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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 use GARCH-in-mean methodology to assess the evolution in market integration for eight emerging markets over the period 1977–2000. Our results suggest that while local risk is still a relevant factor in explaining time variation of emerging market returns, none of the countries appear to be completely segmented. We find that there are substantial cross-market differences in the degree of integration. The evolution toward more integrated financial markets is apparent although at times we do observe reversals. In addition, we provide clear evidence on the impropriety of directly using correlations of market-wide index returns as a measure of market integration. Finally, financial market development and financial liberalization policies play important roles in integrating emerging markets.

I. Introduction

Beginning in the 1970s, the reform and development of local securities markets became an integral part of the development strategies in a host of emerging markets (EMs). Over the last two decades, foreign investment barriers were lowered, country funds (CFs) were floated, and American Depository Receipts (ADRs) were listed on the U.S. markets in an effort to develop financially integrated markets. A move toward integrated markets should lower the cost of capital, increase the investment opportunity set for local and foreign investors, and lead to significant welfare gains from higher savings and growth made possible

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by international risk sharing.[1] Thus, market integration has implications beyond traditional issues in corporate finance and investments and deserves further study.[2]

The process of equity market integration is gradual and takes many years with occasional reversals. It is usually part of a major reform effort that includes the financial sector and the economy as well as the political process. Although it often begins with regulatory changes that can be precisely dated, such official dates do not suggest that the market has become integrated. Indeed, Bekaert (1995) finds that legal barriers are not significantly related to a return-based quantitative measure of market integration. The evolution of market integration is also affected by the ability of foreign investors to access the EMs through CFs and ADRs as well as the ability of domestic investors to invest abroad through direct investments as well as illegal means.

In this paper, we take a novel approach that is based on a theoretical international asset pricing model (IAPM). We assess time-varying market integration for eight EMs over the period 1977–2000. We focus on the impact of substitute assets (industry portfolios, CFs, and ADRs) since theoretical models suggest 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-in-mean methodology to estimate the Errunza and Losq (E-L hereafter) (1985) model, which is a special case of the more general IAPM of Stulz (1981). This approach allows us to estimate the degree and variation through time of market integration. We construct an "integration index" (II), which exploits the model prediction that if markets are fully integrated, only the global systematic risk is priced, whereas under complete segmentation only the local market risk is priced. The model also characterizes the intermediate cases where both types of risks are priced.[3]

An alternative approach that has been used to study the evolution of market integration in EMs is the regime-switching model of Bekaert and Harvey (B-H hereafter) (1995).[4] B-H (1995) develop an innovative econometric methodology to combine the two polar specifications of full integration and complete segmentation. They assess the time-varying probability that markets conform to one of the two regimes within a one-factor model over the period ending in 1992. Our

[1]For a detailed discussion of these issues, see Errunza (2001) and Bekaert and Harvey (2003) and references therein.

[2]There is a large body of theoretical and empirical literature on market integration including Solnik (1974), Stehle (1977), Stulz (1981), Errunza and Losq (1985), (1989), Eun and Janakiramanan (1986), Jorion and Schwartz (1986), Cho, Eun, and Senbet (1986), Harvey (1991), Errunza et al. (1992), Padmanabhan (1992), Sellin and Werner (1993), Uppal (1993), Bailey and Jagtiani (1994), Basak (1995), and Stulz and Wasserfallen (1995).

[3]Karolyi (2003) uses a similar approach to relate the growth and expansion of the ADR market in the 1990s to the development and integration of local markets. He concludes that the increasing number of new ADR programs and their market capitalization and trading volume are positively associated with the pace of international capital flows and greater market integration.

[4]With a similar approach, Cumby and Khanthavit (1998) study a regime-switching model for Korea, Taiwan, and Thailand; however, time variation in the sense of B-H (1995) is not allowed. Hardouvelis, Malliaropulos, and Priestley (2006) study European market integration using a methodology similar to B-H (1995). Recently, Baele (2005) develops a regime-switching model of volatility spillover to account for financial integration in Western Europe and de Jong and de Roon (2005) study the effect of market segmentation on expected returns for a number of EMs.

indices of market integration can then be viewed as complementary to the B-H (1995) integration measures that are based on ex ante probabilities.

At the time of their writing, B-H (1995) found that some countries became less integrated over time, a finding that made a lot of sense but unfortunately was in contrast to the general perception that countries must become more integrated. Such a perception still seems to persist although we do not yet have published evidence to support such claims. Indeed, liberalizations in EMs started in the late 1980s but in the 1990s we witnessed major events that could potentially impact EM pricing such as the Mexican crisis of 1994, the Asian crisis of 1997–1998, and the Russian default of 1998. After about a decade of liberalizations, the reform process stalled in a number of EMs and even reversed. More recently, however, foreign investors' access to equity markets is again being liberalized. Thus, almost a decade after the B-H (1995) study, this study revisits the issue of time-varying market integration and reevaluates persisting beliefs that we should expect unimpeded increases in the degree of integration. This seems particularly important given the evidence in Bekaert, Harvey, and Lumsdaine (2002) who show that the endogenous dates of integration are usually later than official dates.

Our results can be summarized as follows. From the value of the estimated IIs, we establish that mild segmentation has been a reasonable characterization for EMs. Our pricing tests suggest that local risk is still an important factor in explaining the time variation of EM returns. While none of the countries appear to be completely segmented, there are wide ranges in the degree of integration. Based on the IIs we show that Mexico is the most integrated of the countries over the whole sample period and India is the most segmented. The evolution toward more integrated financial markets is apparent although at times we do observe reversals. The plots of the estimated indices uncover that while for some countries significant increases toward higher integration took place at the end of the 1980s, a few countries, especially Argentina, show a larger increase only in the last few years of our sample. This suggests that liberalization is a complex and gradual process and that we did not witness its full impact by the early 1990s. In addition, we provide the first clear empirical evidence in support of the theoretical literature that suggests the impropriety of using market-wide correlation coefficients as a measure of integration.[5] Our results indeed show that correlations of country index returns with the global market structure are significantly lower than the estimated IIs. Finally, we report initial evidence that links financial market integration to financial market development, macroeconomic development, and financial liberalization policies.

The paper is organized as follows. Section II describes the asset pricing model and formalizes the II. Section III presents the test methodology. Section IV contains data and summary statistics. In Section V, we report and discuss results for the tests of the asset pricing model and the IIs. Section VI analyzes the link between financial integration and other variables. The conclusion follows in Section VII.

[5]Dumas, Harvey, and Ruiz (2003) theoretically link stock market correlations to countries' output correlations after controlling for the degree of correlation of economic fundamentals. However, they are only able to compare the polar cases of integration and segmentation in an unconditional setting.

II. The Model

Time-varying capital market integration should be characterized on the basis of a theoretical model that satisfies the following properties: i) The model 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; ii) The model should capture the impact of differential cross-border risk preferences and costs/barriers on the free flow of capital that is widely accepted as a major contributor to a less than a fully integrated global capital market; and iii) The model should be consistent with the well-known phenomenon of home asset bias.

Among the well-known IAPMs, the E-L (1985) model is well suited to test the integration/segmentation hypothesis. The E-L (1985) model states that

$$E(R_i) \quad = \quad R_f + AM\text{cov}(R_i, R_W) + (A_u - A)M_I\text{cov}(R_i, R_I|\underline{\underline{R_e}}), \tag{1}$$

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

$$E(R_I - R_f) \quad = \quad AM\text{cov}(R_i, R_W) + (A_u - A)M_I\text{var}(R_I|\underline{R_e}). \tag{2}$$

The E-L (1985) model explicitly assumes barriers to portfolio flows that capture the restrictions imposed by EMs. Barriers take many forms including capital controls, restrictions/taxes on repatriation, limits on ownership, market regulation, investor protection, and information. 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. Restrictions on the amount of foreign ownership in many EMs result in significant barriers to portfolio capital inflows. Data regarding the availability and quality of market and company information, the 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 during the 1990s. For example, 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). Of course, the mere 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. Hence, we focus on how substitute assets impact 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 the 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.

A. The E-L (1985) 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, the II, can also be developed. Indeed, consider the following ratio:

$$\text{II} \quad = \quad 1 - \frac{\text{var}[R_I|\underline{R_e}]}{\text{var}[R_I]}. \tag{3}$$

By definition, this index lies within the range $(0, 1)$. The critical measure in (3) is thus the ratio between the unspanned variance and the total variance of the country index. Under this interpretation, the II is empirically similar to the R^2 of a regression of R_I on $\underline{R_e}$. Since our methodology allows us to recover conditional variances and covariances, we ultimately construct for each country an R^2 that is time varying. For the sake of illustration, we analyze in turn the following two polar cases:

i) Complete Integration: $\text{II} = 1$ (i.e., $\text{var}[R_I|\underline{R_e}] = 0$).

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 countries would be identical and the only relevant measure of risk would be the beta coefficient defined relative 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:

$$E(R_I) \quad = \quad R_f + AM\text{cov}(R_I, R_W). \tag{4}$$

ii) Complete Segmentation: $\text{II} = 0$ (i.e., $\text{var}[R_I|\underline{R_e}] = \text{var}[R_I]$).

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:

$$\text{cov}[R_I|\underline{R_e}] \quad = \quad 0, \quad e = 1, \ldots, E. \tag{5}$$

Thus,

$$E(R_I) \quad = \quad R_f + A_u M_I \text{var}(R_I). \tag{6}$$

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 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 look upon the II as a means of assessing the degree to which a market is integrated.

We should point out that the fundamental problem of correlation and integration not being the same thing complicates the interpretation of our integration measure. For example, complete segmentation implies zero correlation between local securities and the eligible securities although this is not likely to occur. First, it would be difficult to argue that the returns on the Zimbabwean market are uncorrelated with returns on the global copper industry. Even when markets are fully segmented, it is not necessarily the case that the model will predict full segmentation since countries with industry structures closer to the world's industry structure will seem more integrated. Second, in times of highly volatile or down markets, returns seem to be more highly correlated. This is an implication of any factor model where increased factor volatility drives up return comovements (see Bekaert, Harvey, and Ng (2005)). Thus, as soon as the market is somewhat integrated, the model may generate a higher "integration measure" in times of high volatility that is not really related to integration. We attempt to shed some light on these issues in the ex post panel analysis of Section VI.

III. Methodology

A. The Diversification Portfolios

The diversification portfolio (DIV) is defined as the portfolio of eligible securities that is most highly correlated with the market portfolio of ineligible securities. Specifically, E-L (1985) show that

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

where $\rho_{I,e}$ denotes the correlation coefficient between R_I and the (homemade) DIV. Note that as $\rho_{I,e} \rightarrow 1$, the (homemade) DIV becomes perfectly correlated with the foreign market portfolio.

For each country, we use two DIVs. The first one is obtained by sequentially including the Morgan Stanley Capital International (MSCI) world index, MSCI global industry portfolios, and closed-end CFs and ADRs to generate composite assets that are most highly correlated with the return on the market portfolios of our sample EMs (the ineligible set).[6] The second DIV is the same for every country consisting solely of the world return, and it is used as a benchmark to uncover the specific contribution of the CFs and ADRs.

[6]Note that the introduction of CFs preceded that of the ADRs. Hence, the integrating impact of the first CF is likely much greater than the ADRs or the subsequent issues of other CFs. We include only the first CF from each of our sample countries in the eligible set. Along the same lines, Bekaert et al. (2002) find that the first CF introduction yields the "strongest break" in their financial time series.

To construct the most correlated DIV, we regress in a first step the return of the market, $R_{I,t}$, on the returns of 38 MSCI industry portfolios along with the MSCI world index. Similar to Errunza, Hogan, and Hung (1999), we select from the set of the industry portfolios using a stepwise regression procedure with forward and backward threshold criteria to obtain a DIV of global securities that is available over the full sample period, R_G.

In the next step, we account for the time-varying set of securities as they become available on the U.S. market. We construct an augmented DIV by running the regression,

$$R_{I,t} = \varphi'_{1,t} R_{G,t} + \varphi'_{2,t} R_{\mathrm{CF},t} + \sum_{j=1}^{J_i} \varphi'_{3,j,t} R_{\mathrm{ADR}_j,t} + \mu_t, \tag{8}$$

where

$$\varphi'_{1,t} = \alpha_0 + \alpha_{\mathrm{CF}} D_{\mathrm{CF},t} + \alpha'_{J_i} D_{\mathrm{ADR}_{Ji},t}, \tag{9}$$

$$\varphi'_{2,t} = \beta_{\mathrm{CF}} D_{\mathrm{CF},t} + \beta'_{J_i} D_{\mathrm{ADR}_{Ji},t}, \quad \text{and} \tag{10}$$

$$\varphi'_{3,j,t} = \gamma'_{j,J_i-j+1} D_{\mathrm{ADR}_{J_i-j+1},t} \qquad j = 1, \ldots, J_i. \tag{11}$$

For each market I, we use as regressors the return of the previously estimated portfolio $(R_{G,t})$, the return on the CF $(R_{\mathrm{CF},t})$, and the returns from ADRs $(R_{\mathrm{ADR}_j,t})$. The set of J_i eligible ADRs varies for each of the countries in our data set (see list in Table 1). D_{CF} is a dummy variable set to one at the introduction of the CF. The $D_{\mathrm{ADR}_{J_i}}$ is a vector of dummies set to one at the introduction of the ADRs on U.S. exchanges.[7] The use of dummies allow us to obtain time-varying portfolio weights. The fitted value of this regression is R_{DIV}, the most correlated DIV.

B. Estimating the E-L (1985) Model

The E-L (1985) model assumes a constant investment opportunity set. Testing a fully conditional model would require additional risk premia to hedge against changes in the investment opportunities. Thus, we would need to derive a formal intertemporal model that is beyond the scope of this paper. However, it is important to point out that the conditional model is, indeed, internally inconsistent as argued by Dumas and Solnik (1995).

From the E-L (1985) model, the following system of equations must hold at any point in time,

$$\begin{aligned} E_{t-1}[r_{I,t}] &= \delta_{W,t-1}\mathrm{cov}_{t-1}[r_{I,t}, r_{W,t}] + \lambda_{I,t-1}\mathrm{var}_{t-1}[r_{I,t}|r_{\mathrm{DIV},t}], \\ E_{t-1}[r_{\mathrm{DIV},t}] &= \delta_{W,t-1}\mathrm{cov}_{t-1}[r_{\mathrm{DIV},t}, r_{W,t}], \\ E_{t-1}[r_{W,t}] &= \delta_{W,t-1}\mathrm{var}_{t-1}[r_{W,t}], \end{aligned} \tag{12}$$

[7]Note that for the ADRs the size of this vector changes as it excludes the dummy of the previously introduced ADR.

TABLE 1

The Set of Eligible Securities

Table 1 contains the eligible set of securities used to compute the DIVs for each country. The set consists of 38 MSCI global industry portfolios, eight CFs, 25 ADRs, and the MSCI world index.

Panel A. Global Industry Indices

Aerospace and Military Technology	Energy Equipment and Services	Metals (steel)
Appliances and Household Durables	Energy Sources	Misc. Materials and Commodities
Automobiles	Financial Services	Multi-Industry
Banking	Food and Household Products	Real Estate
Beverages and Tobacco	Forest Products and Paper	Recreation and other Consumer Goods
Broadcasting and Publishing	Gold Mines	Telecommunications
Building Materials and Components	Health and Personal Care	Textiles and Apparel
Business and Public Services	Industrial Components	Transportation (airlines)
Chemicals	Insurance	Transportation (road and rail)
Construction and Housing	Leisure and Tourism	Transportation (shipping)
Data Processing and Reproduction	Machinery and Engineering	Utilities (electrical and gas)
Electrical and Electronics	Merchandising	Wholesale and International Trade
Electronic Components and Instruments	Metals (nonferrous)	

		Start Date
Panel B. Country Funds		
	Argentina Fund Inc.	Oct-91
	Brazil Fund Inc.	Apr-88
	Chile Fund Inc.	Sep-89
	India Growth Fund Inc.	Aug-88
	Korea Fund Inc.	Aug-84
	Mexico Fund Inc.	Jun-81
	Taiwan Fund Inc.	Feb-88
	Thai Fund Inc.	Feb-88
Panel C. ADRs		
Argentina		
	YPF S.A.	Jul-93
	BBVA Banco Frances S.A.	Nov-93
	Telefonica de Argentina S.A.	Apr-94
	Transportadora de Gas del Sur S.A	Nov-94
	MetroGas S.A.	Dec-94
Brazil		
	Aracruz Celulose	Jun-92
	Telecomincacoes Brasileiras S.A.	Dec-95
	Unibanco S.A.	Jun-97
	Companhia Brasileira de Distribuicao	Jul-97
	Ambev	Jul-97
Chile		
	Compania de Telecomunicaciones de Chile	Aug-90
	Compania Cervecerias Unidas S.A	Oct-92
	Madeco S.A.	Jun-93
	Masisa S.A.	Jul-93
	Enersis S.A.	Nov-93
Korea		
	Korea Electric Power Corporation	Nov-94
	Posco	Nov-94
	SK Telecom Company Ltd.	Jul-96
Mexico		
	Telefonos de Mexico S.A	Jun-91
	Vitro S.A.	Dec-91
	Empresas ICA S.A	May-92
	Banca Quadrum S.A	Aug-93
	Grupo Casa Saba	Jan-94
Taiwan		
	Macronix International Company Ltd.	Jun-96
	Taiwan Semiconductor Manufacturing Co.	Nov-97

where $r_{I,t}$ is the excess return on the country's market index, $r_{\mathrm{DIV},t}$ is the excess return on that country's DIV, and $r_{W,t}$ is the excess return on the world index. Note that the first equation in the system is the pricing equation for the EM index 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 homemade diversification and can be rewritten as $\mathrm{var}_{t-1}[r_{I,t}|r_{\mathrm{DIV},t}] = \mathrm{var}(r_I)(1-\rho^2_{I,\mathrm{DIV}})$. The second equation in the system prices the DIV with just the covariance risk with the world market and the last equation is the pricing equation for the world index portfolio.

Therefore, we write the previous system for estimation as

$$(13)\qquad \begin{aligned} r_{I,t} &= \delta_{W,t-1}h_{I,W,t} + \lambda_{I,t-1}h_{I,t}\left(1-\frac{h^2_{I,\mathrm{DIV},t}}{h_{I,t}h_{\mathrm{DIV},t}}\right)+\varepsilon_{I,t},\\ r_{\mathrm{DIV},t} &= \delta_{W,t-1}h_{\mathrm{DIV},W,t}+\varepsilon_{\mathrm{DIV},t}, \qquad \text{and}\\ r_{W,t} &= \delta_{W,t-1}h_{W,t}+\varepsilon_{W,t}, \end{aligned}$$

where $\delta_{W,t-1}$ and $\lambda_{I,t-1}$ are time-varying prices of global risk and local risk, respectively, and $h_{j,t}$ are the elements of H_t, the 3×3 conditional covariance matrix of the assets in the system. In particular, $\mathrm{var}[r_{I,t}|r_{\mathrm{DIV},t}]$ is parameterized as $\mathrm{var}(r_I)(1-\rho^2_{I,\mathrm{DIV}}) = (h_{I,t})(1-(h^2_{I,\mathrm{DIV},t}/h_{I,t}h_{\mathrm{DIV},t}))$ with $h_{I,\mathrm{DIV},t}$, the time-varying covariance, and $h_{I,t}$ and $h_{\mathrm{DIV},t}$, the time-varying variances.

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

$$(14)\qquad \delta_{W,t-1} = \exp(k'_W Z_{W,t-1})$$

be a nonlinear function of a set of global information variables, and

$$(15)\qquad \lambda_{i,t-1} = \exp(k'_i Z_{i,t-1}), \qquad i = 1,\ldots,I,$$

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

Following Bekaert and Wu (2000), we specify the dynamics of H_t as:

$$(16)\qquad H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B,$$

where C is a (3×3) upper triangular matrix of constant coefficients, A and B are (3×3) parameter matrices where the off-diagonal coefficients are set to zero, except for those corresponding to the world column. Such parameterization considerably reduces the number of parameters to be estimated, while preserving flexibility in the volatility dynamics. This implies that lagged world level shocks impact all conditional variances and covariances, while shocks of the other assets only enter their own variances and covariances with the world. The H_t matrix used in Bekaert and Wu (2000) also accounts for asymmetry while B-H (1997) explored asymmetry for a number of EMs in a univariate setting. Adding this feature would further complicate estimation and we show in Section V that asymmetry is not prevalent in our monthly data set.

Equations (13) and (16) give the model for estimation. Assuming a normal conditional density, the log likelihood function is written as

$$(17) \qquad \ln L(\theta) \quad = \quad -\frac{Ts}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{T}\left[\ln\left|H_{t(\theta)}\right| + \varepsilon_t(\theta)' H_{t(\theta)}^{-1}\varepsilon_t(\theta)\right],$$

where θ is the vector of unknown parameters in the model and s the number of system equations. The estimation is performed using the BFGS (Broyden, Fletcher, Goldfarb, and Shanno (1985)) 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).[8] To avoid incorrect inference due to the misspecification 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 that will allow us to construct a measure of time-varying integration.

We estimate I separate trivariate systems, one for each EM in our sample. Since the theory predicts that the world price of risk should be the same for each country, we proceed in two steps. We first estimate the world return equation of the system (13). This provides us with estimates of the time-varying world price of risk and of the coefficients of the time-varying world variance. We then impose these estimates in the I country estimations. As pointed out in B-H (1995), this procedure has the drawback of including sampling errors from the first stage, but it is more in line with the theory and produces more powerful tests. A drawback of this approach is that we will not be able to simultaneously test for global and local risk.

IV. Data and Summary Statistics

Among all EMs, we select those that fit two criteria. First, we need a relatively long sample to facilitate estimation and provide reliable statistical inference. Second, from the subset of countries that meet the first selection criteria, we include those countries with a CF traded on the U.S. markets. This leaves us with eight EMs: Argentina, Brazil, Chile, India, Korea, Mexico, Taiwan, and Thailand. The indices are obtained from the 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 1977 to December 2000, except for Taiwan where the data start in December 1985. We use the one-month Eurodollar rate from Datastream as the risk-free rate.

We use the MSCI world index, 38 MSCI global industry portfolios, CFs, and a sample of ADRs listed on U.S. markets as the eligible set. The number of

[8]We should note, however, that a proof specifically for GARCH-in-mean models is still not available in the literature.

ADRs varies for each country. In the case of Argentina, Chile, and Mexico, a large number of ADRs started listing on U.S. exchanges at different times over our sample period. To preserve degrees of freedom in our regression, for these countries we select up to five ADRs per country based on their listing date.[9] All U.S.-based return data are from the CRSP data set. A complete list of the set of eligible securities is reported in Table 1.

Table 2, Panel A reports descriptive statistics. The relative behavior of EM returns is similar to that reported in past literature. Briefly, EM returns on average are large and display high volatility. The data show a 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.

TABLE 2

Summary Statistics for Assets Returns

Table 2 presents statistics for assets returns. Country equity indices are from IFC (International Finance Corporation) and the world equity index is from MSCI (Morgan Stanley Capital International). Returns are denominated in USD and in excess of the one-month Eurodollar deposit rate. Mean and standard deviation are in annualized percentage terms. The period is from January 1977 to December 2000 except for Taiwan where the data start in December 1985. 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 the Ljung-Box test for autocorrelation of order 12 for the returns and for the returns squared. * indicates significance at the 5% level, and ** indicates significance at the 1% level.

Panel A. Distributional Statistics

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand	World
Mean	31.25	17.02	17.45	6.75	6.14	17.00	15.81	5.14	3.18
Std. dev.	81.49	55.90	34.57	28.23	39.20	42.12	45.78	36.21	14.03
Skewness	2.62**	0.48**	0.92**	0.55**	1.27**	−0.81**	0.62**	0.27	−0.55**
Kurtosis	14.73**	1.44**	4.64**	1.33**	5.81**	3.64**	2.10**	3.00**	1.66**
B-J	2,835**	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	10.00	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

Panel B. Pairwise Correlations for Assets Returns

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Country index and world	0.069	0.197	0.141	0.051	0.306	0.319	0.288	0.318
Country index and div. portfolio	0.299	0.665	0.503	0.527	0.725	0.734	0.552	0.726
Div. portfolio and world	0.475	0.363	0.336	0.177	0.479	0.453	0.574	0.486

Panel B of Table 2 contains pairwise correlations between each country index and DIV with the world index, which is used as a benchmark, and correlation between each country index with its respective DIV. As expected, for the country indices correlations with the world index are very low while those with DIVs are remarkably higher.

In our estimations, we employ two sets of information variables used widely in previous research. The global information variables are: a constant; the U.S. term structure spread; the U.S. default spread; and the world dividend yield in

[9]Some studies, such as B-H (2000), consider only the first ADR introduction as a potential liberalization event. We estimate alternative DIVs by including in the eligible set only the first ADR in addition to the CF. These portfolios exhibit correlations with the country index similar to those obtained with multiple ADRs except in the case of Chile, where the correlation increases from 0.47 to 0.503 as a result of the additional ADRs. See Sarkissian and Schill (2004) for more evidence on ADR introduction as a liberalization event.

excess of the risk-free rate. The set of local information variables includes a constant, the change in the local exchange rate, and the local equity return in excess of the risk-free rate. In the case of Taiwan, exchange rates are not available from the beginning of the sample, thus we use only one local information variable. All information variables are lagged.

V. Results

A. Tests for the Asset Pricing Model

As discussed in Section II, the E-L (1985) model explains asset returns as a function of two premia, a global risk premium and a super risk premium that is proportional to the conditional local risk. We first estimate only the world equation of the trivariate system (13). The average of the estimated global price of risk (1.57) is in line with previously reported measures, however, we do not find significant time variation (p-value of 0.22) most likely because of lack of power in a univariate setting. On the other hand, the GARCH coefficients for time variation in second moments are all significant. While the non-normality has not been eliminated from the residuals, the Engle-Ng diagnostics test shows no evidence of negative asymmetry in the index.

In the second step, we perform the estimation of the system (13) for each country to obtain covariances with the world returns and the super risk premium. Panel A of Table 3 contains the results of these estimations. For each country, we report a robust Wald test for time variation in the local price of risk. In line with our beliefs on EMs, we find that local risk is a relevant source of risk across most of the assets in our sample. The hypothesis that the local price of risk is constant is rejected in five cases and marginally rejected in one case, allowing us to conclude that there is significant time variation in returns that can be explained by the local factor.

All estimated models provide strong evidence that the asset returns follow a GARCH process. The diagonal GARCH coefficients are highly significant and indicate high persistence for all countries, while a few of the off-diagonal coefficients are significant only in the case of Brazil and India. Panel B of Table 3 reports some diagnostics tests on the estimated residuals. The non-normality in the data is reduced in all cases although it is still remarkably high in the case of Argentina.[10] Most indices of kurtosis and the Bera-Jarque statistics are improved relative to the raw returns in Table 2 except in the case of Taiwan, which is the series with the short time span. We find no residual 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. Therefore, we conclude that we cannot find consistent evidence of asymmetry in the relation between conditional second moments and innovations.

[10]These results are driven by the clustering of very large negative values in the period of hyperinflation. The model is unable to fit the exceptional volatility in returns and estimates extreme values for the price of local risk. Thus, the evidence should be interpreted with caution.

TABLE 3

The E-L (1985) Model

The estimated model is:

$$\begin{aligned} r_{I,t} &= \delta_{W,t-1}\text{cov}_{t-1}(r_{I,t}, r_{W,t}) + \lambda_{I,t-1}\text{var}_{t-1}(r_{I,t}|r_{\text{DIV},t}) + \varepsilon_{I,t}, \\ r_{\text{DIV},t} &= \delta_{W,t-1}\text{cov}_{t-1}(r_{\text{DIV},t}, r_{W,t}) + \varepsilon_{\text{DIV},t}, \\ r_{W,t} &= \delta_{W,t-1}\text{var}_{t-1}(r_{W,t}) + \varepsilon_{W,t}, \end{aligned}$$

where $r_{I,t}$ is the country index excess return, $r_{\text{DIV},t}$ is the diversification portfolio excess return, $r_{W,t}$ is the world index excess return, $\delta_{W,t-1}$ is the price of world covariance risk, $\lambda_{I,t-1}$ is the price 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: $\delta_{W,t-1} = \exp(\kappa_W' \mathbf{Z}_{w,t-1})$, where $\mathbf{Z}_W$ is a set of information variables that includes a constant, the U.S. default spread, the U.S. term structure spread, and the world dividend yield in excess of the risk-free rate, $\lambda_{i,t-1} = \exp(\kappa_i' \mathbf{Z}_{i,t-1})$ where $\mathbf{Z}_i$ is a set which includes a constant, the change in the local exchange rate and the local index excess return and $i = 1, \ldots, I$. H_t is the time-varying conditional covariance parameterized as: $H_t = C'C + A'\varepsilon_{t-1}\varepsilon_{t-1}'A + B'H_{t-1}B$, where C is a (3×3) upper triangular matrix of constant coefficients, A and B are (3×3) parameter matrices where the off-diagonal coefficients are zero, except for those corresponding to the world. 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 USD. There are 288 observations from January 1977 to December 2000 except for Taiwan where the data start in December 1985. The model is estimated by Quasi-Maximum Likelihood in two stages. We estimate first the equation for the world index returns and then impose the estimates of $\delta_{W,t-1}$, c_W, a_W, and b_W in each country estimation. p-values for a robust Wald test for the pricing hypothesis are reported under each country.

Panel A. Specification Tests

Null Hypothesis	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan[a]	Thailand
Time-varying local risk $\kappa_{i,j} = 0$, for $j > 1$	0.2290	0.0843	0.0091	0.0040	0.5635	0.0071	0.0007	0.0042

[a] with one information variable since exchange rates are not available over the sample.

Panel B. Diagnostics for the Residuals

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 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. * indicates significance at the 5% level, and ** indicates significance at the 1% level.

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Skewness	1.54**	0.32*	0.32*	0.50**	0.76**	−0.60**	0.96**	0.86*
Kurtosis	7.89**	1.06**	1.99**	0.92**	3.14**	2.16**	2.76**	2.10**
B-J	825.7**	17.53**	51.35**	21.55**	140.95**	70.41**	80.66**	54.5**
$Q(z)_{12}$	6.79	9.31	36.10**	5.58	7.79	36.03**	9.99	38.77**
$Q(z^2)_{12}$	2.61	13.18	17.32	9.96	2.85	9.07	12.57	9.67
Asym$^-$	0.49	0.55	0.52	0.88	−1.95**	−0.45	0.02	−0.05
Asym$^+$	−0.34	−0.60	−1.27	0.27	−0.56	−1.74	1.12	−0.59

B. Time-Varying Integration

To gain insights on the degree of market integration and its variation through time, we construct an estimate of the II. As shown in Section II, the E-L (1985) index should be one under complete integration and zero under complete segmentation. Panel A of Table 4 reports statistics on the estimated indices from our model. Over the whole period, the means indicate different levels in the degree of integration, ranging from 0.605 for Mexico, the highest index, to 0.249 for India, the lowest. We report subperiod averages using the B-H (1995) end period because one of our goals is to analyze this issue given the developments since the B-H (1995) study. In all cases, the subperiod means for the indices suggest a remarkable increase in the degree of integration after 1992. Before 1992, Argentina appears to be the most segmented and Mexico is the most integrated after 1992.

To statistically support our claim, we perform a simple test for a structural break in the series. We test the null hypothesis that the break happened after January 1992 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

TABLE 4

Estimated Integration Indices

Panel A of Table 4 contains statistics for the integration indices estimated from the model in Table 3. The overall mean and standard deviation, means over subperiods, and 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-1992 period. Panel C contains the parameters of a structural break test for the post-1992 period from the cross-sectional time series of all the estimated indices. The regression includes fixed effects. All the standard errors are heteroskedasticity and autocorrelation consistent and are obtained from the Newey-West correction. * indicates significance at the 5% level, and ** indicates significance at the 1% level.

Panel A. Statistics

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Overall mean	0.368	0.453	0.403	0.249	0.359	0.605	0.428	0.306
before 1992	0.114	0.275	0.183	0.186	0.258	0.426	0.284	0.161
after 1992	0.793	0.751	0.769	0.354	0.529	0.902	0.526	0.547
Standard deviation	0.366	0.299	0.318	0.175	0.227	0.300	0.194	0.263

Panel B. Test for Structural Break in the Indices

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Trend × 100	0.03	0.18*	0.22**	0.03	0.26**	0.2**	0.22*	0.15*
s.e.	(0.06)	(0.08)	(0.05)	(0.03)	(0.05)	(0.05)	(0.10)	(0.08)
Dummy	0.623**	0.203	0.257**	0.114	−0.111	0.173	0.037	0.156
s.e.	(0.133)	(0.131)	(0.074)	(0.088)	(0.076)	(0.097)	(0.106)	(0.129)

Panel C. Test for Structural Break with Pooled Data

Trend × 100	0.16**
s.e.	(0.02)
Dummy	0.197**
s.e.	(0.048)

consistent with the fact that liberalizations in EMs started in the late 1980s. Due to the high serial correlation in the series, we compute Newey-West (1987) standard errors for our test. We start by assessing the importance of a trend and a break in separate regressions. We find that in all instances the trend and the dummy are highly significant. The four countries in Latin America show the largest break while the smallest one is found for India, then Thailand and Korea. Panel B of Table 4 contains results of the country by country analysis when we include both the trend and the dummy in the same regression. The change in the average II is positive and it is now statistically significant in two of the eight countries while the trend is significant for all countries except India and Argentina. The largest change is still recorded for Argentina, followed by Chile and Mexico. Korea and Taiwan, which previously had a small break, show no significant break when the trend is included. As a joint test of increased integration across all countries, we pool the time series 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 similar for the fixed effects case. The average change across the countries is 0.197 and is significant at any statistical level.

To assess the evolution of market integration through time, we plot the E-L (1985) IIs in Figure 1, Graphs A through H. These plots provide valuable insights and 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. For a general overview, we focus on two patterns: reversals in the integration process and trends after the B-H (1995) end period. Thus, we superimpose a plot of the Hodrick-Prescott (H-P) filtered series. As is evident, the indices do not show an ever-increasing process since they often level out and even decrease, which is in line with the idea that liberalizations can stall and at times reverse. For example, we can point out reversals in Chile between 1983 and 1985 and in Mexico around 1986. After 1990, when most countries had already started their liberalization process, we observe a leveling out in Thailand and Mexico in the last five years and reversals in India and Chile. Korea appears to be a country with no dramatic reversals, reflecting the gradual lifting of foreign ownership restrictions that the country has implemented. When we look at the overall trend, we see that while for some countries significant increases took place at the very end of the 1980s, a few countries show a larger increase only in the last few years of our sample. This is very striking in the case of Argentina. These findings conform to our a priori expectations based on reduction in barriers to portfolio flows, general liberalization of capital markets, increased availability of ADRs and CFs, increased portfolio flows, better information, and investor awareness. However, they also reflect the fact that liberalization is a complex and gradual process and its impact actually lags the official dates of reforms as Bekaert et al. (2002) point out.

On the same graphs, we also plot the benchmark II, which is obtained from the second-step estimation of a system that includes only the country index and the world market as the DIV. This benchmark index is interesting as it helps uncover the specific contribution of CFs and ADRs. Since we are interested in the general differences between the II and this benchmark, we only report the H-P filtered series. As evidenced throughout all the figures, the benchmark index is always remarkably lower than the index obtained in the system that includes the tracking securities. This confirms that ADRs and CFs are indeed very important in integrating financial markets. It is also interesting to note that in some instances the two indices move in different directions, an indication that the integration process has been different than the dynamics of the world correlations that can be inferred from the benchmark IIs.

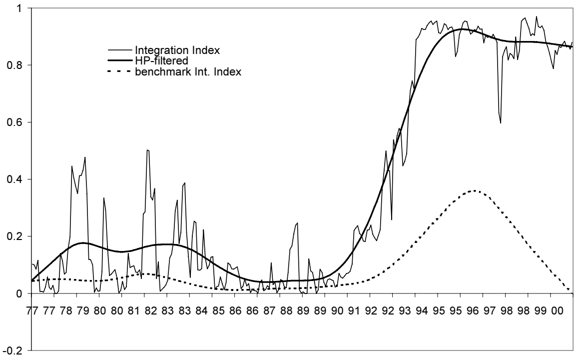
Although it is difficult to compare our results with past studies that use different methodologies and data sets, in what follows we briefly discuss the behavior of our sample markets and compare our results with those of past researchers. The essentially segmented nature of the Argentinian market prior to the 1990s is not surprising given its rather recent liberalization. Nonetheless, the removal of restrictions on repatriation (holding period) and high taxes in October 1991, the introduction of the Argentina Fund on the NYSE in November 1991, ADR listings beginning in 1993–1994, and the maintenance of the currency board starting in April 1991 seem to have led to a quantum jump in the degree of integration with the index averaging 0.793 after 1992. Argentina is indeed the country that shows the largest break in correspondence of the 1992 dummy.

In the case of Brazil, the results suggest a mildly segmented market during the first part of our sample period, which is followed by increasing levels of integration beginning around the introduction of the Brazil Fund in April 1988 and a constant stream of ADRs since 1992. The average level of integration at 0.75 after 1992 suggests that this market is one of the most integrated during the recent period among our sample countries. Past studies and, most notably, B-H (1995) did not include Argentina and Brazil in their investigation.

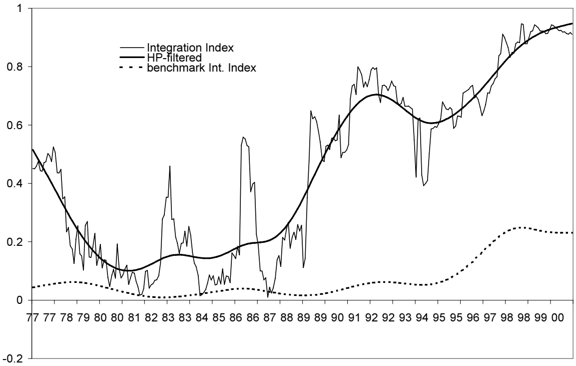
FIGURE 1

Integration Index

Graph A. Argentina



Graph B. Brazil



Graph C. Chile

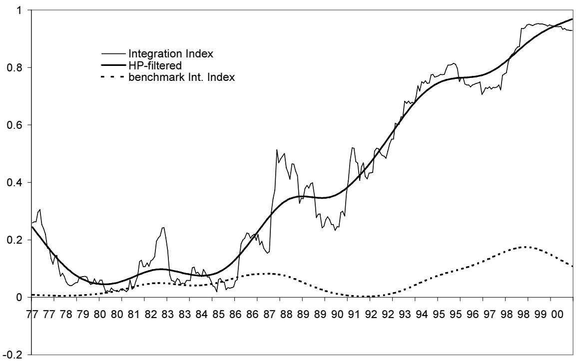


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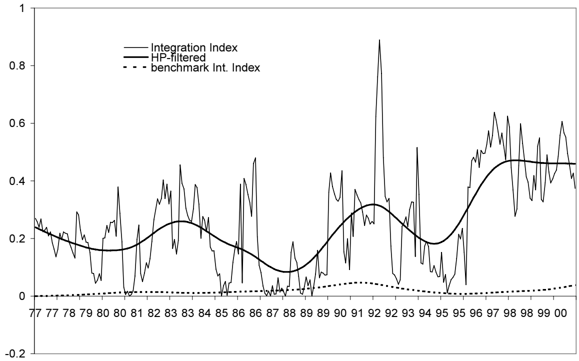
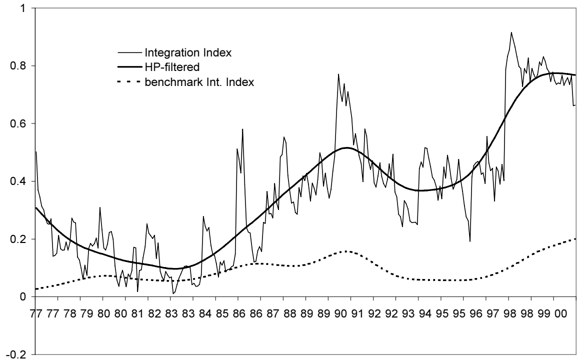
FIGURE 1 (continued)

Integration Index

Graph D. India



Graph E. Korea



Graph F. Mexico

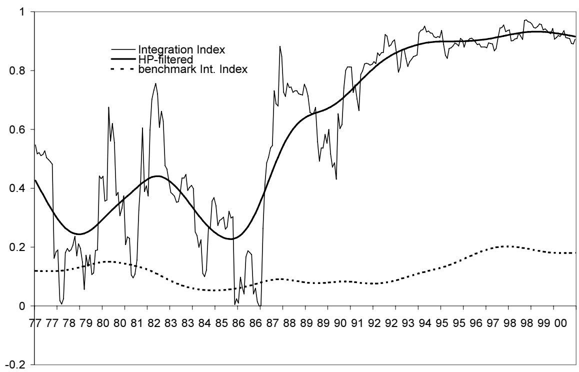


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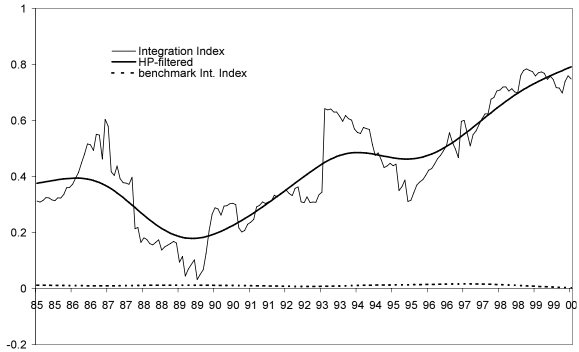
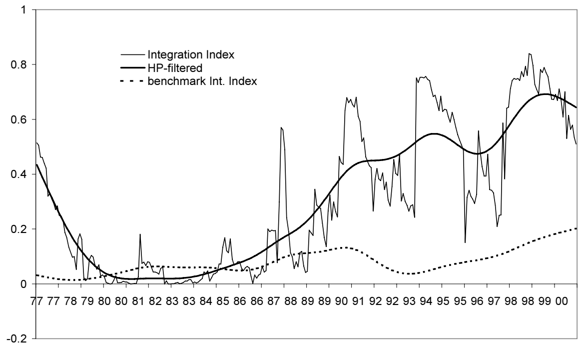
FIGURE 1 (continued)

Integration Index

Graph G. Taiwan



Graph H. Thailand



The Chilean market is essentially segmented until the late 1980s reflecting high taxes and the holding period requirements on foreign investors. However, this is followed by an uptrend in the II around the introduction of the Chile Fund in 1989 and subsequently of the ADRs, which attained very high levels toward the end of our sample period. Note that the average value for the II of 0.403 for the whole sample period and 0.769 during the 1990s is in sharp contrast to that reported by B-H (1995) of 0.59 for the whole period and 0.26 at the beginning of the 1990s.

The Indian market was essentially segmented during the first half of the sample period until around 1988 corresponding to the introduction of the India growth fund on the NYSE. This is in sharp contrast to B-H's (1995) results, which suggest that India was fully integrated until the end of 1984, a result difficult to explain given the significant barriers to cross-border real and financial flows as well as the lack of Indian ADRs or CFs on the world markets. However, our results are consistent with B-H (1995) who report a low degree of integration after 1984 and some recent (early 1990s) evidence of a movement toward higher levels of integration. Our average II of 0.249 for the whole sample period and 0.354 during the 1990s is consistent with the introduction of ADRs, CFs, and the gradual liberalization of foreign portfolio flows that began in 1992.[11]

The Korean market is neither completely segmented nor very integrated, i.e., it is mildly segmented throughout our sample period, remaining at low levels until the mid-1980s and reaching an average of 0.529 since 1992. This result is consistent with the stringent controls on foreign portfolio investments at the beginning of our sample period that have been gradually liberalized as well as the availability of CFs since the mid-1980s and ADRs since the mid-1990s. Although these result are somewhat different from B-H (1995) who suggest Korea is 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.

The II for Mexico suggests this market is the most integrated of our sample countries with an average index level of 0.605 and a very high level of 0.902 since 1992. The market was mildly segmented until about 1986, followed by a peak around October 1987 that reflected a major correction of the Mexican market during the market crash. Since then, the II 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 and ADR listings since 1991. These results are intuitive given the degree of U.S. investor participation in Mexican stocks.

The Taiwan market appears to be mildly segmented during the first half of our sample period with the II in the range of 0.1–0.6. Although this is one of the largest and most liquid of the EMs with a number of CFs listed on mature markets, historically it has imposed significant barriers including investment restrictions and repatriation limits. However, since 1990 there is a steady increase in the level of integration with a significant uptrend around the introduction of ADRs in the mid-1990s.

The Thai market appears to be mildly segmented throughout our sample period. The index shows a modest uptrend in integration beginning in 1987–1988 preceding the introduction of the Thai fund and the opening of the Alien board on the Bangkok exchange. After that, the index trends upward in response to further liberalization and levels out in the last few years. Overall, this market is one of the least integrated in our sample with an average index level of 0.306 and an average level of 0.54 since 1992.[12]

C. Market-Wide Correlations as Integration Measures

Theoretical IAPMs suggest the impropriety of using market-wide correlation coefficients as a measure of integration. Indeed, directly using stock market correlations is problematic since it does not control for economic fundamentals within each country as demonstrated by Dumas, Harvey, and Ruiz (2003). They theoretically link stock market correlations to countries output correlations after controlling for economic fundamentals and show that correlations of stock returns are larger in integrated markets than in segmented markets. In this section, we

[11]Note that in the case of India, the first exchange-traded ADR we found is Infosys Technologies, which started trading in 1999, and thus the DIV only includes the CF.

[12]Since no ADRs were listed on major U.S. exchanges in our sample period, the DIV only includes the CF.

provide further corroborating evidence on the impropriety of inferring financial market integration from market-wide correlations.

Panel B of Table 2 summarizes the unconditional market-wide correlations of each EM in our sample with the world market index and their corresponding DIV. It is not surprising that the correlation of each EM is substantially higher with its DIV than with the world index, given that we constructed the DIV as the most correlated portfolio. Further, CFs and ADRs 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 global market returns. In Panel A of Table 5, we first report the overall means and the subsample means for the unconditional correlations between the world and each EM country that are at times used as a proxy for market integration. We then report the time-varying correlations between the world and each EM country estimated from the bivariate system with the two-step methodology. When compared with the results of Table 4, it is apparent that both the unconditional and the conditional correlations of market-wide country indices with the world market index would underestimate the degree of integration, given the ability of investors to achieve homemade diversification.[13] This evidence is particularly striking in the post-1992 period when world correlations are much lower than the IIs for all countries.

TABLE 5

Estimated World Correlations

Panel A of Table 5 contains the overall and subperiod means for the time-varying correlations between each country and the world obtained in the second step from the bivariate model. Panel B reports *p*-values for a one-sided test for difference in means. The test is based on the null hypothesis that the mean of the time-varying world correlations with each country is higher than the mean of the integration indices of Table 4. Panel C contains the parameters for a structural break test for the post-1992 period from the cross-sectional time series of all the estimated world correlations. The regression includes fixed effects. All the standard errors are heteroskedasticity and autocorrelation consistent and are obtained from the Newey-West correction. * indicates significance at the 5% level, and ** indicates significance at the 1% level.

	Argentina	Brazil	Chile	India	Korea	Mexico	Taiwan	Thailand
Panel A. Statistics								
Unconditional Mean								
Overall	0.069	0.197	0.141	0.051	0.306	0.319	0.288	0.318
before 1992	−0.023	0.095	0.045	0.015	0.226	0.236	0.209	0.240
after 1992	0.485	0.392	0.328	0.013	0.389	0.479	0.370	0.441
Conditional Mean								
Overall	0.184	0.223	0.196	0.041	0.279	0.316	0.076	0.237
before 1992	0.054	0.144	0.147	0.045	0.275	0.280	0.066	0.221
after 1992	0.401	0.356	0.277	0.034	0.285	0.375	0.083	0.265
Standard deviation	0.251	0.157	0.148	0.129	0.117	0.132	0.073	0.150
Panel B. Test for Difference in Means with the Integration Indices								
Overall	0.041	0.024	0.036	0.000	0.154	0.000	0.000	0.149
after 1992	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Panel C. Test for Structural Break with Pooled Data								
Trend × 100	0.04*							
s.e.	(0.02)							
Dummy	0.051							
s.e.	(0.041)							

[13]In the case of Taiwan, the conditional time-varying correlation is substantially out of line with the unconditional one. This is likely due to this country's limited time period. By fixing the estimates of the world conditional variance in the first step, the fitted conditional correlation is unable to reproduce in the second step the level of the unconditional correlation.

To provide statistical support to this claim, we perform a very simple test. For each country, we investigate whether the time series of the estimated market-wide correlations in Table 5 have a higher mean than the IIs of Table 4. Since there is evidence of serial correlation for both series, we use Newey-West adjusted standard errors. The results are in Panel B of Table 5. The one-sided test rejects at the 5% level or better in the case of Argentina, Brazil, Chile, India, Mexico, and Taiwan. When we perform the same test for the post-1992 period, we strongly reject for all countries. The two-sided test for equality between the series after 1992 also rejects for all countries. We can thus conclude that over the sample the IIs have a significantly higher mean than the country-wide correlations. Finally, we perform a test for a structural break after 1992 similar to the one performed on the IIs of Table 4. In the country by country estimations, we find no common pattern as the dummy is negative in some instances or positive if it is associated with a negative trend (not reported). In Panel C of Table 5, we show the results when we pool the data. Both coefficients are smaller than the coefficients in Panel C of Table 4. The estimated trend is positive and significant, but in contrast to the evidence on the IIs there is no evidence of a common structural break. In summary, these results show the impropriety of directly using correlations of market-wide index returns as a measure of market integration, especially after the institutional changes that financial markets underwent in the last decade.

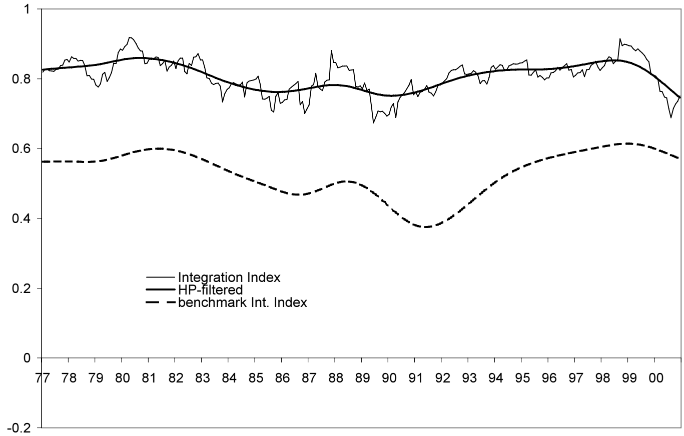
D. Robustness

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 Canada, a small mature market that we suspect to have been well integrated over the sample period. We first estimate the most correlated DIV and then the asset pricing model in equations (13) and (16). Since companies representing almost 50% of TSE300 market capitalization are cross-listed on the NYSE, AMEX, or NASDAQ, the construction of the DIV includes global industry indices and three equally weighted portfolios of Canadian securities cross-listed on the three major U.S. exchanges. The regression to obtain the DIV includes only one dummy variable in correspondence of the introduction of the first Canadian security on NASDAQ, since at the beginning of our sample there are already a number of securities trading on the NYSE or the AMEX. With respect to the pricing test, we find that local risk is only marginally significant (p-value 0.084) in explaining the time variation for market returns while the estimated local premium component represents on average over the whole sample of around 15% of the total premia. Figure 2, Graph A contains a plot of the estimated II. The index has an average of 0.808, which is larger than that of any of the EMs 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 a major shift in the degree of integration. In this case as with the EMs, the benchmark II is lower than the estimated index but tracks it more closely. Overall, these results indicate that our previous findings on the pricing of EMs are not simply due to sample selection and that the methodology can be equally informative across all markets.

FIGURE 2

Integration Index

Canada



VI. What Drives Market Integration?

Although we do not currently have a comprehensive theory to explain what drives market integration, both academics and practitioners have a broad understanding of the important factors. In the previous section, we assess the evolution of market integration through time, however, to date no paper has systematically dealt with this issue. In the past, papers like B-H (1995) 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 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 (1995) 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 used by Bhattacharya and Daouk (2002) in their simplified version of the B-H (1995) model and in the financial development literature by Demirguc-Kunt and Levine (1996) and Rajan and Zingales (2000). Finally, we investigate whether financial liberalization policies have a direct effect on integration. Since the dating of liberalizations is a subject of debate, we rely on two different measures. The first one is a liberalization dummy set at the official liberalization dates of B-H ((2000), Table 1). 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 (2002).[14]

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

$$\text{II}_{i,t} = \alpha_i + \tau + \beta' X_{i,t-1} + \varepsilon_{i,t} \qquad i, = 1, \ldots, I. \tag{18}$$

In estimation, we allow for fixed effects by setting a different intercept per 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.[15] In addition, since there is evidence that returns are more correlated in volatile markets, we add the log of the preestimated world volatility as a control variable.[16] Due to the high serial correlations in the series, we compute Newey-West standard errors for our tests and we correct for heteroskedasticity.

Table 6 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 large and positive, indicating that higher financial market development is linked to a higher degree of integration. The size of the trade sector to GDP is of the opposite sign since we expect that integration should increase when economic integration increases, however, it is not significant in almost all instances.[17] We also find a positive and significant liberalization effect linked to the official dates recorded by B-H (2000). The increase in the degree of integration in correspondence of these dates is 0.155 in the univariate regression. The coefficient only decreases to 0.140 in the multivariate regression after controlling for the development indicators and volatility.[18] The other measure of liberalization is of the right sign as integration should increase with lower financial repression but significant only in the univariate regression. Finally, the coefficient for the conditional market volatility has a different sign in the univariate and multivariate regression but it is not significant.

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

[14]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 (2002) for generously providing this data.

[15]Due to the statistical properties of the series, we include the trend to control for possible non-stationarity in the series. This problem is also alleviated since in the main test we pool the countries for estimation.

[16]A variable that measures the closeness of a country's industry mix to the world industry mix would also be useful. Unfortunately, we could not construct such a measure for our sample countries.

[17]B-H (2000) find that the trade measure is significant and of the expected sign in explaining dividend yields, volatility, and correlations with the world for a number of EMs. Within this general framework, Henry (2000) finds the significance of a trade liberalization dummy for EM expected returns and dividend yields.

[18]If we exclude the time trend, the explanatory power of the integration dummy especially increases, indicating a strong link between de facto and de jure integration.

TABLE 6

What Drives Market Integration?

Table 6 contains results from cross-sectional time-series regressions 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, WVOL is the log of the preestimated world volatility, LIBER is a dummy set to one at the dates of official liberalization from Table I in Bekaert and Harvey (2000), ACQ is an index for acquisition of shares by foreign investors (3 = total repression, 2 = semi-repression, and 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, except for world volatility. The regressions include a trend. Standard errors in parentheses are heteroskedasticity and autocorrelation consistent and are obtained from the Newey-West correction. [a]The regression excludes India, since data on acquisition are not available for this country. * indicates significance at the 5% level, and ** indicates significance at the 1% level.

Panel A. Univariate Regressions

	MCAP	R^2	EXIM	R^2	WVOL	R^2	LIBER	R^2	ACQ[a]	R^2
Fixed effects	0.369**	0.65	−0.006	0.63	−0.038	0.63	0.155**	0.65	−0.079**	0.67
	(0.093)		(0.091)		(0.074)		(0.050)		(0.029)	
No fixed effects	0.239**	0.52	−0.001	0.51	−0.038	0.51	0.169**	0.54	−0.054	0.57
	(0.087)		(0.063)		(0.091)		(0.057)		(0.037)	

Panel B. Multivariate Regressions

	MCAP	EXIM	WVOL	LIBER	ACQ[a]	R^2
Fixed effects	0.314**	−0.006	0.090	0.14**		0.66
	(0.094)	(0.086)	(0.081)	(0.054)		
	0.260*	−0.032	0.012		−0.051	0.68
	(0.113)	(0.105)	(0.082)		(0.035)	
No fixed effects	0.243**	−0.063	0.091	0.167**		0.55
	(0.078)	(0.061)	(0.096)	(0.061)		
	0.216*	−0.159*	−0.0001		−0.013	0.58
	(0.087)	(0.070)	(0.094)		(0.040)	

VII. 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 the world market even though explicit barriers to portfolio flows are in place. We study eight emerging markets over the period 1977–2000 and use GARCH-in-mean methodology to estimate their degree of integration based on the two-factor Errunza-Losq (1985) asset pricing model.

Our results suggest that while local risk is still an important factor in explaining time variation of emerging market returns, none of the countries appears to be completely segmented. The estimated integration indices suggest there are wide ranges in the degree of integration. Whereas Mexico is on average the most integrated over the whole sample, India is the most segmented. Overall, the evolution toward more integrated financial markets is apparent although at times we do observe reversals. 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. The evidence also provides a clear indication of the impropriety of directly using correlations of market-wide index returns as a measure of market integration since such correlations consistently underestimate the degree of integration, especially over the last decade. Finally, financial market development and financial liberalization policies play important roles in the integration of emerging markets.

While the evolution of integration documented in this study conforms to our expectations, it is very interesting to observe increasingly integrated financial markets during the late 1990s. This suggests that liberalization is a complex and gradual process and we had not witnessed its full impact by the early 1990s. Indeed, the process will continue through reduction in barriers to capital flows, further liberalization of capital markets, increased availability of country funds and American Depository Receipts, better information, and investor awareness. There is still room for policy makers in emerging markets to further liberalize.

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