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The Equity Premium and the Risk Free Rate: A Cross Country, Cross Maturity Examination

by

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Abstract

This paper examines the relationship between the equity premium and the risk free rate at three different maturities using post 1973 data for a panel of 7 OECD countries. We show the existence of subsample instabilities, of cross country differences and of inconsistencies with the expectations theory of the term structure. We perform simulations using a standard consumption based CAPM model where cross-country differences in preference and technology parameters are taken into account, and demonstrate that the basic features of the equity premium puzzle remain, regardless of the time period, the investment maturity and the country considered.

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1 Introduction

The historical magnitude of the equity premium in the US has been the object of intense study in the last decade. Since the seminal work of Mehra and Prescott (1985) many authors, including Rietz (1988), Weil (1989), Labadie (1989), Epstein and Zin (1990) Constantinides (1991), Mankiw and Zeldes (1991) and Checchetti, Lam and Mark (1993), have modified the basic theory to account for the wide discrepancy between the time series generated by a complete markets Arrow-Debreu economy and the data. The existing literature, recently surveyed by Kocherlakota (1996), has however disregarded several empirical issues which may provide information useful (i) to understand the extent and the dimensions of the "puzzle" and (ii) to formulate suitable models explaining the relationship between returns on equities and on risk free assets.

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First, the presence of a large average equity premium and of a small average risk free rate has been documented almost exclusively for the US and, to the best of our knowledge, only Siegel (1992) has investigated whether such a phenomenon exists in other countries as well. Second, the historical features of the equity premium and of the risk free rate have changed repeatedly over decades (see e.g. Mehra and Prescott (1985, p.147)). One may wonder whether the choice of sample period may influence our perception of the economic relevance of the phenomenon, and whether considering data which is more homogeneous than typically employed, say, only post WWII data, or post 1973 data, may change the basic features of the relationship. Blanchard (1993), for example, claims that the equity premium for the US has declined substantially since the early 1950's. Third, the empirical properties of the equity premium have been documented under the assumption that the sampling period of the data is identical to the holding period of the investment. If the pure expectations theory of the term structure does not hold, restricting attention to a holding maturity which is equal to the sampling period throws away important information. Documenting the properties of the equity premium for a number of maturities may therefore indicate the extent of the information waste and provide a new perspective on the phenomenon.

The task of this paper is two-fold. First, we want to provide evidence on these three empirical issues. We characterize the equity premium-risk free rate (EP-R) relationship in a number of industrialized countries for the post 1973 era, for buy-and-hold investments of three different maturities. The sample period is selected keeping in mind that with the breakdown of the Bretton

Wood system the size of domestic equity markets has thickened, and the integration of capital markets across countries has increased, therefore giving the best chance to the phenomenon to have an international dimension. The countries of the panel are chosen because the total value of their stock and T-bill markets constitutes over 70% of the world market, and their economies are sufficiently homogeneous and stable to make the comparison meaningful. Finally, the choice of investment maturities is dictated by sample availability. Second, we want to know whether a standard Arrow-Debreu model can account for the time variations, the cross country and the cross maturity heterogeneities present in the data only by means of heterogeneity in the deep parameters of the model. In this respect, the term structure of the (EP-R) pair offers a much more challenging term of comparison to judge the validity of the theory.

The paper is organized in six sections. The next section documents the time series properties of the (EP-R) pair for seven countries (US, Canada, UK, Japan, Italy, Germany and France) for three samples (1973-1991, 1973-1981 and 1982-1991) and for three holding maturities (3, 6 and 12 months). For completeness, we also study the time series properties of a pair of portfolios, composed of stocks and T-bills for the seven countries over the same samples and for the same three maturities. For each country we present summary statistics describing the distribution of the term structure of the (EP-R) pair and examine whether they are stable across time, similar across countries and satisfy one version of the expectations theory. We show that within countries, there are important statistical differences both in the slope and in single elements of the term structure across time due to the changes in the distributional properties of the risk free rate. We also show that the term structures of the (EP-R) pairs display important cross-country heterogeneities evident even among countries which are geographically and economically more integrated, primarily generated by cross country differences in the distributional properties of the risk free rate. Finally, we document that the expectations theory of the EP term structure is violated in almost all countries and that violations are more important at the shortest end of the term structure.

To confront a standard Arrow-Debreu model with the cross country, cross sample and cross maturity evidence we have uncovered, we describe in section 3 the relationship between its deep parameters and the moments of EP and R after imposing distributional assumptions on the exogenous processes of the economy. The maintained hypothesis is that countries differ only in preference and technological parameters and not in their market setups or institutional arrangements. We are interested in knowing if there is sufficient variability in these parameters across time, maturity and countries to generate the heterogeneities we see in the data.

In section 4 we outline a formal evaluation procedure to measure the discrepancy between the distribution of a vector of statistics of actual and simulated (EP-R) pairs for each country, maturity and subsample. The approach builds on the one of Canova (1994) and draws inference about the quality of the model's approximation to the data in a quasi-bayesian fashion. Such an approach is more informative than those typically employed (with the exception of Checchetti, Lam and Mark (1993)) because we explicitly consider parameter uncertainty in the simulations.

Section 5 describes the basic results of our simulations. We find that simulated and actual data differ substantially and in most cases the distribution of the moments of actual and simulated (EP-R) pair hardly overlap. We show that, regardless of the country, the model generates moments for the equity premium which are inconsistent with the cross sectional post Bretton Wood experience. Regardless of the maturity, the model is relatively more successful for the 1973-1981 period, when the means of both the risk free rate and the equity premium were negligible or even negative in some countries; regardless of the country and the time period, it appears to be slightly more successful for 12 months investments and, regardless of the time period and the maturity, it is less inadequate in reproducing actual moments of the (EP-R) pair for Italy than for the other countries. Overall, these results suggest that there is an international dimension to the (EP-R) puzzle, that it exists regardless of the sample period and that, in general, it worsens as the investment period shortens. They also demonstrate the presence of country specific features to the phenomena even in a sample period when financial markets became more integrated and that the economic significance of the puzzle may be related to the time path of (expected) inflation across countries (as suggested by Blanchard (1993)).

In section 6 we examine how certain modifications of the basic model suggested in the literature are likely to impact on the results. In particular, we discuss the question of heteroskedasticity in the driving forces of the economy (as in Kandel and Stambaugh (1990) or Canova and Marrinan (1993)), the issue of inflation (as in Labadie (1989)) and the problem of leverage (as in Benninga and Protopapadakis (1990) or Kandel and Stambaugh (1991)). We argue that none of these modifications is likely to improve the performance of the model in all the dimensions examined and that alternative explanations are needed to account for the heterogeneities we have documented. Section 7 concludes indicating avenues of future research.

2 The Term Structure of the Equity Premium-Risk Free Rate

This section documents the quarterly time series properties of the (EP-R) pair for the US, Canada, UK, Japan, Italy, Germany and France for the period 1973,1-1991,4 and for two subperiods (1973,1-1981,4 and 1982,1-1991,4), for buy-and-hold investments of 3, 6, and 12 months and for two portfolios, one solely composed of risk free assets and one composed of stocks and risk free assets for the seven countries. The definition of the variables, the data employed and their sources are described in appendix A. Table 1 presents estimates of the mean, standard deviation and AR(1) coefficient for the (EP-R) pair for the whole sample and table B.1 presents the same statistics for the two subsamples. To avoid distortions due to the overlapping nature of investments which last longer than the sampling interval, the second moments of 6 and 12 month investments are computed averaging the corresponding second moments obtained from k nonoverlapping series whose starting date of the investment is moved, successively, by one quarter, where k=2 if the investment period is 6 months and k=4 if the investment period is 12 months. The subperiod division we employ is somewhat arbitrary but the break point is chosen keeping in mind the behavior of inflation during the two subperiods (high in the first subsample, low in the second). Garcia and Perron (1993) show that the process for the real risk free rate in the US displays a breaking point at 1981,3 due to changes in Fed policies. Because after that date real rates moved to a higher mean level all over the world, it is likely that this date is also crucial for the remaining G-7 countries. In calculating the equity premium for maturity k we use the standard procedure of subtracting from the equity return for a k period investment the real rate on a 3 month T-bill compounded $k/3$ times. This is not a completely satisfactory procedure because for investments that last longer than 3 months, the equity premium is the sum of a risk premium, due to the fact that stocks are more risky than T-bills for a given maturity, and of a term premium, due to the fact that we use T-bills of a different maturity (see, e.g., Campbell (1986), Abel (1996)). However, many countries do not issue T-bills of the required maturity and proxies constructed using either Eurodeposit rates or holding returns on long term bonds are inadequate as well either because for some currencies euromarkets are very thin or because long term bonds have different risk characteristics than T-bills. Finally, because the CPI bundles we use to convert nominal returns into real differ across countries, term structure differences across countries may be the result of the mismeasurement of real returns. To quantify the extent of this problem, we also computed real returns using GNP deflators and found no qualitative changes.

There are several aspects of the two tables which deserve some attention. All term structures are upward sloping in the whole sample and in the second subsample, while in the first subsample, which contains the high inflationary period of the 70's, the evidence is mixed. The steepest term structure is for Canada: its risk free rate is, on average and for all maturities, higher than those of other countries. The standard deviations of the (EP-R) pair increase almost linearly with the holding period. Individual elements of the term structure show large standard deviations with the risk free rate displaying considerably less variability than the equity premium. In general, the equity premium is almost uncorrelated while the AR(1) coefficient for the risk free rate is high with two exceptions for three month investments. In Italy the two variables have the same AR(1) coefficients while in Germany the AR(1) coefficients of EP is larger than that of the risk free rate but both of them are small. The AR(1) coefficient of EP tends to decrease with the maturity of the investment and turns negative for longer investment horizons in all countries, a feature which suggests the presence of mean reversion characteristics in the data (see, e.g., by Fama and French (1988)). Finally, the time series properties of the two portfolios are somewhat intermediate between those of the various countries with lower standard deviations and AR(1) coefficients. Note that the average equity premium for the US, calculated using annual data for the period, is 5.56 while the risk free rate is 1.62 which are slightly different than those reported by Mehra and Prescott for the 1880-1978 period but are in line with those of Bonomo and Garcia (1993) for the sample 1889-1987.

Next, we examine the stability of the distribution of the term structure of (EP-R) pair over subsamples for each country and their equality across countries for each sample period. We have two goals in mind. First, we would like to know how reliable is a description of the relationship which uses data from the entire sample. Mehra and Prescott report that the distribution of the EP-R pair in the US has changed substantially over decades (see table 1, p.147). Siegel (1992) and Blanchard (1993) present similar evidence. Second, we would like to know whether the cross country differences we noted are accidental, in which case restricting the analysis to one country is sufficient, or whether there is additional information in the international cross section of data.

To examine both hypotheses we use a distance-type test of the form

$$Q = (x_1 - x_2)\Sigma^{-1}(x_1 - x_2)' \tag{1}$$

where x_1 and x_2 are vectors of estimated moments, either across subsamples or across countries, and Σ is the covariance matrix of $x_1 - x_2$. Under the null that x_1 and x_2 are identically and normally distributed, Q is distributed as a $\chi^2(m)$ where m=dim(x_1)=dim(x_2). Because the distribution of returns typically displays fat tails, we first check if the normality assumption for estimates of the moments of interest is appropriate. Using Kendall and Stuart tests for normality, we find that, if we exclude from the data the fourth quarters of 1987 and 1989, the assumptions we made to conduct the tests are appropriate. Table 2 reports the p-values of the tests for the equality of the means, of the standard deviations and of the AR(1) coefficient of EP and of the (EP-R) pair across subperiods jointly at 3, 6 and 12 months maturity for each of the seven countries and for the two portfolios and of a joint test examining the equality of the mean, standard deviation and AR(1) coefficient for the three maturities for the vector of seven countries.

The table shows time instabilities in the term structure in each of the seven countries. The distribution of the real risk free rate has been substantially altered over time in all countries and for all maturities while the distribution of EP appears to be more stable and in Canada and Italy the first two moments of the distribution of EP have not significantly changed over time. This is somewhat surprising, as it indicates that real equity returns and the real risk free rate move together over subsamples, contrary to the characterization offered by Blanchard (1993) for the US. Overall, the mean and the AR(1) coefficient of EP are less stable than its standard deviation and for Canada, Italy, US and France the standard deviations of EP has not significantly changed across subsamples. Looking at single elements of the term structure, at least one moment of the distribution of R has changed at each maturity, while differences across subsamples in EP emerge primarily in the mean for 12 month investments. Very similar results are obtained when we examine the behavior of the two portfolios over the two subsamples.

To complete the characterization of the (EP-R) relationship over time we examine the slope of the joint (EP-R) mean term structure across subperiods. The slope of the mean term structure is an important ingredient to test the expectations theory (see e.g. Campbell and Shiller (1992)). Our analysis may therefore give a rough idea of the magnitude of the changes in the distribution of the liquidity term across subperiods. Table 3, which reports a joint test for the equality of the slopes of the mean term structure for the 7 countries across subperiods and for the portfolios, suggests that the slopes are statistically different because of changes in the slope of the mean risk free rate. Major differences emerge in the slope between 12 and 6 month maturities; changes in the slope between 6 and 3 month maturities are statistically significant, but smaller in size. Among the countries in the panel, the slope of the term structure in Canada is the one with the largest differences across subperiods. For portfolios results are similar except that the the slopes between 3 and 6 months maturities for the (EP-R) pair are no longer significantly different across subperiods.

Next, we examine whether the distribution of the term structure of the (EP-R) pair is similar across countries. We conduct tests on single moments of the distribution jointly for 3, 6 and 12 month maturities and on the vector comprising the mean, the standard deviation and the AR(1) coefficient using moments of the term structure in the US as a benchmark for the three samples. The p-values of the tests are presented in table 4. The mean of the three elements of the term structure of the (EP-R) pair displays differences across countries in all three samples (more marked in the second subsample); the standard deviations show no significant differences and the AR(1) coefficients are different for Germany, Japan and Italy. The joint test on the six term structures of the (EP-R) pair rejects the null hypothesis that they are identical to that of the US, primarily because the mean of the risk free rate displays substantial differences across countries in each subperiod. The results obtained comparing the term structure of the portfolios with the term structure in the US are similar. The only additional feature is that the tests reject the hypothesis that the two term structures have similar moments for all samples.

To check whether the results are sensitive to the choice of the US as benchmark, we also conducted tests using the term structure of Germany as a term of comparison. This alternative test is useful to examine whether the US term structure has special features which may bias the outcomes, and to see whether the four European countries in the panel display stronger similarities which would allow us to treat them as a block in international comparisons. The results we obtain are, however, very similar to those reported in table 4 and are omitted for reason of space.

Almost all work we are aware of which tries to account for the (EP-R) relationship via simulation exercises, considers investments whose holding maturities correspond to the sampling frequency of the data, i.e, if annual data are available, only buy-and-hold investments which last one year are considered. Implicit in this approach is the assumption that the pure expectations theory holds so that one maturity is sufficient to characterize the dynamics of the entire term structure. Put in another way, if the pure expectations theory of the term structure holds, the rolling premium, defined as the mean excess return on a h-month investments over rolling m times a (k/m)-month investments, is zero, for all h, k, m with $k < h$ (see e.g. Campbell and Clarida (1987)).

The standard approach of considering a holding maturity which is equal to the frequency of the data is partially justified by a result of Mehra and Prescott (1985). They show, in fact, that because consumption growth is approximately uncorrelated over time, the term structure of theoretical EP must satisfy the pure expectations theory. However, to the best of our knowledge, this hypothesis has not been tested in the data. Therefore, we examine whether the term structure of EP in each of the seven countries is consistent with the assumption that the rolling premium is zero at all maturities. We construct the rolling premium between 6 and 3 month and 12 and 6 month maturities and examine the relationship for the three samples for single maturities and for a vector comprising the two rolling premia for each country. The p-values of the tests are reported in table 5. In general, the rolling premium are significantly different from zero and deviations from the expectations theory are more evident for short than for long maturities, but there are exceptions. In the first subperiod, the two rolling premia are not statistically different from zero except for Germany at the 6-3 maturity. In the second subsample the rolling premium for Canada, UK and Japan at 12-6 maturity is not significantly different from zero.

Three main conclusions can be drawn from our empirical investigation. First, the joint distribution of the (EP-R) pair is unstable over time. This is true of single elements of the term structure in each country as well as of slopes between various maturities. Changes over time in the mean of the risk free rate, probably linked to changes in the properties of inflation and to policy choices (e.g., targeting a nominal interest rate or targeting monetary aggregates), are the major reason for these instabilities. Hence, by separating historical episodes with different time series characteristics we may have a better chance to understand whether standard theory fails because of incorrect assumptions or intrinsic weaknesses. Second, the joint distribution of the term structure of the (EP-R) pair is significantly different across countries. Differences emerge primarily in the mean and are, to a large extent, due to the differences in the time series properties of the risk free rate across countries. Therefore, there is a scope in confronting numerical versions of Arrow-Debreu economies with data from countries other than the US. Third, there is information in the term structure of the (EP-R) pair which is neglected by letting the investment maturity be equal to the sampling interval of the data. The available data, in fact, does not satisfy a pure expectations theory which would justify focusing attention on one maturity only. While there are exceptions to the tendencies we have outlined, the results suggest the need, on one hand, for a deeper look into the statistical properties of buy-and-hold strategies and, on the other, to confront numerical versions of the theory with the cross country, cross maturity, cross sample heterogeneities we have unveiled.

3 A Model of the Equity Premium-Risk Free Rate Relationship

To use the standard consumption based CAPM model to analyze the (EP-R) relationship across countries we make two hypotheses. First, that countries differ in preferences and technological parameters, but not in institutional setups or market arrangements. Although this is a simplifying assumption, it is useful for it provides a benchmark to compare more complicated versions of the model where institutional constraints are introduced. Moreover, it imposes substantial discipline in the simulation exercises since it forces us to account for cross country heterogeneities only by means of differences in the "deep" parameters of the model. Second, countries' financial markets are autarkic. We chose this setup because, under the opposite extreme of perfect capital markets integration, the model predicts that investors would hold the world market portfolio of risky assets independently of their country of residence, an implication empirically rejected for most countries in the panel (see French and Poterba (1991)).

The task of this section is to identify those parameters which affect the risk free rate but not the equity premium and to see whether heterogeneity present in these parameters across time and countries can account for the cross sectional differences.

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The model is a standard frictionless pure exchange economy with a single representative agent, one perishable consumption good produced by a single productive unit or "tree" and $K+1$ assets, an equity share and K risk free assets of maturity $k = 1, \dots K$, one per maturity. The returns for the K riskless securities and on k-period buy-and-hold equity investments in each country satisfy the following optimality conditions :

$$1 = \beta^k E_t(\prod_{i=1}^{k} x_{t+i})^{-\alpha}(1 + R_{t,k}) \qquad k = 1, \dots, K \tag{2}$$

$$1 = E_t \sum_{i=1}^{k-1} \beta^i (\prod_{l=1}^{i} (x_{t+l})^{-\alpha}) \frac{y_{t+i}}{p_t^e} + \beta^k (\prod_{l=1}^{k} (x_{t+l})^{-\alpha})(1 + R_{t,k}^e) \qquad k = 1, \dots, K \tag{3}$$

where $1 + R_{t,k} = 1/p_{t,k}^f$ is the risk-free gross return for maturity $k = 1, \dots, K$; $1 + R_{t,k}^e = (p_{t+k}^e + y_{t+k})/p_t^e$ is the gross return on equities; y_t is the tree's dividend, p_t^e and $p_t^{f,k}$ are the prices of the equity and of the k-th risk free asset, E_t is the mathematical expectation operator conditional on information at time t, β is the discount factor, α is the relative risk aversion parameter and x_{t+1} is the gross growth rate of dividends.

Closed form expressions for the average risk-free rate of maturity k and the equity premium for investment horizon k in terms of the parameters of agents' preference and technology can be obtained under some distributional assumptions. Following Aiyagary (1993) we let $x_t = \exp(\mu + \epsilon_t)$ and $1 + R^e_{t,k} = (1 + E(R^e_{t,k}))\exp(u_t - \sigma^2/2)$ where ϵ_t and u_t are i.i.d. normal random variables with 0 mean and variances δ^2 and σ^2, respectively and μ is the mean of x_t.

Using (2) and (3) and the approximation $\ln(1+z) \approx z$ for small z, the average risk-free rate for maturity k, denoted by $\bar{R}_k$, and the average equity premium for investment horizon k, denoted by $\bar{EP}_k = \bar{R}^e_k - \bar{R}_k$, are given by:

$$\bar{R}_k = -k\ln(\beta) + k\alpha\mu - 0.5k^2\alpha^2\delta^2 \tag{4}$$

$$\bar{EP}_k = \alpha \mathrm{cov}(\ln(1 + R^e_{t,k}), (\sum_{i=1}^{k} \ln(x_{t+i}))) + (\alpha - 1)\ln(\frac{y_t}{p_t}\sum_{i=1}^{k-1}\beta^i E_t \prod_{l=1}^{i} x_{t+l}) \tag{5}$$

where the second term in equation (5) comes from the fact that dividends may be paid at intermediate dates i of the investment period k. Equation (5) represents a version of the relationships derived by Abel (1988) and Black (1990) when the conditional moments of the dividend process are constrained to be time independent and independent of wealth. Equations (4) and (5) explicitly show the dependence of the average risk-free rate and the average equity premium on the technology parameters (μ, δ), on the preference parameters (α, β) and on the unconditional covariance between the risky asset return and consumption growth. Given technological parameters and the covariance between consumption growth and asset returns, variations in β affect the mean risk free rate only, while variations in α have a monotonic effect on the mean of the equity premium and a non-monotonic one on the mean of the risk free rate. In other words, there is a range of α which induces opposite movements in $\bar{EP}_k$ and $\bar{R}_k$.

In general, the expressions for the standard deviations and the AR(1) coefficients depend in a nonlinear way on the differences between the conditional and unconditional distributions of the exogenous forces of the model (see e.g., Canova and Marrinan (1996)). For example, the standard deviations of (EP-R) depend on the differences between conditional and unconditional moments of the dividend growth process and on the differences between the conditional and the unconditional covariance between risk returns and dividend growth. For the simple case considered here, conditional and unconditional moments are identical and second moments are degenerate. Hence, with the approximation we used, the distribution of simulated (EP-R) pair collapses to a point mass and only uncertainty in the parameters generates uncertainty in the outcomes of the model. We will use this feature in designing an alternative and more formal model evaluation procedure.

4 Evaluation Procedure

To study the properties of the model for each country, maturity and sample, we use a version of the model where the gross growth rate of dividends x_t follows an ergodic first order Markov chain with probability $P(x_{t+1} = x_j | x_t = x_i) = \phi_{ij}$. As in Mehra and Prescott we specify the process for consumption to have two states of the form $\lambda_1 = 1+\mu+\delta$; $\lambda_2 = 1+\mu-\delta$ and restrict the one-period transition matrix to satisfy $\phi_{1,1} = \phi_{2,2} = \phi$ and $\phi_{1,2} = \phi_{2,1} = 1 - \phi$. Cecchetti, Lam and Mark (1993) and Abel (1995) have argued that the assumption that, in equilibrium, consumption equals dividends is a gross misspecification and suggested calibrating the model to a bivariate process for consumption and dividends. We do not consider this possibility here, but argue later that it is unlikely to be crucial in reconciling the model and the data.

To simplify the calculations, and because none of the results depend on this assumption, we assume that dividends accrue to the equity owner at the end of each period but are available for consumption, cumulatively, only at the end of the investment period. Also, we assume that the time interval of the model is a quarter so that the maturities of interest are k=1, 2 and 4.

There are many ways to account for the uncertainty surrounding the choice of the parameters of the model $\theta = (\mu, \delta, \phi, \beta, \alpha)$. The standard approach is to calibrate the three technology parameters (μ, δ, ϕ) so that the mean, the standard error and the AR(1) coefficient of the model's consumption match those of the growth rate of annual US consumption over the sample period and obtain values for the risk free rate and for the equity premium by grid searching the preference parameters $(\beta,\ \alpha)$ over a prespecified interval. Implicit in this procedure is the assumption that technology parameters can be pinned down with sufficient precision, while the sampling uncertainty surrounding estimates of the preference parameters is so large that a researcher places no confidence in any particular value and simply chooses a reasonable range for $(\beta,\ \alpha)$ on the basis of theoretical considerations. In the more formal version of this procedure adopted by Cecchetti, Lam and Mark (1993) one "estimates" the range of (β, α) by choosing those pairs generating (EP-R) which fall within the 95% interval around the point estimates of the mean of (EP-R) found in the data. One advantage of this last procedure is that it allows to construct measures of dispersion for the statistics of interest using the estimated distribution of the (β, α) pair. Here we take a quasi-bayesian approach to the uncertainty surrounding estimates of *all* parameters. Instead of calibrating (μ, δ, ϕ) and searching for the values of the (β, α) that best replicate the actual mean or fall within a prespecified region around the mean of the (EP-R) pair, we construct the empirical distribution for all parameters from the data, perform simulations drawing parameter vectors from these distributions and examine the discrepancy of simulated and actual data using synthetic probabilistic measures of fit.

Formally, given a data-based density on the parameters $\pi(\theta|\mathcal{I})$, where $\mathcal{I}$ is the information set available to a researcher, the outcomes of the model are represented with a density $G(W(\theta)|\mathcal{I}, m)$ where $W = W(X_t(\theta))$ is a vector of statistics of the endogenous variables X_t of the model (e.g. moments) given θ, and m is the particular model specification adopted. Let $\mathcal{F}(W)$ be the empirical distribution of the actual vector of statistics we are interested in. Our task is to compare $G(W(\theta)|\mathcal{I}, m)$ and $\mathcal{F}(W)$, measure how distant they are and what features they have in common. There are two advantages of our approach. First, by examining the *distribution* of a vector of statistics of the model, our evaluation procedure maximizes the use of information present in the data. Second, unlike Cecchetti, Lam and Mark our method allows the formulation of formal statements on the likelihood of the model to reproduce the data.

There is no unique way to obtain $\pi(\theta|\mathcal{I})$. Canova (1994) describes several approaches to the problem. Here we assume that for each of the seven countries $\pi(\theta|\mathcal{I}) = \prod_{j=1}^{5} \pi_j(\theta_j|\mathcal{I})$, where the index j refers to parameters, use a bootstrap algorithm and the implementation method of McCullough and Vinod (1993) to obtain estimates of π_j for each j. Bootstrap distributions are more appropriate than asymptotically normal approximations around the point estimates of the parameters since the sample size is relatively short. In addition, since some parameters must lie in a bounded interval, asymptotic normal approximations allow for values which are unacceptable from an economic point of view. In practical terms, the distribution of technological parameters is obtained by bootstrapping the residuals of a regression of the consumption series for each country on a constant, after prefiltering to make the regression residuals homoskedastic white noises. At each replication we generate a new consumption series and collect values of the mean μ, the standard deviation δ and the AR(1) coefficient, which is used to pin down ϕ. The distribution of the preference parameters is obtained by bootstrapping the residuals of regressions of the risk free rate and of the equity return series on a constant, after prefiltering to make the regression residuals homoskedastic white noises. At each replication, we generate a new risk free rate and a new equity return series, use Brown and Gibbons' (1985) parametric procedure to obtain values of α and equation (4) to obtain values of β. As a byproduct of this last set of bootstraps, the empirical distribution of the mean, standard deviation and the AR(1) coefficient for the (EP-R) pair is obtained for each country, maturity and sample.

As an illustration, figure 1 presents $\pi_j(\theta_j|\mathcal{I})$ for each of the five parameters obtained over the 1973-1991 period for the US, and figure 2 the empirical distribution of the mean of the (EP-R) pair in the US for the three maturities. The empirical distributions of (μ, δ) are slightly skewed, the first to the right, the second to the left, and have a thicker right and left tail respectively, while the one for ϕ is approximately normal. The distributions of α and β resemble a χ^2 with two degrees of freedom, even though for the former some negative values appear. All these facts confirm that the uncertainty characterizing the parameters of the model is not well described by multivariate normal distributions. Also, since the uncertainty surrounding point estimates is substantial, calibrating the parameters to point estimates is restrictive. Finally, the bootstrap distribution of the mean of the EP-R pair at all maturities is approximately normal, even though some skewness appears.

The empirical distributions for the parameters of the other countries are similar in shape with slightly different location measures. However, there appears to be sufficient variation for the model to account for the time variations or the maturity differences we have discussed.

To construct $G(W(\theta)|\mathcal{I}, m)$ we draw with replacement parameter vectors from $\pi(\theta|\mathcal{I})$, perform 1000 simulations for each country, each maturity and each sample period and construct simulated distributions for the mean, the standard deviation and the AR(1) coefficient for the (EP-R) pair implied by the model.

To formally evaluate the discrepancy between the actual (bootstrap) and simulated distributions of the (EP-R) pair, one would ideally report one measure for a vector comprising all statistics for all maturities and countries. However, since the model is, at best, a rough approximation to the real world, such an approach produces uninteresting results (probabilities are all 0 or 1). As an alternative, for each country, each maturity and each statistics we report three summary measures of fit: (1) the probability that the model generates statistics for (EP, R) which fall within the q% bootstrap contour of the actual statistics of (EP, R) where q=95, 80, 50, (2) the probability that the bootstrap values for statistics of (EP, R) fall within the q% contour of the distribution of the simulated statistics for the (EP, R) pair where, again, q=95, 80, 50, (3) the probability that the simulated statistics for the (EP-R) pair are in each of the four quadrants of the space delimited by the bootstrap average of the statistics of the actual (EP, R) pair.

With the first measure we take the bootstrap distribution of the statistics of (EP, R) as the "null" and ask how far is the model from the actual data by calculating the percentage of simulated values in each contour. With the second, we reverse the point of view, take the outcomes of the model as the null and ask how likely are the actual data to be generated by the model. This procedure is entirely analogous to standard hypothesis testing in a classical framework where the null and the alternative are reversed. A percentage close to the nominal size of 95, 80 and 50% for both measures indicates that the distributions of actual data and the model-generated data are sufficiently close and significantly overlap. A percentage close to the nominal size of 95, 80 and 50% for only one measure indicates that the distributions of actual data and the data generated by the model differ significantly, even though they may overlap. Also, while with the first measure we compute distance using a "null" distribution as a reference and probability coverings as a synthetic measure of fit, with the third measure we evaluate the model using a simple cell-probability taxonomy on the location of simulated statistics of the simulated (EP-R) pair. Such a measure is particularly useful as it provides information on higher moments of the simulated distribution of each statistic, i.e. whether most of the simulated statistics lie in a particular quadrant, there is evidence of bimodality or simulated data all lie on a particular ridge, etc.

5 The Results

The results of the simulations appear in tables 6-8 for the entire sample and in tables B.2-B.7 for the two subsamples. Tables 6, B.2 and B.3 contain the results for 3 month investments, tables 7, B.4 and B.5 for 6 month investments and tables 8, B.6 and B.7 for 12 month investments. The tables also report simulations for a portfolio which may be viewed as approximating the one a world investor would hold in a perfectly integrated capital market.

There are several facts which are worth commenting. First, for the mean of 3 month investments, the probability coverings are low except for Italy when the actual data is taken to be null. The presence of only a marginal overlap between the two distributions clearly emerges when q=50%: here the percentage of simulated pairs lying in this contour is close to zero for all countries. Typically, the model generates both a mean risk free rate and a mean equity premium which are lower than what we see in the data, but there is a 6% probability that the simulated mean risk free rate is above the bootstrap mean of the actual risk free rate (see the percentage of simulations which fall in quadrants 1 and 3 in the table). In general, the majority of the simulated mean pairs lie on a ridge very close to the R axis, i.e. while the range for the mean of R generated by the model for each country is consistent with the historical experience, the mean of EP is very close to zero, regardless of the value of the mean of R. Hence, parameter variation affects the distribution of the mean risk free rate and of the mean equity return in the same way leading to a degenerate distribution of the mean of EP. To put this result in another way, changing the location of the univariate distribution for the mean of R will not affect the performance of the model in the EP dimension. Therefore, attempts to account for the large historical equity premium along the lines of Benninga and Protopapadakis (1990) or Kocherlakota (1990) allowing a discount factor in excess of 1, will not change the basic features of the results. The puzzle, as it emerges here, is why the model generates so little independent variation in the mean of the risk free rate and equity return relative to the data (see also Bonomo and Garcia (1993)).

The performance of the model is extremely poor for the standard deviations and the AR(1) coefficient of three month investments. Only when the model is taken to be the null we do find that a substantial portion of the bootstrap distribution of standard deviations falls within the 95% contour of the simulated data for Germany and Japan. However, even in this case and regardless of the country, the large majority of the simulated pairs are in the lower portion of the space delimited by the actual estimates of the standard deviations of the (EP-R) pair. In most cases, the simulated pair of AR(1) coefficients exceed the values we see in the data, but the overlap between the bootstrap and the simulated distribution is, in many cases, small and this is true regardless of the country considered. In general, we find that most of the area of the simulated distributions of the AR(1) coefficient is in the upper tail of the corresponding bootstrap distributions.

The performance of the model for 6 month investments is similar: there is very little overlap between bootstrap and simulated distributions of all three statistics and, relatively speaking, the performance of the model worsens relative to the 3 month maturity. Three features of the results deserve some attention. First, the model tends to generate mean values of R which are higher and mean values of EP which are lower than what we see in the data. Second, it generates a small percentage of simulations where the standard deviation of EP is higher and of R is lower than point estimates of the standard deviations obtained from the actual data. Finally, the overlap of the two distributions for the AR(1) coefficient is close to zero with simulated values always exceeding actual ones.

The performance at the 12 month maturity is slightly better for all countries and all statistics. It is still the case that the simulated mean of EP is too low relative to the data but there is a much more uniform distribution of simulated values in the other three quadrants. In addition, the simulated standard deviation pair are for almost all countries in all four quadrants delimited by actual estimates of the standard deviation of the (EP-R) pair and for Japan, US and Germany the spread around the actual values is roughly appropriate. Also, when we take the model as the null we find a substantial overlap in the distributions for both moments. Finally, the overlap of the two distributions for the AR(1) coefficients is small and the majority of simulated pairs of AR(1) coefficients are larger than what we see in the data.

The performance of the portfolio is in general worse than the one of individual countries for all three investment maturities and changes very little with the investment horizon.

The results for subsamples confirm previous tendencies. The only noticeable differences are an improvement in the overlap of the simulated and bootstrap distribution for the mean of the (EP-R) pair in the first subsample and a better spread of simulated values around the actual ones. This should not come as a surprise as the means of the (EP-R) pair for this subsample are small and even negative for some countries. For the standard deviation and the AR(1) coefficient the results across subperiods are essentially identical.

Overall, we can conclude that the model fails to capture the differences across countries and across time we have noted while it can account for some features of the term structure of the (EP-R) pair. Also, it appears to be more successful for 12 month buy-and-hold investments than for the other two maturities, but because of the small sample of non-overlapping 12 month investments, the evidence on the issue is weak. Relatively speaking, the model also appears to be better suited to explain the bootstrap distribution of the bivariate mean of the (EP-R) pair than the distributions of the bivariate standard deviations or AR(1) coefficients regardless of the country or the maturity. Finally, the qualitative features of the simulations are similar across countries even though, quantitatively speaking, the model seems to be better suited to replicate Italian (EP-R) data.

It is legitimate to ask whether the results are sensitive to any of the assumptions we have made. For example, we would like to know if they crucially depend on use of the bootstrap distribution of estimates of the parameters or on our assumption about the timing of dividends.

To check whether results are sensitive to the use of bootstrap distributions to characterize the dispersion of parameter estimates we have repeated the simulation exercises using two alternative procedures. With the first we obtain recursive estimates of the parameters for each country using rolling samples of 4 years of data. That is, we obtain one value for the 5-parameter tuple using data from 1973,1 up to 1976,4, another using data from 1973,2 up to 1977,1 and so on up to the last one obtained using data from 1988,1 up to 1991,4. In total we have 61 estimates for each country. Then assuming a uniform distribution on each of the 61 5-parameter tuples, we draw from this empirical distribution and construct the distribution of outcomes of the model for each country, each maturity and each subsample. As compared to the original approach, this procedure has the advantage of better tracking how estimates of the parameters evolve over time and this may give a more real-time description of the uncertainty surrounding the choice of the parameters.

In the second case, we draw replications from the frequency distribution of the estimates of the preference parameters, constructed using estimates available in the literature, and use a 4-point uniform distribution on the estimates of technology parameters obtained using 4 year non-overlapping samples (1973-76, 1977-1981, 1982-1986, 1987-1991). This approach has the advantage of condensing information on the parameters coming from both the cross section of experiments and the time series of available data.

Although the quantitative features of the results are altered by each of these modifications, the qualitative message of the exercise is unchanged. It is still true, for example, that regardless of the country, the maturity and the sample period employed the model generates values for the moments of EP which are below the moments of EP in the data, that the joint distribution of the moments of the (EP-R) pair is primarily concentrated on a ridge very close to the R axis and that the range of values over which actual and simulated distributions intersect is very small.

So far, we have assumed that dividends are paid at quarterly intervals. However, because the dividend yields series in each country is measured annually, the k-period series is constructed assuming that dividends accrue in equal proportion each period of the year. If we remove this assumption and assume that dividends are paid once a year, say in the quarter j, j=1, ..., 4, no major changes occurs in the properties of the actual (EP-R) pair. From the point of view of the model, this alternative assumption implies that it is impossible to use dividends for consumption at dates other than those corresponding to the j-th quarter. With this modification, the basic message of the simulation exercise remains. The major change concerns the size of the intersection of bootstrap and actual distributions which substantially decreases under the new assumption (and never exceeds 7%).

6 Altering the Basic Model

Many authors have modified the basic setup used in the previous sections and claimed some success in reproducing features of the equity premium in the US. In this section we examine whether three of these modifications have any potential for explaining the heterogeneities which are unaccounted for by the basic model. Conceptually these alternative setups differ from Mehra and Prescott's as they introduce one or more parameters in the basic structure without altering the number of moments to be matched. Therefore, in judging their success one should discount the additional degrees of freedom allowed for in the simulations.

As Abel (1988), Black (1990) and Canova and Marrinan (1993) have pointed out, changes in the riskiness of an asset may have direct and indirect effects on asset prices. For example, an increase in the variance of dividends increases the equity premium and reduces the riskless rate of return as portfolio holders substitute away from riskier equities toward the riskless asset. To study the implications of changes in the riskiness of assets, Kandel and Stambaugh (1990), Abel (1992), Checchetti, Lam and Mark (1993) and Bonomo and Garcia (1993) have adopted a Markov switching model for the dividend process and have claimed various degrees of success in matching the first two moments of the equity premium and the autocorrelation function of equity returns at various horizons. Is the introduction of time variations in the riskiness of dividends quantitatively important in bringing simulated data closer to the international evidence?

If the lack of heteroskedasticity in dividends is the reason for why the model fails we need substantial cross country differences in the structure of the time variation of second moments to match the cross country heterogeneity and an increase in time variation in the second moments in the second subsample to account for the cross sample variations. None of these features is present in the data: simple ARCH tests for conditional heteroskedasticity do not reject the null of no time variations in the second moments of consumption in all countries but Germany for the period 1973-1991 and we do not find any evidence of additional conditional heteroskedasticity in the second subsample. Finally, note that, because ARCH disappears under time aggregation (see e.g. Diebold (1988)), time variation in the second moment of dividends affects moments of the (EP-R) pair for short but not for long maturity investments (see also Canova and Marrinan (1996)).

Labadie (1989) argued that the lack of a riskless rate of return in the real world may be important to understand the EP puzzle and examined a monetary version of Mehra and Prescott's model where a cash in advance constraint binds in every state of nature. She shows that there are two channels through which inflation affects asset returns. First, because dividends are paid in money and can be used for consumption only in the next period, random variation in the money supply lead to variations in the purchasing power of dividends and equity returns over time. Second, because the intertemporal marginal rate of substitution and inflation are correlated, the model generates an inflation risk premium which equally affects the risk free rate and equity returns. Labadie argues that the second effect is of minor importance and that once the link between inflation and the purchasing power of dividends is taken into account, the mean equity premium generated by the model is broadly consistent with the historical US experience.

Adding inflation effects to the model does not help in the dimensions of interest for two reasons. First, recall that the cross country, cross sample differences are due primarily to differences over time and over countries in the risk free rate. Because none of the two effects impact on the risk free rate only, it is unlikely that differences across countries or time in the path of inflation explain the heterogeneities in the data. Maturity differences in the inflation risk premium however have potential to explain cross maturity differences. Following Labadie, define the inflation risk premium at maturity k as the covariance between S_{t+k} and $\frac{1}{\pi_{t+k}}$, where $S_{t+k} = \beta * (\frac{c_{t+k}}{c_t})^{-\alpha}$ and π_{t+k} is the inflation rate. Given a dividend process, we can obtain estimates of this covariance term, after we have pinned down β and α. Using estimates of α obtained using Brown and Gibbons parametric procedure for each country and each maturity and setting $\beta = 0.98$, we find that the largest inflation risk premium generated by the model is at the 12 month maturity, is only 0.003 and not very different from the premium generated at the three month maturity. Hence, although the presence of an inflation risk premium can qualitatively account for failures of the expectations theory, quantitatively, the magnitude of the effect is minor.

As previously noted, since differences across countries and samples appear primarily in the risk free rate, enriching the model by separating the process for consumption and dividends, as suggested by Checchetti, Lam and Mark (1993) and Abel (1995), is not useful since the risk free rate is independent of the dividend process. Calibrating the model to the bivariate consumption-dividends processes may help to match better the properties of equity returns across countries, but it is unlikely to reconcile the model to the data in the dimensions of interest.

Finally, we consider the issue of leverage. Mehra and Prescott (1985) examined whether or not leverage was crucial in accounting for the large discrepancy between the model and the data and concluded that it was not. On the other hand, Benninga and Protopapadakis (1990) and Kandel and Stambaugh (1991) argue that leverage is an important ingredient to consider if one wants to obtain a better match between the model and the data. However, the value of the leverage parameter used by these authors is either too high or too unconstrained. Checchetti, Lam and Mark claim that once the ratio of dividends to consumption to be around the historical average, the model fails to match the data. Can leverage account for the cross country and cross sample heterogeneities displayed by the data? We believe it can not, as it can not obviously account for the cross maturity differences. The countries of the panel are the most industrialized of the world and their leverage characteristics are similar except perhaps for Italy, where the percentage of equity financing is slightly lower than in the other countries (0.11 vs. 0.17 on average for the other G-7 countries). Similarly, the sample period is sufficiently homogeneous to doubt that leverage displayed marked differential trends across countries or structural changes across time.

7 Conclusions

This paper studies the (EP-R) relationship from two different points of view. First, we characterized the relationship empirically in a number of industrialized countries for the post 1973 era for investments of three different maturities (3-6-12 months). We show that important instabilities emerge in the post 1973 period and that there is independent information in the time series of the (EP-R) pair for the seven countries at different maturities, information which is neglected when we restrict the analysis to the US alone and to holding maturities which are equal to the frequency of the data. Also, we show that it is the distribution of the risk free rate, more than that of the equity premium, which displays differences across countries and time periods. These results taken together suggest that previous efforts designed to reproduce the features of the US (EP-R) pair for a single maturity equal to the time interval of the model were very limited in scope.

In the second part of the paper we examine the performance of a consumption based CAPM when confronted with the richness of the cross-country, cross-maturity, cross-sample evidence. We constrain differences across countries and time periods to appear only in preferences and technological parameters and evaluate the discrepancies of a numerical version of the model from the data using probabilistic measures of distance. We show that the model fails to account for the heterogeneities present in the data. We then examined whether three modifications of the model suggested in the literature help to reconcile the theory with the data and argued that none of them alters the basic flavor of the results.

O.K. sulla conclusione

Overall, our results suggests that a truly satisfactory resolution of the puzzle is more challenging than previously believed, since it requires a model capable of accounting not only for the size of the relative size of the equity premium and of the risk free rate, but also for the cross-country and cross-maturity heterogeneities we have documented.

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Table 1
Cross Country Statistics: Equity Premium - Risk Free Rate
Sample 1973,1-1991,4

Holding	Period	3 Months		6 Months		12 Months	
		EP	R	EP	R	EP	R
U.S.	Mean	1.39	0.41	3.08	0.85	6.68	1.77
	S.D.	7.31	0.73	11.18	1.39	14.89	2.65
	AR(1)	0.11	0.77	-0.14	0.75	-0.36	0.67
FRANCE	Mean	1.78	0.44	4.35	0.94	9.47	2.06
	S.D.	10.38	0.91	17.16	1.75	26.35	3.38
	AR(1)	0.33	0.75	0.007	0.73	-0.16	0.73
UK	Mean	2.56	0.14	5.47	0.32	11.34	0.81
	S.D.	10.70	1.66	16.17	2.94	18.42	5.38
	AR(1)	0.14	0.56	-0.26	0.64	-0.37	0.56
GERMANY	Mean	2.19	0.21	4.53	0.43	9.15	0.92
	S.D.	7.74	0.65	12.39	0.98	21.14	1.59
	AR(1)	0.18	0.09	0.21	0.25	0.01	0.48
CANADA	Mean	0.56	0.71	1.40	1.49	3.27	3.22
	S.D.	8.07	0.87	13.01	1.62	20.13	3.09
	AR(1)	0.25	0.68	0.09	0.65	-0.20	0.56
ITALY	Mean	0.79	0.09	2.64	0.22	7.65	0.63
	S.D.	12.59	1.19	22.95	2.11	42.07	3.68
	AR(1)	0.48	0.55	0.36	0.56	0.07	0.62
JAPAN	Mean	2.22	0.46	4.47	0.96	9.01	2.11
	S.D.	6.40	0.89	10.27	1.54	17.07	2.47
	AR(1)	0.12	0.50	0.003	0.35	0.09	0.52
PORTFOLIO	Mean	1.64	0.35	3.71	0.39	8.08	1.65
	S.D.	6.68	0.75	10.84	0.71	16.20	2.77
	AR(1)	0.27	0.83	-0.06	0.40	-0.15	0.75

Notes: S.D. is the standard deviation of the series, AR(1) is the first order autoregressive coefficient. Portfolio is an efficient portfolio composed of stocks and T-bills (or T-bills only) from the seven countries.

Table 2
Subsample Stability Tests for the Term Structure, P-values
Samples 1973,1-1981,4 and 1982,1-1991,4

		US	France	UK	Germany	Canada	Italy	Japan	Portfolio	Joint
Mean	EP	.003	.001	.97	.00	.70	.33	.00	.002	.00
	EP-R	.00	.00	.00	.00	.00	.00	.00	.00	.00
S.D.	EP	.68	.59	.00	.00	.87	.78	.00	.15	.00
	EP-R	.00	.03	.00	.00	.00	.00	.00	.00	.00
AR(1)	EP	.15	.18	.03	.00	.02	.00	.00	.03	.00
	EP-R	.02	.01	.00	.00	.00	.00	.00	.01	.00
All Moments	EP	.01	.00	.00	.00	.91	.61	.00	.00	.00
	EP-R	.00	.00	.00	.00	.00	.00	.00	.00	.00

Notes: S.D. is the standard deviation of the series, AR(1) the first autoregressive coefficient. Portfolio is an efficient portfolio composed of stocks and t-bills (or t-bills only) for the seven countries. The test are joint for 3-6-12 month maturities. Joint refers to a joint test for a vector of 7 countries and 3 maturities in the sample.

Table 3
Subsample Stability Tests for the Mean Slopes, P-values
Samples 1973,1-1981,4 and 1982,1-1991,4

	Joint 7 Countries		Portfolio	
Slope	EP	EP-R	EP	EP-R
6-3	.57	.00	.33	.59
12-6	.57	.00	.38	.00
Joint	.65	.00	.43	.00

Notes: 6-3 refers to the mean slope between 6 and 3 month holding periods. 12-6 refers to the mean slope between 12 and 6 month holding periods. Portfolio is an efficient portfolio composed of stocks and T-bills (or T-bills only) for the seven countries. Joint refers to a joint test for the vector of the two mean slopes.

Table 4
Tests for Equality of the Term Structure Across Countries
P-values using US as a baseline

Moment	Variable	France	UK	Germany	Canada	Italy	Japan	Portfolio	Joint
				Sample 1973,1-1991,4					
Mean	EP	.45	.08	.27	.50	.90	.63	.07	.46
	EP-R	.002	.08	.01	.001	.01	.54	.00	.00
S.D.	EP	.46	.10	.32	.57	.91	.73	.18	.59
	EP-R	.73	.10	.23	.87	.72	.93	.09	.75
AR(1)	EP	.32	.14	.12	.62	.01	.17	.08	.11
	EP-R	.29	.36	.03	.56	.00	.02	.03	.05
All Moments	EP-R	.02	.04	.01	.01	.07	.87	.00	.00
				Sample 1973,1-1981,4					
Mean	EP	.98	.04	.97	.99	.99	.99	.98	.96
	EP-R	.03	.00	.90	.96	.00	.99	.32	.00
S.D.	EP	.99	.99	.99	.99	.99	.99	.97	1.00
	EP-R	.90	.86	.80	.99	.99	.97	.93	.99
AR(1)	EP	.97	.91	.77	.95	.95	.99	.98	.99
	EP-R	.68	.80	.72	.76	.48	.12	.15	.95
All Moments	EP-R	.19	.00	.95	.99	.00	.99	.06	.005
				Sample 1982,1-1991,4					
Mean	EP	.41	.99	.59	.17	.97	.41	.17	.80
	EP-R	.00	.00	.00	.00	.85	.39	.09	.00
S.D.	EP	.99	.99	.99	.99	.99	.99	.96	1.00
	EP-R	.99	.73	.98	.99	.99	.99	.90	1.00
AR(1)	EP	.94	.90	.88	.95	.44	.16	.27	.99
	EP-R	.12	.08	.04	.11	.02	.05	.10	.09
All Moments	EP-R	.00	.00	.00	.00	.99	.87	.00	.00

Notes: S.D. is the standard deviation of the series and AR(1) the first autoregressive coefficient. Portfolio is an efficient portfolio composed of stocks and t-bills (or t-bills only) for the seven countries. The test are joint for 3-6-12 month maturities. Joint refers to a joint test for a vector of 6 countries and 3 maturities in the sample.

Table 5
Tests for the Existence of Rolling Premia, P-values

Variable	Maturities	US	Canada	Japan	UK	France	Germany	Italy	Portfolio	Joint	Overall
						Sample 1973,1-1991,4					
EP	6-3	.007	.00	.00	.02	.003	.00	.00	.004	.00	
	12-6	.00	.00	.009	.002	.00	.33	.16	.00	.00	.00
						Sample 1973,1-1981,4					
EP	6-3	.48	.18	.62	.72	.05	.003	.28	.19	.42	
	12-6	.43	.61	.32	.73	.54	.27	.08	.05	.03	.06
						Sample 1982,1-1991,4					
EP	6-3	.002	.00	.01	.00	.01	.002	.01	.009	.00	
	12-6	.002	.39	.33	.23	.05	.007	.00	.00	.00	.00

Notes: 6-3 and 12-6 refer to the rolling premia computed using 6 and 3 month and 12 and 6 month maturities. Portfolio is an efficient portfolio composed of stocks and T-bills (or T-bills only) for the seven countries. Joint refers to a joint test that both rolling premia are zero. Overall is a joint test that the rolling premia for 2 maturities for the 7 countries is zero.

Table 6: Probability Measures of Distance
3 Month Holding Period, Sample 1973,1-1991,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
			Data is the Null: Probability Coverings					
95%	0.3	31.1	0.1	0.3	28.6	0.5	89.3	9.8
80%	0.2	19.5	0.0	0.0	17.8	0.0	78.4	0.0
50%	0.0	0.0	0.0	0.0	9.8	0.0	47.7	0.0
			Model is the Null: Probability Coverings					
95%	0.1	0.2	0.2	0.8	1.6	0.2	0.1	0.1
80%	0.1	0.1	0.1	0.8	0.8	0.1	0.1	0.0
50%	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
			Quadrant Probability Coverings					
Q1	89.7	85.7	91.7	91.3	64.9	93.6	55.1	93.3
Q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q3	10.3	14.3	8.3	8.7	35.1	6.1	44.9	6.7
Q4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
				Standard Deviation				
			Data is the Null: Probability Coverings					
95%	0.0	0.1	0.1	1.0	0.1	2.5	0.1	0.2
80%	0.0	0.1	0.0	0.6	0.0	1.4	0.0	0.0
50%	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
			Model is the Null: Probability Coverings					
95%	0.1	0.2	0.1	80.5	0.1	93.5	0.0	4.1
80%	0.0	0.0	0.0	0.4	0.0	1.4	0.0	2.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Quadrant Probability Coverings					
Q1	96.3	99.2	99.5	88.3	98.3	90.3	100.0	89.7
Q2	0.0	0.0	0.1	1.9	0.0	4.1	0.0	0.0
Q3	3.7	0.8	0.4	8.0	1.7	4.2	0.0	10.3
Q4	0.0	0.0	0.0	1.8	0.0	1.4	0.0	0.0
				AR(1) Coefficient				
			Data is the Null: Probability Coverings					
95%	10.1	7.3	0.6	0.4	3.2	1.3	3.2	1.2
80%	6.2	4.2	0.4	0.4	1.7	0.6	2.3	0.4
50%	3.3	2.2	0.2	0.2	0.9	0.6	1.0	0.0
			Model is the Null: Probability Coverings					
95%	23.4	23.3	0.1	0.1	7.2	0.4	0.7	10.9
80%	0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Quadrant Probability Coverings					
Q1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q2	8.8	5.8	0.3	0.4	2.5	1.1	2.2	10.8
Q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Q4	91.2	94.2	99.7	99.6	97.5	98.9	97.8	89.1

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an efficient portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table 7: Probability Measures of Distance
6 Month Holding Period, Sample 1973,1-1991,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	0.1	21.5	0.1	0.3	7.8	0.1	55.3	4.8
80%	0.0	11.3	0.0	0.2	5.6	0.0	43.4	0.0
50%	0.0	0.0	0.0	0.0	2.7	0.0	22.5	0.0
				Model is the Null: Probability Coverings				
95%	1.9	2.2	7.2	6.8	5.8	4.2	1.1	2.3
80%	1.7	1.6	6.4	6.6	4.9	3.4	1.1	1.1
50%	1.0	0.5	0.0	0.0	0.8	0.0	0.1	0.4
				Quadrant Probability Coverings				
Q1	52.8	26.3	84.0	84.9	24.3	88.6	34.1	23.2
Q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q3	47.2	73.7	16.0	15.1	75.7	11.4	65.3	76.8
Q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	0.5	0.1	0.2	1.1	0.3	0.9	0.1	0.2
80%	0.2	0.0	0.1	0.6	0.0	0.7	0.0	0.0
50%	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0
				Model is the Null: Probability Coverings				
95%	6.5	0.1	0.0	99.5	0.1	25.5	0.0	4.1
80%	0.0	0.0	0.0	0.3	0.0	0.2	0.0	2.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	94.8	100.0	79.5	70.4	98.6	56.6	100.0	98.7
Q2	4.0	0.0	20.2	25.1	1.1	41.8	0.0	0.0
Q3	0.6	0.0	0.0	0.7	0.1	1.0	0.0	1.3
Q4	0.6	0.0	0.3	3.8	0.2	1.5	0.0	0.0
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	1.2	0.6	0.4	1.0	0.3	1.0	0.6	1.2
80%	1.0	0.5	0.4	0.9	0.3	0.5	0.2	0.4
50%	0.2	0.4	0.2	0.6	0.0	0.4	0.1	0.0
				Model is the Null: Probability Coverings				
95%	0.6	0.1	0.1	0.1	0.0	0.1	0.1	0.1
80%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q2	1.2	0.5	0.4	0.8	0.4	0.6	0.1	1.8
Q3	0.0	0.0	2.3	0.9	0.0	0.3	0.0	0.1
Q4	98.8	99.5	97.3	98.3	99.6	99.1	99.0	98.1

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an efficient portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table 8: Probability Measures of Distance
12 Month Holding Period, Sample 1973,1-1991,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	0.1	11.1	0.1	4.3	3.6	0.1	39.3	2.7
80%	0.0	8.2	0.0	2.3	2.1	0.0	25.7	0.0
50%	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0
				Model is the Null: Probability Coverings				
95%	99.1	14.2	0.1	6.6	35.2	0.1	30.2	2.4
80%	98.2	12.4	0.1	5.8	29.6	0.1	19.8	0.0
50%	49.2	1.0	0.0	0.0	0.0	0.0	10.3	0.0
				Quadrant Probability Coverings				
1	33.6	18.3	13.6	54.5	7.3	30.6	53.8	23.3
2	26.5	2.4	85.0	38.4	6.5	56.6	0.1	20.2
3	39.9	79.3	1.4	7.1	86.2	12.8	46.1	56.5
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	4.3	0.1	15.5	5.1	7.2	18.0	0.1	0.1
80%	1.8	0.0	3.9	1.8	1.3	9.0	0.0	0.0
50%	0.6	0.0	0.4	0.4	0.1	2.2	0.0	0.0
				Model is the Null: Probability Coverings				
95%	99.1	0.2	49.7	99.5	36.5	99.6	0.0	3.4
80%	98.0	0.0	17.9	95.5	5.1	99.4	0.0	2.3
50%	0.0	0.0	4.5	3.2	0.6	87.3	0.0	0.0
				Quadrant Probability Coverings				
1	70.1	95.4	31.0	55.8	83.7	48.2	100.0	86.7
2	1.1	0.0	66.6	0.6	0.0	11.3	0.0	0.0
3	16.5	4.3	0.2	29.0	17.1	10.2	0.0	13.3
4	12.3	0.3	2.2	14.6	2.2	30.3	0.0	0.0
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	0.7	0.7	0.2	0.9	0.3	0.9	0.7	1.2
80%	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.4
50%	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
				Model is the Null: Probability Coverings				
95%	85.9	0.7	0.1	2.2	0.2	0.1	0.4	2.9
80%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
1	1.9	0.4	0.1	0.4	0.3	0.4	0.0	0.0
2	0.6	0.6	0.1	1.3	0.2	1.0	1.3	1.8
3	12.6	5.9	1.2	3.4	4.1	3.0	2.0	8.1
4	84.9	93.1	98.6	94.9	95.4	95.6	96.7	90.1

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an efficient portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Appendix A: Definition of Variables

The basic series employed in the study are: average of nominal stock price indices (p); per capita real seasonally adjusted (SA) consumption of nondurables and services, where quarterly population is obtained from annual data under the assumption of constant quarterly growth (C); consumption of nondurables and services consumption price deflator (PC); nominal yield on three month nominal securities (RF), and dividend yield, constructed using a 12 month moving average of total dividends on the average stock price index (DY).

The derived series are: per capita real seasonally adjusted consumption growth (CG), Real return on 3-month securities (RFR), obtained as

$$RFR_{t,3} = RF_{t,3} - \frac{PC_{t+3} - PC_t}{PC_t}$$

For longer term maturities we use the formula:

$$RFR_{t,k} = \sum_{j=0}^{k-1} RFR_{t+3j,3}$$

Real returns on equity (RT) for holding period k are obtained as:

$$RT_{t,k} = \frac{P_{t+k} - P_t}{P_t} + \frac{DY_{t+k}}{P_t}$$

where $P_t = p_t/PC_t$ and the equity premium (EP) at maturity k, defined as: $EP_{t,k} = RT_{t,k} - RFR_{t,k}$. Because the dividend yield series is annual, DY_{t+k} is obtained by multiplying the original entries of the series by k/12 and accumulated the resulting series over k periods.

Data Sources

United States, sample: 1973.1-1991.4

C Difference between SA total real consumption (USCONEXPD) and SA real consumption on durables (USCONDURD).

PC Ratio of the difference between SA total value of consumption (USCONEXPB) and SA value of durables consumption (USCONDURB) and the difference between SA total real consumption (USCONEXPD) and SA real consumption on durables (USCONDURD).

RFR Quarter average of end-of-month rates on 3-month Treasury Bills (USTRSBL)

RT k-period average of monthly Standard and Poor 500 price index (USSP) deflated by PC

DY Quarter average of New York-Datastream total market monthly dividend yield (USDY)

Canada, sample: 1973.1-1991.4

C Difference between SA total real consumption (CNCONEXPD) and SA real consumption on durables (CNCNDURBD).

PC Ratio of the difference between SA total value of consumption (CNCONEXPB) and SA value of durables consumption (CNCNDURBB) and the difference between SA total real consumption (CNCONEXPD) and SA real consumption on durables (CNCNDURBD).

RFR Quarter average of end-of-month rates on 3-month Treasury Bills (CNTRSBL)

RT Quarter average of Toronto SE composite end-of-month price index (CNSHRPRC) deflated by PC

DY k-period average of monthly Toronto composite SE dividend yield (CNDY)

Japan, sample: 1973.1-1990.4

C Sum of SA total real nondurables consumption (JPCNNONDD) and SA real services consumption (JPCNSERVD).

PC Ratio of the sum between SA total value of nondurables consumption (JPCNNONDB) and value of services consumption (JPCNSERVB) and the sum of SA total real non durables consumption (JPCNNONDD) and SA real services consumption (JPCNSERVD).

RFR Quarter average of monthly averages of 3-month Gensaki rates (JPOGGEN)

RT Quarter average of Tokyo New Stock Exchange end-of-month price index (JPTOKYO) deflated by PC

DY k-period average of monthly Tokyo Datastream total market dividend yield (JPDY)

United Kingdom, sample: 1973.1-1991.4

C Difference between SA total real consumption (UKCONEXPD) and SA real consumption on durables (UKCNDURBD).

PC Ratio of the difference between SA total value of consumption (UKCONEXPB) and SA value of durables consumption (UKCNDURBB) and the difference between SA total real consumption (UKCONEXPD) and SA real consumption on durables (UKCNDURBD)

RFR Quarter average of end-of-month rates on 3-months Treasury Bills (UKTRSBL)

RT Quarter average of FT Actuaries "All Shares" monthly price index (UKFTAALP) deflated by PC

DY k-period average FT Actuaries monthly dividend yield (UKDY)

Germany, sample: 1973.1-1991.4

C SA total real consumption (BDCONEXPD).

PC Ratio of SA total value of consumption (BDCONEXPB) and SA total real consumption (BDCONEXPD).

RFR Quarter average of end-of-month rates on 3-month Treasury Bills (BDTRSBL)

RT Quarter average of Commerzbank end-of-month shares price indices (BDSHRPRC) deflated by PC

DY k-period average Frankfurt total market monthly dividend yield (BDDY)

France, sample: 1973.1-1991.4

C Difference between SA total real consumption (FRCONEXPD) and SA real consumption on durables (FRCNDURBD).

PC Ratio of the difference between SA total value of consumption (FRCONEXPB) and SA value of durables consumption (FRCNDURBB) and Difference between SA total real consumption (FRCONEXPD) and SA real consumption on durables (FRCNDURBD).

RFR Quarter average of monthly average rates on 3-month Treasury Bills (FRTRSBL)

RT Quarter average of end-of-month industrial shares price indexes (FRSHRPRC) deflated by PC

DY k-period average of Paris bourse total market monthly dividend yield (FRDY)

Italy, sample: 1974.1-1991.4

C SA total real nondurables and services consumption (ISTAT)

PC Ratio of SA total value of non durables and services consumption and SA total real non durables and services consumption (ISTAT).

RFR Quarter average of end-of-month rates on 3-month Treasury Bills (ITTRSBL)

RT Quarter average of end-of-month Milan Bourse shares price indices (ITSHRPRC) deflated by PC

DY k-period average of Milan Datastream total market monthly dividend yield (ITDY)

Notes: Datastream codes are in parenthesis. Datastream erroneously reports as seasonally adjusted the consumption series for Japan and UK when they are not. In both cases we seasonally adjusted them with standard methods using TSP procedures. No disaggregated consumption data exists for Germany. The distortions introduced by using total consumption in place of consumption of nondurables and services does not seem to be very serious. For example, in the US and France the difference in the time series properties (mean, standard deviations, autocorrelations and the partial autocorrelations) of total consumption and of consumption of nondurables and services is very small.

Appendix B: Results for Subsamples
Table B.1
Cross Country Statistics: Equity Premium - Risk-Free Rate

Holding	Period	1973,1-1981,4 3 Months EP	R	6 Months EP	R	12 Months EP	R	1982,1-1991,4 3 Months EP	R	6 Months EP	R	12 Months EP	R
U.S.	Mean	0.02	0.02	0.31	0.13	2.55	0.52	2.76	0.80	5.85	1.56	10.80	3.03
	S.D.	7.15	0.73	11.35	1.48	12.82	3.03	7.31	0.49	10.63	0.83	15.69	1.46
	AR(1)	0.22	0.69	-0.16	0.60	-0.18	0.41	-0.07	0.48	-0.14	0.39	-0.35	0.38
France	Mean	-0.26	-0.29	0.07	-0.54	1.14	-0.78	3.84	1.19	8.62	2.43	17.80	4.91
	S.D.	10.38	0.57	16.23	0.99	22.55	2.09	10.12	0.46	17.50	0.75	28.52	1.14
	AR(1)	0.26	0.32	-0.002	0.19	0.005	0.08	0.36	0.20	-0.11	0.01	-0.45	0.14
UK	Mean	2.29	-0.90	5.26	-1.69	12.21	3.04	2.84	1.18	5.68	2.34	10.46	4.67
	S.D.	13.56	1.70	20.09	2.83	20.21	4.96	6.97	0.69	11.03	1.07	15.14	1.77
	AR(1)	0.16	0.30	-0.22	0.27	-0.42	0.14	0.06	0.12	-0.33	0.19	-0.10	0.04
Germany	Mean	0.54	-0.03	1.10	-0.08	2.53	-0.09	3.84	0.45	7.97	0.96	15.77	1.94
	S.D.	5.17	0.62	7.95	0.77	11.57	1.15	9.45	0.58	15.13	0.89	26.77	1.28
	AR(1)	0.12	-0.20	0.01	-0.12	0.20	0.16	0.15	0.17	0.18	0.02	-0.09	0.09
Canada	Mean	-0.04	0.14	0.10	0.36	2.12	1.00	1.18	1.28	2.70	2.63	4.42	5.44
	S.D.	8.15	0.83	13.43	1.46	21.77	2.59	8.07	0.45	12.86	0.75	18.98	1.28
	AR(1)	0.27	0.55	0.31	0.45	0.24	0.16	0.12	0.23	-0.10	0.13	-0.33	-0.005
Italy	Mean	-0.51	-0.65	-0.32	-1.24	1.98	-2.20	2.10	0.84	5.61	1.69	13.32	3.48
	S.D.	13.25	1.19	24.80	1.90	43.43	2.85	11.95	0.54	21.33	0.95	42.26	1.52
	AR(1)	0.51	0.22	0.31	0.15	0.04	-0.10	0.42	0.47	0.36	0.24	0.05	0.31
Japan	Mean	0.45	0.04	0.76	0.20	2.22	0.75	4.00	0.87	8.17	1.73	15.81	3.46
	S.D.	4.65	1.01	6.80	1.75	7.64	2.74	7.43	0.49	11.91	0.76	21.25	1.16
	AR(1)	0.07	0.43	-0.20	0.20	-0.33	0.28	0.01	0.16	-0.17	0.06	-0.07	0.12
PORTFOLIO	Mean	0.35	-0.23	1.04	-0.17	3.54	-0.54	2.93	0.94	6.37	0.95	12.63	3.85
	S.D.	6.52	0.57	10.23	0.55	12.32	2.16	6.68	0.28	11.04	0.25	18.71	0.86
	AR(1)	0.24	0.59	-0.16	0.26	-0.17	0.32	0.21	0.40	-0.10	0.17	-0.15	0.12

Notes: S.D. is the standard deviation of the series, AR(1) is the first order autoregressive coefficient. Portfolio is an equally weighted portfolio composed of stocks and T-bills (or T-bills only) from the seven countries.

Table B.2: Probability Measures of Distance, 3 Month Holding Period, Sample 73,1-81,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	31.3	33.5	20.8	6.6	11.4	20.5	87.6	11.2
80%	23.8	25.3	16.1	5.0	8.0	14.9	76.4	9.4
50%	13.2	14.7	8.4	2.5	3.5	8.2	46.1	5.5
				Model is the Null: Probability Coverings				
95%	0.7	0.6	1.4	9.8	16.2	3.2	10.0	4.8
80%	0.5	0.5	1.2	8.8	10.1	1.1	0.1	3.7
50%	0.2	0.0	0.5	2.1	4.5	0.5	0.0	1.9
				Quadrant Probability Coverings				
Q1	0.0	0.0	65.7	0.0	0.6	0.9	0.0	2.5
Q2	35.7	37.7	0.0	33.6	37.2	49.0	48.9	44.8
Q3	0.0	0.0	34.3	4.7	4.9	4.6	0.0	0.0
Q4	64.3	62.3	0.0	61.7	57.3	45.5	51.1	57.5
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	0.0	0.1	0.4	5.7	8.3	0.2	0.1	0.5
80%	0.0	0.0	0.3	2.3	3.4	0.1	0.0	0.2
50%	0.0	0.0	0.2	0.7	1.0	0.0	0.0	0.0
				Model is the Null: Probability Coverings				
95%	0.1	0.2	0.1	99.5	99.8	0.2	0.0	5.4
80%	0.0	0.0	0.0	99.3	81.3	0.0	0.0	3.1
50%	0.0	0.0	0.0	69.3	10.0	0.0	0.0	0.9
				Quadrant Probability Coverings				
Q1	94.3	96.6	98.9	60.8	63.6	88.7	100.0	92.6
Q2	0.0	0.0	0.0	8.2	21.6	0.0	0.0	1.0
Q3	5.7	3.4	1.1	11.2	2.9	11.1	0.0	6.4
Q4	0.0	0.0	0.0	19.8	11.9	0.2	0.0	0.0
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	7.3	6.5	1.3	0.1	0.8	3.2	0.1	1.2
80%	3.7	4.3	0.7	0.1	0.6	2.3	0.0	0.4
50%	2.4	2.2	0.4	0.0	0.3	1.2	0.0	0.0
				Model is the Null: Probability Coverings				
95%	5.1	9.5	0.1	0.1	0.2	2.9	0.3	0.9
80%	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q2	6.5	4.8	1.1	0.4	0.7	2.8	0.2	12.1
Q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q4	93.5	95.2	98.9	99.6	99.3	97.2	99.8	87.9

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an equally weighted portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table B.3: Probability Measures of Distance, 3 Month Holding Period, Sample 82,1-91,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	0.1	0.0	0.1	0.0	0.2	21.2	80.3	4.4
80%	0.0	0.0	0.0	0.0	0.0	12.8	70.1	3.3
50%	0.0	0.0	0.0	0.0	0.0	7.3	39.8	0.5
				Model is the Null: Probability Coverings				
95%	0.0	0.0	0.0	0.0	0.1	1.2	0.3	0.1
80%	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.0
50%	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
				Quadrant Probability Coverings				
Q1	97.1	93.4	97.3	94.9	96.3	70.0	67.1	88.1
Q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q3	2.9	6.6	2.7	5.1	3.7	30.0	32.9	11.9
Q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	0.0	0.0	2.1	1.6	0.0	0.1	0.0	0.1
80%	0.0	0.0	0.7	0.6	0.0	0.1	0.0	0.0
50%	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
				Model is the Null: Probability Coverings				
95%	0.0	0.0	100.0	93.4	16.5	0.3	0.0	6.6
80%	0.0	0.0	99.4	6.1	0.0	0.0	0.0	4.2
50%	0.0	0.0	67.4	0.0	0.0	0.0	0.0	1.3
				Quadrant Probability Coverings				
Q1	67.0	82.0	55.1	72.6	60.6	81.8	99.4	94.2
Q2	0.0	0.0	8.7	1.1	0.1	0.0	0.0	0.5
Q3	32.8	17.9	18.4	22.6	37.8	17.7	0.6	5.1
Q4	0.2	0.1	17.8	3.7	1.5	0.5	0.0	0.2
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	8.3	2.7	2.2	2.9	4.9	3.7	0.1	3.3
80%	5.5	2.1	1.0	1.5	2.8	2.3	0.0	1.8
50%	2.8	1.0	0.3	0.7	1.4	1.5	0.0	0.0
				Model is the Null: Probability Coverings				
95%	27.2	3.2	13.5	20.9	37.7	16.1	0.3	2.9
80%	1.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q2	10.8	3.2	2.4	3.5	4.0	7.1	0.0	8.4
Q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q4	89.2	96.8	97.6	96.5	96.0	92.9	100.0	93.6

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an equally weighted portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table B.4: Probability Measures of Distance 6 Month Holding Period, Sample 73,1-81,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	41.3	24.4	14.3	12.4	31.7	15.3	29.3	12.6
80%	30.2	15.9	9.5	7.9	20.3	9.2	15.4	7.8
50%	16.6	7.6	0.2	1.6	5.8	3.5	7.5	0.0
				Model is the Null: Probability Coverings				
95%	4.9	6.6	3.2	7.8	11.7	3.2	2.6	4.6
80%	3.3	1.4	1.3	5.0	9.2	0.6	0.9	2.9
50%	0.6	0.1	0.0	0.0	3.6	0.0	0.1	0.4
				Quadrant Probability Coverings				
Q1	68.2	14.0	96.3	92.6	66.3	92.6	89.9	77.5
Q2	0.0	78.1	0.2	0.5	0.0	0.4	1.7	0.3
Q3	31.8	0.1	3.5	6.9	33.7	6.7	7.9	22.2
Q4	0.0	7.8	0.0	0.0	0.0	0.0	0.5	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	0.6	0.4	0.7	5.2	2.5	0.8	0.1	0.8
80%	0.3	0.0	0.5	1.2	0.6	0.2	0.0	0.4
50%	0.0	0.0	0.2	0.2	0.1	0.2	0.0	0.0
				Model is the Null: Probability Coverings				
95%	13.5	0.4	0.5	99.8	98.6	45.0	0.0	12.4
80%	0.0	0.0	0.0	37.8	1.9	1.1	0.0	9.4
50%	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	95.6	98.3	83.4	48.4	86.3	37.7	99.8	93.5
Q2	3.2	1.2	16.2	42.9	9.0	59.9	0.2	0.0
Q3	0.7	0.3	0.0	1.0	2.2	0.2	0.0	6.5
Q4	0.5	0.2	0.4	7.7	2.5	2.2	0.0	0.0
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	1.9	0.1	0.0	0.1	1.7	0.4	0.0	0.8
80%	1.1	0.0	0.0	0.0	1.1	0.2	0.0	0.3
50%	0.7	0.0	0.0	0.0	0.9	0.2	0.0	0.0
				Model is the Null: Probability Coverings				
95%	11.6	0.0	0.1	0.0	4.4	0.1	0.0	0.1
80%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.2	0.0	0.0	0.0	0.3	0.2	0.0	0.0
Q2	1.7	0.1	0.0	0.4	1.3	0.2	0.0	0.5
Q3	1.1	0.0	0.0	2.3	3.3	1.0	0.0	0.4
Q4	97.0	99.9	100.0	97.3	95.1	98.6	100.0	99.1

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an equally weighted portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table B.5: Probability Measures of Distance, 6 Month Holding Period, Sample 82,1-91,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	0.1	0.0	0.0	0.0	4.3	0.0	0.0	0.4
80%	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.1
50%	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0
				Model is the Null: Probability Coverings				
95%	1.0	1.2	2.5	5.8	9.1	5.2	0.1	2.2
80%	0.7	0.8	1.4	4.5	5.9	3.7	0.0	0.9
50%	0.0	0.2	0.0	0.1	2.7	0.5	0.0	0.0
				Quadrant Probability Coverings				
Q1	77.2	32.3	89.8	79.3	33.3	79.1	2.6	37.9
Q2	0.0	0.0	0.4	0.1	0.0	0.2	0.0	0.0
Q3	22.8	67.7	9.8	20.6	66.4	20.7	97.4	62.1
Q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	4.1	2.2	1.2	5.1	0.9	6.9	0.0	3.3
80%	2.0	1.3	0.6	1.7	0..6	2.9	0.0	1.8
50%	0.3	0.3	0.2	0.4	0.0	1.0	0.0	0.0
				Model is the Null: Probability Coverings				
95%	100.0	98.3	100.0	100.0	100.0	100.0	0.0	85.4
80%	98.2	3.4	50.0	86.0	0.9	99.3	0.0	56.3
50%	13.4	0.0	1.0	8.1	0.0	32.4	0.0	12.1
				Quadrant Probability Coverings				
Q1	61.7	87.4	32.3	65.7	87.1	57.1	99.7	54.5
Q2	19.2	4.8	58.0	20.6	5.1	21.3	0.0	20.3
Q3	6.3	4.5	1.1	3.8	5.0	5.8	0.3	4.5
Q4	12.8	3.3	8.6	9.9	2.8	15.8	0.0	20.7
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	1.0	0.3	0.0	0.3	0.8	0.5	0.1	1.3
80%	0.6	0.2	0.0	0.2	0.4	0.3	0.0	0.7
50%	0.3	0.0	0.0	0.0	0.3	0.1	0.0	0.0
				Model is the Null: Probability Coverings				
95%	0.1	0.1	0.0	0.1	0.0	0.1	0.3	0.1
80%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.2	0.0	0.1	0.1	0.2	0.0	0.0	0.1
Q2	1.0	0.6	0.1	0.1	0.6	0.9	0.0	2.0
Q3	0.0	0.0	1.6	1.7	0.5	0.8	0.0	0.5
Q4	98.8	99.4	98.2	97.2	98.5	98.3	100.0	97.4

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an equally weighted portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table B.6: Probability Measures of Distance, 12 Month Holding Period, Sample 73,1-81,4

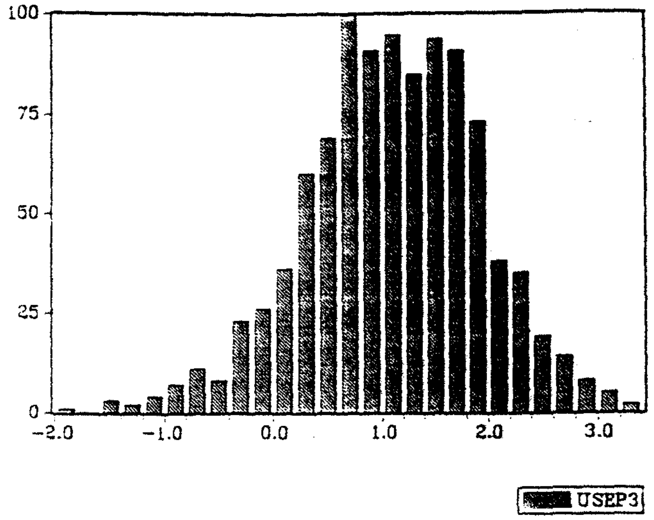
	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	15.1	8.7	0.1	3.3	23.4	0.1	3.9	1.1
80%	9.4	2.9	0.0	1.7	15.1	0.0	2.8	0.5
50%	4.4	1.6	0.0	0.9	8.1	0.0	1.4	0.0
				Model is the Null: Probability Coverings				
95%	57.3	0.2	0.1	0.0	95.2	0.1	0.2	1.4
80%	49.5	0.0	0.1	0.0	77.5	0.1	0.0	0.6
50%	0.7	0.0	0.0	0.0	38.7	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.1	0.0	0.0	1.5	22.8	22.2	0.1	23.3
Q2	81.7	96.4	85.0	96.7	35.1	55.6	97.1	55.5
Q3	11.3	0.5	11.4	1.5	42.1	22.2	1.7	21.2
Q4	6.9	3.1	3.6	0.3	0.0	0.0	0.2	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	16.7	6.1	5.5	17.2	12.6	8.0	1.9	10.2
80%	7.1	2.6	3.9	6.8	7.3	5.2	0.4	6.7
50%	2.2	1.0	0.4	2.2	3.0	1.4	0.2	3.3
				Model is the Null: Probability Coverings				
95%	99.8	80.4	55.7	99.5	100.0	99.6	2.3	42.4
80%	94.0	1.0	43.9	99.5	75.2	80.2	0.0	38.9
50%	3.0	0.0	12.5	94.8	1.3	59.4	0.0	15.8
				Quadrant Probability Coverings				
Q1	71.4	89.0	61.0	28.0	70.7	28.5	97.5	89.7
Q2	3.3	0.9	26.6	10.5	3.6	13.4	1.1	5.0
Q3	12.4	6.9	2.4	22.7	15.3	22.1	1.2	5.3
Q4	12.9	3.2	0.0	38.8	10.4	46.0	0.2	0.0
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	0.5	0.1	0.1	0.1	1.2	0.3	0.2	1.0
80%	0.0	0.1	0.0	0.1	0.2	0.1	0.2	0.2
50%	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0
				Model is the Null: Probability Coverings				
95%	4.1	0.1	0.0	0.0	3.1	0.1	0.9	1.0
80%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	1.1	0.1	0.1	0.2	0.7	0.4	0.0	0.0
Q2	0.9	0.1	0.0	0.2	1.9	3.5	0.0	1.8
Q3	5.1	0.8	0.1	0.7	4.1	2.0	0.0	1.1
Q4	92.9	99.0	99.8	98.9	93.2	93.1	100.0	98.1

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an equally weighted portfolio of stocks and T-bills (or T-bills only) of the seven countries.

Table B.7: Probability Measures of Distance, 12 Month Holding Period, Sample 82,1-91,4

	US	France	UK	Germany	Canada	Japan	Italy	Portfolio
				Mean				
				Data is the Null: Probability Coverings				
95%	0.1	0.0	0.1	0.0	0.2	21.2	3.3	2.4
80%	0.0	0.0	0.0	0.0	0.0	12.8	0.4	0.4
50%	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0
				Model is the Null: Probability Coverings				
95%	0.0	0.0	0.0	0.0	0.1	1.2	0.0	0.1
80%	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0
50%	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
				Quadrant Probability Coverings				
Q1	97.1	93.4	97.3	94.9	96.3	70.0	1.3	5.3
Q2	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
Q3	2.9	6.6	2.7	5.1	3.7	30.0	97.9	94.6
Q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Standard Deviation				
				Data is the Null: Probability Coverings				
95%	0.0	0.0	2.1	1.6	0.0	0.1	1.3	2.4
80%	0.0	0.0	0.7	0.6	0.0	0.1	0.0	0.0
50%	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
				Model is the Null: Probability Coverings				
95%	0.0	0.0	100.0	93.4	16.5	0.3	2.4	3.1
80%	0.0	0.0	99.4	6.1	0.0	0.0	0.8	1.2
50%	0.0	0.0	67.4	0.0	0.0	0.0	0.1	0.1
				Quadrant Probability Coverings				
Q1	67.0	82.0	55.1	72.6	60.6	81.8	94.1	90.1
Q2	0.0	0.0	8.7	1.1	0.1	0.0	0.5	1.5
Q3	32.8	17.9	18.4	22.6	37.8	17.7	5.1	8.1
Q4	0.2	0.1	17.8	3.7	1.5	0.5	0.3	0.3
				AR(1) Coefficient				
				Data is the Null: Probability Coverings				
95%	8.3	2.7	2.2	2.9	4.9	3.7	0.0	3.3
80%	5.5	2.1	1.0	1.5	2.8	2.3	0.0	1.8
50%	2.8	1.0	034	0.7	1.4	1.5	0.0	0.0
				Model is the Null: Probability Coverings				
95%	27.2	3.2	13.5	20.9	16.1	37.7	0.0	2.9
80%	1.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Quadrant Probability Coverings				
Q1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Q2	10.8	3.2	2.4	3.5	4.0	7.1	0.0	8.4
Q3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
Q4	89.2	96.8	97.6	96.5	96.0	92.9	99.3	93.6

Notes: Q1 is a quadrant where the simulated moments of EP-R are both lower than their actual values, Q2 is the quadrant where the simulated moments of EP are above their actual value and the simulated moments of R are below their actual value, Q3 is the quadrant where the simulated moments of EP are below their actual value and the simulated moments of R are above their actual value, Q4 is the quadrant where the simulated moments of EP and R are both above their actual values. Portfolio is an equally weighted portfolio of stocks and T-bills (or T-bills only) of the seven countries.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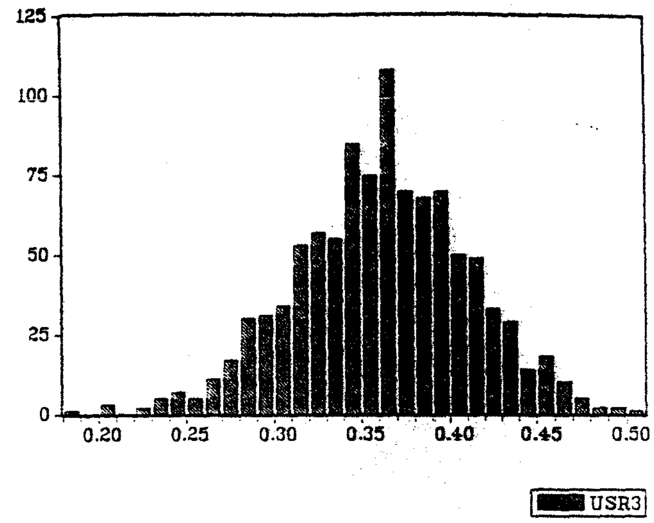
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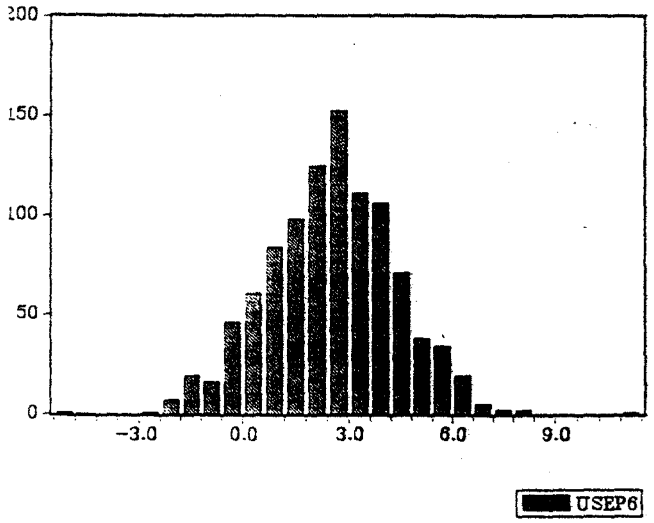
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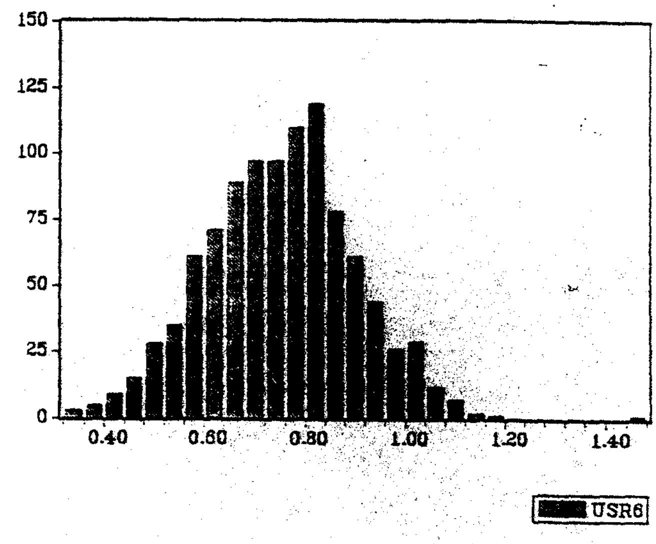
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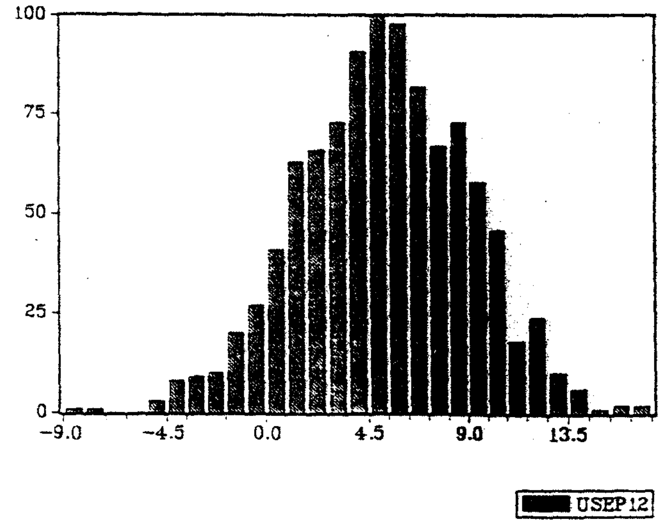
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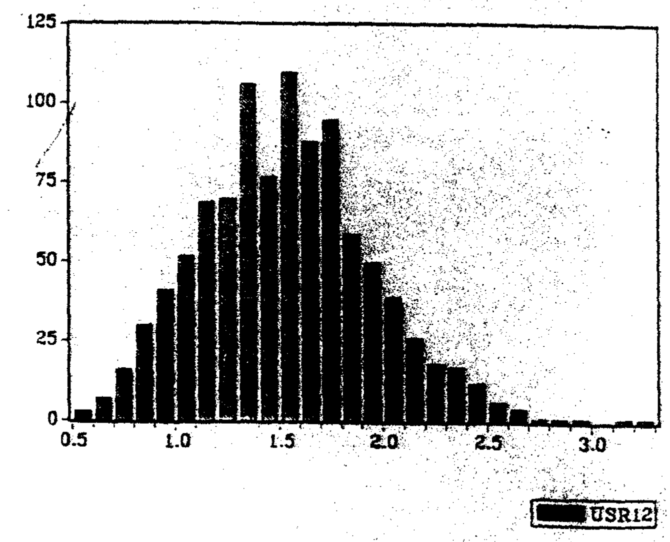
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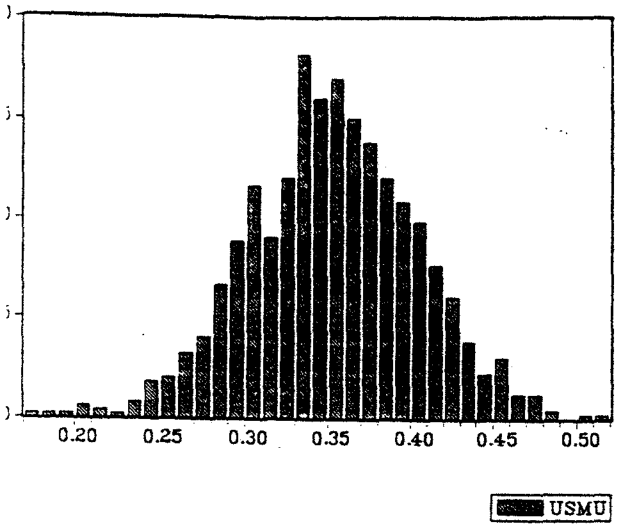
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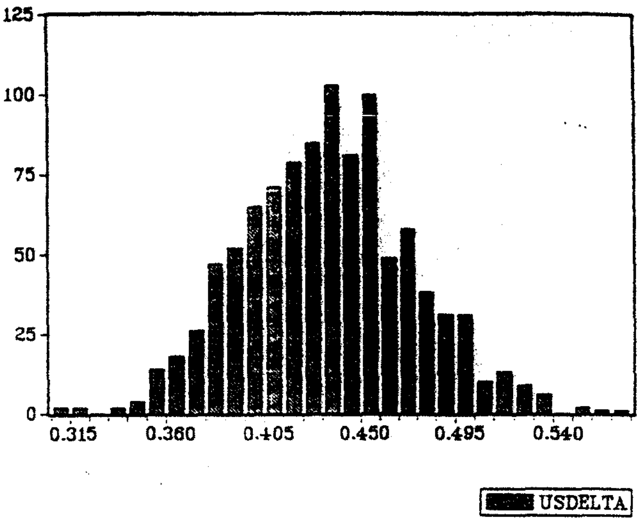
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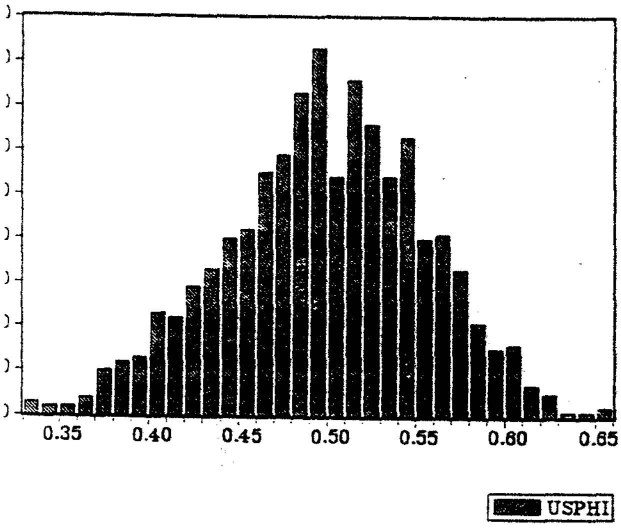
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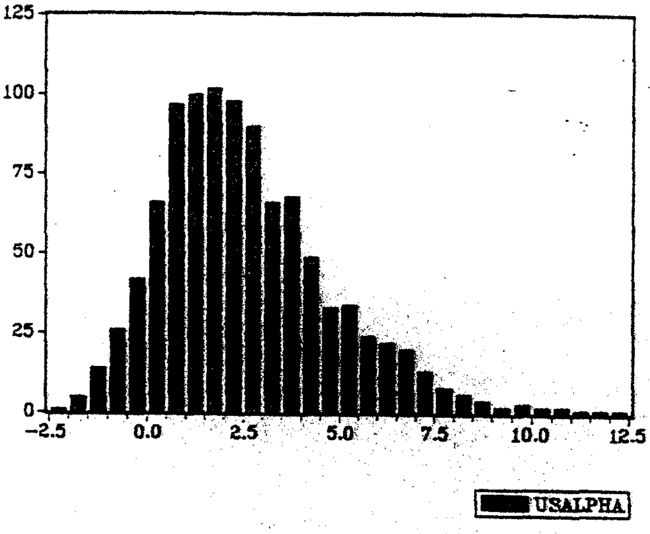
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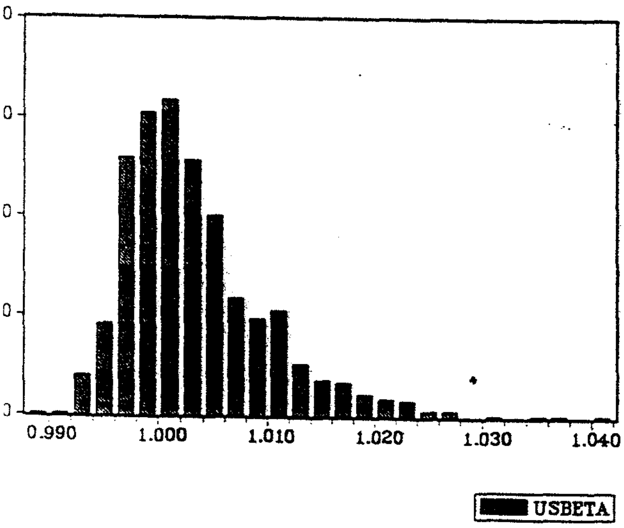
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