

Enter the Dragon: Interactions between Chinese, US and Asia-Pacific Equity Markets, 1995-2010

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Backdrop

- The 1990s and 2000s saw a rise in capital mobility
 - Eventually enshrined as the “Washington” consensus
 - In addition to FDI, ‘hot money’, that is, portfolio investment, came to dominate flows around the world
 - The search for yields, led to the ‘carry trade’, also helped



Backdrop (cont'd)

- The foregoing developments also affected equity markets and for the same reasons
- The results: correlations – this is NOT the same as causation – between asset price movements in EMEs and advanced economies have increased in many cases



Correlation in Equity Returns

Correlations with world equity markets	Latin America	Asia	Central Europe
1994-98	0.80	-0.7	0.9
1999-2003	-0.20	0.6	0.1
2004-07	1.0	0.9	1.0

Source: CGFS – Capital flows and emerging market economies, January 2009, p.67



The GFC: Observations

- EMEs have been resilient through the crisis
 - Equities reflect ‘economic fundamentals’ not a shortage of liquidity
 - Since July 2008, equity markets in EMEs have underperformed: consumption-driven growth in IE mean poorer economic prospects in EMEs
 - Even EMEs are not immune to external shocks
 - EME financial markets still relatively immature – local debt (‘original sin’) and derivatives are in early stages of development



'Enter the Dragon'

- THEN
 - PRC did not even have an operating stock market until 1992
 - Capital controls helped shield China against the worst effects of the Asian financial crisis of 1997-98
- NOW
 - In 2009 Shanghai is # 6 in market cap, just behind LSE
 - Stock prices in China have risen spectacularly; even Greenspan noted its significance
 - Could the 2/2007 “Shanghai surprise” have triggered the GFC?
 - Perhaps better to refer to this as a global wake-up call



Implications

- Does equity market integration include China?
 - Capital controls continue
 - Restrictions on foreigners continue
 - “A” versus “B” shares; differential between “H” shares versus Shanghai persist
- What about financial market integration with Asia more generally?
 - Very little work done
 - Higher profile of Asia makes this more important
- Does financial integration imply greater risk of *contagion*?



The Issues

- The role of financial market integration
- The role of contagion-type effects
- The role of financial crises or other large 'shocks' to equity correlations



Literature Review

- SHORT-RUN style studies
 - VAR, GARCH approaches
- LONG-RUN style studies
 - Cointegration
- *Cointegration*
 - *Shocks affect whether this is found*
- *Contagion*
 - *What is it? Is it correlation? Is it different from interdependence?*



An Application: Basics

- Daily data, 1995-2010
- Use a 'menu' of statistical evidence
- Examine 12 Asia-Pacific economies + USA (S&P 500)
 - IE OR AE
 - USA, JAPAN, HONG KONG, SINGAPORE, AUSTRALIA, NEW ZEALAND
 - EMEs
 - TAIWAN, MALAYSIA, INDONESIA, PHILIPPINES, THAILAND, CHINA (mainly Shanghai)



An Application: Basics

- Daily data means that you have to worry about weekends/holidays
 - Excluded, or $S(t)=S(t-1)$, or interpolation when # days is large ('golden week')
 - Knowing some institutional details helps!
- We want results to be 'robust'
 - Full sample, Recessions versus expansions, crisis versus no-crisis samples
 - Not as straightforward as one might think



Varieties of techniques

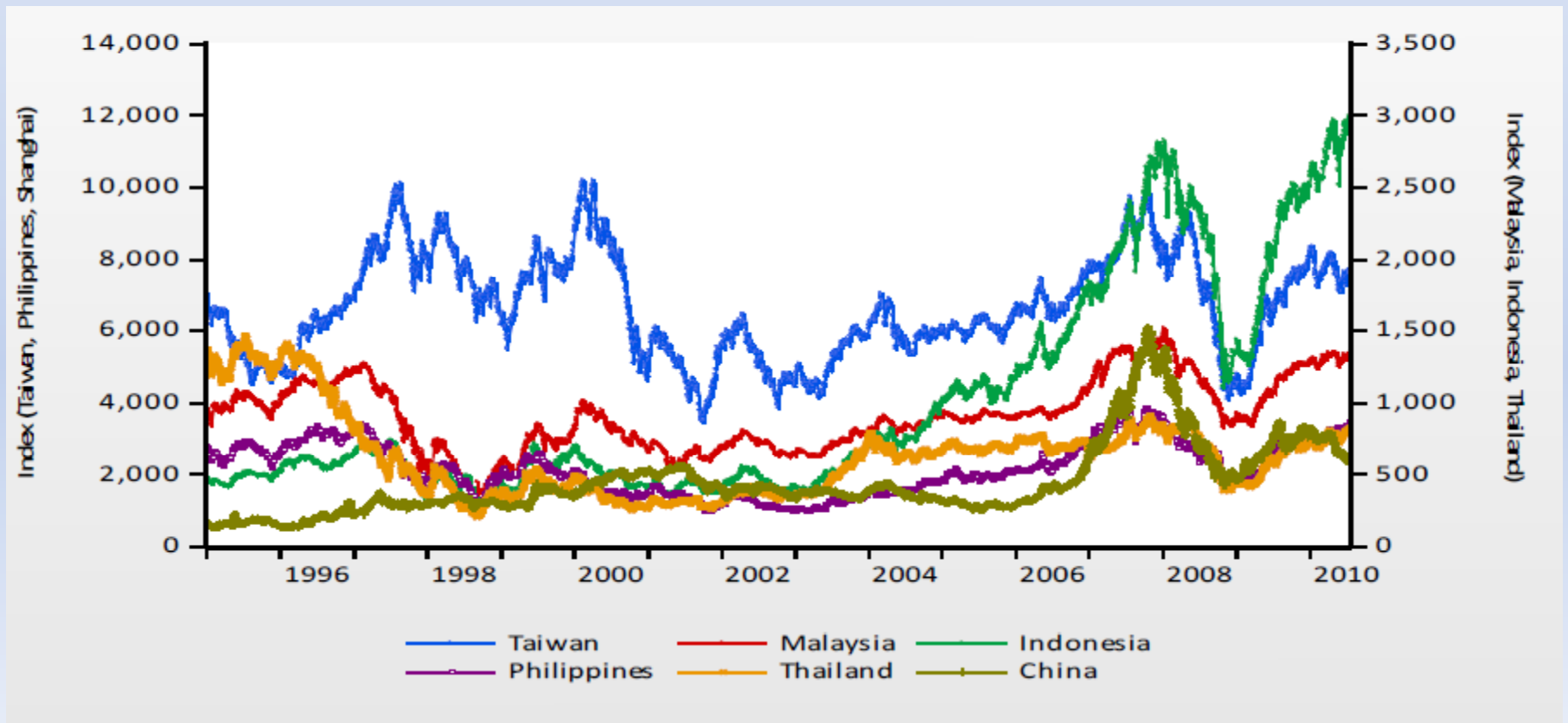
- Stylized facts
- Autocorrelations and persistence measures
- Dynamic conditional correlations
- Contagion tests
- Cointegration tests



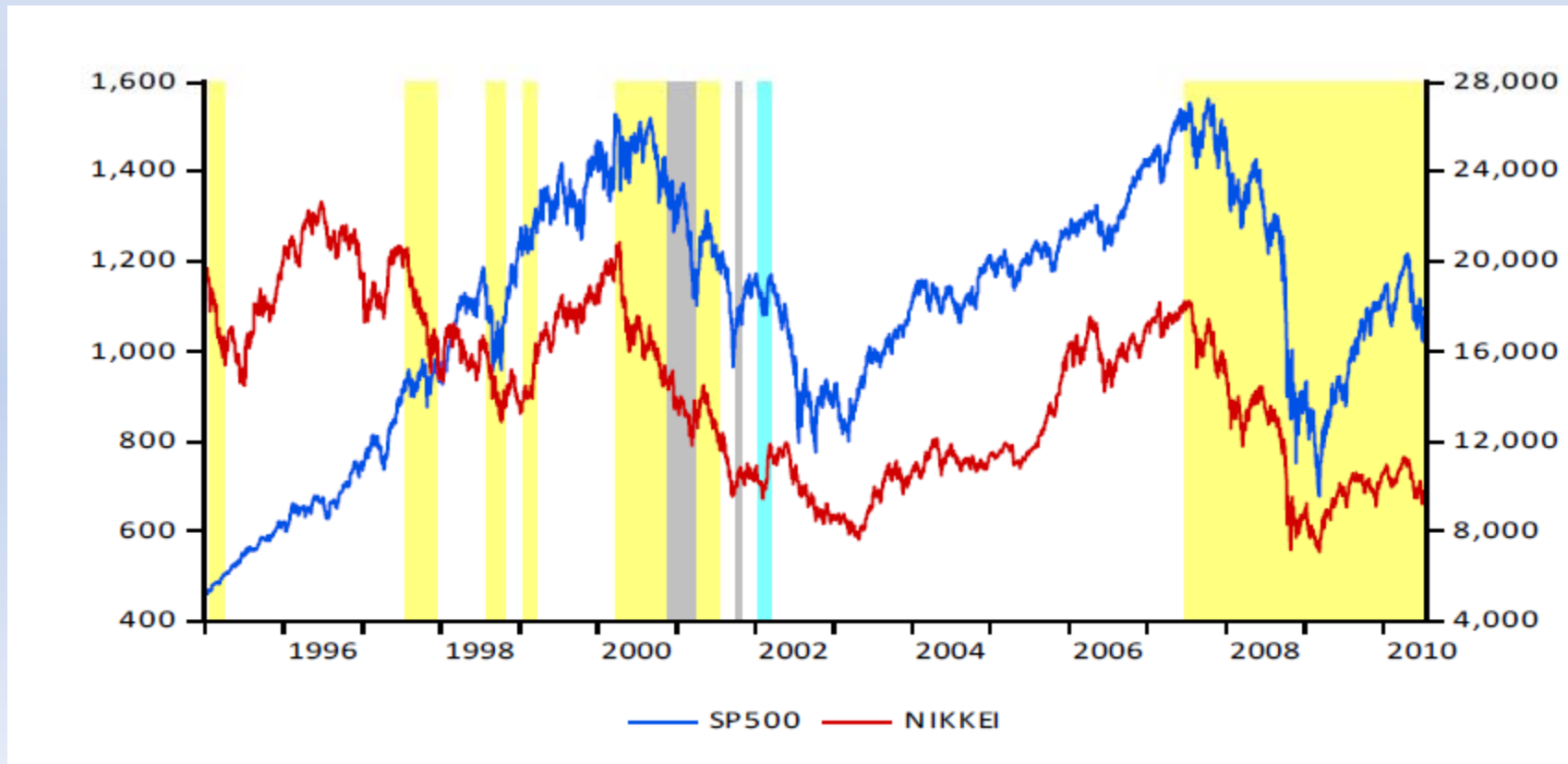
Stock Index Levels



Stock Index Levels



Stock Index Levels



Distribution of Equity Returns

(% of Observations)

Range	S&P500	Nikkei	KLCI	JCI	KOSPI	NZAO	PCOMP	SET	SHNG	STRAITS	TWSE	ASX	Hang Seng
[-5,-4)			0.79	1.78	2.67	0.15	1.33	1.16	2.47		1.33		1.73
[-4,-3)	1.60	2.62	3.50	1.51	2.79	0.20	4.91	7.53	6.81	2.08	2.47	0.89	6.81
[-3,-2)	2.94	5.50		3.87	5.77	0.79				3.56	4.52	1.60	
[-2,-1)	10.07	12.96	43.63	10.69	11.97	6.69	43.58	41.98	37.65	11.42	11.70	8.00	39.46
[-1,0)	31.61	29.52		28.55	23.82	39.57				31.27	28.99	36.72	
[0,1)	39.07	29.13	47.93	33.07	29.10	44.85	43.68	41.09	43.87	34.76	29.51	41.95	43.48
[1,2)	10.71	14.02		13.55	14.04	6.64				12.209	13.83	9.03	
[2,3)	2.57	4.34	3.16	4.07	5.26	0.91	5.60	6.71	7.43	3.17	4.74	1.11	7.06
[3,4)	1.38	1.89		1.41	2.15	0.18				1.56	2.91	0.68	
[4,5)			0.98	1.51	2.43		0.89	1.53	1.77				1.14
Mean	.026	-.050	.012	.046	.0009	.014	.008	-.003	.031	-.0005	.006	.024	.034
S.D.	1.251	1.491	1.403	1.617	1.916	.789	1.471	1.668	1.873	1.310	1.550	.980	1.724
Median	.070	-.02	.037	.090	.081	.035	.000	-.019	.079	.050	.027	.045	.054
Test	-2.25 (.02)	-1.29 (.20)	-1.09 (.28)	-1.74 (.08)	-2.63 (.01)	-1.69 (.09)	.33 (.74)	.02 (.54)	-1.64 (.10)	-2.05 (.04)	-.88 (.38)	-1.35 (.18)	-.72 (.47)

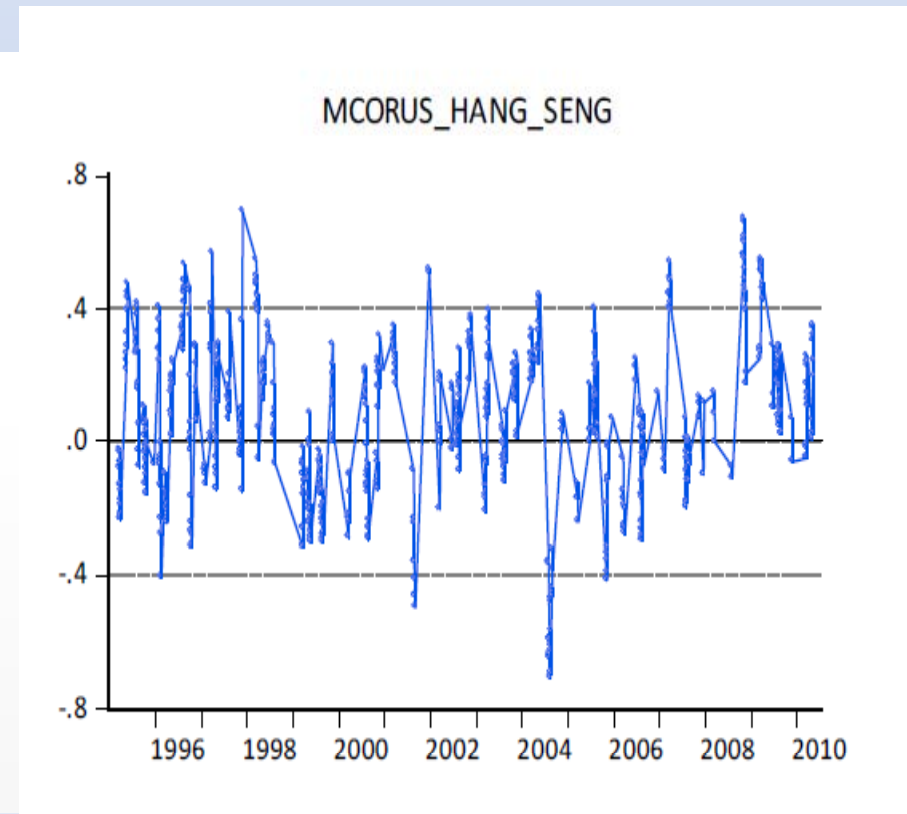
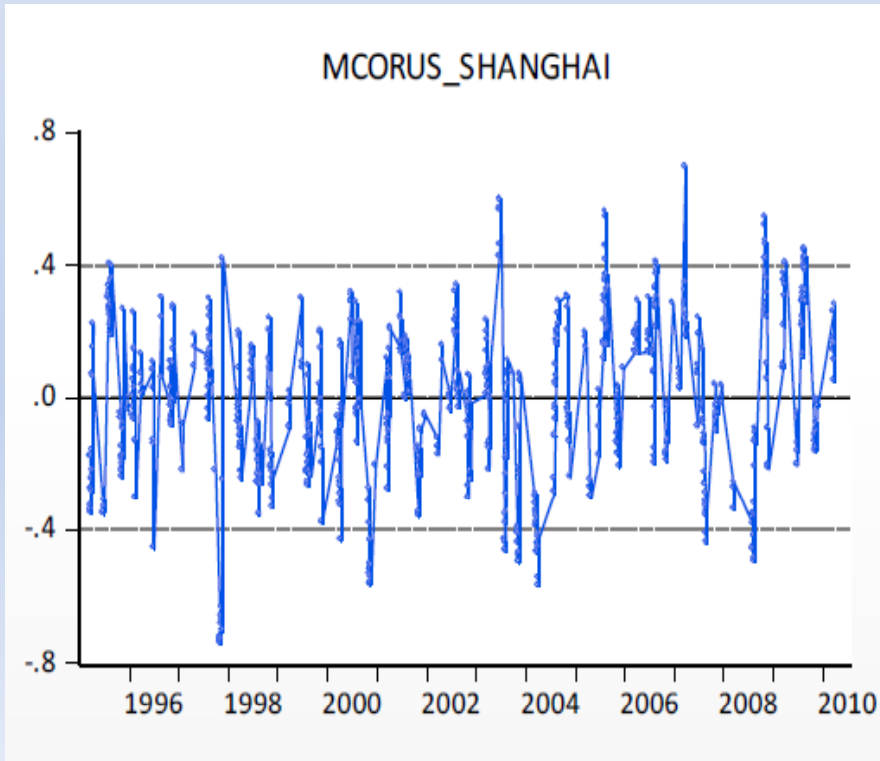


Unconditional Correlations

	S&P 500	Nikkei
Hang Seng	.18*	.54*
ASX	.10*	.57*
NZAO	-.02	.37*
KOSPI	.13*	.45*
STRAITS	.21*	.59*
TWSE	.08*	.38*
KLCI	.05*	.27*
JCI	.06*	.32*
PCOMP	.04*	.29*
SET	.12*	.28*
SHANGHAI	-.00	.13*
Memo		
SHANGHAI B	.003	.11*
SHENZHEN B	.01	.14*
H Shares	.11*	.40*



Moving Correlations



Unconditional correlations

- Hard to tell them apart
- Not clear that sub-samples would help
 - How to choose?
- Maybe correlations are affected by the location in the distribution?
 - Quantiles might be more useful

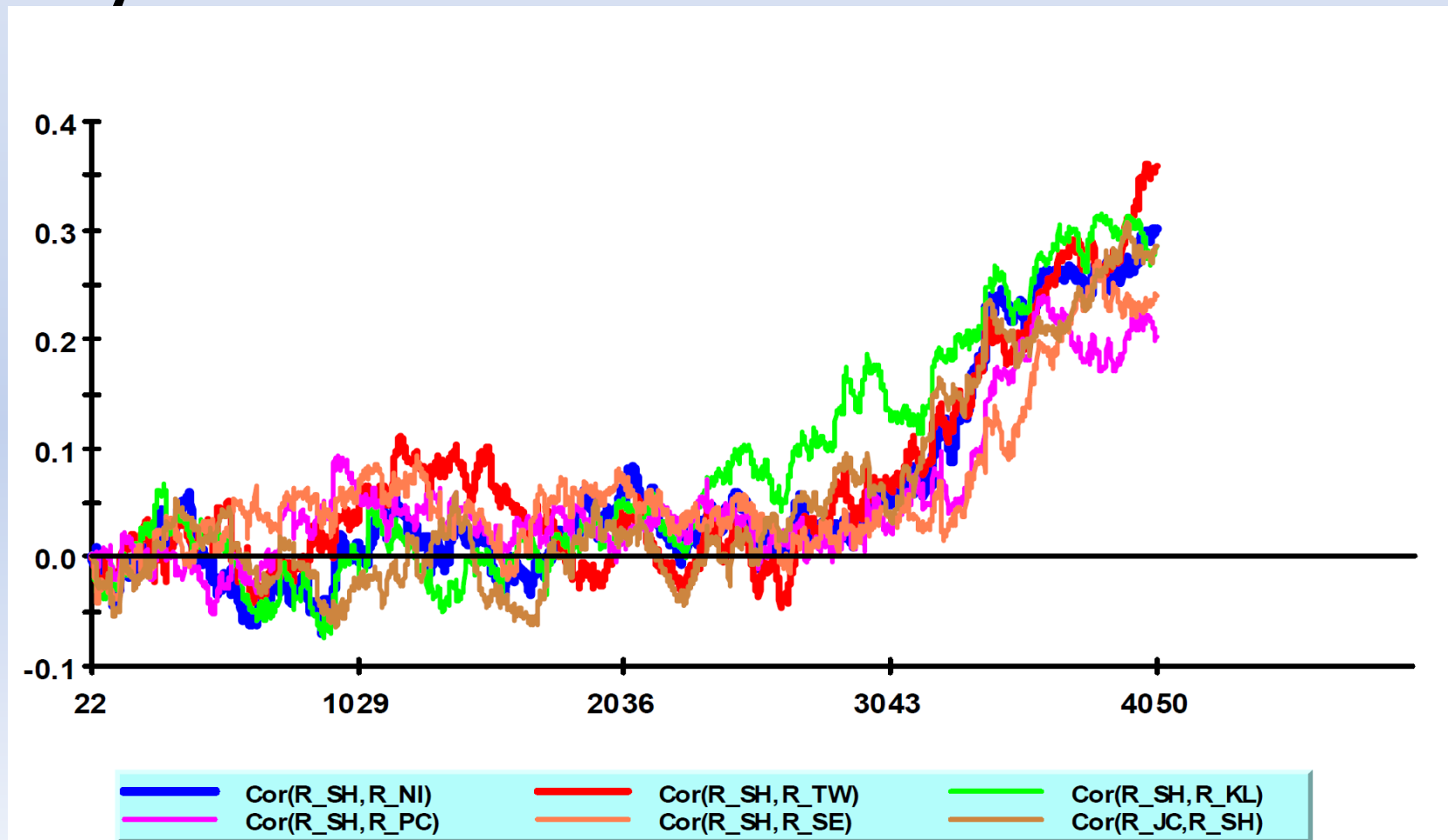


Correlations By Quantile

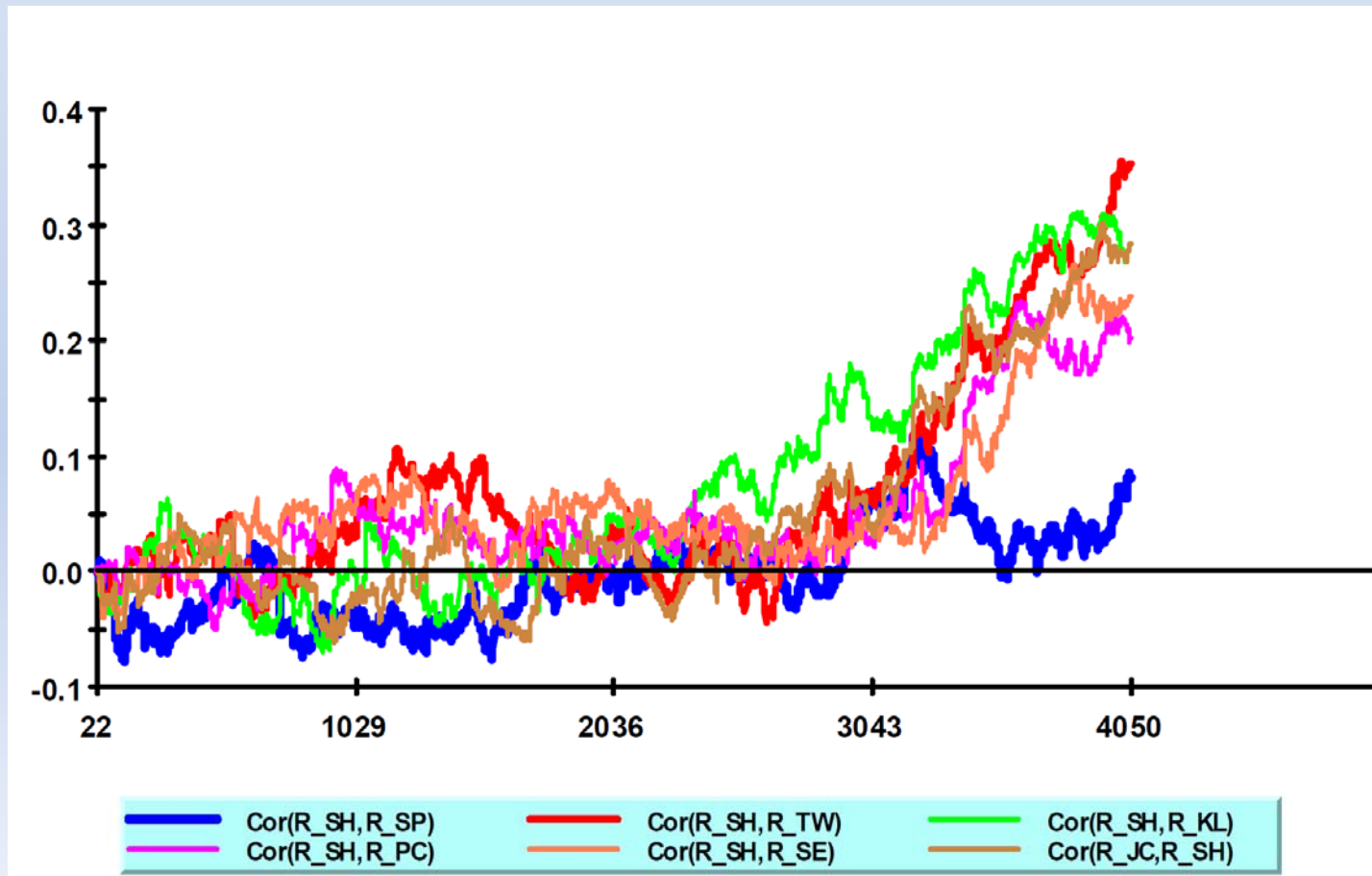
	S&P 500		Nikkei	
	Q<=.2	Q>=.8	Q<=.2	Q>=.8
Hang Seng	0.10***	0.03	0.20***	0.14***
ASX	0.06**	-0.01	0.16***	0.13***
NZAO	0.03	0.01	0.09***	0.05**
KOSPI	0.09*	0.03	0.20***	0.11***
STRAITS	0.08**	0.07***	0.14***	0.07**
TWSE	0.03	0.02	0.20***	0.09***
KLCI	0.03	-0.02	0.15***	0.07**
JCI	0.05	-0.01	0.12***	0.11***
PCOMP	0.07*	-0.02	0.13***	0.06**
SET	0.07**	0.01	0.15***	0.10***
SHANGHAI	0.0004	-0.03	0.13***	0.07**
Memo				
SHANGHAI B	-0.03	-0.03	0.13***	0.05*
SHENZHEN B	-0.01	-0.03	0.13***	0.05**
H Shares	0.10***	0.04	0.16***	0.11***



Dynamic Conditional Correlations



Dynamic Conditional Correlations



Returns Persistence

Stock Index	Full Sample	Crisis Only Sample
S&P 500	-.06***	-.10***
Nikkei	-.04**	-.04
Hang Seng	-.01	-.06**
ASX	-.03*	-.02
NZAO	.06***	.04
KOSPI	.06***	.02
STRAITS	.01	-.001
TWSE	.02	.02
KLCI	.07***	-.002
JCI	.18***	.19***
PCOMP	.17***	.15***
SET	.07***	.05*
Shanghai	.01	.001
Memo		
Shanghai A	.02	.07***
Shanghai B	.11***	.08***
Shenzhen	.04**	.08***
Shenzhen A	.04***	.08***
Shenzhen B	.11***	.11***
H shares	.11***	.07***



More Formal Testing

- Contagion
- Cointegration
- DCC – dynamic conditional correlation



Contagion

- Identify crisis and non-crisis periods
- Normalize returns to non-crisis period
- Consider that contagion can come in many forms



Test Equation

Multiple sources of contagion

$$\tilde{s}_{1t} = \omega_1' + \theta_1' C_t + \theta_{21}' \tilde{s}_{2t} + \theta_{31}' \tilde{s}_{3t} + \lambda_{12} \tilde{s}_{2t} C_t + \lambda_{13} \tilde{s}_{3t} C_t + \xi_{1t}$$

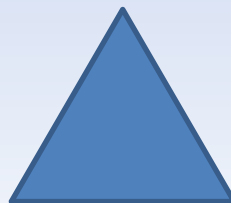
$$\tilde{s}_{2t} = \omega_2' + \theta_2' C_t + \theta_{22}' \tilde{s}_{2t} + \theta_{32}' \tilde{s}_{3t} + \lambda_{21} \tilde{s}_{2t} C_t + \lambda_{23} \tilde{s}_{3t} C_t + \xi_{2t}$$

$$\tilde{s}_{3t} = \omega_3' + \theta_3' C_t + \theta_{23}' \tilde{s}_{2t} + \theta_{33}' \tilde{s}_{3t} + \lambda_{31} \tilde{s}_{2t} C_t + \lambda_{32} \tilde{s}_{3t} C_t + \xi_{3t}$$

DUMMY
=1 for crisis

Equity return
(normalized)

USA



CHINA

3rd Market

Crisis- return
interaction



BALSILLIE SCHOOL
OF INTERNATIONAL AFFAIRS

Contagion? What Contagion?

<i>Contagion from</i>	<i>Contagion to</i>
A. Benchmark-Mature	
None	S&P 500
None	Nikkei
Nikkei	ASX
None	NZAO
None	KOSPI
KOSPI	Hang Seng
B. Benchmark-EMEs	
KLCI, TWSE, SET	S&P 500
Shanghai, S&P 500	FBMKLCI
None	TWSE
None	JCI
Shanghai, S&P 500	SET
None	PCOMP
KLCI	Shanghai
C. Mature – EMEs	
None	ASX
TWSE, SET	NZAO
SET	KOSPI
KOSPI	Hang Seng
Shanghai	FBMKLCI
Hang Seng, NZAO	TWSE
None	JCI
NZAO, Shanghai	SET
None	PCOMP
KLCI	Shanghai



Cointegration

- Asks whether series are ‘attracted’ to each other in a statistical sense
 - If differences in series are ‘stationary’ (constant mean, variance) then the series in question are cointegrated
 - Can there be more than 1 CI relation? YES, but the focus here is on whether it exists NOT how much
- The CI question can also be asked at the quantile level



Cointegration

'Standard'

$$s_{1t} = \beta_1 + \beta_2 s_{2t} + \beta_3 s_{3t} + \dots + u_t$$

Quantile cointegration

$$Q_{s_{1t}}[\tau] = \beta(\tau)_1 + \beta(\tau)_2 s_{2t} + \beta(\tau)_3 s_{3t} + \dots + F_u^{-1}(\tau)$$

Quantile

Constant



Standard CI

Variable	tau-statistic	Prob.	z-Statistic	Prob.
TWSE	-6.07	0.06	-87.83	0.01
FBMKLCI	-5.24	0.32	-58.44	0.23
JCI	-6.20	0.04	-94.67	0.00
PCOMP	-6.47	0.02	-85.43	0.01
SET	-3.89	0.92	-36.24	0.81
SHANGHAI	-3.44	0.98	-23.93	0.98
HANG SENG	-5.55	0.19	-76.65	0.03
KOSPI	-5.64	0.16	-64.19	0.13
NZAO	-5.14	0.37	-56.90	0.26
ASX	-5.49	0.21	-60.50	0.19
STRAITS	-6.26	0.03	-84.93	0.01
S&P500	-5.04	0.42	-53.65	0.33



Quantile CI: Hang Seng vs Rest

<u>1st Quantile</u>				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.08	0.18	17.59	0.00
TWSE	0.35	0.03	12.37	0.00
FBMKLCI	-0.37	0.04	-8.43	0.00
JCI	0.34	0.02	14.28	0.00
PCOMP	-0.27	0.03	-9.78	0.00
SET	-0.06	0.02	-3.70	0.00
SHANGHAI	0.07	0.01	10.11	0.00
KOSPI	-0.28	0.02	-13.10	0.00
NZAO	-0.27	0.03	-9.18	0.00
ASX	0.27	0.04	7.38	0.00
STRAITS	0.90	0.03	25.75	0.00

<u>Median Quantile</u>				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.18	0.19	17.09	0.00
TWSE	0.27	0.03	9.86	0.00
FBMKLCI	-0.28	0.04	-6.92	0.00
JCI	0.23	0.03	7.99	0.00
PCOMP	-0.09	0.03	-3.09	0.00
SET	-0.01	0.02	-0.17	0.86
SHANGHAI	0.07	0.01	8.52	0.00
KOSPI	-0.25	0.02	-13.03	0.00
NZAO	-0.39	0.04	-8.73	0.00
ASX	0.29	0.03	9.10	0.00
STRAITS	0.84	0.02	44.66	0.00



Quantile CI: Shanghai vs Rest

<u>1st Quantile</u>				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.06	1.49	1.39	0.17
TWSE	0.51	0.06	8.83	0.00
FBMKLCI	0.40	0.24	1.65	0.10
JCI	0.03	0.083	0.38	0.70
PCOMP	0.19	0.10	1.96	0.05
SET	0.04	0.10	0.04	0.97
HANG SENG	0.72	0.08	9.42	0.00
KOSPI	-0.53	0.05	-11.42	0.00
NZAO	-2.00	0.12	-17.30	0.00
ASX	1.92	0.13	14.36	0.00
STRAITS	-1.20	0.17	-7.08	0.00

<u>3rd Quantile</u>				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.2	0.63	-9.94	0.00
TWSE	-0.19	0.07	-2.75	0.01
FBMKLCI	1.07	0.13	8.45	0.00
JCI	-0.48	0.07	-6.63	0.00
PCOMP	0.82	0.07	12.35	0.00
SET	-0.20	0.06	-3.51	0.00
HANG SENG	1.13	0.10	11.84	0.00
KOSPI	0.10	0.05	2.06	0.04
NZAO	-0.25	0.14	-1.80	0.07
ASX	1.09	0.10	11.06	0.00
STRAITS	-1.59	0.11	-14.21	0.00

Conclusions

- Interdependence has risen
- There is some contagion but its not pervasive
- Shanghai has a growing influence in spite of capital controls and other restrictions on equity investors
- There is some evidence of decoupling by Asia from US
- Conventional correlation/cointegration testing not the way to go

