



Dispersion, Equity Returns Correlations and Market Integration

PRESENTED BY

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*Inquire
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Global investment strategies

- **Low correlations between national equity markets → substantial international diversification benefits**
 - e.g. Lessard 73, Solnik 74, Elton & Gruber 92, De Santis & Gerard 97
- **Cross border investing is at all time high**
- **Important issues when designing a global portfolio:**
 - **Country versus industry-based investing?**
Gerard, Hillion, De Roon and Eiling 07: industry-based strategies outperform, but only when short selling is allowed
 - **How to deal with currency risk?**
Gerard *et al.* 07: include currency deposits in international portfolios
 - **And what about emerging markets?**

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Global investment strategies

- **Expected returns, volatilities, correlations and betas change over time → this affects global investment strategies**
 - Eiling, Gerard and De Roon 06: after 1999, change in structure Euro-zone equity returns → impacts optimal investment strategy
- **Important to understand what drives global equity market returns**

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Two key issues in international finance

1. **Are cross-country correlations increasing over time?**
 - Ongoing debate
 - upward trend*: e.g. Longin & Solnik 95, Goetzmann, Li & Rouwenhorst 05
 - no trend*: e.g. King, Sentana & Wadhvani 94, Bekaert, Hodrick & Zhang 05
 - Focus on **developed markets**
- 2) **Are markets becoming more integrated over time?**
 - Financial market integration: global rather than local risk factors matter
 - Existing literature: integration increases over time
 - Bekaert & Harvey 95, De Jong & De Roon 05, Carrieri, Errunza, Hogan 07
 - Focus on **emerging markets**

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Measuring time-varying correlations

Existing approaches have various drawbacks:

- Correlation matrices in different subperiods
e.g. Kaplanis 88
- Parametric approach, based on GARCH, DCC or dynamic factor models
e.g. King, Sentana and Wadhvani 94; Bekaert, Hodrick & Zhang, 2006
- Cross-sectional dispersion
Solnik and Roulet 00, Baur 06

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Measuring time-varying market integration

- Cross-country correlations cannot be used directly to measure integration!
e.g. Forbes and Rigobon 02, Dumas, Harvey and Ruiz 03, Carrieri, Errunza and Hogan 07
- Existing measures of market integration have various drawbacks:
 - Multifactor/ regime switching model,
e.g. Bekaert and Harvey 95, 97
 - MktCap non-investable / Total MktCap,
De Jong and De Roon 05
 - Fraction of variance of non-investable assets not spanned by investable assets,
Carrieri, Errunza and Hogan 07

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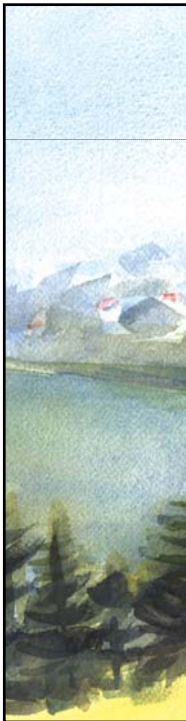


This paper

Have global equity market comovements changed over time?

- **Two new measures** of time-varying correlation and integration
 - Nonparametric
 - Easy to estimate for large cross-sections
 - Daily returns → monthly estimates
 - Robust for time variation in factor exposures and variances
 - Straightforward to test for trends, breaks etc.
 - Use as dependent variable in regressions on structural economic variables
 - Measure of instantaneous correlation has many practical applications
- **Extensive sample:** 24 developed and 26 emerging markets, 1973-2005

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Main findings

- **Developed markets: co-movements ↑**
 - Cross-country and cross-regional correlations increase
 - Upward trends in integration
- **Emerging markets: no increase in co-movements**
 - Cross-country and cross-regional correlations do not increase
 - While global factors have become more important, country-specific risk has not decreased
 - No upward trend integration

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Theoretical setup

- Consider country i of region a
- Excess returns follow a two-factor model with global & regional factors

$$r_{it} = \beta_{at} W_t + \gamma_{at} L_{at} + \varepsilon_{it}$$

- Assume orthogonality of factors and idiosyncratic shocks
- **Total country variance (in region a) can be decomposed as:**

$$\sigma_{at}^2 = \underbrace{\beta_{at}^2 \sigma_{Wt}^2}_{\text{total global}} + \underbrace{\gamma_{at}^2 \sigma_{Lat}^2}_{\text{regional}} + \underbrace{\sigma_{\varepsilon_{it}}^2}_{\text{country}}$$

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Theoretical setup (ctd)

- Cross-country correlations in region a :

$$\rho_{at} = 1 - \frac{\sigma_{\varepsilon_{it}}^2}{\sigma_{at}^2}$$

- ρ_{at} is inversely related to $\sigma_{\varepsilon_{it}}^2$ only if the systematic variance σ_{at}^2 is constant
→ **Take all components of ρ_{at} into account!**

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Combining cross-sectional and short time series data

- σ_{eat}^2 can be estimated as **cross-sectional dispersion**
- For σ_{at}^2 we need a time dimension: **realized variance**
- Daily returns for a cross-section of countries → monthly cross-country correlations

- **Estimator for instantaneous correlation:** $\hat{\rho}_{at} = 1 - \frac{\hat{\sigma}_{eat}^2}{\hat{\sigma}_{at}^2}$

where
$$\hat{\sigma}_{eat}^2 = \frac{1}{N} \sum_{i=1}^N \sum_{d=1}^{D_t} (r_{id} - \bar{r}_{Ewd})^2$$

$$\hat{\sigma}_{at}^2 = \frac{1}{N} \sum_{i=1}^N \sum_{d=1}^{D_t} r_{id}^2$$

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Measuring time-varying market integration

- **Measure for market integration:**
$$I_{at} = \frac{\beta_{at}^2 \sigma_{Wt}^2}{\sigma_{at}^2}$$

I_{at} close to 0 → segmentation,

I_{at} close to 1 → integration


- **Global/ systematic risk:**

$$\frac{\beta_{at}^2 \sigma_{Wt}^2}{\beta_{at}^2 \sigma_{Wt}^2 + \gamma_{at}^2 \sigma_{Lat}^2}$$

Details estimation:

- Proxy W_t by value-weighted world index → σ_{Wt}^2
- Orthogonalize regional factor w.r.t. $r_{world,t} \rightarrow \gamma_{at}^2 \sigma_{Lat}^2$
- Extract β_{at} from variance decomposition

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Measuring time-varying market integration


- **Instantaneous average correlation estimator:**

$$1 - \frac{\text{Average Cross Sectional Dispersion}}{\text{Average Realized Variance}}$$
- **Market integration measure :**

$$\frac{\text{Average Global Risk}}{\text{Average Realized Variance}}$$
- **Global/systematic risk:**

$$\frac{\text{Average Global Risk}}{\text{Average Systematic Risk}}$$

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Data

- **Daily USD excess returns for 24 developed markets (Datastream) and 26 emerging markets (S&P's EMDB)**
- **7 regions**

<i>Region</i>	<i>Starting date</i>	<i># corr. estimates</i>	<i># int. estimates</i>
Developed markets Europe	Jan 73	386	193
North America	Jan 73	386	193
Asia Pacific	Jan 73	386	193
Eastern Europe	Dec 91	135	67
Middle East / Africa	Febr 93	145	72
Emerging markets Asia	Febr 87	217	108
Latin America	Aug 89	187	93

- **Adjust for serial correlation due to nonsynchronous trading and non-common holidays**

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Developed Markets Included

Europe

1 Austria	3-Jan-73	7 Italy	3-Jan-73	13 Spain	1-Apr-87
2 Belgium	3-Jan-73	8 Netherlands	3-Jan-73	14 Finland	1-Apr-88
3 Denmark	3-Jan-73	9 Switzerland	3-Jan-73	15 Greece	1-Feb-90
4 France	3-Jan-73	10 UK	3-Jan-73	16 Portugal	1-Feb-90
5 Germany	3-Jan-73	11 Norway	1-Feb-80	17 Luxembourg	3-Feb-92
6 Ireland	3-Jan-73	12 Sweden	1-Feb-82		

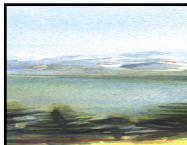
North America

18 Canada	3-Jan-73	19 US	3-Jan-73
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Asia Pacific

20 Australia	3-Jan-73	22 Japan	3-Jan-73	24 New Zealand	1-Feb-88
21 Hong Kong	3-Jan-73	23 Singapore	3-Jan-73		

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Emerging Markets Included

Eastern Europe

25 Czech republic	1-Dec-93	27 Poland	1-Apr-94	29 Hungary	3-Jul-95
26 Turkey	1-Dec-93	28 Russia	1-Jul-94	30 Slovakia	3-Feb-97

Middle East - Africa

31 Israel	1-Feb-93	33 Nigeria	3-Jul-95	35 Morocco	1-Jan-96
32 South Africa	1-Feb-93	34 Zimbabwe	3-Jul-95		

East Asia

36 Malaysia	2-Feb-87	39 Taiwan	1-Jun-88	42 China	2-Aug-93
37 Thailand	2-Feb-87	40 Philippines	1-Dec-88	43 India	3-Jul-95
38 Korea	1-Oct-87	41 Indonesia	1-May-90		

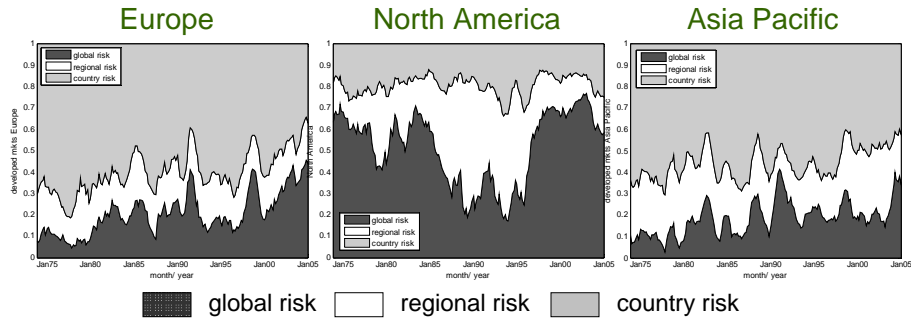
Latin America

44 Chile	1-Aug-89	47 Argentina	1-Sep-93	50 Colombia	3-Jul-95
45 Mexico	1-Aug-89	48 Peru	1-Feb-94		
46 Venezuela	1-Feb-90	49 Brazil	1-Aug-94		

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Developed markets



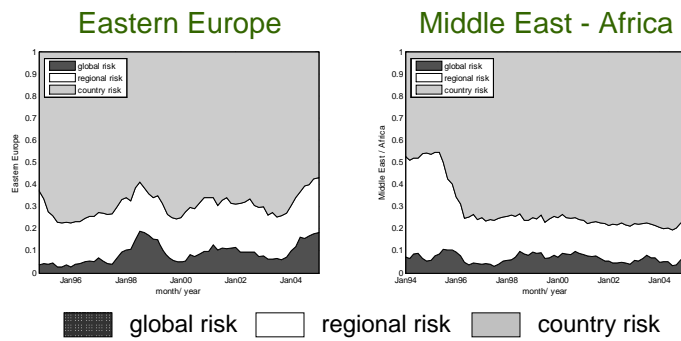
	Europe		North America		Asia Pacific	
	Trend *10 ⁵	t-PS ¹	Trend *10 ⁵	t-PS ¹	Trend *10 ⁵	t-PS ¹
Correlation	52.57**	[3.28]	1.50	[0.12]	27.85**	[2.08]
Integration	112.89**	[3.10]	-83.84	[-0.22]	90.29**	[2.86]
Global/ syst risk	166.07**	[2.85]	-121.41	[-0.22]	175.48**	[2.20]

Vogelsang (98) test for trend, 5% critical value ± 1.72

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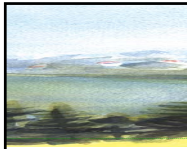
Emerging markets - I



	Eastern Europe		Middle East - Africa	
	Trend *10 ⁵	t-PS ¹	Trend *10 ⁵	t-PS ¹
Correlation	4.59	[0.08]	-253.18	[-1.33]
Integration	126.08	[1.40]	-8.57	[-0.24]
Global/ syst risk	352.82**	[1.92]	243.52	[1.51]

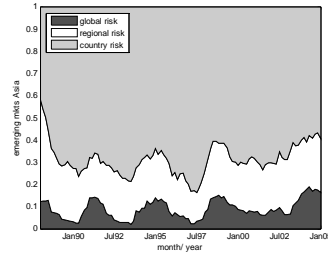
Vogelsang (98) test for trend, 5% critical value ± 1.72

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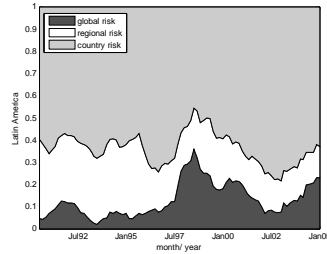


Emerging markets - II

EM Asia



Latin America

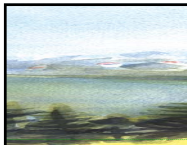


global risk
 regional risk
 country risk

	Emerging mkts Asia		Latin America	
	Trend *10 ⁵	t-PS ¹	Trend *10 ⁵	t-PS ¹
Correlation	-26.35	[-0.38]	-51.37	[-1.25]
Integration	22.31	[0.64]	184.10	[1.11]
Global/ syst risk	107.57**	[2.04]	494.68**	[1.85]

Vogelsang (98) test for trend, 5% critical value ± 1.72


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Trends in correlation and integration

	Annualized trends in		
	Correlation	Integration	Global SystRisk
Developed markets			
Europe	0.63%	1.35%	1.99%
North America	0.02%	-1.01%	-1.46%
Asia Pacific	0.33%	1.08%	2.11%
Emerging Markets			
Eastern Europe	0.06%	1.51%	4.23%
Mid East/Africa	-3.04%	-0.10%	2.92%
East Asia	-0.32%	0.27%	1.29%
Latin America	-0.62%	2.21%	5.94%
Test of difference in trends (Vogelsang & Fransens 05)			
Europe vs AsiaPac	5.93	4.07	1.62
Europe vs EastEurope			-1.09


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Differences in speed of integration

- **Which region integrates faster?** Test for equality of trends.
- **Main findings:**
 - Developed Mkts Europe vs Asia Pacific:
 - Trends in integration & correlations higher in Europe than among Asia Pacific markets
 - Changes in the share of systematic risk due to the global factor are similar
 - Developed Mkts Europe vs EM Europe:
 - Increasing integration & correlation in dev. Europe while no trends for Eastern Europe
 - Trends in global / systematic risk are similar
- **Differences in the speed of integration are due to country risk rather than global and regional factors!**

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Robustness

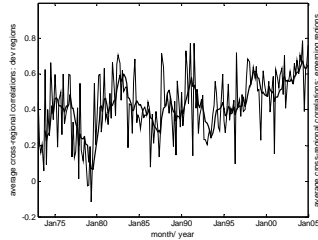
- **Dispersion based measure of correlation**
 - Average of short horizon pair-wise realized correlations yield similar results
- **Is the integration measure driven by differing and time varying country weights in world index?**
- Use EW G16 index as global factor rather VW world index
 - results are similar
 - time variation in integration is not mainly driven by time variation in market shares

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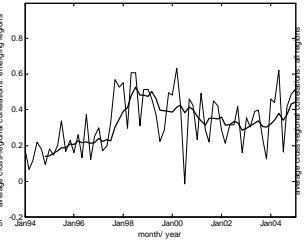


Cross-regional correlations

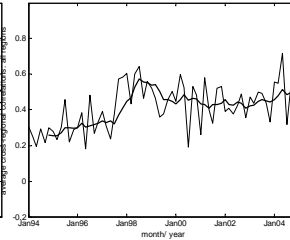
Dev. Markets



EM Markets



All Regions



	developed mkts	emerging mkts	all regions
trend ($\times 10^5$)	100.45**	354.76	362.23
t-PS ¹	[2.39]	[0.95]	[1.51]
Det. trend in pairwise corr?	3 out of 4	none	


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Next: What drives comovements

- **Relate correlation and integration to structural economic variables:**
 - Macro-economic development:
(imports+exports)/GDP
 - Financial market development:
Equity MktCap/ GDP
 - Productivity growth:
growth in real GDP per capita
 - Business cycle:
*US term premium, excess world market dividend yield,
US default spread*
 - Industry alignment
 - Capital market barriers:
liberalization dummy
 - Etc.
- Work in progress

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Conclusions

Changing global equity market comovements!

- Comovements and integration:
 - increasing across dev. markets and regions
 - higher rate of increase in Europe than Asia/Pac
 - no upward trend across EM markets and regions
- Share of global factor in systematic risk
 - Increasing across all markets and regions
 - No difference in rate of increases
- Share of local factors in total risk:
 - Decreasing in developed markets
 - Stable or increasing in EM markets

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Conclusions - ctd

- Increasing importance global factors and decreasing importance of regional factors: true global phenomenon
- Important implications for international investors
 - Decreasing benefits of diversification across developed markets.
 - EM markets have not lost their diversifiers characteristics over last 2 decades
- Methodology: when total and factor volatility is time varying
 - Dispersion: poor measure of average correlation
 - Correlation: poor measure of integration
 - Proposed measures for correlation & integration: many possible academic and practical applications

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