

## A Test of the International Fisher Effect in Selected Asian Countries

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### Abstract

*In a simplified statistical test of the IFE (International Fisher Effect), a regression analysis was applied to historical exchange rates and interest differentials data for eight selected Asian countries namely: China, India, Japan, South Korea, Malaysia, Thailand, Vietnam, and Indonesia. Each of these countries was interchangeably used as the home country, and foreign country to track the trail of the effect. While caution must be exercised in applying and assessing the theory, the IFE model may not be realistic to put into practice in daily currency transactions, but its value lies in its ability to illustrate the expected relationship between interest rates, inflation and exchange rates. This information is helpful in appraising the price competitiveness of foreign imports and in exploring export opportunities for countries.*

**Key Words:** IFE, Regression Analysis, Exchange Rates, Interest rates Differentials

### INTRODUCTION

The appreciation or depreciation of currency prices is proportionally related to differences in nominal rates of interest. The International Fisher Effect (IFE) theory is an important concept in the fields of economics and finance that links interest rates, inflation and exchange rates. Similar to the Purchasing Power Parity (PPP) theory, IFE attributes changes in exchange rate to interest rate differentials, rather than inflation rate differentials among countries. Nominal interest rates would automatically reflect differences in inflation by a purchasing power parity or no-arbitrage system. The two theories are closely related because of high correlation between interest and inflation rates. The IFE theory suggests that currency of any country with a relatively higher interest rate will depreciate because high nominal interest rates reflect expected inflation. Assuming that the real rate of return is the same across countries, differences in interest rates between countries may be attributed to differences in expected inflation rates. For example, between the Indian and the Chinese currencies, the INR/CNY spot exchange rate on November 22, 2011 was 0.122. The interest rate at that time in China was 6.56% and 7.5% in India. The IFE predicts that the country with the higher nominal interest rate (India in this case) will see its currency depreciate. The expected future spot rate is calculated by multiplying the spot rate by a ratio of the foreign interest rate to domestic interest rate:  $(0.122 \times (1.075/1.0656)) = 0.123$ .

The IFE expects the INR/CNY to appreciate to 0.123. Interchangeably, the CNY/INR spot exchange rate on November 22, 2011 was 8.2497. The interest rate at that time in China was 6.56% and 7.5% in India. The IFE predicts that the country with the lower nominal interest rate (China in this case) will see its currency appreciate. The expected future spot rate is calculated by multiplying the spot rate by a ratio of the foreign interest rate to domestic interest rate:  $(8.2497 \times (1.0656/1.075)) = 8.177$ . The IFE expects the CNY/INR to depreciate to 8.177. In the end, investors in either currency will achieve the same average return i.e. an investor in CNY will earn a lower interest rate of 6.56% but will also gain from appreciation of the CNY. Changes in the exchange rate can have a powerful effect on the macro-economy affecting variables such as the demand for exports and imports; real GDP growth, inflation and unemployment – but as with most variables in economics, there are time lags involved.

For the shorter term, the IFE has proven to be unpredictable because of the various short-term factors that affect exchange rates and the predictions of nominal rates and inflation. Longer-term International Fisher Effects have on the other hand appeared to be better, but not by very much. Exchange rates eventually offset interest rate differentials, but prediction errors often occur when the objective is to try to predict the spot rate in the future. One of the problems affecting consumers and the world economy is exchange rates fluctuations and interest rates disparities. Among others, exchange rates fluctuations can create inefficiency and distort world prices. Moreover, the long term profitability of investment, export opportunities and price competitiveness imports are all impacted by long-term movements in exchange rates; hence international investors/companies usually have to pay very close attention to countries' inflation.

International businesses engaging in foreign exchange transactions on daily basis could benefit by knowing some short-term foreign exchange movements. Those that rely on exports can find their products suddenly competitive - or prohibitively expensive - in overseas markets as exchange rates fluctuate. Similarly, companies that rely on imports can see the costs of these imports rise and fall with the exchange rate. In an extension of capital preservation, companies may use information at hand to decide how much more derivative securities such as options, forwards, and futures to hedge in order to mitigate risk arising from exchange rate movements. In addition, investors and fund managers often use these very tools to speculate as well, hoping to profit from fluctuations in exchange rates. Also, exchange rates directly affect the realized return on an investment portfolio with overseas holdings. If you own stock in a foreign company and the local currency goes up a percentage, the value of your investment goes up the same percentage even if the stock price doesn't change at all. The IFE theory is very attractive because it focuses on the interest-exchange rates relationship.

### **Literature Review**

The International Fisher Effect (IFE) theory suggests that foreign currencies with relatively high interest rates will tend to depreciate because the high nominal interest rates reflect expected rate of inflation (Madura, 2010). Does the interest rate differential actually help predict future currency movement? Available evidence is mixed as in the case of PPP theory. In the long-run, a relationship between interest rate differentials and subsequent changes in spot exchange rate seems to exist but with considerable deviations in the short run (Hill, 2004). The international Fisher effect is known not to be a good predictor of short-run changes in spot exchange rates (Cumby and Obstfeld, 1981). Using quarterly and yearly data for the interest rates, inflation rate differentials, and changes in exchange rates over a five-year period, 2003-2008, Suti and Eno (2009) applied a test of the IFE to four "foreign countries", namely, the USA, Japan, Singapore, and the UK. Indonesia was the "home country". Regression results showed that interest rate differentials had positive but no significant effect on changes in exchange rate for the USA, Singapore, and the UK relative to that of Indonesia. On the other hand, interest rate differentials had negative significant effect on changes in exchange rates for Japan. Once again, we see mixed results with evidence of IFE holding (though statistically not significant) for the USA, Singapore and UK pairing with Indonesia, while not holding for the Japan pairing with Indonesia.

This inconstancy may be explained by the fact that there is a whole host of factors that could cause exchange rates fluctuations. These include foreign exchange supply and demand, balance of payments problems, rising inflation, interest rate, national income, monetary policy, expectations and speculations (Khalwaty, 2000). Thomas (1985) conducted a test of the IFE theory by examining results of purchasing future contracts of currencies with higher interest rate that contained discounts (relative to the spot rate) and selling futures on currencies with low interest rate that contained premiums. Contrary to the IFE theory the study found that 57 percent of the transactions created by this strategy were profitable. The average gain was higher than the average loss. If the IFE theory holds, the high interest rate currencies should depreciate while the low interest rate currencies should appreciate, therefore yielding insignificant profits by the transactions. Adler and Lehman (1983), Adler and Dumas (1983), Mishkin (1984), and Abuaf and Jorion (1990) all found evidence of significant variation in the relationship between inflation rate differential and exchange rate. Hakkio (1986) found however that even in the long-run, the relationship between inflation rates differentials and exchange rates was not perfect but recognized the use of inflation differentials in forecasting long-run movements in exchange rates.

A study by Madura and Nosari (1984) simulated a speculative strategy by borrowing currency with the lowest quoted interest rate and invested in the currency with the highest interest rate. After the loan repayment at the end of the investment period, it was found that the difference between return on the investment and the cost of borrowing (spread) was usually positive. This is in contrary to the IFE theory. In a different but related study, Cheung et al. (1995) found more positive evidence for the support of the PPP hypothesis. Using reduced rank co-integration analysis, they found that the currency realignments of the European Monetary System (EMS) have been effective in maintaining PPP among its member countries. They attribute the difference in their findings to the statistical technique employed for the study.

In view of the above, it is the objective of this paper to examine the International Fisher Effect theory as relevant to some selected Asian nations. The governments of the selected countries with the exception of China are less likely to intervene in the foreign exchange market in attempting to influence the values of their currencies. Analysis of the results will be made and suggestions offered where necessary.

**METHODOLOGY AND DATA COLLECTION**

Various secondary data were collected for the following countries: China, India, Japan, South Korea, Malaysia, Thailand, Vietnam, and Indonesia. The data include quarterly money market interest rates and percentage change in the exchange rates. The data range from the first quarter of 1990 to the fourth quarter of 2009. The data were obtained from various sources of International Financial Statistics, published by the International Monetary Fund (IMF).

Following Madura (2010), statistical tests of international Fisher effect among selected countries were conducted. Ordinary least squares regressions were run on the historical exchange rates and the nominal interest rate differential. The equations follow from the assumptions that the effective (exchange rate adjusted) return on a foreign bank deposit (or any money market security) is:

$$r = (1 + i_f)(1 + e_f) - 1 \quad (1)$$

where  $i_f$  is the foreign interest rate, and  $e_f$  is the percentage change in the value of the foreign denominating the security. The equation (1) states that the actual or effective return on a foreign money market security depends on foreign interest rate ( $i_f$ ), as well as the percent change in the value of foreign currency ( $e_f$ ) denominating the security. Furthermore, the investors who invest in the money market at the home country is expected to receive the actual rate of return which is simply the interest rate offered on those securities. In accordance with the IFE the effective return on a home investment

( $i_h$ ) should be on average equal to the effective return on a foreign investment ( $r$ ),  $r = i_h$ . Substituting equation (1) for  $r$ , the equation becomes:

$$(1 + i_f)(1 + e_f) - 1 = i_h \quad (2)$$

solving for  $e_f$ :

$$e_f = [(1 + i_h)/(1 + i_f)] - 1 \quad (3)$$

when  $i_h > i_f$ ,  $e_f$  will be positive. This means that the foreign currency will appreciate when the home interest rate is greater than the foreign interest rate. Conversely when  $i_h < i_f$ ,  $e_f$  will be negative. That is, the home currency will appreciate when the home interest rate is smaller than the foreign interest rate. It should be recalled that the difference in the nominal interest rate between countries is due to differences in expected inflation rates assuming that the real rate of return is equal across countries. It should also be recalled that the PPP theory suggests that the currency of a country with a higher inflation rate will depreciate by the amount of inflation differential. Therefore, the country with a higher interest rate will experience depreciation in the value of its currency by the amount of interest rate differential which will consequently negate any gains by investors who invested in the securities of those countries due to a higher interest rate. Eventually, the return on investment in respective countries will be similar. For detailed information on derivation of this equation, see Madura (2010).

**TEST FOR INTERNATIONAL FISHER EFFECT**

To test for international Fisher effect, the percentage change in currency is regressed against the nominal interest rate differential among the selected countries. Thus, the regression equation is as follows:

$$e_f = a_0 + a_1 [(1 + i_h)/(1 + i_f)] - 1 + \mu \quad (4)$$

where,

$a_0$  = constant

$a_1$  = slope coefficient, and

$\mu$  = error term.

The hypothesized values of  $a_0$  and  $a_1$  are 0 and 1.0, respectively, implying an equal offsetting average percentage change in the exchange rate for a given interest rate differential. Each coefficient is divided by its standard error. The level of significance is determined by the critical t-value from the table based on the number of observations and degrees of freedom (Gujarati, 1988).

To test the direction of IFE, each country is used as home country and then foreign country respectively. This will make it possible to investigate if the International Fisher Effect is unidirectional or not.

## **RESULTS AND DISCUSSION**

Table 1 provides the regression results for the International Fisher Effect. As shown in this table, the results are mixed. While the theory holds for some countries, it does not hold for others. In other words, for some countries, the coefficients imply that a given differential in nominal interest rates on the average is off-set by an equal percentage change in the exchange rates. For other countries, this may not be true. The coefficients obtained in table 1 must be tested to determine if the IFE theory holds or not. The statistical tests are described below (Madura, 2010):

(a) Test for  $a_0 = 0$

$$t = (a_0 - 0) / \text{s.e. of } a_0$$

(b) Test for  $a_1 = 1$

$$t = (a_1 - 1) / \text{s.e. of } a_1$$

Each regression coefficient is compared to its hypothesized value, divided by its standard error. The significance of the test is determined by the procedure described in the previous section. If either hypothesis is rejected, then IFE theory is refuted. The results of the test are presented in Table 2.

When Indonesia is used as the home country, the theory holds between Indonesia and the selected countries except Japan. When the Philippines are used as the home country, the theory holds between the Philippines and China, South Korea, Singapore, and Malaysia, but does not hold between the Philippines and Indonesia, and India. The theory holds between China and the Philippines, the South Korea, Singapore, and Malaysia. However, it does not hold between China and Indonesia, Japan, and the India. Between Japan and other countries, the theory holds except for Indonesia, and the India. Between The South Korea and the selected countries, the theory holds except for Indonesia and Singapore. When Singapore is used as the home country, the theory holds between Singapore and Indonesia, China, South Korea, but it does not hold between Singapore and Indonesia, Malaysia, and India. While the theory holds between Malaysia and the selected countries, it does not hold with Indonesia and the India. The theory holds between India and Indonesia, The Philippines, China, Japan, South Korea, but does not hold for India and Singapore, and Malaysia.

In most cases, the theory holds except for few instances. It is intriguing to note that the theory holds between Indonesia and all other countries except Japan, when Indonesia was used as the home country. However, when Indonesia was used as the foreign country, the theory only holds between India and Indonesia. This suggests that the exchange rate adjustment may not be a reciprocal phenomenon. Other reasons are that the exchange rate may not fully offset the interest rate differential in some cases, while in others; the exchange rate may more than offset interest rate. However, the results balance out such that interest rate differentials are on the average offset by fluctuation in the exchange rate over time. This is in accordance with suggestion by Madura that the IFE theory does not suggest that the relationship will exist over each time period, but periodic investments that attempt to capitalize on the higher interest rate would achieve a similar yield on the average if they are simply made domestically and periodically.

Whether the test holds or not also depends on other factors, such as the period of time under study. While it may hold for certain period, it may not hold for another. Other limitation of the theory is that exchange rate determination is not affected primarily by inflation alone. There are other psychological factors, as opposed to macroeconomic fundamentals, that play important role in determining the likely future exchange rates. The bandwagon effects which are difficult to predict should not be ignored (Allen and Taylor, 1990, and T. Ito, 1990). Exchange rate is also influenced by the markets for exchange rate. It should also be noted that different functional forms or estimating techniques may produce different results.

### **Summary**

A test of international Fisher effect theory was conducted for eight selected industrialized nations namely: Indonesia, the Philippines, China, Japan, South Korea, Singapore Malaysia, and India. Each of these countries was used interchangeably as the home country, and foreign country so as to investigate the direction of the parity. The results are mixed. While the theory holds for some countries, it does not hold for others. The theory holds when some countries were used as home country but was refuted when they were used as foreign countries.

This suggests that there may be some impediments to foreign trade that may affect exchange rate adjustment apart from interest and inflation rates differentials. While caution must be exercised in applying or interpreting the theory, this information is useful in international business in terms of export opportunities and price competitiveness of foreign imports.

Foreign Country		Indonesia	Phillip	China	Jap	S. Kor	Sing	Malaysia	India
Home Country	Indonesia		-.0027 <sup>1</sup> (.7728 <sup>*</sup> )	.5417 (.8956)	1.987 (.9079)	-.6150 (.9130)	-.3589 (.6268)	1.987 (1.178)	-.8990 (0.6703)
			-2.057 <sup>2</sup> (2.567)	.5023 (1.452)	-1.1737 (1.398)	0.3688 (1.301)	3.4447 (2.382)	-0.293 (.652)	-4.451 (3.1637)
	Phillip	.0876 (.324)		.7129 (1.227)	1.218 (1.062)	.5330 (.959)	-.5849 (.6311)	.6499 (1.372)	-4.001 (3.163)
		-1.778 (.5378)		.0153 (1.945)	.5154 (1.6059)	.7497 (1.22)	2.7793 (1.9974)	-.2123 (.8167)	-4.8951 (1.3829)
Home Country	China	-.6478 (.546)	-.41421 (1.2196)		.3751 (.664)	.8271 (.698)	-.2858 (.7899)	1.565 (1.14)	-2.0678 (1.004)
		-9876 (.7654)	-1.684 (3.485)		.8455 (1.708)	.7678 (1.402)	1.134 (1.842)	-1.201 (1.460)	-3.9407 (2.504)
	Jap	-.5644 (0.322)	.0004 (1.078)	.9114 (.7257)		.770 (.7039)	.0111 (.7235)	1.4002 (1.072)	-2.5609 (1.175)
		-.6677 (.082)	-.1586 (1.061)	.0706 (1.998)		.0636 (1.047)	1.962 (1.575)	-.1847 (1.090)	-6.216 (3.051)
Home Country	S. Kor	-.6766 (.3155)	-.1736 (1.063)	.9255 (.7254)	1.4411 (.6701)		.0340 (.7614)	1.9408 (.976)	-1.1343 (1.099)
		-1.222 (.6789)	-.7695 (1.978)	-.1581 (1.939)	-1.180 (1.564)		1.986 (1.758)	-.8042 (.7891)	-2.009 (2.843)

Table 1 (Cont'd): Regression Results of International Fisher Effect for Selected Countries									
Foreign Country									
		Indonesia	Phillip	China	Jap	S. Kor	Sing	Malaysia	India
Home Country	Sing	-.2345 (.3211)	.0902 (.6584)	1.2327 (1.060)	1.260 (.8169)	(.9255) (.9255)		2.5227 (1.409)	-.5435 (.5941)
		-.7898 (.4365)	-1.512 (2.076)	-.5869 (1.449)	.1226 (.8042)	-.3788 (1.087)		-.865 (.8713)	-3.914 (1.577)
Home Country	Malaysia	-.5826 (.4166)	2.157 (1.712)	1.7341 (1.233)	.4376 (.8120)	.972 (.7713)	2.133 (1.593)		-3.231 (1.701)
		-.567 (.7688)	4.243 (3.179)	2.8177 (3.467)	.4117 (1.902)	.8456 (1.455)	5.2378 (2.970)		-5.226 (3.032)
Home Country	India	-.2744 (.255)	-.1574 (.6966)	.0663 (1.139)	1.9213 (1.150)	.1723 (.9522)	-1.016 (.643)	1.8177 (1.274)	
		-.1881 (.898)	2.086 (2.490)	1.326 (1.387)	-.9573 (1.542)	.9285 (1.0139)	4.4086 (1.7057)	-.2855 (.635)	

<sup>1</sup>Constant of the regression

<sup>2</sup>Coefficient estimate of the regression

\*In parentheses are the standard errors of the coefficient estimates

Table 2: Test of International Fisher Effect Theory between Countries.									
Foreign Country									
		Indo	Phil	China	Jap	SKor	Sing	Malaysia	India
Home Country	Indo		H	H	nh	H	H	H	H
	Phil	h		H	H	H	H	H	nh
	China	nh	H		nh	H	H	H	nh
	Jap	nh	H	H		H	H	H	nh
	S.Korea	nh	H	H	H		H	nh	H
	Sing	nh	H	H	H	H		nh	nh
	Malaysia	nh	H	H	H	H	H		nh
	India		H	H	H	H	nh	nh	

H: Theory holds

nh : Theory does not hold

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