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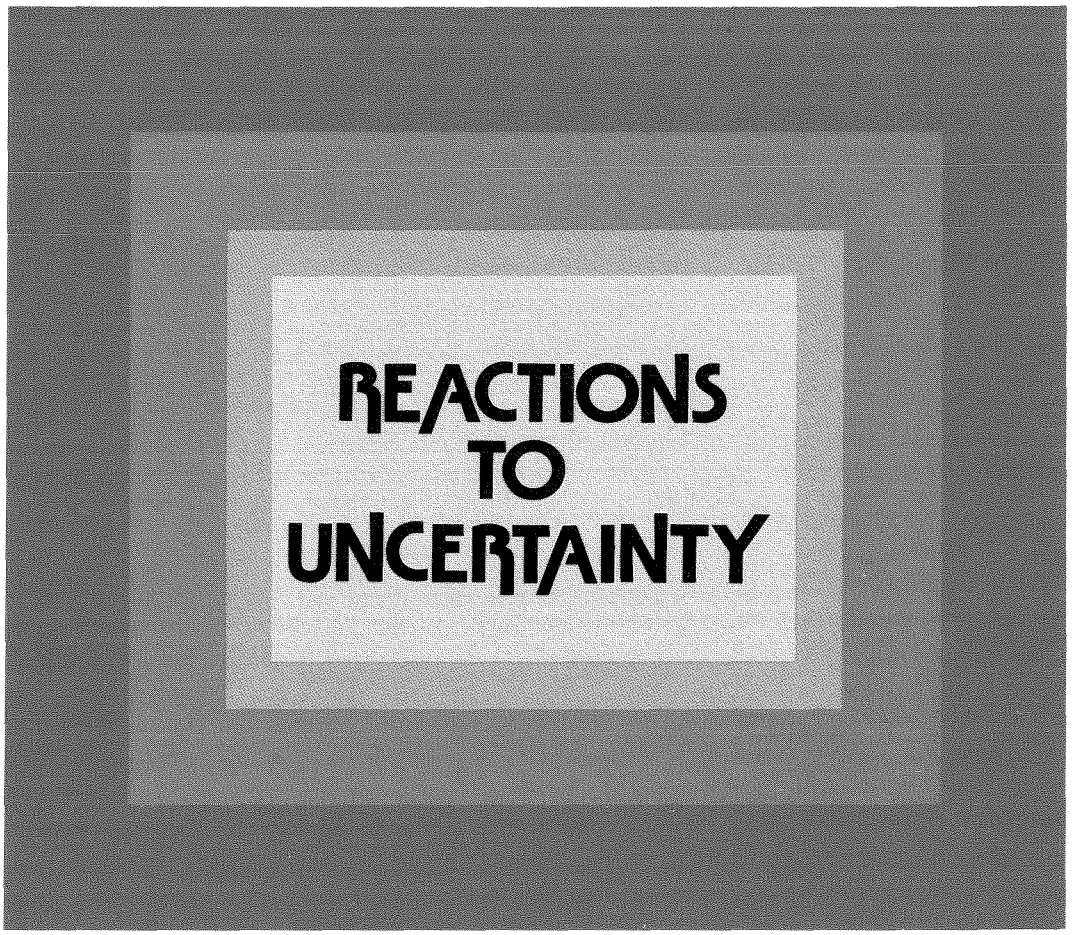

SUMMER 1977

Risk Premiums in International Securities Markets: The Canadian-U.S. Experience

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An investor who purchases foreign securities exposes himself to a variety of risks. For example, unanticipated movements in exchange rates may adversely affect the returns on his investment. Or the sudden imposition of exchange controls may prevent the repatriation of interest and dividends. There is also the possibility that interest rates may rise, causing a capital loss if the security has to be sold prior to maturity. (This type of risk is common to domestic securities as well.) And, of course, a borrower—whether a corporation or a country—may default.

This article analyzes the role which two of these categories of risk—unanticipated movements in exchange rates and in interest rates—play in the determination of yield spreads between countries. An understanding of this issue helps to explain why international yield differentials may be poor guides to the market's beliefs about future exchange-rate movements. Furthermore, the article shows how the interaction of exchange-rate risk and interest-rate risk may at times make foreign assets appear less risky to an investor than domestic ones.

The fact that foreign assets are not necessarily more risky has also been emphasized by Donald Heckerman.[1] He reaches that conclusion through a consideration of the risk of changes in the terms-of-trade to an individual whose consumption is heavily weighted towards imports. For example, the treasurer of a multinational corporation may find foreign assets the better hedge against inflation in countries where his firm purchases raw materials. This way of looking at exchange risk is analogous to the "preferred habitat" theory of the domestic term structure—in which some investors view long bonds as less risky than short ones[2]—and serves as a useful complement to the view adopted here.

Since the concept of risk is central to this article, Section I examines just what is meant by the term. It introduces the notion of "risk aversion" in the simple case in which the only risk is that of unanticipated exchange-rate movements. Section II then proceeds to the case in which interest-rate risk is present as well. It discusses in qualitative terms what patterns of international yield relationships might obtain if investors are assumed to be averse to risk. Section III presents a formal model of the effect of risk aversion on international yield spreads. The model is used to derive an expression relating interest rates in two countries to (a) the expected change in the exchange rate between the currencies of the two countries and (b) an adjustment for risk. The latter term is seen to be a simple international analogue of the measure of risk developed in the literature on domestic securities markets.[3] This section is more technical than the others and may be skipped by those readers not interested in the mathematical formulation of the argument.

Section IV tests the model against the evidence provided by the pattern of interest rate differentials between government bonds in Canada and the U.S. in the period from mid-1971 through 1975. The data appear to support the hypothesis that these yield differences can be partly explained as adjustments for risk. Section V briefly summarizes the principal conclusions and their implications.

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I. The Nature of Exchange Risk

Perhaps the easiest way to approach the problem of risk in general and of exchange risk in particular is to consider the choice faced by an individual as he decides whether to purchase a domestic bond or a foreign bond. To keep the example simple, it will be assumed that both bonds mature in one year, and that the individual intends to hold whichever one he purchases until maturity. These assumptions imply that the investor knows for certain the nominal returns on both bonds.[4] He must then ask himself: What are the chances that any difference in the nominal yields will be more than offset by changes in the exchange rate?

He knows, of course, the current (spot) exchange rate at which he could purchase the currency needed to buy the foreign bond. What he does not know is what the spot exchange rate will be a year in the future.[5] However, he no doubt has some beliefs about the likelihood of alternative values of the exchange-rate obtaining. It is convenient to think of these views as constituting a "subjective probability distribution;" i.e., with each possible future value of the exchange rate, the investor associates a number representing the probability that that rate will be the actual one. The expected value of the distribution then represents his "best guess" as to what rate will prevail in a year.

To make this example more concrete, imagine that a U.S. investor could get a 7-percent return on a domestic bond and 9 percent on a Canadian bond of comparable quality. If he expects the Canadian dollar to depreciate vis-a-vis the U.S. dollar by less than 1.835 percent at the very worst, his expected net gain would be greater on the Canadian bond than on the American one. To see why, suppose that the current spot exchange rate were unity. Then a U.S. investor could convert $100 into C$100, buy a Canadian bond, and have C$109 at the end of a year. If the Canadian dollar had depreciated by 1.835 percent in the interim, each Canadian dollar would than exchange for only $0.98165. The investor's C$109 would be worth just $107, the amount which he could have obtained by purchasing the U.S. security instead.

In general, if F is the current spot exchange rate (expressed as the U.S. dollar price of a unit of foreign currency), E(F) the expected value of the future spot rate, R the domestic yield, and R* the foreign yield, then the U.S. investor will expect a net gain from choosing the foreign security whenever

$$1 + R < (E(F)/F) \cdot (1 + R^*). \qquad (1)$$

The left-hand side of expression (1) represents the value in one year of a U.S. dollar invested in the U.S. security. The right-hand side shows the value in one year of a U.S. dollar which was first converted into (1/F) units of foreign currency and then invested in the foreign security, the proceeds from which investment were then converted back to U.S. dollars at the expected future spot exchange rate, E(F). It should be noted that if the foreign currency were expected to appreciate, then $E(F) > F$, and it would be possible to have R* less than R and yet for the U.S. investor to still expect a net gain from buying the foreign security as opposed to the domestic one.

Of course, the investor's expectations about the exchange rate might turn out to be wrong. If, in the above example, he had bought the Canadian bond on the basis of an expected 1-percent depreciation of the Canadian dollar and it had in fact depreciated by 3 percent, his net return on the foreign investment would be less than the amount which he could have earned domestically. Economists reserve the term "exchange risk" for the possibility of such deviations from expected movements in the value of a currency.

Some individuals may be willing to make their investment decisions on the basis of expected returns alone, without regard for the risk of unfulfilled expectations. Such individuals are said to be "risk-neutral." In the above example, a risk-neutral investor would opt for the Canadian bond as long as his expectation of the rate of depreciation of the Canadian dollar were less than 1.835 percent. Other individuals, while also expecting a depreciation of under 1.835 percent, might only buy the Canadian bond if its return were higher than 9 percent. These individuals are said to be "risk-averse."

In a world dominated by risk-neutral investors, equilibrium in international bond markets would require that yield differentials in favor of any country be exactly offset by an expected

depreciation of that country's currency. Any other configuration of interest rates and exchange rates (both actual and expected) would leave at least some investors with inducements to change the composition of their portfolios. For consider again the above example, in which there exists a 2-percent yield differential in favor of Canada. If the expected depreciation of the Canadian dollar were less than 1.835 percent, risk-neutral American investors would have an incentive to sell their holdings of U.S. bonds and to buy Canadian bonds. These actions would tend to raise U.S. yields and to depress Canadian ones, thereby reducing the differential in favor of Canada. Canadian investors would similarly switch from U.S. to Canadian bonds. This process would continue until the yield spread just offset the expected rate of depreciation of the Canadian dollar, i.e., until[6]

$$1 + R = (E(F)/F) \cdot (1 + R^*). \qquad (2)$$

Could a different equilibrium relationship hold in a world of risk-averse investors? In this simple example in which there is no interest-rate risk, the answer is "Yes" only when one of the countries is a net international debtor. In that case, the yield on the bonds of the debtor nation will have to incorporate a risk premium in order to induce investors in the creditor nation to hold such bonds.

In order to see why, recall that a risk-averse investor, by definition, is content to give up some expected yield as the necessary price of reducing his exposure to risk. Thus, a U.S. investor, for example, faced with a yield spread in favor of Canada which exceeds the expected rate of depreciation of the Canadian dollar, might not feel any incentive to switch from U.S. securities to Canadian ones. But although there might not be any market forces emanating from the U.S. to drive the yield differential back into conformity with (2), the actions of Canadian investors might achieve the same results. For in their eyes, it is the U.S. bonds only which are risky. Given the circumstances just described, a Canadian investor could get a *certain* return on his own country's security which exceeds the *expected* return on the U.S. security. Clearly, he would have an incentive to sell his U.S. bonds and buy Canadian ones, whether he were risk-neutral or risk-averse. Once again, yield spreads would move back toward the relationship given in (2).

However, if Canada were a net international debtor, the movement would not be complete. For then Canadian holdings of U.S. bonds would be less than U.S. holdings of Canadian bonds. As Canadians proceeded to switch to their own bonds, a situation would be reached in which Canadians held only the obligations of their own country while some U.S. investors still held Canadian securities. Again, the risk-averse U.S. investors would only be willing to hold the Canadian bonds if the premium attached to them in the form of a higher yield exceeded the amount necessary to just offset the expected depreciation of the Canadian dollar. But now there would be no further possibility of riskless arbitrage on the part of the Canadians. In order to take advantage of the international yield spread, they would have to borrow U.S. dollars to buy more Canadian bonds. If they, too, were risk-averse, they would not expose themselves to an uncovered U.S.-dollar liability unless the gain from doing so, i.e., the yield spread, were greater than the expected appreciation of the U.S. dollar. In other words, it would be possible for the Canadians as well as for the Americans to be in equilibrium with the interest rate differential between the two countries larger than that given by (2).

Several observations should be made regarding this conclusion. If it were only to hold for the case in which investors in one country specialized completely in their own bonds, it would not be very interesting. However, the same conclusion holds for the more general case—in which investors in both countries hold internationally diversified portfolios—once the menu of available assets is expanded to include bonds which are subject to interest-rate risk as well as exchange-rate risk. Moreover, nothing in the discussion so far limits the applicability of these results to a world of floating exchange rates. Even if exchange rates were officially "pegged," as under the Bretton Woods system, investors would reasonably attach positive probabilities to the prospect of different rates obtaining in the future. Finally, since there is ample evidence from the domestic term-structure literature that investors tend to be risk-averse,[7] it seems worthwhile to pursue further the implications of risk aversion for international yield spreads. That is the subject of the next two sections.

II. International Yield Spreads in a Risk-Averse World

In order to highlight the concept of exchange risk, the only investment choice considered so far has been the choice between a domestic bond and a foreign bond whose nominal returns in their respective currencies are known with certainty. In the real world, of course, the typical investor can also hold domestic assets whose nominal returns are uncertain. For example, one might purchase a long-term bond with the knowledge that it might have to be sold prior to maturity. Once the range of asset choice is extended to include in each country a domestic bond subject to interest-rate risk, the question of how risk affects international yield spreads becomes more complex.

Each investor can hold one asset which is free from both interest-rate and exchange-rate risk. For simplicity, this asset may be thought of as a short-term bond issued by the government of the investor's own country. He may also hold one asset subject only to interest-rate risk, which will be considered here as a long-term bond of his own government. A third asset—the foreign government short-term bond—is subject only to exchange risk, and a fourth—the foreign government long-term bond—is subject to both types of risk. One safe and three risky assets are therefore available to all investors, but the risk attributes of any given asset depend on the nationality of the investor appraising it.

The decision faced by a risk-averse investor who must allocate his funds among one safe and several risky assets has been extensively analyzed in terms of the portfolio-balance theory pioneered by Markowitz[8] and Tobin.[9] That theory focuses on the way in which an investor, through diversification, can reduce the fluctuations in the earnings of his portfolio as a whole. In other words, "Don't put all your eggs in one basket."

In order for diversification to have this benefit, it is necessary that the returns on the various assets held be less than perfectly correlated. If the returns on different assets move together, there is no advantage to diversification. However, if the returns on one asset tend to be high when those on another are low, and vice versa, the earnings of a portfolio consisting of both of them will have less variability than will the earnings of either of them individually. Therefore, when an investor assesses the value of a potential addition to his portfolio, he places particular attention on the covariance between the returns on the new asset and the returns on those which he already holds. The lower that covariance, the greater is the reduction in risk gained from purchasing the new asset. It follows that even a risk-averse investor will generally find it to his advantage to include in his portfolio some assets which, when viewed individually, appear very risky.

Herbert Grubel has extended these ideas to an international setting.[10] He points out that diversification into foreign assets can also reduce the overall risk (i.e., variability of earnings) of a portfolio even though it involves purchasing assets subject to exchange risk. Of course, the investor must now "translate" the returns on the foreign assets into his own currency. Even so, if business cycles are out of phase in different countries, a portfolio consisting of assets of several countries might generate more stable earnings than a portfolio consisting only of domestic assets.

Grubel is primarily interested in showing the potential welfare gains from international diversification and in explaining observed patterns of capital flows. However, it is possible to use his idea of international portfolio balance to see how yield spreads between countries in a risk-averse world could be different from those under risk-neutrality. Consider again a situation in which the yield spread—in this case, on long bonds—in favor of Canada more than compensated for an expected depreciation of the Canadian dollar. As before, it is clear that such a situation could represent an equilibrium position from the point of view of U.S. investors. But, once more, the question arises whether it could represent an equilibrium from the point of view of Canadians. Would not Canadians have an incentive to sell their U.S. long bonds and to buy Canadian long bonds until the spread were equal to the expected change in the exchange rate?

Not necessarily, because the Canadian long bond is not a riskless asset from a Canadian

perspective. Although it is free from exchange risk, it is still subject to interest-rate risk. There is no reason to presume *a priori* that it is less risky (to the Canadians) than the U.S. long bond. If it is not, risk-averse Canadian investors, like their U.S. counterparts, would be willing to hold U.S. long bonds despite the higher expected yield on the Canadian securities.

There is a fundamental difference, then, between the example considered in Section I, in which the only risk was exchange risk, and that considered here, in which interest-rate risk is present as well. Investors in either country might find the combined risks on the foreign long-term bond to be less than the interest-rate risk on the domestic long bond. In that situation, they would demand a premium on their domestic long bond rather than on the foreign long bond.

To recapitulate, once account is taken of both kinds of risk, it is possible to explain how international yield spreads under risk aversion can differ from those under risk neutrality without any appeal to the net debtor status of a particular country. However, it would be desirable to be more precise than that. In particular, it would be desirable to develop a relationship equivalent to equation (2) for the case of risk-averse investors. To do so, it is necessary to develop a formal model of international bond markets.

III. A Model of International Bond Markets

In recent years, several authors have developed elaborate models of international securities markets.[11] However, the flavor of their results can be adequately captured by a much simpler model which we have developed based on the work of Michael Porter.[12] Porter considers the case of a country whose international lendings and borrowings are too small to have any impact on the level of yields prevailing in the world capital market. The yields in the world market are taken as given and are not explained within the model. What the model explains are the spreads—positive or negative—between those yields and the ones in the "small" country.

This model will be the starting point for the empirical work in Section IV, in which Canada will be viewed as a small country and the U.S. as the world market. In 1976, the total value of new Canadian bond issues sold abroad by all entities—corporate and government—amounted to less than three percent of net funds raised in the U.S. Moreover, 1976 was a year of unusually heavy borrowing by Canadians. During the first half of the 1970's, Canadian bond issues sold abroad typically amounted to only about one percent of net funds raised in the U.S.[13] Therefore, the simplifying assumption of the model—that the small country does not have an appreciable effect on yields in the world market—appears to be a reasonable one in the context of this study.

As in the previous discussion, investors are assumed to have four assets to choose from: short and long bonds issued by both the small country and the "rest-of-the-world" (which will be referred to as Canada and the U.S., respectively). The stock of bonds outstanding is taken as exogenous. Each investor knows with certainty the spot exchange rate and the one-period nominal yields on both short securities; i.e., the "period" of the analysis just matches the maturity of the shorts. He does not know for certain the value of the exchange rate at the end of the period nor the one-period nominal yields on the longs, but his subjective probability distributions for these variables can be completely summarized by their means and variances. With that information, he sets out to allocate his funds among the available assets so as to maximize the expected utility of his end-of-period wealth, expressed in terms of his domestic currency.[14]

The maximization problem is straightforward, and the details are set forth in a technical appendix which is available upon request. The resulting conditions for a maximum can be simplified in the case of the average U.S. investor by recognizing that, in equilibrium, Canadian bonds must account for only a negligible fraction of the value of his portfolio. Otherwise, Canadian lending and borrowing decisions would influence U.S. yields, in violation of the small country assumption. If the shares of Canadian bonds in the typical U.S. portfolio are actually set at zero as an approximation to the condition for an

expected-utility maximum for U.S. investors, it is possible to derive expressions for Canadian yields.

The result which is of most interest here is:

$$E[(1 + \tilde{R}^*_L)(1 + \tilde{\Delta F})] = 1 + R_S + \frac{[E(\tilde{R}_L) - R_S] \cdot A}{\text{var}(\tilde{R}_L)}$$

$$\text{where } A = \text{cov}[(1 + \tilde{R}_L), (1 + \tilde{R}^*_L)(1 + \tilde{\Delta F})]. \quad (3)$$

R_S is the known one-period yield on the U.S. short, and $\tilde{R}_L$ the one-period yield on the U.S. long. Since R_L is a random variable at the start of the period, it is written with a tilde. R^*_S and $\tilde{R}^*_L$ are the corresponding Canadian yields. The symbol $\tilde{\Delta F}$ stands for the percentage change in the spot exchange rate during the next period.

Equation (3) relates the total expected yield on the Canadian long, adjusted for any change in the exchange rate, to the yield on the U.S. short, plus a term which may be thought of as constituting a risk premium. The reason for interpreting it as a risk premium is simple: were it to be zero, equation (3) would reduce to (2), the equilibrium condition under risk neutrality.

Since (3) was derived solely from the conditions for a maximum for U.S. investors, the small-country assumption might seem to imply that Canadian yields are determined in the U.S. However, it would be incorrect to make that inference. For (3) is merely a statement about the expected *product* of the Canadian long yield and the rate of change in the exchange rate. It says nothing about the determination of either of those magnitudes individually. For example, it does not rule out the possibility that Canada could arbitrarily peg the yield on its long bonds. But equation (3) *does* say that such an action would determine the expected rate of change in the exchange rate, given values for the yield on the U.S. short and for the risk premium.[15]

The risk premium term will look familiar to anyone acquainted with the work done on domestic financial markets by Lintner and Sharpe.[16] Their "capital asset pricing model" indicates that the expected yield on a risky asset will, in equilibrium, equal the yield on the safe asset plus a premium of the form:

$$\frac{[E(\tilde{R}_M) - R_S] \cdot \text{cov}(\tilde{R}_j, \tilde{R}_M)}{\text{var}(\tilde{R}_M)},$$

where the subscript j refers to the risky asset in question, S to the safe asset, and M to a market basket of risky assets. In the risk premium term in (3), R_j is replaced by the total return to a U.S. investor on the risky foreign long. In place of R_M there appears R_L, which is the domestic market basket in this simplified model.

There are intuitive explanations for the presence of the various components of the risk premium in (3). The higher the expected yield on the U.S. long relative to the yield on the safe asset—the U.S. short—the higher must be the total return expected on the Canadian long before a risk-averse U.S. investor will purchase it. Thus, $[E(\tilde{R}_L) - R_S]$ enters the premium term with a positive sign. The greater the covariance between the yields on the U.S. long and on the Canadian long (adjusted for expected exchange rate changes), the smaller are the gains from diversification provided by the latter. Again, the total return of the Canadian long must be higher to compensate, so A enters positively. Its total yield must similarly be higher, the smaller the variance of the return on the U.S. long, for then the risk of a capital loss on the U.S. long is smaller. The variance of R_L therefore enters negatively.

The preceding discussion looked at the components of the risk premium from the point of view of a U.S. investor, who would demand such a premium as a condition for holding Canadian bonds. But, as was argued in Section II, a risk-averse Canadian investor would generally not want to sell all of his U.S. longs in order to buy Canadian longs whenever the yield on the latter was higher than the level consistent with equation (2). Both longs are risky assets to him, and the relative desirability of each would depend on the same kind of factors which entered the calculations of the U.S. investor.

The fact that the concerns of investors in both countries are really quite similar suggests that, *a priori,* one should not expect a positive premium to be always included in the yield on the long bond of the small country. U.S. investors could reasonably decide that the combined exchange-rate risk and interest-rate risk of the Canadian security is less than the interest-rate risk of the U.S. long. In fact, the "premium" in equation (3) could clearly be negative as well as positive, for

the two terms in the numerator could individually be of either sign. It is really better thought of as an "adjustment" for risk. But the word "premium" is well-established and will be maintained here, with the understanding that it need not be positive.

The incorporation of risk premiums (positive or negative) into the yields of internationally traded assets can create a fundamental difference in the interpretation of international yield spreads, depending on the risk characteristics of investors. In a risk-neutral world, the foreign yield could exceed the domestic one only when the foreign currency was expected to depreciate. In the case of risk-aversion, no such inference about expected exchange-rate changes can be made from an observation of yield differentials alone. A yield differential in favor of a foreign country would be compatible with an expected appreciation of the foreign currency, provided that the risk premium associated with that country's bonds were great enough. The likelihood of such an occurrence depends on the quantitative significance of the risk premiums, which is the subject of the next section.

IV. Empirical Tests of the Model

In real-world financial markets, of course, there are many factors influencing interest-rate spreads other than expectations of exchange-rate movements and adjustments for interest-rate and exchange-rate risk. Differences among national tax systems and government controls on capital flows are two which come immediately to mind. Some of these problems are avoided in the present case by choosing Canada and the U.S. for the empirical part of this study. Observation of model relationships is facilitated by the high degree of integration of the U.S. and Canadian capital markets, and by the relative absence of official interference in financial transactions between the two countries. Also, by limiting observations to yields on government bonds, we avoid distortions caused by default risk. Because of difficulties in obtaining comparably-defined data series for the two countries, yields on bonds maturing in three-to-five years were used for their long-term interest rates. The market yield on three-month Treasury bills was used for the U.S. short rate.[17]

The period analyzed was from June 1971 through December 1975, during all of which time the Canadian dollar was allowed to float. Canada had actually dropped its fixed exchange rate in mid-1970, but, as is explained below, a year's worth of observations was used up in the formation of a proxy for the risk premium. It would have been desirable to have included a period of fixed exchange rates in the study, to determine whether the effect of exchange risk on interest-rate differentials had in fact differed under the two regimes. Conceptually, the model outlined in the technical appendix is applicable to both fixed and flexible rates. However, the problem of finding adequate proxies for expectations and risk under fixed rates has so far prevented its use outside of a period of flexible rates.

The behavior of yield spreads between the two countries, under both types of exchange-rate systems, is summarized in Table 1 and in Chart 1.

Table 1
Summary Statistics for Canadian-U.S. Yield Differentials on 3-5-Year Bonds

	1 U.S. Yields	2 Canadian Yields	3 Yield Spread, Canadian-U.S.	4 Correlation Coefficient Cols. 1 & 2
July 1962-December 1969				
Mean	4.862	5.609	0.747	0.957
Standard deviation	1.079	1.097	0.319	
June 1971-December 1975				
Mean	6.900	7.048	0.148	0.904
Standard deviation	0.889	1.100	0.490	

Perhaps the most obvious relationship is the close parallel movement of yields on Canadian and U.S. medium-term bonds under both types of exchange-rate regimes. The correlation is higher for the fixed-rate period than for the period of float, but not strikingly so.

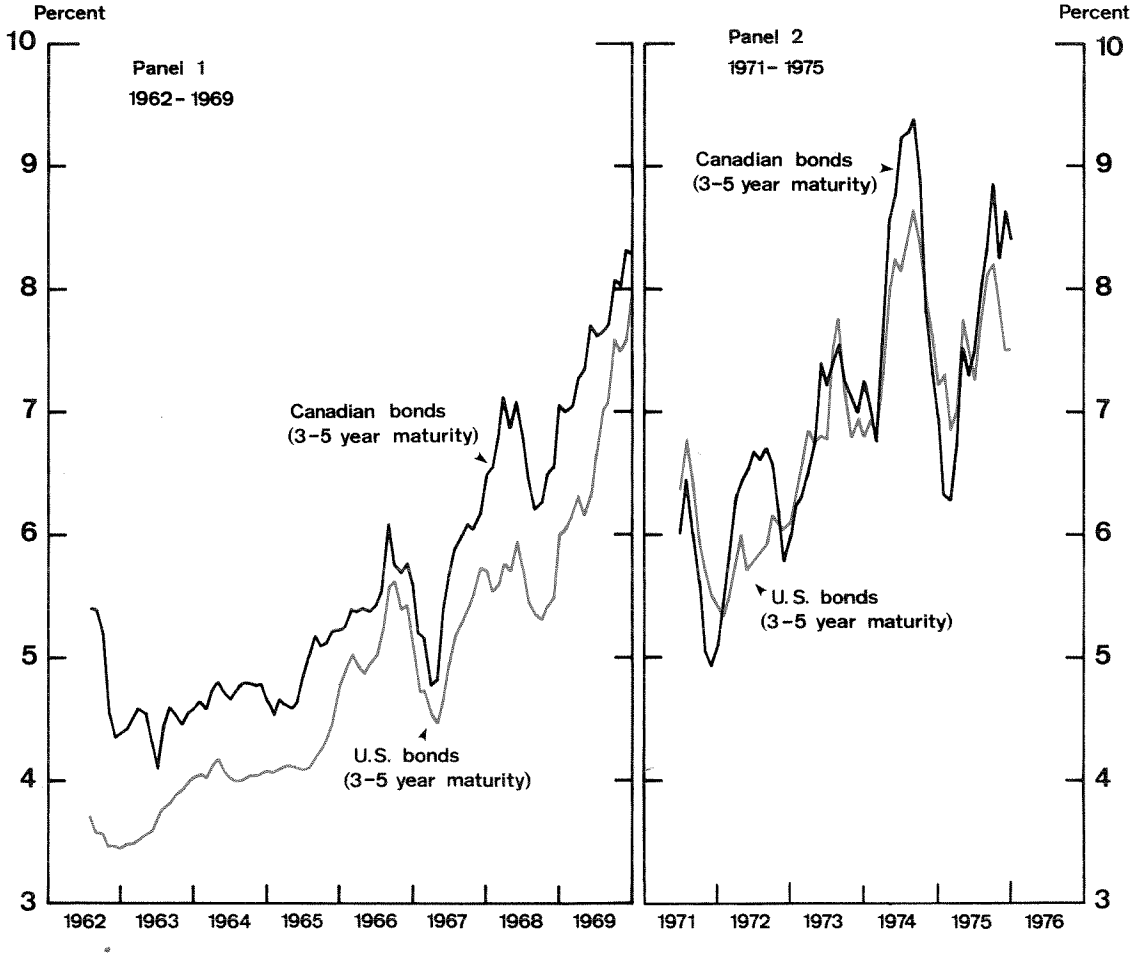
The comparison also shows that the average spread in the 1960's exceeded that of the flexible-rate period of the 1970's. This pattern of yield spreads does not accord with the simple view that foreign lending is riskier under flexible rates than under fixed rates, and that U.S. lenders, who are assumed to determine the spread, therefore demand higher yields to compensate for the greater risk resulting from flexible rates. The fact that average spreads were positive during the fixed-rate period also casts doubts on the model of risk neutrality, since, "with the exception of brief periods when U.S. balance of payments programs were applied to Canada, the predominant pressures on the Canadian dollar [from 1962 to 1970] were up, not down."[18] Given the expectation of a revalued Canadian dollar, the model of risk neutrality would predict *lower,* not higher, Canadian yields in relation to U.S. yields.

These observations suggest the importance of risk premiums in Canadian-U.S. interest differentials, but econometric tests are necessary to see whether those premiums are really statistically significant. Consider again the basic model, which is rewritten here with the left-hand side expanded:

$$[1 + E(\tilde{R}^*_L)]\ [1 + E(\tilde{\Delta F})] + \mathrm{cov}(\tilde{R}^*_L\ ,\tilde{\Delta F}) = 1 + R_S + \frac{[E(\tilde{R}_L) - R_S] \cdot A}{\mathrm{var}(\tilde{R}_L)}$$

Chart 1

CANADIAN-U.S. BOND RATES



Before one can run a regression on that equation, the unobservable expectation and risk variables have to be replaced with observable magnitudes.

For the expected yields on the long bonds, we made the usual assumption that expected yields equal current-market yields.[19] For the components of the risk premium, we proxied the unobserved variances and co-variances with twelve-month moving sample variances and covariances. This procedure is also a standard one, although the choice of twelve months for the size of the sample was somewhat arbitrary.[20]

It was also necessary to find a suitable proxy for exchange-rate expectations—a crucial problem, since the use of an inadequate expectations proxy could seriously bias the tests for the significance of the risk premium. Rather than trying to find "the" correct proxy, we decided to run regressions with two different expectations variables in order to gauge the strength of any results involving the risk premium.

Under the first alternative, we assumed that investors expect no change in the exchange rate. They may have a wide variance concerning their expectations, but their "best guess" is that the rate will be the same in the future as now.[21] Under the second alternative, we assumed that investors expect some "normal" level of the exchange rate to prevail in the long-run. Whenever the current rate deviates from this level, they expect that future rates will move back to it. This assumption is supported by the fact that the Canadian-U.S. exchange rate could statistically be described as "stationary" during the sample period, showing a tendency to fluctuate around a mean level of $1.003.[22] This value was used as the expected future spot rate in the second set of estimations.

The tests of the model were based on regressions of the form:

$$[1 + E(\tilde{R}^*_L)]\,[1 + E(\Delta\tilde{F})] + \mathrm{cov}(\tilde{R}^*_L, \Delta\tilde{F}) - (1 + R_S) = a + b \cdot (\text{Risk Premium}) + u.$$

The left-hand variable is the amount by which the expected total return on a Canadian bond to a U.S. investor exceeds the return on the U.S. safe asset. The model would predict a coefficient on the risk premium of +1. However, since the model itself was based on highly restrictive assumptions, and since a proxy was used for the premium, the only presumption we could make about this coefficient was that it should be positive and significant. Similarly, although no constant term appears in the theoretical equation, one was included in the regressions to pick up those effects not covered by the model, such as differential tax policies in the two countries.

For the expectations assumption of no exchange-rate change, the results of a least-squares estimation were:

Constant 0.0034 (2.9)
Risk Premium 0.57 (9.1)
$\bar{R}^2$ 0.61
D.W. 0.44

(Note: Numbers in parentheses are t-statistics.)

Although the t-statistics are quite large, the very low Durbin-Watson statistic indicates that the t-values may be biased upwards. The low D.W. value indicates either positive autocorrelation in the error-term of the equation or the inclusion of a distributed lag in the correct specification of the equation. On the basis of a test suggested by Griliches, it was concluded that autocorrelation was the better explanation.[23] Accordingly, the equation was re-estimated using the Cochrane-Orcutt correction for autocorrelation. The results were:

Constant 0.0051 (1.5)
Risk Premium 0.42 (4.5)
ρ 0.81 (9.9)
$\bar{R}^2$ 0.85
D.W. 1.8

The risk premium appeared to be highly significant and had the correct sign. But, of course, the validity of any inferences based on the equation are conditional on the assumption that exchange-rate expectations are adequately captured by the proxy used for them. It was therefore important to see how robust these results would be under an alternative expectations assumption.

When the equation was re-estimated with the second expectations proxy—the exchange rate reverting to its mean—the Durbin-Watson statistic was again very low, 0.21. Application of the Cochrane-Orcutt procedure did not cure the problem. After some experimentation with alternative distributed lags, it was found that the

best specification was a simple Koyck lag, corrected for autocorrelation.

Constant –0.011 (–2.8)
Risk Premium 0.29 (2.7)
Dependent Lagged One 0.81 (12.0)
ρ 0.26 (1.9)
$\bar{R}^2$ 0.91
D.W.[24] 2.03

The risk premium is still significant at the 5-percent level and still has the correct sign. However, the steady-state value of its coefficient is $[1/(1 - 0.81)]\ (0.29) = 1.5$, which is much larger than the coefficient under the first expectations assumption.

The fact that the risk premium is significant in both sets of regressions suggests that Canadian-U.S. yield spreads do incorporate adjustments for risk, caused by interest-rate and exchange-rate variability. But without a more rigorous approach to modeling exchange-rate expectations, the magnitude of those adjustments is difficult to gauge.

V. Summary and Conclusions

The major theme of this article has been the difference in international yield spreads on long-term bonds when investors are averse to risk, as opposed to when they ignore risk. In the latter case, yield spreads merely reflect expected exchange-rate movements. In the former, they also reflect adjustments for the combined effects of interest-rate risk and exchange-rate risk.

Why would an investor simultaneously hold both domestic and foreign long bonds when their expected yields (adjusted for anticipated exchange-rate changes) are not equal? The explanation can be found in the concept of "portfolio balance." Both bonds are subject to interest-rate risk; the foreign bond is subject to exchange-rate risk as well. By holding a diversified portfolio which includes both of them, an investor is generally able to reduce the fluctuations in his total earnings. A risk-averse investor will therefore find it worthwhile to hold some portion of his wealth in the form of the bond with the lower expected yield, in order to reap the gains from diversification.

Empirical evidence based on the behavior of Canadian-U.S. interest-rate differentials supports the hypothesis that investors are risk-averse. As a result, yield spreads between countries may be a poor guide to the market's expectations about future exchange rate movements. At the very least, those yield spreads may give a false impression about the *size* of expected movements. At worst, if the risk premium is large enough, they may even give a wrong signal regarding the *sign* of such movements.

FOOTNOTES

1. Donald Heckerman, "On the Effects of Exchange Risk," **Journal of International Economics** (September 1973), pp. 379-387.
2. Franco Modigliani and Richard C. Sutch, "Innovations in Interest Rate Policy," **American Economic Review** (May 1966), pp. 178-197.
3. See, for example, the survey article by Michael C. Jensen, "Capital Markets: Theory and Evidence," **Bell Journal of Economics and Management Science** (Autumn 1972), pp. 357-398.
4. Other sources of risk, such as default risk, have been implicitly assumed away in this example in order to highlight the effect of exchange risk. Furthermore, the complications introduced by differences in national tax policies are not considered. For a recent discussion of the potential impact of such differences, see Maurice D. Levi, "Taxation and 'Abnormal' International Capital Flows," **Journal of Political Economy** (June 1977), pp. 635-646.
5. The investor could, of course, sell forward the anticipated foreign exchange receipts. But for most currencies, organized forward markets do not exist for maturities as long as a year. Throughout Section I, it is assumed that investors are concerned with the value of their wealth as expressed in terms of their own currencies. Some of the implications of relaxing this assumption are discussed in Section III.
6. The adjustment mechanism need not work entirely through changes in the yields. As funds are shifted from the U.S. to Canada, F will increase, helping to restore equality (2). But E(F) may then change in response to the change in F, further complicating matters. *A priori*, all that can be said is that some or all of the four quantities, R, R*, F, and E(F) will change until (2) is satisfied.
7. For a summary discussion of recent work on domestic term-structure, see Rose McElhattan, "The Term Structure of Interest Rates and Inflation Uncertainty," **Economic Review,** Federal Reserve Bank of San Francisco (December 1975), pp. 27-35.
8. Harry Markowitz, **Portfolio Selection** (New York: Wiley, 1959).

9. James Tobin, "Liquidity Preference as Behavior Toward Risk," **Review of Economic Studies** (February 1958), pp. 65-86.
10. Herbert Grubel, "Internationally Diversified Portfolios: Welfare Gains and Capital Flows," **American Economic Review** (December 1968), pp. 1299-1314.
11. Bruno H. Solnik, **European Capital Markets** (Lexington, Massachusetts: D.C. Heath and Company, 1973); Frederick Grauer, Robert Litzenberger, and Richard Stehle, "Sharing Rules and Equilibrium in an International Capital Market under Uncertainty," **Journal of Financial Economics** (June 1976), pp. 233-256.
12. Michael G. Porter, "A Theoretical and Empirical Framework for Analyzing the Term Structure of Exchange Rate Expectations," **International Monetary Fund Staff Papers** (November 1971), pp. 613-642.
13. Sources: **Bank of Canada Review** and **Federal Reserve Bulletin.**
14. The conditions under which it would be optimal for an investor to have a time horizon of only one period into the future are detailed in the author's, **An Analysis of International Yield Curve Differentials** (unpublished Ph.D. thesis, Harvard University, 1977), pp. 38-40.
15. An even stronger version of the small-country assumption appears in Robert Mundell's article, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," **Canadian Journal of Economics and Political Science** (November 1963), pp. 475-485. There, he assumes that the expected change in the exchange rate is zero, so that the small-country yield *is* determined abroad. It is worth noting that, in assessing the realism of the small-country simplification, he states that "It should have a high degree of relevance in a country like Canada whose financial markets are dominated to a great degree by the vast New York market." (p. 475.).
16. The basic references to these and other authors may be found in the survey article by Jensen cited in fn. 3.
17. These series all appear in various issues of the **Federal Reserve Bulletin** and of the **Bank of Canada Review.** The latter publication was the source of the exchange rate series, which consists of monthly averages of daily noon rates.
18. Paul Wonnacott, **The Floating Canadian Dollar** (Washington, D.C.: American Enterprise Institute, 1972), p. 39.
19. See the discussion of F.W. Sharpe, "Reply," **Journal of Business** (April 1968), p. 235.
20. It would be wrong to use as a risk proxy just a moving variance of the exchange rate, despite the intuitive appeal of such a construct as a measure of the risk on foreign assets. To do so would ignore the role of interest-rate risk. Furthermore, it would miss the fundamental notion of portfolio-balance theory: that covariances among yields are the key factors in gauging risk. Finally, a moving variance is always positive, while the "premium" can be positive or negative.
21. Empirical support for this expectations assumption, based on its forecasting ability, may be found in Ian H. Giddy and Gunter Dufey, "The Random Behavior of Flexible Exchange Rates: Implications for Forecasting," **Journal of International Business Studies** (Spring 1975), pp. 1-32.
22. A time-series analysis of the Canadian-U.S. exchange rate is contained in the author's dissertation, cited in fn. 14.
23. Zvi Griliches, "Distributed Lags: A Survey," **Econometrica** (January 1967), pp. 33-34.
24. When one of the regressors is a lagged-dependent variable, the proper test for autocorrelation is based on the h-statistic. See Potluri Rao and Roger Miller, **Applied Econometrics** (Belmont, California: Wadsworth, 1971), p. 123. In this instance, however, the h-test merely confirms the impression given by the D.W. statistic, that autocorrelation is no longer present.