

Price Discovery of Indexes Futures across Markets

Jerry CAO, Sun Yat-Sen University

Xiaoming WANG, Shanghai University of Finance and Economics

Nelson YAP, Singapore Management University

Sili ZHOU, Singapore Management University

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Background

- ▶ Integration and globalization among exchanges

- ▶ Cross-listing equity

- Thomas Reuter (NYSE:TRI; TSE:TRI)

- Sinopec (SEHK:0386; SSE:600028; NYSE: PTR; LSE:SNP)

- ▶ **Indexes futures**

- CNX Nifty Index (SGX and NSE)

- Nikkei 225 Index (SGX and OSE)

- FTSE A50 China Index (SGX) v.s. CSI300 Index(CFFEX)

- MSCI Taiwan Index (SGX) v.s. TAIEX Index (TAIFEX)

Economic Questions

- ▶ One index, two markets
 - ▶ Same/Similar underlying
 - ▶ Different market structure
 - Regulation, liquidity, barrier for trading etc.
- ▶ Where price discovery occurs?
 - Domestic versus Foreign
- ▶ How efficient is the price discovery?
 - Information Shares

Nifty IS at SGX (30 days Average)



Why SGX

- ▶ SGX is Asia's largest offshore futures market
- ▶ SGX offers Asia's broadest range of derivatives, covering over 80% of Asia's economics
- ▶ Total value traded in 2013:
Japan US\$2.8 trillion, Taiwan US\$530 billion,
India US\$190 billion, China US\$170 billion,
Indonesia US\$3.6 billion.

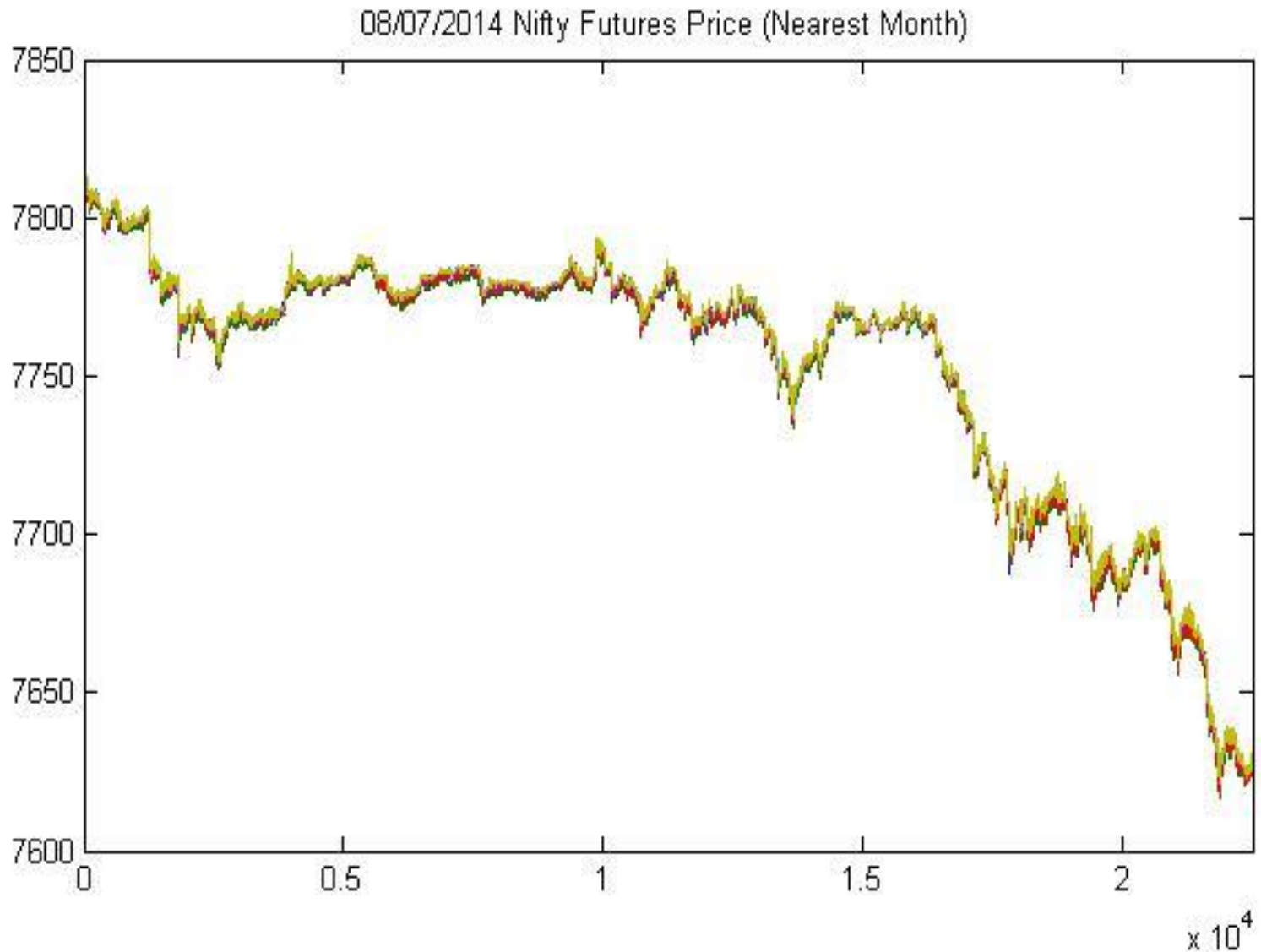
Exchange	OSE		SGX		NSE		SGX	
Underlying	Nikkei225 Index		Nikkei225 Index		Nifty Index		Nifty Index	
Multiplier	Y1000		Y500		Rs. 25		USD 2	
Trading Hours	Regular Session	09:00-15:10	Opening	08:45-15:25	Normal Market	09:15-15:30	Opening	06:30-15:40

Exchange	TAIFEX		SGX		CFFEX		SGX	
Underlying	TAIEX Index		MSCI Taiwan Index		CSI 300 Index		FTSE China A50 Index	
Multiplier	NT\$200		USD 100		CNY 300		USD1	
Trading Hours	Regular Trading	08:45-13:45	Opening	08:45-13:45	First Session	09:15-11:30	Opening	09:00-15:55
					Second Session	13:00-15:15		

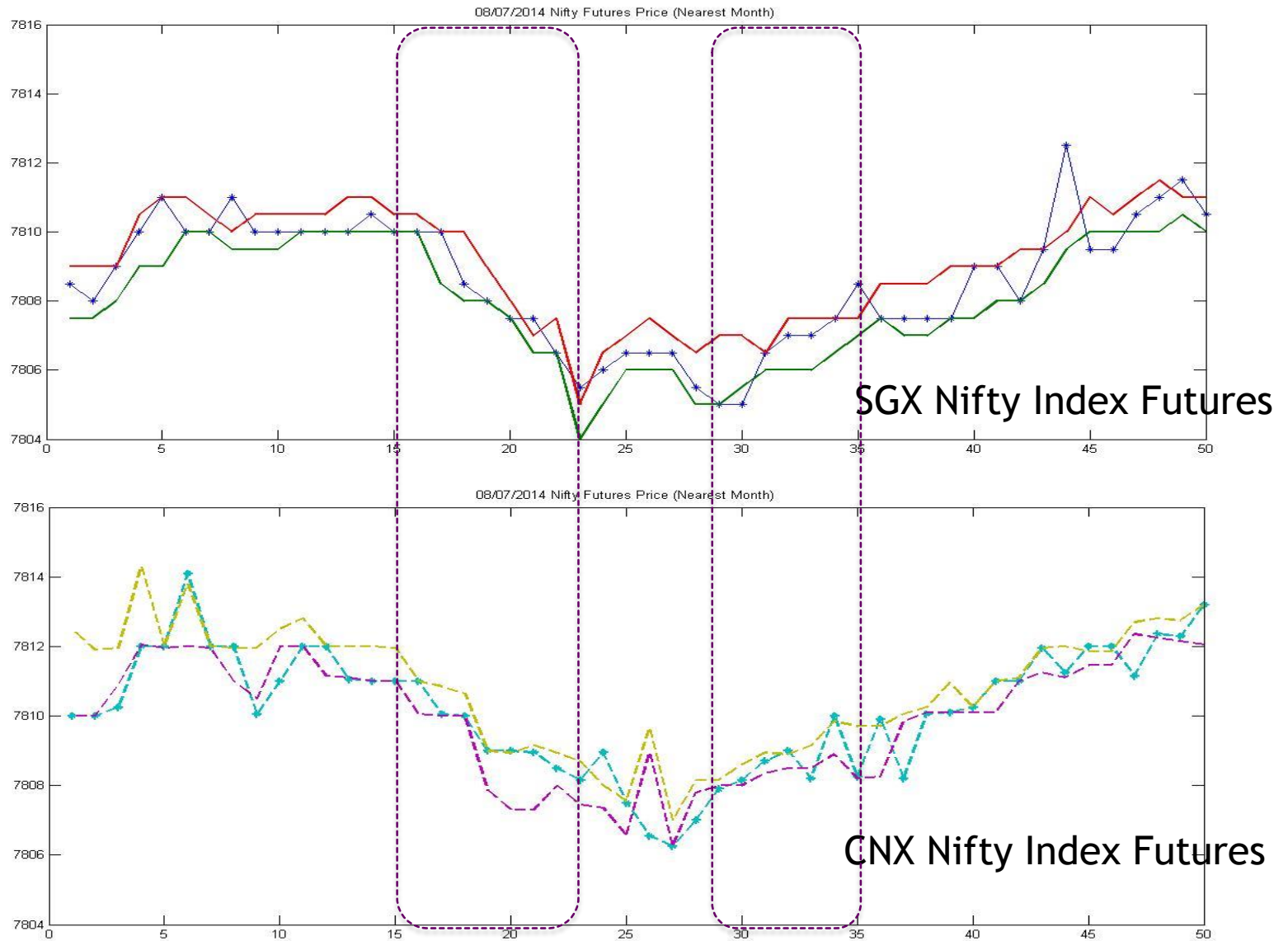
Data

- ▶ Tick by tick data from Bloomberg : 2014 Jul - 2015 Jan
- ▶ 1 second time interval.
 - ▶ Latest price for each second used if duplicated
 - ▶ Previous one second used if no price on a given second
- ▶ Most informative: Transaction, Bid, Ask prices are treated differently for each futures contract within the same market.
- ▶ We remove the time if the futures are not tradable in either of two markets.

Day Movement



50 Sec Movement



Lot Sizes

CNX Nifty Index	Lot Sizes					Lot Ratios
	≤2	3 to 5	6 to 10	11 to 20	>20	
SGX	27.92%	18.55%	15.47%	14.28%	23.79%	1.00
NSE	59.11%	20.87%	9.94%	5.79%	4.28%	0.21
A50 / CSI300	≤2	3 to 5	6 to 10	11 to 20	>20	Ratios
SGX	41.73%	23.45%	17.52%	10.62%	6.69%	1.00
CFFE	0.00%	0.00%	0.00%	3.30%	96.70%	15.68
Nikkei 225 Index	≤2	3 to 5	6 to 10	11 to 20	>20	Ratios
SGX	73.31%	17.28%	6.51%	1.99%	0.92%	1.00
OSE	42.28%	18.63%	17.27%	9.60%	12.21%	2.00
Taiex / MSCI Taiwan Index	≤2	3 to 5	6 to 10	11 to 20	>20	Ratios
SGX	76.97%	16.77%	4.75%	0.98%	0.53%	1.00
TFE	58.06%	16.57%	15.86%	6.14%	3.38%	1.76

Methodology

Hasbrouck (1995), Lien and Shrestha (2009)

- ▶ Assume each price is I(1):

$$\Delta p_t = \Phi(L)e_t$$

- ▶ Assume that the prices are cointegrated:

$$\text{Define : } \beta' = [\tau_{n-1}, -I_{n-1}]$$

$$\text{s.t. : } \beta' p_t = \textit{stationary}$$

Methodology

- ▶ Estimate a VECM:

$$\Delta p_t = \alpha(\beta' p_{t-1} - \mu) + \Gamma_1 \Delta p_{t-1} + \Gamma_2 \Delta p_{t-2} + \dots + \Gamma_K \Delta p_{t-K} + e_t$$

- ▶ Use the VECM to estimate VAR and VMA

$$\Delta p_t = \Phi(L)e_t$$

- ▶ Estimate Information Share:

$$S_j = \frac{\phi_j^2 \Sigma_{jj}}{\phi \Sigma \phi'}$$

Information Share

	Nifty (SGX)	CNX Nifty(NSE)	Difference
Mean	63%	37%	26%
S.D.	2.51%	2.51%	0.00%
Obs	118	118	
	A50 (SGX)	CSI300(CFFEX)	Difference
Mean	21%	79%	-58%
S.D.	2.10%	2.10%	0.00%
Obs	118	118	
	N225 (SGX)	N225 (OSE)	Difference
Mean	62%	38%	24%
S.D.	1.92%	1.92%	0.00%
Obs	94	94	
	MSCI TAIEX (SGX)	TAIEX (TAIFEX)	Difference
Mean	25%	75%	-50%
S.D.	2.21%	2.21%	0.00%
Obs	125	125	

Determinants of IS

SGXIS	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lag SGXIS	0.135***	0.117***	0.137***	0.136***	0.133***	0.132***	0.114***
	(3.38)	(2.89)	(3.45)	(3.44)	(3.38)	(3.29)	(2.85)
Spread Ratio		-0.033***					-
		(-3.07)					0.032***
							(-2.76)
Volatility Ratio							-
			-0.121***				0.120***
			(-2.78)				(-2.62)
Depth Ratio				-0.007			-0.008
				(-1.32)			(-1.16)
Volume Ratio					0.022		0.046
					(0.41)		(0.71)
Order Imbalance Ratio							
						0.001**	0.001***
						(2.36)	(2.63)

Portfolio Strategy

Assume Information Shares: $SGX < \text{Foreign}$, i.e. SGX follows Foreign



Compare the price of index futures in SGX and that in foreign

T-1

Long/Short in Lag Market

Long futures in SGX if the price is lower than the price in Foreign ;

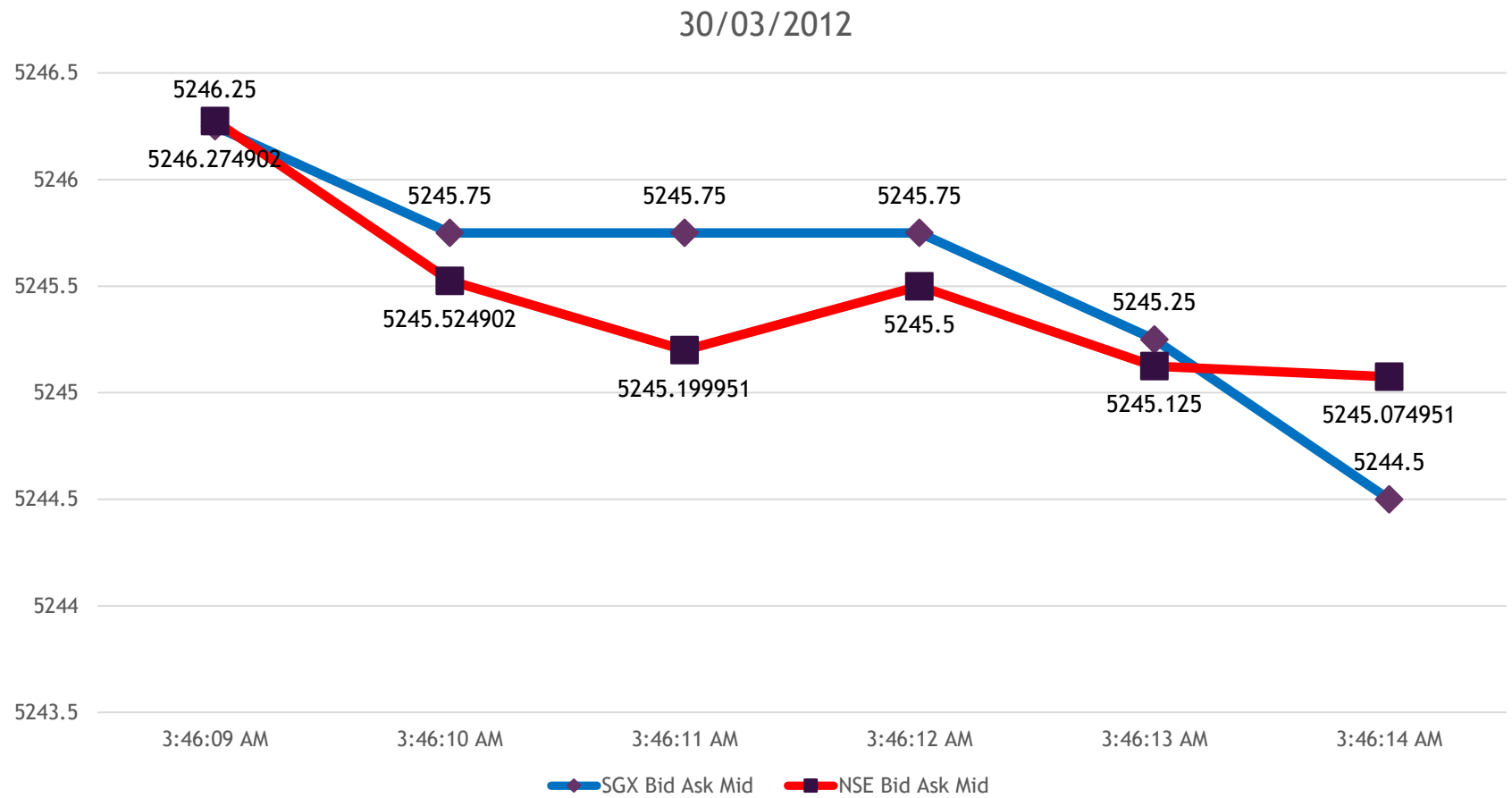
Short futures in SGX if the price is higher than the price in Foreign

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Close the Long/Short position

Past IS = 0.12 (SGX follows NSE)

Example



Example

Past IS = 0.12 (SGX follows NSE)

TIME	SGX Bid Ask Mid	NSE Bid Ask Mid	SIGNAL	TIME	SGX Nifty(t+1) FP	TIME	SGX Nifty(t+2) FP	Profit SGX->NSE
3:46:09 AM	5246.25	5246.275	1	34609.38	5246.25	34610.38	5245.75	-0.5
3:46:10 AM	5245.75	5245.525	-1	34610.38	5245.75	34611.35	5245.75	0
3:46:11 AM	5245.75	5245.2	-1	34611.35	5245.75	34612.38	5245.25	0.5
3:46:12 AM	5245.75	5245.5	-1	34612.38	5245.25	34613.38	5244.5	0.75
3:46:13 AM	5245.25	5245.125	-1	34613.38	5244.5	34614.38	5243.25	1.25
3:46:14 AM	5244.5	5245.075	1	34614.38	5243.25	34615.4	5242.5	-0.75

Portfolio Result

	Random Walk (1 min)			
	CHINA	INDIA	JAPAN	TAIWAN
Total number of trades	268	373	373	297
Average Daily Dollar Profits	27	7	50	2
Average Daily Returns	0.49%	0.09%	0.29%	0.61%
Return Volatility	2.82%	0.69%	0.92%	0.67%
Return Skewness	-3.207	-0.495	-0.567	-0.361
Return Kurtosis	21.019	3.733	3.999	3.359
Max Trade Drawdown	-91	-43	-140	-10
Max Daily Drawdown	-1830	-185	-428	-4
Sharpe Ratio	0.174	0.128	0.318	0.909

Conclusions

- ▶ Price discovery happened in
 - ▶ Domestic market: CSI 300 (CFFEX), TAIEX (TAIFEX)
 - ▶ Foreign market : Nifty (SGX), Nikkei (SGX)
- ▶ Information Share is sticky. Smaller spread, lower volatility and higher order imbalance contribute to the information share.
- ▶ Evidence of profitability when trading on the lagged market, when lead market has more information share.