

International Equity Market Correlations

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Discussion Topics

- Is our ability to diversify international portfolios deteriorating?
- Does diversification disappear right when you need it most?
- Should the country approach be replaced with a sector approach?



Why the Answers Matter

Stress-testing--assessment of effects of high volatility on portfolio should include expected changes in the correlation.

Choice of long-term or recent history to estimate covariance.

Better assessment of risk and opportunity.

Optimal allocation of assets.

Hedging strategies.

Data

Datastream indices:

Daily market returns (Jan 1973 through Oct 2000, US\$)

60 day cross-country correlations (231 pairs of countries)

Weekly individual country sector returns

(9cty X 10sect, Jan 1990 - Oct 2000, E)

eg: French telecom, German telecom . . .

French banks, German banks . . .

Weekly regional sector returns (Jan 1973 through Oct 2000, E)

Weekly country returns (Jan 1973 through Oct 2000, E)

Deteriorating Diversification

Globalization--countries, companies and markets becoming more and more alike.

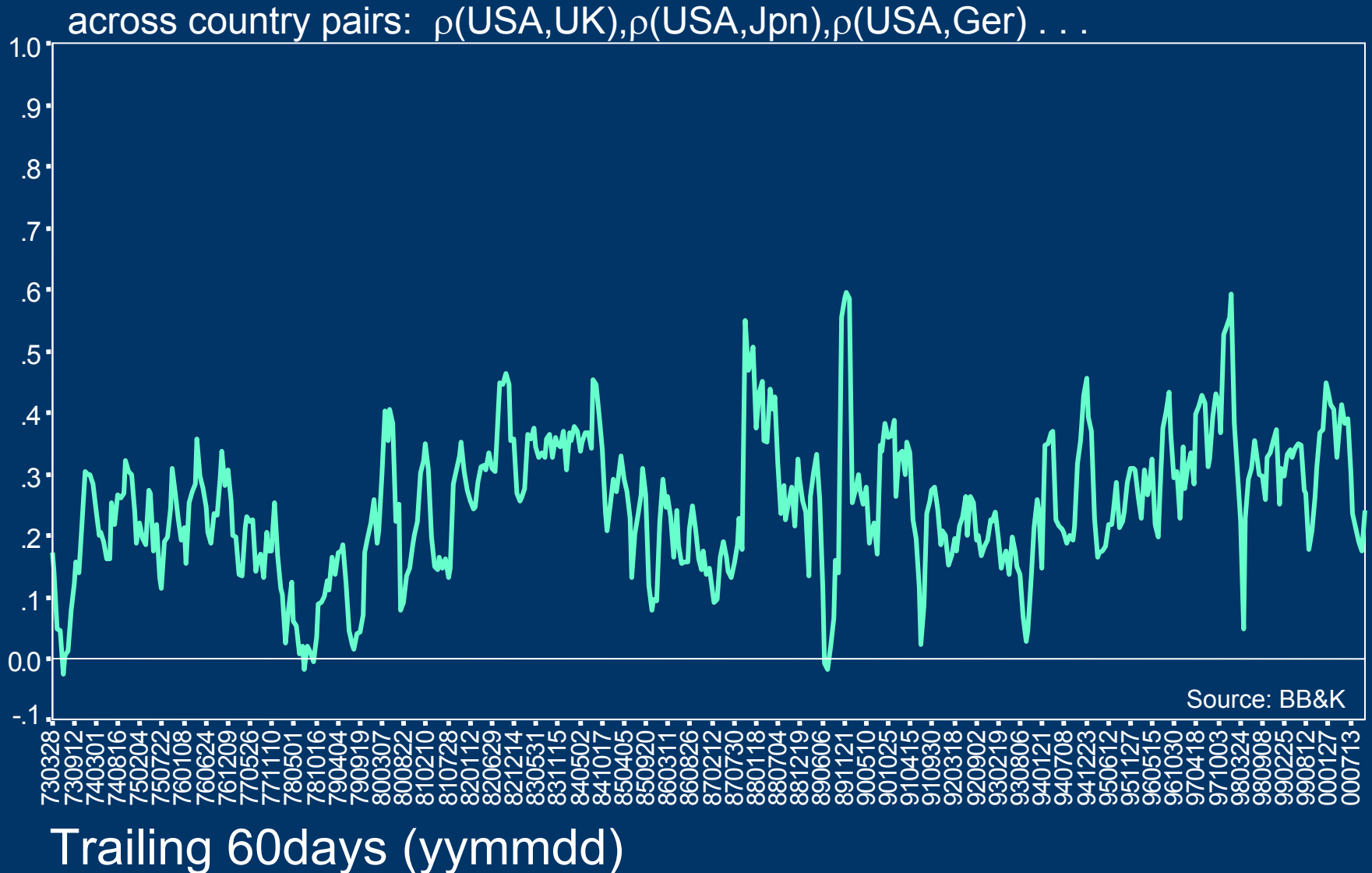
Euroland--move to single currency, single market.

Cross border mergers and acquisitions.

Multiple listings, expanded trading hours.

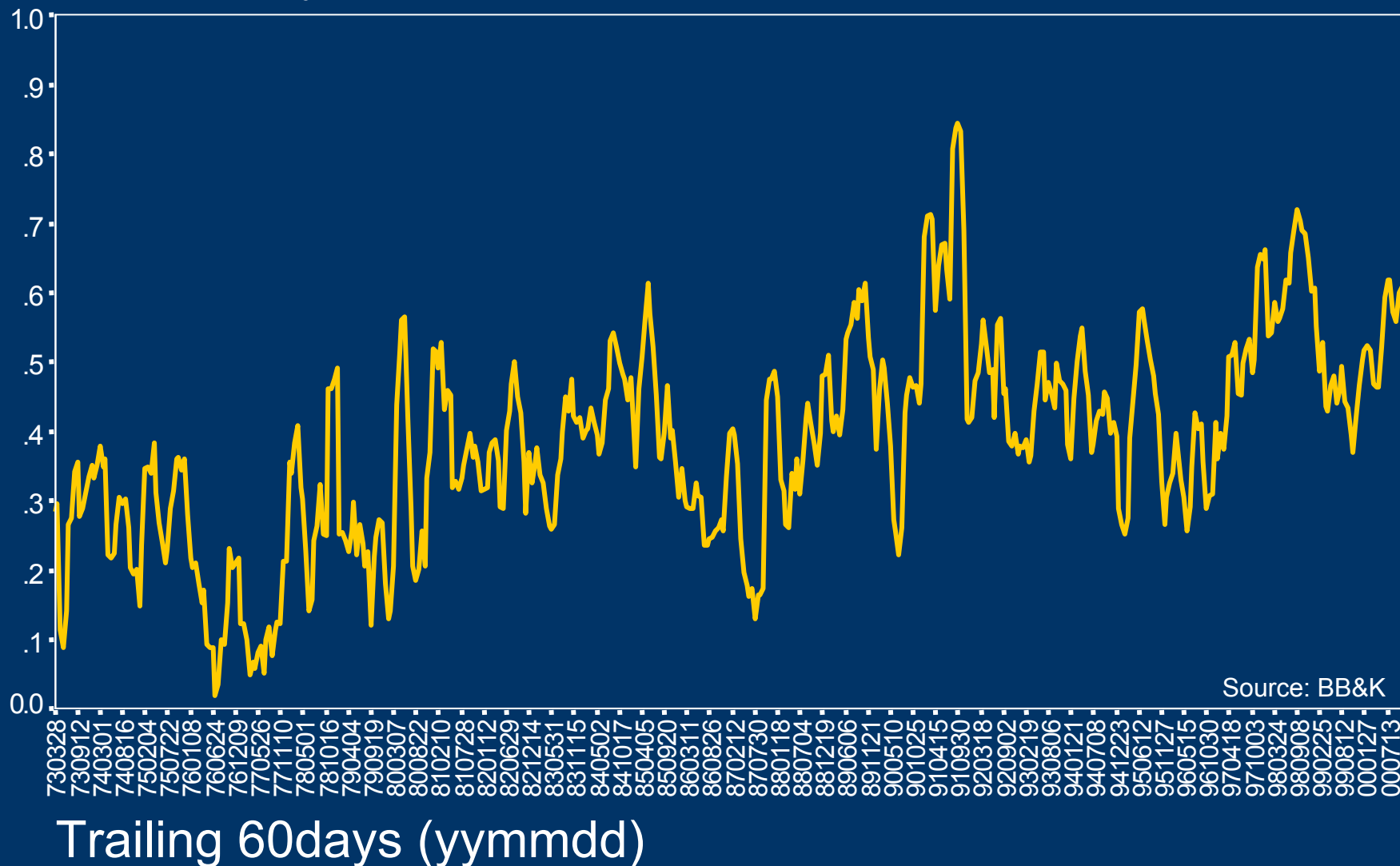
Institutional portfolio manager herding.

Average Correlations With USA



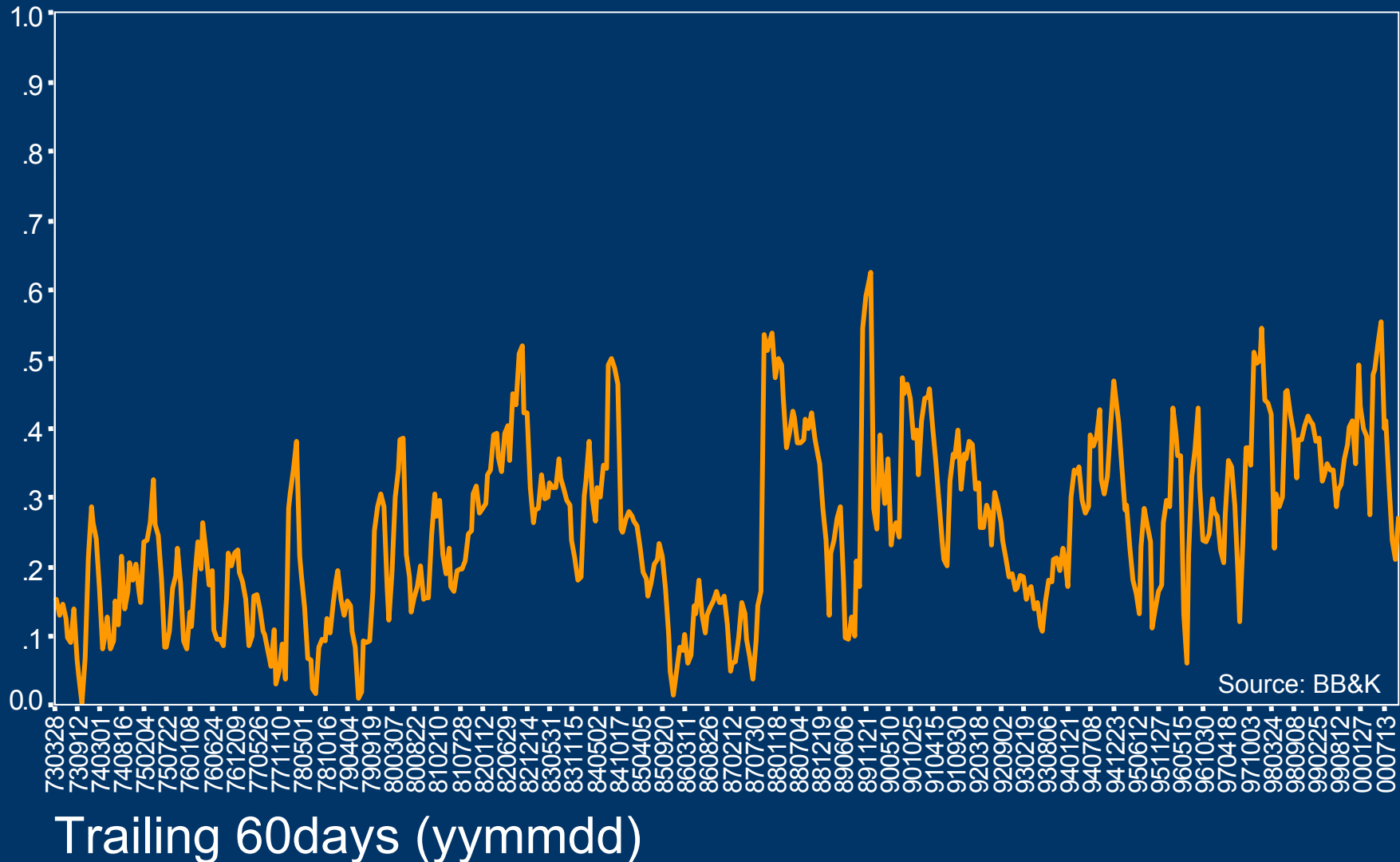
Average Correlations Within Euroland

across country pairs: $\rho(\text{Fra, Ger}), \rho(\text{Fra, Ita}), \rho(\text{Ger, Ita}) \dots$



Average Correlations Within Pacific Rim

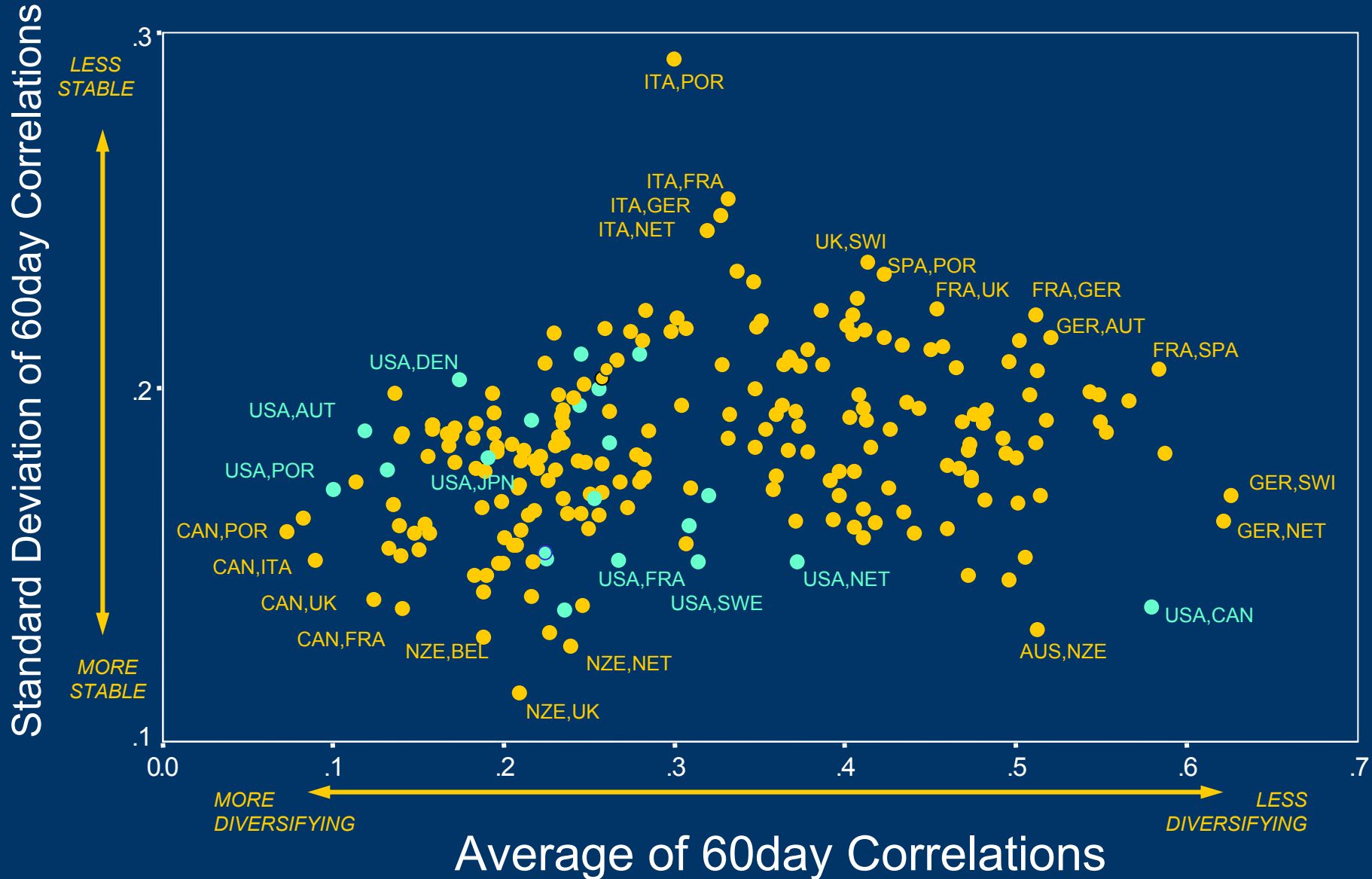
across country pairs: $\rho(\text{Jpn}, \text{HKg}), \rho(\text{Jpn}, \text{Sng}), \rho(\text{HKg}, \text{Sng}) \dots$



Regional Comparison

	73-81		82-91		92-10/00	
	avg	st dev	avg	st dev	avg	st dev
Euro-Other Eur	0.28	<i>0.22</i>	0.44	<i>0.21</i>	0.48	<i>0.18</i>
within Euroland	0.27	<i>0.22</i>	0.43	<i>0.21</i>	0.47	<i>0.19</i>
within Other Eur	0.21	<i>0.22</i>	0.43	<i>0.21</i>	0.45	<i>0.16</i>
within Pacific Rim	0.17	<i>0.20</i>	0.30	<i>0.22</i>	0.31	<i>0.20</i>
Pac Rim-Other Eur	0.13	<i>0.18</i>	0.27	<i>0.19</i>	0.22	<i>0.16</i>
Pac Rim-Euro	0.14	<i>0.18</i>	0.25	<i>0.20</i>	0.21	<i>0.16</i>
with USA	0.19	<i>.21</i>	0.23	<i>0.21</i>	0.28	<i>0.18</i>

Correlation Stability



Phantom Diversification vanishes when most needed

Higher correlations when markets fall.

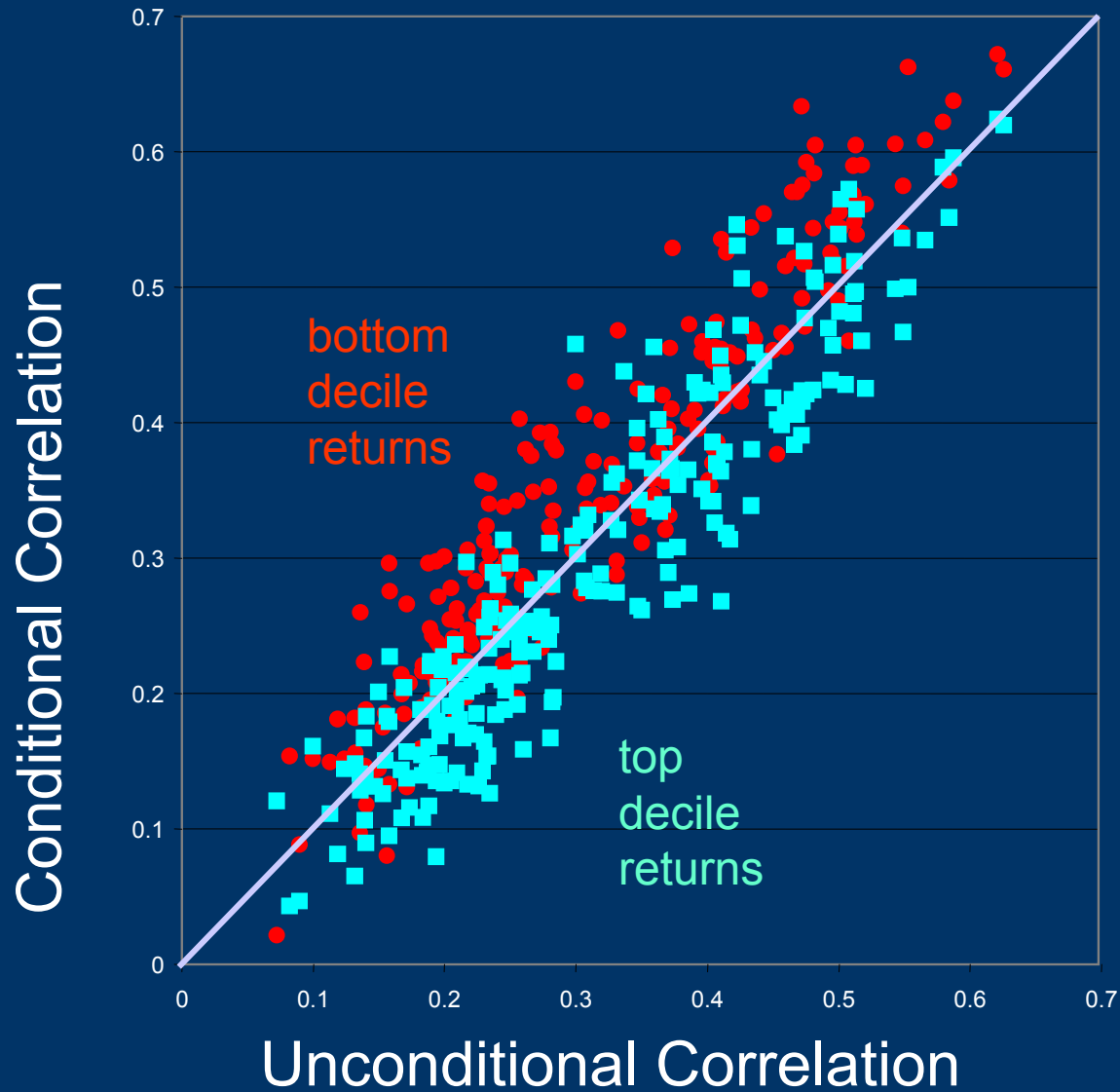
Higher correlations when markets are volatile.

Does this reflect a real change in the relationships between asset returns?

How inconsistent is this with constant correlation assumption? Normality assumption? Compare with theoretical conditional correlations.

What about “contagion”?

Extreme Market Moves



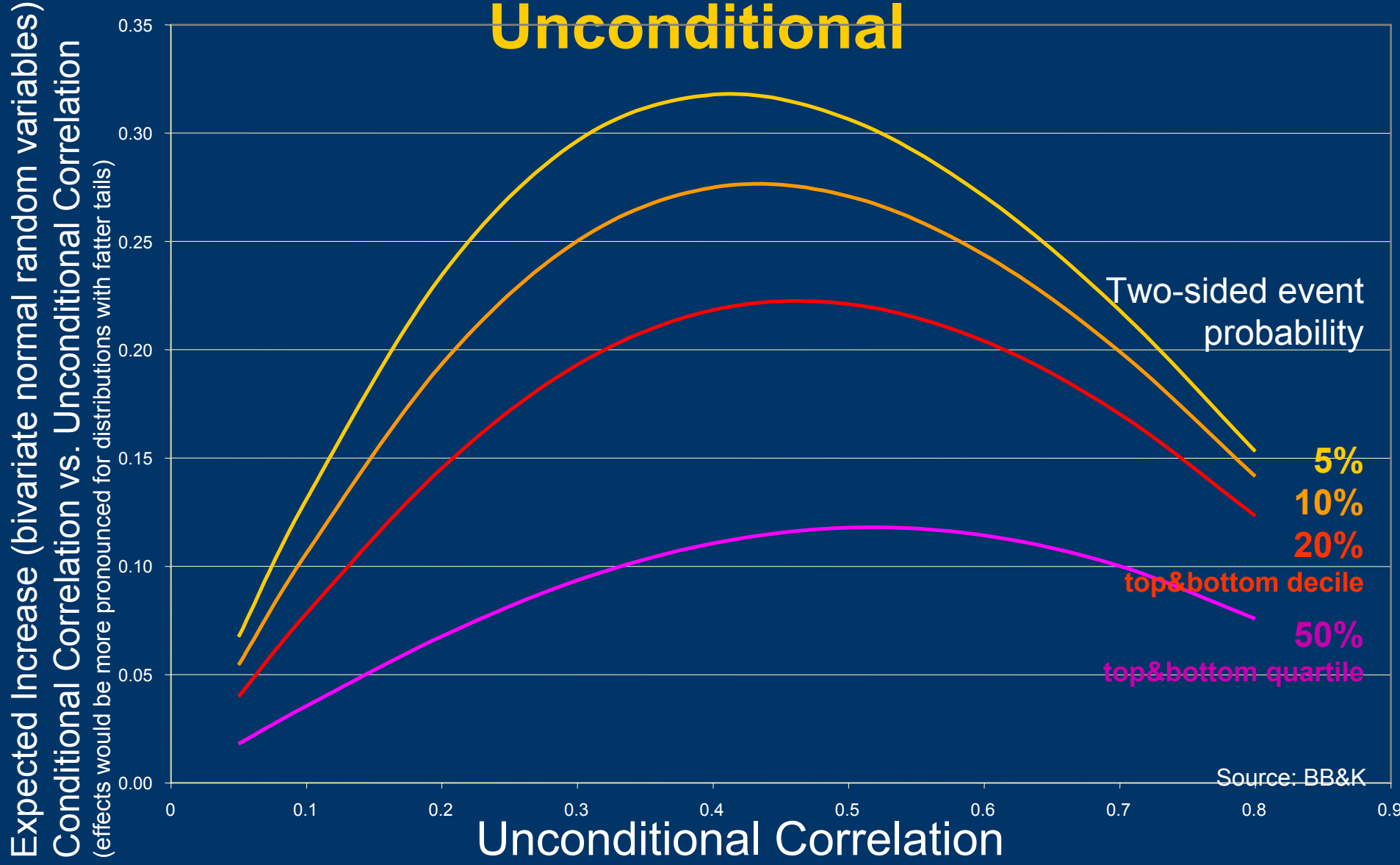
Constant Correlation Mandates Higher Conditional Correlation in the Tails


$$\rho_A = f\left(\rho, \frac{\text{Var}(x|A)}{\text{Var}(x)}\right)$$

$$\rho_A = \frac{\rho}{\sqrt{\rho^2 + (1-\rho^2) \text{Var}(x) / \text{Var}(x|A)}}$$

Significant differences between the conditional correlations are caused by the choice of subsamples alone; they do not necessarily indicate any change in the parameters of the data generating process, merely the time-varying market volatility.

Expected Increase Conditional Correlation vs. Unconditional



Observations

Expect correlations to increase significantly, especially for unconditional correlations between 0.4-0.5, and especially for more extreme conditions:

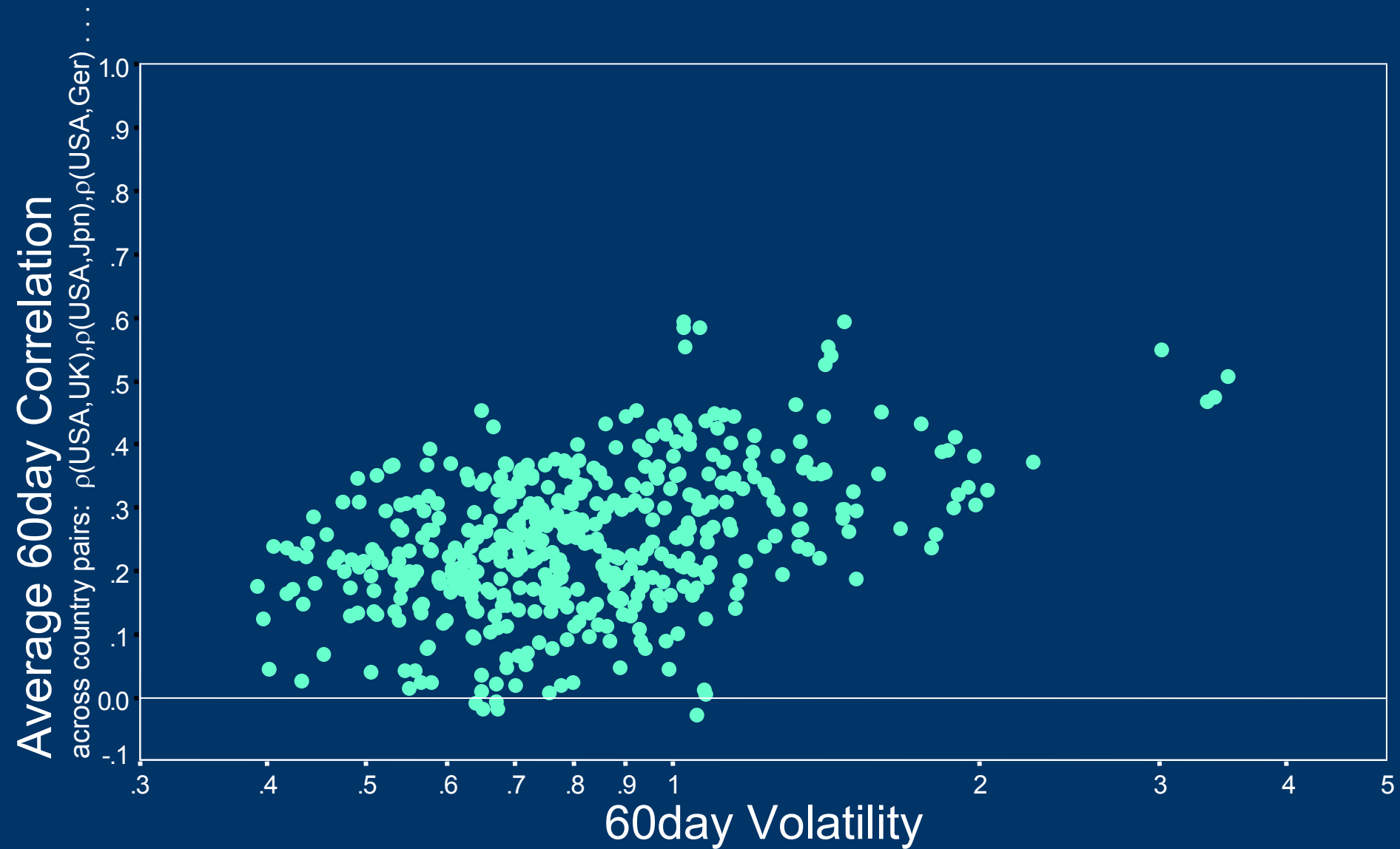
.4 --> .5+ conditioned on top&bottom quartile returns

.4 --> .6+ conditioned on top&bottom decile returns

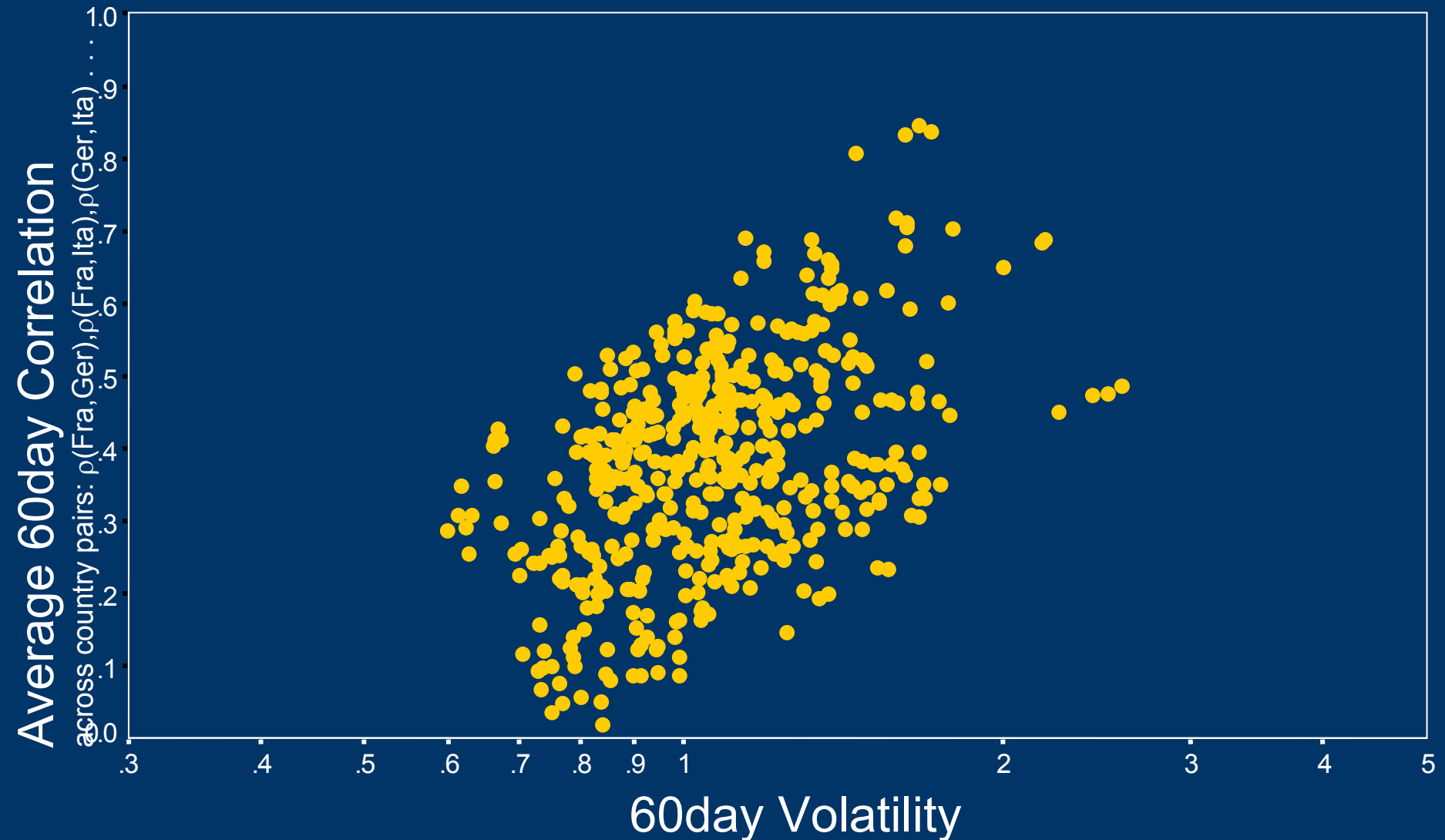
Correlations do not increase uniformly. Optimal portfolios based on the conditional variance-covariance matrix therefore will differ from those based on the unconditional.

Market returns exhibit significant excess kurtosis & negative skewness--affects will be worse than shown on previous slide.

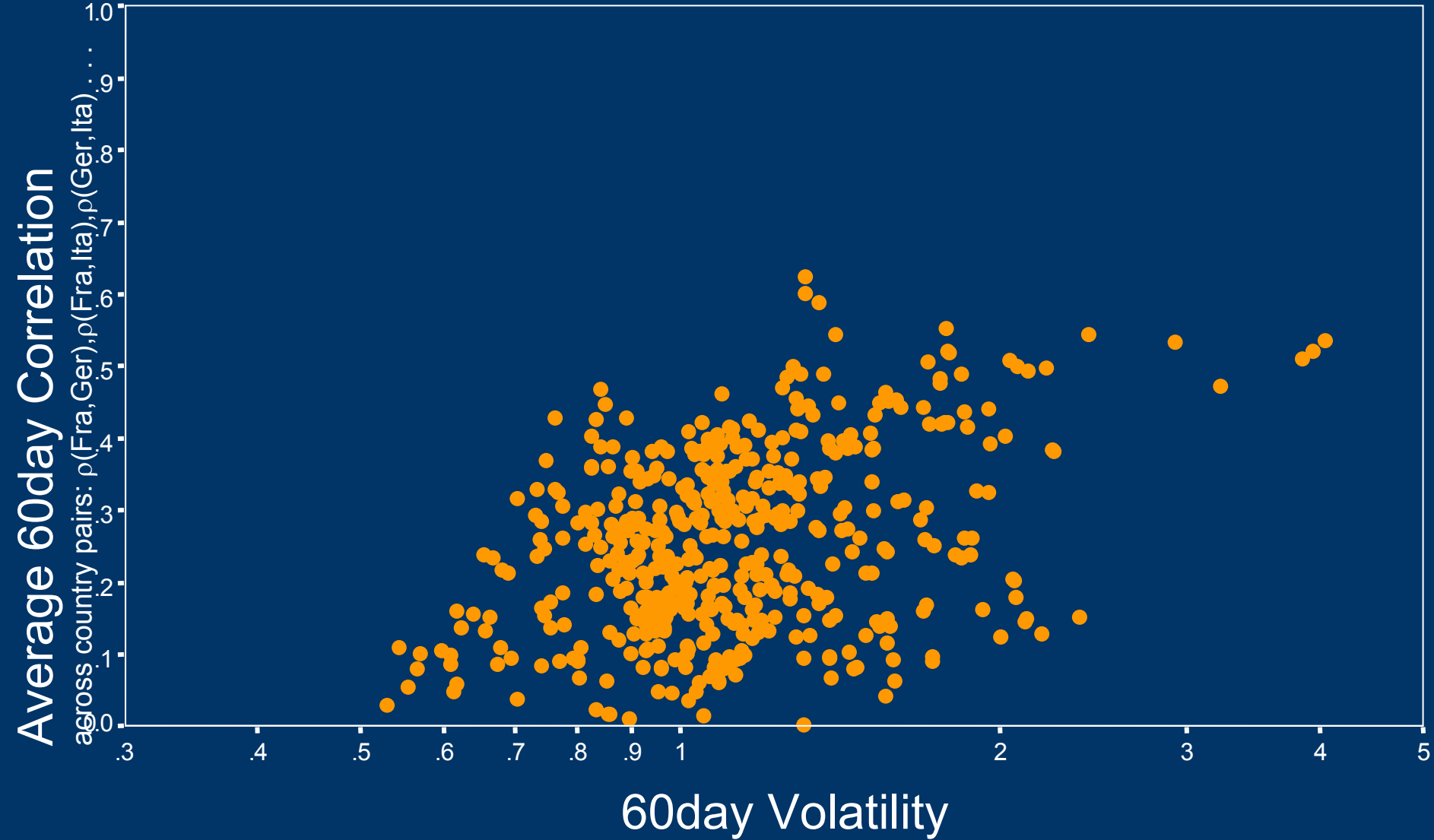
Average Correlations With USA vs. Volatility



Average Correlations Within Euroland vs. Volatility



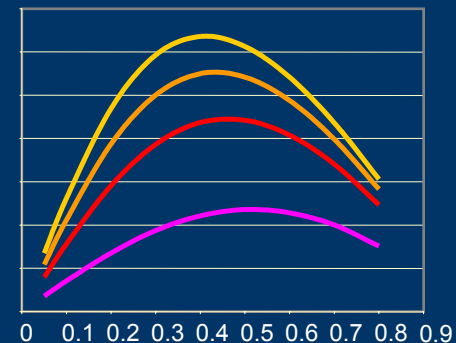
Average Correlations Within Pacific Rim vs. Volatility



Worse in Euroland?

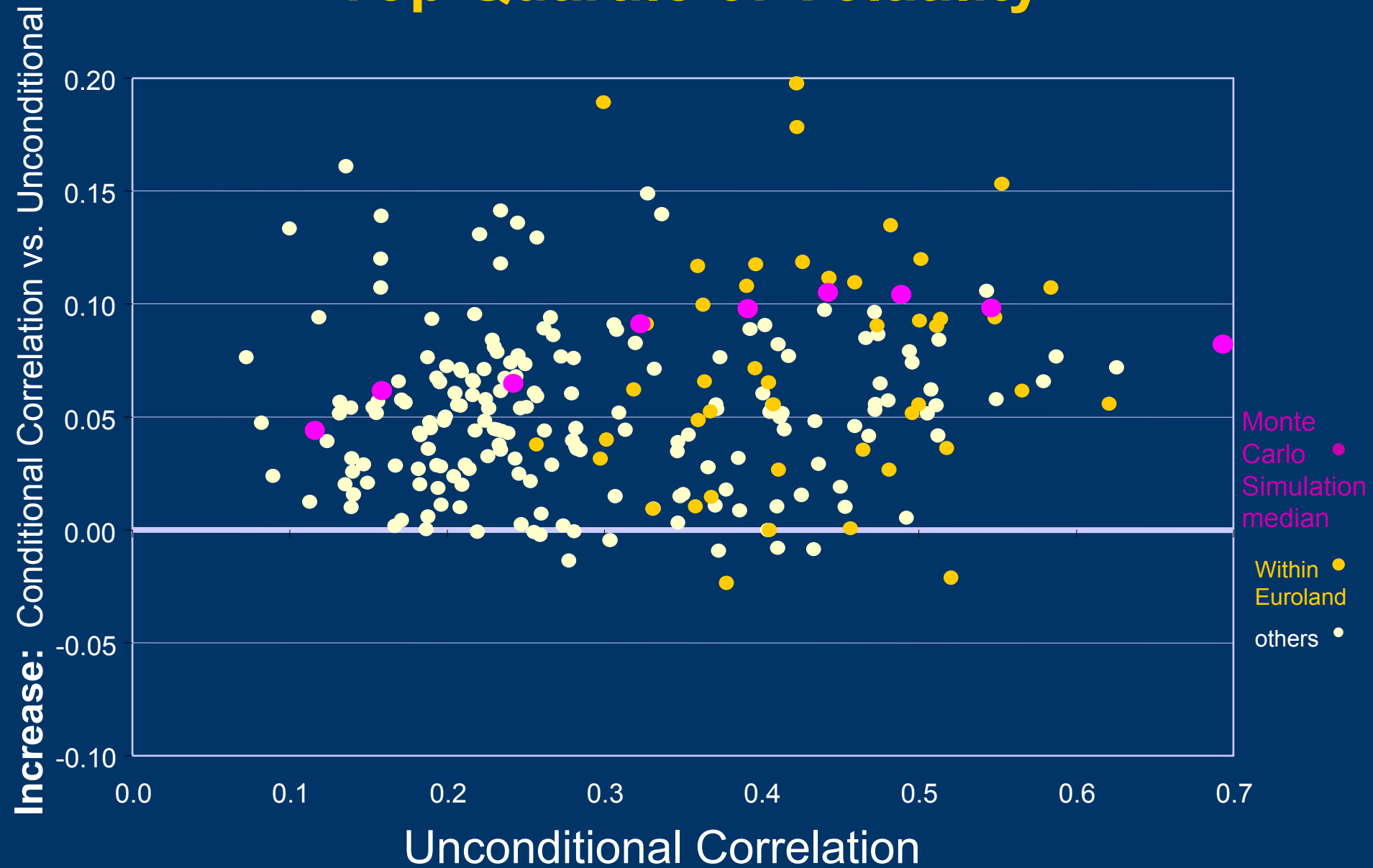
Does the steeper slope (correlation vs volatility) in Euroland indicate some effect beyond what statistics predicts?

Probably not. The unconditional correlations within Euroland are higher than for other regions, closer to peak impact from sampling effects.



Check by comparing actual increase in conditional correlation for top quartile of volatility with expected. (from Monte Carlo Simulation)

Top Quartile of Volatility



Summary

Very easy to make compelling, in some cases alarming, pictures.

Especially post mortem.

Autopsy reveals statistics not pathology.

2 Aspirin

Use a conditional variance-covariance matrix:

- if downside risk control is paramount
- when stress-testing portfolios

Significant serial correlation in volatility: around 0.5 for larger markets, 0.3-0.4 for most other markets.

- ARCH, GARCH, SWARCH, \mathbb{C} ARCH etc. prescribed by some researchers (see references).

Sectors vs Countries

Many of the same arguments as for deteriorating ability to diversify.

Premise: stocks more correlated with other stocks in same sector in any market than they are with other stocks in their own market but in different sectors.

Self-fulfilling prophecy?

Counterarguments

Structural differences among countries-- taxes, government, regulation, labor, language, accounting,

Asynchronous business cycles,

Asymmetric impact of single monetary policy,

Currency alone does not a single market make (Hong Kong),

Sell-side ploy.

Countries vs. Sectors

Are correlations stronger:

- within the same sector across countries?
- within the same country across sectors?

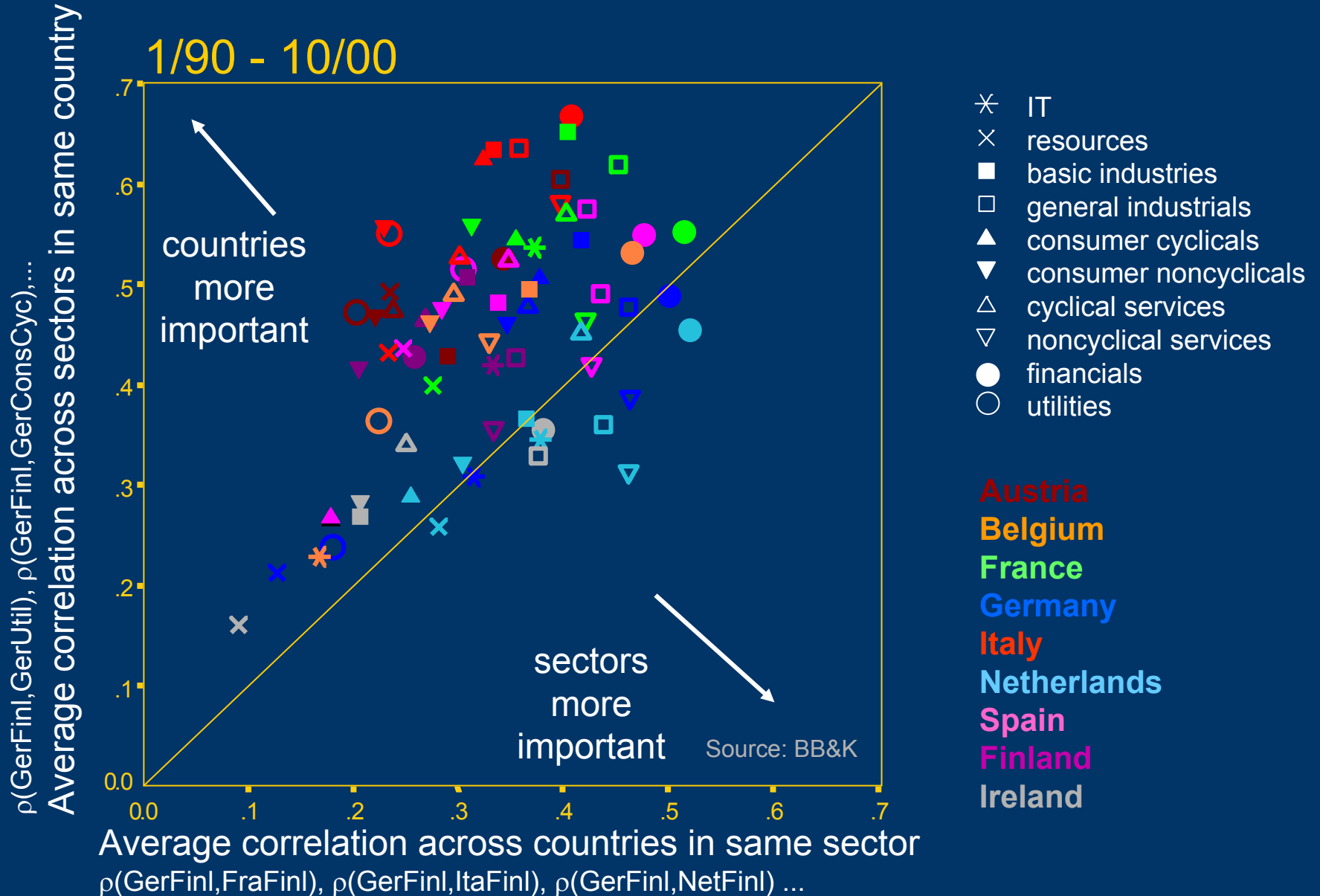
I.E. is the German Financial sector more correlated with:

- French financials, Swiss Financials, Dutch financials
...
- or German Utilities, German Consumer Cyclicals ...

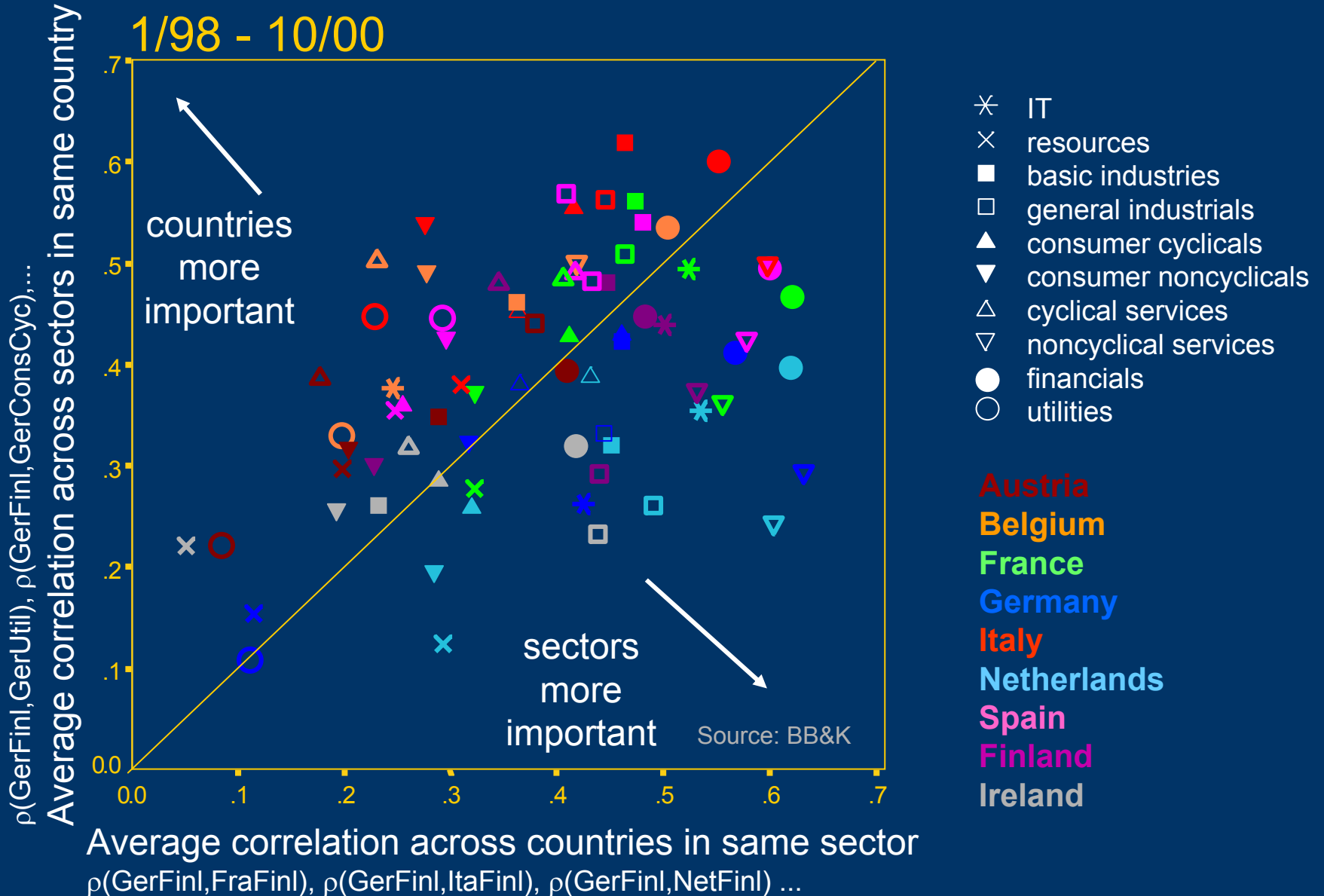
Use a scatterplot to compare the average correlation for each country--sector index with the indices for:

- other countries--same sector
- same country--other sectors

Countries vs. Sectors



Countries vs. Sectors



“Risk Map”

Specifically which indices are most/least alike?

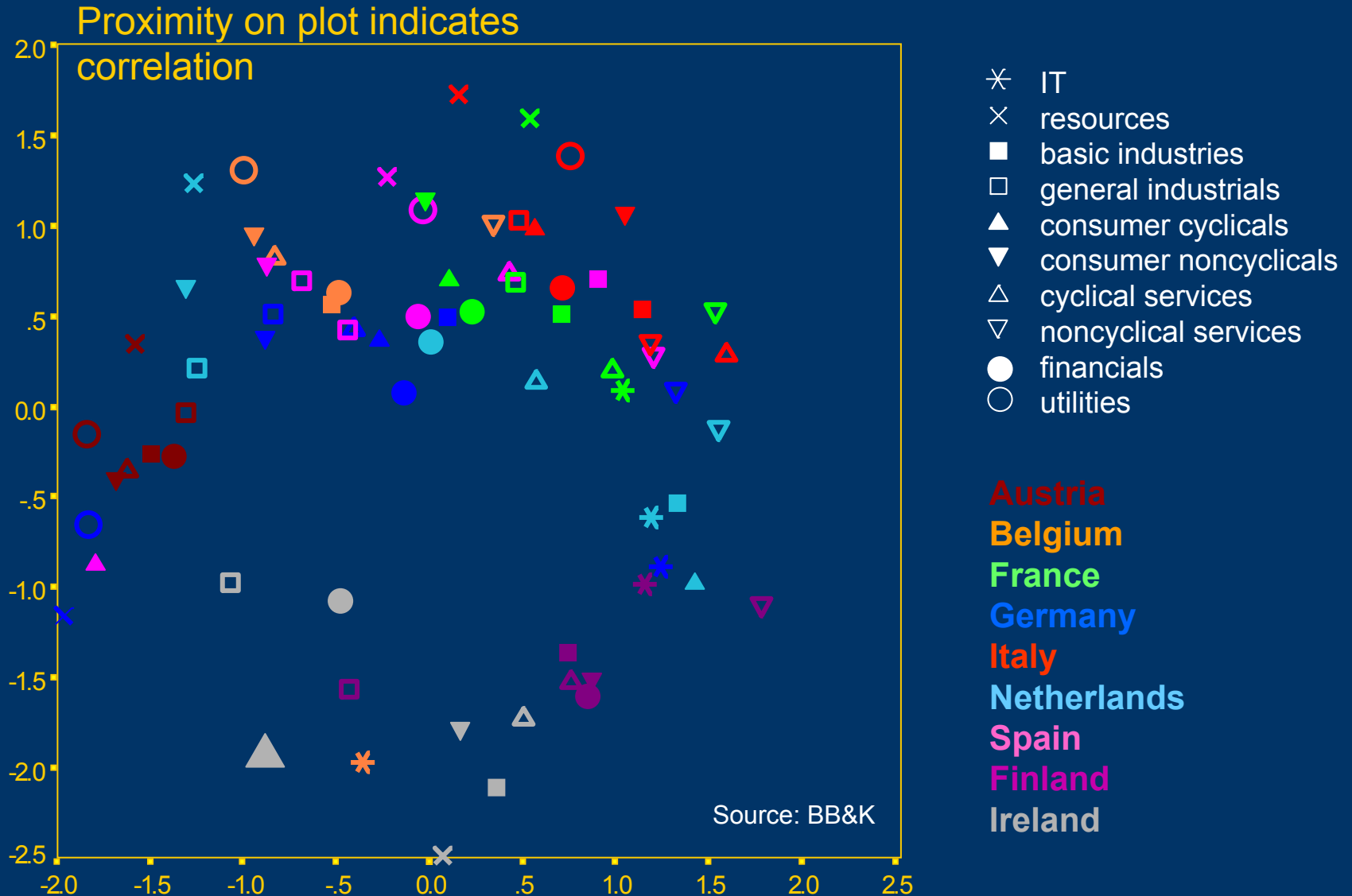
Plot each series as a point (x,y) so that proximity on the map corresponds to strength of correlation.

Effectively a least squares fit with

$$\rho_{AB} = \text{correlation of series A and B}$$
$$z_{AB} = \sqrt{(x_A - x_B)^2 + (y_A - y_B)^2}$$

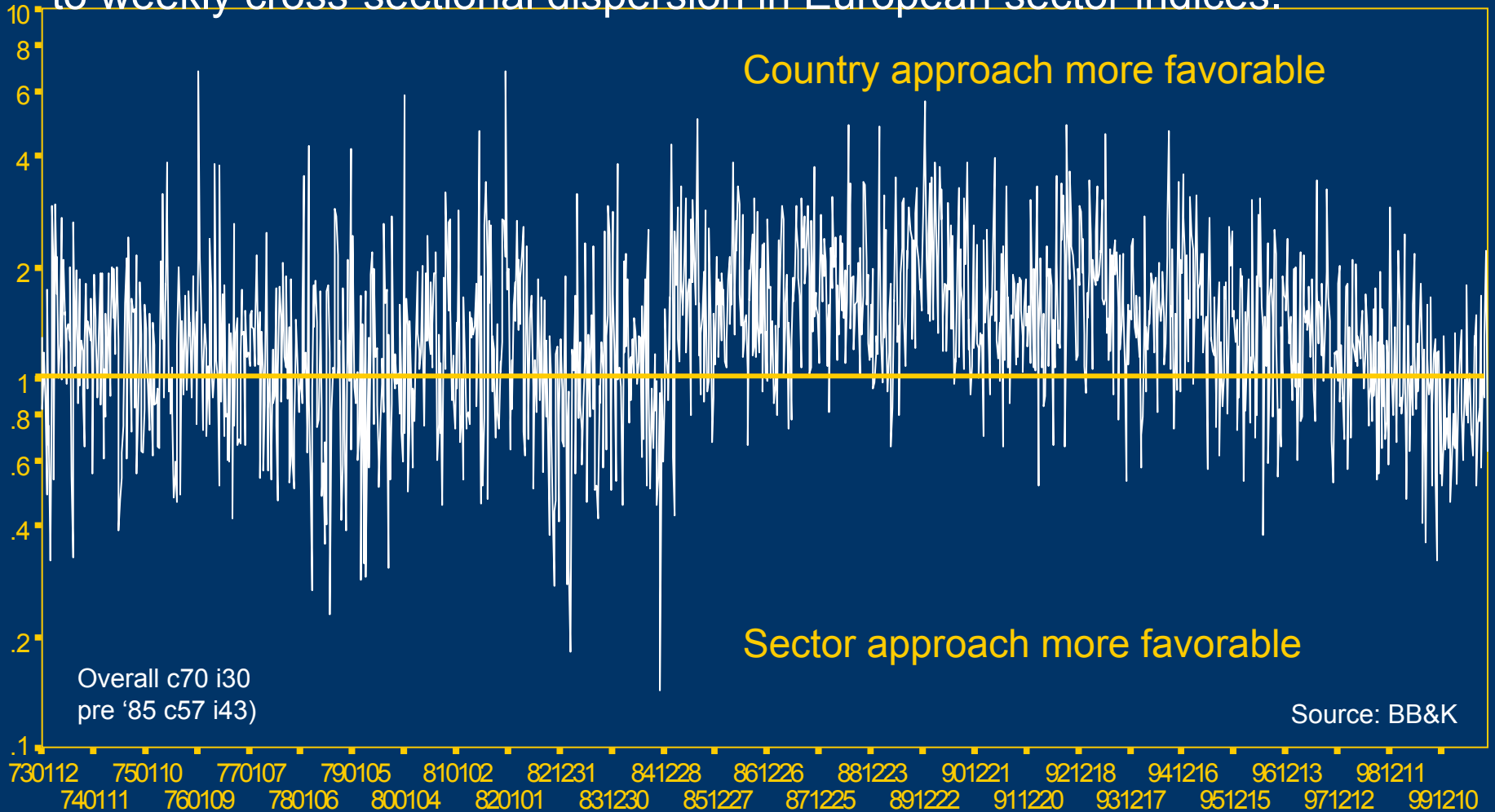
Code the points on the plot & look for clusters
by color for country
by shape for sector

“Risk Map” 1/90-10/00



Opportunity

Ratio of weekly cross-sectional dispersion in European country indices to weekly cross-sectional dispersion in European sector indices.



Observations

Evidence in the Countries vs. Sectors debate fluctuates over time.

Last two years, the balance of opportunity (as well as sentiment), has shifted to sectors.

Overall, countries have represented the greater opportunity (70/30),

Even pre-1985 when countries were not as dominant.
(57/43)

References, Further Reading

“Pitfalls in Tests for Changes in Correlations,” Boyer, Brian H, Michael S Gibson and Mico Loretan, Board of Governors of the Federal Reserve System International Finance Discussion Papers Number 597, December 1997.

- how conditioning on events affects correlations (selection bias)

“Evaluating ‘Correlation Breakdowns’ During Periods of Market Volatility,” Loretan, Mico and William B. English, Board of Governors of the Federal Reserve System International Finance Discussion Papers Number 658, February 2000.

- If “contagion” is defined as an elevation in correlations between asset returns, then contagion is a natural by-product of temporal variation in volatilities.

“Is the Correlation in International Equity Returns Constant: 1960-1990?” Longin, Francois, Bruno Solnik, CEPR Financial Markets Paper, RePEc:cpr:ceprfm:0037, October 1993

“Covariance and Correlation in International Equity Returns: A Value-at-Risk Approach,” Campbell, Rachel, Kees Koedijk, Paul Kaufman May 2000

- fat tails in return distribution are better fit by student-t distribution than normal distribution.

“Correlation in International Equity and Currency Markets: A Risk Adjusted Perspective,” Sheedy, Elizabeth, Centre for Studies in Money, Banking and Finance [CMBF] Paper No. 17, June 1997

- accounting for volatility clustering effectively eliminates structure in return correlation
GARCH-CC, BEKK, several other models evaluated
- daily data significantly improve portfolio efficiency (Sharpe ratio), even when portfolio adjustments are made only monthly.



“Do World Markets Still Serve as a Hedge?” Erb, Claude B., Campbell R. Harvey, Tadas E. Viskanta, *Journal of Investing*, Fall 1995 pp26-42

- developed and emerging market stocks & bonds
- correlations higher for extreme moves, especially negative moves
- currency hedging increases correlation

“International Market Correlation and Volatility,” Solnik, Bruno, Cyril Boucrelle, Yann Le Fur. *Financial Analysts Journal*, Sept/Oct 1996

- $r(\text{US,XXX})$ monthly 1959-95 correlations increasing slightly
- $r(\text{US,XXX})$ weekly 1982-95 correlations not increasing
- correlations fluctuate widely over time
- correlation increases during volatile markets

“European Equity Markets and the EMU,” Rouwenhorst, K Geert, *Financial Analysts Journal*, May/June 1999 pp 57-64.

- “no evidence supports the disappearance of differences between EMU countries’ equity returns.”

For very interesting work on emerging markets contagion tests, start with MIT Prof Kristin Forbes’ website & papers, with good links, also.

Conclusions

- Our ability to diversify international portfolios does *not* appear to be deteriorating.
- Correlations are inherently higher in extreme periods.
 - This *is* consistent with constant correlations.
 - Even so, worthwhile to diversify.
- Evidence for a permanent switch from countries- to sectors- focus is not compelling.

