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Capital Control Liberalization and Stock Market Development*

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Summary. — This paper addresses two questions. First and foremost, what happened to stock market size, liquidity, volatility, and international integration following capital control liberalization in 16 emerging market economies? Second, what is the empirical relationship between stock market size, liquidity, volatility, and international integration and regulations concerning information disclosure, accounting standards, and investor protection? We find that stock markets tend to become larger, more liquid, more volatile, and more integrated following the liberalization. In addition, countries with firms that widely disseminate comprehensive information have larger, more liquid, and more internationally integrated markets. © 1998 Elsevier Science Ltd. All rights reserved

Key words — financial policy, capital flows, stock markets

1. INTRODUCTION

In light of theory and evidence that the functioning of stock markets may affect national saving rates, the allocation of those savings, firm financing decisions, and economic growth,[1] this paper addresses two policy questions. First and foremost, what happened to stock market size, liquidity, volatility, and degree of international integration following capital control liberalization in 16 emerging market economies? Second, what is the empirical relationship between stock market size, liquidity, volatility, and international integration and regulations concerning information disclosure, accounting standards, and investor protection? To address these questions, we construct measures of stock market size, liquidity, volatility, and international integration and then examine the empirical relationship between these stock market indicators and both capital control liberalization and national stock market regulations.

To examine the effect of international capital control liberalization on the functioning of stock markets, we test whether indicators of stock market development change following the liberalization of specific capital controls in 16 countries. To do this, we first identify event dates of major policy changes involving portfolio flows. These policy changes involve alterations in restrictions governing capital flows and the repatriation of both principal and dividends. We then use the technique of Perron (1989) and test for a structural break in our stock market development indicators at the event date. As these indicators tend to trend upward, we distinguish between unit roots and structural changes in the time series properties of the series following capital control liberalization. Although this event study methodology does not control for other factors affecting stock market development, the same event across a wide variety of countries and at different points in time yields similar results.

To our knowledge, the relationships between capital controls and stock market size, liquidity, and volatility have not been the focus of previous analysis. To conduct this study, we measure market size as the ratio of market capitalization to Gross Domestic Product (GDP). We use two measures for market liquidity: the ratio of total value traded to GDP (value traded ratio) and the ratio of total value traded to market capitaliza-

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tion (turnover ratio). Although these measures of "liquidity" do not directly quantify trading costs or the uncertainty associated with market prices, settlement, etc., these indicators do quantify the level of trading relative to the size of the economy and the size of the market, and are directly motivated by theoretical models of stock market liquidity (Levine, 1991; Bencivenga *et al.*, 1995). To measure the volatility of stock returns, we use an adjusted 12-month rolling standard deviation of returns based on Schwert (1989). We find that stock markets tend to become larger, more liquid, and more volatile following the liberalization of restrictions on international portfolio flows.

This paper also contributes to the large literature on international capital control liberalization and world capital market integration. Unlike previous work on integration which focuses on testing whether world capital markets are perfectly integrated or have a fixed degree of segmentation, our study examines the effect of specific liberalizations on capital market integration. We use the International Capital Asset Pricing Model (ICAPM) and the International Arbitrage Pricing Model (IAPM) to compute monthly measures of integration using the estimation procedure of Korajczyk and Viallet (1989). We then analyze the time-series behavior of these integration measures before and after policy changes. We find that 10 out of 16 national markets exhibit significant signs of becoming more integrated internationally following the liberalization of investment and repatriation restrictions.

Besides studying international capital control liberalization, we investigate the empirical association between three regulatory indicators and measures of stock market integration, size, liquidity and volatility. The three regulatory measures are (a) the availability and quality of published information on listed firms, (b) the level of accounting standards, and (c) the intensity of investor protection laws. We obtain these measures from the International Financial Corporation's assessment of the institutional features of emerging stock markets from 1986–93. We do not believe that previous authors have studied the links between these regulatory features and stock market functioning. The data do not suggest a robust empirical relationship between stock market integration, size, liquidity, and volatility and the official imposition of internationally accepted accounting standards or investor protection laws. Thus, the data do not support the contention that imposing internationally accepted accounting and investor protection rules will promote stock market development. But, countries with firms that widely disseminate comprehensive information have larger, more liquid, and more internationally integrated stock markets.

We organize the paper as follows. Section 2 describes the stock market indicators and policy events in our study. Section 3 then evaluates whether stock markets developed following the policy changes and Section 4 presents results on the relationship between regulatory regimes and stock market development. Section 5 concludes.

2. MEASURING STOCK MARKET DEVELOPMENT

To assess what happens to stock market integration, size, liquidity, and volatility following the lowering of international investment barriers, we need time-series measures of stock market integration, size, liquidity, and volatility, and dates when countries changed policies. This section first describes six stock market indicators that we use to measure integration, size, liquidity, and volatility. Although each of these indicators has shortcomings, using a variety of measures provides a richer picture of the ties between stock markets and policy changes than if we used only a single indicator. We also compute two conglomerate indexes to measure the overall level of stock market development which combines individual indicators. Finally, the section defines the policy event dates for 16 countries.

(a) *Definitions, relevance, and problems*

We use six indicators and two conglomerate indexes of stock market development.

The *market capitalization ratio* equals the value of listed shares divided by GDP. We use the market capitalization ratio as a measure of market size. Although large markets do not necessarily function well and taxes may distort incentives to list companies, many observers use the market capitalization ratio as an indicator of stock market development under the assumption that stock market size is positively correlated with the ability to mobilize capital and diversify risk.

The *value traded ratio* equals the total value of trades on the stock market exchange divided by GDP. The value traded ratio measures the organized trading of firm equity as a share of national output. While not a direct measure of trading costs or the uncertainty associated with

trading on a particular market, the assumption behind the value traded ratio is that it positively reflects liquidity on an economy-wide basis. The value traded ratio complements the market capitalization ratio: although a market may be large, there may be little trading. Thus, taken together, the market capitalization and the value traded ratios provide more information about a country's stock market than if one uses only a single indicator.

The *turnover ratio* equals the value of total shares traded divided by market capitalization. Though it is not a direct measure of theoretical definitions of liquidity, high turnover is often used as an indicator of low transactions costs. The turnover ratio complements market capitalization. A large but inactive market will have a large market capitalization ratio but a small turnover ratio. Turnover also complements the total value traded ratio. While the value traded ratio captures trading relative to the size of the economy, turnover measures trading relative to the size of the stock market. Put differently, a small, liquid market will have a high turnover ratio but a small value traded ratio.

The fourth and fifth stock market development indicators measure the degree of financial integration of equity markets. In financially integrated markets, capital should flow across international borders to equate the price of risk. If international capital controls or other barriers impede capital movements, then the price of risk may differ internationally. To compute measures of stock market integration we use two asset pricing models: the international capital asset pricing model (ICAPM) and the international arbitrage pricing model (IAPM).

The capital asset pricing and arbitrage pricing models imply that the expected return on each asset is linearly related to a benchmark portfolio or linear combination of a group of benchmark portfolios. In domestic versions of these asset pricing models, the benchmark portfolios include only securities traded on the local exchange. The international versions include all securities. Since these models are well known and since we use the estimation procedures clearly explained by Korajczyk and Viallet (1989) and Korajczyk (1996), we only cursorily outline the estimation procedures.

Following Korajczyk and Viallet (1989, pp. 562–564), let P denote the vector of excess returns on a benchmark portfolio. In the case of the ICAPM, the benchmark portfolio is the excess return on a value-weighted portfolio of common stocks. For the IAPM, P represents the estimated common factors based on an international portfolio of assets using the asymptotic principal components technique of Connor and Korajczyk (1986). Given m assets and T time periods, consider the following regression:

$$R_{i,t} = \alpha_i + b_i P_t + \varepsilon_{i,t}, \; i = 1, 2, \ldots, m; \; t = 1, 2, \ldots, T, \quad (1)$$

where $R_{i,t}$ is the excess return on asset i in period t above the return on a risk free asset or zero-beta asset (an asset with zero correlation with the benchmark portfolio). If stock markets are perfectly integrated, then the intercept in a regression of any asset's excess return on the appropriate benchmark portfolio, P, should be zero. Specifically, the IAPM and ICAPM plus the assumption of perfect integration imply that

$$\alpha_1 = \alpha_2 = \ldots = \alpha_m = 0. \quad (2)$$

Korajczyk and Viallet (1989) refer to α_i as the mispricing of asset i relative to the benchmark portfolio, P. Assuming market integration, α_i represents the deviation of expected returns from the predictions of the ICAPM and IAPM, i.e. a direct measure of deviations from the law of one price. Thus, rejection of the restrictions defined by equation (2) may be interpreted as rejection of the underlying asset pricing model or rejection of market integration.

We are concerned about both positive and negative deviations of α from zero, so we interpret estimates of the absolute value of the intercept terms from the multivariate regression (equation (1)) as measures of market integration. To compute estimates of stock market integration for each national market, we compute the average of the absolute value of α_i across all assets in each country. Thus, the ICAPM and IAPM measures are designed to be negatively correlated with integration. Moreover, if the underlying asset pricing models are sound, the IAPM and ICAPM integration measures will be negatively correlated with higher official barriers and taxes to international asset trading, bigger transactions costs, and larger impediments to the flow of information about firms as illustrated theoretically by Korajczyk (1996).

Two critical estimation issues should be highlighted. First, the ICAPM and IAPM integration measures rely on equilibrium models of asset pricing that the data sometimes rejected as good representations of the pricing of risk. These measures, however, provide time-series estimates of the degree of market integration. These time-series estimates then allow us to investigate what happens to measures of stock market integration following specific policy actions. Thus, even if the stock market integration measures include a constant bias, the ICAPM and IAPM integration measures still

provide sound information on the time-series behavior of market integration following policy events. A second potential problem with the ICAPM and IAPM measures of integration that we use regards stability. As shown by Korajczyk (1996), the estimation procedure assumes that the asset pricing relation is in a steady-state equilibrium. Major policy changes involving the liberalization of international capital controls will induce changes in the pricing relationship. In the long-run (once the new steady-state is achieved), enhanced market integration will lead to smaller pricing errors (smaller absolute estimates of α_i). In the transition to the new steady-state pricing relation, however, Korajczyk (1996) shows that there will be larger pricing errors. The ICAPM and IAPM estimates of α_i will be biased upward during the transition. Thus, there will be a bias *against* finding enhanced market integration following the liberalization of international capital controls. Even with this bias, we find that most countries enjoy enhanced stock market integration following capital control liberalization.

VOLATILITY is the sixth stock market indicator that we examine in studying the links between stock markets, international capital flow policies and regulations. This indicator is a 12-month rolling standard deviation estimate that is based on market returns. We cleanse the return series of monthly means and 12 months of autocorrelations using the procedure defined by Schwert (1989). We include this measure because of the intense interest in market volatility by academics, practitioners, and policy makers.

Each of the six individual indicators — market capitalization ratio, value traded ratio, turnover ratio, IAPM measure of integration, ICAPM measure of integration, and stock return volatility — measure different characteristics of stock markets, so that each is individually informative. We also believe that it is illustrative to construct and examine the relationship between overall indexes of stock market development and various policy and regulatory changes. We construct two overall stock market development indexes. INDEX-1 incorporates information on the market capitalization, value traded, and turnover ratios which are all directly measured variables. INDEX-2 also incorporates information on our IAPM estimates of international integration.

INDEX-1 equals the average of the means-removed values of the market capitalization, total value traded, and turnover ratios. Specifically, the means-removed market capitalization ratio for country i equals the market capitalization ratio for country i averaged over 1976–93 minus the mean for all countries of the market capitalization ratio over 1976–93, all divided by the mean for all countries of the market capitalization ratio over 1976–93. Thus, the means-removed value of variable X for country i is

$$X_i^m = (X_i - \bar{X})/|\bar{X}|$$

where the mean of X is the average value of the X_i values across all countries from 1976–93. Then, we take a simple average of the means-removed market capitalization, total value traded, and turnover ratios to obtain an overall index of stock market development, INDEX-1. Thus, INDEX-1 gives equal weights to the market capitalization, value traded, and turnover ratios.[2]

INDEX-2 is the second conglomerate index and incorporates the IAPM estimate of market integration. We adjust the IAPM measure of integration so that great values imply greater integration. To compute adjusted-IAPM measure, we simply multiply the original IAPM measure by a negative one. Thus, INDEX-2 equals the average of the means-removed values of the adjusted-IAPM integration measure, the market capitalization, valued traded, and turnover ratios.

(b) *Summary information*

Given our focus on the association between major policy changes and stock market development, we highlight developing countries and use industrial countries mainly for comparison purposes. Our sample includes Argentina, Austria, Australia, Brazil, Chile, Colombia, Spain, Finland, France, India, Italy, Jordan, Korea, Mexico, Malaysia, Nigeria, Netherlands, Norway, Pakistan, Philippines, Portugal, Sweden, Thailand, Turkey, Taiwan, Venezuela, and Zimbabwe. Furthermore, as a benchmark, we compute stock market development indicators for the three most developed stock markets: Japan, the United Kingdom, and the United States. Data are obtained from the International Finance Corporation's Emerging Market Data Base (EMDB), the International Finance Corporation's annual *Factbook* (IFC, various issues) and the International Monetary Fund's *International Financial Statistics* (IMF, various issues).

Table 1 presents the means for each of the six stock market indicators for the 16 countries that we study plus the United States (USA), the United Kingdom (UK), and Japan (JPN) for

comparison. The six indicators exhibit considerable variability both across countries and across indicators within the same country. While Malaysia ranks among the top five countries according to the market capitalization ratio, it has below average turnover. On the other hand, Thailand has an average market capitalization ratio but has a "top five" turnover ratio. Argentina has the most volatile market, which is 10 times more volatile than that of the United States. In terms of international integration as measured by the APT indicator, Venezuela appears the least integrated, with a value 2.5 times that of the United States. The emerging markets have almost twice the amount of mispricing as the average of the United States, the United Kingdom, and Japan, as measured by both the APT and ICAPM measures of integration.

Table 2 presents the correlations and corresponding *p*-values of the six stock market development indicators and the two conglomerate indexes. The market capitalization ratio is positively related to the total value traded ratio and the indexes, and negatively related to volatility and the ICAPM and IAPM measures of market integration. The total value traded ratio is significantly correlated with turnover, with a correlation coefficient at 0.79. In addition, we find that volatility is strongly and positively correlated with international integration suggesting that less integrated markets are more volatile.

(c) *Policy event dates*

To evaluate what happens to stock market size, liquidity, international integration, and volatility after countries change international capital controls, we need to identify dates on which countries changed their policies. Selecting the one or two key dates when a country importantly changed policies toward international capital flows is both arduous and, ultimately, less systematic than we would like. We reviewed the International Monetary Fund's *International Exchange Restrictions*, the International Finance Corporation's *Emerging Markets Fact Book*, and various World Bank country reports for 1980–93. Based on this information, we selected one, and in the case of Korea two, period(s) when the

Table 1. *Means of stock market development indicators*

Country	Market capitalization/	GDP	Total value traded/GDP	Turnover	Volatility	IAPM[a]	ICAPM[b]
ARG	0.046	0.002	2.932	0.317	5.454	9.883	
BRA	0.208	0.041	0.338	0.199	6.165	5.600	
CHL	0.489	0.003	0.727	0.065	6.417	5.238	
COL	0.063	0.001	0.733	0.057	5.536	4.823	
IND	0.171	0.005	4.029	0.043	2.554	2.298	
JOR	0.554	0.011	1.859	0.043	2.492	2.007	
KOR	0.342	0.033	9.753	0.082	3.574	3.081	
MEX	0.200	0.008	4.457	0.107	5.758	5.468	
MYS	1.151	0.044	2.599	0.054	3.822	2.443	
PAK	0.101	0.001	1.029	0.031	2.574	2.151	
PHL	0.216	0.004	2.348	0.070	5.218	4.858	
PRT	0.139	0.003	2.043	0.035	3.817	4.852	
THA	0.301	0.026	7.677	0.060	3.154	3.164	
TUR	0.088	0.004	3.729	0.159	6.439	6.674	
TWN	—	—	2.045	0.149	5.663	4.582	
VEN	0.105	0.002	2.080	0.080	6.628	5.202	
AVERAGE	0.265	0.009	4.021	0.102	4.547	4.443	
USA	0.562	0.327	0.529	0.031	2.466	2.071	
UK	0.665	0.253	0.349	0.040	2.706	2.487	
JPN	0.662	0.406	0.469	0.035	2.171	2.101	
Average of Big Three	0.630	0.329	0.449	0.035	2.448	2.220	

[a]IAPM measure of market integration. Smaller numbers imply greater integration with world capital markets.
[b]ICAPM measure of market integration. Smaller numbers imply greater integration with world capital markets.

Table 2. *Correlations of stock market development indicators*[a]

Stock market development indicators	Market capitalization/ GDP	Total value traded/GDP	Turnover	Volatility	IAPM[b]	ICAPM[c]
Market capitalization/GDP	1.000					
Total value traded/GDP	0.283 (0.066)	1.000				
Turnover	−0.083 (0.597)	0.786 (0.000)	1.000			
Volatility	−0.292 (0.084)	0.026 (0.880)	0.127 (0.460)	1.000		
IAPM	−0.371 (0.074)	−0.081 (0.708)	−0.002 (0.993)	0.572 (0.005)	1.000	
ICAPM	−0.480 (0.018)	−0.198 (0.353)	−0.081 (0.707)	0.838 (0.000)	0.780 (0.000)	1.000

[a]*P*-values in parentheses.
[b]IAPM measure of market integration. Smaller numbers imply greater integration with world capital markets.
[c]ICAPM measure of market integration. Smaller numbers imply greater integration with world capital markets.

country liberalized restrictions on international capital flows or the repatriation of dividends. Based on our review of the above IMF/World Bank documents, we tried to choose "important" policy changes. When possible, "important" means corroborated in more than one publication and described in the reports as "major" or "significant." We summarize the dates and policy changes in Table 3. Table 3 indicates that most of the major policy changes involve liberalization of capital and dividend repatriation policies, though some of the country policy events involve liberalizing capital inflow restrictions. Thus, the empirical analysis in Section 3 addresses the question: what happens to the size of the stock market, the liquidity of the stock market, the volatility of the stock market, and international integration once a country liberalizes international capital flow restrictions?

3. CAPITAL CONTROL LIBERALIZATION AND STOCK MARKET DEVELOPMENT

(a) *Methodology*

To examine the behavior of measures of stock market integration, size, liquidity, and volatility before and after a change in policy toward international capital flows, we begin with an examination of the time series properties of each stock market indicator. If the indicator series is stationary, we can use a simple comparison of the means of the series before and after the policy event date to gauge the effects of the policy on stock market development. If a stock market development indicator is trending upward, then no matter where the event date lies, the data will show that stock market development subsequently rose.

A trending series suggests the possibility of a unit root, which would make a *t*-test comparison of pre- and post-event date means invalid. Traditional tests for unit roots, however, frequently do not reject the hypothesis of a unit root even when the series are stationary. In addition, Perron (1989, p. 1361) shows how "standard tests of the unit root hypothesis against trend stationary alternatives cannot reject the unit root hypothesis if the true data generating mechanism is that of stationary fluctuations around a trend function that contains a one-time break." In the present case, the inability to reject the hypothesis of a unit root may instead imply the existence of a one-time break in the series at the policy event date.

Consequently, we use a multipronged approach to examine the behavior of each indicator. First, we test for a simple unit root with lag one, and use the significance tables provided by Dickey and Fuller (1979) and Dickey *et al.* (1984). We allow for all three variations of the "Dickey–Fuller" tests: an intercept, an intercept and a linear time trend, and no trend or intercept. Using a *p*-value of 0.05, we evaluate the null hypothesis of a unit root. If the

null hypothesis is rejected, we can use the simple t-test comparison of means for each indicator before and after the event date. If the null hypothesis cannot be rejected, we use the technique of Perron (1989) to test for a structural break in the series. Finally, if there is evidence of a unit root, and no evidence of a structural break in the series, we are unable to make a statistical conclusion regarding the effect of the policy on the stock market development indicator.

Table 4 shows the results of the Dickey–Fuller tests. In every case, each of the three variations of the tests produces the same conclusion regarding the rejection (or "acceptance") of a unit root. In Table 4, a "YES" entry indicates the data do not reject the hypothesis of a unit root at the 0.05 significance level. For every country, the unit root hypothesis cannot be rejected for the market capitalization ratio. For about one-third of the countries, the total value traded ratio and the turnover ratio exhibit unit root behavior. Approximately half of the countries' integration indicators cannot reject the unit root hypothesis.

Consequently, for those series in Table 4 that show a "YES" entry, we test for a structural break. As in Perron (1989), we consider three different models for each indicator series. The first allows for an exogenous change in the level of the series, the second permits an exogenous change in the growth rate of the series, and the third permits both. For indicator series y, these are:

$$y_t = \mu_1 + (\mu_2 - \mu_1)DUM_t + \varepsilon_t \quad (4)$$

$$y_t = \mu_1 + \beta_1 t + (\beta_2 - \beta_1)TDUM_t + \varepsilon_t \quad (5)$$

$$y_t = \mu_1 + \beta_1 t + (\mu_2 - \mu_1)DUM_t + (\beta_2 - \beta_1)TDUM_t^* + \varepsilon_t \quad (6)$$

where

Table 3. *Policy event dates*

Argentina	6/1980	Eased restriction on foreign portfolio investment in Argentina
Brazil	6/1990	Liberalized capital repatriation and capital inflow restrictions
Chile	1/1988	Liberalized repatriation of dividends
Colombia	12/1989	Eased portfolio and direct foreign investment restrictions; also liberalized repatriation restrictions in 12/1991
India	5/1990	Automatic approval of foreign investment proposals of foreign companies with equity share of up to 40%; also liberalized capital dividend repatriation in 1992
Jordan	1/1987	Liberalized capital repatriation
Korea	8/1981 2/1992	Liberalized inflows and outflows of direct foreign investment Liberalized portfolio inflows and outflows
Malaysia	11/1986	Culminated liberalization of direct foreign investment and portfolio inflow restrictions
Mexico	5/1989	Liberalized direct foreign investment inflows
Pakistan	1990	Liberalized dividend and capital repatriation
Philippines	1988	Liberalized capital and dividend repatriation; intensified in 1992
Portugal	1988	Liberalized dividend repatriation; followed by full liberalization of foreign investment by residents in 1989 and 1990
Taiwan	2/1991	Opened stock market to foreign investment
Thailand	1988	Liberalized capital and dividend repatriation
Turkey	2/1990	Finished 18-month process of liberalizing portfolio inflows and outflows
Venezuela	1/1990	Liberalized direct foreign investment and portfolio inflows

Table 4. *Dickey–Fuller test results for presence of unit root*[a]

Country	Market capitalization/ GDP	Total value traded/GDP	Turnover	Volatility	IAPM[b]	ICAPM[c]	INDEX-1[d]	INDEX-2[e]
ARG	YES	NO	NO	YES	NO	NO	YES	YES
BRA	YES	YES	NO*	NO	NO	NO	NO	NO
CHL	YES	NO	NO	NO	NO	NO	NO	NO
COL	YES	YES	YES	NO	YES	YES	NO	NO
IND	YES	NO*	YES	NO	YES	NO	NO	YES
JOR	YES	NO	NO	NO	NO	NO	NO	NO
KOR	YES	YES	NO	NO	NO*	YES	NO	NO
MEX	YES	YES	NO*	NO	NO	NO	NO	NO
MYS	YES	NO	YES	NO	YES	YES	NO	NO
PAK	YES	YES	YES	NO	YES	YES	NO	YES
PHL	YES	NO*	YES	NO	YES	YES	NO	NO
PRT	YES	NO	NO	NO	YES	NO	NO	NO
THA	YES	NO	NO	NO	YES	NO	NO	NO
TUR	YES	YES	NO	NO	YES	YES	NO	NO
TWN	ND	ND	NO*	NO	NO*	YES	NO	NO
VEN	YES	NO	NO	NO	YES	YES	NO	NO

[a]"NO" indicates a rejection at the 0.05 level of the hypothesis of a unit root in the stock market development indicator. An asterisk (*) indicates rejection at the 0.10 level. "YES" indicates the hypothesis of a unit root cannot be rejected. ND indicates no data available.
[b]IAPM measure of international integration. Smaller values imply greater integration in world capital markets.
[c]ICAPM measure of international integration. Smaller values imply greater integration in world capital markets.
[d]Conglomerate index composed of market capitalization/GDP, total value traded/GDP, and turnover.
[e]Conglomerate index composed of market capitalization/GDP, total value traded/GDP, turnover, and IAPM integration measure.

$DUM_t = 1$ if $t >$ policy event date t^*,

0 otherwise

$TDUM_t = t - t^*$ if $t >$ policy event date t^*,

0 otherwise

$TDUM^*_t = t$ if $t >$ policy event date t^*,

0 otherwise.

Tests for a structural break entail testing whether the coefficients on *DUM*, *TDUM*, and *TDUM** are significantly different from zero. However, these *t*-tests are only valid if the residuals from the above three models do not contain a unit root. Consequently, we (i) run regressions for the above three models, (ii) test whether there is a one-time structural break at the policy event date for each stock market indicator, and (iii) use Perron's calculated critical values to test whether the residuals from the regressions are stationary.

(b) *Results*

Table 5 summarizes the evidence regarding the question of whether the policy event dates are associated with a structural break and a subsequent rise in stock market development for each stock market development indicator. Three types of entries are possible. First, if the original indicator rejected the unit root hypothesis, then Table 5 reports the results of a *t*-test comparing the level of each indicator before and after the policy events. Using monthly data for each country, we compute the average of each indicator before the policy event date (period 1) and use a *t*-test to detect whether the value of the indicator changed significantly following the policy change (period 2). If the value of an indicator is significantly larger in period 2 than period 1, the entry in the table reads "2 > 1." Thus, "2 > 1" shows that the indicator rejected the unit root hypothesis and that its mean is significantly higher in the period following the policy change.

Second, if the original indicator failed to reject the unit root hypothesis, we conduct a test of whether the series exhibits a one-time break at the event date. Thus, if the series did not reject the unit root hypothesis *and* the series displays a significant improvement at the event date (defined by the significance of the dummy variable coefficients in equations (4)–(6)) and the errors from this structural break regression pass Perron's test of stationarity, then the entry

in Table 5 is "Y," for yes the stock market indicator improved. If no significant break is found and the errors pass Perron's stationarity test, then the entry in Table 5 is "N" for no the stock market indicator did not improve. If the series did not reject the unit root hypothesis, and the series displays a significant worsening at the event date (defined by the significance of the dummy variable coefficients in equations (4)–(6)) and the errors from this structural break regression pass Perron's test of stationarity, then the entry in Table 5 is "W" since the stock market indicator worsened.

Finally, there were cases where the original indicator failed to reject the unit root hypothesis, so that we conducted a test of a one-time break at the event date, but the resultant errors failed to pass Perron's stationarity test. Here, the Table 5 entries are "?Y?" if a significant improvement is identified, "?N?" if no significant break is identified, and "?W?" if a significant worsening is identified. The question marks highlight that the standard errors on these tests of a structural break are questionable because the residuals do not reject Perron's stationarity test.

Consider, for example, Portugal's entry in Table 5. The ND entry under volatility indicates we do not have monthly individual stock price data for Portugal. All of the other indicators show that stock markets significantly developed in Portugal following liberalization of dividend repatriation by foreign investors in Portugal. For the IAPM indicator, this finding required the use of a one-time trend break specification at the policy event date. The resultant errors from this specification passed Perron's stationarity test. Thus, under IAPM a "Y" appears for Portugal. For the market capitalization ratio, we use a trend break specification. While the results are significant, the errors do not reject the null

Table 5. *Did stock markets develop following liberalization?*[a]

Country	Market capitalization/ GDP	Total value traded/GDP	Turnover	Volatility	IAPM[b]	ICAPM[c]	INDEX-1[d]	INDEX-2[e]
ARG	?Y?	2 > 1	2 > 1	W	NS	2 > 1	?Y?	?Y?
BRA	?Y?	?Y?	NS	2 > 1	1 > 2	NS	2 > 1	2 > 1
CHL	?Y?	2 > 1	NS	NS	1 > 2	1 > 2	2 > 1	2 > 1
COL	?Y?	Y	Y	2 > 1	?Y?	?W?	2 > 1	2 > 1
IND	?Y?	2 > 1	N	2 > 1	?Y?	2 > 1	NS	?Y?
JOR	?Y?	2 > 1	2 > 1	NS	NS	NS	NS	NS
KOR	?Y?	Y	3 > 2	NS	1 > 3; 1 > 2	?N?	3 > 2; 2 > 1	3 > 1; 2 > 1; 3 > 2
MEX	?Y?	?Y?	1 > 2	NS	1 > 2	1 > 2	2 > 1	2 > 1
MYS	?Y?	NS	NS	ND	?Y?	?N?	2 > 1	2 > 1
PAK	?Y?	Y	Y	2 > 1	?W?	?W?	2 > 1	?Y?
PHL	?Y?	2 > 1	N	NS	Y	?Y?	2 > 1	2 > 1
PRT	?Y?	2 > 1	2 > 1	ND	Y	1 > 2	2 > 1	2 > 1
THA	?Y?	2 > 1	2 > 1	2 > 1	?Y?	NS	2 > 1	2 > 1
TUR	?Y?	?Y?	2 > 1	ND	?Y?	?Y?	2 > 1	2 > 1
TWN	ND	ND	2 > 1	NS	?Y?	Y	2 > 1	2 > 1
VEN	?N?	2 > 1	ND	2 > 1	?Y?	?N?	2 > 1	2 > 1

[a] $X > Y$ indicates no unit root and significantly greater mean of indicator in period X than period Y.
NS indicates no unit root, but means of indicator are not significantly different across policy periods.
Y indicates a significant improvement in the series at event date and errors pass Perron test.
N indicates no significant break in series at event date, and errors pass Perron test.
W indicates a significant worsening the series at event date and errors pass Perron test. (Note: increased volatility is interpreted as a worsening in stock market development.)
?Y? indicates a significant improvement at event date but errors do not pass Perron test.
?W? indicates a significant worsening event date but errors do not pass Perron test.
?N? indicates no significant break at event date, and errors do not pass Perron test.
ND indicates no data.
[b] IAPM measure of international integration. Smaller values imply greater integration in world capital markets.
[c] ICAPM measure of international integration. Smaller values imply greater integration in world capital markets.
[d] Conglomerate index composed of market capitalization/GDP, total value traded/GDP, and turnover.
[e] Conglomerate index composed of market capitalization/GDP, total value traded/GDP, turnover, and IAPM integration measure.

hypothesis of a nonstationary series. Thus, the entry is "?Y?" under market capitalization/GDP. The total value traded and turnover ratios, the ICAPM integration measure and the two conglomerate indexes display significant improvements following the liberalization of dividend repatriation restrictions and reject the hypothesis of a nonstationary series.

The Table 5 results indicate that stock market size, liquidity, and international integration tend to improve following capital control liberalization. The INDEX-1 measure of overall stock market development rose significantly in 13 out of 16 countries. One additional country enjoyed significant improvement but the errors did not pass Perron's stationarity test. No country's level of stock market development significantly fell following reform. The INDEX-2 results are not much different. Significant stock market development follows international capital liberalization.

Finally, for those cases in Table 5 where the errors from the trend specification did not pass Perron's stationarity test, we graph the actual and fitted values from the model where we allowed a change in the intercept and growth rate at the event date.[3] Using this subjective graphical tool, we construct a final summary table, Table 6.

In Table 6, the entries are a simple Y, N, ?, or NS. A "Y" shows significantly greater stock market development following liberalization. An entry of "?" suggests that our tests indicate a positive affect on stock market development, though the indicator still contains a unit root so that the results remain inconclusive. An entry of "N" shows that the stock market development worsened following liberalization.

The "Y" entries — indicating greater stock market development following liberalization — dominate Table 6. There are no N entries under the market capitalization, total value traded, IAPM, INDEX-1, or INDEX-2 entries. Only Argentina has an N entry under the CAPM and ICAPM indicators. The conglomerate INDEXES significantly rise in 13 out of 16 countries following liberalization. Stock market capitalization growth, enhanced liquidity, and greater integration follows liberalization of international capital and dividend flows.

These results have at least two implications: the first is direct, while the second requires an additional layer of analysis. First, measures of

Table 6. *Do stock markets develop following liberalization?*[a]

Country	Market capitalization/ GDP	Total value traded/GDP	Turnover	Volatility	IAPM[b]	ICAPM[c]	INDEX-1[d]	INDEX-2[e]
ARG	Y	Y	Y	N	NS	N	?	?
BRA	?	?	NS	N	Y	NS	Y	Y
CHL	?	Y	NS	NS	Y	Y	Y	Y
COL	?	Y	Y	N	Y	?	Y	Y
IND	Y	Y	N	N	?	Y	NS	?
JOR	?	Y	Y	NS	NS	NS	NS	NS
KOR	?	Y	Y	NS	Y	?	Y	Y
MEX	?	?	N	NS	Y	Y	Y	Y
MYS	?	NS	NS	—	?	?	Y	Y
PAK	Y	Y	Y	N	Y	Y	Y	Y
PHL	?	Y	N	NS	Y	Y	Y	Y
PRT	Y	Y	Y	—	Y	Y	Y	Y
THA	?	Y	Y	N	?	NS	Y	Y
TUR	Y	Y	Y	—	?	?	Y	Y
TWN	—	—	Y	NS	?	Y	Y	Y
VEN	?	Y	—	N	?	?	Y	Y

[a]"Y" indicates that liberalizing policy has positive impact on the indicator. "?" indicates that the indicator remains unstationary, so a definite conclusion cannot be drawn. "N" indicates that the policy had negative impact on the indicator. "NS" indicates that the policy had no effect.(Note: we interpret increased volatility as a worsening of stock market development.)
[b]IAPM measure of international integration. Smaller values imply greater integration in world capital markets.
[c]ICAPM measure of international integration. Smaller values imply greater integration in world capital markets.
[d]Conglomerate index composed of market capitalization/GDP, total value traded/GDP, and turnover.
[e]Conglomerate index composed of market capitalization/GDP, total value traded/GDP, turnover, and IAPM integration measure.

stock market size, liquidity, and international integration tend to improve following the reduction of impediments to international capital and dividend flows. Although this paper's findings do not establish a causal link running from policy to stock market development, the results are consistent with the view that international capital flow liberalization may be a useful policy tool for countries seeking to boost stock market development. A second potential implication builds on other research. Levine and Zervos (1998) show that countries with more liquid stock markets tend to enjoy faster growth rates of real per capita GDP over subsequent decades even after controlling for many other economic, political, and legal factors affecting long-run growth. Thus, increases in stock market liquidity tend to follow international capital flow liberalization and countries with greater stock market liquidity grow faster over future decades.

4. REGULATORY REGIMES

(a) *Description of regulatory regimes*

Many regulatory and institutional factors may influence the functioning of stock markets. For example, reliable information about firms and financial intermediaries may enhance investor participation in equity markets. Regulations and institutions that instill investor confidence in brokers and other capital market intermediaries should encourage investment through and trading in the stock market. Similarly, restrictive or costly regulations may impede the efficient functioning of stock markets.

To assess the relationship between stock market development and several regulatory and institutional features of emerging stock markets, we use indicators constructed by the International Finance Corporation (IFC). These indicators are available on an annual basis from 1986–93, for 20 developing countries. Table 7 gives the average of these indicators over this period, for each country. The first column shows whether the country's firms provide comprehensive, internationally published information such as the P/E ratios and yields. The IFC gives a value of 0 if information is published and a value of 1 when the information is comprehensive and published internationally. Column 2 gives information on accounting standards. The IFC assigns values of 0, 1, or 2 for countries with poor, adequate, or internationally accepted accounting standards, where "internationally accepted" incorporates the standards used in major industrialized countries. Column 3 gives information on investor protection laws. Again, 0 indicates poor, 1 signifies adequate, and 2 means internationally accepted investor protection laws as judged by the IFC. Finally, the last three columns give IFC evaluations of the types of policies investigated earlier in this paper; they classify restrictions on dividend and capital repatriation, and entry into the stock market into "restricted" with a value of 0, "some restrictions" with a value of 1 or "free" with a value of 2.

Table 7 shows that Jordan freely allows international capital flows cross its borders, but does not publish regular price–earnings information and has relatively poor accounting standards. India has accounting standards of internationally accepted quality, but restricted capital inflows and the repatriation of capital and dividends. Nigeria tightly restricted capital flows over most of the period and did not publish price–earnings on firms in a comprehensive and internationally accepted manner. In contrast, Malaysia, Mexico, and Thailand ranked high in all categories, offering a relatively strong investor protection, comprehensive and widely published information on firms, and free environment for domestic and foreign investors in the stock market.

(b) *Simple comparison of means across regulatory regimes*

Because we only have 8 years of data with classifications of regulatory regimes, we group country–year observations together by each regime classification. For instance, for the investor protection classification "0," we combine Argentina's 1988 observation with Nigeria's 1990 observation. To make these groupings comparable across countries, we extract country effects from each indicator. Thus, we subtract each country's mean before we group them with other countries. This is analogous to regressions that control for country-fixed-effects. We compute conglomerate indices of stock market development that are analogous to INDEX-1 and INDEX-2 above. Specifically, the new indices, INDEX-1* synthesizes information on the market capitalization ratio, the value traded ratio, the turnover ratio, while INDEX-2* combines these three variables with the IAPM measure of integration.[4]

Using t-tests of the differences in the means, we investigate whether stock market development, as measured by the grouped indicator indexes, is significantly different across regulatory regimes. Table 8 presents the results. As in previous tables, "$2 > 1$" signifies that the indicator is significantly higher in regime 2 than

regime 1. For Price–Earning disclosure (PE Disclosure), there is one row that compares those observations with a value of 0 with those observations with a value of 1. For the other regulatory indicators — Accounting Standards, Investor Protection Standards, Dividend Repatriation Restrictions, Capital Repatriation Restrictions, and Capital Inflow Restrictions — there are two rows. The row first compares regimes ranked 2 with regimes ranked 1 and the second compares regimes ranked 1 with regimes ranked 0.

The results in Table 8 suggest the following conclusions. First, countries where information about firms, such as price–earnings ratios, is comprehensive and published internationally have larger, more liquid, and more internationally integrated stock markets than countries that do not publish firm information as comprehensively and widely. Second, the data give ambiguous results on the level of accounting standards and investor protection laws. For example, the conglomerate stock market development indexes, INDEX-1 and INDEX-2, indicate that although poor accounting standards and poor investor protection laws are associated with low stock market development, moving from adequate to internationally accepted accounting and investor protection standards is actually associated with a drop in stock market development.[5] Thus, the data do not support the contention that imposing internationally accepted investor protection rules and accounting standards boosts stock market development. Finally, the IFC international capital restriction rankings confirm the time-series findings of Section 3. There is a strong positive relationship between stock market development and lower restrictions on capital flows. In sum, comprehensive and widely published information about firms along with the unrestricted flow of capital and dividends are positively associated with stock market size, liquidity, and risk pricing efficiency, but reaching some officially defined set of accounting standards and investor protection laws is not strongly correlated with stock market development.

Table 7. *Institutional indicators: 1986–93 averages*[a]

	1	2	3	4		Entry
	Information on firms	Accounting standards	Quality of investor protection	Restrictions on:		
				dividend repatriation	capital repatriation	
Argentina	0.25	1.00	1.00	1.25	1.63	2.00
Brazil	0.75	2.00	2.00	2.00	1.50	1.50
Chile	0.88	2.00	2.00	1.75	1.00	2.00
Colombia	0.25	1.00	1.00	1.38	2.00	1.50
Greece	0.67	0.43	0.14	1.13	1.00	1.88
India	0.50	2.00	2.00	1.38	1.50	1.00
Indonesia	1.00	0.16	0.83	1.29	1.29	1.71
Jordan	0.00	0.25	1.00	2.00	1.88	2.00
Korea	1.00	2.00	2.00	2.00	1.63	1.25
Malaysia	1.00	2.00	2.00	2.00	2.00	2.00
Mexico	1.00	2.00	2.00	1.75	1.75	1.75
Nigeria	0.00	1.00	1.00	0.75	0.75	0.00
Pakistan	0.13	1.00	1.00	1.50	1.50	1.50
Philippines	0.88	1.75	1.00	1.75	1.75	1.13
Portugal	0.71	1.14	1.00	1.71	2.00	2.00
Taiwan	0.75	0.25	0.13	1.63	2.00	1.13
Thailand	1.00	1.00	1.00	1.75	1.75	2.00
Turkey	0.57	0.75	0.25	1.75	1.75	1.38
Venezuela	0.25	1.00	1.00	1.00	1.00	1.75
Zimbabwe	0.13	1.00	1.00	0.13	0.25	1.13

Source: the table is based on the information provided in the International Finance Corporation's *Emerging Markets Fact Book* (IFC, various issues).

[a]Figures in columns 1–4 are 1986–93 averages. In each year columns can take the following values:
column 1, 0 = published, 1 = comprehensive and published internationally.
columns 2 and 3, 0 = poor, 1 = adequate, 2 = good, of internationally acceptable quality.
column 4, 0 = restricted, 1 = some restrictions, 2 = free.

5. CONCLUSION

This paper evaluates the behavior of stock market size, liquidity, volatility, and international integration after 16 emerging market economies liberalized their policies regarding international capital and dividend flows. The data suggest that stock markets become larger, more liquid, more internationally integrated, and more volatile following the liberalization of restrictions on capital and dividend flows. This analysis contributes to existing work on the links between capital controls and integration by studying the time path of ICAPM and IAPM measures of national stock market integration following specific policy changes for a large sample of countries. This analysis also contributes to the literature examining the time-series properties of stock market size, volatility, and liquidity after countries reduce barriers to international capital flows. The finding that stock market liquidity tends to rise following the liberalization of international capital controls is particularly noteworthy because Levine and Zervos (1998) show that stock market liquidity is a robust predictor of long-run real per capita GDP growth.

The second part of this paper presented summary statistics on the relationship between three regulatory institutional indicators and stock market development. The data indicate that easy access to information about listed firms by domestic and foreign investors is positively associated with stock market development. Furthermore, countries with adequate accounting standards and investor protection laws tend to have better developed stock markets. Countries that officially establish internationally accepted accounting standards and investor protection laws do not necessarily, however, have better developed stock markets than other countries. While suggestive, we need more detailed measures of stock market regulations with correspondingly rigorous analyses of the effects of those regulations to provide reliable advice to

Table 8. *Tests of differences in stock market development over different regulatory regimes*[a]

Institutional indicator	Market capitalization/ GDP	Total value traded/GDP	Turn-over	Volatility	IAPM[b]	ICAPM[c]	INDEX-1[d]	INDEX-2[e]
Firm information[f]	1 > 0	1 > 0	1 > 0	NS	NS	0 > 1	1 > 0	1 > 0
Accounting standards[g]	1 > 2	NS	NS	NS	1 > 2 1 > 0	2 > 1 0 > 1	1 > 2	1 > 2 1 > 0
Investor protection[g]	1 > 2 0 > 1	NS	NS 1 > 0	NS	1 > 2 1 > 0	NS 0 > 1	1 > 2 NS	1 > 2 1 > 0
Dividend restrictions[h]	2 > 1	NS 1 > 0	2 > 1 NS	1 > 2 1 > 0	2 > 1 NS	1 > 2 NS	2 > 1 1 > 0	2 > 1 1 > 0
Capital repatriation[h] restrictions	2 > 1 0 > 1	2 > 1 2 > 0	NS	NS 1 > 0	2 > 1 NS	1 > 2 NS	2 > 1 NS	2 > 1 NS
Entry restrictions[h]	2 > 1 1 > 0	2 > 1 1 > 0	2 > 1 NS	2 > 1 NS	2 > 1 0 > 1	1 > 2 NS	2 > 1 NS	2 > 1 NS

[a] $X > Y$ indicates a significantly greater mean of the development indicator in regime X than regime Y.
[b] IAPM measure of integration. Smaller values imply greater integration in world capital markets.
[c] ICAPM measure of integration. Smaller values imply greater integration in world capital markets.
[d] Conglomerate index composed of market capitalization/GDP, total value traded/GDP, and turnover.
[e] Conglomerate index composed of market capitalization/GDP, total value tradedlGDP, turnover, and IAPM integration measure.
[f] 0 = P/E ratios published, 1 = P/E ratios comprehensive and published internationally.
[g] 0 = poor, 1 = adequate, 2 = of internationally accepted quality.
[h] 0 = restricted, 1 = some restrictions, 2 = free.

policy makers.

This paper's results imply that lowering international investment barriers will promote economic development. Thus, the paper's findings support recent changes to the International Monetary Fund's articles of agreements that will allow it to take a more active role in reducing impediments to capital flows. The data indicate that liberalization boosts stock market liquidity. The rise in liquidity, according to Levine and Zervos (1998) translates into faster long-run rates of economic growth. While liberalization tends to increase stock return volatility, this increase is short-lived and volatility is not negatively associated with long-run economic growth (Levine and Zervos, 1998). Moreover, greater openness to international capital flows tends to be associated with lower stock return volatility in the long-run (Demirguc-Kunt and Levine, 1996). Thus, if policy makers have the patience to weather some short-run volatility, liberalizing restrictions on international portfolio flows and the repatriation of dividends and principal offers expanded opportunities for economic development. While capital control liberalization does not represent a financial elixir for economic growth, there are good reasons to believe that lowering barriers to international investing will boost equity market development and promote economic growth.

NOTES

1. For example, Levine (1991) and Bencivenga *et al.* (1995) argue that enhanced market liquidity can affect resource allocation and economic growth. Devereux and Smith (1994) and Obstfeld (1994) show that the ability to diversify risk internationally can influence national saving, productivity, and long-run growth rates. Demirguc-Kunt and Maksimovic (1996b), Rajan and Zingales (1997), and Levine and Zervos (1998) provide firm-level, industry-level, and cross-country evidence respectively that equity market development is closely associated with economic growth. On the empirical relationship between corporate financing decisions and stock market size and liquidity, see Demirguc-Kunt and Maksimovic (1996a). Considerable disagreement exists, however. Morck *et al.* (1990) argue that stock markets are a relatively unimportant sideshow, and Shleifer and Summers (1988) and DeLong *et al.* (1989) note conditions when stock markets hurt economic activity. For a survey of this literature, see Levine (1997).

2. Furthermore, we used principal component analysis to construct another conglomerate measure. Specifically, given the market capitalization, total value traded, and turnover ratios, we compute the one principal component that is the best linear predictor of the three original indicators. The principal components measure gives very similar results to the INDEX-1 results.

3. These figures are available from the authors on request.

4. Earlier, we were comparing stock market development over time for each country. Consequently, we computed INDEX-1 and INDEX-2 relative to each country's average overthe sample period. Now, we are comparing stock market development across countries. Consequently, we compute INDEX-1* and INDEX-2* relative to the cross-country average for each year.

5. There is no statistically significant difference when comparing 0 with 2 rankings directly.

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