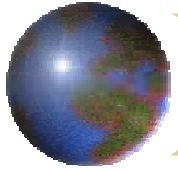


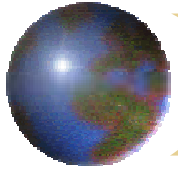
# *The Role of ADRs in the Integration of World Equity Markets*

G. Andrew Karolyi  
Fisher College of Business  
Ohio State University



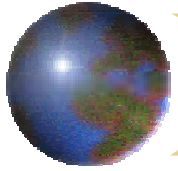
## *The Question*

- International cross-listings of stocks, especially in the U.S. by means of ADRs, can bring advantages of liquidity, transparency, ease of trade to investors; by attracting global investors to shares across which to spread risks, companies can lower cost of capital
- There has been significant growth in ADR market
- Does development of ADR market for companies from different markets around the world lead to a greater or lesser degree of market integration with global markets?



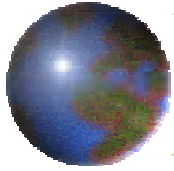
## *Null Hypothesis*

- As companies and investors choose ADRs, local exchanges, brokers and regulatory authorities come under competitive pressure to modernize operations, enhance disclosure standards, strengthen enforcement to make local markets more liquid, transparent, efficient
- Increased participation by local companies, investors leads to greater liquidity, visibility and credibility of local market for global investors “spiralling” toward greater efficiency, expansion and development
- $H_0$ : Development of ADR market is a “catalyst” and is positively associated with integration of local market with world markets



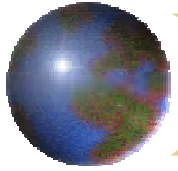
## *Alternative Hypothesis*

- Development of ADR market represents a diversion of activity away from the local market
- Deterioration of quality of local market as trading volume and liquidity diminish leading to fewer global investors in stocks beyond those trading as ADRs and increasingly lower participation by local investors and companies
- $H_A$ : Development of ADR market is a “hindrance” and is negatively associated with integration of local market with world markets



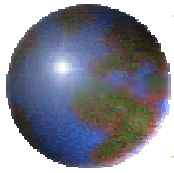
# *Motivation*

- Research can contribute to literature on market liberalization and its impact on financial market development. How?
- Measuring integration of capital markets is challenging task; often rely on regulatory changes which often have little or unexpected impact on functioning of capital markets
  - Bekaert and Harvey (1995), Henry (2000), Kim and Singal (2000)
  - Most liberalization studies are “event-driven” using relaxation of foreign currency controls, changes in foreign investment restrictions, initiation of first ADR listing, first country fund as “guide-posts”
  - Bekaert and Harvey (2002) show endogenous breaks in financial series do not necessarily coincide with “guide-posts”
- Development of ADRs market is by its nature a “process” not an event and can be captured empirically by the fraction of local shares listed as ADRs, or as fraction of total market capitalization or fraction of total dollar value of trading activity



## *Further Motivation*

- Research can also contribute to literature on ADR market
- Numerous studies on why firms list overseas, economic benefits and costs, capital market impact of listing decisions:
  - Foerster and Karolyi (1999), Miller (1999) - market segmentation
  - Foerster and Karolyi (1998), Domowitz, Glen and Madhavan - liquidity
  - Coffee (2000), Stulz (2000), Reese and Weisbach (2002) - legal bonding
  - Doidge, Karolyi and Stulz (2001) - agency costs & controlling shareholders
- Very few studies of macroeconomic influence of development of ADR market and none on integration of markets
  - Hargis (1998), Hargis and Ramanlal (1998), Moel (2001)



# *Empirical Methodology*

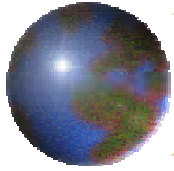
- How to measure time-varying capital market integration?
- Follow approach of Errunza, Hogan and Hung (2000) using a multivariate GARCH-M model that allows time-varying world price of covariance risk ( $\delta_{w,t-1}$ ) and local market price of risk ( $\lambda_{i,t-1}$ ) to explain local national index returns ( $r_{i,t}$ ):

$$r_{i,t} = \delta_{w,t-1} \text{cov}_t(r_{i,t}, r_{w,t}) + \lambda_{i,t-1} \text{var}(r_{i,t} | r_{ADR,t}) + \varepsilon_{i,t}$$

$$r_{ADR,t} = \delta_{w,t-1} \text{cov}_t(r_{ADR,t}, r_{w,t}) + \varepsilon_{ADR,t}$$

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

- Integration Index (II) =  $1 - [\text{var}(r_{i,t} | r_{ADR,t}) / \text{var}(r_{i,t})]$  measures substitutability of local market by subset of stocks traded as ADRs
  - Complete integration: II = 1 or  $\text{var}(r_{i,t} | r_{ADR,t}) = 0$
  - Complete segmentation: II = 0 or  $\text{var}(r_{i,t} | r_{ADR,t}) = \text{var}(r_{i,t})$
- Proxy measure: II =  $1 - [\text{var}(r_{i,t}) (1 - \rho_{i,ADR})]$



# *Empirical Methodology*

- Prices of world covariance and local market risk are specified by:

$$\begin{aligned}\delta_{w,t-1} &= \exp(\kappa_w' Z_{t-1}) \\ \lambda_{i,t-1} &= \exp(\kappa_i' Z_{t-1})\end{aligned}$$

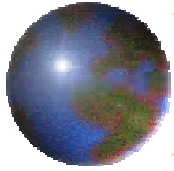
- Instrumental variables ( $Z_{t-1}$ ) include a constant, the local and world dividend yields, local exchange rate versus the U.S. dollar, and the U.S. 10-year Treasury bond yield

- Law of motion for the time-varying conditional covariance is parameterized using the Ding-Engle (1994) specification:

$$H_t = H_0 * (\mathbf{1}' - \mathbf{a}\mathbf{a}' - \mathbf{b}\mathbf{b}') + \mathbf{a}\mathbf{a}' * \{\boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}'\} + \mathbf{b}\mathbf{b}' * H_{t-1}$$

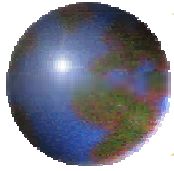
- The model is estimated by quasi-maximum likelihood using the Broyden, Fletcher, Goldfarb, Shanno maximization technique.



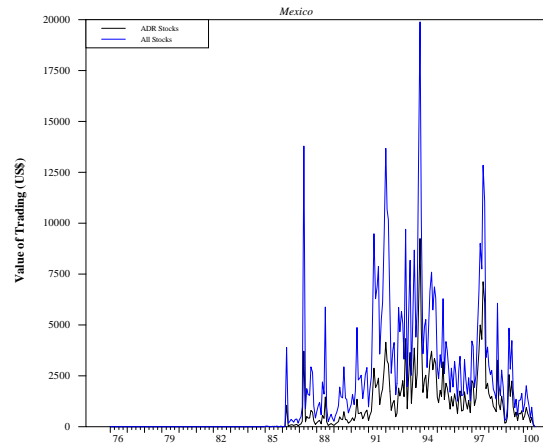
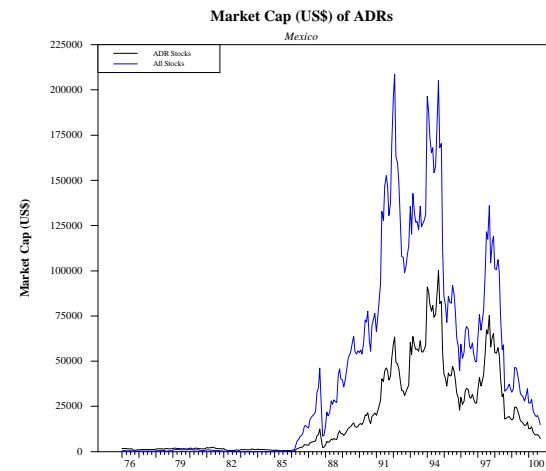
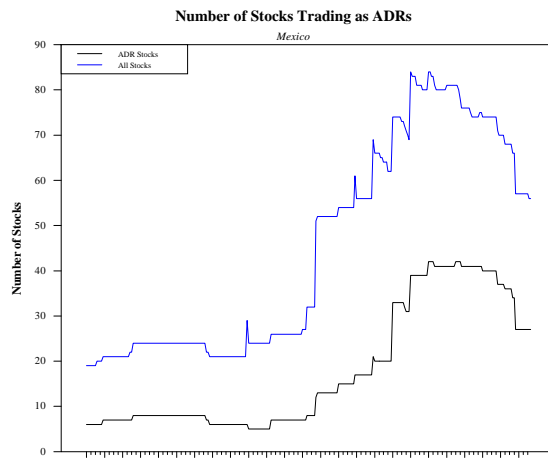


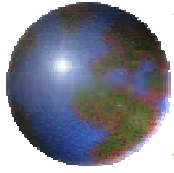
## *Data*

- Cross-listings/ADRs from NYSE, Amex, Nasdaq, Bank of New York ([www.adrbny.com](http://www.adrbny.com)), OTC Bulletin Board and “pink sheet” lists
- Monthly prices, dividends, market capitalization, trading volume from Standard & Poor’s Emerging Market Database (2000)
- Countries included: Argentina, Brazil, Chile, Colombia, Mexico and Venezuela from Latin America; Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand from Asia.
- Computed value-weighted U.S. dollar returns for ADR portfolio and took IFCG value-weighted indices from EMDB
- Morgan Stanley Capital International world market index
- Ibbotson & Associates for U.S. 10-year Treasury yield

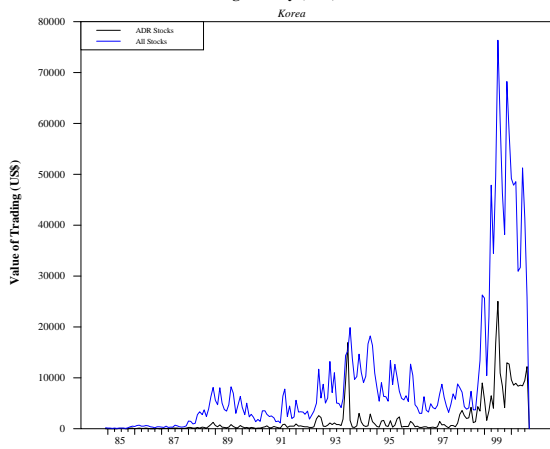
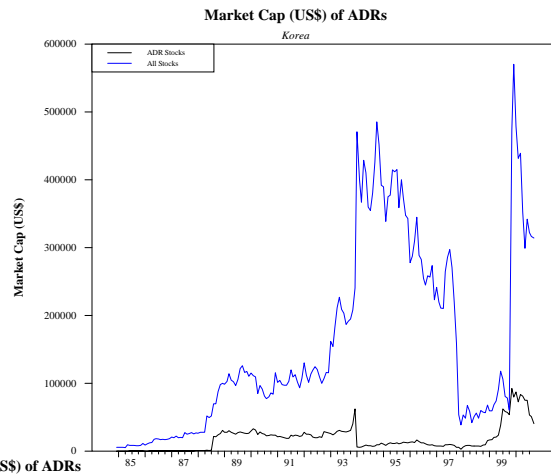
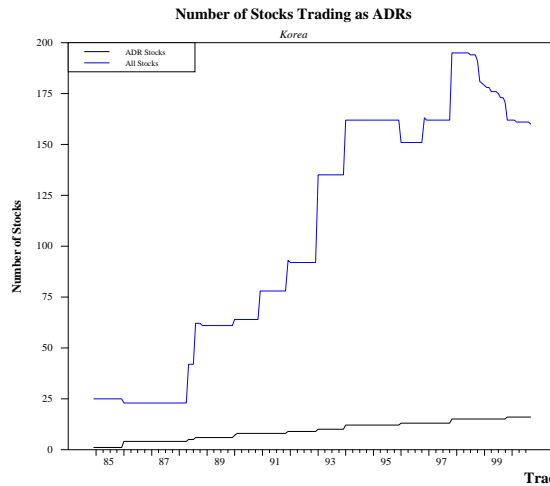


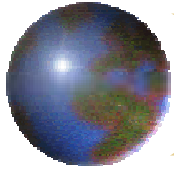
# ADR Activity in Mexico





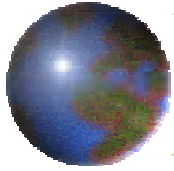
# ADR Activity in Korea





# Summary Statistics

Market (initial date)	Argentina (1985:01)	Brazil (1987:12)	Chile (1985:5)	Colombia (1985:1)	Indonesia (1989:12)	Korea (1984:12)	Malaysia (1984:12)	Mexico (1985:1)	Philippines (1986:1)	Taiwan 1986:1	Thailand (1988:7)	Venezuela (1986:1)	World (1976:1)
<b>IFCG index</b>													
Mean	0.614%	0.734%	0.908%	0.597%	-0.476%	0.326%	0.118%	0.505%	0.178%	0.525%	-0.198%	0.451%	4.408%
Std. Dev.	8.784%	7.664%	3.415%	3.777%	6.393%	4.964%	4.481%	5.782%	4.649%	5.719%	5.527%	6.018%	1.878%
Skewness	0.363	-0.838	-0.339	0.644	-0.419	0.277	-0.188	-2.055	0.059	-0.091	-0.259	-0.604	-0.484
Kurtosis	9.226	3.895	1.114	1.952	2.378	3.286	3.325	10.002	2.247	1.666	1.334	3.034	1.495
$\rho_1$	-0.076	-0.061	0.236	0.401	0.215	0.059	0.125	0.237	0.285	0.037	0.133	-0.006	0.002
$\rho_2$	-0.097	-0.032	-0.055	0.095	-0.099	0.053	0.195	-0.055	0.027	0.057	0.146	0.172	-0.045
$\rho_3$	0.082	-0.127	-0.130	0.002	-0.019	-0.007	-0.114	-0.051	-0.052	-0.056	-0.123	-0.000	-0.033
Q-statistic	4.434	3.311	14.294	32.369	7.492	1.237	12.962	18.473	14.249	1.415	8.185	5.355	0.932
<b>ADR index</b>													
Mean	0.687%	1.112%	0.694%	1.591%	-0.627%	1.067%	0.171%	0.508%	0.241%	0.392	-0.678%	-0.305%	
Std. Dev.	9.674%	9.710%	7.500%	6.054%	7.323%	7.479%	6.422%	7.368%	5.933%	6.948	8.589%	7.936%	
Skewness	0.258	0.424	1.076	0.781	0.025	0.854	0.345	-0.811	-0.439	-0.088	-1.049	-0.135	
Kurtosis	8.186	1.828	8.105	3.004	1.086	4.837	2.913	6.085	1.679	2.040	6.401	1.544	
$\rho_1$	-0.168	0.079	-0.037	0.218	0.054	0.024	0.107	0.115	0.042	0.019	0.049	0.040	
$\rho_2$	-0.024	-0.014	0.042	0.145	-0.098	0.010	0.136	-0.055	0.073	0.028	0.056	0.141	
$\rho_3$	0.049	-0.175	0.051	0.063	-0.055	-0.073	-0.071	-0.032	0.014	0.039	0.105	0.096	
Q-statistic	6.281	5.908	1.097	13.965	2.098	1.169	6.740	5.173	1.248	0.492	2.533	5.599	
<b>Correlations</b>													
$\rho(\text{Index, ADR})$	0.928	0.375	0.204	0.410	0.511	0.556	0.552	0.701	0.278	0.869	0.778	0.968	
$\rho(\text{Index, World})$	0.034	0.108	0.004	-0.020	0.251	0.324	0.308	0.247	0.107	0.192	0.197	-0.057	
$\rho(\text{ADR, World})$	0.025	0.089	0.081	0.069	0.275	0.276	0.278	0.320	0.326	0.224	0.250	-0.023	



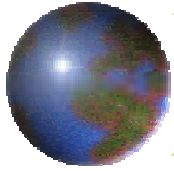
# Model Specification Tests

Panel A: Specification tests

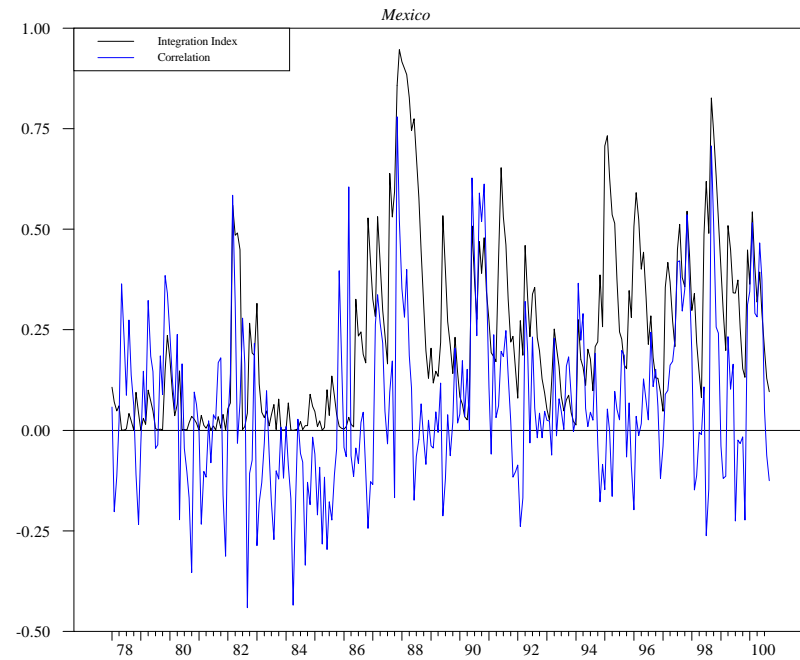
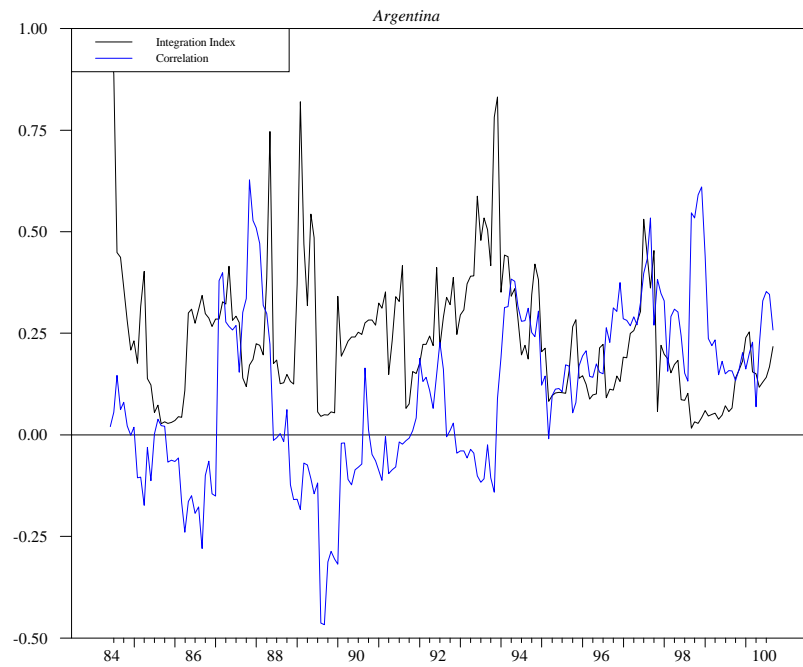
Market (initial date)	Argentina (1985:01)	Brazil (1987:12)	Chile (1985:5)	Colombia (1985:1)	Indonesia (1989:12)	Korea (1984:12)	Malaysia (1984:12)	Mexico (1985:1)	Philippines (1986:1)	Taiwan 1986:1)	Thailand (1988:7)	Venezuela (1986:1)
H <sub>0</sub> : Market price of covariance risk is time-varying, $\kappa_{w,j} = 0$ for $j > 1$												
p-values	106.3 <0.00	3.46 0.48	11.52 0.02	25.60 <0.00	0.90 0.92		4.08 0.39	913.2 <0.00	9.22 0.06	141.1 <0.00		65.72 <0.00
H <sub>0</sub> : Market price of local market risk is time-varying, $\kappa_{i,j} = 0$ for $j > 1$												
p-values	143.3 <0.00	82.11 <0.00	0.28 0.99	16.56 <0.00	8.24 0.08	1.26 0.87	4.12 0.39	389.6 <0.00	8.72 0.07	83.48 <0.00	12.60 0.01	59.14 <0.00

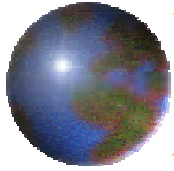
Panel B: Residual diagnostics

Market (initial date)	Argentina (1985:01)	Brazil (1987:12)	Chile (1985:5)	Colombia (1985:1)	Indonesia (1989:12)	Korea (1984:12)	Malaysia (1984:12)	Mexico (1985:1)	Philippines (1986:1)	Taiwan 1986:1)	Thailand (1988:7)	Venezuela (1986:1)
<b>IFCG Index</b>												
Mean	-0.044	0.006	0.193	-0.034	-0.084	0.069	-0.007	-0.066	-0.103	0.029	-0.105	-0.088
Std. Dev.	1.251	1.325	1.156	1.193	1.114	1.055	1.033	1.089	1.053	1.107	1.119	1.234
T-statistic	-0.496	0.059	2.274	-0.392	-0.858	0.899	-0.089	-1.046	-1.256	0.347	-1.139	-0.950
Skewness	0.101	0.796	0.833	0.159	-0.635	0.549	-0.236	-0.217	0.36	0.250	0.067	0.037
Kurtosis	4.653	14.75	3.902	10.29	4.261	2.005	0.591	2.267	1.276	2.676	2.591	1.254
Q-statistics	1.092	0.951	2.496	4.436	6.956	1.165	2.146	7.644	1.890	6.656	0.323	4.633
<b>ADR Portfolio</b>												
Mean	0.040	0.117	0.117	0.257	-0.090	0.139	0.049	0.079	0.031	0.049	-0.037	-0.042
Std. Dev.	1.236	1.041	0.988	1.006	0.984	1.029	1.001	1.057	1.009	1.176	1.150	1.238
T-statistic	0.459	1.393	1.611	3.508	-1.045	1.857	0.683	1.279	0.398	0.555	-0.386	-0.462
Skewness	-0.325	0.679	0.656	0.323	-0.326	0.596	0.337	0.069	-0.609	0.249	-0.186	0.316
Kurtosis	5.598	2.292	3.324	2.632	1.097	1.782	0.692	3.251	1.218	3.302	2.772	1.509
Q-statistics	0.395	4.419	0.870	1.236	0.674	1.096	6.516	1.146	3.406	3.269	4.209	3.816

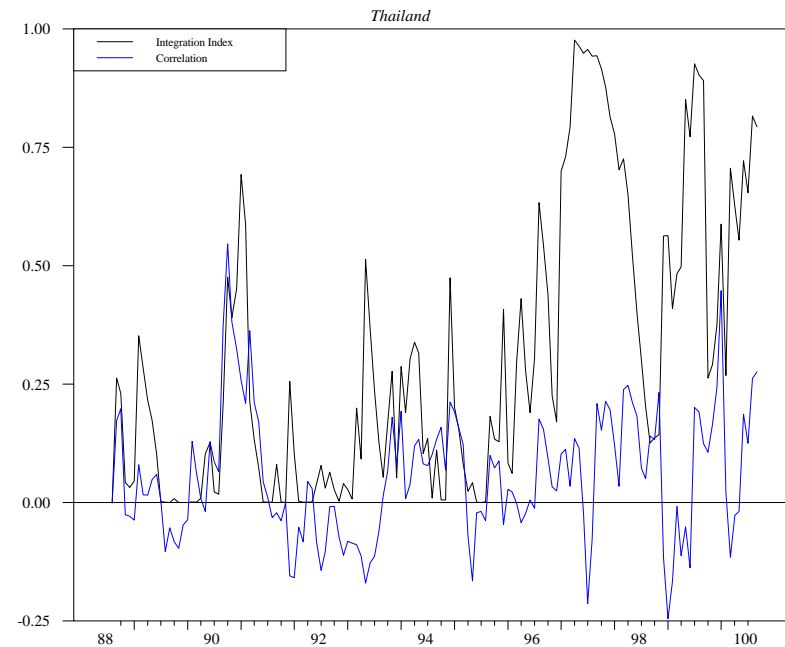
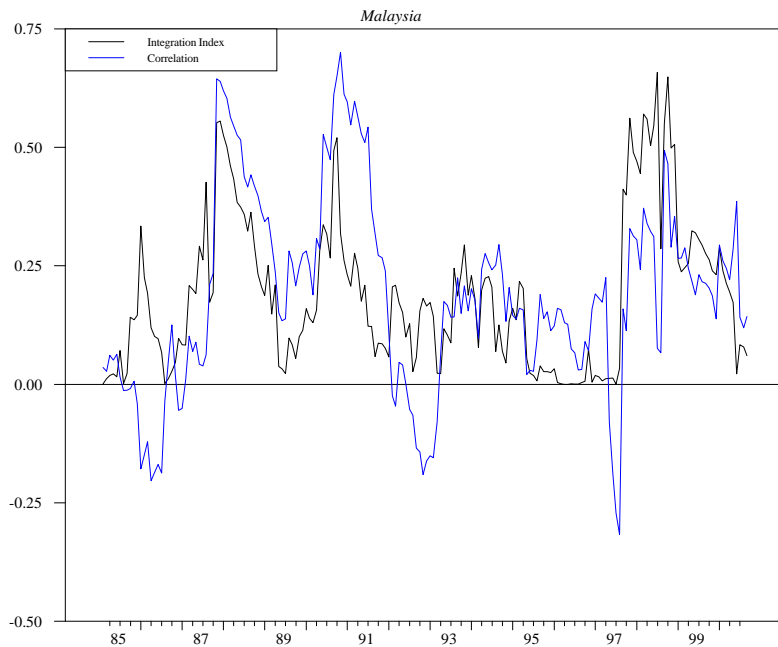


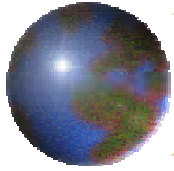
# *Time-Varying Market Integration*





# *Time-Varying Market Integration*





# ADRs and Time-Varying Integration

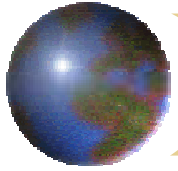
Panel A: Integration Indexes

Market (initial date)	Argentina (1985:01)	Brazil (1987:12)	Chile (1985:5)	Colombia (1985:1)	Indonesia (1989:12)	Korea (1984:12)	Malaysia (1984:12)	Mexico (1985:1)	Philippines (1986:1)	Taiwan 1986:1)	Thailand (1988:7)	Venezuela (1986:1)
Constant	0.247 (5.00)	0.054 (1.39)	0.053 (1.92)	0.108 (3.75)	0.041 (1.95)	0.009 (0.35)	0.495 (5.25)	0.306 (5.95)	0.164 (4.27)	0.275 (4.43)	-0.192 (-3.16)	0.013 (0.44)
LDATE	-0.061 (-1.17)	-0.169 (-5.36)	0.033 (1.59)	-0.017 (-0.57)	0.007 (0.25)	0.059 (3.33)	-0.016 (-0.45)	-0.162 (-3.16)	-0.012 (-0.89)	-0.158 (-2.68)	0.200 (4.59)	-0.097 (-2.41)
VOLFRAC	0.251 (1.91)	0.044 (0.73)	-0.013 (-0.32)	-0.025 (-0.47)	0.078 (1.76)	0.136 (1.55)	0.312 (4.40)	0.006 (0.60)	-0.146 (-2.36)	-0.149 (3.41)	-0.039 (-3.65)	0.359 (1.86)
MCAPFRAC	0.420 (4.37)	-0.150 (-1.87)	0.009 (0.37)	-0.904 (-0.63)	0.005 (4.22)	-0.032 (-0.48)	-0.188 (-1.37)	-0.304 (-6.46)	-0.027 (-0.72)	0.669 (0.84)	-0.319 (-5.33)	-1.450 (-11.98)
NUMFRAC	-1.169 (-5.09)	1.129 (3.85)	-0.071 (-0.51)	-0.064 (-0.39)	0.001 (0.02)	0.653 (2.79)	-6.421 (-3.52)	0.653 (4.81)	0.106 (1.34)	0.831 (0.96)	5.971 (8.32)	1.295 (7.40)
R <sup>2</sup>	0.233	0.154	-0.011	-0.015	0.372	0.036	0.141	0.134	0.142	0.137	0.455	0.491

Panel B: Conditional Correlations with World Market Returns

Market (initial date)	Argentina (1985:01)	Brazil (1987:12)	Chile (1985:5)	Colombia (1985:1)	Indonesia (1989:12)	Korea (1984:12)	Malaysia (1984:12)	Mexico (1985:1)	Philippines (1986:1)	Taiwan 1986:1)	Thailand (1988:7)	Venezuela (1986:1)
Constant	-0.119 (-2.08)	-0.005 (-0.09)	0.028 (0.47)	-0.026 (-0.59)	-0.224 (-7.39)	0.028 (0.69)	0.384 (2.49)	0.108 (1.89)	0.193 (2.85)	-0.001 (-0.01)	0.027 (0.55)	0.342 (2.66)
LDATE	-0.058 (-0.96)	-0.042 (-1.03)	-0.034 (-0.65)	-0.048 (-1.45)	0.139 (3.05)	0.047 (2.17)	0.176 (3.70)	0.028 (0.56)	-0.067 (-2.28)	-0.059 (-1.12)	-0.051 (-1.57)	0.011 (0.44)
VOLFRAC	0.264 (1.95)	-0.007 (-0.12)	-0.016 (-0.17)	-0.048 (-0.32)	0.075 (1.67)	-0.065 (-0.70)	-0.025 (-0.35)	-0.001 (-0.05)	-0.137 (-2.14)	0.022 (0.81)	0.001 (0.10)	-0.459 (-4.44)
MCAPFRAC	0.090 (1.04)	0.023 (0.20)	0.061 (1.19)	3.943 (1.79)	-0.001 (-1.19)	0.052 (0.83)	-0.577 (-3.62)	-0.190 (-3.77)	-0.128 (-1.62)	-0.507 (-0.88)	0.045 (1.53)	0.499 (4.25)
NUMFRAC	0.323 (1.56)	0.338 (0.79)	-0.079 (-0.28)	-0.098 (-0.47)	2.864 (2.88)	0.798 (2.18)	-4.651 (-1.55)	0.119 (0.69)	0.264 (1.66)	0.999 (1.46)	0.499 (1.01)	-0.894 (-3.25)
R <sup>2</sup>	0.440	-0.022	0.026	0.052	0.390	0.014	0.066	0.052	0.070	0.019	0.005	0.081





## *Future Work*

- Numerous specification tests - concern about model misspecification errors and how influences integration index and conditional correlations, other instrumental variables
- Broaden measures of ADR activity - home versus U.S. trading activity, fraction of shares in ADR form
- More countries - benchmark against developed markets
- Benchmark regression tests with other factors influencing integration - monthly capital flows, macroeconomic/business cycle variables,