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Comovements among National Stock Markets

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This paper uses the methodology of Hansen and Jagannathan (1991) to derive a lower bound on the correlation between any pair of asset returns under the hypothesis of complete markets. The bound is a simple function of the two assets' Sharpe ratios and the coefficient of variation of a unique stochastic discount factor. The paper uses this bound to conduct robust, nonparametric tests of the hypothesis that international equity markets are integrated.

Using monthly stock return data from the U.S., Japan, and Great Britain for the period 1980 through 1993, I find that conclusions about market integration depend sensitively on the assumed variation of the (unobserved) common world discount rate. Given the observed correlations in returns, markets are more likely to be integrated the more volatile is the discount rate.

International capital markets play an important role in the world economy. It is through these markets that risk and investment resources are allocated across countries. Gauging the extent to which international bond and equity markets perform these functions efficiently has therefore been a topic of great interest to economists. Traditionally, this question has been posed as whether or not national capital markets are "integrated" or "segmented." That is, do assets issued in different countries yield the same risk-adjusted returns, or do they consistently yield different returns because of informational and governmentally imposed barriers? Clearly, if international capital markets are to provide appropriate signals to savers and investors, national bond and equity markets must be integrated.

Attempts to answer this question are plagued by two difficulties not encountered in studies of domestic capital market efficiency. First, assets issued in different countries tend to be denominated in different currencies, and exchange rate volatility adds an additional element of uncertainty to international investments. As a result, when testing the integration hypothesis one must either include a model of the pricing of exchange rate risk, or consider returns that have been "covered" against exchange rate risk. Second, because of taste differences and transportation costs, consumption patterns differ across countries much more than they do across regions within a single country. Since investors want to hedge their real consumption risks, this means that the riskiness of a given asset depends on the owner's country of residence. These problems make it even more difficult than usual to define a risk-adjusted return, and consequently, make the results in this literature difficult to interpret.

Studies of international bond markets generally conclude that markets are becoming increasingly integrated. This is particularly true when exchange risk and consumption differences are not an issue, e.g., when testing Covered Interest Parity.[1] Tests of Uncovered Interest Parity, however, have led to more ambiguous results. Although the hypothesis is typically rejected, no one has yet formulated

1. See Frankel (1993) for a survey of the evidence on short-term covered interest parity. Popper (1993) provides evidence on long-term covered interest parity.

an economic model of exchange rate risk that can explain these rejections. This has led some observers to question the efficiency of the foreign exchange market.[2] Even more stringent tests of international bond market integration, which require assumptions about both foreign exchange risk and international consumption differences, are conducted by Cumby and Mishkin (1986). They document close, but imperfect, linkages among the (ex ante) real interest rates of the U.S. and Europe. Glick and Hutchison (1990) apply the same methodology to real interest rate linkages between the U.S. and a set of Pacific Basin countries and find that financial liberalization has increased the linkages among these markets.

In this paper, I examine the integration of international stock markets. Early work on this topic followed the same basic logic as bond market studies. That is, the extent of integration was judged by the correlation of returns, the idea being that greater equity market integration should lead to greater correlation among national stock markets.[3] Although this idea seems plausible, and in fact remains the conventional wisdom within the business community, we know from the work of Lucas (1982) that the important implication of integrated capital markets is the equalization among countries of marginal rates of substitution in consumption, both intertemporally and across states of nature. Stock returns in an integrated market may or may not be highly correlated, depending upon the nature of international specialization and the correlation of national productivity shocks. For example, stock markets may be segmented, yet stock returns could nonetheless be highly correlated if countries produce similar goods or if productivity shocks are highly correlated across countries. Conversely, stock markets might be integrated even if national stock returns are weakly correlated if countries are specialized in the production of different goods and if productivity shocks are weakly correlated across countries. This suggests that the coherence among national consumption growth rates probably provides a better metric for the degree of international capital market integration than does the correlation of stock returns.

Obstfeld (1993) pursues this strategy and concludes that the weak relationships observed among national consumption growth rates are inconsistent with the hypothesis of internationally integrated capital markets, although he does find that markets have become more integrated over time. However, as Obstfeld himself acknowledges, this approach suffers from a couple of severe drawbacks. First, in order to link consumption data to the marginal rate of substitution, one must specify a utility function. That is, this strategy is "parametric," and as a result one can never be sure whether a given rejection represents a bona fide rejection of the hypothesis of integrated markets or merely represents a rejection of the posited utility function. Second, it is widely recognized that consumption data contain measurement error. This creates econometric difficulties in implementing this approach.

This paper adopts a strategy that avoids these problems. Not only is it nonparametric, and therefore robust to functional form misspecification and measurement error biases, but it also resurrects the intuitive notion that integration of equity markets should place restrictions on the observed correlation among national stock markets. In particular, I adapt the methodology of Hansen and Jagannathan (1991) to derive a lower bound on the correlation between national stock market returns under the hypothesis of integrated markets. If the observed correlation between a pair of stock market returns is below its lower bound, then we can conclude that these markets do not share the same discount rate, or in other words, are not integrated.

The basic idea behind this approach is as follows. Hansen and Jagannathan derive a lower bound on the volatility of an unobserved stochastic discount factor. This discount factor translates future state-contingent payoffs into current asset prices. Economic theories of asset pricing are distinguished according to how they link this discount factor to observable variables. For example, in the approach taken by Obstfeld the discount rate is assumed to be equal to the intertemporal marginal rate of substitution in consumption, while in the static CAPM it is assumed to be proportional to the return on the "market portfolio." Now, the hypothesis of integrated markets means that this discount factor is the same across countries, which implies that the Hansen-Jagannathan bound must be the same across countries. In particular, the lower bound on the standard deviation of the common world discount rate becomes a function of the observed variances and covariances of national stock market returns. In essence, all I do in this paper is invert this volatility bound to derive a lower bound on the correlation coefficient of returns as a function of the standard deviation of the unobserved discount factor. If the observed correlation is below this bound, then we must reject the joint hypothesis of integrated markets and the given value for the volatility of the stochastic discount factor.

Before proceeding, one should understand the caveats to this approach. First, as always we are testing a *joint hypothesis*. This manifests itself here as the need to specify

2. Froot and Thaler (1990) survey the evidence on Uncovered Interest Parity.

3. See Jorion (1989) for a survey of early work on international stock market integration.

the standard deviation of the unobserved discount rate process. As we will see, we can always accept the hypothesis of integrated markets if we are willing to entertain a sufficiently volatile discount rate. The advantage of this approach, therefore, is the flexibility it provides in linking the integration hypothesis to a broad spectrum of asset pricing models. We merely have to determine whether the volatility of the model-implied discount rate falls in a region that is consistent with the observed correlation of stock returns. If not, then either the discount rate model is false, or markets are segmented.

The second caveat to keep in mind is that we are actually testing a stronger hypothesis than stock market integration. In particular, we are testing whether markets are *complete,* i.e., whether individuals have access to a full menu of date- and state-contingent securities, so that everyone, regardless of country of residence, has the same marginal rate of substitution in consumption, across all points in time and across all states of nature. Clearly, this is a very strong assumption. Stock and bond markets might be perfectly integrated, yet individuals could nonetheless end up with different marginal rates of substitution if these markets do not provide adequate insurance for all the risks that individuals face. Thus, as Obstfeld (1994) stresses in his recent survey, it would be desirable to develop a framework that allows us to test the stock market integration hypothesis without at the same time making such strong assumptions about the integration of goods markets and the nature of uncertainty.[4]

The remainder of the paper is organized as follows. Section I briefly outlines the derivation of the Hansen-Jagannathan bound on the volatility of stochastic discount factors. Section II then inverts this bound to get a lower bound on the correlation between asset returns. The correlation bound turns out to be a simple function of the two assets' Sharpe ratios and the coefficient of variation of the unobserved discount factor. Section III turns to empirical evidence. In particular, I consider whether the pairwise correlations among the stock markets of the U.S., Japan, and Great Britain satisfy their lower bounds. For standard models of the discount factor, observed correlations lie well below their lower bounds. This is because these models imply *lower* bounds that exceed unity. Of course, as noted above, rather than concluding that stock markets are segmented, an equally valid interpretation of this result is to reject the posited models of the discount factor. In fact, this has been the typical finding in this literature.[5] Not surprisingly, if we instead consider discount factors with volatilities approaching the Hansen-Jagannathan bounds reported in Bekaert and Hodrick (1992), we find that observed correlations satisfy their lower bounds. Finally, Section IV contains the conclusion and offers some suggestions for future research.

I. DERIVING BOUNDS ON STOCHASTIC DISCOUNT FACTORS

This section outlines how Hansen and Jagannathan (1991) use a set of observed asset returns to derive a lower bound on the volatility of an unobserved stochastic discount factor. The discussion will be brief, and the interested reader is urged to consult Hansen and Jagannathan's paper for full details.

The starting point for the analysis is the following equation, which relates the price, $\pi(p)$, of a given future state-contingent payoff, p, to an unobserved stochastic discount factor, m:

$$\pi(p) = E(mp). \tag{1}$$

There are several ways to interpret this expression. The most general is to view m as the continuous linear pricing functional that is guaranteed to exist (by the Riesz Representation Theorem) as long as asset prices satisfy the "Law of One Price." If we also assume there are no arbitrage opportunities, then m must be nonnegative at all dates and in all states. Moreover, of particular relevance for this paper is the fact that if markets are complete, then m is unique (i.e., the same for all assets and all investors).

While viewing m as an implication of the Riesz Representation Theorem provides a powerful unifying principle for asset pricing theories, a more intuitive interpretation of eq. (1) is to use the definition of the covariance operator to write it as follows:

$$\pi(p) = E(m)E(p) + \text{cov}\,(m,p), \tag{2}$$

Equation (2) illustrates the sense in which m plays the role of a discount rate. The first term on the right hand side of eq. (2) uses $E(m)$ to discount the mean payoff, while the second term adjusts for the payoff's riskiness.

Next, it often proves convenient to normalize asset prices to unity and rewrite eq. (1) in terms of asset *returns:*

$$1 = E(mr), \tag{3}$$

4. In a related context, Tesar (1993, 1994) has stressed the need to incorporate nontraded goods into models of international capital market equilibrium.

5. Employing standard utility function specifications, Obstfeld (1993) soundly rejects the consumption-based model of the discount factor. Frankel (1994) discusses the poor performance of static CAPM models of the discount factor.

where r denotes the (gross) rate of return on an asset. Clearly, eq. (3) by itself imposes no restrictions on the data, since for a single asset we could always take $m = 1/r$. However, because the same m must satisfy eq. (3) for *all* returns, we have a set of overidentifying restrictions that can be tested if an explicit model for m is specified. This is the strategy pursued by Obstfeld (1993). However, to impose as little structure on the data as possible, Hansen and Jagannathan (1991) proceed nonparametrically and infer bounds on the moments of m from the observed moments of a set of portfolio returns.

To do this, note that since eq. (3) must hold for all assets (and, indeed, for all portfolios of assets), we can use the linearity of the expectations operator to subtract the analogous expression for the risk-free rate and get:

(4) $$0 = E(mr^e),$$

where r^e denotes an asset's excess rate of return. Finally, define the $n \times 1$ column vector of excess returns, R^e, and write the vector analogue of eq. (4):

(5) $$0 = E(mR^e),$$

where m is a scalar, and 0 is an $n \times 1$ column vector of zeros. Equation (5) provides a succinct representation of capital market equilibrium.

Now, although m is not directly observable, imagine regressing m onto a constant and the vector of excess returns, i.e., $m = \alpha + \beta' R^e$, where α is the regression intercept and β is the vector of slope coefficients. Of course, this regression will not provide a perfect fit. That is, there will be a regression error term, which by construction is uncorrelated with the fitted value from the regression. As a result, the variance of m must be at least as large as the variance of its predicted value. This variance is just equal to $\beta'\Sigma\beta$, where Σ is the variance-covariance matrix of excess returns. In other words, it must be the case that

(6) $$\sigma_m^2 \geqslant \beta'\Sigma\beta,$$

where σ_m^2 denotes the variance of m. Finally, from the algebra of least squares we know that

(7) $$\beta = \Sigma^{-1}\left[E(mR^e) - E(m)E(R^e)\right].$$

Using eq. (5), this can be simplified to:

(8) $$\beta = -\Sigma^{-1} E(m)E(R^e).$$

Finally, plugging eq. (8) into eq. (6), and then rearranging, we get:

(9) $$\left(\frac{\sigma_m}{E(m)}\right)^2 \geqslant E(R^e)'\Sigma^{-1}E(R^e).$$

Equation (9) is a version of Hansen and Jagannathan's volatility bound. It says that the (squared) coefficient of variation of the unobserved stochastic discount factor must be at least as large as the quadratic form on the right-hand side of (9). In the next section, I write out this quadratic form for the case of two stock returns, and then rearrange it to get a bound on their correlation coefficient as a function of $\sigma_m/E(m)$.

II. INVERTING THE HANSEN-JAGANNATHAN BOUND TO GET A CORRELATION BOUND

The following proposition is the major result of this section. It relates the lower bound on the correlation between two assets to the two assets' Sharpe ratios and the volatility of a stochastic discount factor.

PROPOSITION: *If markets are complete, then the correlation between any pair of excess returns must satisfy the following lower bound:*

(10) $$\rho \geqslant \frac{2s_i s_j - x_m^2}{x_m^2 - 4(s_i - s_j)^2},$$

where s_i and s_j are the observed Sharpe ratios of assets i and j, and x_m is the coefficient of variation of a unique (unobserved) stochastic discount factor.[6]

PROOF: The proof consists of two steps. First, with complete markets eq. (9) must hold (with the same unique m) for all collections of assets. By writing out the quadratic form on the right-hand side of (9) for the case of just two assets, and then simplifying, we get:

(11) $$\left(\frac{\sigma_m}{E(m)}\right)^2 \equiv x_m^2 \geqslant \frac{2s_i s_j}{1+\rho} + \frac{(s_i - s_j)^2}{(1+\rho)(1-\rho)}.$$

Since this is nonlinear in ρ, it is convenient to take an approximation in order to be able to isolate ρ. Thus, the second step involves taking a first-order Taylor series expansion of $1/(1-\rho)$ around the point $\rho = .5$. Given the strict convexity of $1/(1-\rho)$, this delivers the inequality $4\rho < 1/(1-\rho)$. Using this in (11) and rearranging gives the bound in the proposition.

Three points need to be made about this correlation bound. First, note that we could apply the quadratic formula in (11) and get a more precise bound. The only reason I take a linear approximation is to obtain a simple and easy to use expression for the bound. Calculations have shown that unless the true correlation bound is well outside the interval (0, 1) the approximation works quite well.

6. The Sharpe ratio of an asset is its mean excess return divided by its standard deviation.

Second, as noted earlier the bound contains no information that is not already contained in the volatility bound of Hansen and Jagannathan. In fact, plugging in the volatility bound implied by the two assets under consideration simply yields the actual observed correlation coefficient as the correlation bound! (Up to a second-order approximation error that is involved in deriving the bound.) Thus, the correlation bound is just an alternative expression for the Hansen-Jagannathan bound, although one that is perhaps more convenient to apply and interpret when assessing the market integration hypothesis.

The third point to note is that the bound declines as the volatility of the discount factor increases. In other words, the more volatile is the discount rate implied by a given economic model, the more likely it is that the model will be consistent with the market integration hypothesis. At first it might seem puzzling that greater volatility in the discount rate lowers the required correlation between two stock markets. After all, the discount rate is a common factor in the stochastic evolution of the two markets, and increasing the variance of a common factor should increase the degree of comovement between the two markets. This intuition is indeed correct, but it ignores the distinction between covariance and correlation. Increasing the volatility of the discount rate also increases the standard deviation of stock returns, and it turns out that this offsets the greater covariance of returns, so that in the end the correlation bound decreases with σ_m.

III. EMPIRICAL EVIDENCE

The previous section showed that the hypothesis of international stock market integration imposes restrictions on the correlations among national stock markets. Specifically, if markets are integrated, then the observed correlation between each pair of returns must exceed its lower bound given by eq. (10). If it doesn't, then we must either reject the posited value for the volatility of the discount rate, or conclude that these two markets do not share the same discount rate, and therefore are not integrated.

Clearly, the crucial input in the analysis is the presumed volatility of the unobserved discount rate. From inspection of eq. (10), we can always accept the integration hypothesis if we posit a large enough value for $\sigma_m/E(m)$. Thus, this section considers various specifications for this parameter and their associated implications for the hypothesis of international stock market integration.

Before doing this, however, we must take a look at some data, since we also need to have values for the stock market correlations and the Sharpe ratios in each market. In this paper I consider the global economy's three major stock markets: those of the U.S., Japan, and Great Britain. The data are monthly, end-of-period observations on Morgan Stanley's *Capital International* indices for the period 1980:1 through 1993:11. These indices are value-weighted and are based on a large sample of firms in each market. Cross-listed securities have been netted out. Returns are inclusive of (gross) dividend reinvestment and are expressed in U.S. dollar terms. Each return series is converted to "excess returns" by subtracting the one-month U.S. CD rate.

The three pairwise correlations between excess returns are:

(US, JP) = .246   (US, UK) = .531   (JP, UK) = .430

While the mean excess returns are (in units of percent per month):

US = .563   JP = .847   UK = .747

And the standard deviations are:

US = 4.46   JP = 7.42   UK = 6.30

Therefore, the Sharpe ratios turn out to be:

US = .126   JP = .114   UK = .119

Thus, from the perspective of the static CAPM, it appears that over this period the U.S. market offered investors the best (dollar-denominated) risk/return trade-off.[7]

Using these data, Figure 1 plots out the correlation bound for each country pair as a function of $\sigma_m/E(m)$. The dotted line in each figure represents the actual observed value for the correlation coefficient. Evidently, of the three bivariate relations, the UK-Japan pair exhibits the strongest evidence in favor of market integration. That is, the bound is satisfied with the smallest value for $\sigma_m/E(m)$. On the other hand, the US-Japan pair exhibits the strongest evidence against the integration hypothesis, since it takes the largest value of $\sigma_m/E(m)$ to satisfy its correlation bound. Still, the differences are not large. Any value of $\sigma_m/E(m)$ below .135 indicates market segmentation, while a value greater than .155 would suggest market integration.

What does economic theory tell us about the value of $\sigma_m/E(m)$? As emphasized by Hansen and Jagannathan, traditional economic models of the discount rate have a hard time producing discount rates with this much volatility. For example, the two most commonly employed discount rate models are the static CAPM, which links the discount rate to the return on a (value-weighted) world market port-

7. As noted in the introduction, this inference can be misleading since residents of different countries consume different goods. As a result, it would probably be more accurate to consider own-currency excess returns, under the supposition that investors completely hedge the exchange rate risk associated with foreign equity investments.

folio, and the consumption-based CAPM, which links the discount rate to a representative agent's intertemporal marginal rate of substitution in consumption. Constructing a value-weighted portfolio from the U.S., Japanese, and British markets produces a value for $\sigma_m/E(m)$ of just .045. Moreover, unless you introduce habit persistence or state-nonseparabilites, the consumption-CAPM produces even smaller values for $\sigma_m/E(m)$. Values for $\sigma_m/E(m)$ of this order of magnitude then produce *lower* correlation bounds well in excess of unity. By itself, this suggests that international stock markets are segmented. However, remember that an alternative interpretation of these results is to reject the posited models of the discount rate.

How are we to decide between these two inferences? While the joint nature of the integration hypothesis can never be eluded entirely, the approach in this paper facilitates the choice between the two interpretations. Clearly, it makes no sense to test the hypothesis of *international* stock market integration using a model for the (common) discount rate that produces a value for $\sigma_m/E(m)$ that is below the maximum Sharpe ratio of the considered countries. After all, two markets cannot be "integrated" if each individually violates the Hansen-Jagannathan bound.[8] In the context of this paper, this means that it only makes sense to consider discount rate models with implied volatilities (i.e., coefficients of variation) in excess of .126, which is the maximal Sharpe ratio among the markets of the U.S., Japan, and Great Britain. Testing the integration of these three markets using a model that implies a less volatile discount rate is bound to lead to ambiguous results, as it is not even consistent with *domestic* stock market efficiency.

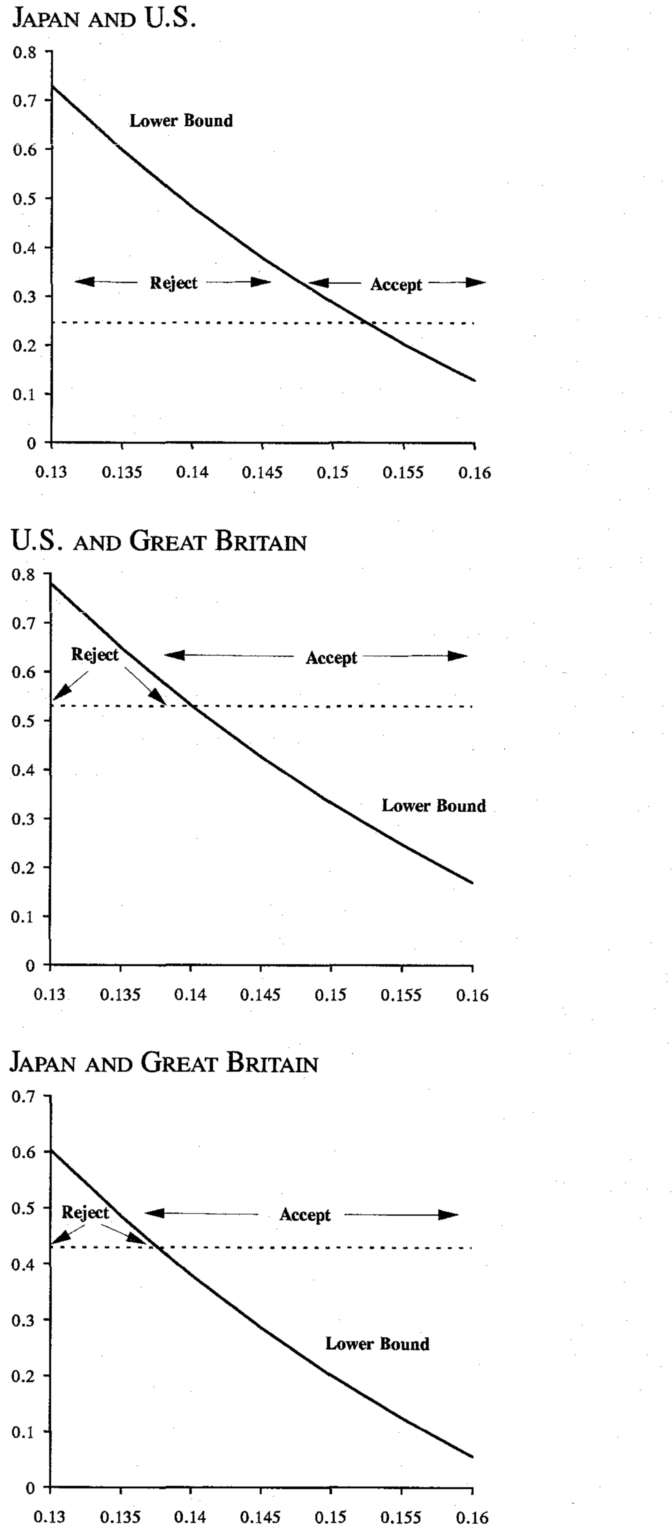
Figure 1 illustrates that it is possible to conclude that individual national stock markets are efficient, but not integrated. For example, any value of $\sigma_m/E(m)$ that lies between .13 and .15 is a viable model of the U.S. and Japanese equity markets considered in isolation, but is inconsistent with the hypothesis that these two markets are integrated. As noted earlier, however, it is quite difficult to formulate economic models with implied discount rate volatility anywhere near .13. This suggests that parametric testing of the international stock market integration hypothesis must await further advances in dynamic asset pricing theory.

Given this state of affairs, the nonparametric approach of this paper provides a valuable tool for the assessment of international stock market integration. Specifically, by

8. By the Cauchy-Schwarz inequality, adding countries to the calculation of the Hansen-Jagannathan bound must increase (or at least not decrease) the lower bound on the volatility of the discount factor.

FIGURE 1

CORRELATION BOUNDS



NOTE: The horizontal axis measures the coefficient of variation of the discount factor.

checking to see by how much the minimum integration-consistent discount rate volatility exceeds the maximal Sharpe ratio, we get a rough idea of how likely it is that two markets are integrated. This is the basis for the previous conclusion that the integration hypothesis is most strongly supported in the case of Japan and Great Britain, and least supported in the case of the U.S. and Japan.

IV. CONCLUSIONS AND EXTENSIONS

This paper has developed a simple, "back-of-the-envelope" procedure for determining whether the observed correlation between two national stock markets is consistent with the hypothesis of international stock market integration. All you have to do is get data on the countries' Sharpe ratios, and then specify a parameter that captures the volatility of the common world discount rate. The advantage of the approach is that it provides a flexible and intuitive method for mapping out the relationship between economic theory (as expressed in a discount rate model) and normative conclusions about capital market efficiency.

Perhaps not surprisingly, conclusions about market integration depend sensitively on this parameter. The more volatile is the posited discount factor, the more likely it is that observed comovements among national stock markets are consistent with the hypothesis of internationally integrated markets. As noted above, none of the standard economic models of asset pricing produce discount factors that are sufficiently volatile to be consistent with the hypothesis of integrated markets. However, I argued that at this stage it is more appropriate to reject the models than it is to reject the integration hypothesis. In addition, I argued that the nonparametric approach of this paper provides guidance on how to construct models that are minimally capable of addressing the integration hypothesis, in the sense that they are at least viable models of domestic capital market efficiency.

As a final caveat, one should keep in mind that all of the analysis here has been based on point estimates that are subject to sampling variability. Future work along these lines should attempt to incorporate standard statistical inference considerations. This would enable us to assess the statistical significance of observed differences between market correlations and their lower bounds. The recent work of Hansen, Heaton, and Luttmer (1993) should provide the necessary tools for such an extension.

REFERENCES

Bekaert, Geert, and Robert J. Hodrick. 1992. "Characterizing Predictable Components in Excess Returns on Equity and Foreign Exchange Markets." *Journal of Finance* 47, pp. 467–508.

Cumby, Robert E., and Frederic S. Mishkin. 1986. "The International Linkage of Real Interest Rates: The European-U.S. Connection." *Journal of International Money and Finance* 5, pp. 5–23.

Frankel, Jeffrey A. 1993. "Quantifying International Capital Mobility in the 1980s. In *On Exchange Rates* (Chapter 2). MIT Press.

__________. 1994. "Introduction." In *The Internationalization of Equity Markets*, ed. J. Frankel. NBER.

Froot, Kenneth A., and Richard H. Thaler. 1990. "Anomalies: Foreign Exchange." *Journal of Economic Perspectives* 4, pp. 179–192.

Glick, Reuven, and Michael Hutchison. 1990. "Financial Liberalization in the Pacific Basin: Implications for Real Interest Rate Linkages." *Journal of the Japanese and International Economies* 4, pp. 36–48.

Hansen, Lars P., John Heaton, and Erzo Luttmer. 1993. "Econometric Evaluation of Asset Pricing Models." NBER Technical Working Paper No. 145.

Hansen, Lars P., and Ravi Jagannathan. 1991. "Implications of Security Market Data for Models of Dynamic Economies." *Journal of Political Economy* 99, pp. 225–262.

Jorion, Philippe. 1989. "The Linkages between National Stock Markets." In *The Handbook of International Financial Management*, ed. R. Aliber. Dow Jones-Irwin.

Lucas, Robert E., Jr. 1982. "Interest Rates and Currency Prices in a Two-Country World." *Journal of Monetary Economics* 10, pp. 335–359.

Obstfeld, Maurice. 1993. "Are Industrial-Country Consumption Risks Globally Diversified?" NBER Working Paper No. 4308.

__________. 1994. "International Capital Mobility in the 1990s." In *Understanding Interdependence: The Macroeconomics of the Open Economy*, ed. Peter Kenen. Princeton Univ. Press.

Popper, Helen. 1993. "Long-Term Covered Interest Parity: Evidence from Currency Swaps." *Journal of International Money and Finance* 12, pp. 439–448.

Tesar, Linda L. 1993. "International Risk-Sharing and Nontraded Goods." *Journal of International Economics* 35, pp. 69–89.

__________. 1994. "Evaluating the Gains from International Risk-Sharing." Unpublished manuscript.