

Yield Curves and International Equity Returns

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Abstract:

This paper examines empirical evidence on the international transmission of shocks to financial asset markets. The relationships between yield curves and risk premiums of stocks for eight industrialized countries are examined. Only the stocks of the three largest economies: Germany, Japan, and the USA, show negative risk premiums during periods preceded by the inverted yield curves of their respective government bonds. This is not the case for stocks of the five smaller countries in the sample. However, four of the five smaller countries have negative risk premiums in periods preceded by inverted German or US yield curves. This is consistent with the view that a world risk factor, captured by major country yield curves, affects the pricing of assets in smaller economies.

The consumption CAPM is unable to explain the phenomenon of the negative risk premiums. In almost all cases the conditional covariance between consumption growth and the risk premiums is statistically indifferent from zero.

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I. Introduction

Many researchers have investigated the relation between yield curves and financial asset returns. Fama and French (1989), show that excess returns on US stocks and corporate bonds are positively related to the slope of the yield curve of US Treasury securities. Fama and French say that the yield curve has predictive ability because it is a proxy for discount rate shocks. Both stocks and long-term Treasury bonds are long-term investments, and are highly susceptible to changes in investors' intertemporal discount rates. Boudoukh, Richardson, and Smith (1993) and Ostdiek (1998) show how *ex ante* risk premiums on US stocks and the world stock portfolio are negative in periods preceded by inverted yield curves. For individual foreign countries, the research has been limited, although Aspren (1989) examined the relationship between the US term spread and the returns on stocks of ten European countries.

The purpose of this research is to look at the effects of foreign country yield curves on the risk premiums of their own stocks, and also the effects of the larger economies' yield curves (U.S., Germany, and Japan) on the smaller countries' stocks. Using returns on country stock indices compiled by MSCI, these relations are tested for eight industrialized countries, including the United States, for the period from 1970 to 1994. There is strong evidence for negative risk premiums for only the US, Germany, and Japan, when using each country's own yield curve. However, negative risk premiums occur for many of the smaller economies when the US or German yield curve is inverted. The Japanese yield curve does not show this relation with the other countries' stocks. This is consistent with the view that a world risk factor, captured by the US and German yield curves, affects the pricing of assets in smaller economies.

Boudoukh, Richardson, and Whitelaw (1997) find that the relation between the U.S. term spread and the risk premium on U.S. stocks is nonlinear. This research also finds that the relation for the U.S. variables is nonlinear, but does not find the evidence to be so strong for the other seven countries' term spreads and stocks. However, there is a nonlinear relation between the U.S. term spread and the risk premiums of the other seven countries' stocks, in particular for Canada and the UK.

The large differences of the conditional risk premiums signaled by upward-sloping and inverted yield curves may be due at least in part to differences in the volatility of the stock returns. This research finds that in many cases the volatility of the returns is much higher when the yield curves are upward-sloping than when they are inverted, in particular the U.S. or German yield curves. However, the results are not perfectly consistent because the Japanese yield curve gives the opposite results. Moreover, the volatilities cannot explain why the risk premiums become negative when the yield curve inverts. Stocks are always riskier investments than Treasury Bills.

Why are investors willing to accept a negative expected risk premium? It seems that when confronted with an inverted yield curve they should bid down the prices of stocks and bid up the prices of short-term bonds until the risk premiums become positive. One possible explanation, suggested by Boudoukh, Richardson, and Whitelaw (1997), comes from the consumption capital asset pricing model (CCAPM). Investors are willing to accept the negative risk premiums if the stocks can help them smooth their consumption. If this is the case, it results in an empirically testable implication. The covariance of consumption growth with the risk premium on the stocks should be negative during periods preceded by inverted yield curves, in order for investors to accept

a negative risk premium. This implication is tested using consumption data from each country. In all cases the covariances are statistically indifferent from zero and thus financial theory fails to explain the phenomena from the perspective of the investors.

Section II describes the data. Section III looks at the relations between each country's stock returns and the yield curves. Section IV discusses the relations between the risk premiums and consumption growth. Section V concludes.

II. Description of the Data

This research uses quarterly investment horizons because the best consumption data available are quarterly. There are monthly consumption data available for the U.S., but they are rough estimates based on retail sales. Other research has shown that the results for the risk premiums are not dependent on the choice of time horizon. McCown (1999) uses both monthly and quarterly data for U.S. stocks and fixed income securities, and receives the same results for both horizons. Boudoukh, Richardson, and Smith (1993) use annual data and find a similar relation between the term spread and the risk premium for the 1802 – 1990 period.

Returns on stocks are from the Morgan Stanley Capital International local currency indices for each country. The returns include dividends. The period under examination is 1970 - 1994. The term spreads are computed as the difference in the yield to maturity between a ten-year government bond and a 90-day instrument. The appendix describes the interest rate data in detail.

For all of the countries, the consumption data are seasonally-adjusted private consumption, which include durables. This differs from the usual practice of using

consumption of nondurables and services for the U.S.. Since data for nondurables and services for some of the foreign countries are not available, total private consumption is used instead. The U.S. data also uses total private consumption, so that the sources are consistent. McCown (1999) does a similar test using only nondurables and services consumption for the U.S. data, and achieves similar results.

III. Relations Between Risk Premiums and Yield Curves

Throughout this research, stock returns and interest rates are denominated in local currencies. This section of the research takes the perspective of an investor who could be living in any country, investing in any country's stocks, and completely hedges all foreign exchange risk. This is obviously unrealistic, because investors can and do make unhedged or partially hedged foreign investments. However, this research is concerned with the returns on the underlying securities rather than the currencies. Since foreign exchange rates are very volatile, returns on unhedged securities might be driven more by exchange rates than by security prices. Working with local currency returns allows us to isolate the securities from the currencies to some extent. Of course, exchange rates affect even the local currency returns, especially through their impact on corporate profits from imports and exports.

Table 1 shows the unconditional risk premiums of each country portfolio's stock returns in excess their short-term interest rate. All are positive. Table 1 also shows summary statistics for the term spreads for each country. The average term spreads for most of the countries lie in the range from 0.926 % for Sweden to 1.585 % for the US.

Japan's average of 0.395% is unusual. Out of 100 quarters examined, the countries have inverted yield curves ranging between 18 and 32 occurrences.

Table 2 shows the conditional risk premiums of each country's stocks for periods preceded by its own normal and inverted yield curves. The risk premiums are computed using the generalized method of moments. A binary instrument for each country is defined as $S_{t-1} = 1$, if the term spread is positive, and $S_{t-1} = 0$, if the term spread is negative. This will give us the conditional risk premium for upward-sloping yield curves. To compute the conditional risk premium for inverted yield curves: $S_{t-1} = 1$ if the term spread is negative and $S_{t-1} = 0$ if the term spread is positive. The moment condition is:

$$(r_t - \mu) \otimes S_{t-1} = 0. \quad (1)$$

Where r_t is the risk premium at time t and μ is the conditional mean risk premium being computed. This method has the advantage of utilizing all of the data in order to estimate the asymptotic distribution. Six out of eight of the country portfolios in the sample have negative risk premiums when their yield curves are inverted. Z-statistics are computed for the test of the null hypothesis $\mu_N = \mu_I$, where μ_N is the risk premium when the yield curve is normal, and μ_I is the risk premium when the yield curve is inverted. These z-statistics are computed using standard errors that are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992). The z-statistics for Japan, and the USA, are statistically significant at 99%. The statistic for Germany is significant at 94% confidence. The stocks of Australia, Canada, and France also show negative risk premiums when their yield curves are inverted, but are not statistically significant. The stocks of Sweden and the UK show the risk premiums to be positive and higher when their yield curves are inverted than when they are normal.

Why do the inverted yield curves signal statistically significant negative risk premiums for only the three large economies? Estrella and Mishkin (1996) show how the U.S. yield curve is a good predictor of business cycle fluctuations for the US.. The probability of a recession increases as the term spread decreases. When the yield curve is inverted (typically at the peak of a business cycle) the probability of a future recession is at its highest. The yield curve inverts when the short-term interest rate rises above the long-term rate, often caused by contractionary monetary policies that slow real growth and hurt corporate profits in the near term. Since stock prices tend to rise and fall with earnings and dividends, the yield curve also serves as a predictor of future stock returns.

To determine if there is a relation between the conditional risk premiums and their volatility, the conditional standard deviations are computed and shown in Table 2. The standard deviations and the z-statistics for their difference are computed using the same methodology as was used for the means. All of the country portfolios except for Japan's show higher volatility during periods preceded by normal yield curves than during periods preceded by inverted yield curves. The result for the U.S. is consistent with the finding of Boudoukh, Richardson, and Whitelaw (1997), who find the volatility to be higher when yield curve is upward-sloping, but they do not find the difference to be statistically significant. This research finds the z-statistics for the differences between the two conditional volatilities to be statistically significant for the stocks of Canada, France, Germany, and the UK. The differences in the volatilities suggest that at least part of the explanation for the higher risk premiums for the periods preceded by normal yield curves is a compensation for the higher volatility. However, the results are not consistent. Japanese stocks have lower risk premiums when their yield curve is inverted, but they

have higher volatility. Moreover, the lower volatilities that occur when the yield curves are inverted do not justify a negative risk premium. Stocks are always a riskier investment than Treasury Bills. A mean–variance framework cannot fully explain the phenomena, but a consumption–based asset pricing model has the potential to do so.

Why do inverted yield curves signal statistically significant negative risk premiums for only the largest economies? Exogenous international macroeconomic shocks have a greater effect on the economies of smaller countries than on larger countries. Crucini (1997) shows that larger economies have less volatile investment, consumption, and trade balances, and higher correlations of domestic savings and investment rates than smaller economies, due to the large economies’ stronger ability to withstand international shocks. It stands to reason that the effects of these shocks will also be felt more strongly in the small countries’ financial markets than in the large countries. The shocks can obfuscate the relationship between the yield curve and returns on stocks in the smaller countries. Sweden, which has the smallest economy in the sample, has the highest conditional risk premiums when its own yield curve is inverted. Since the small economies are susceptible to international shocks, do the yield curve inversions in the larger economies also make their presence felt in the small countries? The next step is to examine the relations between the larger countries’ yield curves and the smaller countries’ risk premiums.

Table 3 shows the conditional risk premiums, for each country, for those periods preceded by normal and inverted US yield curves. The differences from Table 2 are striking. All of the countries except for Germany have lower conditional risk premiums when the US term spread is used, instead of each country’s own term spread, and all are

negative. That the U.S. term spread could have such an impact is illustrated by the fact that 56% of the world's debt is dollar-denominated (*The Wall Street Journal*, March 22, 1996, p. C1.). If a foreign corporation has dollar-denominated debt, then the slope of the U.S. yield curve will have an impact on its financing and investment decisions. The results for the UK are particularly interesting. Risk premiums on UK stocks are negative and statistically significant when conditioned on inverted U.S. yield curves, but are positive when conditioned on inverted UK yield curves. The UK stock market has a closer relationship with the U.S. yield curve than with the UK yield curve. Figure I shows a graph of the time series of term spreads for the U.S. and UK.

Asprem (1989) regressed the stock returns for several European countries on the U.S. term spread. He found a positive and statistically significant relationship for the stock returns of Germany, the Netherlands, Switzerland, and the UK. His results are consistent with the results of this research, since a positive relationship would imply a low risk premium when the yield curve is inverted.

Table 3 also shows that the volatilities of the risk premiums are higher for all eight country portfolios when the U.S. yield curve is upward-sloping, than when it is inverted. The z-statistics for Germany, Japan, Sweden, and the UK are statistically significant.

Table 4 shows the conditional risk premiums for those periods preceded by inverted German yield curves for each country. The conditional risk premiums are negative and significant for Australia, France, and Japan, and negative but insignificant for the UK and the U.S. Figure II shows the graphs of the U.S. and German term spreads. Both are negative at approximately the same times. One major exception is the second

quarter of 1980 that is positive for the US but negative for Germany. This instance, caused by a rapid reversal of US monetary policy and the sudden imposition and relaxation of credit controls, is an anomaly for the US. Another exception is the period from 1991 to 1993, when German term spreads became negative while US term spreads were positive. France, Sweden, and the UK also had inverted yield curves during most of this period. Other researchers have noted the influence of German monetary policy on the financial markets of the other European countries during this time period, but it is interesting to see similar results for Australia and Japan. Gagnon and Unferth (1995) note the similarity between the German and Japanese *ex post* real interest rates from 1977 to 1993. They also find that the German *ex post* real interest rate has the highest correlation with their estimate of the world real interest rate. Comparing the results for the UK between Tables 3 and 4 shows a tighter relation between the financial markets of the UK and the U.S., than between the UK and Germany. The volatilities for all eight country portfolios are greater when the German yield curve is upward-sloping than when it is inverted. The z-statistics for the differences in the volatilities are statistically significant for France, Germany, the UK, and the U.S.

Table 5 shows the risk premiums conditioned on Japanese yield curves. All are positive when preceded by an inverted yield curve except for those of Japan, Australia, and Canada. The only statistically significant z-statistic is that of Japan. The Japanese yield curve does not capture the world risk factor that is proxied by the US and German yield curves, and suggests that the Japanese financial markets have a more isolated role in the world economy than do the U.S. or Germany. Moreover, the volatilities for the Japanese, British, and U.S. portfolios are higher when the Japanese yield curve is inverted

than when it is upward-sloping, and none of the eight z-statistics for the volatilities are significant.

Ostdiek (1998) finds that the relation between the U.S. term spread and the risk premium on the world portfolio varies by subperiod. She divides her 1970 – 1992 sample in half and shows that the negative risk premiums are more prevalent in the 1970 – 1981 subperiod than in the 1981 – 1992 subperiod. For this research, the sample is also divided into halves: 1970.1 – 1982.2, and 1982.3 – 1994.4. Each subperiod has 50 quarters. This method of dividing the sample has the added attraction of beginning the second subperiod just before the bull market of August, 1982 began.

Table 6 shows the subperiod results for the conditional risk premiums using each country's own yield curve. The first period shows results similar to the entire sample, but only the German and U.S. z-statistics are statistically significant. The second subperiod shows very different results. Only the Canadian and Japanese risk premiums are negative when their yield curves invert, and only the Japanese z-statistic is significant. The results for the U.S. are consistent with the subperiod results that Ostdiek finds for the world portfolio. The only occasion during the second subperiod that the U.S. yield curve inverted was during the last three quarters of 1989.

Table 7 shows the subperiod results using the U.S. yield curve as the conditioning variable. During the first subperiod, all country portfolios have negative risk premiums when the U.S. yield curve inverts, except for Sweden. The French, German, British, and U.S. z-statistics are significant. During the second subperiod, five of the country portfolios show the negative risk premiums, but none are both negative and statistically

significant. The German risk premium is positive and significant when the U.S. yield curve inverts.

Table 8 shows the subperiod results using the German yield curve as the conditioning variable. During the first subperiod, all country portfolios show negative risk premiums when the German yield curve inverts, except for Sweden. The z-statistics for Australia, Canada, France, Germany, Japan, and the U.S. are significant. During the second subperiod, only the Japanese stocks show the negative conditional risk premiums and they are not statistically significant.

Ostdiek (1998) suggests that the different subperiod results may be driven by the power of the instruments in the different periods. She cites the fact that most of the U.S. yield curve inversions occur during the first subperiod. This is also the case with the data and subperiods used in this research. However, this is not the case for the German yield curve. During the second subperiod, the German yield curve was inverted during 15 out of 50 quarters, as compared with 17 out of 50 quarters in the first subperiod.

Boudoukh, Richardson, and Whitelaw (1997) explore the risk premium – yield curve relation further by testing for nonlinearity in the relation. One of the tests that they run is a piecewise linear regression of the risk premium on the lagged term spread, using a spread of zero for the breakpoint:

$$rp_{t+1} = \alpha + \beta_1(\Delta r_{lf,t}) + \beta_2 \max[0, \Delta r_{lf,t}] + \varepsilon_{t,t+1}. \quad (2)$$

Boudoukh, Richardson, and Whitelaw find that the relation is nonlinear and concave for the 1897 – 1990 period for the U.S. term spread and U.S. stocks. This research tests the relation for nonlinearity using the same method for both each country's own term spread as well as the U.S. term spread.

Table 9 shows the results for the test using each country's own term spread as the independent variable. Only the U.S. portfolio shows statistically significant slope coefficients on both sides of the breakpoint. The coefficients are positive for a negative term spread and negative for a positive term spread, implying a concave relation, just as Boudoukh, Richardson, and Whitelaw find for their longer data set. The results for the German portfolio are similar, but the coefficient for the positive term spread is not statistically significant. The results for Sweden imply a convex relation, but again the second slope coefficient is not significant.

Table 10 shows the results for all eight country portfolios, using the U.S. term spread as the independent variable. All eight portfolios have a positive point estimate for the first slope coefficient and a negative estimate for the second, implying a concave relationship. The Canadian, UK, and U.S. portfolios have statistically significant results for both slope coefficients. Overall the results shown in Table 9 and 10 are consistent with the findings of Boudoukh, Richardson, and Whitelaw (1997), but only show that the U.S. term spread has this effect.

IV. The Relations Between Risk Premiums and Consumption

The yield curves of Germany, Japan, and the U.S. can be used to forecast negative risk premiums for their respective stocks, and the German and U.S. yield curves can be used to forecast negative risk premiums for the other countries' stocks. Boudoukh, Richardson, and Smith (1993) show that this phenomenon also holds for annual returns for US stocks. They also show that this relationship is an ancient one: their data set runs

from 1802 to 1990. This section investigates whether this phenomenon be explained by asset pricing theory.

In one-period capital asset pricing models such as the conditional version of the CAPM, if investors are risk averse then the expected return on the market of risky assets must be greater than the return on risk free assets:

$$E_t [R_{m,t+1}] \geq R_{ft}$$

(3) where $R_{m,t+1}$ is the return on the market portfolio from time t to $t+1$ and R_{ft} is the return on the risk free asset from time t to $t+1$. E_t is the expectation operator as of time t , conditional on the information investors use to form their expectations. A potential problem with testing this prediction of the CAPM, as suggested by Roll (1977) is that the true market portfolio is unobservable. We are restricted to testing returns of a proxy of the market portfolio: R_{pt+1} . However, this is not a problem if the conditional covariance between the proxy and the true market portfolio is positive. If the conditional CAPM holds, then it must be true that:

$$E_t[(R_{pt+1} - R_{ft})] = \frac{\text{cov}_t[R_{pt+1}, R_{mt+1}]}{\text{var}_t[R_{mt+1}]} E_t[(R_{mt+1} - R_{ft})] \quad (4)$$

Therefore, if the market risk premium is positive, and the conditional covariance is positive, then the risk premium on the proxy portfolio must also be positive. Thus, each country's stock portfolio should have a positive *ex ante* risk premium at all times, provided that it is positively correlated with the world market portfolio of all assets. The correlations between the returns on the stock portfolios for each pair of countries in the sample were computed (not shown). All of the correlations are positive and statistically significant.

The results of Boudoukh, Richardson, and Smith (1993), Ostdiek (1998), and this research do not support the inequality constraint of equation (3). The CAPM is a one period model that assumes that an investor's consumption is equal to the gross return from her investments. A dynamic, consumption-based asset pricing model, such as Breeden's (1979) CCAPM, can result in a negative risk premium for any asset, including the market portfolio. The first-order conditions for an individual's optimal consumption and portfolio plan imply that:

$$E_t \left[(R_{it+1} - R_{ft}) \frac{U'(C_{t+1})}{U'(C_t)} \right] = 0 \quad (5)$$

where $U'(\cdot)$ is marginal utility and C_t is consumption at time t . The expression

$\frac{U'(C_{t+1})}{U'(C_t)}$ is the intertemporal marginal rate of substitution (IMRS) which will be

abbreviated as M_{t+1} . R_{it+1} is the return on any risky asset, which could be the market portfolio.

Taking a first-order Taylor series expansion of the numerator of the IMRS around C_t gives us:

$$\frac{U'(C_{t+1})}{U'(C_t)} \approx \frac{U'(C_t) + (C_{t+1} - C_t)U''(C_t)}{U'(C_t)} \quad (6)$$

Rearranging the RHS of (3) we get:

$$\frac{U'(C_t) + (C_{t+1} - C_t)U''(C_t)}{U'(C_t)} = 1 - \left(\frac{-C_t U''(C_t)}{U'(C_t)} \right) \left(\frac{C_{t+1} - C_t}{C_t} \right) \quad (7)$$

Let $b = \left(\frac{-C_t U''(C_t)}{U'(C_t)} \right)$ denote the aggregate relative risk aversion, which is

nonstochastic because it depends only on C_t , which is known at time t . Let

$c_{t+1}^* = \left(\frac{C_{t+1} - C_t}{C_t} \right)$ denote the growth rate of consumption. Combine equation (5) with

equations (6) and (7), and ignore the approximation to get:

$$E_t[(R_{i,t+1} - R_{ft})(1 - bc_{t+1}^*)] = 0. \quad (8)$$

Applying the definition of covariance, rearranging, and taking the limit to continuous time we get:

$$E_t[R_{i,t+1} - R_{ft}] = bCov_t(R_{i,t+1} - R_{ft}, c_{t+1}^*) \quad (9)$$

Equation (9) suggests two possible explanations for negative *ex ante* risk premiums: the covariance between the risk premium and the growth rate of consumption might be negative in those states of the world, or the relative risk aversion might be negative, but not both. If both are positive or both are negative, then the risk premium will be positive.

Over the long run the covariance in (9) should be positive, but Cornell (1981) has shown that the conditional relationship need not be constant. It is theoretically possible for the relationship to be positive in some states of the world and negative in others.

Boudoukh, Richardson, and Whitelaw (1997) develop a stylized model that assumes that consumption and dividend growth follow a discrete Markov process. They show that, given the right assumptions about the parameters of the process, the equity returns will act as a hedge to consumption shocks and that therefore investors will be willing to accept negative expected risk premiums on equities. However, they are merely showing that it *can* happen. This research concerns the question of whether or not it actually is happening. Boudoukh, Richardson, and Whitelaw do not perform any empirical tests on the consumption data at all.

The next step of this research is to determine if the sign of the risk premiums can be explained by the sign of their covariance with the growth rate of consumption. Per equation (9), the CCAPM predicts that the sign of the risk premium should be the same as the sign of the covariance between consumption growth and the risk premium, assuming risk aversion. Table 11 shows the conditional covariances between consumption growth and the risk premiums on stocks for each country, for those periods preceded by their own inverted yield curves. The conditional covariances are computed using the generalized method of moments. GMM relies on the assumption that the variables being tested are stationary. The time series of the risk premiums of the assets as well as the consumption growth rates were tested for stationarity (not shown). All of the time series strongly rejected the null hypothesis of unit root nonstationarity. In order to compute the covariances, it is necessary to estimate three moments: the mean risk premium, the mean consumption growth rate, and the mean of the product of the two variables:

$$\begin{pmatrix} r_t - \bar{r} \\ c_t^* - \bar{c}^* \\ r_t c_t^* - \bar{r} \bar{c}^* \end{pmatrix} \otimes S_{t-1} = 0. \quad (10)$$

Where $S_{t-1} = 0$ if the preceding yield curve is normal, 1 if inverted. The conditional covariance is then computed as:

$$\text{Cov}_t(r_t, c_t^*) = \left(\frac{t}{t'} \right) \overline{rc^*} - \left(\frac{t}{t'} \right)^2 \bar{r} \cdot \bar{c}^*. \quad (11)$$

Where t is the total number of periods in the sample, and t' is the number of periods preceded by inverted yield curves. Robust standard errors are computed using the method of Andrews and Monahan (1992). All of the covariances in Table 11 are statistically

indifferent from zero. Many researchers have found that the relationship between stock returns and aggregate consumption growth is very weak for the U.S. It is not surprising that this should also prove to be the case for the foreign countries.

Table 12 shows the covariances using the US or German yield curves as the conditioning variable. The results are similar to Table 11. The CCAPM cannot explain why investors are willing to accept the negative risk premiums. Even if the cause of the failure of the test were lack of power, the point estimates of the covariances do not support equation (9) in most cases. For example, U.S. stocks show negative risk premiums when the U.S. yield curve is inverted, but the conditional covariance is positive. For equation (9) to hold with a positive covariance, the coefficient of relative risk aversion would have to be negative. There are certainly some investors who are risk-loving, but it is unlikely that most are.

V. Conclusions

Negative, statistically significant risk premiums occur for U.S., German and Japanese stocks during periods preceded by their own inverted yield curves. This phenomenon is not found for the smaller economies in the sample. In particular, Sweden, and the UK have positive risk premiums in such periods. The effects of the German and U.S. yield curves on the smaller country's stocks show evidence of international transmission of shocks to financial asset markets. Many of the smaller economies have negative risk premiums in periods preceded by inverted German or U.S. yield curves. An examination of the graphs of the U.S. and German term spreads shows that they become

negative during approximately the same time periods. The Japanese yield curve does not show this relation with the smaller countries' stock returns.

For most of the country portfolios, the volatility of the risk premiums tends to be lower when either each country's own yield curve, or the U.S. or German yield curves are inverted. This is not the case for the Japanese yield curve.

Tests for nonlinearity in the risk premium-term spread relation show that the U.S. term spread shows a concave relation with U.S., Canadian, and British equities.

The CCAPM is not able to explain the phenomenon of the negative risk premiums. The conditional covariance between the risk premium and consumption growth is statistically insignificant from zero.

Future research should investigate what international risk factor is being transmitted across financial markets. Are the negative risk premiums a result of US and/or German monetary policy, or are real shocks involved? It would also be interesting to solve the puzzle of why investors are willing to accept the *ex ante* negative risk premiums.

Table 1**Summary Statistics**

1970.1 - 1994.4 (100 quarters)

See appendix for descriptions and sources of interest rate data.

Stock returns and interest rates are annualized.

Country	Return on Stocks	Short-Term Interest Rate	Risk Premium	Average term spread (Long-term yield minus short-term yield)	# of times spread is negative
Australia	9.87 %	9.38 %	0.49 %	0.978 %	21
Canada	9.64	8.57	1.07	1.035	23
France	13.06	9.14	3.92	1.017	23
Germany	9.17	6.48	2.69	1.066	32
Japan	10.63	6.22	4.41	0.395	31
Sweden	15.47	9.00	6.47	0.926	32
United Kingdom	15.10	9.38	5.72	1.070	30
United States	9.80	6.86	2.94	1.585	18

Table 2**Risk Premiums on Stocks: Conditioned on Each Country's Own Yield Curve: 1970 - 1994**

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	σ_N	σ_I	Z-stat Ho: $\sigma_N = \sigma_I$
Australia	1.28 %	-2.49 %	0.3376 (0.734)	10.22 %	6.19 %	1.5633 (0.119)
Canada	1.41	-0.06	0.1634 (0.873)	7.43	4.34	2.3371 (0.019)
France	5.95	-2.84	0.6538 (0.516)	10.00	5.47	2.3502 (0.019)
Germany	7.81	-8.16	1.8843 (0.060)	8.52	4.79	2.2683 (0.023)
Japan	12.08	-12.67	2.7783 (0.005)	7.16	7.65	-0.2826 (0.779)
Sweden	4.15	11.38	-0.6298 (0.529)	9.16	7.71	0.7497 (0.453)
United Kingdom	5.31	6.67	-0.1599 (0.873)	10.23	4.50	3.0959 (0.002)
United States	7.81	-19.26	2.8752 (0.004)	6.86	4.63	1.5714 (0.116)

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted. σ_N is the standard deviation of the risk premium conditional on the preceding yield curve being upward-sloping, σ_I is the standard deviation of the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums and standard deviations computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$, and $\sigma_N = \sigma_I$. P-values in parentheses show the probability of a type I error.

Table 3**Risk Premiums on Stocks: Conditioned on the US Yield Curve: 1970 – 1994**

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	σ_N	σ_I	Z-stat Ho: $\sigma_N = \sigma_I$
Australia	3.51 %	-13.27 %	1.1440 (0.254)	9.79 %	6.79 %	0.9198 (0.358)
Canada	5.24	-17.90	1.9461 (0.051)	7.00	4.84	1.5013 (0.134)
France	8.35	-16.23	1.9363 (0.052)	9.64	5.90	1.9018 (0.057)
Germany	4.53	-5.66	1.0935 (0.276)	9.26	3.34	3.8347 (0.000)
Japan	8.22	-12.97	1.9528 (0.051)	9.42	4.81	2.7316 (0.006)
Sweden	8.14	-1.16	0.8219 (0.412)	11.22	4.01	3.8894 (0.000)
United Kingdom	12.88	-26.93	3.1156 (0.002)	9.46	5.30	1.9878 (0.046)
United States	7.81	-19.26	2.8752 (0.004)	6.86	4.63	1.5714 (0.116)

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted. σ_N is the standard deviation of the risk premium conditional on the preceding yield curve being upward-sloping, σ_I is the standard deviation of the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums and standard deviations computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$, and $\sigma_N = \sigma_I$. P-values in parentheses show the probability of a type I error.

Table 4**Risk Premiums on Stocks: Conditioned on the German Yield Curve: 1970 – 1994**

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	σ_N	σ_I	Z-stat Ho: $\sigma_N = \sigma_I$
Australia	6.87 %	-13.06 %	2.3629 (0.018)	10.18 %	6.06 %	1.8256 (0.067)
Canada	2.22	4.54	-1.6900 (0.091)	6.09	5.93	0.1254 (0.904)
France	10.40	-9.83	2.5166 (0.012)	10.03	5.19	2.6664 (0.008)
Germany	7.81	-8.16	1.8843 (0.060)	8.52	4.79	2.2683 (0.023)
Japan	12.07	-11.88	2.7010 (0.007)	8.78	5.74	1.8397 (0.066)
Sweden	5.42	8.67	-0.2964 (0.764)	9.33	7.50	0.7959 (0.424)
United Kingdom	11.16	-5.84	1.7969 (0.072)	10.02	4.68	2.5605 (0.010)
United States	6.54	-4.71	1.5146 (0.131)	7.28	4.18	2.4372 (0.015)

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted. σ_N is the standard deviation of the risk premium conditional on the preceding yield curve being upward-sloping, σ_I is the standard deviation of the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums and standard deviations computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$, and $\sigma_N = \sigma_I$. P-values in parentheses show the probability of a type I error.

Table 5**Risk Premiums on Stocks: Conditioned on the Japanese Yield Curve: 1970 – 1994**

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	σ_N	σ_I	Z-stat Ho: $\sigma_N = \sigma_I$
Australia	1.88 %	-2.60 %	0.3863 (0.697)	9.63 %	7.07 %	0.7434 (0.459)
Canada	3.58	-4.51	0.9384 (0.347)	6.85	5.17	1.0578 (0.289)
France	5.36	0.73	0.3722 (0.711)	8.78	7.30	0.6556 (0.509)
Germany	2.45	3.25	-0.0825 (0.936)	7.63	6.27	0.7409 (0.459)
Japan	12.08	-12.67	2.7783 (0.005)	7.16	7.65	-0.2826 (0.779)
Sweden	8.59	1.74	0.6222 (0.535)	9.25	7.54	0.6666 (0.503)
United Kingdom	7.50	1.74	0.4185 (0.674)	7.29	8.44	-0.5484 (0.582)
United States	2.07	4.87	-0.2892 (0.772)	5.64	6.31	-0.4407 (0.660)

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted. σ_N is the standard deviation of the risk premium conditional on the preceding yield curve being upward-sloping, σ_I is the standard deviation of the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums and standard deviations computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$, and $\sigma_N = \sigma_I$. P-values in parentheses show the probability of a type I error.

Table 6**Subperiod Results for Risk Premiums on Stocks: Conditioned on Each Country's Own Yield Curve: 1970 – 1982.2, and 1982.3 - 1994**

Period 1: 1970.1 – 1982.2 (50 quarters)

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	P-value
Australia	-1.64 %	-44.02 %	1.462	0.144
Canada	-1.47	0.05	-0.090	0.928
France	2.46	-9.91	0.536	0.589
Germany	7.88	-22.46	3.456	0.000
Japan	9.46	-5.30	1.357	0.174
Sweden	3.77	-2.18	0.478	0.631
United Kingdom	2.95	4.10	-0.076	0.936
United States	6.56	-23.99	2.851	0.004

Period 2: 1982.3 – 1994.4 (50 quarters)

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	P-value
Australia	5.36 %	7.28 %	-0.163	0.872
Canada	4.23	-0.19	0.428	0.667
France	9.35	4.88	0.406	0.682
Germany	7.75	8.04	-0.023	0.984
Japan	14.34	-22.88	2.495	0.012
Sweden	4.66	18.49	-0.810	0.418
United Kingdom	9.30	7.31	0.209	0.834
United States	8.74	4.40	0.341	0.734

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$. P-values show the probability of a type I error.

Table 7**Subperiod Results for Risk Premiums on Stocks: Conditioned on U.S. Yield Curves: 1970 – 1982.2, and 1982.3 - 1994**

Period 1: 1970.1 – 1982.2 (50 quarters)

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	P-value
Australia	-1.06 %	-14.30 %	0.735	0.459
Canada	6.60	-19.08	1.689	0.091
France	8.26	-20.98	2.047	0.040
Germany	2.62	-14.24	2.342	0.019
Japan	10.32	-10.25	1.758	0.078
Sweden	2.55	2.25	0.026	0.976
United Kingdom	17.90	-31.48	3.141	0.003
United States	6.56	-23.99	2.851	0.004

Period 2: 1982.3 – 1994.4 (50 quarters)

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	P-value
Australia	6.91 %	-8.09 %	0.806	0.418
Canada	4.23	-12.01	1.193	0.234
France	8.42	7.55	0.056	0.952
Germany	5.96	37.24	-4.145	0.000
Japan	6.66	-26.56	0.913	0.363
Sweden	12.30	-18.20	1.706	0.087
United Kingdom	9.15	-4.20	0.916	0.358
United States	8.74	4.40	0.341	0.734

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$. P-values show the probability of a type I error.

Table 8**Subperiod Results for Risk Premiums on Stocks: Conditioned on German Yield Curves: 1970 – 1982.2, and 1982.3 – 1994**

Period 1: 1970.1 – 1982.2 (50 quarters)

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	P-value
Australia	7.36 %	-29.09 %	3.485	0.000
Canada	11.54	-25.66	3.634	0.000
France	8.82	-18.63	2.564	0.010
Germany	7.88	-22.46	3.456	0.000
Japan	11.63	-10.37	2.088	0.037
Sweden	0.66	5.96	-0.495	0.617
United Kingdom	12.93	-16.01	1.909	0.056
United States	4.72	-16.83	2.281	0.023

Period 2: 1982.3 – 1994.4 (50 quarters)

Country	μ_N	μ_I	Z-stat Ho: $\mu_N = \mu_I$	P-value
Australia	6.40 %	5.10 %	0.141	0.889
Canada	1.47	7.42	-0.700	0.484
France	11.90	0.13	1.119	0.262
Germany	7.75	8.04	-0.023	0.984
Japan	12.50	-13.61	1.724	0.085
Sweden	9.92	11.75	-0.094	0.928
United Kingdom	9.49	5.68	0.436	0.660
United States	8.25	9.01	-0.103	0.920

Annualized returns from quarterly data.

μ_N is the risk premium conditional on the preceding yield curve being upward-sloping, μ_I is the risk premium conditional on the preceding yield curve being inverted.

Conditional risk premiums computed using the generalized method of moments. Standard errors used in computing the z-statistics are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

The z-statistics are for the test of the null hypotheses: $\mu_N = \mu_I$. P-values show the probability of a type I error.

Table 9**Piecewise Linear Regression of the Risk Premium – Term Spread Relation: Each Country’s Own Term Spread: 1970 - 1994**

Country	$\hat{\alpha}$	$\hat{\beta}_1$	$\hat{\beta}_2$	\bar{R}^2
Australia	-0.005 (0.024)	-0.005 (0.014)	0.007 (0.022)	-0.019
Canada	0.008 (0.017)	0.014 (0.011)	-0.014 (0.017)	0.002
France	0.006 (0.022)	0.008 (0.016)	-0.004 (0.024)	-0.012
Germany	0.030 (0.020)	0.037 ** (0.018)	-0.044 (0.024)	0.028
Japan	-0.004 (0.022)	0.008 (0.014)	0.013 (0.027)	0.023
Sweden	0.008 (0.017)	-0.023 ** (0.011)	0.022 (0.015)	0.028
United Kingdom	-0.010 (0.021)	-0.007 (0.014)	0.021 (0.020)	0.005
United States	0.027 (0.019)	0.071 ** (0.026)	-0.076 ** (0.032)	0.067

$$rp_{t+1} = \alpha + \beta_1 (\Delta r_{lf,t}) + \beta_2 \max[0, \Delta r_{lf,t}] + \varepsilon_{t,t+1}$$

rp_{t+1} is the risk premium, $\Delta r_{lf,t}$ is the term spread. Standard errors in parenthesis are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992). Coefficients significant at the 95% confidence level are marked with a double asterisk.

Table 10

Piecewise Linear Regression of the Risk Premium – Term Spread Relation: U.S. Term Spreads: 1970 - 1994

Country	$\hat{\alpha}$	$\hat{\beta}_1$	$\hat{\beta}_2$	\bar{R}^2
Australia	0.009 (0.028)	0.037 (0.039)	-0.038 (0.047)	-0.007
Canada	0.029 (0.020)	0.066 ** (0.027)	-0.074 ** (0.033)	0.039
France	0.018 (0.027)	0.045 (0.037)	-0.045 (0.044)	0.002
Germany	0.002 (0.023)	0.021 (0.032)	-0.017 (0.039)	-0.005
Japan	0.008 (0.025)	0.037 (0.034)	-0.032 (0.042)	0.010
Sweden	0.015 (0.029)	0.007 (0.039)	-0.006 (0.047)	-0.020
United Kingdom	0.056 ** (0.025)	0.111 ** (0.034)	-0.124 ** (0.042)	0.084
United States	0.027 (0.019)	0.071 ** (0.026)	-0.076 ** (0.032)	0.067

$$rp_{t+1} = \alpha + \beta_1 (\Delta r_{lf,t}) + \beta_2 \max[0, \Delta r_{lf,t}] + \varepsilon_{t,t+1}$$

rp_{t+1} is the risk premium, $\Delta r_{lf,t}$ is the term spread. Standard errors in parenthesis are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992). Coefficients significant at the 95% confidence level are marked with a double asterisk.

Table 11

**Conditional Covariance of Consumption Growth Rates With Risk Premiums:
Quarters Preceded by Each Countries' Inverted Yield Curve**

	Covariance	Standard Error
Australia	-0.000448	0.000301
Canada	0.000075	0.000263
France	-0.000366	0.000352
Germany	-0.000289	0.000240
Japan	-0.000495	0.000349
Sweden	0.002621	0.003489
UK	0.000095	0.000416
USA	0.000507	0.000285

Covariances and standard errors are computed using the generalized method of moments. Standard errors are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

Table 12**Conditional Covariance of Consumption Growth Rates With Risk Premiums:
Quarters Preceded by Major Countries' Inverted Yield Curves****US Yield Curves:**

	Covariance	Standard Error
Australia	-0.000055	0.000398
Canada	0.000197	0.000148
France	-0.000807	0.000467
Germany	-0.000711	0.000613
Japan	-0.000698	0.000551
Sweden	-0.002345	0.002547
UK	-0.000993	0.000659
USA	0.000507	0.000285

German Yield Curves:

	Covariance	Standard Error
Australia	-0.000199	0.000321
Canada	0.000327	0.000238
France	-0.000395	0.000252
Germany	-0.000289	0.000240
Japan	-0.000360	0.000329
Sweden	0.003844	0.003488
UK	0.000150	0.000250
US	0.000287	0.000185

* More than one standard error different from zero.

** More than two standard errors different from zero

Covariances and standard errors are computed using the generalized method of moments. Standard errors are adjusted for heteroskedasticity and autocorrelation using the method of Andrews and Monahan (1992).

Appendix

Descriptions and Sources of Interest Rate Data

Country	Long-Term Rate: Description	Source	Short-Term Rate: Description	Source
Australia	10 year Treasury Bonds	Reserve Bank of Australia, Monthly Statistical Bulletin	13 week Treasury Note	IFS
Canada	Government Bonds > 10 years	IFS	3 month Treasury Bills	IFS
France	10 Year Government Bonds	Global Financial Data, Inc.	Call Money Rate	IFS
Germany	1970 – 1975: 5 year Federal Bonds 1976 – 1994: 10 year Federal Bonds	DRI/McGraw-Hill Deutsche Bundesbank, Monthly Report	3 month Interbank Rate	IFS
Japan	1970 – 1980: 7 year Government Bonds 1980 – 1994: 10 year Government Bonds	DRI/McGraw-Hill Bank of Japan, Economic Statistics Monthly	Call Money Market Rate	IFS
Sweden	10 Year Government Bond Yield	Sveriges Riksbank, Quarterly Review	3 month Treasury Discount Notes	IFS
United Kingdom	10 Year Government Bond Yield	Central Statistical Office, Annual Abstract of Statistics, and the Financial Times	91 Day Treasury Bill Rate	IFS
United States	10 Year Government Bond Yield	Federal Reserve, Board of Governors	Quarterly Treasury Bill Rate	IFS

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