INFLATION, INTEREST RATE, AND EXCHANGE RATE: WHAT IS THE RELATIONSHIP?

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ABSTRACT

A test of IFE (International Fisher Effect) theory was conducted for eight selected industrialized countries namely: Canada, France, Germany, Japan, The Netherlands, Sweden, Switzerland, and the United Kingdom. Each of these countries was used interchangeably as the home country, and foreign country to investigate the direction of the effect. Applying regression analysis to historical exchange rates and interest differentials was developed in a simplified statistical test of IFE. While caution must be exercised in applying and interpreting the theory, this information is useful in international business, export opportunities and price competitiveness of foreign imports.

INTRODUCTION

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. 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.

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.

LITERATURE REVIEW

This theory is very attractive because it focuses on the interest-exchange rates relationship. 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, 1997). The international Fisher effect is known not to be a good predictor of short-run changes in spot exchange rates (Cumby & Obstfeld, 1981).

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.

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 cointegration 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 industrialized nations. The choice of the countries stem among others, the fact that the currencies of five of them make up the basket of the currencies of the Special Drawing Right (SDR); a reflection of the relative importance of those currencies in international trade and payments. Also the governments of the selected countries 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: Canada, France, Germany, Japan, The Netherlands, Sweden, Switzerland, and the United Kingdom. The data include quarterly money market interest rates and percentage change in the exchange rates. The data range from the second quarter of 1972 to the fourth quarter of 1996. The data were obtained from various sources of International Financial Statistics, published by the International Monetary Fund (IMF).

Following Madura (1995), 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:

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

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:

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

solving for e_f :

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

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 that countries due to a higher interest rate. Eventually, the return on investment in respective countries will be similar. For a detailed information on derivation of this equation, see Madura (1995).

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:

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

where,

a_0 = constant
a_1 = slope coefficient, and

μ	=	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 Fisher effect, 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.

TABLE 1
Regression Results of International Fisher Effect for Selected Countries

Foreign Country									
		CAN	FR	GER	JAP	NETH	SW	SZ	UK
Home Country	CAN		-.0034[1]	.6818	1.862	-.6091	- .3960	1.760	-.9002
			(.6638)*	(.9847)	(.9079)	(.9130)	(.6268)	(1.178)	(0.670)
			-1.096[2]	.5023	-1.1737	0.3688	3.4447	-0.293	-4.0001
			(2.739)	(1.452)	(1.398)	(1.301)	(2.382)	(.652)	(3.164)
Home Country	FR	.0961		.9129	1.118	.53332	-.5849	.6499	-4.001
		(.234)		(1.227)	(1.062)	(.959)	(.6311)	(1.372)	(3.163)
		-1.895		.0058	.4154	.4497	2.6093	-.2023	-3.7759
		(.6317)		(1.945)	(1.606)	(1.22)	(1.997)	(.8167)	(1.383)

TABLE 1
Regression Results of International Fisher Effect for Selected Countries

Foreign Country

		CAN	FR	GER	JAP	NETH	SW	SZ	UK
Home Country	GER	-.4729	-.45421		.3851	.7271	-.1898	1.995	-2.0768
		(.258)	(1.2196)		(.664)	(.698)	(.7899)	(1.14)	(1.004)
		-.8319	-1.684		.8406	.7633	1.030	-1.107	-4.9407
		(.6317)	(3.485)		(1.708)	(1.402)	(1.842)	(1.460)	(2.504)
Home Country	JAP	-.4359	.0004	.9114		.770	.0100	1.4938	-2.5809
		(0.273)	(1.099)	(.7257)		(.7039)	(.7235)	(1.072)	(1.175)
		-.6182	-.1586	.0706		.0636	1.962	-.1847	-6.216
		(.072)	(1.061)	(1.889)		(1.047)	(1.575)	(1.090)	(3.051)
Home Country	NETH	-.5751	-.1736	.9255	1.4411		.0340	1.9408	-1.1343
		(.2694)	(1.063)	(.7254)	(.6701)		(.7614)	(.976)	(1.099)
		-1.283	-.7695	-.1581	-1.180		1.986	-.8042	-2.009
		(.7029)	(1.978)	(1.939)	(1.564)		(1.758)	(.7891)	(2.843)
Home Country	SW	-.2040	.0902	1.2327	1.260	.9255		2.5227	-.5435
		(.2312)	(.6584)	(1.060)	(.8169)	(.9255)		(1.409)	(.5941)
		-.7959	-1.512	-.5869	.1226	-.3788		-.865	-3.914
		(.4365)	(2.076)	(1.449)	(.8042)	(1.087)		(.8713)	(1.577)
Home Country	SZ	-.5826	2.157	1.7341	.4376	.972	2.133		-3.231
		(.4071)	(1.712)	(1.233)	(.8120)	(.7713)	(1.593)		(1.701)
		-.640	4.243	2.8177	.4117	.8456	5.2378		-5.226
		(.7742)	(3.179)	(3.467)	(1.902)	(1.455)	(2.970)		(3.032)
Home Country	UK	-.2567	-.1574	.0663	1.9213	.1723	-1.016	1.8177	
		(.277)	(.6966)	(1.139)	(1.150)	(.9522)	(.643)	(1.274)	
		-.1881	2.086	1.326	-.9573	.9285	4.4086	-.2855	
		(.964)	(2.490)	(1.387)	(1.542)	(1.014)	(1.706)	(.635)	
[1] Constant of the regression									

TABLE 1									
Regression Results of International Fisher Effect for Selected Countries									
Foreign Country									
		CAN	FR	GER	JAP	NETH	SW	SZ	UK
2 Coefficient estimate of the regression									
* In parentheses are the standard errors of the coefficient estimates									

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, 1993, 22l):

(a) Test for $a_0 = 0$; $t = (a_0 - 0)/$ s.e. of a_0
(b) Test for $a_1 = 1$; $t = (a_1 - 1)/$ 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.

TABLE 2									
Test of International Fisher Effect Theory Between Countries.									
Foreign Country									
		CAN	FR	GER	JAP	NETH	SW	SZ	UK
Home Country	CAN		H	H	NH	H	H	H	H
	FR	NH		H	H	H	H	H	NH
	GER	NH	H		NH	H	H	H	NH
	JAP	NH	H	H		H	H	H	NH
	NETH	NH	H	H	H		H	NH	H
	SW	NH	H	H	H	H		NH	NH
	SZ	NH	H	H	H	H	H		NH
	UK	H	H	H	H	H	NH	NH	
H: Theory holds									

NH: Theory does not hold

When Canada is used as the home country, the theory holds between Canada and the selected countries except Japan. When France is used as the home country, the theory holds between France and Germany, the Netherlands, Sweden, and Switzerland, but does not hold between France and Canada, and the United Kingdom. The theory holds between Germany and France, the Netherlands, Sweden, and Switzerland. However, it does not hold between Germany and Canada, Japan, and the United Kingdom. Between Japan and other countries, the theory holds except for Canada, and the United Kingdom. Between The Netherlands and the selected countries, the theory holds except for Canada and Switzerland. When Sweden is used as the home country, the theory holds between Sweden and France, Germany, The Netherlands, but it does not hold between Sweden and Canada, Switzerland, and the United Kingdom. While the theory holds between Switzerland and the selected countries, it does not hold with Canada and the United Kingdom. The theory holds between the United Kingdom and Canada, France, Germany, Japan, The Netherlands, but does not hold for the United Kingdom and Sweden, and Switzerland.

In most cases, the theory holds except for few instances. It is intriguing to note that the theory holds between Canada and all other countries except Japan, when Canada was used as the home country. However, when Canada was used as the foreign country, the theory only holds between United Kingdom and Canada. 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 other cases, 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 & Taylor, 1990; 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: Canada, France, Germany, Japan, The Netherlands, Sweden, Switzerland, and the United Kingdom. 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.

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