Characterizing world market integration through time

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Abstract

International asset pricing models suggest that barriers to portfolio flows and availability of market substitutes affect the degree and time variation of world market integration. We construct diversification portfolios for eight emerging markets over the period 1976-2000, use GARCH-M methodology to estimate the Errunza-Losq model and empirically assess the time variation in market integration. Our results suggest that although local risk is the most relevant factor in explaining time-variation of emerging market returns, global risk is also conditionally priced for some countries. Further, there are substantial cross-market differences in the degree of integration. We find evidence of a significant increase in the degree of integration during the last decade. Our results strongly suggest the impropriety of using correlations of marketwide index returns as a measure of market integration. Finally, financial market development, macroeconomic development and financial liberalization policies play important roles in integrating emerging markets.

CHARACTERIZING WORLD MARKET INTEGRATION THROUGH TIME

INTRODUCTION

Beginning in the 1970s, the reform and development of local securities markets became an integral part of development strategy in a host of emerging markets (EMs). Over the last two decades, foreign investment barriers were lowered, country funds (CFs) were floated and firms were cross-listed on mature markets in an effort to mobilize foreign equity flows and increase globalization of local markets. One of the most important consequences of globalization is the impact on cost of capital. Further, the increased opportunity set, active foreign participation as well as higher savings and growth made possible by international risk-sharing should lead to significant welfare gains.[1] Indeed, the globalization of EMs has implications beyond the traditional issues in corporate finance and investments and deserves further study.

Although a number of papers have investigated the structure of global markets, the emphasis has been on major markets. Most past investigations of the structure of global capital markets are based on joint tests of the hypothesis that equity markets are fully integrated, the underlying asset pricing model holds and markets are efficient. Representative examples include tests of IAPMs (see Solnik (1974), Jorion and Schwartz (1986), Harvey (1991), Dumas and Solnik (1995)), international arbitrage pricing theory (see, Cho, Eun and Senbet (1986)), consumption based IAPM (see Wheatley (1988)), multibeta models (see Ferson and Harvey (1993, 1994)) and latent factor models (see Campbell and Hamao (1992) and Bekaert and Hodrick (1992)). Aside from the numerous single country studies, explicit tests based on segmented capital markets include Stehle (1977) and Errunza and Losq (1985). Thus, most past studies investigated the polar cases of full integration and/or complete segmentation although it is well recognized that markets do not conform to either polar case but

[1] For a detailed discussion of the various issues, see for example, Errunza (2000) and references therein.

fall somewhere in between. In an attempt to shed further light on this issue, Errunza, Losq and Padmanabhan (1992) investigated the two polar cases as well as the intermediate case of mild segmentation for a group of securities from eight emerging markets (EMs). Although their results are intuitively appealing and conform to our a priori expectations that emerging markets should plot somewhere in the continuum of full integration and complete segmentation, the tests were not designed to capture the apparently changing degree of market integration through time. In a more recent paper, Bekaert and Harvey (1995, henceforth B-H) develop an innovative econometric methodology to combine the two polar specifications of full integration and complete segmentation and assess the time-varying probability that markets conform to one of the two regimes.[2] Thus, the B-H specification investigates the impact of barriers to free flow of portfolio capital within a one-factor model framework. We have also witnessed major events in EMs that might impact their pricing since the end of the B-H study period in 1993. Indeed, during the last five years, foreigner investors access to equity markets has been further liberalized.

Hence, we assess time-varying market integration for eight emerging markets over the period 1976-2000. We focus on the impact of substitute assets since theoretical models indicate that the substitute assets allow investors to duplicate returns on unavailable EM assets through homemade diversification, thereby effectively integrating EMs even though explicit barriers to portfolio flows may be in place. We use GARCH-M methodology to estimate the Errunza and Losq model (1985, henceforth E-L) and empirically measure the time variation in market integration. To the best of

[2]In a similar approach, Cumby and Khanthavit (1998) study a regime switching model for Korea, Taiwan and Thailand. Although they allow for different means and variances in each regime, time variation in the sense of B-H is not allowed. Very recently, Hardouvelis, Malliaropulos and Priestley (2001) study European market integration using a methodology similar to B-H. They use converging forward interest differentials as integration proxy and conclude that European markets have increasingly become integrated.

our knowledge, this is one of the first papers to test time-varying market integration based on a theoretical IAPM. Specifically, we construct an "Integration Index" based on the two factor E-L asset pricing model, which is a special case of the more general IAPM of Stulz (1981) derived under barriers to free flow of capital. The "Integration Index" exploits the model prediction that if markets are fully integrated, only the global systematic risk is priced whereas under complete segmentation, only the conditional market risk is priced. It also characterizes the intermediate cases where both types of risks are priced. Our methodology allows us to estimate not only the degree and variation through time of market integration but also the relative contributions of the time-varying world and local risk premia. In addition, we provide the first clear empirical evidence in support of the theoretical literature that suggests the impropriety of using marketwide correlation coefficients as a measure of integration.

Our results can be summarized as follows. Although local risk is the most relevant factor in explaining the time-variation of EM returns consistently across all countries in our sample, global risk is also conditionally priced for some markets. While none of the countries appear to be completely segmented, there are wide ranges in the degree of integration. We show that Mexico is the most integrated of the countries with Argentina being the most segmented. The evolution toward more integrated financial market is rather interesting. The plots of the estimated indices uncover cross-market differences in the dynamics of market integration as indication of different timing of the liberalization policies by individual governments. For most of the countries, significant increases toward higher integration took place around the beginning of the Nineties, while a few countries show evidence of change only in the last five years of our sample. Our results also demonstrate the impropriety of inferring integration from correlations between broad market indices. Finally, we provide initial evidence that links financial market develpment, macroeconomic development and financial liberalization policies to financial market integration.

The paper is organized as follows. Section I describes the asset pricing model and formalizes the integration index. Section II presents the test methodology. Section III contains data and summary statistics. In section IV, we report and discuss results. Conclusion follows.

I - THE MODEL

Time varying capital market integration should be characterized on the basis of a theoretical model that satisfies the following properties:

1. It should be rich enough to accommodate the continuously evolving world market structure from completely segmented to fully integrated markets as well as the increasing availability of substitute assets.

2. It should capture the impact of differential cross-border risk preferences, and costs/barriers to free flow of capital that are widely accepted as major contributors to a less than a fully integrated global capital market.

3. It should be consistent with the stylized fact that investors do not hold world market portfolio but a disproportionately larger share of their home assets.

Among the well known IAPMs, the Errunza-Losq (1985) model is well suited to test the integration-segmentation hypothesis.[3] Formally, the E-L model states that,

$$E(R_i) = R_f + AMCov\left(R_i, R_W\right) + \left(A_u - A\right) M_I Cov\left(R_i, R_I \left| \underline{R_e}\right.\right) \tag{1}$$

where $E(R_i)$ is the expected return on the ith security that belongs to Ith market that is accessible only to its nationals, R_f is the risk free rate, $A(A_u)$ is the aggregate

[3]Other IAPMs under barriers to portfolio flows include Stulz (1981), Eun and Janakiramanan (1986), Errunza and Losq (1989), Padmanabhan (1992), Stulz and Wasserfallen (1995), Sellin and Werner (1993), Uppal (1993), Bailey and Jagtiani (1994) and Basak (1995).

risk aversion coefficient for all (Ith) market investors, $R_w(R_I)$ is the return on the World (Ith) market portfolio, $M(M_I)$ is the market value of the global (Ith) market portfolio, and $\underline{R_e}$ is the vector of returns on all securities that can be bought by all investors irrespective of their nationality. Thus, the expected return on the ith security commands a global risk premium and a super risk premium which is proportional to the conditional market risk. Securities that can be bought without restriction by any investor will be priced as if the markets were completely integrated i.e., they will not command a super risk premium. Note that Equation 1 can also be expressed in terms of the ineligible security market index by aggregating over the ineligible set of securities yielding the following expression:

$$E\left(R_I - R_f\right) = AMCov\left(R_I, R_W\right) + \left(A_u - A\right) M_I Var\left(R_I \left| \underline{R_e}\right.\right) \tag{2}$$

The E-L model explicitly assumes barriers to portfolio flows that capture the restrictions imposed by emerging markets (EMs). Barriers have taken many forms including capital controls, restrictions/taxes on repatriation, limits on ownership, market regulation, investor protection, information etc. Although most EM governments restrict portfolio capital outflows, they do not appear to be binding when one considers the participation of large (privileged) EM investors in global markets. There are also restrictions on the amount of foreign ownership in many EMs resulting in significant barriers to portfolio capital inflows. Data regarding availability and quality of market and company information, quality of accounting standards and the extent of investor protection are also difficult to quantify. Thus, although it is impossible to construct a composite measure of the different types of barriers in place in a given market at a point in time, taken together with portfolio flows into EMs, we can be confident that significant barriers were in place until the early 1990s.[4] Of course, the mere

[4]For example, at the end of 1993, some EMs (e.g., Mexico) were freely accessible, some were partially restricted (e.g., India) and others for all practical purposes were closed (e.g., Nigeria).

existence of barriers does not necessarily imply market segmentation just as their removal does not necessarily result in increased market integration. The degree of integration depends critically on the other factor suggested by the IAPM, namely, the availability of substitute assets. Given the emphasis on investment restrictions in the B-H paper, we focus on the impact of substitute assets on the time-varying capital market integration.

To summarize, the model reduces to the two polar cases of full integration/complete segmentation and represents the intermediate cases depending on the barriers to investments, and the availability of substitute assets that may offer same diversification opportunities as the world market including the EMs. Indeed, the model is simple, yet powerful to provide empirical content to time variation in the structure of the global capital market.

The E-L Integration Index

Whereas the conditional market risk can be interpreted as a measure of substitutability between a specific (ineligible) security and the eligible segment of the world market, an aggregate measure of substitution, Integration Index (II) can also be developed. Indeed, consider the following ratio:

$$\Pi = 1 - \frac{Var\left[R_I|\underline{R_e}\right]}{Var\left[R_I\right]} \tag{3}$$

By definition, this index lies within the range (0,1). For the sake of illustration, we analyze in turn the following two polar cases:

Complete Integration: $\Pi = 1$(i.e. $Var\left[R_I | \underline{R_e}\right] = 0$)

In such a case, there must exist an eligible security (or a combination of such) whose return is perfectly correlated with the return on the market portfolio of ineligible securities. Equation (2) makes it clear that in such a case no super-premium would exist and the two segments of the market would be effectively integrated. The security market lines for all the countries would be identical and the only relevant measure of risk would be the beta coefficient defined relatively to the world market portfolio. In particular, the required return on the market portfolio of ineligible securities would be determined exclusively by the world-wide risk-aversion coefficient and the systematic risk of the ineligible securities:

$$E\left[R_I\right] = R_f + AMCov\left[R_I, R_W\right] \tag{4}$$

Complete Segmentation: $\Pi = 0$(i.e. $Var\left[R_I | \underline{R_e}\right] = Var\left[R_I\right]$)

For the unconditional and conditional variances to be equal, there must not be any correlation between the return on the market portfolio of ineligible securities and the return on any eligible security/portfolio:

$$Cov\left[R_I, \underline{R_e}\right] = 0, \;\; e = 1, \ldots, E. \tag{5}$$

Thus,

$$E\left[R_I\right] = R_f + A_u M_I Var\left[R_I\right] \tag{6}$$

In such a case, the expected return on the portfolio of ineligible securities would be determined only by the variance of the returns and not by the covariance with the return on the world market portfolio. In other words, the presence of the restricted investors and of the eligible securities in the market would have no effect on the aggregate market value of all the ineligible securities: complete segmentation would prevail. At the analytical level, we can thus look upon the Integration Index as a means of assessing the degree to which a market is integrated.

II - METHODOLOGY

II-A. The diversification portfolios

The Diversification Portfolio (DP) is defined as the portfolio of eligible securities that is most highly correlated with the market portfolio of ineligible securities. Specifically, E-L show that

$$Var\left[R_I|\underline{R_e}\right] = Var\left(R_I\right)\left(1-\rho_{I,e}^2\right) \tag{7}$$

where $\rho_{I,e}$ denotes the correlation coefficient between R_I and the (homemade) diversification portfolio. Note that as $\rho_{I,e} \rightarrow 1$, the (homemade) diversification portfolio becomes perfectly correlated with the foreign market portfolio. We sequentially include the Morgan Stanley Capital International (MSCI) World index, MSCI global industry portfolios, multinational firms and closed-end CFs (the eligible set) to generate composite assets that are most highly correlated with the return on the market portfolios of our sample EMs (the ineligible set).[5] We construct the diversification portfolios using the same methodology as Errunza Hogan and Hung (1999).

In the first step, we regress the return of the market, $R_{I,t}$, on the returns of 38 MSCI industry portfolios, a sample of 24 large MNCs along with MSCI World index. We use the same stepwise regression procedures and the forward and backward threshold

[5] Note that the number of observations for American depository receipts (ADRs) are relatively few given their recent origin. Also, the introduction of Country funds have preceded that of the ADRs. Hence, the integrating impact of the first country fund is likely much greater than the ADRs or the subsequent issues of other country funds. Thus, we include only the first country fund from each of our sample country in the eligible set. See Errunza Hogan and Hung (1999) for further details.

criteria as in Errunza Hogan and Hung (1999) to obtain a diversification portfolio, R_D.[6]

Next, the portfolio weights of an augmented diversification portfolio are estimated by regressing the I^{th} market return on the return of the previous diversification portfolio (R_D) and the return on the CF (R_c) from the corresponding I^{th} market,

$$R_{I,t} = \varphi_1 R_{D,t} + \varphi_2 R_{c,t} + \mu_t \tag{8}$$

to obtain what we call the diversification portfolio, R_{DIV}.[7]

II-B. Estimating the E-L model

From the E-L model, the following system of equations has to hold at any point in time,

$$\begin{aligned} E_t[r_{It}] &= \delta_{W,t-1} cov_t[r_{It}, r_{Wt}] + \lambda_{I,t-1} var_t[r_{It}|r_{DIV,t}] \\ E_t[r_{DIV,t}] &= \delta_{W,t-1} cov_t[r_{DIV,t}, r_{Wt}] \\ E_t[r_{Wt}] &= \delta_{W,t-1} var_t[r_{Wt}] \end{aligned} \tag{9}$$

where r_{It} is the excess return on the country's market index, $r_{DIV,t}$ is the excess return on that country's diversification portfolio, r_{Wt} is the excess return on the world index. Note that the first equation in the system is just the pricing equation for the emerging market index as derived in section I, where two factors are priced, the world market covariance risk and the super risk premium. This second risk factor depends on the availability of assets for home made diversification and can be rewritten as $var\left[r_I|\underline{r_e}\right] = var\left(r_I\right)\left(1-\rho_{I,e}^2\right)$. The second equation in the system prices the diversification portfolio with just the covariance risk with the world and the last equation is the pricing equation for the world index portfolio.

[6] For a full discussion of methodology, see Errunza, Hogan and Hung (1999)

[7] The average correlation between the diversification portfolio for each country R_D and its country fund R_c is 0.44. This low correlation should not cause any bias in the estimated coefficients.

Therefore, we write the previous system for estimation as,

$$\begin{aligned} r_{It} &= \delta_{W,t-1} h_{I,W,t} + \lambda_{I,t-1} h_{I,0} (1 - \frac{h^2_{I,DIV,t}}{h_{It} h_{DIV_t}}) + \epsilon_{I,t} \\ r_{DIV,t} &= \delta_{W,t-1} h_{DIV,W_t} + \epsilon_{DIV,t} \\ r_{Wt} &= \delta_{W,t-1} h_{W,t} + \epsilon_{W,t} \end{aligned} \tag{10}$$

where $\delta_{W,t-1}$ and $\lambda_{I,t-1}$are time-varying prices of global risk and local risk, respectively, $h_{j,t}$ are the elements of H_t, the 3×3 conditional covariance matrix of the assets in the system. In particular, $var_t[r_{It}|r_{DIV,t}]$ is parameterized as $var_t(r_{It})(1-\rho^2) = h_{I0}(1 - \frac{h^2_{I,DIV,t}}{h_{It} h_{DIV_t}})$ with $h_{I,DIV,t}$, the time-varying covariance, h_{It} and h_{DIV_t}, the time-varying variances and h_{I0}, the unconditional variance obtained from the residuals.[8]

Since there is large amount of evidence that prices of risk are time varying (see Harvey (1991), Bekaert and Harvey (1995), De Santis and Gerard (1997, 1998)), we specify the price of global and local risk as a function of a set of information variables. Specifically, we let

$$\delta_{W,t-1} = \exp(k'_W Z_{W,t-1}) \tag{11}$$

be a non linear function of a set of global information variables, and

$$\lambda_{i,t-1} = \exp(k'_i Z_{i,t-1}), \qquad i = 1, ..., I \tag{12}$$

also a non linear function of a set of local information variables. The exponential specification will ensures that the prices will always be positive, as implied by the theoretical model.

[8]Although the unconditional variance h_{I0} is unknown, it can be evaluated recursively from our system. In the first iteration h_{I0} is approximated from the variance of the returns and then updated at each iteration with the unconditional variance of the estimated residuals from the previous iteration.

Following De Santis and Gerard (1997, 1998), we specify the dynamics of H_t as:

$$H_t = H_0 * (\iota\iota' - \mathbf{aa}' - \mathbf{bb}') + \mathbf{aa}' * \epsilon_{t-1}\epsilon_{t-1}^{'} + \mathbf{bb}' * H_{t-1} \tag{13}$$

where $\mathbf{a}$ and $\mathbf{b}$ are $s \times 1$ vectors of constant coefficients, H_0 is the unconditional variance-covariance matrix of the residuals and * is the Hadamard matrix product (element by element).[9]

Equations (10) and (13) give the model for estimation.[10] Assuming a normal conditional density, the log likelihood function is written as,

$$\ln L(\theta) = -\frac{Ti}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{T}\left[\ln\left|H_{t(\theta)}\right| + \epsilon_t(\theta)' H_t(\theta)^{-1}\epsilon_t(\theta)\right] \tag{14}$$

where θ is the vector of unknown parameters in the model. The estimation is performed using the BHHH (Bernt, Hall, Hall and Hausman, (1974)) algorithm. Under regularity conditions, the quasi-maximum likelihood estimator of θ is generally consistent and asymptotically normal for GARCH models, as shown in Bollerslev and Wooldridge (1992). To avoid incorrect inference due to the mispecification of the conditional density of asset returns, quasi-maximum likelihood estimates for the standard errors are used to guarantee robustness of the results(see White (1982), Bollerslev and Wooldridge (1992)). The advantage of this fully parameterized approach is in obtaining estimates of the conditional second moments and of the time-varying risk premia. This is a crucial feature which will allow us to construct a measure of time-varying integration.

We estimate I separate trivariate systems, one for each emerging market in our

[9]This specification for the conditional variance-covariance matrix has been successfully applied to emerging markets in De Santis and Imrohoroglu (1997). Bekaert and Harvey (1997) explore asymmetry in the volatility process for a number of EMs.

[10]For a detailed illustration of the methodology, its advantages and potential drawbacks, please refer to the original papers by De Santis and Gerard (1997, 1998).

sample. This implies that we will have I estimates for the price of world risk, even though the theory predicts that the price of world risk should be the same for all countries. However, this would entail estimating a very large system which is beyond our capabilities. To get around these constraints, Bekaert and Harvey (1995) estimate a price of world risk in the first stage and then impose such price in their country-by-country estimations. As they point out, this procedure has the drawback of including sampling errors from the first stage estimates. We simultaneously estimate the price of world risk within each country estimation since, our trivariate system includes an asset that was estimated in a previous stage.[11] We do not correct for the sampling errors but we will be conservative in drawing our conclusions.

III - DATA AND SUMMARY STATISTICS

We use the MSCI World index, 38 MSCI global industry portfolios, a sample of 24 multinational firms and CFs listed on U.S. markets as the eligible set. The sample of multinational firms was selected based on the 50 largest U.S. multinationals in 1976, ranked by sales, as reported by Fortune Magazine.[12] All U.S. based return data is from the CRSP data set. Stocks which were no longer listed as of December 31, 2000, or for which data were missing from the CRSP data files during the sample period were deleted from the eligible set. This left us with a sample of 24 MNCs. A complete list of the set of eligible securities is reported in Table I.

Among the set of all emerging markets, we select those ones that fit two criteria. First, we need a relatively long sample to facilitate estimation and provide reliable statistical inference. Then, among those countries that fit the first selection crite-

[11] The fact that we will obtain multiple estimates for the price of global risk is not of great concern since it turns out that such estimates are very much consistent across the different sets. We do not report them but they are available on request.

[12] See Fortune, May 1977 p. 366-7.

ria, we consider those countries with a country fund traded on the US markets. This leaves us with eight emerging markets, Argentina, Brazil, Chile, India, Korea, Mexico, Taiwan and Thailand.[13] The indices are obtained from International Finance Corporation (IFC), they are market value weighted and expressed in U.S. dollar terms. We compute total returns over the period from January 1976 to December 2000.[14] As risk-free rate we use the one-month Eurodollar rate from Datastream.

Table II panel A reports descriptive statistics. The relative behavior of emerging market returns is similar to that reported in past literature. Briefly, EM returns on average are large and display high volatility. The data shows high level of skewness (except for Thailand) and kurtosis and normality is rejected by a Bera-Jarque test in all instances. The returns are more autocorrelated than developed markets' returns, as indicated by the $Q(z)_{12}$ statistics, and in most instances they show high autocorrelation also in the squared series.

Panel B of table II contains pairwise correlations between each country index and diversification portfolio with the world index, and correlation between each country index with the respective diversification portfolio. As expected, for the country indices, correlations with the world index are very low while those with the diversification portfolios are remarkably higher.

In our estimations, we use two sets of information variables used widely in previous research. The global information variables are: a constant, the term structure spread, the default spread and the world dividend yield in excess of the risk free rate. The set of local information variables includes a constant, the change in the local exchange

[13] The other emerging market that fits these criteria is Malaysia. Although this country was part of our original data set, we do not report the results since we could not provide reliable statistical inference on the country index.

[14] Although returns for these emerging markets are available from January1976, we estimate our model with January 1977 as starting period since we loose one year of observations to contruct the dividend yield information variable.

rate, the local dividend yield and the local equity return in excess of the risk free rate. All the information variables are lagged.

IV-RESULTS

IV-A. Tests for the asset pricing model

As discussed in section I, the E-L model explains asset returns as a function of two premia, a global risk premium and a super risk premium which is proportional to the conditional local risk. The first issue of interest is the ability of the model to price the relevant factors. If markets were completely integrated, only global risk would be relevant while some form of segmentation would imply relevance of country-specific risk. Panel A of table III contains the results of our country-by-country estimation of the trivariate system in (10). For each country we report two robust Wald tests, one for time-variation in the global price of risk and the other for time-variation in the local price of risk. The table uncovers some interesting findings. In line with our beliefs on emerging markets, local risk is consistently the relevant source of risk across all assets in our sample. The hypothesis that the local price of risk is constant is rejected in five cases and marginally rejected in three cases which allows us to conclude that there is significant time-variation in returns that can be explained by local risk.[15] Our conclusion on local risk is in sharp contrast with the findings in De Santis and Imrohoroglu (1997) who could not detect the significance of constant country-specific risk for most of the countries included in our sample. An explanation for our result is that in their model, the constant prices of local risk might not have enough power to explain the exceptional volatility that we observe in EM returns.[16]

[15] In the case of Argentina, the reported diagnostic tests indicate that the results should be interpreted with caution.

[16] Even though it conforms with our expectations, it is worth mentioning that De Santis and Gerard (1997) could not detect the relevance of constant prices of local risk in developed markets.

The more interesting result is documented for global pricing. For three countries we find that global risk is also conditionally priced, while for two countries it exhibits marginal significance.[17] It is surprising to find that Mexico, the largest emerging market in terms of capitalization, shows only the local risk as the most relevant factor. This could be an indication that the global price of risk cannot sufficiently explain the time-variation in returns in some of the countries in our dataset.[18]

To gain further insight on this matter, we estimate a multivariate GARCH-M model that excludes local risk and prices returns only with a world risk factor. We use five of the emerging markets included in our dataset[19] and the same set of global information variables used in our previous tests. This procedure allows us to perform a more powerful test on the significance of the price of global risk. The null hypothesis of a constant global price of risk this time is rejected with a p-value of 0.045. The average of the estimate of the time-varying price of risk is 2.65, which is in line with what has been previously reported in the literature for developed markets. This evidence is again in contrast with that reported in De Santis and Imrohoroglu (1997) who find that a constant global price of risk is also not significant for a partially different group of emerging markets. Therefore the evidence which was previously obtained on our country-by-country estimation is also confirmed in this multicountry setting.

Figure I, panels A through H, contains plot of the estimated premia. While it is evident that local premia very often represent the most important component of total premia for the assets, global premia can become economically, if not statistically, sig-

[17] The results are stonger relative to an earlier version of the paper and are driven by the addition of 20% more recent observations to our dataset. Their robustness has been confirmed through a boostrapping exercise.

[18] An alternate explanation for the rejection is a possible mispecification of the volatility process. We thank Campbell Harvey for pointing this out to us.

[19] The countries included in the test are Brazil, Chile, Korea, Mexico and Thailand. The estimation could not converge with the full data set.

nificant over subperiods.[20] It is interesting to note that the dynamics of global premia is quite similar across all assets, with larger premia around the 1982-1983 period and the 1991-1993 period, a possible reflection of a US driven world wide recession. On the other hand, as expected, the dynamics of local premia are quite different as they tend to reflect domestic events, such as the hyperinflation in Argentina, the Asian crisis in Korea and Thailand, and market liberalizations in general.

All the estimated models provide strong evidence that the asset returns follow a GARCH process. All the GARCH estimates are highly significant and they indicate higher persistence for country indices than for the world index. However, the stationarity conditions are met in all cases.[21] Panel B reports some diagnostics tests on the estimated residuals. The non-normality in the data is reduced in all cases except for Argentina where there is evidence that the proposed specification is unable to accomodate the raw data.[22] Most indices of kurtosis and the Bera Jarque statistics are improved relative to the raw returns and there is no more serial correlation in the squared standardized residuals. However, the performed estimation cannot eliminate all the non-normality and autocorrelation observed in the data. We also add a specification test for asymmetry. The Engle-Ng tests show evidence of significant negative asymmetry only for one country. We therefore conclude that we cannot find consistent evidence of asymmetry in the relation between conditional second moments and innovations.

[20] Since local premia can at times be substantially larger than global premia, we equally trim the plots to facilitate comparison.

[21] We do not report individual estimates, but they are available from the authors.

[22] By inspection of the estimated residuals, it is evident that their behavior is driven by the clustering of very large negative values in the period of hyper-inflation at the end of the Eighties, where the model is unable to fit the exceptional volatility in returns.

IV-B. Time-varying integration

The main advantage of the fully parameterized methodology adopted for estimation is the ability to provide all the relevant estimates of the conditional second moments. This allow us to construct an estimate of the integration index and gain insights on the degree of market integration and its variation through time. Table IV contains information regarding the integration indices estimated from the previous model. As shown in section I, the E-L index should be one under complete integration and zero under complete segmentation. Panel A reports statistics on the estimated indices. The overall means indicate different levels in the degree of integration, ranging from 0.5 for Mexico, the most integrated among the countries, to 0.159 for Argentina, the most segmented.[23] In all cases, the subperiod averages for the indices suggest an increase in the degree of integration during the last decade. To support the claim that the change in the indices has been significant, we compute a simple test for a structural break in the series. We test the null hypothesis that a structural break happened after January 1990 by regressing the time-series of our estimated indices on a dummy variable and a trend. Although the choice of the break can be viewed as arbitrary, it is commonly observed that most countries had liberalized by the begining of the Nineties. Due to the high serial correlation in the series, we compute Newey-West standard errors for our test. Panel B contains results of the country by country analysis. The change in the average integration index is positive and statistically significant in 5 out of the 8 countries, and marginally significant for one. The largest change is recorded for India, followed by Brazil and Chile. One country, Taiwan, shows a significant but negative break, while Argentina shows no significant change. As a joint test of increased integration across all countries, we pool the time-series

[23] Even though the diagnostic tests seem to reject the model for Argentina, the integration index is based on estimated second moments, which are very significant and remarkably robust across specifications.

cross-sections and estimate a panel data regression across all countries. The reported coefficient on panel C is for the estimation without fixed effects, but the results are qualitatively similar for the fixed effects case. The average change across the countries is 0.178 and is significant at any statistical level.

To assess the evolution of market integration through time, we plot E-L integration indices in figure II, panels A through H. These plots provide valuable insights into the trending behavior in market integration across EMs. The figures illustrate important cross-market differences in the evolution of market integration for our sample countries that appear to reflect the adoption and the timing of wide ranging policies by individual governments. Overall, our finding that the degree of integration has increased over time conforms to our apriori expectations based on reduction in barriers to portfolio flows, general liberalization of capital markets, increased availability of ADRs and country funds, increased portfolio flows, better information and investor awareness. The importance of this result is in terms of our ability to assess the degree of integration that conforms to our expectations as well as in its consistency. Although it is difficult to compare our results with past studies that use different methodologies and datasets, it is important to note that for our sample markets the degree of integration is higher in the 1990s. What follows is a brief discussion of the behavior of our sample markets and comparison of our results with those of past researchers.

The essentially segmented nature of the Argentinian market prior to the 1990s is not surprising given the rather recent liberalization of the market. Nonetheless, the removal of restrictions on repatriation (holding period) and high taxes in October 1991 and the introduction of Argentina fund on NYSE in November 1991 seem to have led to an increase in the degree of integration with the index averaging 0.235 during the 1990s.

In the case of Brazil, the results suggest a mildly segmented market during the first part of our sample period. This is followed by increasing level of integration beginning around the introduction of the Brazil Fund. The average level of integration at 0.613 in the 1990s suggests this market as one of the most integrated during the recent period amongst our sample countries.[24]

The Chilean market is essentially segmented until about 1990 reflecting high taxes and the holding period requirements on foreign investors. However, this is followed by an uptrend in the integration index around the introduction of the country fund and reduction in other barriers, attaining a very high level of 0.75 towards the end of our sample period. Note that the average value for the integration index of 0.294 for the whole sample period, and 0.520 during the 1990s is in sharpe contrast to that reported by B-H of 0.59 for the whole period and 0.26 at the beginning of the1990s.

The Indian market was essentially segmented during the first half of the sample period with a downward trend until around 1988 corresponding to the introduction of the India growth fund on NYSE. This is in sharpe contrast to the results of B-H who suggest that India was fully integrated until the end of 1984, a result difficult to explain given significant barriers to flow of cross-border real and financial flows as well as lack of Indian ADRs or country funds on the World markets. However, our results are consistent with B-H who report low degree of integration after 1984 and some recent (early 1990s) evidence of a movement towards higher levels of integration. Our average integration index of 0.304 for the whole sample period and 0.434 during the 1990s is consistent with the introduction of a number of ADRs, country funds and the gradual liberalization of foreign portfolio flows that began in 1992.

The Korean market is neither completely segmented nor very integrated i.e. it is mildly segmented throughout our sample period remaining in the low range of 0.2-0.4 until mid 1980s and reaching a high of 0.75 in the recent years. This result

[24] Note that the past studies (most notably B-H), did not include Argentina and Brazil in their investigation.

is consistent with the stringent controls on foreign portfolio investments that have been gradually liberalized and increasing availability of a large number of country funds, ADRs and convertible bonds of Korean firms on mature markets. Although these result are somewhat different from B-H who suggest Korea to be fully integrated throughout the sample period, our results are consistent with Bae (1993) who suggests that this market has become more integrated in recent years. Indeed, the estimate of the index points to an economically significant movement only in the last five years of our sample.

The integration index for Mexico suggests this market as the most integrated of our sample countries with an average index level of 0.505, a relatively high level of 0.699 during the 1990s and peaks of over 0.85 in recent years. The market was mildly segmented until about 1986, followed by a peak around October 1987 reflecting a major correction of the Mexican market during the market crash. Since then, the integration index has trended up in response to further liberalization including the removal of all restrictions on foreign direct purchases of non bank stocks in May 1989. These results are intuitive given the degree of U.S. investor participation in Mexican stocks. However, our results are in sharpe contrast to those of B-H who are surprised by their finding that suggest this market to be segmented during most of their sample period.[25]

The Taiwan market appears to be neither segmented nor integrated, i.e. it is mildly segmented throughout our sample period with the integration index in the range of about 0.2-0.5. Although this is one of the largest and most liquid of the EMs with a number of country funds listed on mature markets, historically it has

[25] As our previous eveidence has shown, in the case of Mexico only local risk is priced and the plots of the estimated premia also indicate that the size of local premia is remarkably higher than that of global premia for most part of the Eighties. This could explain the B-H findings that the return dynamics for Mexico conform to a segmented regime.

imposed significant barriers including investment restrictions and repatriation limits. Even though our results are different from B-H who report full integration, caution is in order. This is because, although our sample period is much longer than B-H, it is still relatively short with the CF introduction happenning at the very beginning of the available sample period. Hence, there might not be enough data points for our methodology to characterize the change from a segmented to a more integrated market.

The Thai market appears segmented until about 1986. The index shows a dramatic increase in integration in 1987-88 preceding the introduction of the Thai fund and the opening of the Alien board on the Bangkok exchange. After that the index trends upwards in response to further liberalization. Overall, the market is one of the most integrated in our sample with an average index level of 0.44, an average level of 0.611 in the 1990s with a peak value of 0.75. These results are consistent with those reported by B-H and Cumby and Khanthavit (1998).

IV-C. Marketwide Correlations As Integration Measure

Panel B of table II summarizes the unconditional correlations of each emerging market in our sample with the world market index and their corresponding diversification portfolio. It is not surprising that the correlation of each emerging market is substantially higher with their diversification portfolio than with the world index, given that we constructed the diversification portfolio as the most correlated portfolio, and country funds, that should provide investors with a superior ability to duplicate EM returns even under high cross-border barriers, are either not included or contribute marginally to the national and global market returns. In panel A of table V we report the overall mean and the subsample mean for the time-varying correlations between the world and each EM country obtained from the estimated model. In figure II we plot the indices along with the correlation with the world.[26] It is apparent that the popular literature that has tended to equate correlations of marketwide index returns with the degree of market integration has and would underestimate the actual degree of integration given the ability of investors to achieve homemade diversification. In most cases, the conditional correlations have not changed substantially in the Nineties, in spite of increasing opportunities for international investors to access emerging markets. We formally support this claim by running a test similar to the one performed on the integration indices. Also in this case, the regressions are performed on a trend and on a dummy variable for the post 1990 period and we base our inference on the Newey-West standard errors. The differences between panel B and C of table V with the corresponing tests of table IV are striking. We observe no consistent pattern for changes in world correlations. Most countries show a negative change which is not significant most of the times, except in the case of Chile. The only significant increase is recorded for Mexico. The joint test in panel C confirms that no clear evidence of a structural break can be found in the marketwide correlations. Thus if we had to use these correlations to infer integration we would wrongly conclude that there has been no significant change in the last decade. In summary, these results strongly suggest the impropriety of using correlations of marketwide index returns as a measure of market integration.

IV-D. Robustness

To ensure that the results are not simply linked to the estimation methodology previously used, we test our model for a developed market. A perfect candidate for this exercise is represented by Canada, a small mature market that we suspect to have been well-integrated over the sample period. We first estimate the diversification

[26] Notice the similarity of our results for Mexico and Thailand with Figures 2 and 3 in Bekaert and Harvey (1997).

portfolio and then the asset pricing model in equations (10) and (13).[27] The results are very interesting. The p-value on the time-variation for global risk is 0.026 while the p-value for local risk is 0.64, indicating that local risk is not important in explaining developed market returns. De Santis and Gerard (1997) also find only the global price to be significant for a range of developed countries, including Canada. However, in that paper, local risk is priced as constant, so the rejection of its significance could be attributed to the failure of modeling it as time-varying. On the other hand, we reach the same conclusion by modelling both global and local risk prices as time-varying. Figure III, panel A, contains plot of the estimated premia. By simple inspection of the plot, it is evident that global risk is the largest component of total risk premia. This is in clear contrast with the estimated premia of figure I that consistenly show local premia to be the most important factor in emerging markets. The estimated integration index is in panel B of figure III. The index has an average of 0.76 which is larger than any of the emerging markets in our sample. There is also no clear indication of a structural change in the series. This confirms our expectation that Canada has been well integrated and has not experienced major shift in the degree of integration. In this case as with the EMs, the market correlation with world market is lower than the estimated index but tracks it more closely. Overall, these results indicate that our previous findings on the pricing of emerging markets are not simply due to sample selection and that the methodology can be equally informative across

[27] The construction of the diversification portfolio only includes global industry indices since we could not find any US traded country fund for Canada. This implies that the ability of international investors to achieve homemade diversification is significantly constrained and thus would be biased against our results. It also explains why the integration index is only marginally higher than the marketwide correlation in figure III. Further, given that companies representing almost 50% of TSE300 market capitalization are crosslisted on the NYSE, AMEX or NASDAQ, an augmented diversification portfolio which included cross-listings would allow virtually perfect home-made diversification.

all markets.

IV-E. What drives market integration

Market integration is a dynamic process. It evolves over time in response to innovations in the economic, financial and socio-political sectors both at home and abroad. As a result, it is time-varying and exhibits increasing as well as decreasing periods i.e. contrary to what we would like to see, it does not increase monotonically. Although we do not currently have a comprehensive theory to explain what drives market integration, both academics and practitioners have broad understanding of the important factors. In the previous section, we assessed the evolution of market integration through time, however, todate, no paper has systematically dealt with this issue. In the past, papers like B-H or Bhattacharya and Daouk (2002) have conjectured that certain variables might contain information on the dynamics of integration but have not formally tested their impact. Hence, we use similar economic and market liberalization factors, as a first attempt at explaining the behavior of market integration.

As discussed earlier, opening of the market to foreign investors should lead to increased integration if it generates foreign portfolio investments that did not occur before such liberalization. Thus we use equity market capitalization to GDP as a broad proxy to capture the extent of financial markets development. B-H use this variable in their model as conditioning information to infer the switching probabilities. It is also widely believed that increasing economic integration should lead to greater capital market integration. We proxy the macroeconomic development factor with the size of the trade sector to the GDP. This variable is the one used in Bhattacharya and Daouk (2002) in their simplified version of the B-H model.[28] Finally, we investigate

[28] This variable has been previously used in the financial development literature (see Demirguc-Kunt and Levine (1996), Rajan and Zingales (2000))

whether financial liberalization policies have a direct effect on integration by relying on two different measures.[29] The first one is a liberalization dummy set at the official liberalization dates of Bekaert and Harvey (2000, Table I). The second one is an index of restrictions to capital inflows, "Acquisition of Shares in the Domestic Stock Market by Foreigners", developed recently by Kaminsky and Schmukler (2001).[30]

To understand the drivers of market integration, we use the integration indices estimated in the previous section as dependent variable. We estimate a pooled cross-sectional time-series regression of the preestimated indices $\mathbf{II}_i$ on the lagged values of the above specified factors.

$$\mathbf{II}_i = \boldsymbol{\alpha}_i + \boldsymbol{\tau} + \boldsymbol{\beta}'\mathbf{X}_i + \boldsymbol{\epsilon}_i \qquad i = 1, ...I \tag{15}$$

In estimation, we allow for fixed effects by setting a different intercept per each country. In another specification, we also constrain the intercept to be constant across countries to infer the average impact of each variable. We control for time using a trend. Due to the high serial correlations in the series, we compute Newey-West standard errors for our tests and we correct for heteroskedasticity. On the other hand, we do not correct for possible estimation error of our dependent variable.

Table VI reports the estimates and the R^2 of univariate and multivariate regressions. The ratio of market capitalization to GDP plays an important role in all specifications. In all cases, the estimated coefficient is positive, indicating that higher financial market development is linked to a higher degree of integration. The size of the trade sector to GDP is significant and of the expected sign only in the regressions with no fixed effects.[31] We also find a positive and significant liberalization effect

[29] The dating of liberalizations is object of debate. For this reason, Bekaert and Harvey (2000) also consider a number of different dating schemes in their analysis.

[30] The index is equal to 1 if investors are allowed to hold domestic equity without restrictions, it is equal to 2 in case of semi-repression and 3 if total repression. We thank Kaminsky and Schmukler for generously providing this data.

[31] Bekaert and Harvey [2000] find that the trade measure is significant and of the expected sign

linked to the official dates recorded by Bekaert and Harvey (2000). On average, the increase in the degree of integration in correspondence of these dates is 0.18 in the univariate regression. The coefficient only decreases to 0.16 in the multivariate regression, after controlling for the development indicators. On the other hand, the other measure of liberalization is almost in all cases insignificant or of the opposite sign, as we expect that integration should increase when financial repression decreases.

In summary, we show in this section that some development proxies as well as some financial liberalization indicators are significant drivers of market integration. Our findings also provide support to previous studies that used some of these indicators as information variables for integration.

V - CONCLUSION

International asset pricing models suggest that the availability of market substitutes that allow investors to duplicate the returns on unavailable foreign assets affect the degree and time variation of world market integration. Hence, we focus on homemade diversification that could effectively integrate world market even though explicit barriers to portfolio flows are in place. We study eight emerging markets over the period 1976-2000. We first construct "Diversification Portfolios" that capture the ability of globally traded assets to substitute foreign assets. Next, we use GARCH-M methodology to estimate the E-L model and empirically assess the time variation in market integration. Specifically, we construct an "Integration Index" based on the two factor E-L asset pricing model. The "Integration Index" exploits the E-L model prediction that if markets are fully integrated, only the global systematic risk is priced whereas under complete segmentation, only the conditional market risk is priced.

in explaining dividend yields, volatility and correlations with the world for a number of emerging markets. Within this general framework, Henry [2000] finds the significance of a trade liberalization dummy for emerging market expected returns and dividend yields.

Our results suggest that although the local risk is the most relevant factor in explaining time-variation of EM returns, global risk is also conditionally priced for three countries, while for two countries it exhibits marginal significance. Further, there are substantial cross-market differences in the degree of integration. For example, Mexico is the most integrated whereas Argentina is the most segmented among our sample markets. More interestingly, we observe evolution towards more integrated financial markets. This conforms to our apriori expectations based on reduction in barriers to portfolio flows, general liberalization of capital markets, increased availability of ADRs and country funds, increased portfolio flows, better information and investor awareness. The importance of this result is in terms of our ability to assess the degree of integration that conforms to our expectations as well as in its consistency. Indeed, for all our sample markets, the degree of integration is higher in the 1990s. Our results strongly suggest the impropriety of using correlations of marketwide index returns as a measure of market integration. Finally, financial market development proxied by the ratio of market capitalization to GDP, macroeconomic development proxied by the size of the trade sector to GDP and financial liberalization policies play important roles in integrating emerging markets.

Bae, Kee-Hong, 1993, "Time Variation in the Price of Risk and the International Capital Market Structure", Unpublished Dissertation, The Ohio State University.

Bailey, Warren, and Julapa Jagtiani, 1994, "Foreign Ownership Restrictions and Premiums for International Investment: Some Evidence from the Thai Capital Market," *Journal of Financial Economics,* 36, 57–88.

Bhattacharya, Utpal and Hazem Daouk, 2002, "The World Price of Insider Trading," *Journal of Finance 5*7, 75-108.

Basak, Suleyman, 1995, "An Intertemporal Model of Segmentation," 1996, *Journal of Financial and Quantitative Analysis*, 31, 161-188.

Bekaert, Geert and Robert Hodrick, 1992, " Characterizing Predictable Components in Excess Returns on Equity and Foreign Exchange Markets", *Journal of Finance* 47, 467-509.

Bekaert, Geert and Campbell Harvey, 1995, "Time-varying World Market Integration", *Journal of Finance,* 50, 403-444.

Bekaert, Geert and Campbell Harvey, 1997, "Emerging Equity Market Volatility," *Journal of Financial Economics,* 43, 29-77.

Bekaert, Geert and Campbell Harvey, 2000, "Foreign Speculator and Emerging Equity Markets," *Journal of Finance,* 55, 565-613.

Berndt, E.K., B.H. Hall, Robert Hall and Jerry Hausman, 1974, "Estimation and Inference in Nonlinear Structural Models", *Annals of Economics and Social Measurement* 3, 653-665

Bollerslev, Tim and Jeffrey Wooldridge, 1992, “Quasi-maximum Likelihood Estimation and Inference in Dynamic Models with Time-varying Covariance,” *Economic Reviews*, 11, 143–172.

Campbell, John and Yasushi Hamao, 1992, ”Predictable Stock Returns in the United States and Japan: A Study of Long-term Capital Market Integration, *Journal of Finance* 47, 43-69.

Chang, Eric, Cheol Eun, and Richard Kolodny, 1993, “International Diversification Through Closed-end Country Funds,” Working Paper, University of Maryland.

Cho, D.C., Cheol Eun and Lamme Senbet, 1986, ”International Arbitrage Pricing Theory: An Empirical Investigation”, *Journal of Finance* 41, 313-329.

Cooper, Ian and Kaplanis, 1994, ”Home bias in equity portfolios inflation hedging, and international capital market equilibrium,” *Review of Financial Studies* v7 nl, 45-60.

Cumby, Robert and Anya Khanthavit, 1998, “A Markov Switching Model of Market Integration,” in *Emerging Market Capital Flows*, Richard M. Levich, ed., London: Kluwer Academic Publishers, 237-257.

Demirguc-Kunt, Asli and Ross Levine, 1996, ”Stock Market Development and Financial Intermediaries: Stylized Facts”, *World Bank Economic Review* 10, 291-322.

De Santis, Giorgio and Bruno Gerard, 1997, ”International Asset pricing and Portfolio Diversification with Time-varying Risk,” *Journal of Finance* 52, 1881-1912

De Santis, Giorgio and Bruno Gerard, 1998, ”How Big is the Premium for Currency Risk?,” *Journal of Financial Economics,* 49, 375-412.

De Santis, Giorgio and Selahattin Imrohoroglu, 1997, "Stock Returns and Volatility in Emerging Financial Markets," *Journal of International Money and Finance,* 16, 561-579.

Dumas, Bernard and Bruno Solnik, 1995, "The World Price of Foreign Exchange Risk", *Journal of Finance* 50, 445-479.

Engle, Robert and Victor Ng, 1993, "Measuring and Testing the Impact of News on Volatility", *Journal of Finance* 48, 1749-1778.

Errunza, Vihang, 2000, "Foreign Portfolio Equity Investments, Financial Liberalization And Economic Development," Special issue of *Review of International Economics*, International Financial Liberalization, Capital Flows and Exchange Rate Regimes: Essays in Honor of Robert A. Mundell, Vol. 9, No. 4, November 2001.

Errunza, Vihang and Etienne Losq, 1985, "International Asset Pricing Under Mild Segmentation and Segmentation Hypothesis," *Journal of Finance*, 40, 105–124.

Errunza, Vihang and Etienne Losq, 1989, "Capital Flow Controls, International Asset Pricing and Investors' Welfare: A Multi Country Framework," *Journal of Finance*, September, 1025–1037.

Errunza, Vihang, Kenneth Hogan and Mao-Wei Hung, 1999, "Can the Gains from International Diversification be Achieved Without Trading Abroad?," *Journal of Finance*, 54, 2075-2107.

Eun, Cheol, and S. Janakiramanan, 1986, "A Model of International Asset Pricing with a Constraint on the Foreign Equity Ownership," *Journal of Finance*, 41, 897–914.

Ferson, Wayne and Campbell Harvey, 1993, "The Risk and Predictability of International Equity Returns", *Review of Financial Studies* 6, 527-566.

Ferson, Wayne and Campbell Harvey, 1994, "Sources of Risk and Expected Returns in Global Equity Markets," *Journal of Banking and Finance* 18, 775-803.

Hardouvelis, Gikas, Demetrios Malliaropulos and Richard Priestley, 2001, "EMU and European Stock Market Integration," Working Paper

Harvey, Campbell, 1991, "The World Price of Covariance Risk" *Journal of Finance*, 46, 111-157.

Henry, Peter Blair, 2000, "Stock Market Liberalization, Economic Reform, and Emerging Market Equity Prices," *Journal of Finance*, 55, 529-564.

International Finance Corporation, 1993, IFC Index Methodology, World Bank, Washington, D.C.

Jorion, Philippe and Eduardo Schwartz, 1986, "Integration versus Segmentation in the Canadina Stock Market", *Journal of Finance* 41, 603-613.

Kaminsky, Graciela and Sergio Schmukler, 2001, "On Booms and Crashes: Financial Liberalization and Stock Market Cycles" The World Bank, Mimeo.

Newey, Whitney and Kenneth West, 1987, "A Simple Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica* 55, 703-708.

Padmanabhan, Prasad, 1992, "Investment Barriers and International Asset Pricing," *Review of Quantitative Finance and Accounting,* 2, 299–319.

Rajan, R. and Luigi Zingales, 2000, The Great Reversals: The politics of Financial Development in the 20th Century" Working Paper, University of Chicago

Sellin, Peter and Ingrid Werner, 1993, “International Barriers in General Equilibrium,” *Journal of International Economics*, 34, 2107–2138.

Solnik, Bruno, 1974, “The International Pricing of Risk: An Empirical Investigation of the World Capital Market Structure,” *Journal of Finance* 29, 365–378.

Stehle, Richard, 1977, An Empirical Test of the Alternative Hypotheses of National and International Pricing of Risky Assets, *Journal of Finance* 32, 493-502

Stulz, Rene, 1981, “On the Effects of Barriers to International Investment,” *Journal of Finance*, 36, 923–934.

Stulz, Rene and W. Wasserfallen,1995, ”Foreign equity investment restrictions, capital flight, and shareholder wealth maximization,” *Review of Financial Studies*, 1019-1058.

Uppal, Raman, 1993, “International Financial Flows with Segmented Goods Markets: A General Equilibrium Analysis,” working Paper, University of British Colombia.

Wheatley, S., 1988 ”Some Tests of International Equity Integration”, *Journal of Financial Economics* 21, 177-212.

White, Halbert, 1982, “Maximum Likelihood Estimation of Mispecified Models,” *Econometrica,* 50, 1-25.

Table I: The Set of Eligible Securities

This table contains the eligible set of securities used to computed the diversification portfolios for each country. The set consists of 24 multinational corporations ranked by 1976 sales as reported by Fortune Magazine, 38 MSCI global industry porfolios, eight country funds and the MSCI world index.

PANEL A: Global Industry Indices

Aerospace and military technology
Appliances and household durables
Automobiles
Banking
Beverages and tobacco
Broadcasting and publishing
Building materials and components
Business and public services
Chemicals
Construction and housing
Data processing and reproduction
Electrical and electronics
Electronic components and instruments
Energy equipment and services
Energy sources
Financial services
Food and household products
Forest product and paper
Gold mines
Health and personal care
Industrial components
Insurance
Leisure and tourism
Machinery and engineering
Merchandising
Metals (nonferrous)
Metals (steel)
Misc. materials and commodities
Multi-industry
Real estate
Recreation and other consumer goods
Telecommunications
Textiles and apparel
Transportation (airlines)
Transportation (road and rail)
Transportation (shipping)
Utilities (electrical and gas)
Wholesale and international trade

PANEL B: Multinational Corporations

Amerada Hess Corporation
Ashland Inc
Bethlehem Steel Corp
Boeing Co
Carterpillar Inc
Dow Chemical Co
Du Pont E I De memours Co
Eastman Kodak Co
Exxon Mobil
Ford Motor Co.
General Electric Co.
General Motors Corp.
Goodyear Tire and Rubber Co.
International Business Machines
Monsanto Company
Occidental Petroleum Corp.
Phillips Petroleum Corp
Procter & Gamble Co.
Rockwell International Corp.
Tenneco Autv.
Texaco Inc.
Union Carbide Corp.
United Technologies
Xerox Corp.

PANEL C: Country Funds

Argentina Fund Inc.
Brazil Fund Inc.
Chile Fund Inc.
India Growth Fund Inc.
Korea Fund Inc.
Mexico Fund Inc.
Taiwan Fund Inc.
Thai Fund Inc.

Table II: Summary Statistics for Assets Returns

PANEL A: Distributional Statistics

Statistics for asset returns. Country equity indices are from IFC and the world equity index is from MSCI. Returns are monthly percentage, denominated in USD and in excess of the one-month Eurodollar deposit rate. The period is from January 1977 to December 2000. The test for the kurtosis coefficient has been normalized to zero, B-J is the Bera-Jarque test for normality based on excess skewness and kurtosis, Q is here the Ljung-Box test for autocorrelation of order 12 for the returns and for the returns squared.

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand	World
Mean	2.6	-0.29	1.45	0.56	-0.86	1.69	1.31	-0.2	0.55
Std. Dev.	23.52	16.14	9.97	8.15	11.32	12.16	13.22	10.45	4.04
Skewness	2.62**	0.477**	0.92**	0.55**	1.26**	-0.81**	0.62**	0.27	-.54**
Kurtosis	14.73**	1.44**	4.64**	1.33**	5.81**	3.64**	2.09**	3.00**	1.66**
B-J	2835**	34.30**	287.7**	34.46**	465.2**	183.8**	44.71**	106.5**	45.47**
$Q(z)_{12}$	10.20	13.02	45.44**	13.25	9.99	26.39**	11.48	47.03**	13.97
$Q(z^2)_{12}$	16.43	48.59**	30.51**	52.86**	52.5**	87.95**	39.45**	153.9*	10.28

* significant at the 5% level

** significant at the 1% level.

PANEL B: Pairwise Correlations for Assets Returns

	Argentina	Brazil	Chile	India	Korea	Taiwan	Mexico	Thailand
Country index and world	0.054	0.178	0.127	0.019	0.288	0.245	0.316	0.321
Country index and div. portfolio	0.310	0.641	0.453	0.546	0.670	0.596	0.712	0.737
Div. portfolio and world	0.216	0.414	0.310	0.197	0.580	0.495	0.508	0.480

TABLE III: The EL model

The estimated model is:

$$r_{I,t} = \delta_{W,t-1}\, cov\,(r_{It}, r_{Wt}) + \lambda_{It-1}\, var\,(r_{It}|r_{DIVt}) + \varepsilon_{It}$$

$$r_{DIV,t} = \delta_{W,t-1}\, cov\,(r_{DIVt}, r_{Wt}) + \varepsilon_{DIV,t}$$

$$r_{W,t} = \delta_{W,t-1}\, var\,(r_{W,t}) + \varepsilon_{W,t}$$

where $r_{I,t}$ is the country index excess returns, $r_{DIV,t}$ is the diversification portfolio excess returns, $r_{W,t}$ is the world index excess returns, δ_W is the price of world covariance risk, λ_I is the prices of local risk and $\varepsilon_t| \vartheta_{t-1} \sim N(0, H_t)$. The time-varying prices are estimated with a different set of conditioning information. Price specifications are given by:

$$\delta_{W,t-1} = exp\,(\kappa_W'\, \mathbf{Z}_{t-1})$$

where $\mathbf{Z_W}$ is a set of *j* information variables which includes a constant, the default spread (DP), the term structure spread (TP) and the world dividend yield in excess of the risk free rate (XWDY) ,

$$\lambda_{i,t-1} = exp\,(\kappa_i'\, \mathbf{Z}_{i,t-1})$$

where $\mathbf{Z_i}$ is a set which includes a constant, the change in the local exchange rate (XR), the local dividend yield (DY) and the local index return (DX).

H_t is the time-varying conditional covariance parameterized as:

$$H_t = H_0 * (\iota\iota' - \mathbf{aa'} - \mathbf{bb'}) + \mathbf{aa'} * \Sigma_{t-1} + \mathbf{bb'} * H_{t-1}\,,$$

where * denotes the Hadamard product, **a** and **b** are (N x 1) vector of constants, ι is (N x 1) unit vector, and Σ_{t-1} is the matrix of cross error terms, $\varepsilon_{t-1}\varepsilon'_{t-1}$.

Country equity indices are from IFC and the world equity index is from MSCI. The risk free rate is the one-month Eurodollar rate from Datastream. All returns are denominated in US$. There are 288 observations, from January 1977 to December 2000.

The model is estimated by Quasi-Maximum Likelihood. P-values for robust Wald test for the hypothesis are reported under each country.

PANEL A: Specification tests

Null Hypothesis	Argentina[a]	Brazil	Chile	India	Korea	Mexico	Taiwan[b]	Thailand
for time-varying market risk								
$\kappa_{W,j} = 0$, for j>1	0.073	0.1267	0.0209	0.0711	0.1686	0.1583	0.0136	0.0115
for time-varying local risk								
$\kappa_{i,j} = 0$, for j>1	0.0000	0.0887	0.0346	0.0000	0.0582	0.0030	0.0597	0.0450

[a] The full model failed to converge, thus we use only two local information variables

[b] Exchange rates are not available from the beginning of the sample, thus we use only two local information variables

The test for the kurtosis coefficient has been normalized to zero, B-J is the Bera-Jarque test for normality based on excess skewness and kurtosis, Q is here the Ljung-Box test for autocorrelation of order 12 for the residuals and the residuals squared, $Asym^-$ and $Asym^+$ are respectively the Engle-Ng negative size bias and positive size bias test on the squared residuals.

PANEL B: Diagnostics for the residuals

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Skewness	-6.44**	0.25	0.34*	0.67**	0.66**	-0.68**	0.89	0.23
Kurtosis	89.7**	1.13**	1.77**	1.10**	2.5**	2.13**	2.52**	1.85**
B-J	95183**	17.34**	40.94**	35.11**	92.79**	73.97**	68.03**	41.72**
$Q(z)_{12}$	17.61	12.36	37.01**	11.20	10.18	24.24*	9.91	42.15**
$Q(z^2)_{12}$	6.26	11.16	17.05	22.37*	3.03	8.21	15.90	13.08
$Asym^-$	0.29	-0.82	0.68	-0.70	-1.62	-0.35	-0.14	-0.12
$Asym^+$	0.07	-0.66	-1.06	1.92	-0.17	-2.21*	1.59	0.60

* significant at the 5% level

** significant at the 1% level.

TABLE IV: Estimated integration indices

Panel A contains statistics for the integration indices estimated from the model in table III. The overall mean and standard deviation, means over subperiods, minimum and maximum are reported.
Panel B contains the parameters of individual structural break tests from the regression of the estimated indices on a constant, a time-trend and a dummy variable for the post 1990 period.
Panel C contains the parameter of a structural break test for the post 1990 period from the cross-sectional time-series of all the estimated indices.
Standard errors are heteroskedasticity and autocorrelation consistent obtained from the Newey-West correction.

PANEL A: Statistics

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Overall mean	0.159	0.391	0.294	0.304	0.418	0.505	0.379	0.440
after 90	0.235	0.613	0.520	0.434	0.539	0.699	0.405	0.611
Standard deviation	0.153	0.250	0.242	0.172	0.144	0.230	0.123	0.198
Min.	0.000	0.015	0.000	0.000	0.143	0.000	0.161	0.034
Max.	0.732	0.900	0.780	0.722	0.758	0.908	0.595	0.781

PANEL B: Test for structural break in the indices

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
coefficient	-0.032	0.262	0.265	0.274	0.077	0.185	-0.145	0.212
s.e	(.092)	(.105)	(.089)	(.097)	(.048)	(.091)	(.064)	(.075)

PANEL C: Test for structural break with pooled data

coefficient	0.178
s.e	(.052)

TABLE V: Estimated world correlations

Panel A contains the overall and subperiod means for the time-varying correlations between each country and the world as reported in figure II.
Panel B contains the parameters of individual structural break tests from the regression of the estimated correlations on a constant, a time-trend and a dummy variable for the post 1990 period.
Panel C contains the parameter of a structural break test for the post 1990 period from the cross-sectional time-series of all the estimated correlations.
Standard errors are heteroskedasticity and autocorrelation consistent obtained from the Newey-West correction.

PANEL A: Statistics

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Overall mean	0.118	0.175	0.148	0.041	0.286	0.324	0.291	0.294
after 90	0.155	0.289	0.185	0.027	0.335	0.395	0.306	0.325
Standard deviation	0.114	0.160	0.118	0.052	0.110	0.144	0.151	0.137

PANEL B: Test for structural break in the correlations

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
coefficient	-0.024	0.096	-0.151	-0.044	0.02	0.164	-0.048	-0.069
s.e	(.074)	(.061)	(.050)	(.037)	(.065)	(.072)	(.038)	(.116)

PANEL C: Test for structural break with pooled data

coefficient	-0.001
s.e	(.044)

TABLE VI: What drives Market Integration

This table contains results from a cross-sectional time-series regression of the preestimated integration indices on a number of variables. The estimated indices are for Argentina, Brazil, Chile, India, Korea, Mexico and Thailand from January 1977 to December 2000. MCAP is the market capitalization to GDP, EXIM is the size of the trade sector to GDP, LIBER is a dummy set to one at the dates of official liberalization from table I in Bekeart and Harvey (2000), ACQ is an index for acquisition by foreign investors (3=total repression, 2= semi-repression, 1=no repression). Panel A reports the results from univariate regressions while panel B reports the results from the multivariate regressions. All variables are lagged. The regressions include a trend. Standard errors in parenthesis are heteroskedasticity and autocorrelation consistent obtained from the Newey-West correction.

PANEL A

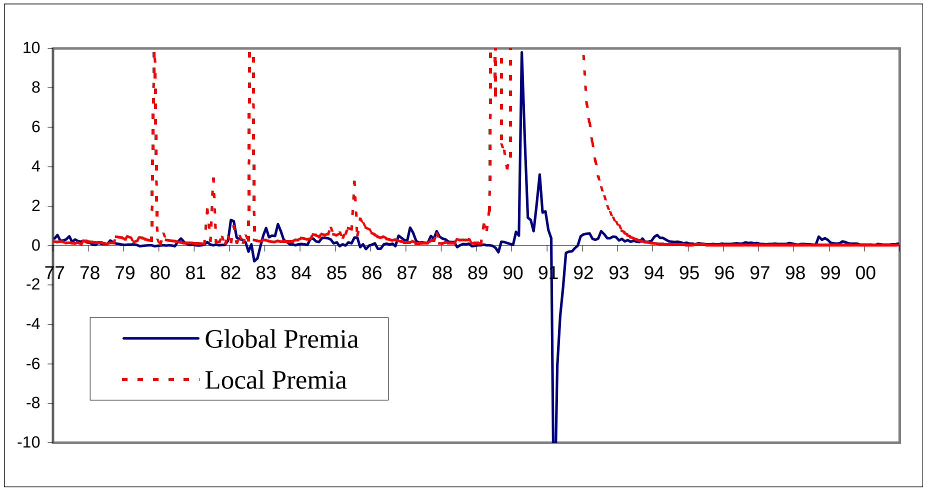
	MCAP	R^2	EXIM	R^2	LIBER	R^2	ACQ	R^2
fixed effects	0.458	0.68	0.073	0.63	0.164	0.66	-0.011	0.64
	(.066)		(.069)		(.035)		(.026)	
no fixed effects	0.326	0.45	0.244	0.47	0.183	0.46	0.077	0.43
	(.083)		(.049)		(.048)		(.038)	

PANEL B

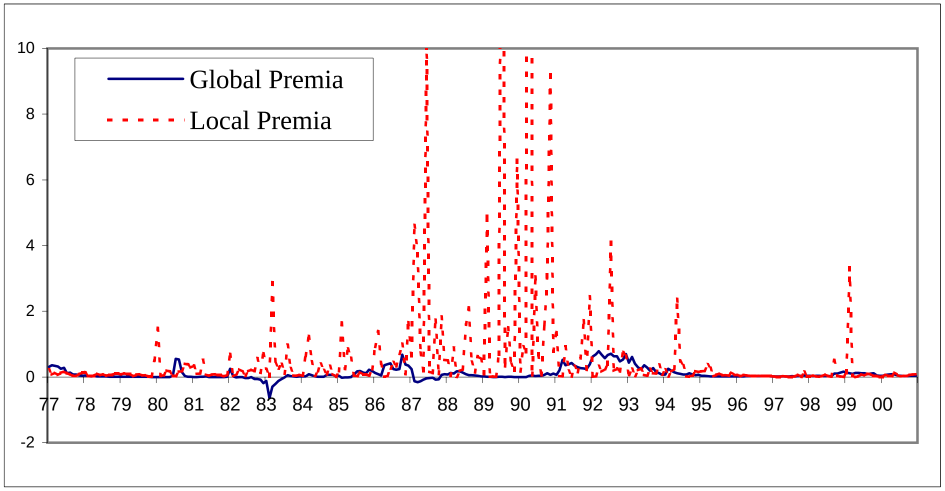
	MCAP	EXIM	LIBER	ACQ	R^2
fixed effects	0.371	0.062	0.124		0.70
	(.064)	(.064)	(.033)		
	0.470	-0.030		0.036	0.69
	(.072)	(.076)		(.025)	
no fixed effects	0.140	0.204	0.160		0.52
	0.071	(0.044)	(0.046)		
	0.198	0.153		0.044	0.48
	(.075)	(0.066)		(0.041)	

FIGURE I: Estimated Premia

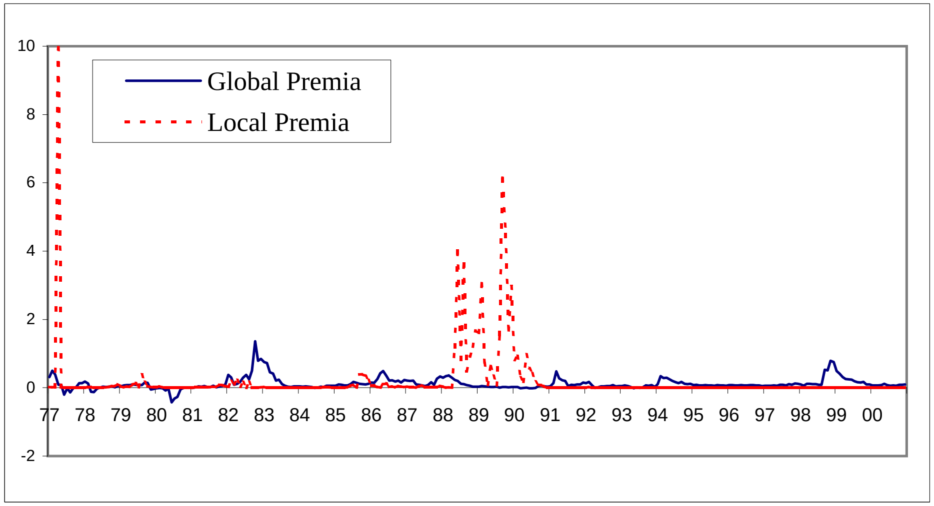
PANEL A: Argentina



PANEL B: Brazil



PANEL C: Chile



PANEL D: India

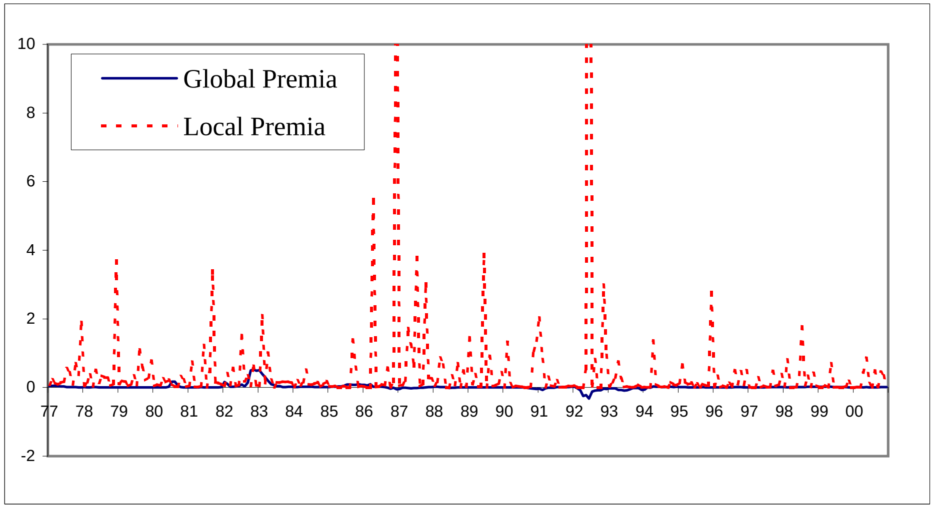


FIGURE I: Estimated Premia

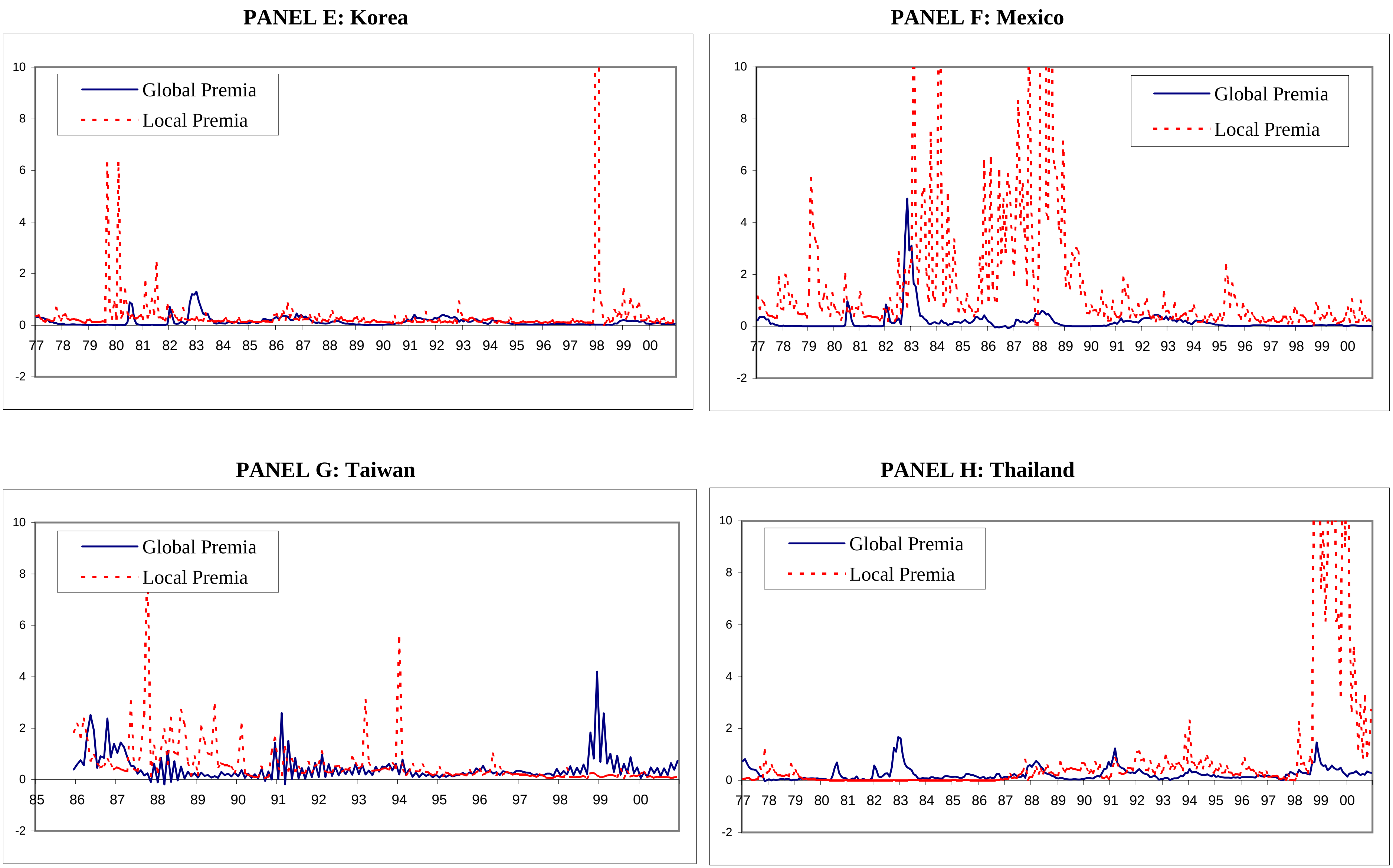
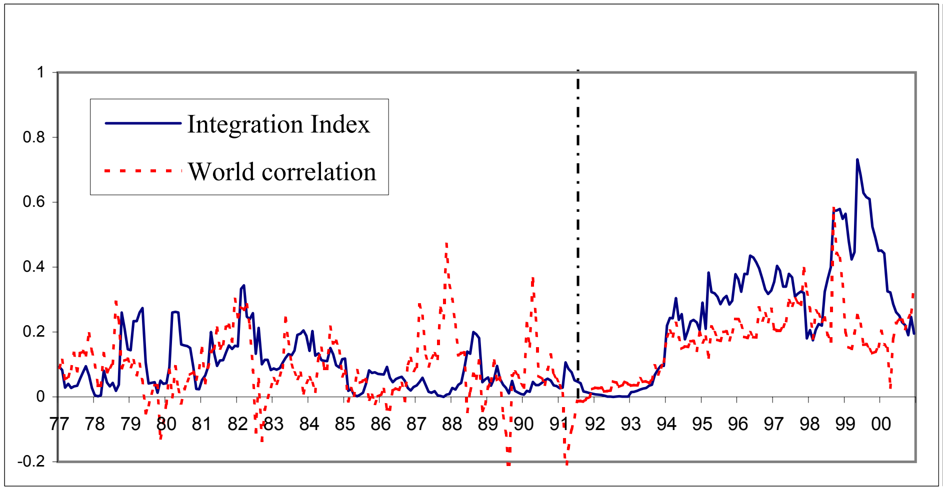
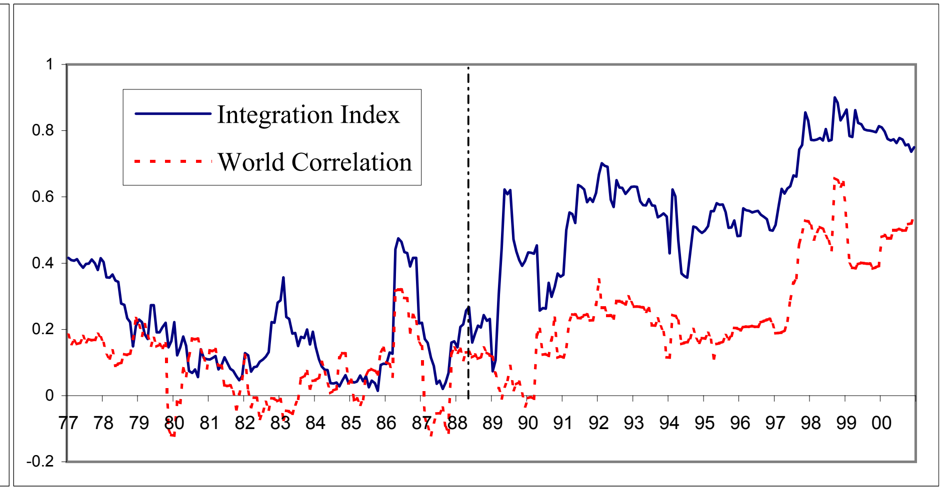


FIGURE II: Integration index

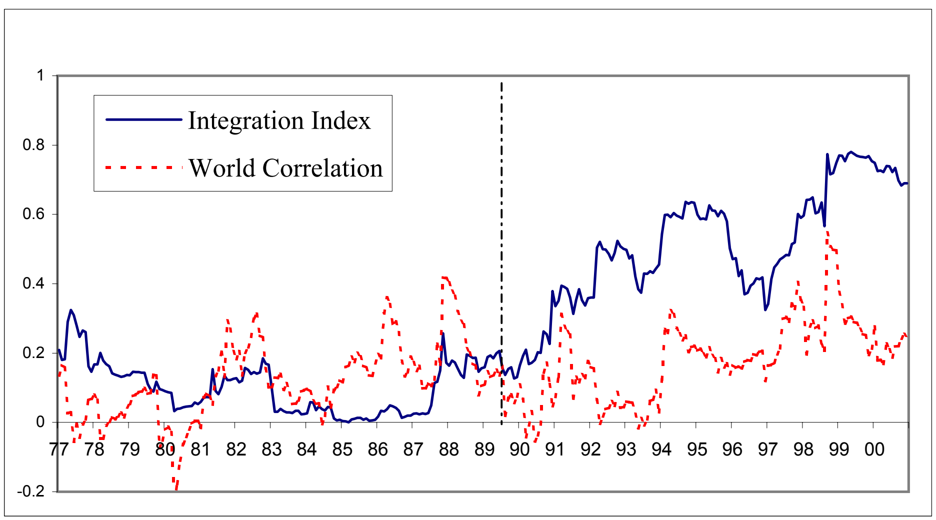
PANEL A: Argentina



PANEL B: Brazil



PANEL C: Chile



PANEL D: India

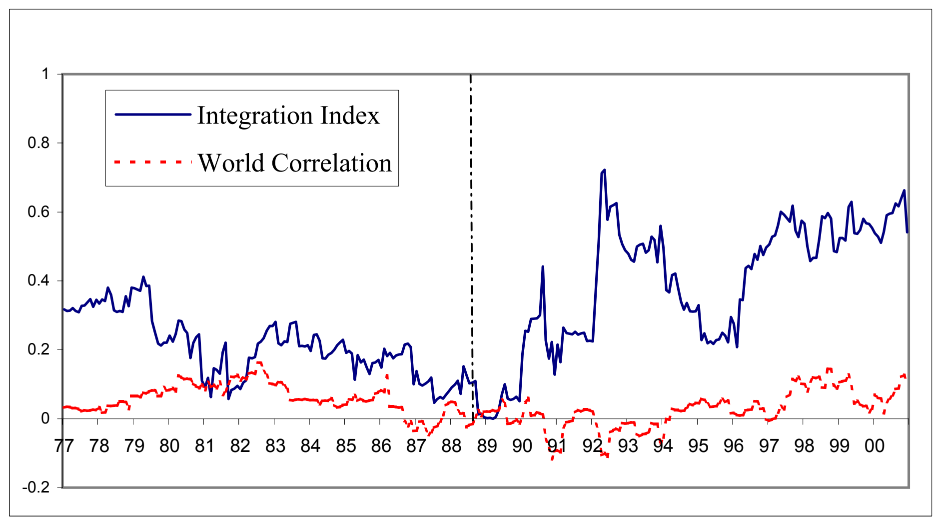
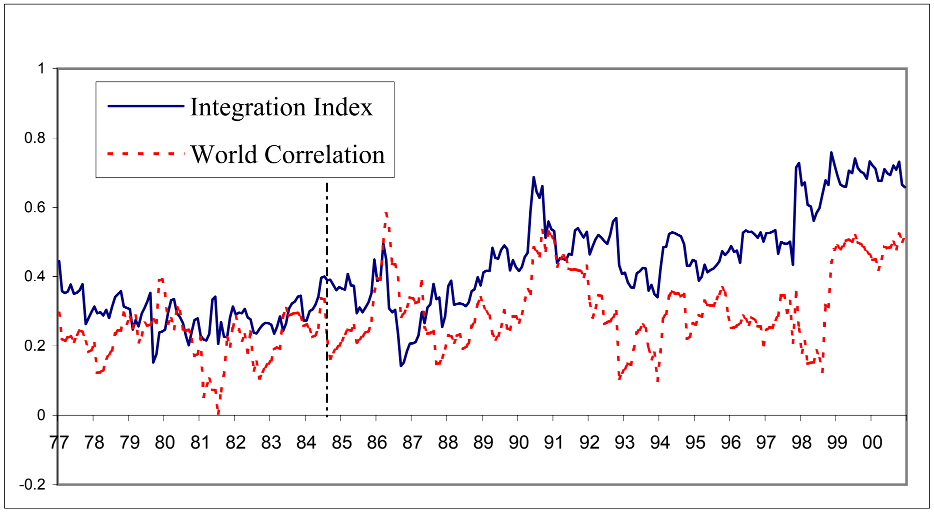
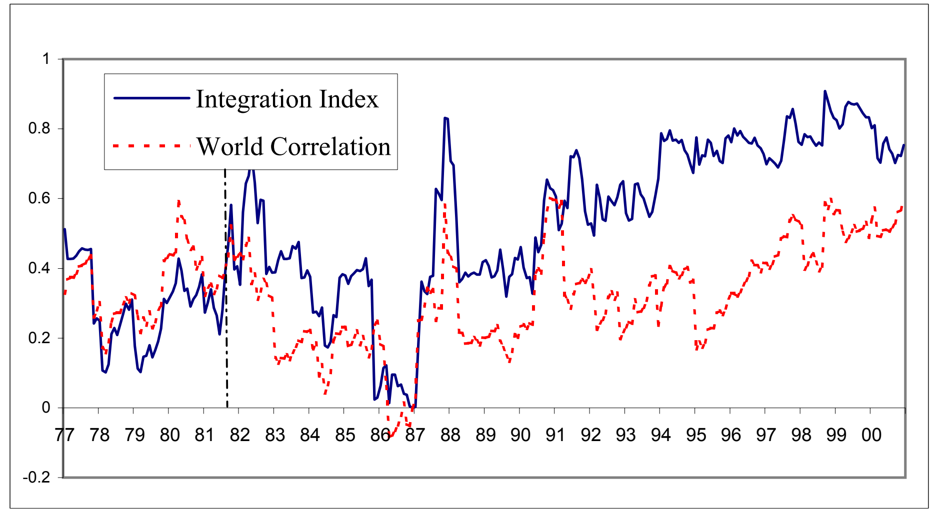


FIGURE II: Integration index

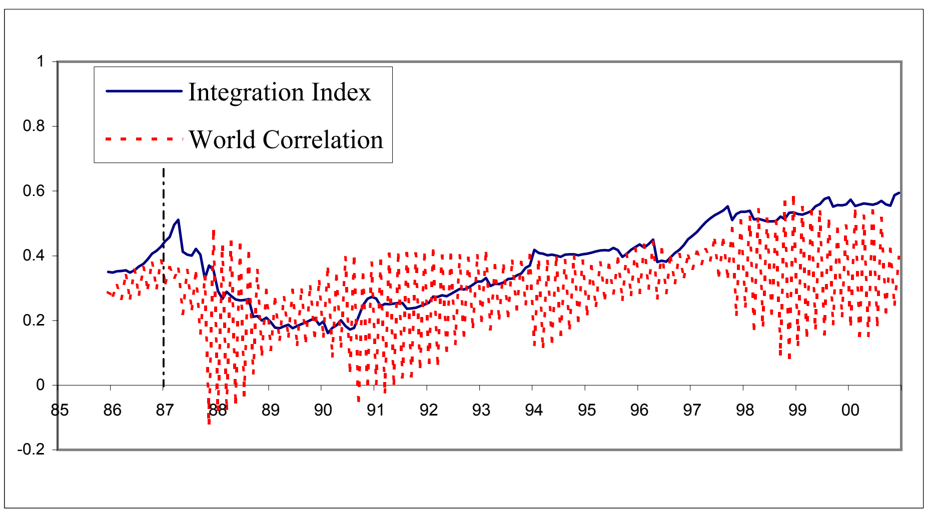
PANEL E: Korea



PANEL F: Mexico



PANEL G: Taiwan



PANEL H: Thailand

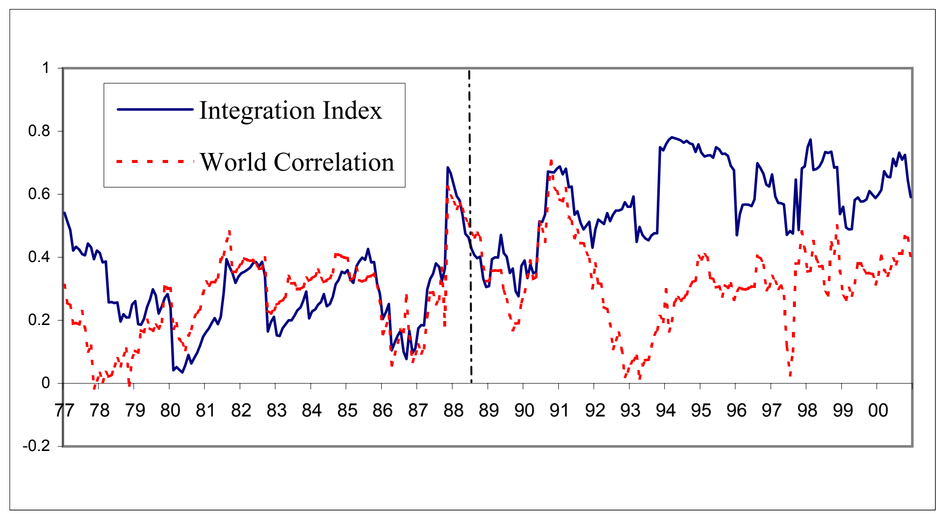
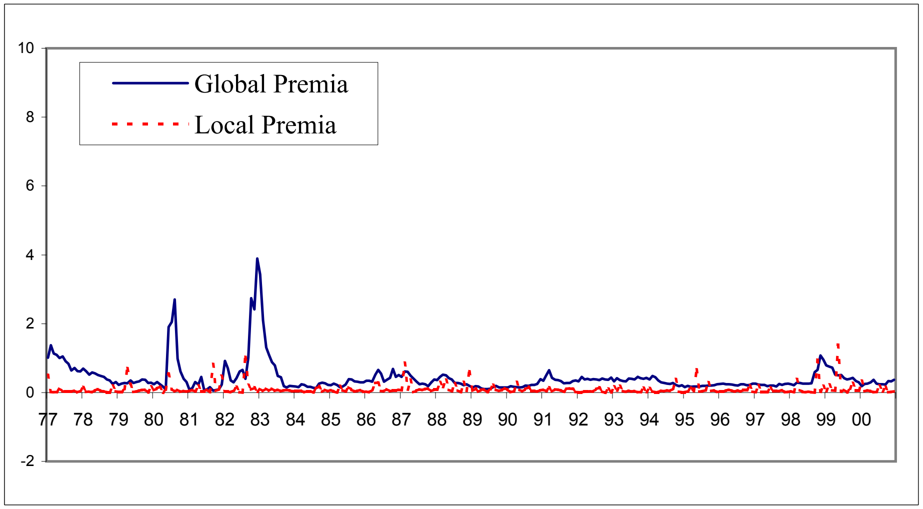


FIGURE III: Canada

PANEL A: Risk premia



PANEL B: Integration index