The result from using cointegration was different. It came out that every hypothesis was rejected. This means there is no long run relationship between exchange rate and the differential of real interest rate.

From all the above empirical studies, the findings reject testing the FRU hypothesis and the UIP hypothesis under the maintained hypothesis of a time invariant (constant) risk premium. The rejection of FRU and UIP is found to hold at several horizons, over quite a wide variety of alternative information sets, across different currencies and over several time spans of data. Although the hypothesis that the forward rate is a unbiased predictor of the future spot rate has usually been rejected, the rejection can be explained by time-varying risk premium switches, speculative bubbles, the "peso problem"*, or the failure of the maintained rational expectation.

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[26] Rakchanok Nuchpong (1997) "The relationship between exchange rate and differential of real interest rate" Master of Economics, Thamasat University (in Thai).

* The peso problem is the possibility that the market expectations are reflected from the risk of large events that do not actually occur over the sample period. This will effect or bias the result of the test.

However, none of the studies above test for the efficiency of the Thai foreign exchange market under the hypothesis of Forward Rate Unbiasedness (FRU) and Uncovered Interest Parity (UIP) in the same model.

In general the recent studies testing the FRU hypothesis and the UIP hypothesis are base on Ordinary Least Square (OLS) and Cointegration Analysis technique estimation. Recently most studies start to recognize the importance of the cointegration literature when formulating the variables to include in the VAR methodology. In our case, the study will apply VAR (Vector Autoregressive) methodology that is a technique capable to test efficiency in the foreign exchange markets using UIP and FRU conditions. The special feature of the VAR approach is that it can be applied to any theoretical model involving multiperiod forecasts, which is linear in the variables. Hence, in our study we will use VAR methodology to test risk neutrality based on FRU and UIP over multiperiod forecast horizons.