

# Volatility and Interactions on International Financial Markets

*Ádám Kóbor, Ali Kutan, and István P. Székely*

*World Bank (QRA) Southern Illinois Univ. IMF, European Department and European Commission, DGECFIN*

# Road Map

- Motivation
- Previous work
- Techniques used
- Estimation results
- Implications

# Motivation

- Overall a substantial decline in market volatility in the past five years, but periods of major corrections. Is there a regime change?
- General perception of increased role of global factors on financial markets (financial market globalization). Do global factors explain it all? Is financial market globalization getting stronger over time?
- Frequent arguments about nonlinearities. Do our models reflect this?
- Is there a European core? If so, which countries belong to it? And which countries are on the periphery?

# Motivation

- This is a work in progress, and part of a larger project on financial market globalization with a view to identify different regimes on financial markets.
- Focus is on high volatility regimes
  - nature of high volatility regimes
  - factors that bring about high volatility
  - interaction among asset markets and countries during high volatility
  - transmission of volatility
- Feed results into work on bank soundness: identify high volatility periods on financial markets
- Potential policy responses to mitigate the impact of high volatility

VIX ↑ 13.07 - .17

Index GP

At 11:46 Op 13.57 Hi 13.66 Lo 13.03 Prev 13.24

VIX INDEX

GP - Line Chart

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Range: 04/18/97 - 03/30/07 Upper: Line Chart Mov. Avgs: Currency: USD  
Period: Weekly Lower: None Mov. Avg: 15

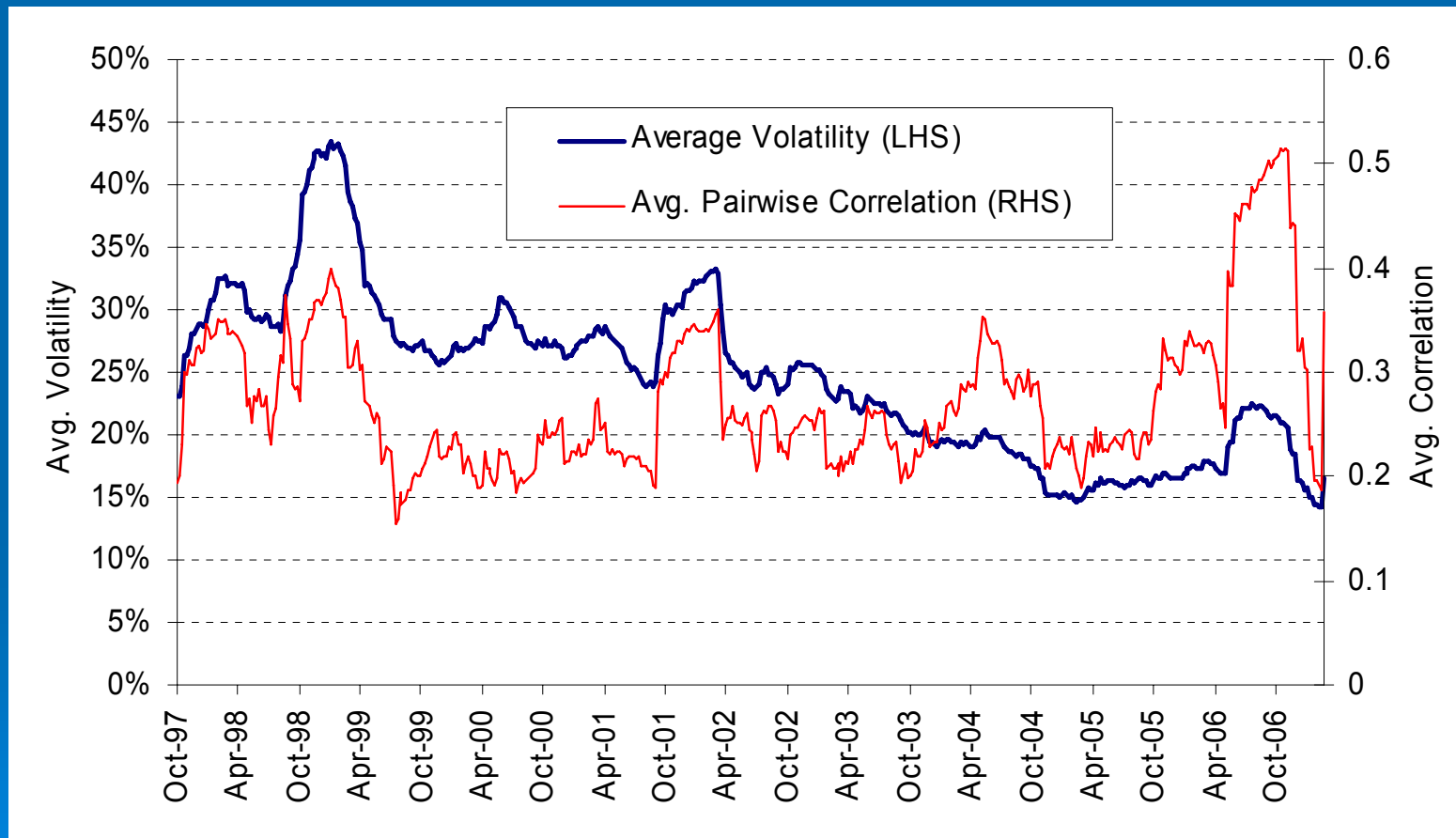


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G619-417-0 05-Apr-2007 11:47:14

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# Average Rolling Volatility and Pairwise Correlation

## Rolling 26-week data (annualized volatility)

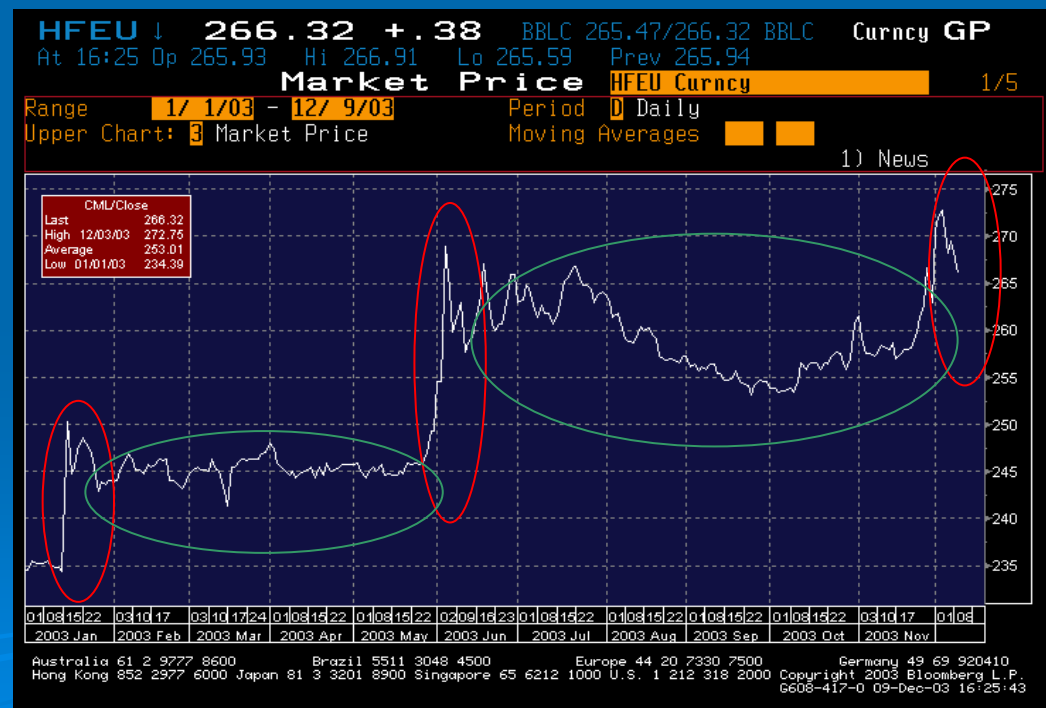


# Statistical Methods Used

- Cluster analysis: to identify core and periphery
- Principal Component Analysis: to reduce dimension
- Regime switching VAR(1): to identify regimes

# Statistical model

- Financial time-series are typically described by their unconditional means and volatilities
  - Financial time-series, however, may exhibit very different behavior in different time periods
    - Time-varying parameters
    - Identify and separate time periods exhibiting different behavior
    - Describe the transitions from one regime to the other





# Selection of the statistical model

- Alternative models
  - GARCH-type models
- Why a Markov-switching model?
  - Quantitative properties
  - Intuitive interpretation
  - Easy to expand to m-dimensions

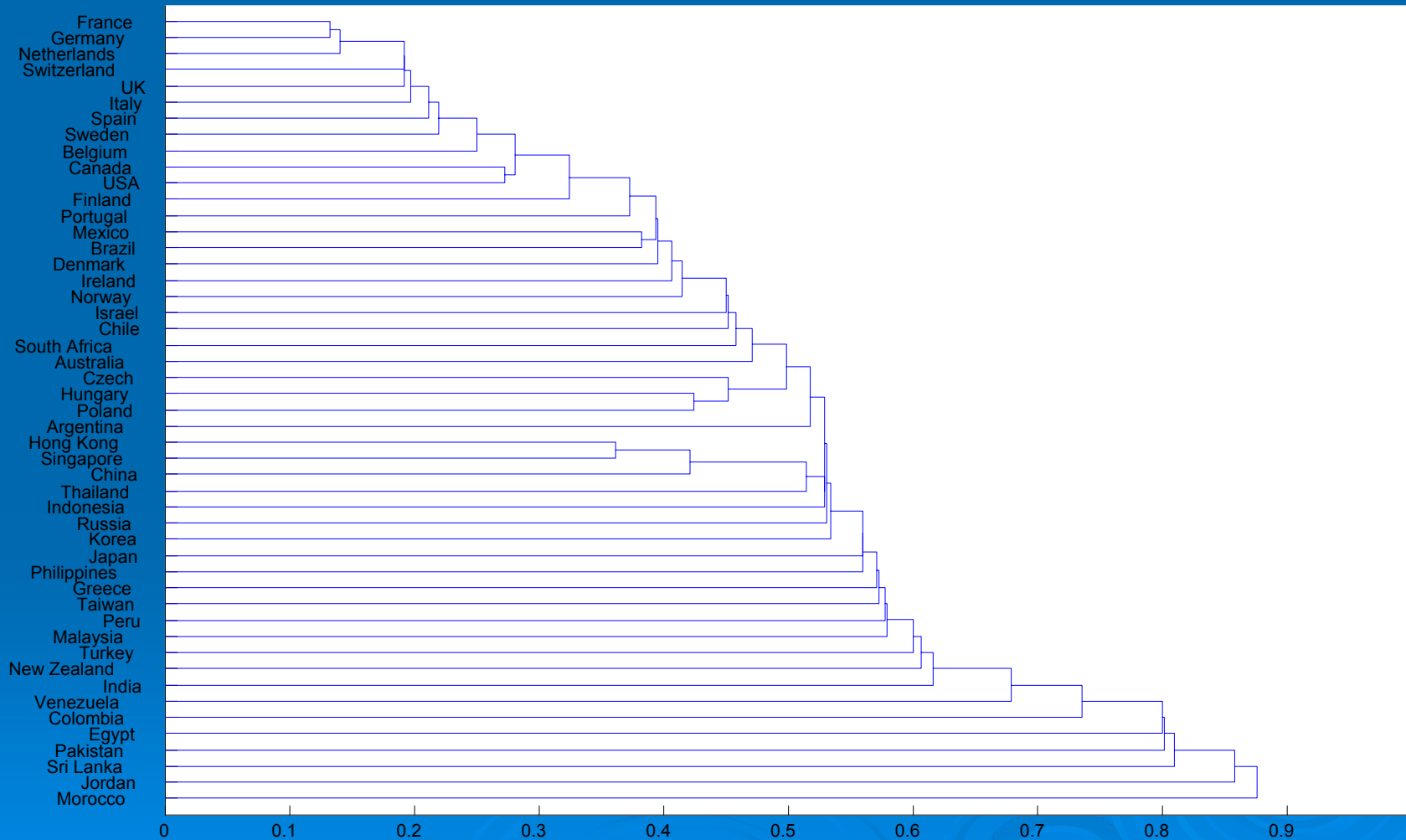
# Equity Markets



# Database

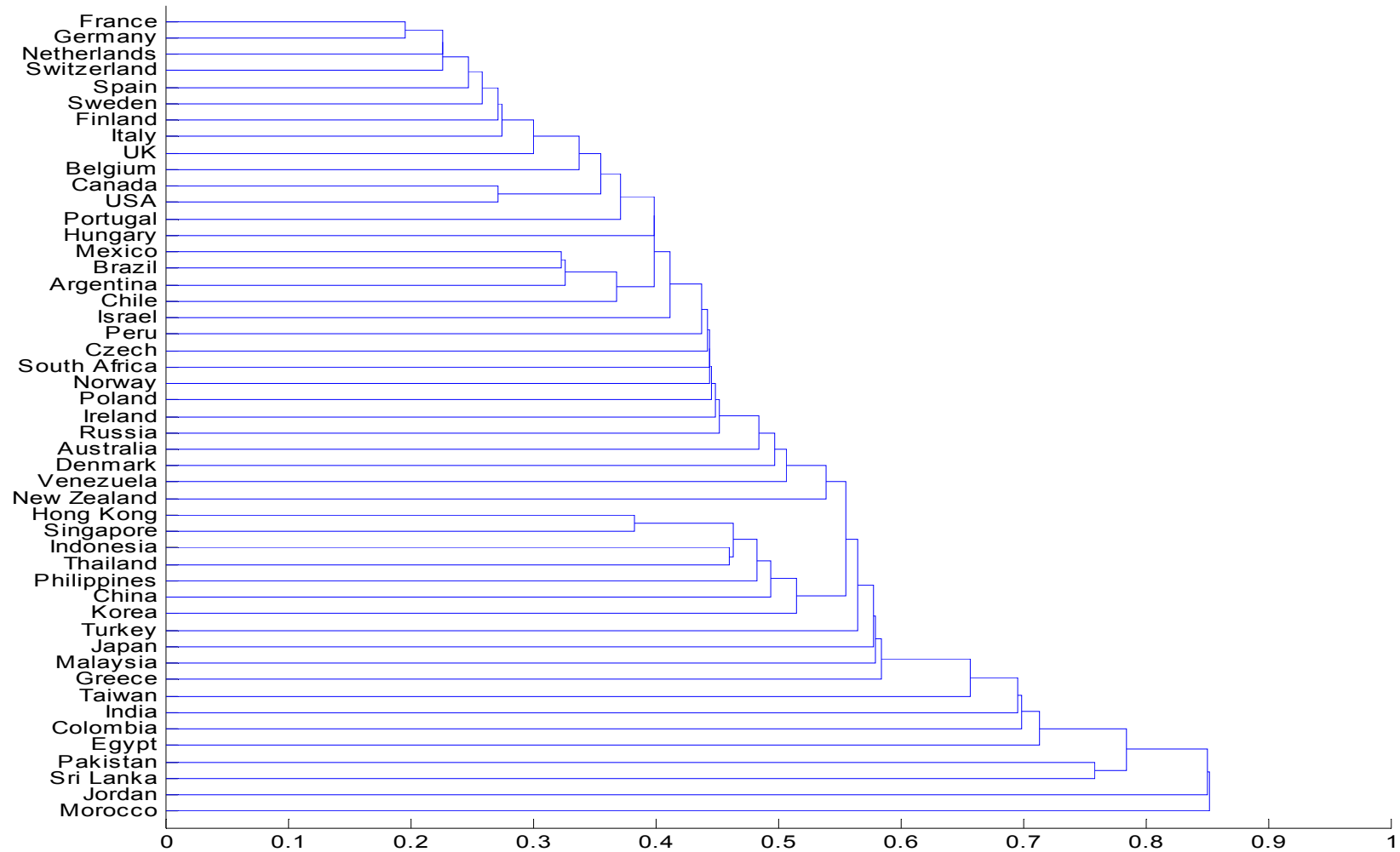
- Weekly data of MSCI equity country indices
  - 04/11/97-03/02/07
  - 517 weeks, 49 countries
- Market coverage: 85% +/- 5%
- Minimum thresholds for inclusion (\$mn)
  - USA: 3000
  - Western Europe: 1600-1800; 800
  - Japan, Canada, Australia: 1300
  - Emerging countries: 50-600 / countries

# Cluster Analysis: 1997-2007

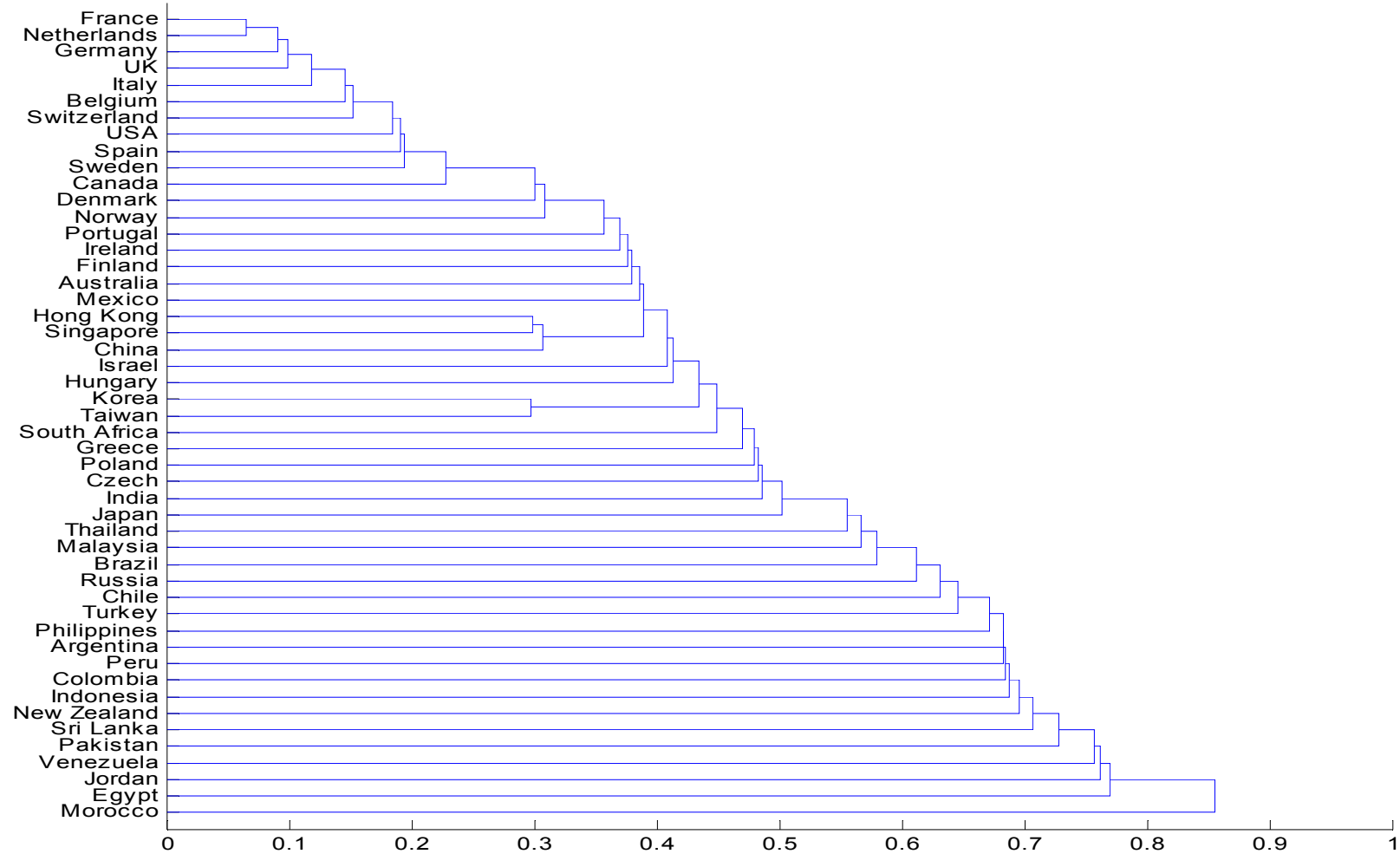


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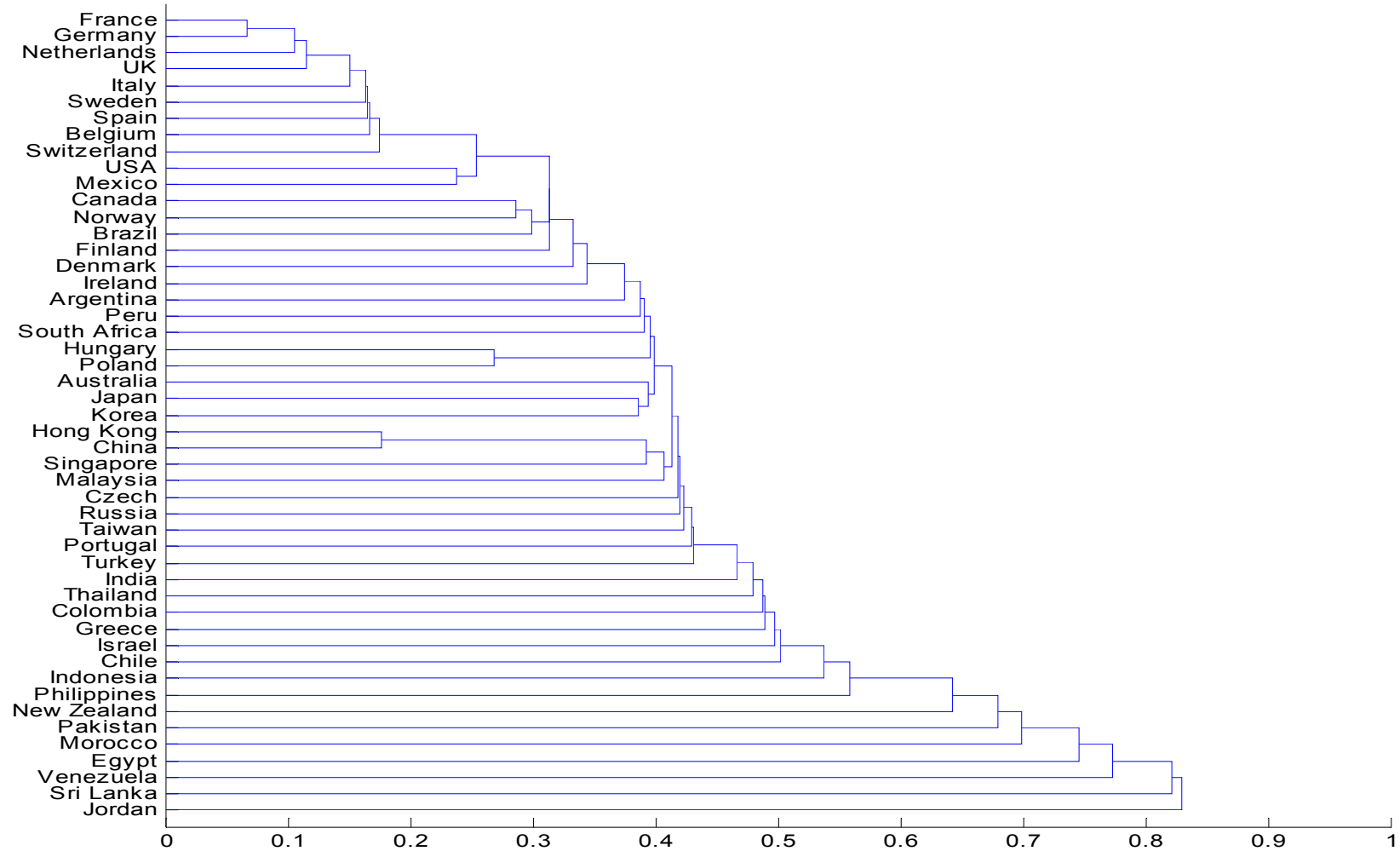
# Cluster Analysis: 1997-2000



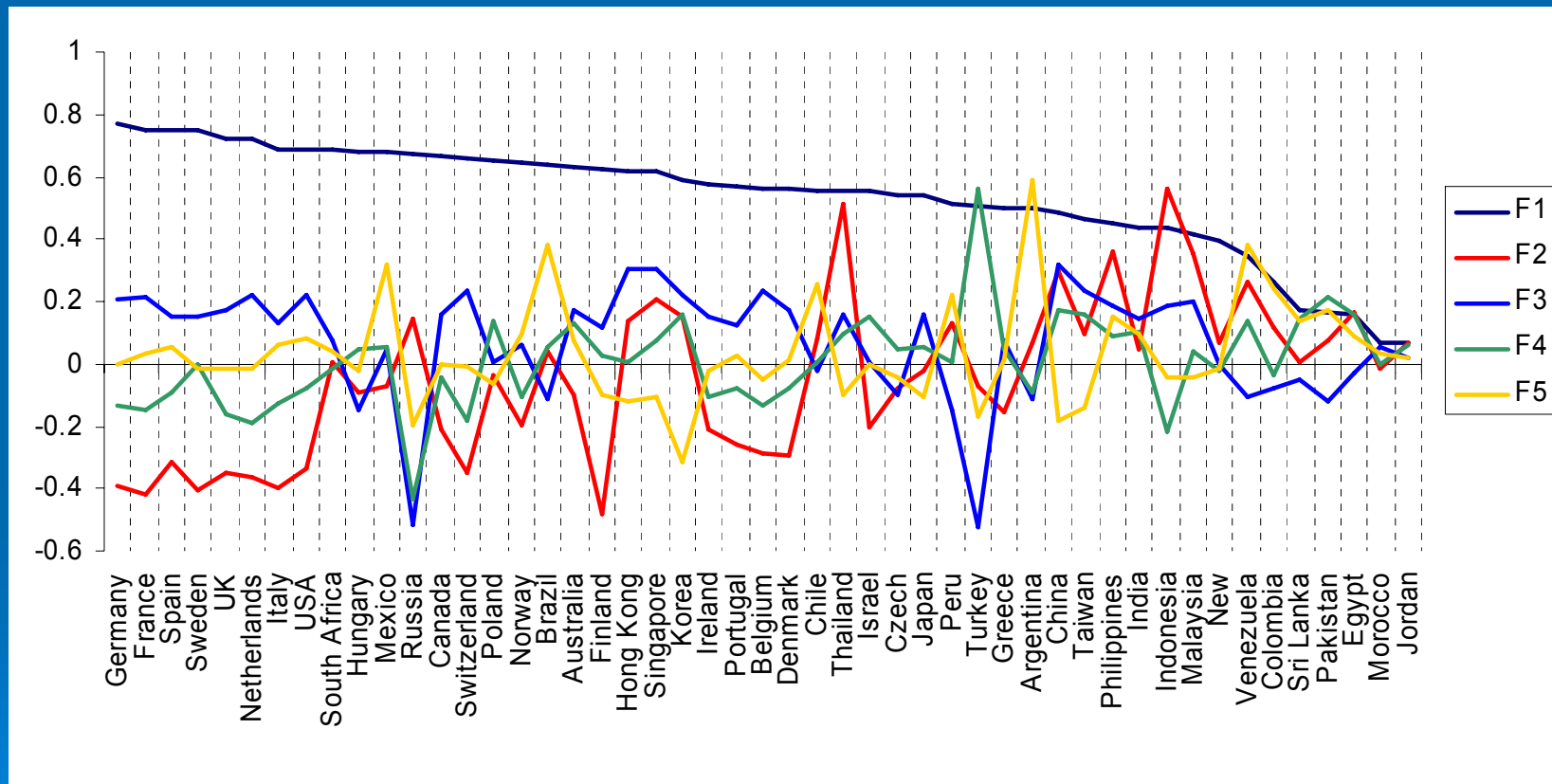
# Cluster Analysis: 2000-2004



# Cluster Analysis: 2004-2007



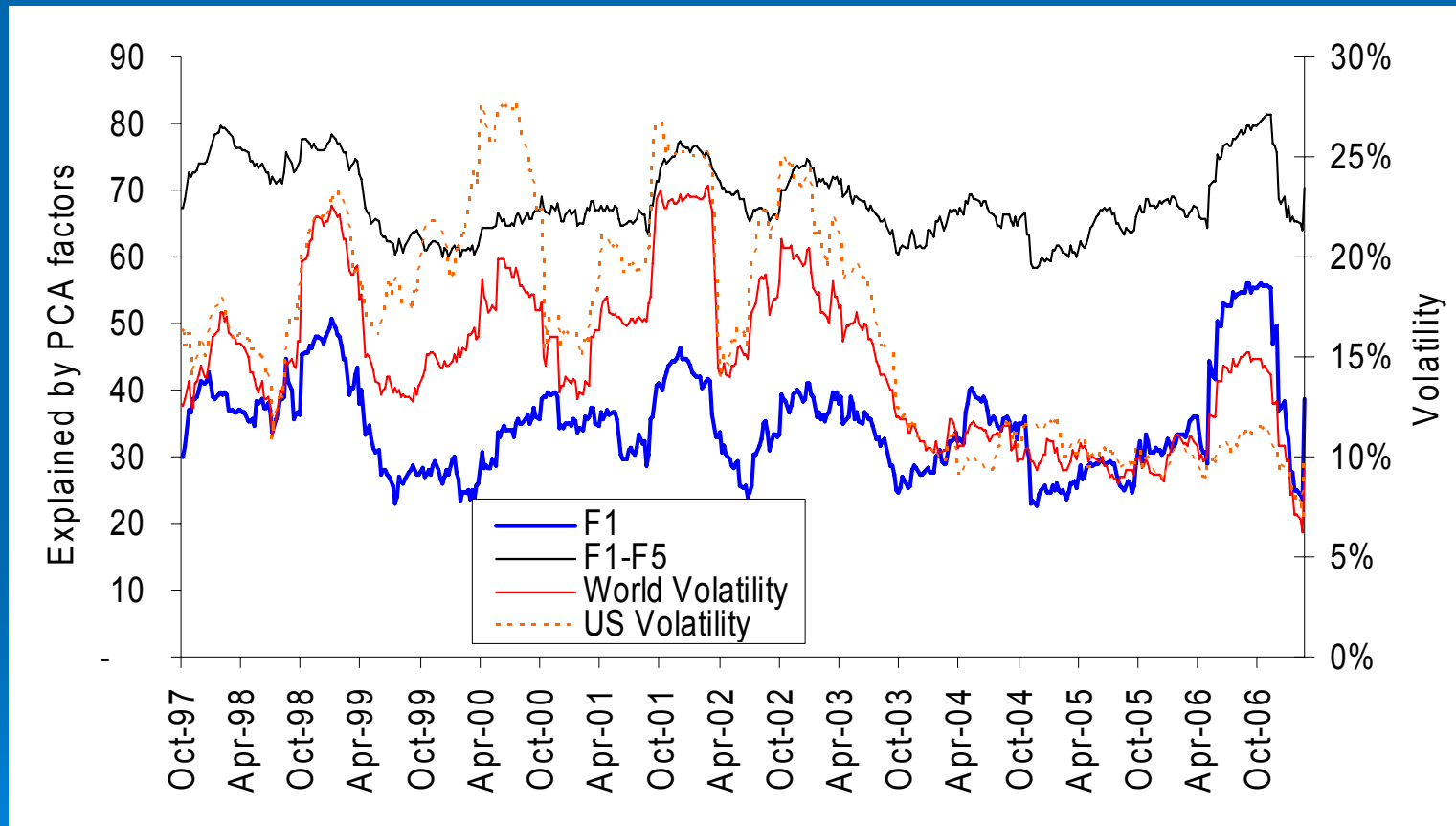
# Correlations with Factors (1997-2007)





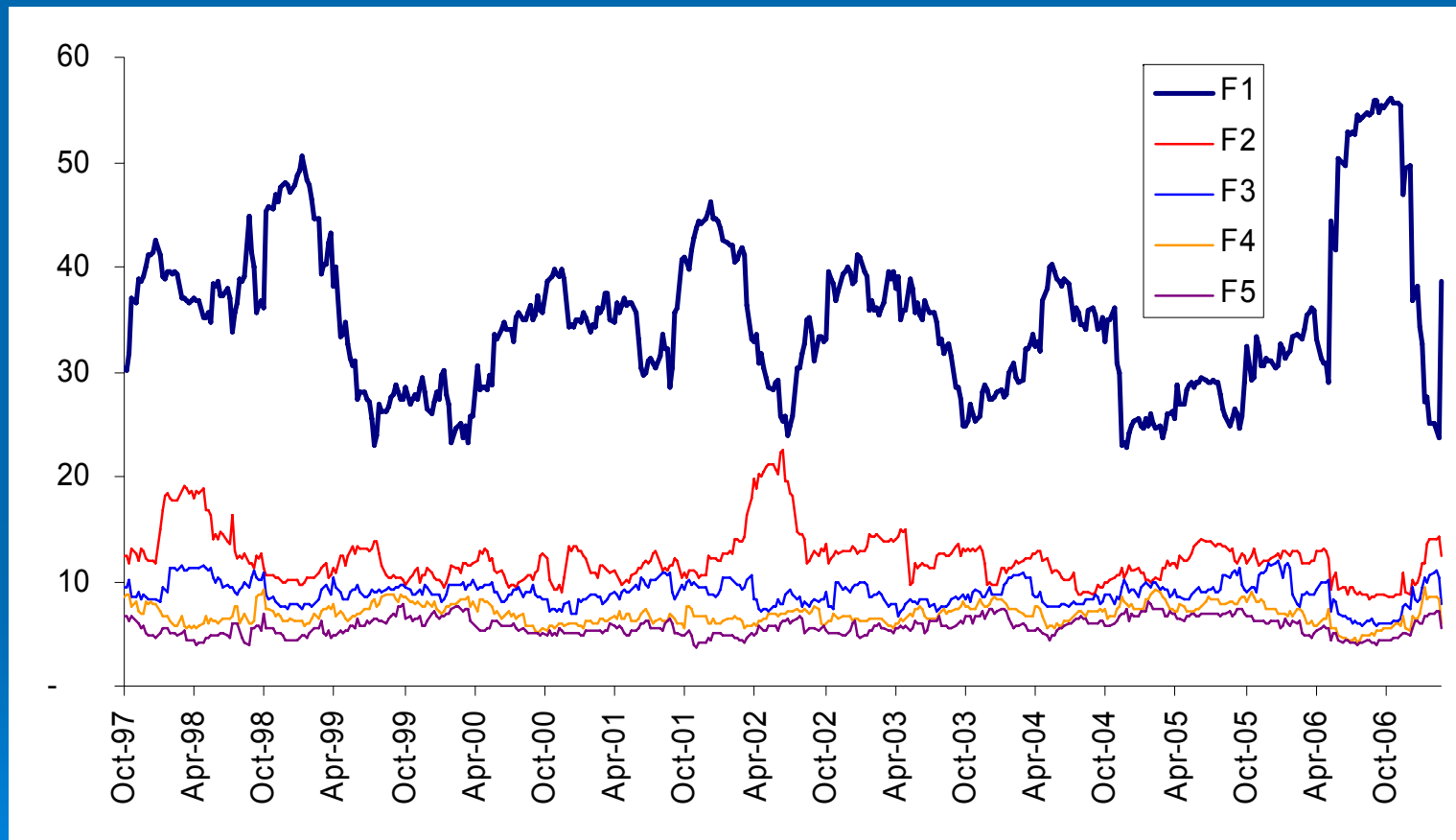
# Rolling-PCA

Percentage of total variance explained by F 1–5



# Rolling-PCA

Percentage of total variance explained by F 1–5



# Regime-Switching VAR(1)

F1-F5 Scores: 1997-2007

Prob (S1→S1)=96% Prob (S2 →S2)=95%

VAR(1) Coefficients:

Regime 1	F1	F2	F3	F4	F5
c	0.0087	0.0079	0.001	-0.0045	0.0064
F1	<b>0.1362</b>	0.0134	0.0153	0.0058	0.06
F2	-0.1553	<b>0.0441</b>	-0.0604	0.0075	-0.0123
F3	-0.3607	0.0275	<b>-0.0648</b>	0.0024	0.0231
F4	-0.0414	-0.0157	-0.0171	<b>-0.109</b>	0.1041
F5	0.2155	0.1815	0.1632	0.1192	<b>-0.097</b>

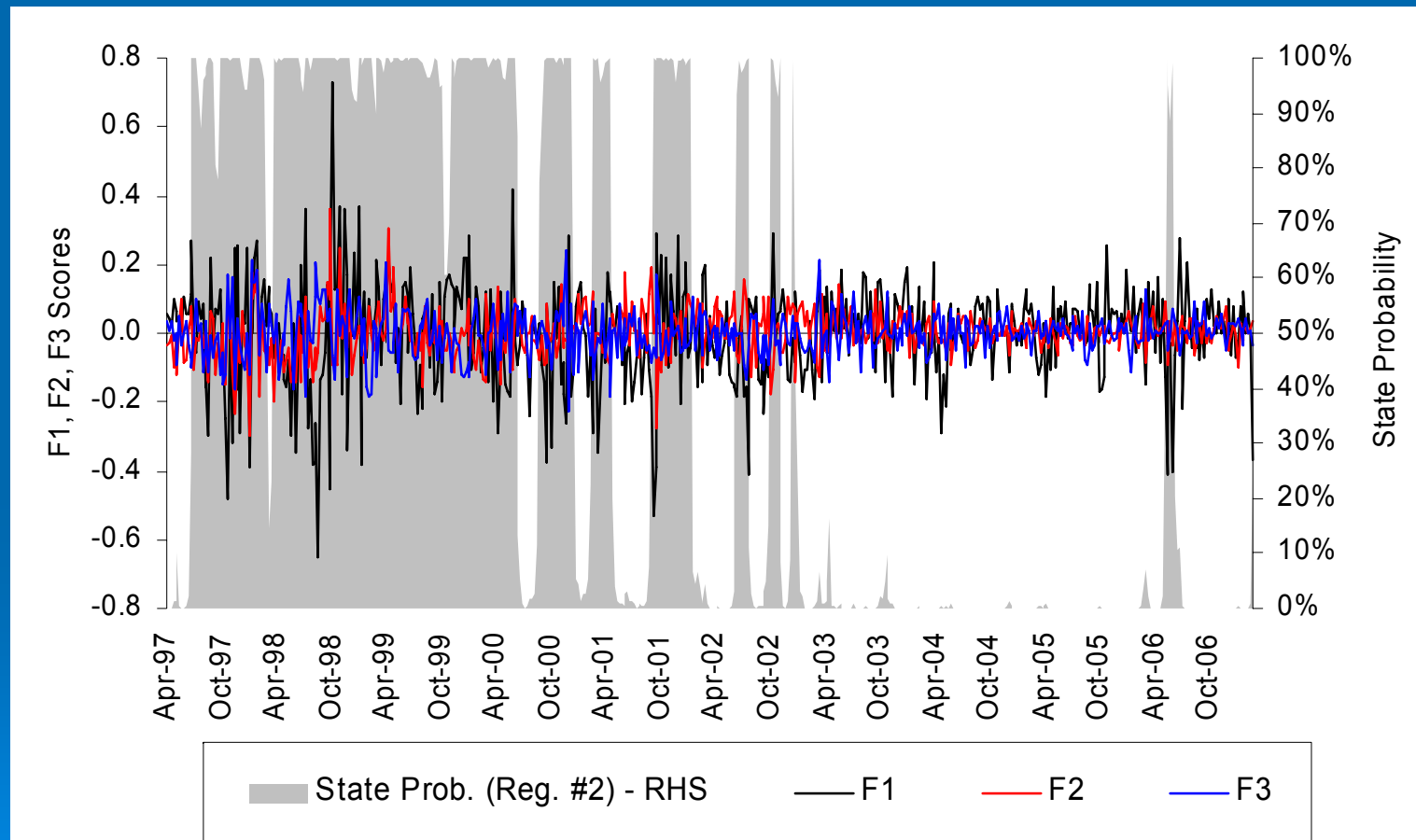
Regime 2	F1	F2	F3	F4	F5
c	-0.0096	-0.0113	-0.0047	0.0054	-0.0076
F1	<b>0.0798</b>	0.0204	-0.0465	0.0525	0.0168
F2	-0.0484	<b>0.0692</b>	-0.057	-0.0919	0.0635
F3	0.2282	0.0397	<b>0.1148</b>	-0.0005	0.0056
F4	-0.2969	0.1633	0.0253	<b>-0.0186</b>	0.1671
F5	0.2104	0.1349	-0.1492	0.1088	<b>0.0329</b>

Factor Volatilities:

	F1	F2	F3	F4	F5
Volatility Regime 1	0.0964	0.0500	0.0480	0.0387	0.0346
Volatility Regime 2	0.1929	0.0889	0.0831	0.0742	0.0700

# Regime-Switching VAR(1)

## F1-F5 Scores: 1997-2007



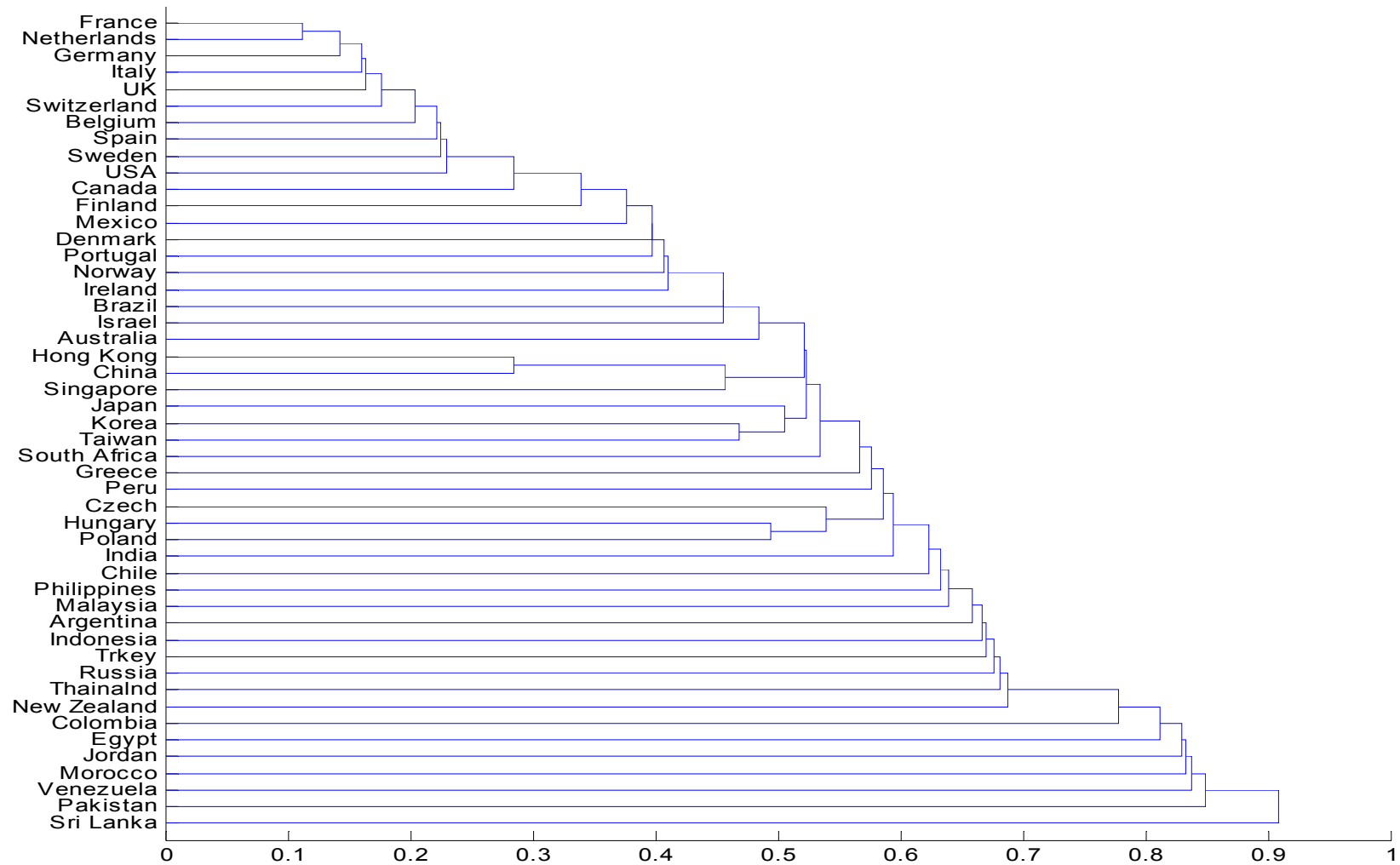
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# Regime-Dependent PCA

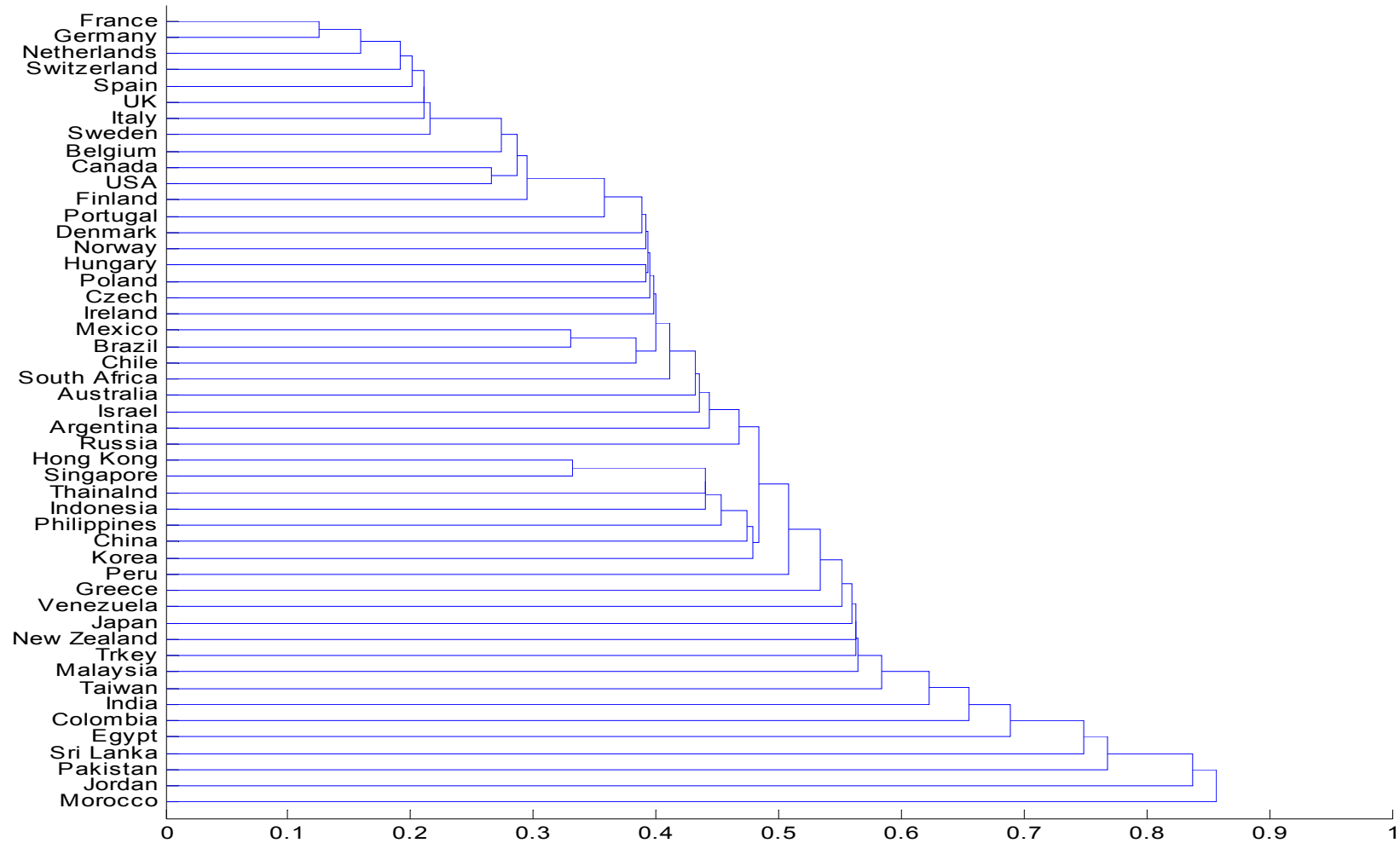
Percentage of total variance explained by F1 – 5

	Regime 1	Regime 2	Unconditional
F1	25.82	34.06	30.37
F2	7.28	7.68	6.96
F3	5.68	5.85	6.09
F4	4.81	5.02	4.59
F5	4.24	4.60	4.04
<b>F1:F5</b>	<b>47.82</b>	<b>57.22</b>	<b>52.05</b>

# Regime-Dependent Clusters: Regime 1



# Regime-Dependent Clusters: Regime 2



# Implications

- There is a European core group on international equity markets and it is rather stable over time and across regimes.
- RAMS seem to form a distinct group which gets closer to the (European) core during high volatility.
- High volatility is associated with (downward) market corrections.
- Regimes are rather persistent, with volatility roughly doubling in the high volatility regime.
- Global factors seem mostly responsible for high market volatility.



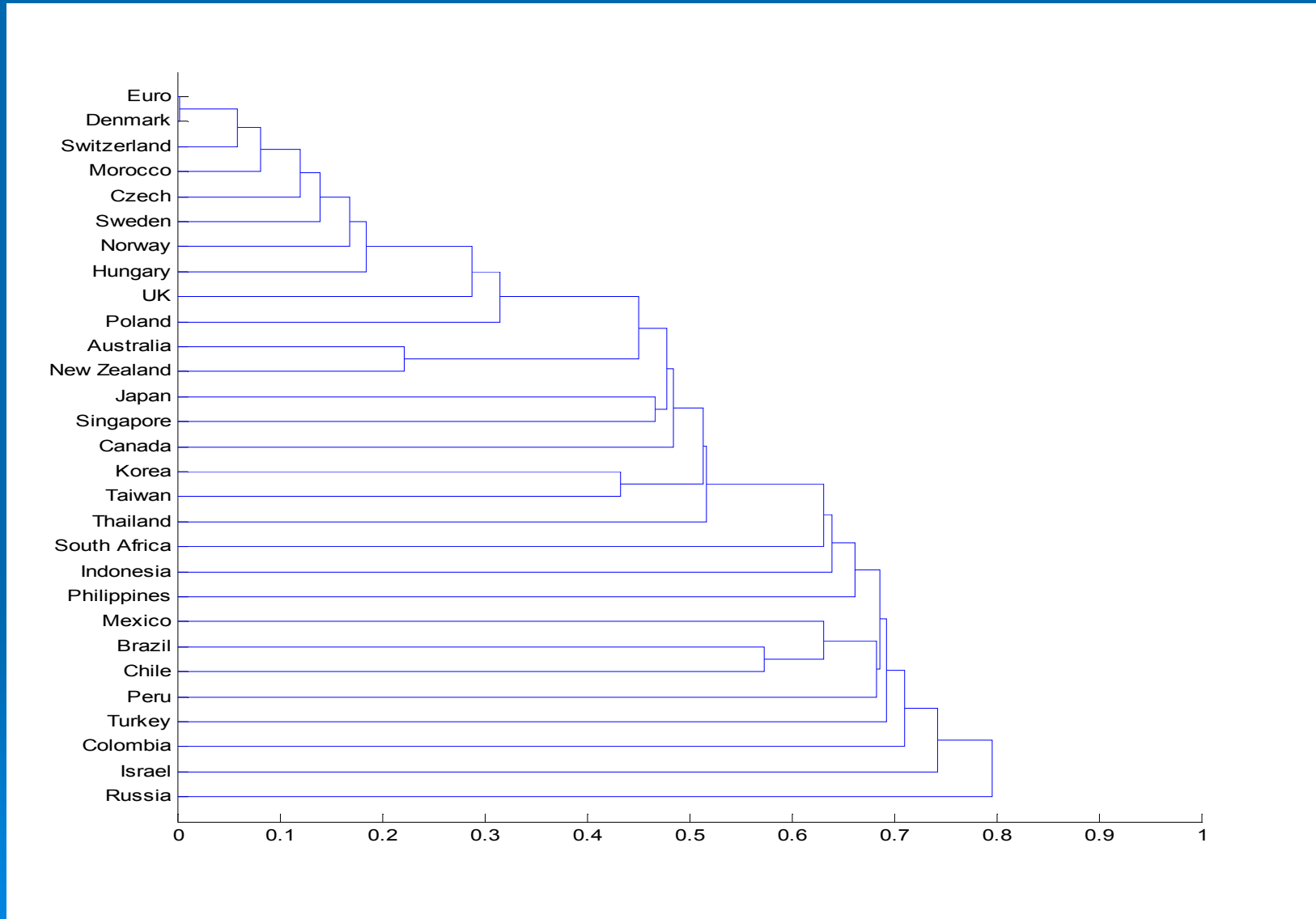
# Forex Spot Markets



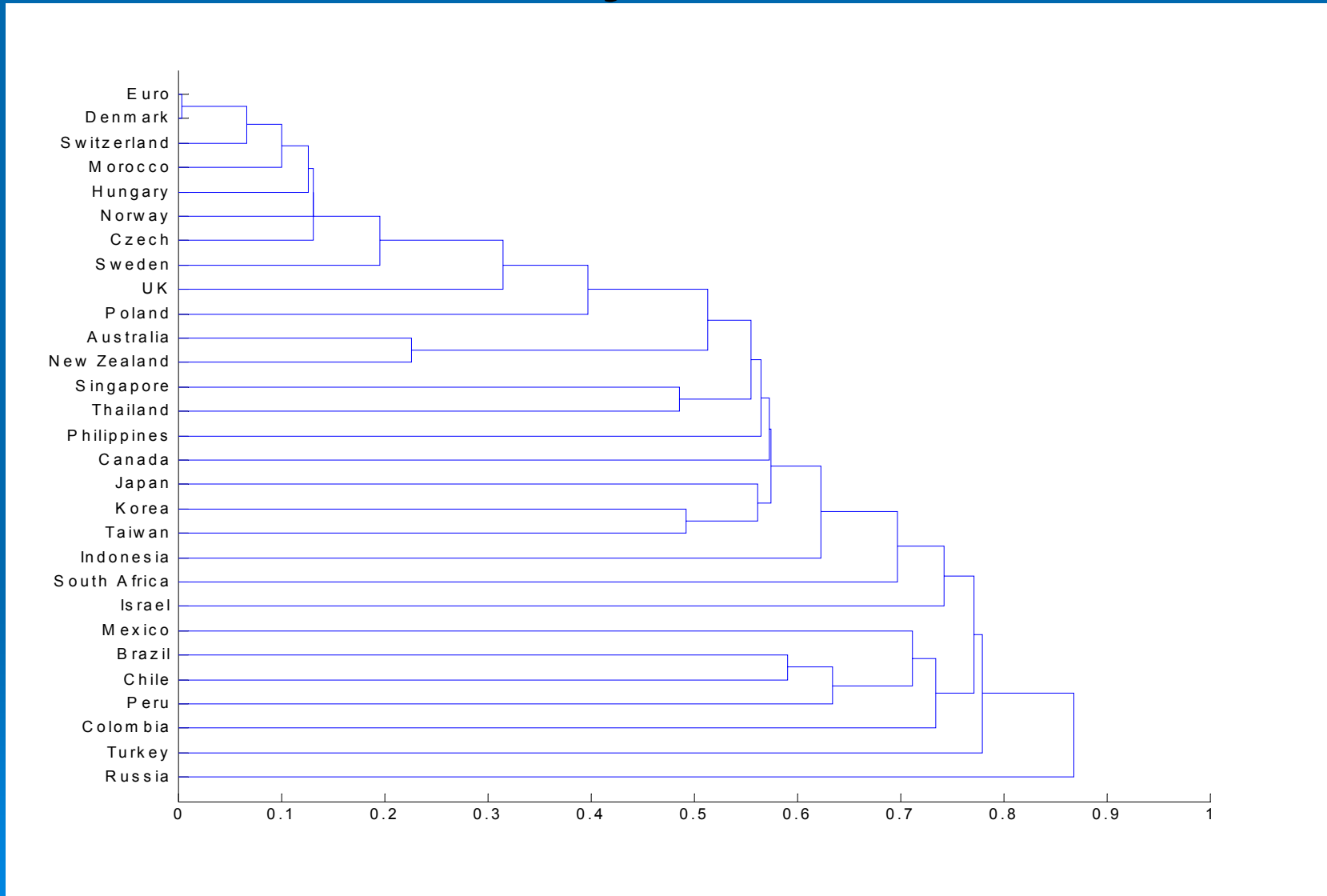
# Database

- Weekly data spot FX rates
  - 01/08/1999-06/22/07
  - 442 weeks
  - 29 currencies (all measured versus USD)
  - EUR covers 13 countries

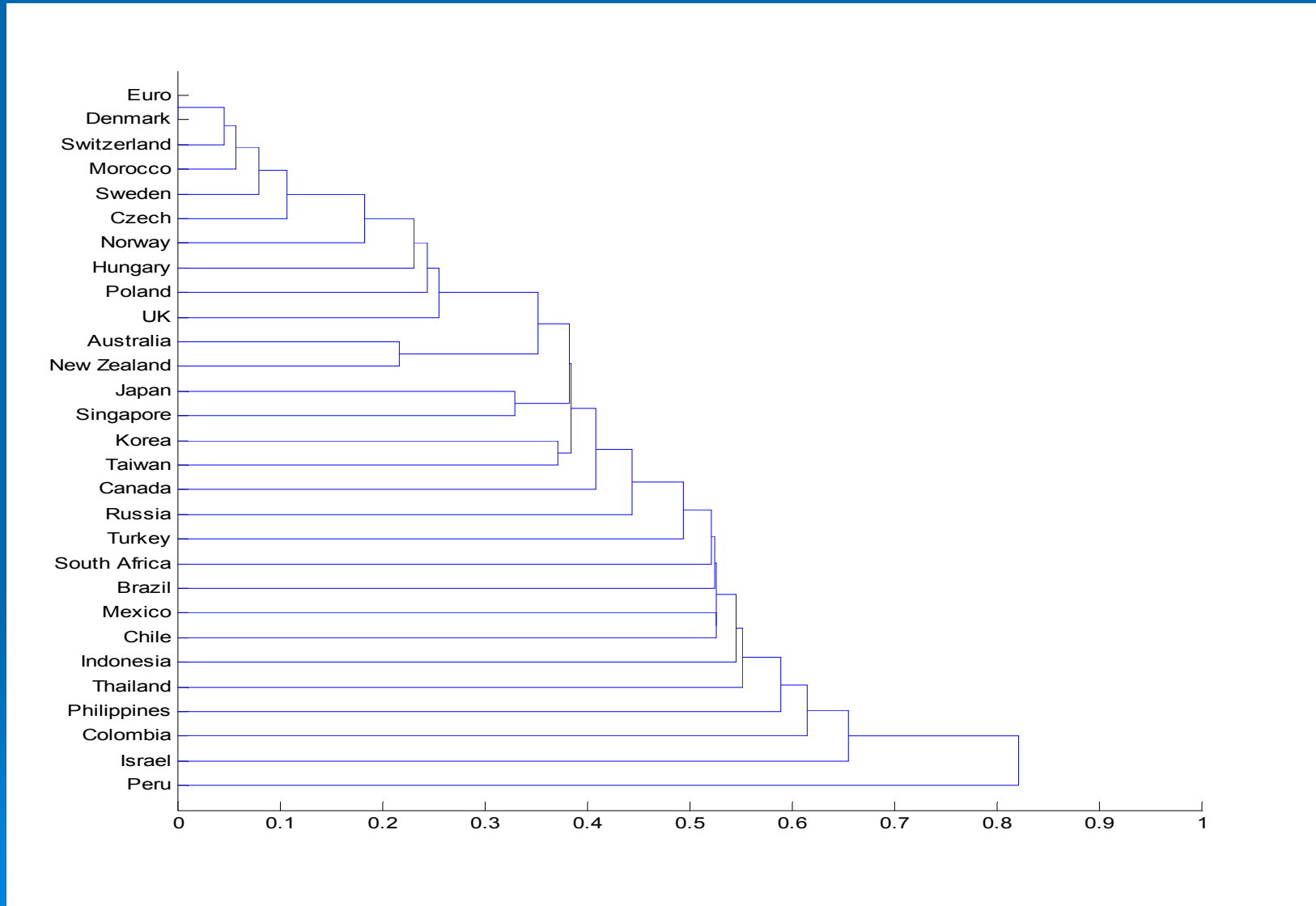
# Cluster Analysis 1999-2007



# Cluster Analysis: 1999-2002

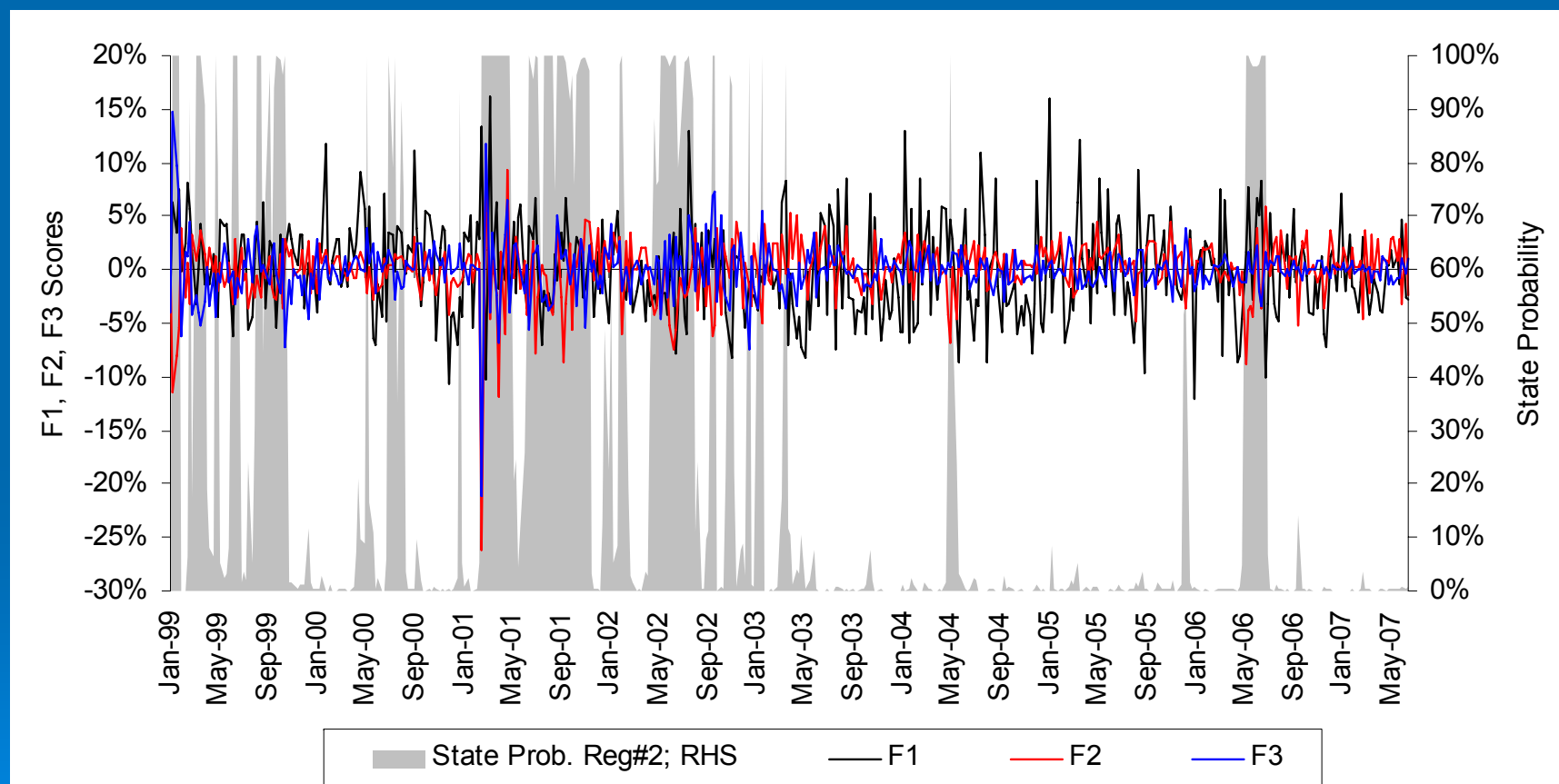


# Cluster Analysis: 2003-2007



# Regime-Switching VAR(1)

## ➤ F1-F5 Scores: 1999-2007, weekly



# Regime-Switching VAR(1)

## ➤ F1-F5 Scores: 1999-2007, weekly

- Prob (S1→S1)=92%
- Prob (S2 →S2)=74%
- VAR(1) Coefficients:

Regime 1	F1	F2	F3	F4	F5
c	-0.0018	0.0049	-0.0008	-0.0018	-0.0007
F1	0.0086	0.0273	-0.0105	-0.0622	-0.0408
F2	0.0437	-0.0499	0.1113	0.1106	0.1323
F3	-0.0715	0.1936	-0.0789	-0.0069	0.0263
F4	0.2132	0.1420	-0.0794	-0.0666	-0.0520
F5	0.1213	-0.0043	0.0198	0.0200	0.1313

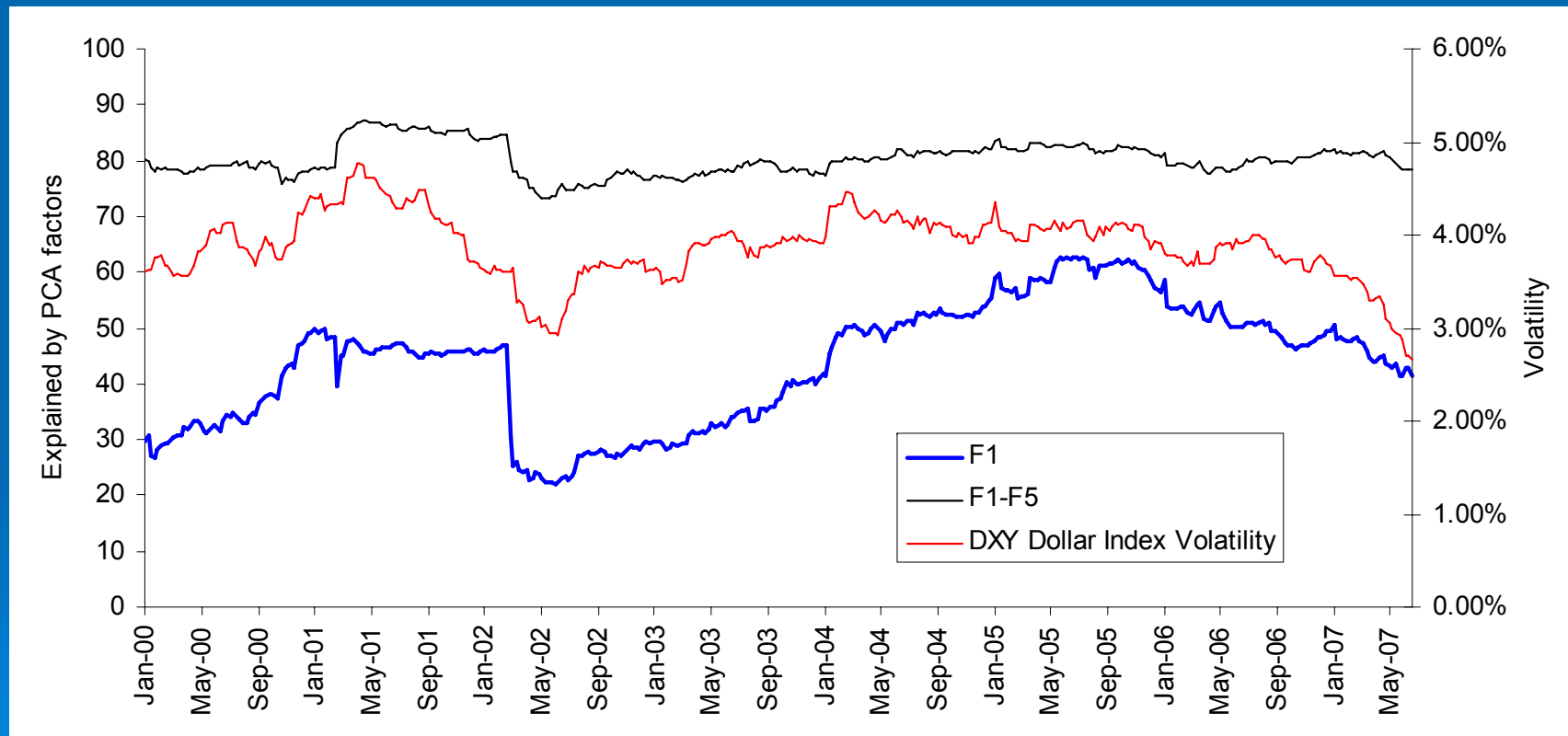
Regime 2	F1	F2	F3	F4	F5
c	0.0036	-0.0143	-0.0049	0.0034	0.0016
F1	0.0640	-0.0789	0.0970	-0.0643	-0.0195
F2	-0.0497	-0.0098	-0.3419	-0.0318	0.0591
F3	0.4099	-0.2858	0.1405	0.0516	-0.1293
F4	-0.0360	-0.3123	-0.0059	0.0560	0.0001
F5	0.4821	0.0450	0.0626	0.0166	-0.0549

## ➤ Factor Volatilities:

	F1	F2	F3	F4	F5
Regime 1	0.0436	0.0173	0.0141	0.0100	0.0173
Regime 2	0.0424	0.0412	0.0374	0.0361	0.0200

# Rolling-PCA

- Percentage of total variance explained by Factor 1 – Factor 5 (rolling 52-week):

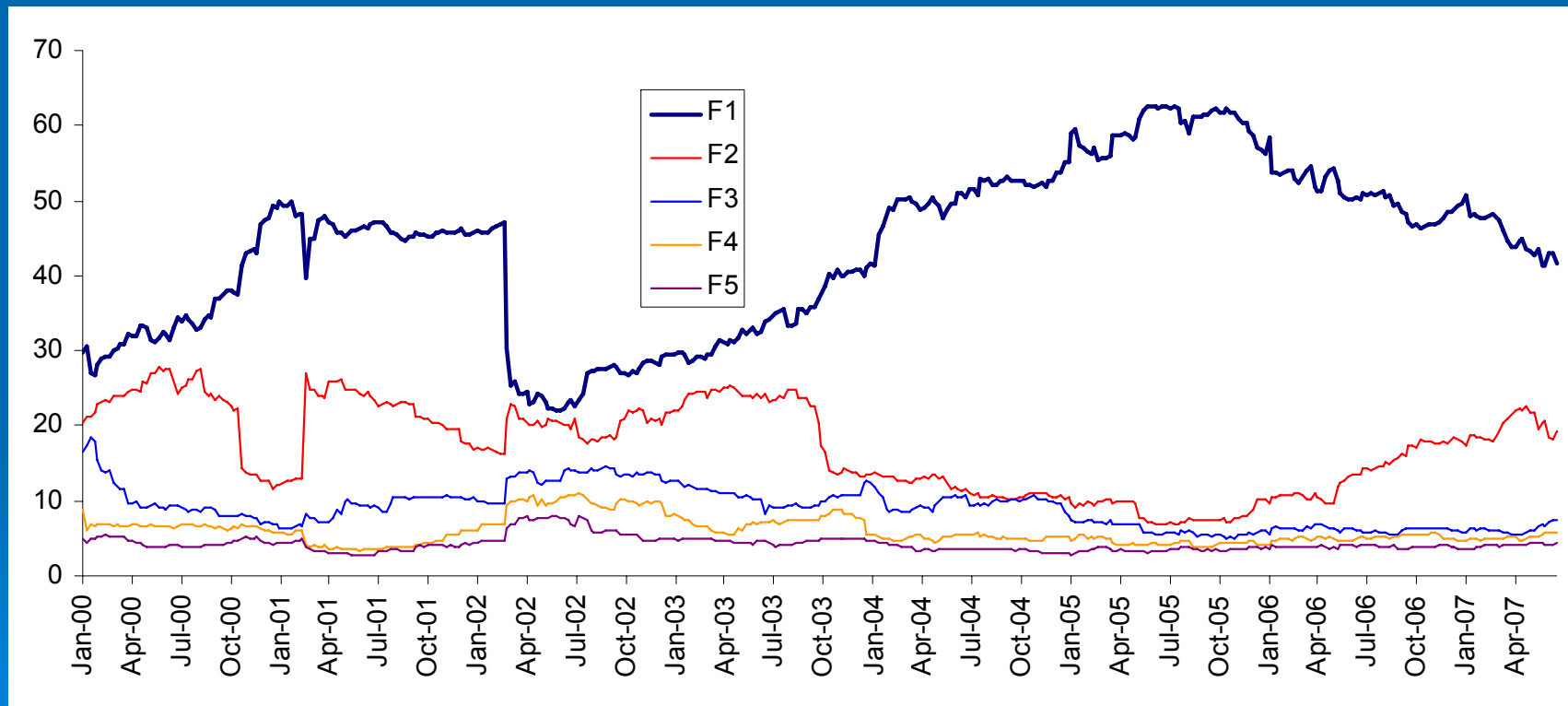


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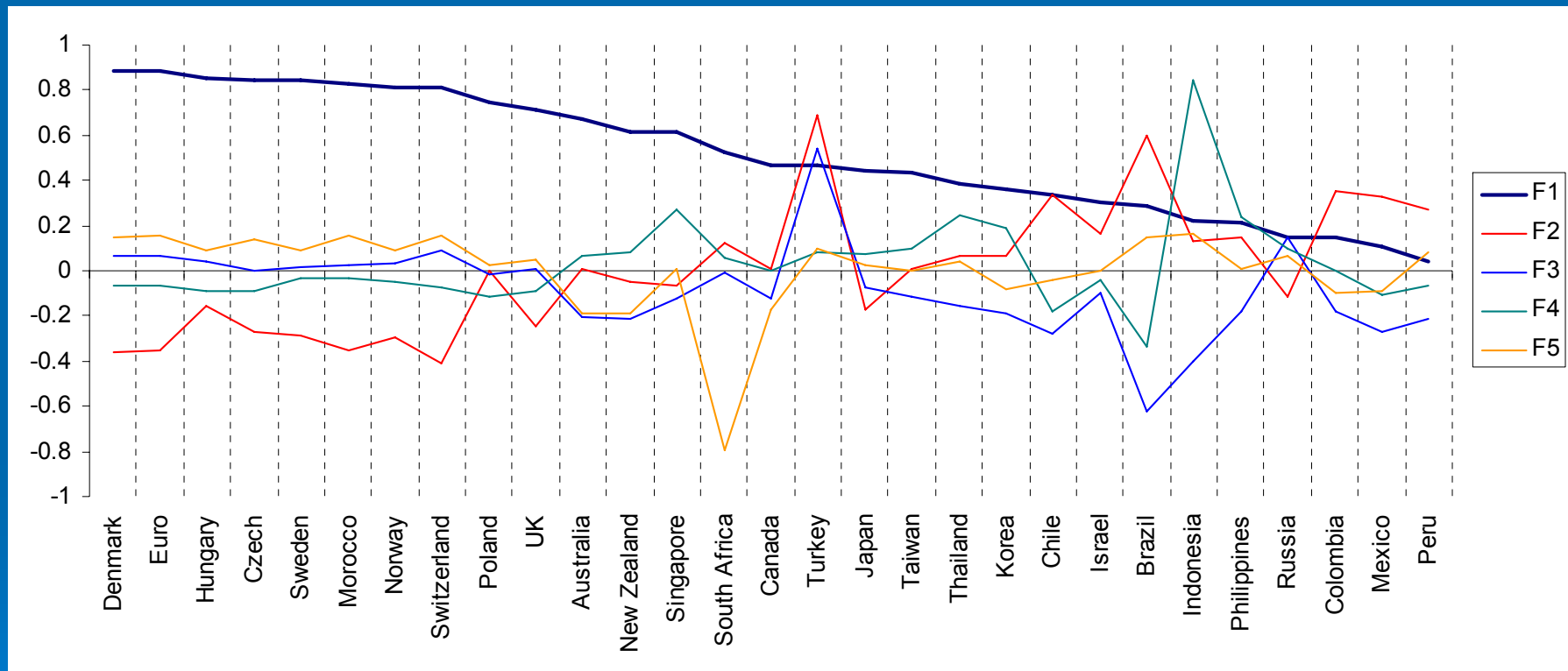
# Rolling-PCA

- Percentage of total variance explained by Factor 1 – Factor 5 (rolling 52-week):



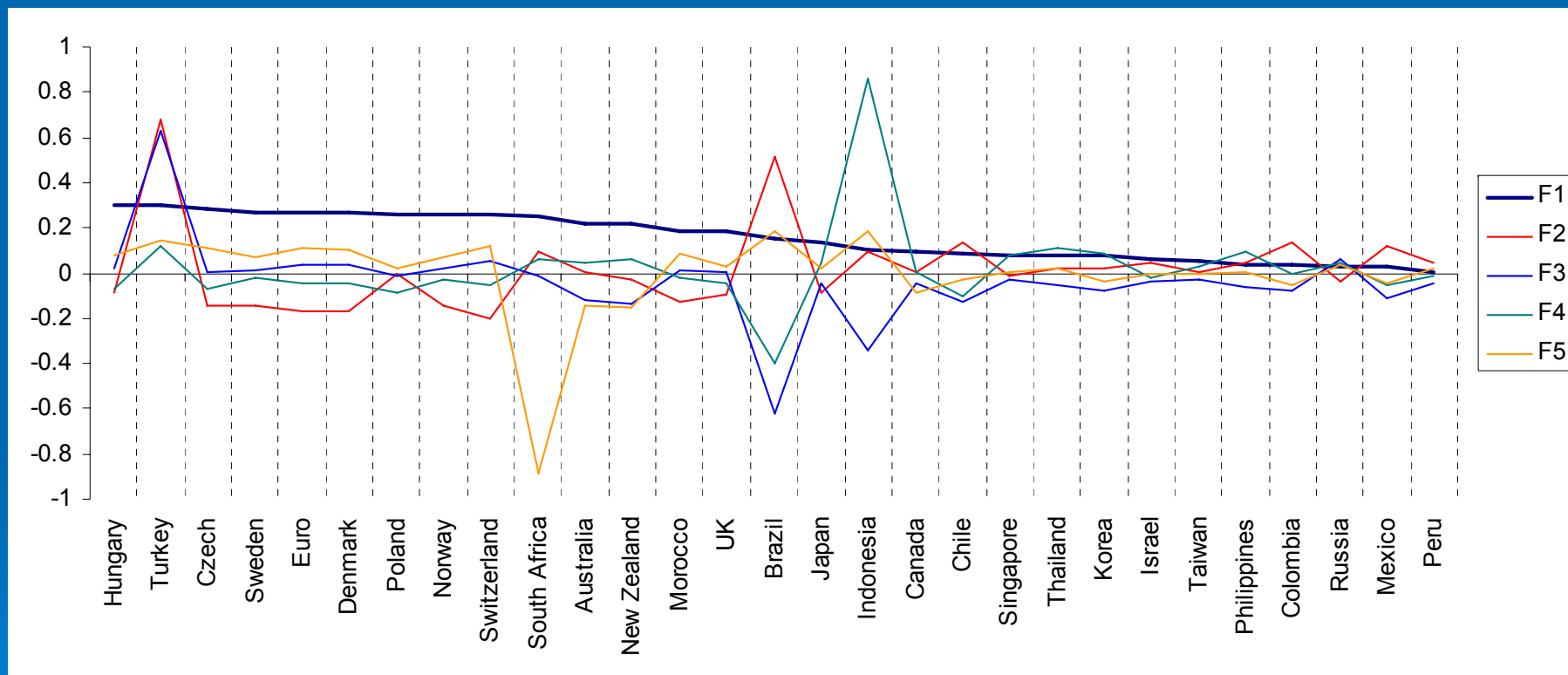
# Correlations with Factors

## ➤ Full Period



# Factor Loadings

## ➤ Full Period



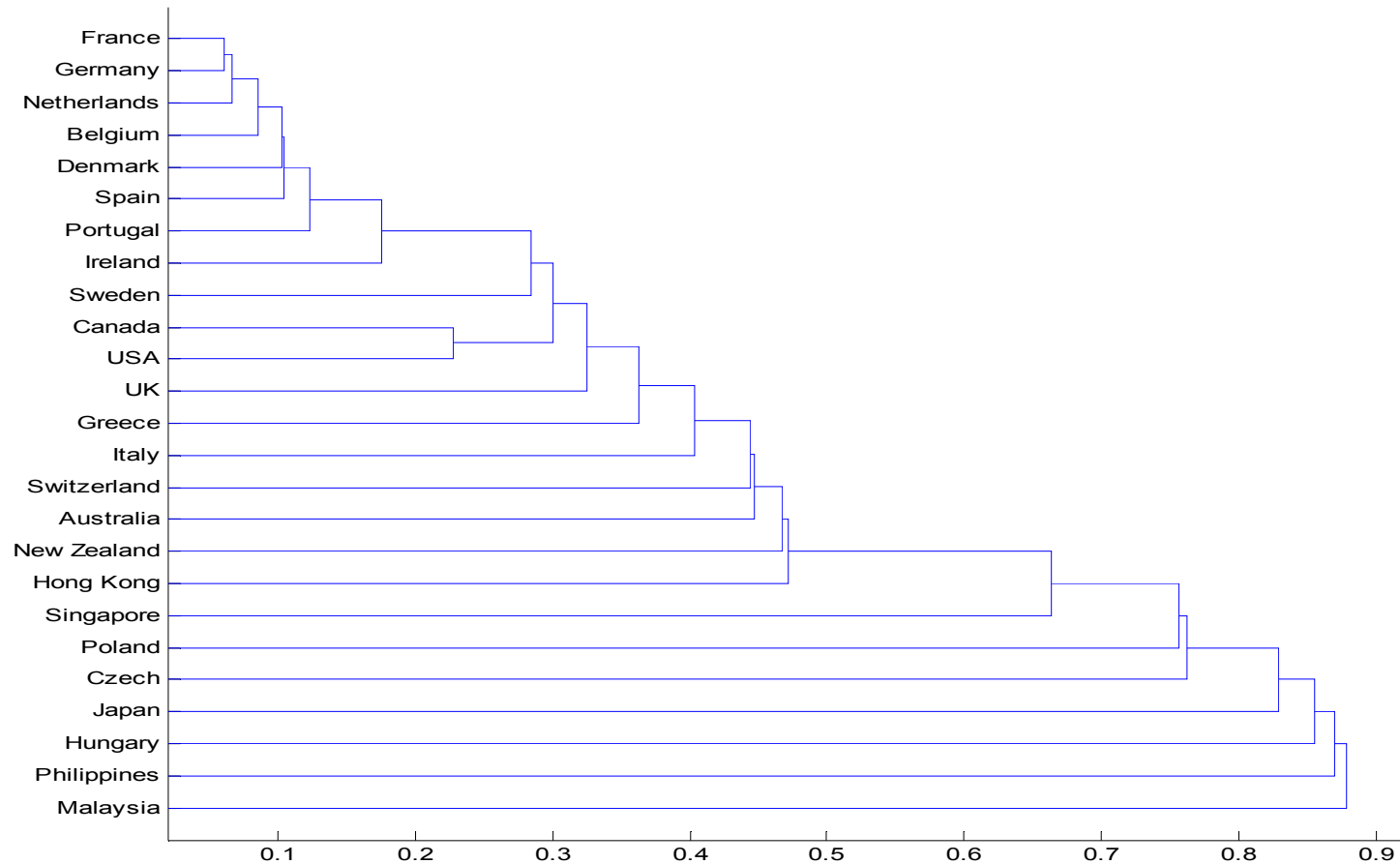
# Bond Markets



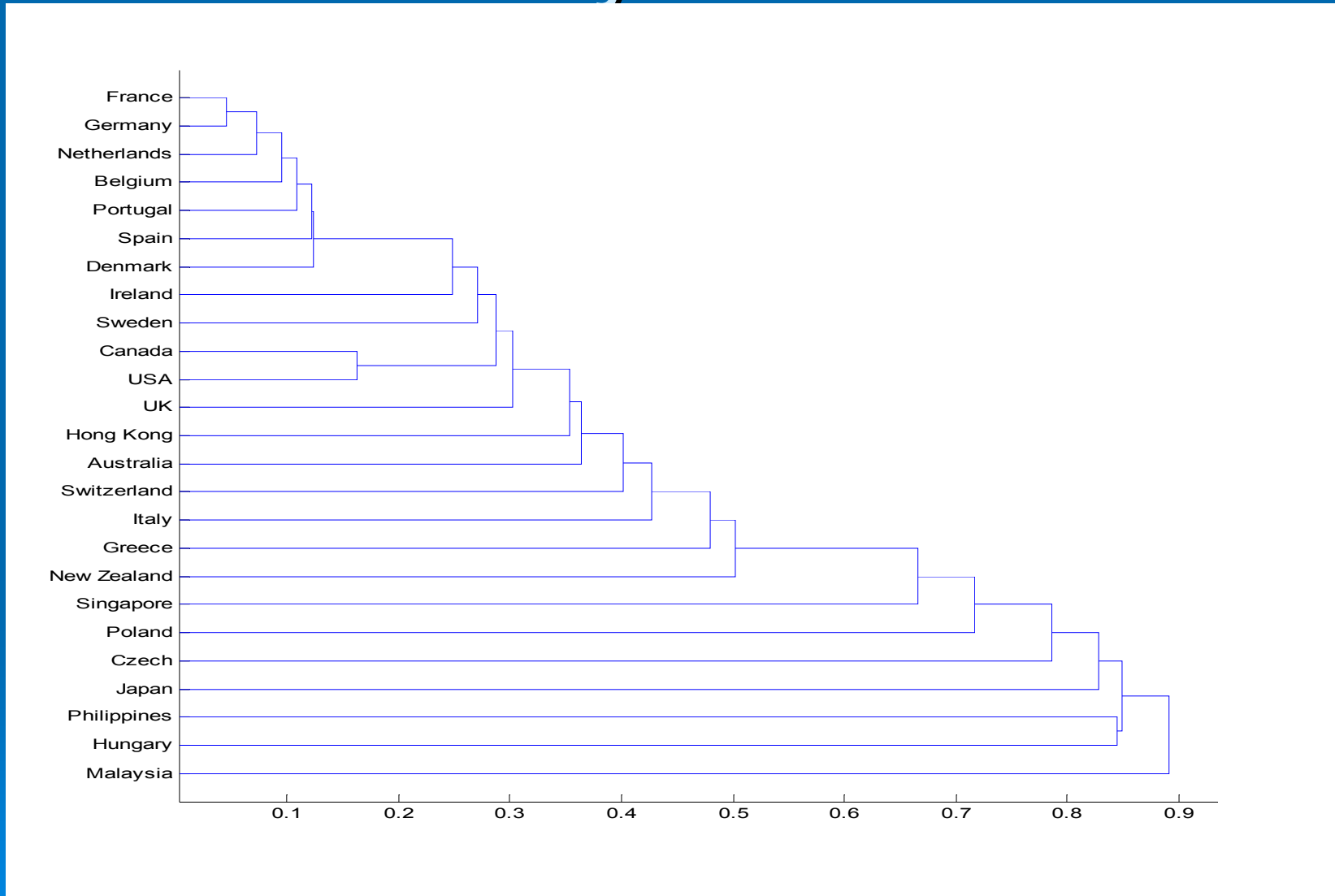
# Database

- Weekly data of generic 2-year government yields (source: Bloomberg)
  - 03/12/99-06/22/07
  - 433 weeks, 25 countries
  - We measured weekly yield changes

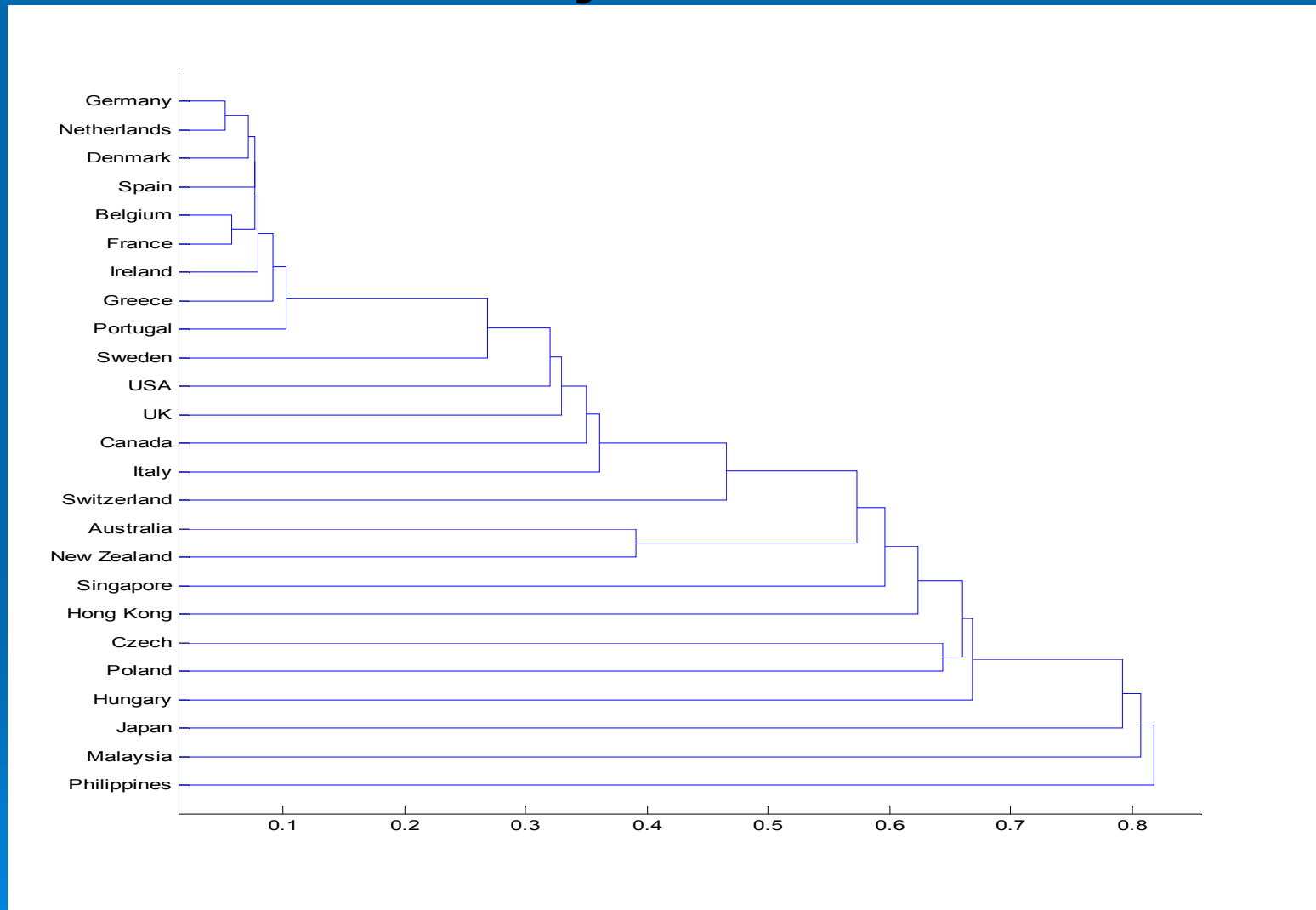
# Cluster Analysis: 1999-2007



# Cluster Analysis: 1999-2002



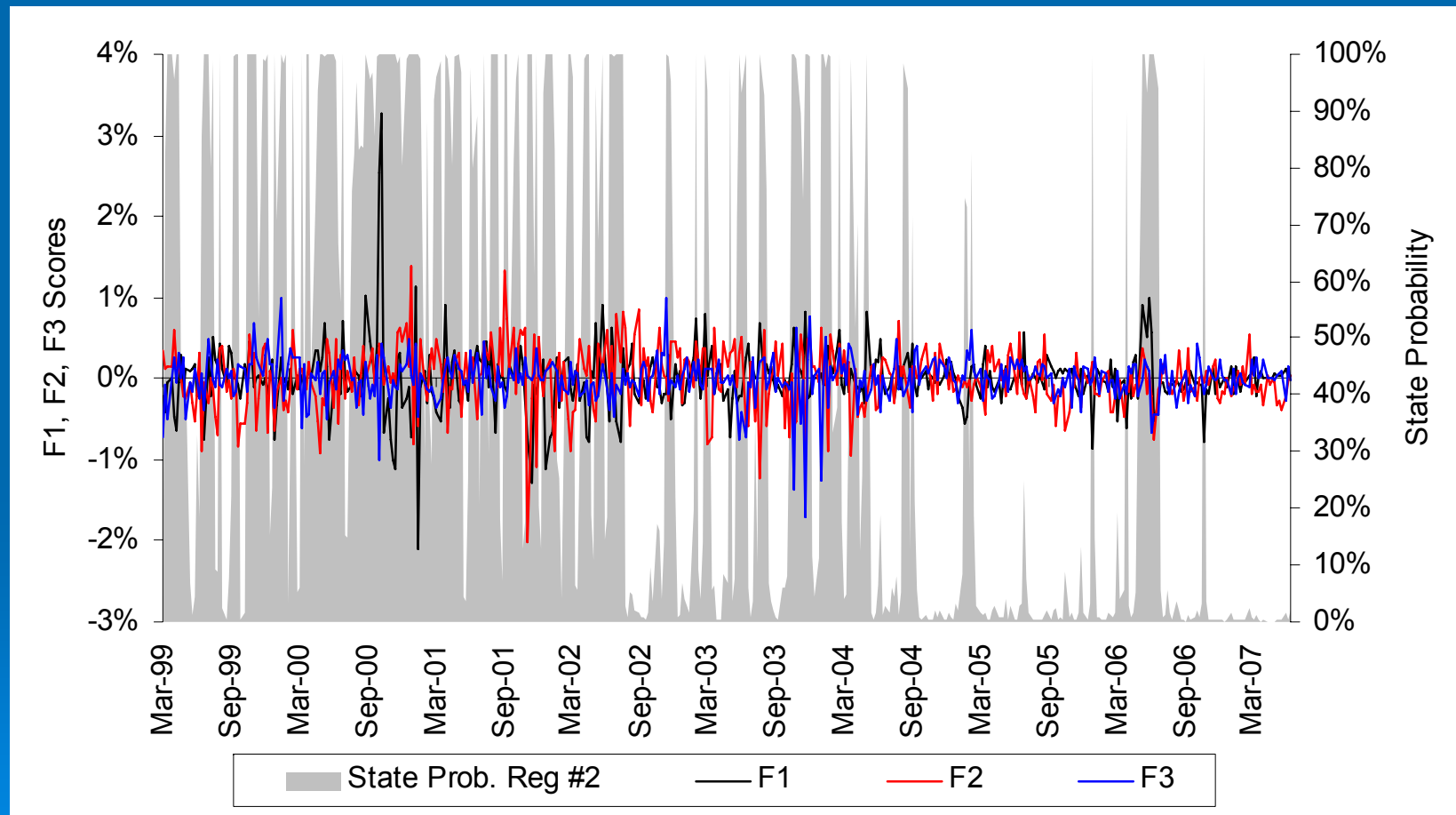
# Cluster Analysis: 2003-2007





# Regime-Switching VAR(1)

## ➤ F1-F5 Scores: 1999-2007, weekly



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# Regime-Switching VAR(1)

## ➤ F1-F5 Scores: 1999-2007, weekly

- Prob (S1→S1)=82%
- Prob (S2 →S2)=74%
- VAR(1) Coefficients:

Regime 1	F1	F2	F3	F4	F5
c	-0.0001	-0.0001	0.0002	0.0000	0.0000
F1	0.0762	0.0483	0.0178	0.0612	0.0336
F2	-0.0406	0.2406	0.0144	0.0169	0.0231
F3	0.0589	0.2744	0.0165	-0.0047	-0.0145
F4	0.1548	0.3979	-0.0338	0.0992	-0.1487
F5	0.0340	-0.1836	0.1328	0.0689	-0.0190

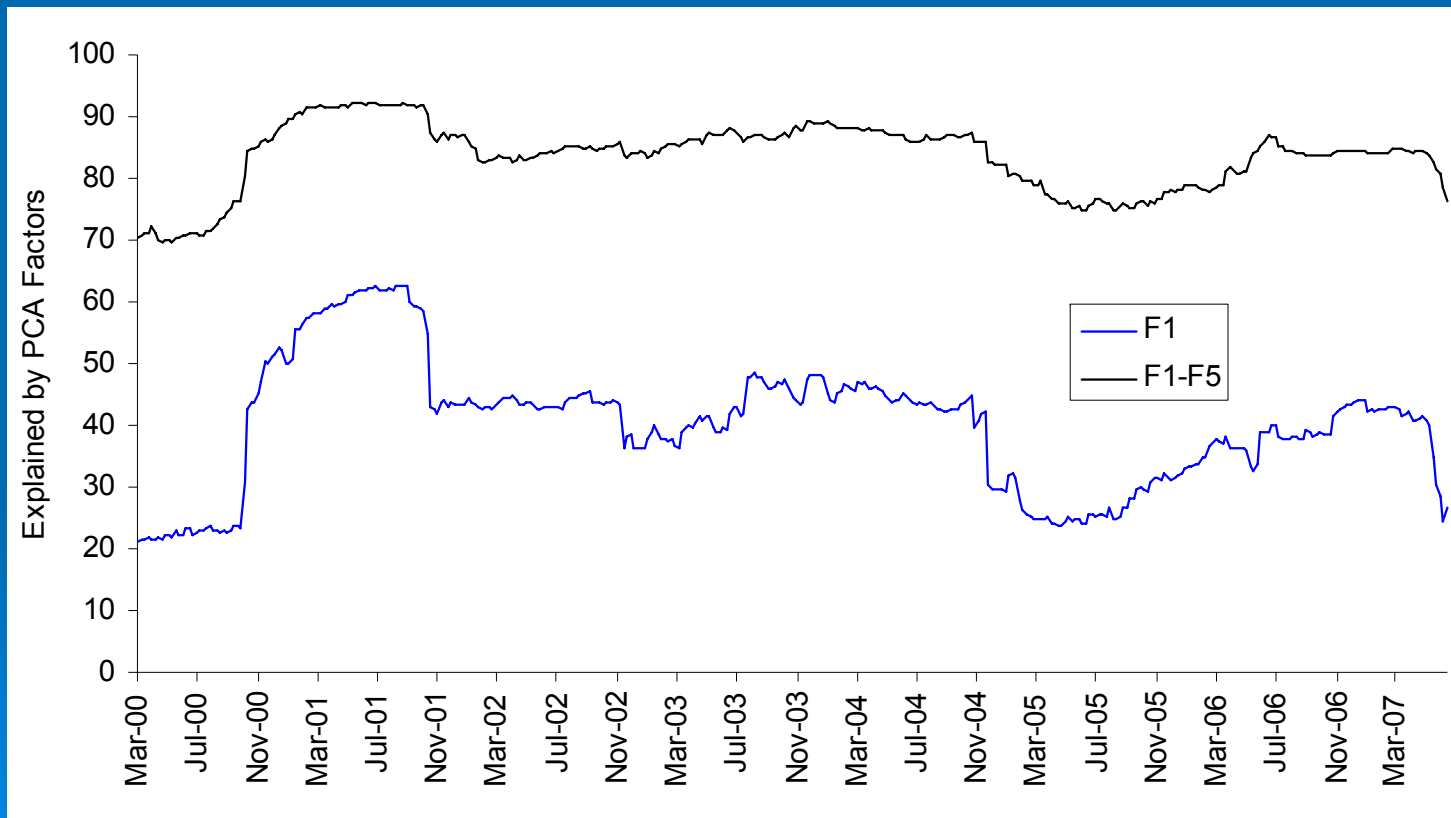
Regime 2	F1	F2	F3	F4	F5
c	0.0001	0.0000	-0.0002	0.0001	0.0000
F1	0.2562	-0.0336	-0.0015	-0.0407	-0.0132
F2	-0.0137	-0.0547	-0.0082	0.0783	0.1020
F3	-0.1324	-0.1332	-0.0413	0.0265	-0.0181
F4	0.0409	0.0434	0.0570	-0.1862	0.0299
F5	0.0117	0.3805	-0.1595	-0.2730	0.0079

## ➤ Factor Volatilities:

	F1	F2	F3	F4	F5
Regime 1	0.16%	0.27%	0.16%	0.11%	0.13%
Regime 2	0.55%	0.47%	0.35%	0.31%	0.17%

# Rolling-PCA

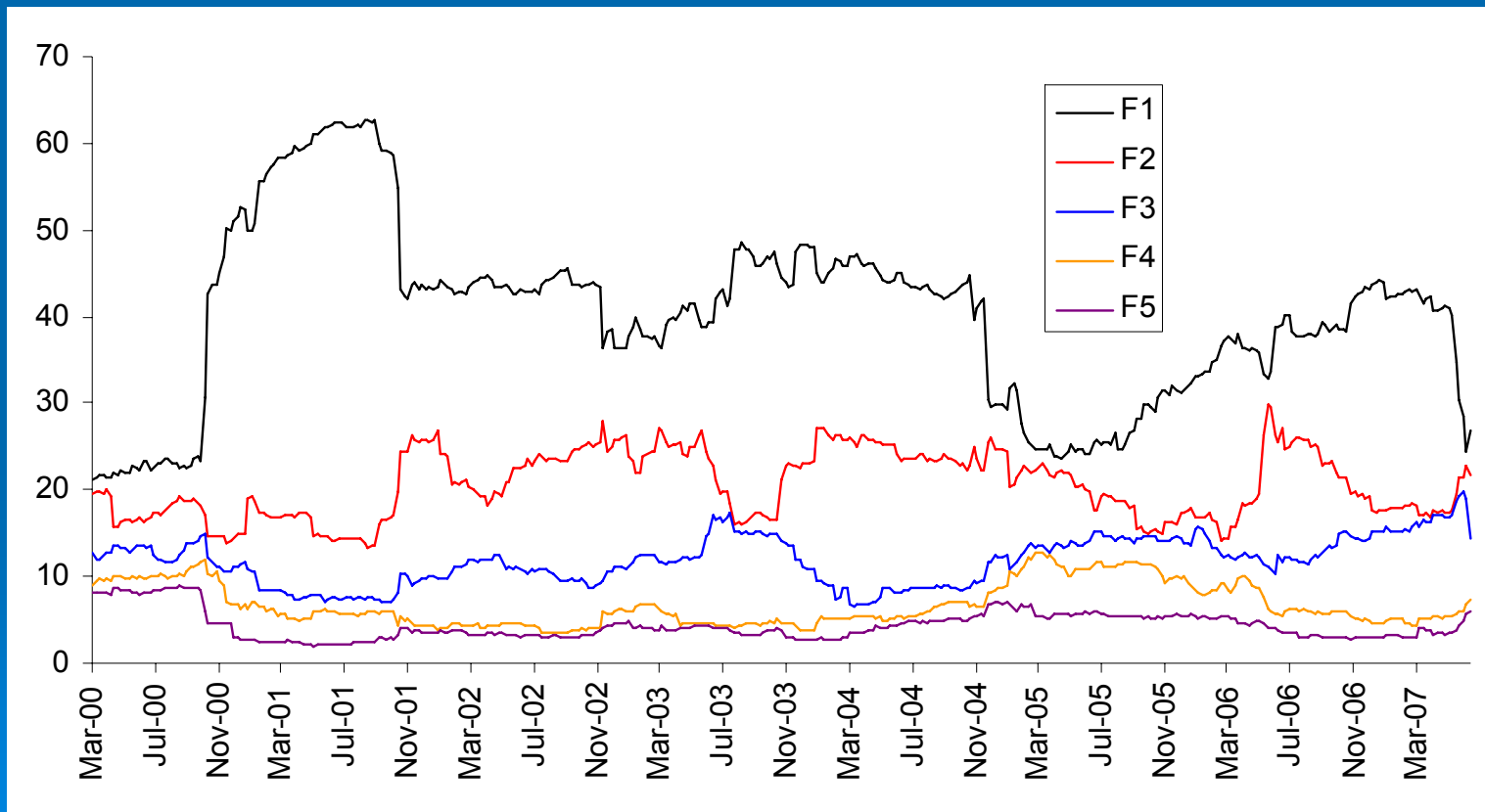
- Percentage of total variance explained by Factor 1 – Factor 5 (rolling 52-week):



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# Rolling-PCA

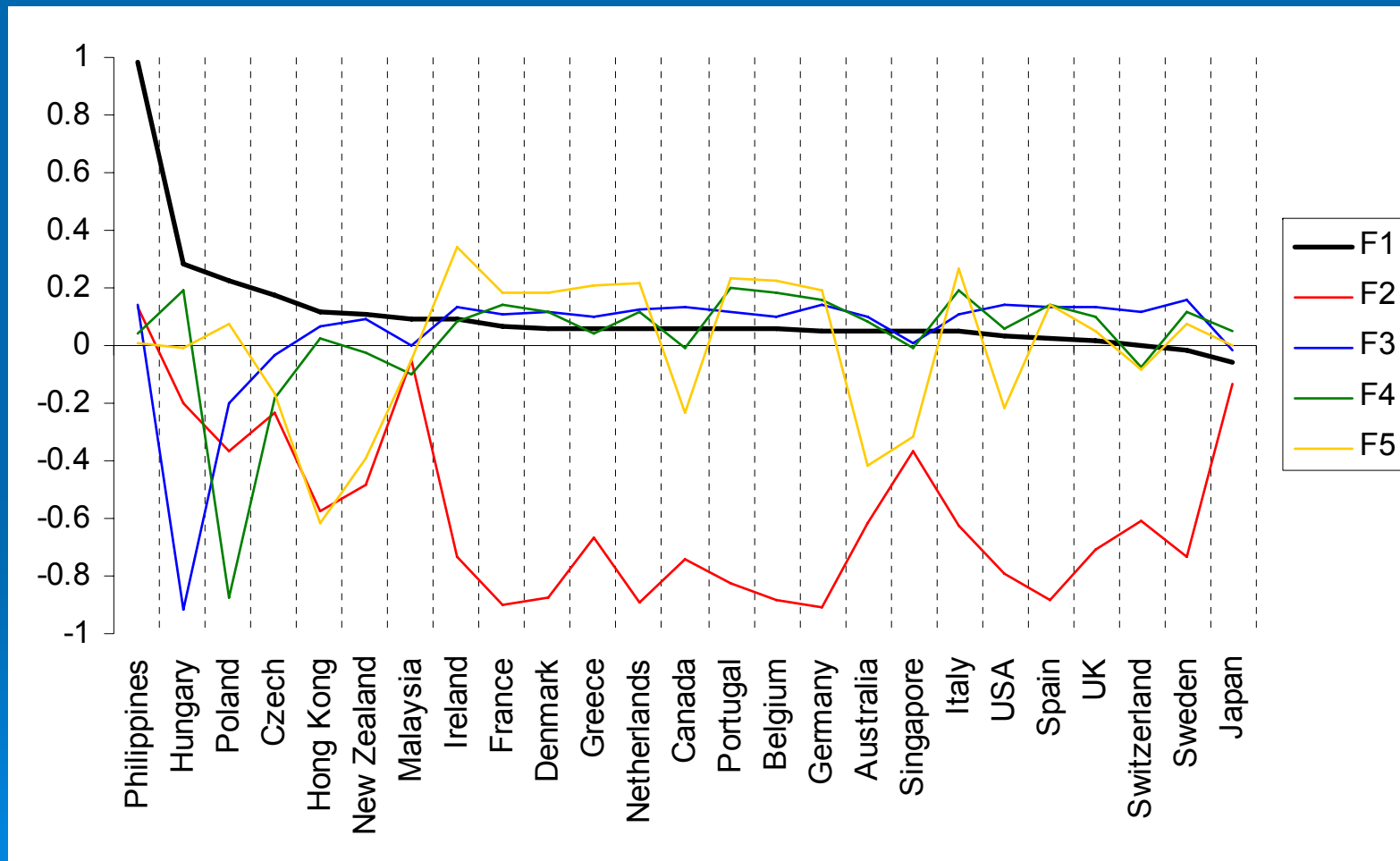
- Percentage of total variance explained by Factor 1 – Factor 5 (rolling 52-week):



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# Correlations with Factors

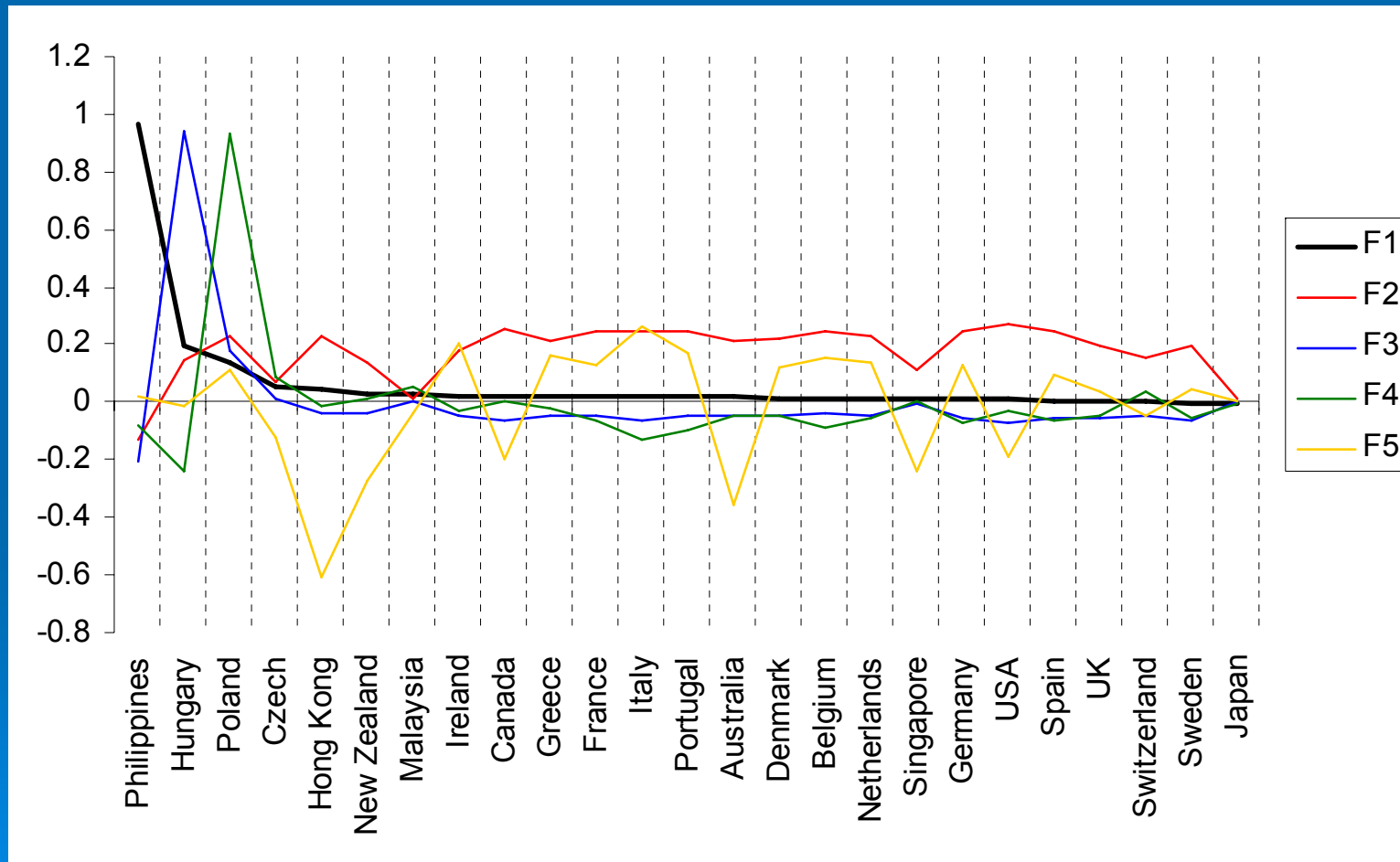
## ➤ Full Period



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# Factor Loadings

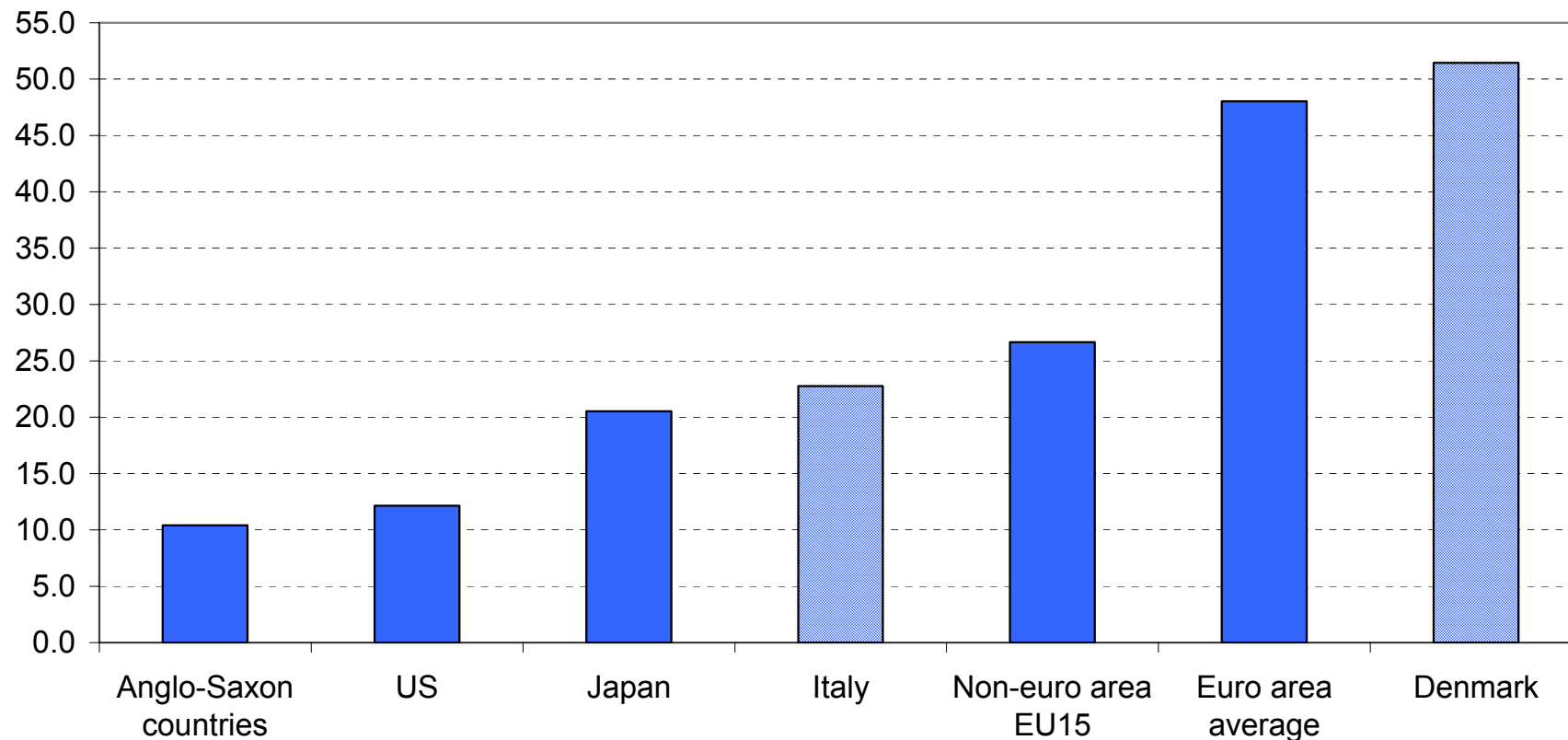
## ➤ Full Period



Köbor-Kutan-Székely Volatility and Interactions on International Financial Markets

# Market Comovements and the Speed of Financial Integration

**Increase in Extrenal Financial Integration, 1999-2004**  
(percentage change in the ratio during 1999-2004)



Note: For the euro area, intra-euro area assets are included and average over individual countries is taken.

End of Presentation

