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Efficiency Tests in Foreign Exchange Market

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ABSTRACT: The main purpose of the paper is applying filter rules to examine the efficiency of foreign exchange. This paper uses three strategies of filter rules (buy long, sell short, buy long and sell short strategies) to test the performance of the transaction for EUR, JPY, GBP. The findings show that people will obtain more return by taking buy long/sell short strategies of filter rules without considering transaction cost. However, the transaction of these three foreign exchange rate (EUR, JPY, GBP) will be more efficient by considering transaction cost. The results imply the foreign exchange market is efficient for the EUR, JPY and GBP.

Keywords: Filter rule; Foreign exchange; Market efficiency
JEL Classification : F30; F31; G14

1. Introduction

Efficient Market Hypothesis (EMH) relies on the efficient exploitation of information by economic actors. EMH is also referred as Informational Efficiency (Hallwood and MacDonald, 1994). Therefore, an asset market is efficient if the asset price fully reflects all available information. EMH requires that market agents have rational expectations and there is no transaction cost that averts them from buying and selling assets. (Giannellis and Papadopoulos, 2009). Predictability is a perplexing matter in financial markets, and even more so in efficient financial markets. There might be several reasons why the markets are not efficient (Azad, 2009). First, the prices in these markets do not quickly adjust to the new information (Fama, 1970). Second, the prices in this market are not set at the equilibrium level due to distortions in the pricing of capital and the valuing of risk (Smith et al., 2002). Third, the emergence of a parallel/ black market due to the existence of the exchange rate controls and resulting divergence between the equilibrium rate and the official rate.(Diamandis et al., 2007).

Foreign exchange market efficiency is an important consideration for all currency market participants. If exchange rate markets are efficient, then the current rate is hypothesized to incorporate all the information in past rates. Especially, market efficiency implies zero serial correlations in exchange rate changes. Fama (1984) states that a foreign exchange market is efficient if fully reflect all available information. A weaker-form efficient market, presented by Jensen (1978), states that an efficient market reflects information up to the point where the marginal benefit of information does not exceed the marginal cost of collecting it.

Whether or not foreign exchange rate market is efficient has been extensively investigated in the past. Grossman and Stiglitz (1980) argue that perfect informationally efficient markets are impossible, because if markets are perfectly efficient the profits from trading on information would be zero while the cost of gathering and trading on information is positive. Meese and Singleton (1982), Corbae and Ouliaris (1986) and Coleman (1990) find unit roots in major foreign exchange rates, and claim that foreign exchange rates follow a random walk process. McQueen (1992) and Chow and Denning (1993) perform a joint variance ratio test and all find evidence supporting the random walk hypothesis in stock prices. But the Liu and He (1991) and Ajayi and Karemera (1996) reject the random walk hypothesis in major and Asian foreign exchange rates.

In this paper, we adopt filter rule by Fama and Blume (1966) and Sweeney's (1988) to test the market efficiency of the foreign exchange market. This paper uses three strategies of filter rules (buy long, sell short, buy long and sell short strategies) to test the performance of the transaction for Euro

dollars(EUR), Japanese yen(JPY), great Britain pound (GBP). And the paper is to take one step ahead compared with three filter rules on the EUR, JPY and GBP.

The remainder of this paper is organized as follows. Section 2 is presenting the relate literatures on foreign exchange market efficiency. Section 3 describes the data and methodology. Section 4 then discusses the empirical results. Finally, section 5 summarizes the findings and presents conclusions.

2. The Literature on Foreign Exchange Market Efficiency

The recent studies present that the foreign exchange market is efficient and different kinds of methodologies and data frequencies are used to explain the efficiency of the foreign exchange market. For example, Fama (1984), who examines efficiency in nine exchange rates (nine currencies against US dollar), use OLS estimation which shows the market efficiency hypothesis is not accepted because of a time-varying risk premium. Hakkio and Rush (1989) examine the efficiency hypothesis for the UK pound and the Deutsche mark. They find that spot and forward rates within a country are cointegrated, which is consistent with efficiency. Wu and Chen (1998) test the foreign exchange market efficiency for nine OECD countries. He finds that supports the hypothesis of foreign exchange market efficiency. Zivot (2000) tests the foreign exchange market efficiency for the British pound, Japanese yen, and Canadian dollar against US dollar. He finds that cointegration analysis in the first case, estimating a VECM, strongly rejects the efficiency hypothesis in all exchange rates. Aroskar et al.(2004) this study investigates the impact on foreign exchange market efficiency of the European financial market crisis in 1992 by studying pre-crisis, crisis, and post-crisis periods. The results above show that market inefficiency is strong. Giannellis and Papadopoulos (2009) propose an alternative way of testing FOREX efficiency for developing countries. This paper finds that no evidence of nonlinear adjustment in the misalignment series. Beside, linear unit root tests imply that the Poland/Euro FOREX market is efficient; the Czech/Euro FOREX market is not, while the Slovak/Euro FOREX market is quasi-efficient. Chiang et al.(2010) uses three methods to re-examine the validity of the weak-form efficient market hypothesis for foreign exchange markets in four floating-rate markets in Asian economies (Japan, South Korea, Taiwan and the Philippines). This paper shows that the random walk patterns of the exchange rate return rate series cannot be rejected, except Taiwan, where inefficiency is shown to be most prominent. The paper concludes that the foreign exchange markets in Japan, South Korea and the Philippines are weak form efficient, while the foreign exchange market of Taiwan is inefficient.

3. Data and Methodology

3.1 Research sample and period

This paper tests the foreign exchange market efficiency for the Euro dollars(EUR), Japanese yen(JPY), great Britain pound (GBP). The research period of this study is from January 2, 2003 to December 30, 2009, a period which provides a total of 1713 observations. The data used in this study are taken from the foreign exchange index of the Taiwan Economic journal (TEJ) database.

3.2 Methodology

The testing methods of the paper are by the Fama and Blume (1966) proposed "buy long / short" rules, and Sweeney's (1988) "buy long" rule and "short" rule. The following describes the meaning of the three operating principles and methods. Filter rule used in this study the ratio of top and bottom of filter size set (l%, 1%), (1.5%, 1.5%) and (2% 2%) combination of 3 parameters for testing.

1. Buy long rule

(1) When the currency more than one pre-determined percentage of filter size x%, a fact that is determined by the impact of currency prices to keep rising, this time the buy and hold the currency, known as "buying long. "

(2) Occurs when the currency price rally fell back, and fell more than the highest point of the previous x%, then predicted currency price will continue to decline, at this time that originally held the currency sold and the cash received switch to risk-free investment. Until the currency price go up again and raised more than the previous lowest point of the x % and then buy the currency.

(3) Filter rules continued to operate and in operation less than x% application will not be considered currency price changes, regarded as noise, namely, x% of the filter rule to buy long.

2. Short-selling rule

(1) When the currency price fell by more than one pre-determined percentage of filter size x%, a fact that is determined by the impact of currency prices will continue to decline, then has sold the currency, known as "short selling"

(2) When the currency price decline rebound, and rose more than the highest point of the previous x%, the share price is forecast to keep rising, this time covering short selling borrowed currency, until the price rose after the twisted back, and fell more than the previous. The highest point of the x% and then sell the currency when the pill.

(3) Filter rules continued to operate during the operation x% lower than the price movement will not be considered, be regarded as noise, namely x% of the filter rule to short sell.

3. Buy long /Short-selling rule

(1) When the currency price more than one pre-set ratio of x%, a fact that is determined by the impact of currency prices to keep rising, this time the buy and hold the currency is called a buy long ", while the ratio of x% Filter that is in the process to determine the facts of rising currency prices occurred.

(2) When currency prices fell back, and fell more than the highest point of the previous x%, then the predicted currency price will continue to decline, then that is selling the original holding of currency lending transactions engaged in short selling until the currency price go up again or more than the previous lowest point of the x% to buy currency again when, and covering short selling borrowed currency, this time called "short selling".

(3) Filter rules continued to operate and within the course of the operation x % lower than the price movement will not be considered, be regarded as noise, namely x% of the purchase long / short filter rule.

4. Empirical Results

4.1 Buy long-strategy

4.1.1. Euro Dollars (EUR)

The filter rule is implemented where by the foreign currency is purchased (sold) when it falls (rises) by x % over the period. Three filter sizes are implemented where f have values of 1%, 1.5%, and 2%. According to the buy long strategy, the results from applying the three different filter sizes for the Euro dollars are present in Table 1-A. As the filter size is 2%, the average return rate is highest (0.436%). As the filter size is 1.5%, the average return rate is lowest (-0.454%). By using filter size to the buy long strategy, the average return rates are not significantly greater than zero for the Euro dollars.

Table 1-B shows the comparison of the average return rate while applying buy long strategy and different filter sizes for the Euro dollars. Compared the filter size 1% with the filter size 1.5%, the T-value is 1.188 and it is not significant. Compared the filter size 1% with the filter size 2%, the T-value is -0.403 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is 0.968 and it is not significant.

Table 1. The buy long strategy by filter rule for the EUR

1-A The buy long strategy for any filter size

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	90	49	24
average return	0.087%	-0.454%	0.436%
standard deviation	2.249%	2.727%	4.081%
t Value	0.369	-1.166	0.524

1-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	1.188		
(2% , 2%)	-0.403	0.968	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level,*: significant at the 1% table under the significant level.

4.1.2. Japanese Yen (JPY)

The filter rule is implemented where by the foreign currency is purchased (sold) when it falls (rises) by x% over the period. Three filter sizes are implemented where f have values of 1%, 1.5%, and 2%. According to the buy long strategy, the results from applying the three different filter sizes for the Japanese yen are present in Table 2-A. As the filter size is 1.5%, the average return rate is highest (0.06%). As the filter size is 1%, the average return rate is lowest (-0.393%). By using filter rule to the buy long strategy, the average return rates are not significantly greater than zero for the Japanese yen.

Table 2-B shows the comparison of the average return rate while applying buy long strategy and different filter rules for the Japanese yen. Compared the filter size 1% with the filter size 1.5%, the T-value is -1.989 and it is significant. Compared the filter size 1% with the filter size 2%, the T-value is -0.966 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the T-value is 0.327 and it is not significant.

Table 2. The buy long strategy by filter rule for the JPY

4-2-A The buy long strategy for any filter size

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	174	18	34
Average return	-0.393%	0.306%	0.106%
Standard deviation	1.280%	1.432%	2.960%
t Value	-4.047	0.906	0.210

4-2-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	-1.989***		
(2% , 2%)	-0.966	0.327	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

4.1.3. Great Britain Pound (GBP)

The filter rule is implemented where by the foreign currency is purchased (sold) when it falls (rises) by x% over the period. Three filter sizes are implemented where f have values of 1%, 1.5%, and 2%. According to the buy long strategy, the results from applying the three different filter sizes for the British pound are present in Table 3-A. As the filter sizes is 2%, the average return rate is highest (1.196%). As the filter size is 1.5%, the average return rate is lowest (-0.486%). By using filter size is 2% to the buy long strategy; the average return rates are significantly greater than zero for the British pound.

Table 3-B shows the comparison of the average return rate while applying buy long strategy and different filter sizes for the British pound. Compared the filter size 1% with the filter size 1.5%, the t value is 0.850 and it is not significant. Compared the filter size 1% with the filter size 2%, the t-value is -1.208 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the T-value is -1.548 and it is significant.

Table 3. The buy long strategy by filter rule for the GBP

3-A The buy long strategy for any filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	91	38	19
Average return	0.075%	-0.486%	1.196%
Standard deviation	2.291%	3.787%	3.905%
t Value	0.312	-0.791	1.335*

3-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	0.850		
(2% , 2%)	-1.208	-1.548*	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

4.2 Short sell rules

4.2.1. Euro Dollars (EUR)

The filter rule is implemented where by the foreign currency is sold (purchased) when it rises (falls) by x% over the period. Three filter sizes are implemented where f have values of 1%, 1.5%, and 2%. According to the short sell strategy, the results from applying the three different filter sizes for the Euro dollars are present in Table 4-A. As the filter size is 1.5%, the average return rate is highest (1.119%). As the filter size is 1%, the average return rate is lowest (0.303%). By using filter size is 1% and 1.5% to the short sell strategy, the average return rates are significantly greater than zero for the Euro dollars.

Table 4-B shows the comparison of the average return rate while applying short sell strategy and different filter sizes for the Euro dollars. Compared the filter size 1% with the filter size 1.5%, the t-value is -1.736 and it is significant. Compared the filter rule 1% with the filter size 2%, the t-value is -0.895 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is 0.014 and it is not significant.

Table 4. The short sell strategy by filter rule for the EUR

4-A The short sell strategy for any filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	89	47	24
Average return	0.303%	1.119%	1.105%
Standard deviation	1.653%	2.991%	4.304%
t Value	1.729**	2.566***	1.258

4-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	-1.736**		
(2% , 2%)	-0.895	0.014	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

4.2.2. Japanese Yen (JPY)

The filter rule is implemented where by the foreign currency is sold (purchased) when it rises (falls) by x% over the period. Three filter sizes are implemented where f have values of 1%, 1.5%, and 2%. According to the short sell strategy, the results from applying the three different filter sizes for the Japanese yen are present in Table 5-A. As the filter size is 2%, the average return rate is highest (0.951%). As the filter size is 1.5%, the average return rate is lowest (0.418%). By using filter size is 1% and 2% to the buy long strategy; the average return rates are significantly greater than zero for the Japanese yen.

Table 5-B shows the comparison of the average return rate while applying short sell strategy and different filter sizes for the Japanese yen. Compared the filter size 1% with the filter size 1.5%, the t-value is 0.185 and it is not significant. Compared the filter size 1% with the filter size 2%, the t-value is -0.797 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is -0.693 and it is not significant.

Table 5. The short sell strategy by filter rule for the JPY

5-A The short sell strategy for any filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	169	17	37
Average return	0.523%	0.418%	0.951%
Standard deviation	1.088%	2.293%	3.226%
t Value	6.249***	0.752	1.793**

5-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	0.185		
(2% , 2%)	-0.797	-0.693	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

4.2.3. Great Britain Pound (GBP)

The filter rule is implemented where by the foreign currency is sold (purchased) when it rises (falls) by x% over the period. Three filter sizes are implemented where f have values of 1%, 1.5%, and 2%. According to the short sell strategy, the results from applying the three different filter sizes for the British pound are present in Table 6-A. As the filter size is 1.5%, the average return rate is highest (0.463%). As the filter size is 2%, the average return rate is lowest (-0.784%). By using filter size to the short sell strategy, the average return rates are not significantly greater than zero for the British pound.

Table 6-B shows the comparison of the average return rate while applying short sell strategy and different filter sizes for the British pound. Compared the filter size 1% with the filter size 1.5%, the t-value is -0.836 and it is not significant. Compared the filter size 1% with the filter size 2%, the t-value is 0.931 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is 1.255 and it is not significant.

Table 6. The short sell strategy by filter rule for the GBP

6-A The short sell strategy for any filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	94	38	21
Average return	0.063%	0.463%	-0.784%
Standard deviation	1.803%	2.716%	4.082%
t Value	0.339	1.051	-0.880

6-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	-0.836		
(2% , 2%)	0.931	1.255	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

4.3 Buy long / short sell rules

4.3.1. Euro Dollars (EUR)

The filter rule is implemented where by the foreign currency is purchased and sold (sold and purchased) when it falls and rises (rises and falls) by x% over the period. Three filter sizes are implemented where x% have values of 1%, 1.5%, and 2%. According to the buy long/short sell strategy, the results from applying the three different filter sizes for the Euro dollars are present in Table 7-A. As the filter size is 2%, the average return rate is highest (0.862%). As the filter size is 1%, the average return rate is lowest (0.194%). By using filter size is 1% and 2% to the buy long/short sell strategy, the average return rates are significantly greater than zero for the Euro dollars.

Table 7. The buy long / short sell strategy by filter rule for the EUR

7-A The buy long / short sell strategy for any filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	189	96	48
Average return	0.194%	0.306%	0.862%
Standard deviation	1.972%	2.949%	4.339%
t Value	1.356*	1.018	1.377*

7-B t-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	-0.335		
(2% , 2%)	-1.039	-0.800	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

Table 7-B shows the comparison of the average return rate while applying buy long/short sell strategy and different filter sizes for the Euro dollars. Compared the filter size 1% with the filter size 1.5%, the t-value is -0.335 and it is not significant. Compared the filter size 1% with the filter size 2%, the t-value is -1.039 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is -0.800 and it is not significant.

4.3.2. Japanese Yen (JPY)

The filter rule is implemented where by the foreign currency is purchased and sold (sold and purchased) when it falls and rises (rises and falls) by x% over the period. Three filter sizes are implemented where x% have values of 1%, 1.5%, and 2%. According to the buy long/short sell strategy, the results from applying the three different filter sizes for the Japanese yen are present in Table 8-A. As the filter size is 2%, the average return rate is highest (0.542%). As the filter size is 1%, the average return rate is lowest (0.076%). By using filter size is 2% to the buy long/short sell strategy, the average return rates are significantly greater than zero for the Japanese yen.

Table 8-B shows the comparison of the average return rate while applying buy long/short sell strategy and different filter sizes for the Japanese yen. Compared the filter size 1% with the filter size 1.5%, the t-value is -1.036 and it is not significant. Compared the filter size 1% with the filter size 2%, the t-value is -1.158 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is -0.168 and it is not significant.

Table 8. The Buy long / short sell strategy by filter rule for the JPY

8-A The buy long / short sell strategy for any filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	343	35	71
Average return	0.076%	0.453%	0.542%
Standard deviation	1.456%	2.100%	3.325%
t Value	0.969	1.276	1.374*

8-B T-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	-1.036		
(2% , 2%)	-1.158	-0.168	

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

4.3.3. Great Britain Pound (GBP)

The filter rule is implemented where by the foreign currency is purchased and sold (sold and purchased) when it falls and rises (rises and falls) by x% over the period. Three filter sizes are implemented where x% have values of 1%, 1.5%, and 2%. According to the buy long/short sell strategy, the results from applying the three different filter sizes for the British pound are present in Table 9-A. As the filter size is 2%, the average return rate is highest (0.172%). As the filter size is 1.5%, the average return rate is lowest (0.061%). By using filter size to the buy long/short sell strategy, the average return rates are not significantly greater than zero for the British pound.

Table 9-B shows the comparison of the average return rate while applying buy long/short sell strategy and different filter sizes for the British pound. Compared the filter size 1% with the filter size 1.5%, the t-value is 0.276 and it is not significant. Compared the filter size 1% with the filter size 2%, the t-value is -0.195 and it is not significant. Compared the filter size 1.5% with the filter size 2%, the t-value is -0.331 and it is not significant.

Table 9. The Buy long / short sell strategy by filter rule for the GBP

9-A The buy long / short sell strategy for any filter size

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
N	185	76	40
Average return	0.052%	-0.061%	0.172%
Standard deviation	2.101%	3.316%	3.754%
t Value	0.339	-0.160	0.290

9-B T-value for the comparison of different filter sizes

filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
(1% , 1%)			
(1.5% , 1.5%)	0.276		
(2% , 2%)	-0.195	-0.331	

Note: ***: significant at the10 % table under the significant level,**: significant at the5 % table under the significant level,*: significant at the 1% table under the significant level.

4.4 Comparison of various rules

The table 10-A shows the compared with three rule, the average return rate of each filter size on the Euro dollars. As the filter size is 1% and 2%, show that the three filter rules are not difference significant. As the filter size is 1.5%, show that the buy long/short sell strategy is the best. The table 10-B show the compared with three rule, the average return rate of each filter size on the Japanese yen. As the filter size is 1.5% and 2%, show three filter rules are not difference significant. As the filter size is 1%, show that the buy long/short sell strategy is the best. The table 10-C show the compared with three rule, the average return rate of each filter size on the British pound. As the filter size is 1% and 1.5%, show that the three filter rules are not difference significant. As the filter size is 2%, show that the buy long strategy is the best. To sum up, the buy long/short sell strategy is the best strategy in the three filter rules. Use the filter rule can make excess returns in the foreign market.

Table 10. Comparison of various rules

10-A EUR			
filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
buy VS sell	-0.732	-2.691***	-0.553
buy VS buy/sell	-0.387	-1.546*	-0.409
sell VS buy/ sell	0.479	1.534*	0.225
10-B JPY			
filter sizes	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
buy VS sell	-7.146 ***	-0.173	-1.150
buy VS buy/sell	-3.755 ***	-0.300	-0.677
sell VS buy/ sell	3.891 ***	-0.052	0.619
10-C GBP			
Filter size	(1% , 1%)	(1.5% , 1.5%)	(2% , 2%)
buy VS sell	0.039	-1.255	1.568*
buy VS buy/sell	0.079	-0.588	0.953
sell VS buy/ sell	0.044	0.901	-0.894

Note: ***: significant at the10 % table under the significant level, **: significant at the5 % table under the significant level, *: significant at the 1% table under the significant level.

5. Conclusions

The main purpose of the study use filter rule to examine the efficiency of foreign exchange market. The paper discussed EUR, JPY and GBP. There are two empirical findings as follows: First, as the filter size is 2%, the average return is almost highest. The results imply filter size is higher, it will

easily to earn the excess returns. Second, under the three filter rules the buy long/short sell strategy is the best strategy in these rules. The findings show that people will obtain more return by taking buy long/ sell short strategies of filter rules without considering transaction cost. However, the transaction of these three foreign exchange rate (EUR, JPY, GBP) will be more efficient by considering transaction cost. The results imply the foreign exchange market is efficient on the EUR, JPY and GBP. Our findings are the same as Fama (1984), Zivot (2000), and Giannellis and Papadopoulos (2009) mentioned.

References

Ajayi, R.A., Karemera, D., (1996). A variance ratio test of random walks in exchange rates: evidence from Pacific Basin economies. *Pacific-Basin Finance Journal,* 4(1), 77–91.

Aroskar, R., Sarkar, S.K., Swanson, P.E., (2004), European foreign exchange market efficiency: evidence based on crisis and non-crisis periods, *International Review of Financial Analysis,* 13(3), 333-347.

Azad, A.S.M., (2009), Random walk and efficiency tests in the Asia-Pacific foreign exchange markets: evidence from the post-Asian currency crisis data, *Research in International Business and Finance,* 23(3), 322-338.

Chow, K.V., Denning, K., (1993). A simple multiple variance ratio test. *Journal of Econometrics,* 58(3), 385-401.

Coleman, M. (1990). Cointegration-based tests of daily foreign exchange market efficiency. *Economics Letters,* 32(1), 53-59.

Corbae, D., Ouliaris, S., (1986). Robust tests for unit roots in the foreign exchange market. *Economics Letters,* 22(4), 375-380.

Diamandis, P.F., Kouretas, G.P., Zarangas, L., (2007). Dual foreign currency markets and the role of expectations: evidence from the Pacific Basin countries. *Research in International Business and Finance,* 21(2), 238-259.

Fama, E.F., (1970). Efficient capital markets: a review of theory and empirical work. *Journal of Finance,* 25(2), 383-417.

Fama, E., (1984). Forward and spot exchange rates. *Journal of Monetary Economics,* 14(3), 319-338.

Fama, E.F., Blume, M.E., (1966). "Filter rule and stock market trade" *Journal of business*, 39(1), 226-241.

Giannellis, N., Papadopoulos, A.P., (2009), Testing for efficiency in selected developing foreign exchange markets: an equilibrium-based approach, *Economic Modelling,* 26(1), 155-166.

Grossman, S.J., Stiglitz, J.E., (1980). On the impossibility of informationally efficient market. *American Economic Review*, 70(3), 393-408.

Hallwood, C., MacDonald, R., (1994). International money and finance. Blackwells, Oxford. chapters 11 & 12.

Hakkio, C., Rush, M., (1989). Market efficiency and cointegration: an application to the sterling and deutschemark exchange markets. *Journal of International Money and Finance,* 8(1), 75-88.

Jensen, M., (1978). Some anomalous evidence regarding market efficiency. *Journal of Financial Economics,* 6(2-3), 95-101.

Liu, C.Y., He, J., (1991). A variance ratio test of random walks in foreign exchange rates. *Journal of Finance,* 46(2), 773-785.

Meese, R.A., Singleton, K.J., (1982). On the unit roots and the empirical modeling of exchange rates. *Journal of Finance,* 37(4), 1029-1034.

McQueen, G., (1992). Long-horizon mean reverting stock prices revisited. *Journal of Financial Quantitative Analysis,* 27(1), 1-18.

Smith, G., Jefferis, K., Ryoo, H.-J., (2002). African stock markets: multiple variance-ratio tests of random walks. *Applied Financial Economics*, 12(7), 475-484.

Sweeney, R..J., (1988). Same filter rule test - method and result, *Journal of Financial Quantitative Analysis,* 23(3), 285-300

Wu, J.L., Chen, S.L., (1998), Foreign exchange market efficiency revisited, *Journal of International Money and Finance,* 17(5), 831-838.

Zivot, E., (2000). Cointegration and forward and spot exchange rate regressions. *Journal of International Money and Finance,* 19(6), 785-812.