A Multinational Examination of International Equity and Bond Investment with Currency Hedging

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INTRODUCTION

In 1980 non-domestic private sector pension assets were only $3.3 billion in the U.S. and $0.4 billion in Japan. By 1986 those amounts had grown to $45 billion and $14.5 billion.[1] Large international portfolio investment has heightened interest in foreign exchange risk and the potential for managing it.

The arguments in favor of international portfolio diversification are well-known and widely accepted. Work by Grubel (1968), Lessard (1970), Levy and Sarnat (1976), and Solnik (1974), among others, has demonstrated that in terms of mean-variance efficiency, international portfolios dominate purely U.S. portfolios. Imperfect correlations between national equity indices create the opportunity for risk reduction. However, taking advantage of international investment opportunities entails accepting foreign exchange exposure.

The returns on foreign equities and bonds are determined by both the nominal, or domestic performance of the securities, and the behavior of the foreign currency relative to the investor's domestic currency. Most previous authors studied only the combined effects of security and currency returns. [One exception is Solnik and Noetzlin (1982).] It is important to consider their effects separately, especially when examining the risk management potential of futures transactions, because a hedge of a foreign stock or bond is a cross-hedge. It incorporates a hedge of the foreign currency and a hedge of the foreign stock or bond return in its home currency. These two variables are likely to be related.

[1] *Euromoney*, April 1988, p. 48.

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A country's fundamental economic characteristics, such as levels of output, inflation and interest rates, influence and are influenced by the values of its currency and securities. Thus, the values of the currency and the securities are interrelated. The interrelationship is complex and subject to some dispute. For example, a traditional trade approach would associate an increase in the real exchange rate with a slowdown in economic activity and a fall in the value of equities. A money demand approach would reach the opposite conclusion: economic growth and appreciating equity values would be associated with an appreciating real currency value.[2] Hedging investment in foreign stocks and bonds, entails a cross-hedge of two values which may be interrelated. There are conflicting theoretical models of the relationship.

Given the growing importance of international financial investment and the uncertainty of how one might manage the currency risk associated with it, this study addresses three empirical questions: (1) What role does currency risk play in determining the riskiness of foreign equities and bonds? (2) What hedges minimize the risk of foreign equity and bond investments? (3) How and why do answers to these two questions differ from the perspectives of investors in different countries, i.e., investors using different numeraires. The answers to these questions extend the literature by providing evidence on the stability of returns, hedges, and hedging effectiveness over time. They also extend previous analyses by including analysis of international bond investments. Finally, the article examines the differences created by alternative numeraires.

ANALYTICAL STUDY OF FOREIGN FINANCIAL INVESTMENT

The rate of return earned from an investment in a foreign security, r, is a combination of the rate of return on the security denominated in its home currency, s, and the rate of return on the foreign currency, c.

$$r = (1 + c)(1 + s) - 1 \tag{1}$$

Similarly, the expected return and the risk (variance) of the return on an investment in a foreign security are influenced by s and c and their interaction.[3]

$$E(r) = E(c) + E(s) \tag{2}$$

$$\text{var}(r) = \text{var}(c) + 2\,\text{cov}(c, s) + \text{var}(s) \tag{3}$$

E, var, and cov identify the expected value, variance, and covariance, respectively.

The variance of the foreign returns, measured in the domestic currency, will vary directly with the correlation between foreign security returns and foreign currency returns. The domestic investor can receive a double jolt if unexpectedly low security returns are exaggerated by unexpected declines in the foreign currency value and vice versa.

Given the potential influence of currency changes on domestic returns, it is natural to examine how effectively hedging can reduce foreign exchange exposure.[4] Assuming that futures contracts do not absorb capital, the domestic rate of return on a portfolio investment in foreign securities in one country, either equity or bonds, and the associated

[2]For a more complete analysis of this subject and a description of competing ideas concerning the relationship between currency values and bond values see Solnik (1991), chapter 1.

[3]The cross product term cs complicates the expressions for expected return and variance, but does not add anything in analytical terms. Therefore, eqs. (2) and (3) drop it and are approximations.

[4]This article focuses on minimum risk portfolios. Mean returns are not included primarily because the mean return vector is less stable over time than the covariance matrix. Thus mean/variance results are likely to be sample specific.

currency futures is

$$r_p = r + h_r f \tag{4}$$

The subscript p refers to the portfolio of securities and futures for an individual country. The ratio of currency futures bought (+) or sold short (−) to the value of the securities in a country is h_r. The one-period change in the price of the futures contract of the currency, expressed as a percentage of the spot price, is f.

The variance of the rate of return on the portfolio is

$$\text{var}(r_p) = \text{var}(r) + 2h_r \,\text{cov}(r, f) + h_r^2 \,\text{var}(f) \tag{5}$$

Minimizing eq. (5) with respect to h_r yields

$$h_r^* = -\text{cov}(r, f)/\text{var}(f) \tag{6}$$

The variance-minimizing hedge can reduce the risk of foreign securities from two sources: the variance of the currency and the variance of the security return in the foreign currency. Following Adler and Dumas (1980), the hedge of the return in domestic currency is referred to as the *exposure hedge.* Because $r_i \approx c_i + s_i$ the exposure hedge, h_r^* can be partitioned into two components: the currency hedge, h_c^*, and the securities hedge, h_s^*. Equation (6) can be rewritten as

$$\begin{aligned} h_r^* &= -\text{cov}(r, f)/\text{var}(f) \\ &= -[\text{cov}(c, f) + \text{cov}(s, f)]/\text{var}(f) \\ &= -[h_c^* + h_s^*] \end{aligned} \tag{7}$$

The exposure hedge is a cross-hedge. It is the sum of a direct hedge, the currency hedge, and the indirect hedge, the securities hedge. An empirical investigation is undertaken to determine whether the securities hedge has a material effect on the risk management of international equity and bond investment.

EMPIRICAL STUDY OF FOREIGN FINANCIAL INVESTMENT

Investment data for six countries—Canada, Germany, Japan, Switzerland, the United Kingdom, and the United States—are used in this study. These countries are included because dollar denominated currency futures contracts for their currencies have traded on the International Monetary Market of the Chicago Mercantile Exchange since at least the mid-70s. Further, the equity markets of these countries are six of the seven largest in the world and accounted for 90% of world capitalization at the end of 1988.

Returns for the period August, 1975 through December, 1988 are examined. Spot currency and equity and bond indices values are from Morgan Stanley/Capital International and FT-Actuaries World Indices supplemented when necessary by data from the *Wall Street Journal.* Data on futures are settlement prices for the near-by contract, provided by the IMM.

Each of the six currencies is used as the numeraire for a set of calculations. A no-arbitrage price series is created by calculating effective cross-rates from the exchange rate quotations in U.S. dollars.

While estimation of relationships in a period are valuable, it is also important to examine the stability of relationships over time. To that end the data is divided in half. August, 1975 to March, 1982 is the estimation period and April, 1982 to December, 1988 is the out-of-sample period. This is to simulate the experience of investors who use

estimates based on data from one 80-month period to guide them for the next 81-month period.[5]

In addition to reporting means and standard deviations of returns, variance-minimizing hedge estimates and performance are reported. The variance-minimizing hedge of a long position in a foreign asset can be estimated as the negative of the slope coefficient from the following ordinary-least-squares equation.

$$r = \hat{a}_r + \hat{h}_r f + e_r \tag{8}$$

Just as one can estimate the exposure hedge, h_r, by regressing r on f, the currency and securities hedges, h_c and h_s, can be estimated by regressing c and s on f.

$$c = \hat{a}_c + \hat{h}_c f + e_c \tag{9}$$

$$s = \hat{a}_s + \hat{h}_s f + e_s \tag{10}$$

The coefficient of determination, R^2, which measures the proportion of total risk eliminated by the hedge is reported for the estimation period. The proportion of variance eliminated by the exposure hedge from the estimation period and the R^2 for the out-of-sample period are reported also. This provides a performance comparison. Table I reports estimates of the currency risk for the estimation and out-of-sample periods. All of the results appear in matrices. The left column identifies the home country or numeraire currency and the top row identifies the country being examined.

Several aspects of these estimates deserve emphasis. The currency risk tends to be substantial, as compared to securities risks. There is considerable cross-section variability, apparently related to the degree of integration between the economies of countries. The C$/US$ exchange rate is much less risky than any other relationship with the US$. Likewise, the German mark/Swiss franc relationship is relatively less risky. Over time

Table I
STANDARD DEVIATION OF CURRENCY RETURNS: AUGUST 1978 TO MARCH 1983 (I), APRIL 1983 TO DECEMBER 1988 (II)

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada I		11.3%	12.6%	13.9%	11.3%	5.2%
II		12.0	12.5	12.9	11.8	4.5
Germany I	11.2%		12.0	7.4	10.5	11.4
II	11.9		8.4	4.7	9.2	12.0
Japan I	12.4	11.7		12.9	11.5	12.1
II	12.1	8.4		7.7	11.7	11.9
Switz. I	13.9	7.3	12.9		12.9	14.1
II	12.6	4.8	7.8		9.4	12.9
U.K. I	11.2	10.7	11.6	13.1		11.2
II	11.5	9.2	12.1	9.6		12.0
U.S. I	5.1	11.4	12.1	13.9	11.1	
II	4.5	12.2	12.4	13.3	12.4	

[5]There are more sophisticated simulation approaches. One such involves updating estimates from historical data each period. Such estimates were used as well and the results are not materially different! The more naive simulation results are reported because it is much easier to summarize those results.

the relationships are moderately stable. There is some indication of a decreasing risk between the European pairs. It also appears as if the German and Swiss currencies may have become less risky with respect to the Japanese yen.

Tables II and III provide estimates of the riskiness of equity and bond returns. As one would expect, the equity returns are riskier than the bond returns in both periods. The equity returns in home currencies (the diagonal entries in the matrix) are considerably larger in the second period than in the first for the U.S., Japan, Switzerland, and especially Germany. They are somewhat lower for Canada and the U.K. The effect of the currency risk increases equity risk in every case but one. The risk of U.S. equity returns in Canadian dollars was lower than the risk of U.S. equity returns in U.S. dollars. As already noted, the currency risk between these two countries is relatively small. In addition, the correlation between the currency return and the equity return is sufficiently negative to make the risk in Canadian dollars lower than the risk in U.S. dollars. Bond risk in home currencies varies from a low of 3.4% for Japan in the second period, to a high of 13.0% for the U.S. in the first period. Risk is generally lower in the second period than in the first. Currency risk increases the risk of bond returns in every instance, including the Canada/U.S. case.

Table IV reports the results of estimating eq. (9), the currency hedges. As expected, the currency hedges are all relatively close to -1.0, ranging from -0.80 to -0.98. The majority are statistically different from -1.0, but Eaker and Grant (1987) show that this difference is not important with respect to risk reduction.

Table V reports the equity securities hedges. The Canada/U.S. estimates are the most remarkable. From the U.S. perspective, the positive relationship between the Canadian equity return and the Canadian futures return creates a risk-reducing securities hedge of -1.466. This is statistically significantly different from zero and, as shown in Table VI, increases the absolute value of the exposure hedge to -2.406. Conversely, the securities hedge of U.S. equity from the Canadian perspective is $+0.784$. This is also statistically different from 0.0 and decreases the absolute value of the exposure hedge to -0.171. Unlike the case for currency hedge deviations from -1.0, these securities hedge deviations from 0.0 materially affect risk reduction. The other noteworthy result

Table II
STANDARD DEVIATION OF EQUITY RETURNS: AUGUST 1978 TO MARCH 1983 (I), APRIL 1983 TO DECEMBER 1988 (II)

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada I	20.2%	16.7%	16.9%	18.0%	23.7%	13.3%
II	17.9	22.6	22.2	19.2	20.0	16.8
Germany I	23.4	10.7	16.9	13.2	24.9	16.4
II	23.2	20.9	21.3	18.4	20.5	22.1
Japan I	24.7	16.3	11.6	17.3	24.8	18.3
II	23.1	21.8	17.5	19.5	21.4	21.9
Switz. I	24.8	12.2	17.6	11.8	25.8	18.4
II	23.1	21.8	20.6	18.0	20.4	22.8
U.K. I	22.3	14.9	16.1	16.0	20.4	16.5
II	22.2	23.3	23.0	19.8	18.1	22.4
U.S. I	22.7	16.9	17.3	18.5	24.5	13.9
II	19.8	22.6	22.7	19.7	21.0	17.3

Table III
STANDARD DEVIATION OF BOND RETURNS: AUGUST 1978 TO MARCH 1983 (I), APRIL 1983 TO DECEMBER 1988 (II)

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada I	10.0%	14.2%	15.4%	15.6%	18.4%	13.1%
II	8.9	14.0	15.9	14.0	17.2	12.1
Germany I	13.5	6.6	14.6	9.5	18.5	14.2
II	15.1	5.2	10.9	6.0	15.8	16.4
Japan I	13.8	13.7	5.9	14.0	17.9	15.3
II	15.7	10.0	6.0	9.0	17.7	17.4
Switz. I	14.7	9.7	15.4	5.4	19.6	15.2
II	15.8	7.1	10.1	3.4	15.5	17.6
U.K. I	13.1	13.2	13.9	14.7	12.7	13.6
II	15.3	11.4	14.9	10.9	10.8	17.2
U.S. I	12.5	14.5	15.5	15.7	18.4	13.0
II	11.5	14.5	16.1	14.5	18.5	12.5

concerns the estimates of the U.K. equity securities hedges. All five estimates from the perspectives of the other countries are negative and relatively large. Two of the five are also statistically different from zero. There is no obvious pattern for the remainder of the estimates.

Table VI combines the results reported in Tables IV and V. Of the 30 estimates reported, 6, or 20% are statistically different from −1.0 at the 5% confidence level. These are the U.S./Canada pair, the Germany/Switzerland pair, the U.K. equity exposure hedge from the German perspective, and the Swiss equity exposure hedge from the U.K perspective.

The final important piece of empirical information is the risk-reducing effectiveness of the exposure hedges. Table VII reports those in-sample estimates. These hedging effectiveness values for the cross-hedges are much lower than the values found for regular hedges. That is because there are two sources of risk, the rates of return of the foreign assets and the currency risks. In general, the currency hedge is effective at reducing the latter, but not the former. Thus it reduces a smaller portion of the total risk.

Table IV
CURRENCY HEDGES ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada		−0.938	−0.905[a]	−0.848[a]	−0.897[a]	− 0.963
Germany	−0.952		−0.926[a]	−0.801[a]	−0.914[a]	−0.976
Japan	−0.918[a]	−0.925[a]		−0.854[a]	−0.913[a]	−0.955
Switz.	−0.872[a]	−0.810[a]	−0.868[a]		−0.886[a]	−0.894[a]
U.K.	−0.889[a]	−0.889[a]	−0.891[a]	−0.859[a]		−0.923[a]
U.S.	−0.957	−0.964	−0.943	−0.870[a]	−0.932[a]	

[a]These coefficients are significantly different from 1.0 at the 5% confidence level.

Table V
EQUITY SECURITIES HEDGES ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada		−0.118	−0.017	−0.008	−0.141	+0.784[a]
Germany	−0.041		−0.060	+0.017	−0.479[a]	+0.156
Japan	−0.111	−0.050		−0.009	−0.289	−0.009
Switz.	−0.058	−0.211	−0.079		−0.389[a]	+0.098
U.K.	+0.147	+0.031	−0.005	+0.106		+0.180
U.S.	−1.466[a]	−0.156	−0.081	−0.049	−0.360	

[a]These coefficients are significantly different from 0.0 at the 5% confidence level.

Table VI
EQUITY EXPOSURE HEDGES ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada		−1.055	−0.931	−0.587	−1.047	−0.171[a]
Germany	−0.998		−0.991	−0.782[a]	−1.389[a]	−0.807
Japan	−1.052	−0.970		−0.854	−1.219	−0.953
Switz.	−0.949	−0.599[a]	−0.954		−1.275	−0.798
U.K.	−0.742	−0.854	−0.908	−0.748[a]		−0.749
U.S.	−2.406[a]	−1.111	−1.032	−0.918	−1.299	

[a]These coefficients are significantly different from 1.0 at the 5% confidence level.

Table VII
EQUITY R^2S ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada		0.530	0.534	0.533	0.280	0.004
Germany	0.234		0.544	0.209	0.387	0.309
Japan	0.302	0.537		0.483	0.353	0.400
Switz.	0.332	0.141	0.563		0.449	0.420
U.K.	0.162	0.441	0.500	0.441		0.278
U.S.	0.281	0.557	0.545	0.556	0.354	

One case deserves specific comment. There is no risk-reducing potential for U.S. equities from the Canadian perspective. Recall that the U.S equity return and the U.S. currency return from the Canadian perspective are, as revealed in Table I, negatively correlated. In effect, there is a natural hedge. That being so, the futures contract offers no additional risk reduction potential and that is reflected in a statistically insignificant exposure hedge (−0.171) and a minuscule R^2 (0.004).

Tables VIII, IX, and X provide the same information for bonds that Tables V, VI, and VII do for equity. The currency hedges, reported in Table IV, are a common element of the equity and bond hedges. Twice as many of the bond securities hedges as the equity securities hedges, 12 versus 6, are statistically significant. Most of the significant relationships involve either the U.S. or Canada, or both. From the U.S. perspective, foreign bond returns, including Canadian bond returns, are positively correlated with their respective currency returns. Conversely, from the foreign perspective, U.S. bond returns are negatively correlated with the U.S. currency returns. Put in terms of interest rates, this is consistent with the view that when U.S. interest rates rise (bond returns are negative), the U.S. dollar tends to rise against other currencies. Because the Canadian and U.S. economies are closely integrated, the other countries have the same relationships with Canada as with the U.S.

The results for the bond securities hedges in Table VIII are reflected in the exposure hedge estimates reported in Table IX. From the U.S. perspective the bond exposure hedges tend to have values less than −1.0. From the foreign view, U.S. bond investment hedges tend to values greater than −1.0. Finally, the most extreme of these results is for the Canada/U.S. relationship.

The measures of hedging effectiveness reported in Table X are, in general, higher than the comparable values for equities reported in Table VII. The only notable exception is for U.S. bonds, where the results for equities and bonds are very similar.

Table VIII
BOND SECURITIES HEDGES ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K.**	**U.S.**
Canada		−0.116	−0.125[a]	−0.046	−0.162	+0.424
Germany	+0.135		−0.103[a]	−0.059	−0.291[a]	+0.291[a]
Japan	+0.174[a]	−0.037		−0.002	−0.074	+0.220
Switz.	+0.163[a]	−0.019	−0.084		−0.182	+0.280[a]
U.K.	+0.186[a]	−0.072	−0.095	−0.054		+0.344[a]
U.S.	−0.499[a]	−0.168*	−0.181[a]	−0.057	−0.207	

[a]These coefficients are significantly different from 0.0 at the 5% confidence level.

Table IX
BOND EXPOSURE HEDGES ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K**	**U.S.**
Canada		−1.055	−1.034	−0.898	−1.067	−0.544
Germany	−0.822		−1.037	−0.866	−1.206	−0.690[a]
Japan	−0.753[a]	−0.963		−0.856[a]	−0.987	−0.746[a]
Switz.	−0.714[a]	−0.792	−0.963		−1.070	−0.621[a]
U.K.	−0.709[a]	−0.965	−0.989	−0.917		−0.581[a]
U.S.	−1.466[a]	−1.129[a]	−1.132[a]	−0.930	−1.142	

[a]These coefficients are significantly different from 1.0 at the 5% confidence level.

Table X
BOND R^2'S ESTIMATED FOR 1975M8 TO 1982M3

	Foreign Countries					
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K**	**U.S.**
Canada		0.734	0.793	0.772	0.486	0.044
Germany	0.474		0.798	0.488	0.523	0.311
Japan	0.499	0.747		0.741	0.445	0.350
Switz.	0.533	0.388	0.752		0.546	0.373
U.K.	0.428	0.721	0.795	0.782		0.245
U.S.	0.345	0.807	0.824	0.795	0.499	

Table XI reports the hedging effectiveness of futures for equities and bonds from April, 1982 to December, 1988. These are the out-of-sample measures of hedging effectiveness. Each table also includes estimates of the R^2s for the period 1982–1988. This allows a comparison of the realized reduction of risk to the maximum possible, R^2. With a few exceptions, the hedges estimated in the first half of the period are very successful at eliminating risk in the second half. Comparing Tables XI and VII reveals a large reduction in the potential for hedging Japanese and European equities, from the first to the second half of the period. Table II suggests that the reason for that decline is an increase in the risk of equities in home currencies for those countries in the second half of the period. This means that the currency related proportion of the risk is lower.

Comparable results for bonds appear in Table XII. Again the out-of-sample risk reduction performance is very good.[6] Furthermore, the potential for risk reduction in the second half tends to be as high or higher than in the first half of the period, because

Table XI
REALIZED AND POTENTIAL PROPORTIONAL RISK REDUCTION FOR EQUITIES, APRIL 1982 TO DECEMBER 1988, USING HEDGES ESTIMATED IN THE PRIOR PERIOD

		Foreign Countries					
Home Countries		**Canada**	**Germany**	**Japan**	**Switz.**	**U.K**	**U.S.**
Canada	R		0.123	0.379	0.089	0.097	0.000
	P		0.160	0.384	0.140	0.160	0.001
Germany	R	0.404		0.329	0.040	0.180	0.364
	P	0.416		0.373	0.043	0.213	0.392
Japan	R	0.406	0.076		0.131	0.227	0.366
	P	0.412	0.084		0.132	0.255	0.371
Switz.	R	0.345	0.041	0.234		0.078	0.348
	P	0.348	0.042	0.237		0.157	0.365
U.K.	R	0.317	0.142	0.403	0.145		0.352
	P	0.350	0.143	0.431	0.146		0.388
U.S.	R	0.252	0.108	0.414	0.109	0.098	
	P	0.256	0.161	0.418	0.167	0.221	

the currency component of the bond returns is just as high in the second half of the period as in the first.

The above analysis ignores the effects of hedging on the means of the returns of equities and bonds. Such results tend to be sample specific. The focus of this study is risk management; attention to the mean returns effects of futures is essentially a forecasting issue.

To illustrate the sample specific issue, Table XIII reports the out-of-sample mean returns of equities earned by not hedging and by implementing the hedge estimated in the first half of the period. Table XI indicated that hedging tends to reduce the risk of foreign equities. Whether it decreases or increases returns, is perspective specific. Japanese investors would have reduced risk and increased mean returns by an average of over 5 percentage points through hedging. For this period, hedging is unequivocally good for a risk averse Japanese investor. U.S. investors would have reduced risk, but also would have reduced mean returns by from 1 to 8 percentage points. Whether this is a desirable trade-off depends on the risk tolerance of the risk averse investor. These results have managerial implications only if you can forecast unexpected currency changes with a sufficient degree of accuracy.

CONCLUSIONS

Currency risk is an important component of international financial investment risk. The degree of importance depends on the currency, the perspective of the investor and the financial instrument. (The correlation between the rates of return on the financial instrument and the currency is an important statistical relationship.) At one extreme, currency risk can make equity investment by Canadians in U.S. equities less risky than

Table XII
REALIZED AND POTENTIAL PROPORTIONAL RISK REDUCTION FOR BONDS, APRIL 1982 TO DECEMBER 1988, USING HEDGES ESTIMATED IN THE PRIOR PERIOD

		Foreign Countries				
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K**	**U.S.**
Canada R		0.799	0.852	0.807	−0.028	−0.024
P		0.803	0.858	0.807	0.037	0.006
Germany R	0.589		0.651	0.306	0.124	0.174
P	0.598		0.651	0.406	0.125	0.217
Japan R	0.599	0.643		0.626	0.140	0.191
P	0.640	0.644		0.634	0.142	0.237
Switz. R	0.527	0.268	0.496		0.108	0.168
P	0.551	0.298	0.522		0.108	0.219
U.K. R	0.551	0.714	0.769	0.729		0.165
P	0.592	0.715	0.772	0.738		0.229
U.S. R	0.498	0.800	0.869	0.816	0.046	
P	0.512	0.811	0.870	0.816	0.083	

[6]Two factors account for this performance. First, the hedge ratios are relatively stable over time. Second, performance deteriorates quite slowly for hedge ratios that are in the range of the ratio that is ex post best.

Table XIII
AVERAGE ANNUAL RETURNS, APRIL 1982 TO DECEMBER 1988, ON UNHEDGED AND HEDGED EQUITY INVESTMENTS

		Foreign Countries				
Home Countries	**Canada**	**Germany**	**Japan**	**Switz.**	**U.K**	**U.S.**
Canada U		22.2%	36.2%	15.9%	21.3%	18.0%
H		21.1	30.1	16.6	20.1	18.3
Germany U	13.1%		31.8	11.7	17.3	14.9
H	11.6		25.6	12.2	15.0	15.1
Japan U	7.6	12.3		6.4	12.0	9.3
H	12.1	17.6		11.9	16.7	15.0
Switz. U	13.9	18.7	32.5		18.1	15.9
H	11.8	18.2	26.0		15.0	15.4
U.K. U	17.3	22.6	36.6	16.3		19.4
H	17.2	23.4	31.8	17.6		20.6
U.S. U	17.0	22.6	36.7	16.5	22.0	
H	12.8	21.4	28.8	15.6	18.2	

it is for Americans. At the other extreme, currency risk can make bond investment by Americans in Swiss bonds three times more risky than it is for the Swiss.

Risk management with futures is complicated by the two sources of risk. The risk-minimizing hedge is a cross-hedge, combining a hedge of the currency and a hedge of the foreign denominated returns. In a relatively large number of cases, the magnitude of the risk-minimizing hedge ratio differs significantly from the standard hedging result of -1.0. This occurs because security values and currency values are both influenced by fundamental economic characteristics of a country. The results of this study do not support a particular theory of the relationship. The empirical results vary depending on the currency, the perspective of the investor, and the financial instrument.

Finally, hedging can materially reduce international financial investment risk. Hedges estimated in one period are relatively effective in the subsequent period. While hedging is quite effective at reducing the currency risk, the foreign denominated rate of return risk can be large and variable across time.

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