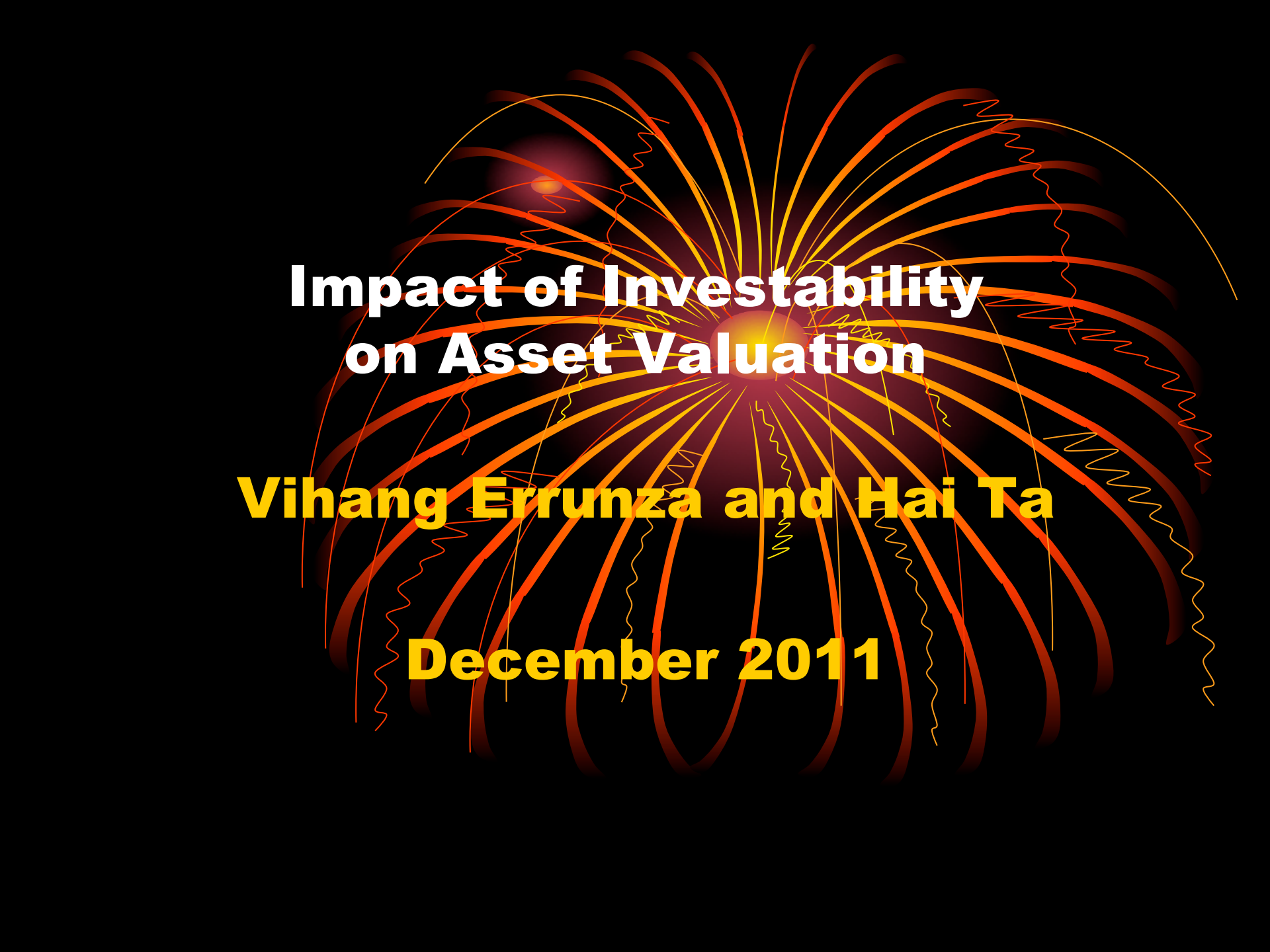


Impact of Investability on Asset Valuation

Vihang Errunza and Hai Ta

December 2011

Motivation

$$E(R_i) = R_f + AMCov(R_i, R_w) + (A_u - A)M_I Cov(R_i, R_I \mid \underline{R_e})$$

- Many emerging markets (EMs) have embarked on liberalization policies to develop financially integrated markets. Increased integration should lower cost of capital.

- Complete integration and **one factor model**:

$$E_{t-1}[r_{I,t}] = \lambda_{t-1} cov_{t-1}(r_{I,t}, r_{w,t}).$$

- Complete segmentation and **one factor model**:

$$E_{t-1}[r_{I,t}] = \lambda_{i,t-1} var_{t-1}(r_{I,t}).$$

-

Motivation

- Bekaert and Harvey (2000), Henry(2000) & Errunza and Miller (2000) investigate the impact of initial stock market liberalization around liberalization date.
- Henry(2000) reports 44% & Errunza and Miller(2000) report an average reduction of 42% in C.E.C.
- The process of liberalization is gradual, evolves over time as countries continuously adopt their policies.
- Hence, we need to evaluate impact of liberalization policy to-date that would inform further steps.

We take a long-term perspective and focus on a specific ongoing liberalization--Investability.

Research Questions

- Can we provide a tractable model that takes into account investability?

- Is the model supported empirically?

- What is the effect of investability on C.E.C ?

Main Results

Expected returns

- Unresrticted assets are priced solely with a global factor
- Restricted assets are priced with 3 factors: global factor, conditional local premium and local discount factors.

Results for 18 major EMs strongly support the model.

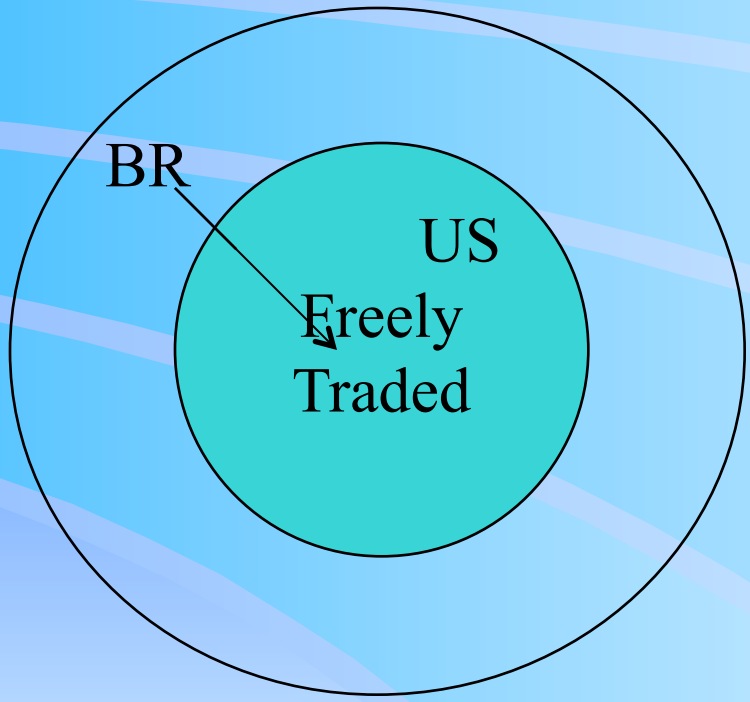
Discount measures economic benefits of loosening equity ownership restrictions. Move from non-investable to binding portfolio results in average reduction of 26% and further reduction of 21% in C.E.C. to an unrestricted status. Total reduction 42%

Agenda

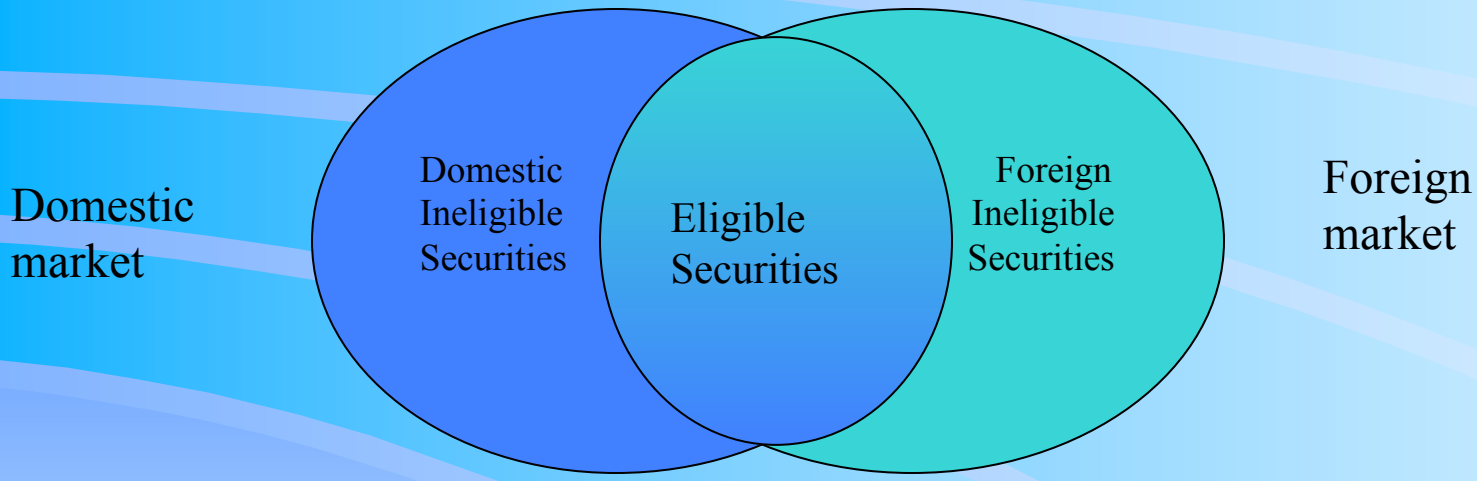
- The Models
- Methodology
- Results
- Conclusion

THE MODEL

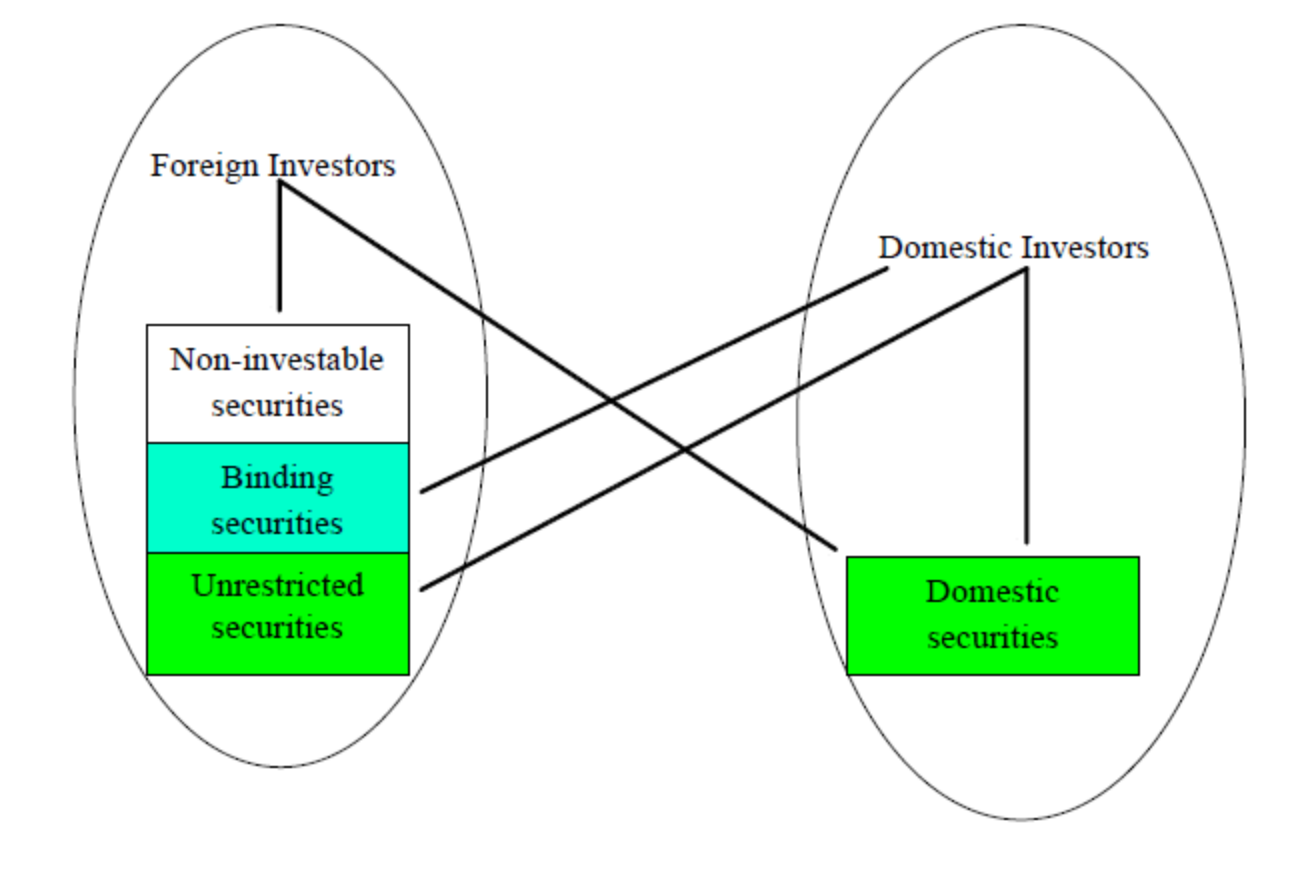
MILD SEGMENTATION
Errunza & Losq (1985)
Limiting Case of Stulz (1981)



PARTIAL SEGMENTATION
Chaieb & Errunza (2007)



Market Structure with Ownership Restriction Errunza & Ta (2011)



Investable Weight Factor - IWF

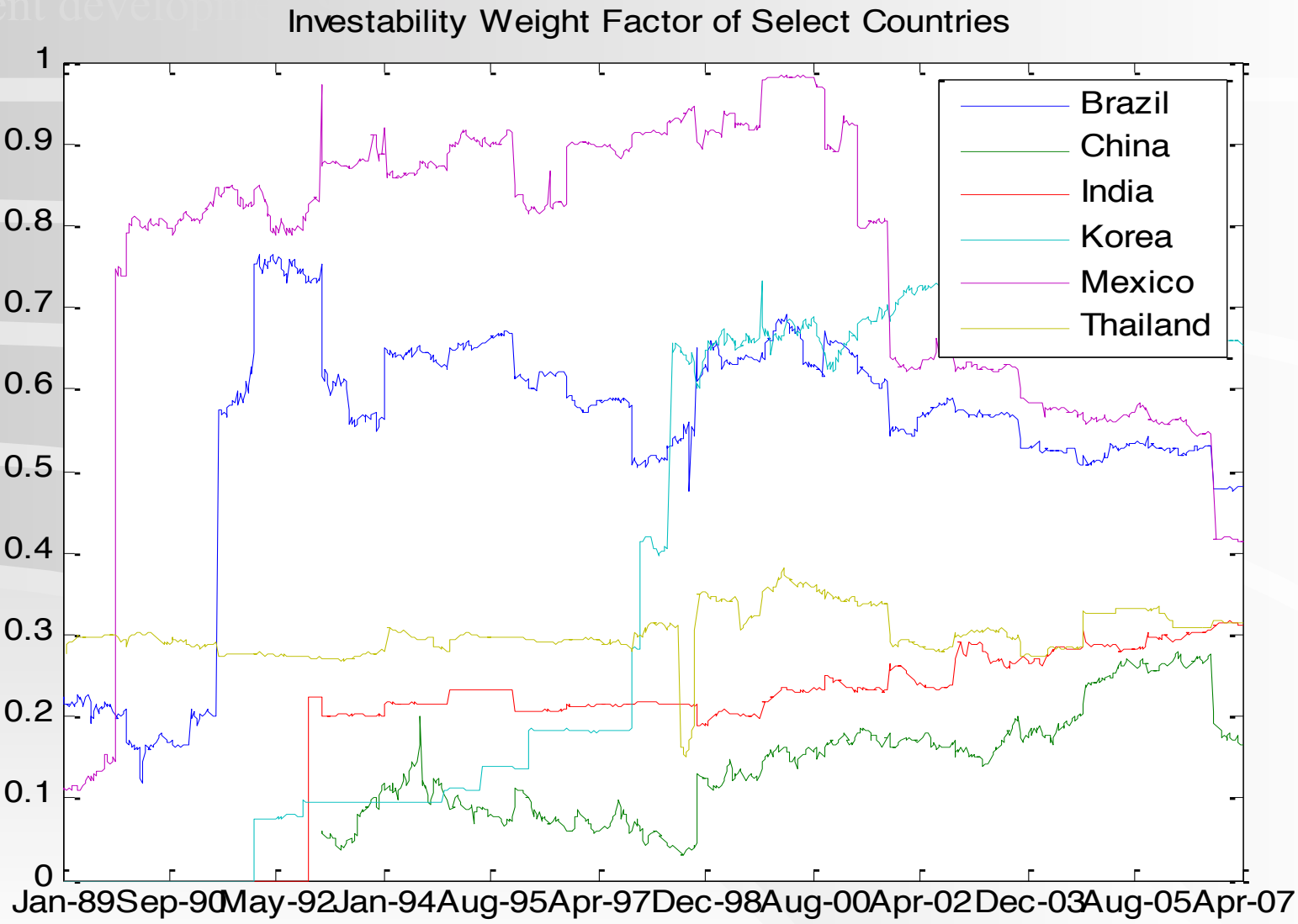
- Value range in [0, 1].
- Zero indicates non-investable; one denotes unrestricted
- IWF is a composite index that takes into account:

--Foreign investment restriction at firm & country level

--Size and liquidity

--Available float

EMs Have Been Relaxing Foreign Portfolio Restrictions



EM Market Structure

- Unrestricted assets - freely accessible to all investors, IWF > 0.5
- Binding ownership assets - available to non-nationals up to a certain limit, IWF $<$ or $= 0.5$
- Non-investable assets can not be traded by non-nationals, IWF $= 0$
- Last two subsets constitute restricted assets for the non-nationals.

First time the pricing of different sets of securities has been modeled and tested

Model Assumptions

- Two countries: domestic (U.S.) & foreign (E.M.). Each has a representative agent
- Returns are measured in domestic currency.
- All investors borrow and lend at the domestic risk free rate.
- Foreign investors can freely access all stocks.
- Domestic investors have access to their domestic stocks, unrestricted securities of the foreign market and up to the legal limit of foreign stocks.
- Markets are otherwise perfect.

A Constrained Optimization Problem

- Investor l={D,F} maximizes indirect utility,

$$J^l(W^l) = \max_{C^l,\pi^l} E_0 \int_0^\infty U^l(C^l(t))dt$$

- with budget constraint,

$$dW^l = [\sum_{i=1}^N \pi_i^l(\mu_i - r) + rW^l - C^l]dt + \sum_{i=1}^N \pi_i^l \sigma_i dz_i$$

- and portfolio constraint for domestic investor,

$$\underline{\pi}_m^D \leq \underline{\omega}_m \circ \underline{M}_m$$

Pricing of Unrestricted Assets

- Priced solely with a global risk premium - the covariance with the world market portfolio,

$$\mu_i - r = AMcov(R_i, R_W)$$

- where M is the world market capitalization, A is the aggregate absolute risk aversion, defined below,

$$\frac{1}{A} = \frac{1}{A^D} + \frac{1}{A^F}$$

Definitions

- Local Premium Factor is the value weighted index of all restricted assets (those with binding ownership restrictions),

$$\tilde{\mathrm{R}}_{K_1} = \sum_{i \in S_k} \frac{M_i}{M_{K_1}} \tilde{R}_i \qquad M_{K_1} = \sum_{i \in S_k} M_i$$

- Local Discount Factor is the value weighted index of investable portion of restricted assets,

$$\tilde{\mathrm{R}}_{K_2} = \sum_{i \in S_k} \frac{\omega_i M_i}{M_{K_2}} \tilde{R}_i \qquad M_{K_2} = \sum_{i \in S_k} \omega_i M_i$$

Pricing of Restricted Assets

- Restricted assets command a global premium, a conditional local premium and a conditional local discount
- Global risk premium, $AM\mathrm{cov}(R_i, R_W)$
- Conditional local premium, $(A^F - A)M_{K_1}\mathrm{cov}(R_i, R_{K_1} \mid R_p)$
- Conditional local discount, $-A^F M_{K_2}\mathrm{cov}(R_i, R_{K_2} \mid R_p)$

Limiting Cases

- All foreign assets non investable Model collapses to EL
- At the limit, if unrestricted risky assets are perfect substitutes for restricted assets, the markets will be effectively integrated.
- As domestic investors are allowed to hold increasing proportions of restricted foreign securities, the contribution of discount increases which at the limit (when all ownership restrictions are removed), equalizes the local discount to local risk premium and the security is priced with only the world risk factor. Thus, the discount provides a measure of the economic benefits of loosening equity ownership restrictions.

Methodology

Construction of Test Portfolios & Factors

Test portfolios are constructed based on the firm level IWF data.

- Non-investable: zeros IWF, ownership-binding IWF < or = 0.5, unrestricted: IWF > 0.5
- Portfolios are rebalanced annually at the end of calendar year
- Local premium factor consists of non-investable and binding securities and local discount factor consists of investable portion of binding securities

Construction of Factors

we regress the return of the local factor $\tilde{R}_{K_1}$ or $\tilde{R}_{K_2}$ on the world portfolio return and the returns of 38 world sector portfolios. Using a stepwise regression procedure with backward and forward threshold criteria to select from the set of sector portfolios, we obtain an initial DP, $\tilde{R}_{DP_1}$.

In the second step, we augment $\tilde{R}_{DP_1}$ with U.S. and globally traded CF and DRs, and allow the weights assigned to these securities to be time-varying as the CF and DRs become available in the U.S. or the global market. In particular, we run the following regressions for $\tilde{R}_{K_1}$ and $\tilde{R}_{K_2}$

$$\tilde{R}_{K,t} = \omega_{1,t}\tilde{R}_{DP_1,t} + \omega_{2,t}\tilde{R}_{CF,t} + \sum_{i=1}^{N} \omega_{3_i,t}\tilde{R}_{DR_i,t} + \tilde{r}_{res,t}$$

fitted value of this regression is $\tilde{R}_{DP}$, whereas the residual $\tilde{r}_{res,t}$ is the residual factor of the corresponding local factor.[18]

Estimation Method

- We test our model for unrestricted, binding and non-investable portfolios for each country .

$$
\begin{aligned}
E(\tilde{r}_n) &= \delta_w cov(\tilde{r}_n, \tilde{r}_w) + \delta_p cov(\tilde{r}_n, \tilde{r}_{res_p}) - \delta_d cov(\tilde{r}_n, \tilde{r}_{res_d}) \\
E(\tilde{r}_b) &= \delta_w cov(\tilde{r}_b, \tilde{r}_w) + \delta_p cov(\tilde{r}_b, \tilde{r}_{res_p}) - \delta_d cov(\tilde{r}_b, \tilde{r}_{res_d}) \\
E(\tilde{r}_u) &= \delta_w cov(\tilde{r}_u, \tilde{r}_w)
\end{aligned}
$$

where, δ_w, δ_p,and δ_d are respectively the price of risk the world, local premium and local discount factors; $\tilde{r}_n, \tilde{r}_b$,and $\tilde{r}_u$ are excess returns for the non-investable, binding and unrestricted portfolios respectively; $\tilde{r}_{res_p}$ and $\tilde{r}_{res_d}$ are returns on residual factors built upon the concept of diversification portfolios described in section 4.1. Briefly, $\tilde{r}_{res_p}$ and $\tilde{r}_{res_d}$ are respectively the residual returns from the regression of $\tilde{R}_{K_1}$ and $\tilde{R}_{K_2}$ on $\underline{\tilde{R}}_p$. Note that

Estimation Method - continued

- A system of 6 equations for each country

$$
\begin{aligned}
\widetilde{r}_{b,t} &= \delta_{w,t-1} h_{b,w,t} + \delta_{p,t-1} h_{b,res_p,t} - \delta_{d,t-1} h_{b,res_d,t} + \widetilde{\varepsilon}_{b,t} \\
\widetilde{r}_{n,t} &= \delta_{w,t-1} h_{n,w,t} + \delta_{p,t-1} h_{n,res_p,t} - \delta_{d,t-1} h_{n,res_d,t} + \widetilde{\varepsilon}_{n,t} \\
\widetilde{r}_{u,t} &= \delta_{w,t-1} h_{u,w,t} + \widetilde{\varepsilon}_{u,t} \\
\widetilde{r}_{res_p,t} &= \delta_{w,t-1} h_{res_p,w,t} + \delta_{p,t-1} h_{res_p,t} - \delta_{d,t-1} h_{res_p,res_d,t} + \widetilde{\varepsilon}_{res_p,t} \\
\widetilde{r}_{res_d,t} &= \delta_{w,t-1} h_{res_d,w,t} + \delta_{p,t-1} h_{res_p,res_d,t} - \delta_{d,t-1} h_{res_d,t} + \widetilde{\varepsilon}_{res_d,t} \\
\widetilde{r}_{w,t} &= \delta_{w,t-1} h_{w,t} + \widetilde{\varepsilon}_{w,t}
\end{aligned}
$$

- Price of risk specifications:

$$
\begin{aligned}
\delta_{w,t} &= \exp(k'_w Z_{w,t}) \\
\delta_{p,t} &= \exp(k'_p Z_{L_p,t}) \\
\delta_{d,t} &= \exp(k'_d Z_{L_d,t})
\end{aligned}
$$

Z_w is a set of global information variables and Z_L is a set of local instrumental variables

Estimation Method - continued

- Specify dynamics of covariance matrix with BEKK-VVT-BW specification to capture asymmetric volatility

$$H_t = \Omega_0 \circ (ii' - bb' - cc') - \Pi_0 \circ dd' + bb' \circ H_{t-1} + cc' \circ \tilde{\varepsilon}_{t-1}\tilde{\varepsilon}'_{t-1} + dd' \circ \tilde{\eta}_{t-1}\tilde{\eta}'_{t-1}$$

where b, c, d are 6×1 coefficient parameter vectors, $\tilde{\varepsilon}_t$ is a 6×1 vector of residuals and $\tilde{\eta}_t$ is a 6×1 vector defined as follows,

$$\begin{aligned} \tilde{\eta}_{i,t} &= -\tilde{\varepsilon}_{i,t}, \quad if \quad \tilde{\varepsilon}_{i,t} < 0, \forall i = 1, .., n \\ \tilde{\eta}_{i,t} &= 0, \quad otherwise \end{aligned}$$

- Compared to De Santis and Gerard (1987) the BEKK-VVT-BW has one additional vector of coefficient, d, designed to capture the asymmetry of volatility.

Results

Data

- Weekly data, 18 major EMs, from 01/01/89 to 30/04/ 07
- Country stock-level data from S&P/IFC EMDB
- Investable Weight Factor (IWF)
- World market and global sector data from Datastream
- Country Fund and ADR Data from CRSP and Datastream
- Instruments:

--Global: excess world dividend yield, U.S. term premium, U.S. default premium, change in Eurodollar rate

--Local: local market return, local dividend yield, and local value weighted IWF

Specification tests

Null Hypotheses:

- H1: Time-varying price of the discount factor, $k_{K,i}=0 \ \forall i>1$
- H2: Time-varying price of the local premium and discount factors, $k_{L,i}=0$ and $k_{K,i}=0 \ \forall i>1$
- H3: Time-varying price of the global factor, $k_{W,i}=0 \ \forall i>1$
- H4: Are the factor risk premia constant ? $k_{W,i}= 0$ & $k_{L,i}= 0$ & $k_{K,i}=0 \ \forall i>1$
- where i denotes the index of the coefficient vectors.

Average prices of risk for the global, local premium and local discount factors are 2.27, 2.3, 2.16-all very significant.

Specification Tests – Robust Wald Stats.

Null Hypothesis	d.f.	Argentina	Brazil	Chile	China	Colombia	India	Indonesia	Israel	Korea
		Statistics								
H1	4	49.80**	14.66**	15.34**	46.45**	14.71**	41.20**	20.37**	9.43*	33.64**
H2	7	75.04**	79.97**	25.23**	55.57**	27.40**	59.52**	58.22**	62.31**	82.51**
H3	5	69.80**	51.07**	18.85**	42.56**	8.29	35.20**	76.37**	55.43**	68.36**
H4	9	129.91**	199.93**	38.84**	83.42**	9.99	121.14**	126.14**	107.35**	127.34**
Null Hypothesis	**d.f.**	**Malaysia**	**Mexico**	**Pakistan**	**Peru**	**Philippines**	**S Africa**	**Taiwan**	**Thailand**	**Turkey**
		Statistics								
H1	4	24.25**	56.89**	36.19**	9.06	10.49*	25.27**	15.02**	10.48*	18.50**
H2	7	62.77**	75.68**	72.19**	45.37**	36.38**	63.95**	51.45**	45.54**	73.03**
H3	5	35.28**	45.13**	37.67**	86.73**	32.61**	30.97**	33.33**	80.89**	23.10**
H4	9	107.00**	170.66**	41.78**	134.16**	122.64**	101.77**	33.91**	87.34**	27.95**

*Note: ** and * denote the statistical significance at 1% and 5% levels respectively.*

Risk Premium Non-Investables

Country	Global Premium	Local Premium	Local Discount
Argentina	5.50%	94.50%	-8.80%
Brazil	51.24%	48.76%	-29.09%
Chile	17.24%	82.76%	-29.79%
China	16.50%	83.50%	-11.83%
Colombia	1.90%	98.10%	-25.23%
India	12.84%	87.16%	-40.28%
Indonesia	21.04%	78.96%	-48.61%
Israel	22.60%	77.40%	-47.21%
Korea	15.69%	84.31%	-34.38%
Malaysia	45.72%	54.28%	-48.56%
Mexico	11.63%	88.37%	-34.16%
Pakistan	8.47%	91.53%	-32.09%
Peru	44.96%	55.04%	-1.06%
Philippines	41.05%	58.95%	-39.03%
S Africa	20.55%	79.45%	-27.76%
Taiwan	27.37%	72.63%	-5.07%
Thailand	35.77%	64.23%	-34.15%
Turkey	21.73%	78.27%	-38.75%
Average	23.43%	76.57%	-29.77%

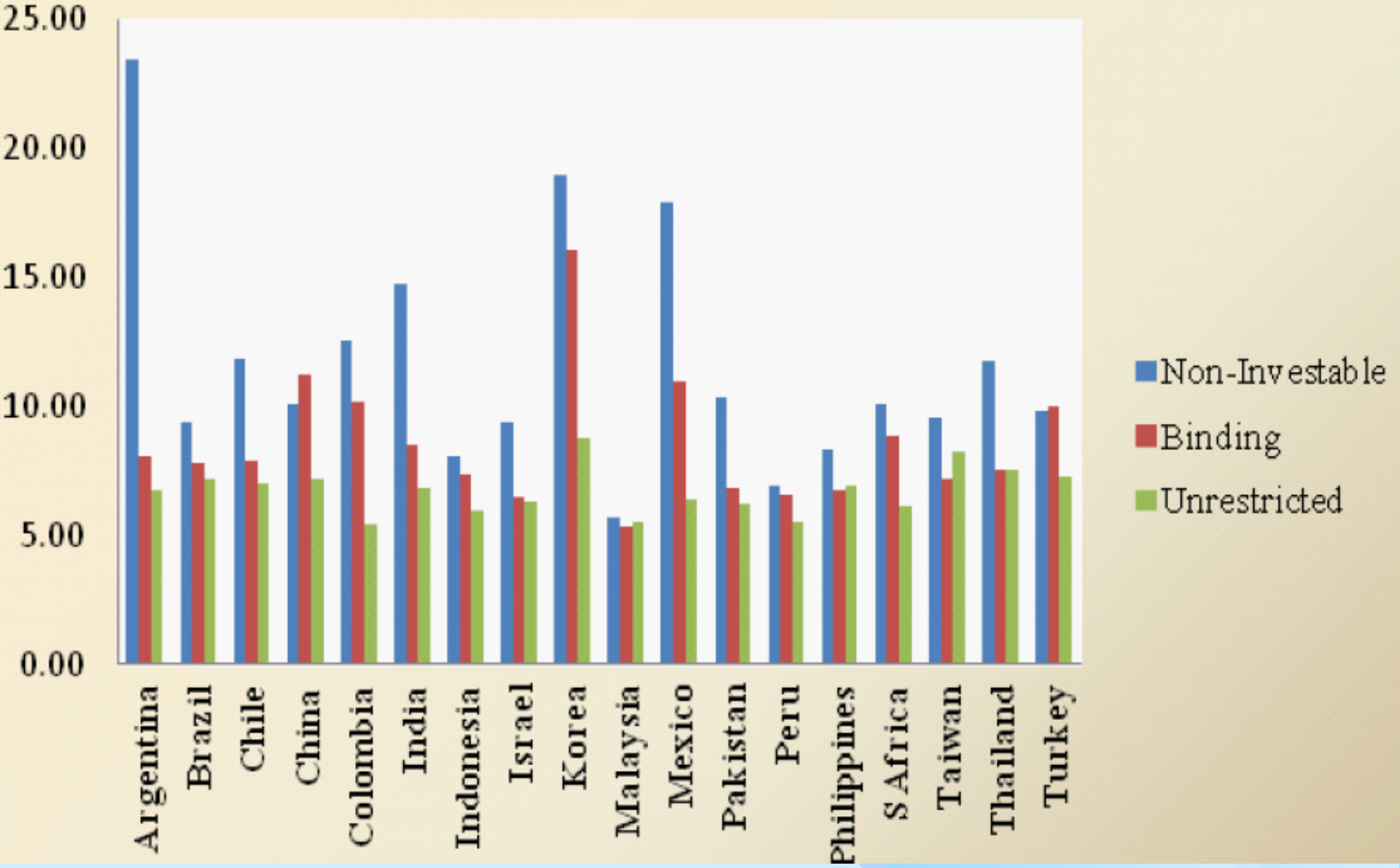
Risk Premium-Binding Portfolios

Country	Global Premium	Local Premium	Local Discount
Argentina	69.84%	30.16%	-24.55%
Brazil	54.07%	45.93%	-40.84%
Chile	25.21%	74.79%	-43.99%
China	52.54%	47.46%	-29.01%
Colombia	8.93%	91.07%	-32.53%
India	51.28%	48.72%	-44.97%
Indonesia	34.87%	65.13%	-49.27%
Israel	48.42%	51.58%	-48.25%
Korea	43.06%	56.94%	-38.82%
Malaysia	30.96%	69.04%	-49.52%
Mexico	13.03%	86.97%	-42.38%
Pakistan	23.15%	76.85%	-43.77%
Peru	21.58%	78.42%	-0.25%
Philippines	50.26%	49.74%	-44.71%
S Africa	14.67%	85.33%	-22.91%
Taiwan	53.25%	46.75%	-15.34%
Thailand	42.44%	57.56%	-44.10%
Turkey	30.92%	69.08%	-39.59%
Average	**37.14%**	**62.86%**	**-36.38%**

Average Annual Expected Return %

Country	Non-Investable	Binding	Unrestricted
Argentina	23.48	8.04	6.76
Brazil	9.37	7.80	7.18
Chile	11.88	7.86	6.96
China	10.10	11.23	7.21
Colombia	12.54	10.15	5.38
India	14.75	8.49	6.86
Indonesia	8.02	7.32	5.91
Israel	9.41	6.48	6.25
Korea	18.97	16.07	8.75
Malaysia	5.67	5.35	5.48
Mexico	17.90	10.93	6.39
Pakistan	10.32	6.81	6.18
Peru	6.89	6.59	5.55
Philippines	8.34	6.72	6.91
S Africa	10.09	8.88	6.09
Taiwan	9.53	7.14	8.26
Thailand	11.74	7.52	7.49
Turkey	9.78	10.00	7.31
Average	**11.60**	**8.52**	**6.72**

Average Annual Expected Return %



Major Empirical Findings

- Global & conditional local factors are significantly priced and time varying in most countries.
- Discount accounts for 30% and 36% of the total premium for non-investable and binding portfolios
- Move from non-investable to binding portfolio results in average reduction of 26% and further reduction of 21% in C.E.C. to an unrestricted status. Total reduction 42%

Conclusions

- Our IAPM characterizes more realistic international market structure characterized by ownership restrictions

- In equilibrium, unrestricted assets are priced solely with the global risk premium. The restricted assets are priced with three factors: the global premium, a conditional local premium, and a conditional local discount.

- Results for 18 major EMs strongly support the model.

- Discount provides a measure of economic benefits of loosening equity ownership restrictions. Move from non-investable to binding portfolio results in average reduction of 26% and further reduction of 21% in C.E.C. to an unrestricted status. Total reduction 42%