Price Discovery of Indexes Futures across Markets

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16 December 2016

7th Emerging Markets Finance Conference, 2016

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

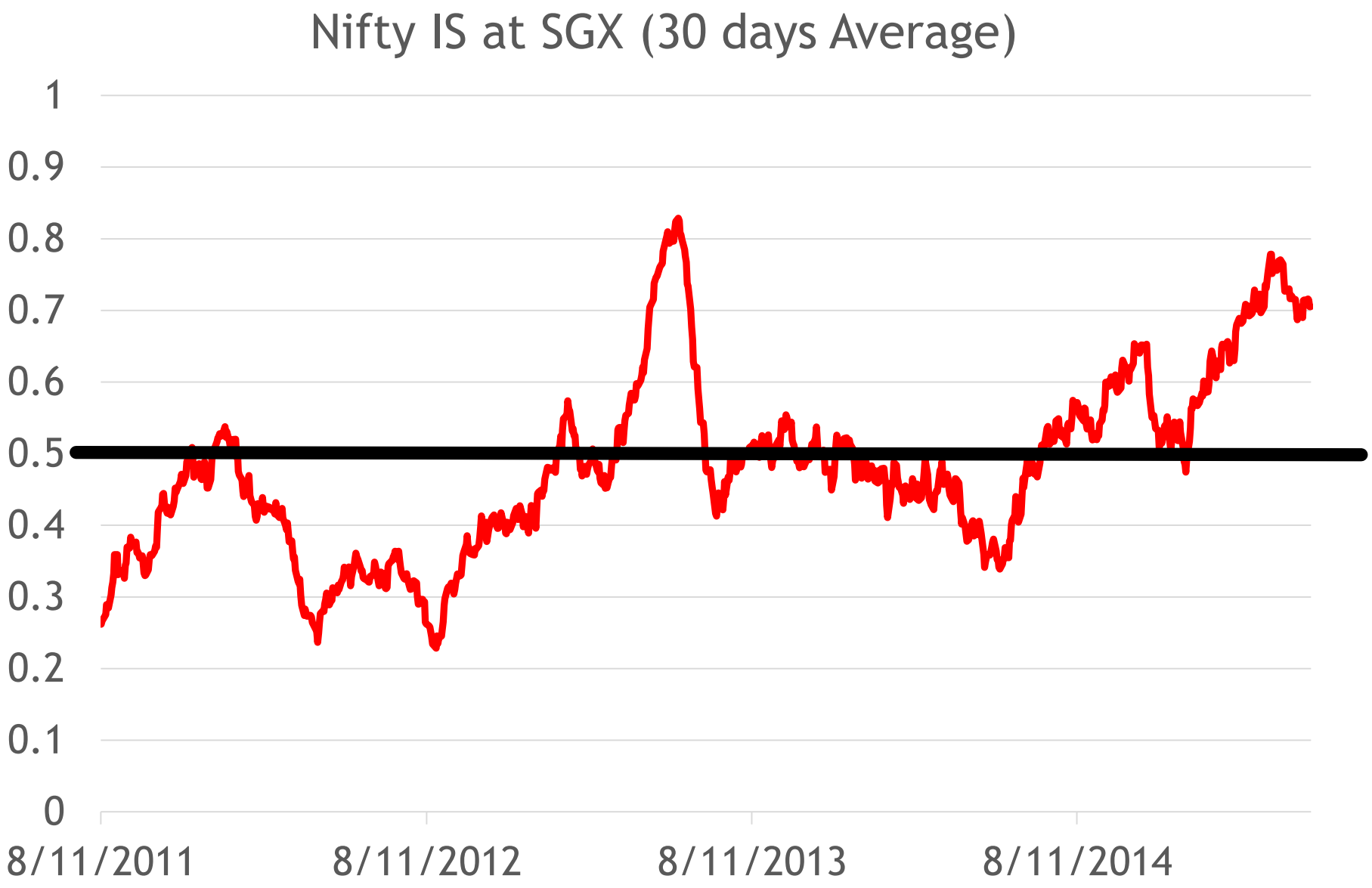
- One index, two markets
  - Same/Similar underlying
  - Different market structure

  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)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8/11/2011
8/11/2012
8/11/2013
8/11/2014

Why SGX

- SGX is Asia's largest offshore futures market
- SGX offers Asia's broadest rage 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.

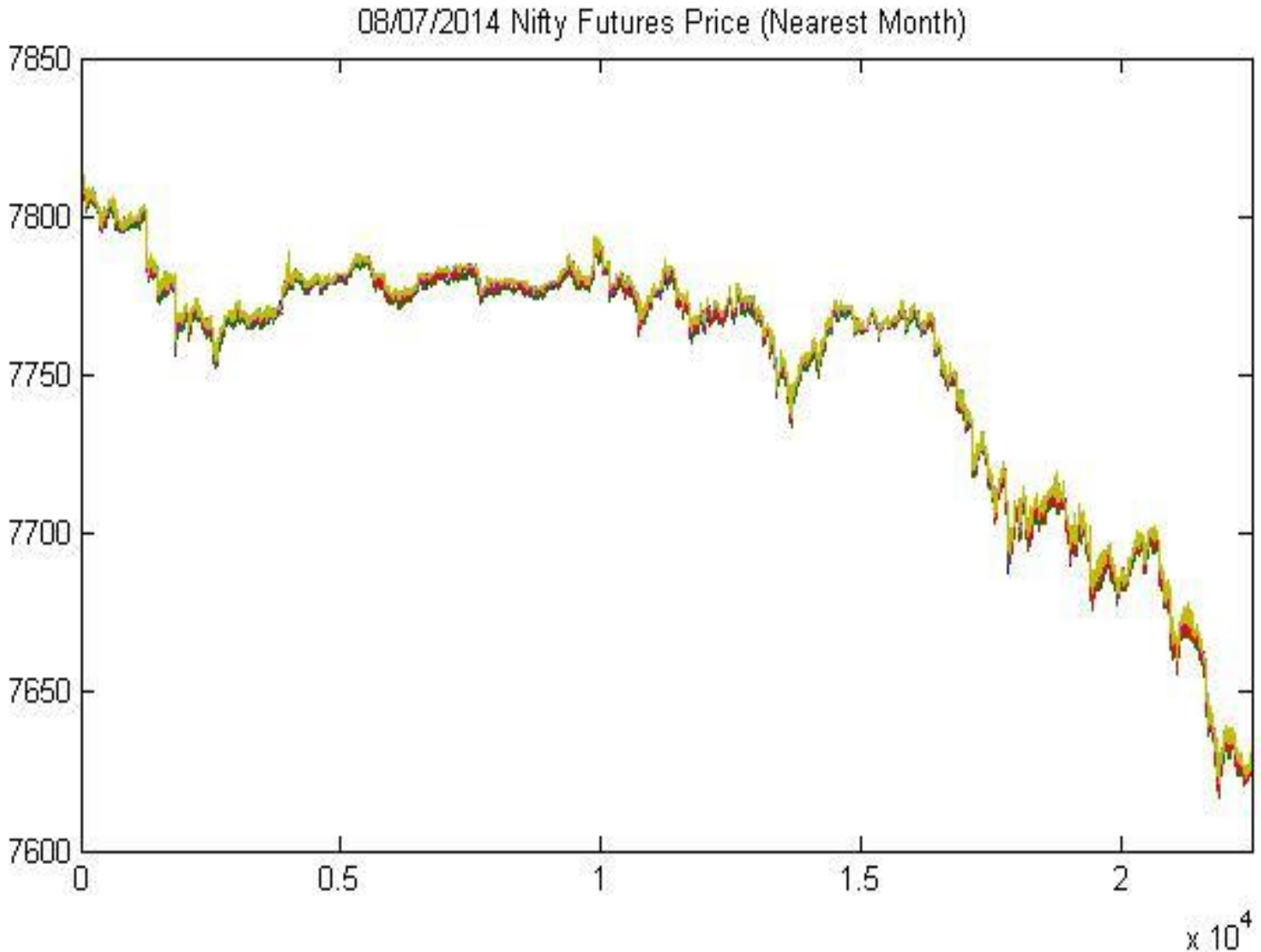
Exchange	**OSE**		**SGX**		**NSE**		**SGX**	
Underlying	Nikkei225 Index		Nikkei225 Index		Nifty Index		Nifty Index	
Multiplier	Y1000		Y500		Rs. 25		USD 2	
Trading Hours	**Regular Session**	**09:00-15:10**	**Opening**	**08:45-15:25**	**Normal Market**	**09:15-15:30**	**Opening**	**06:30-15:40**

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		

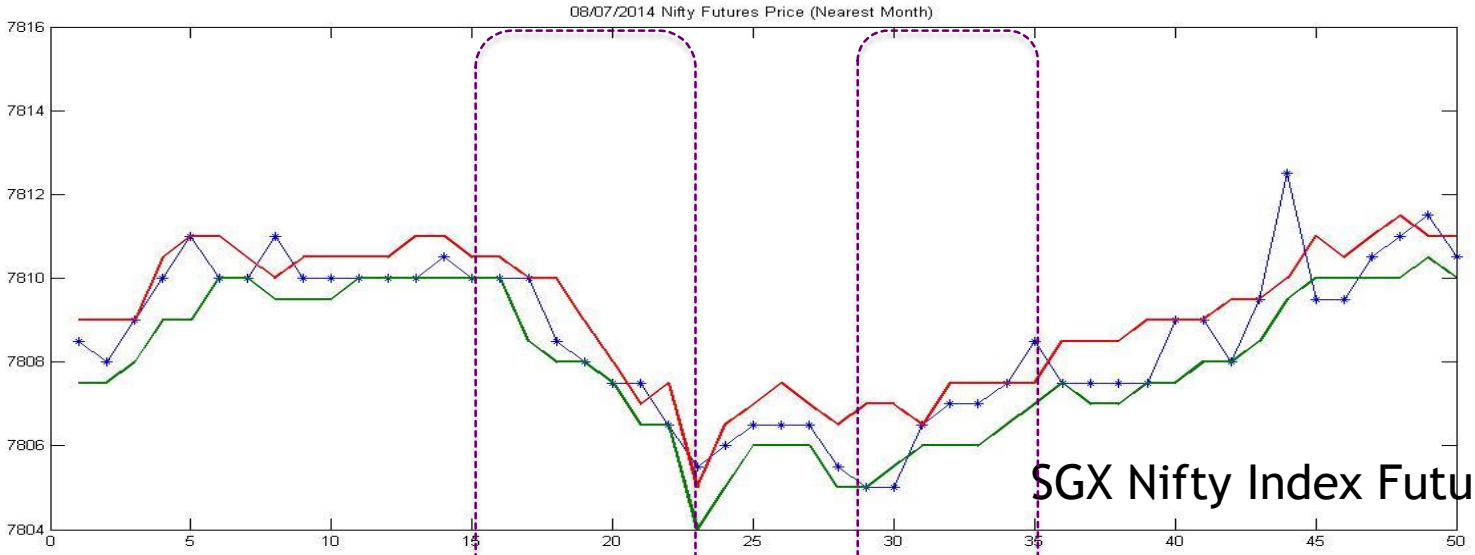
Data

- 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.

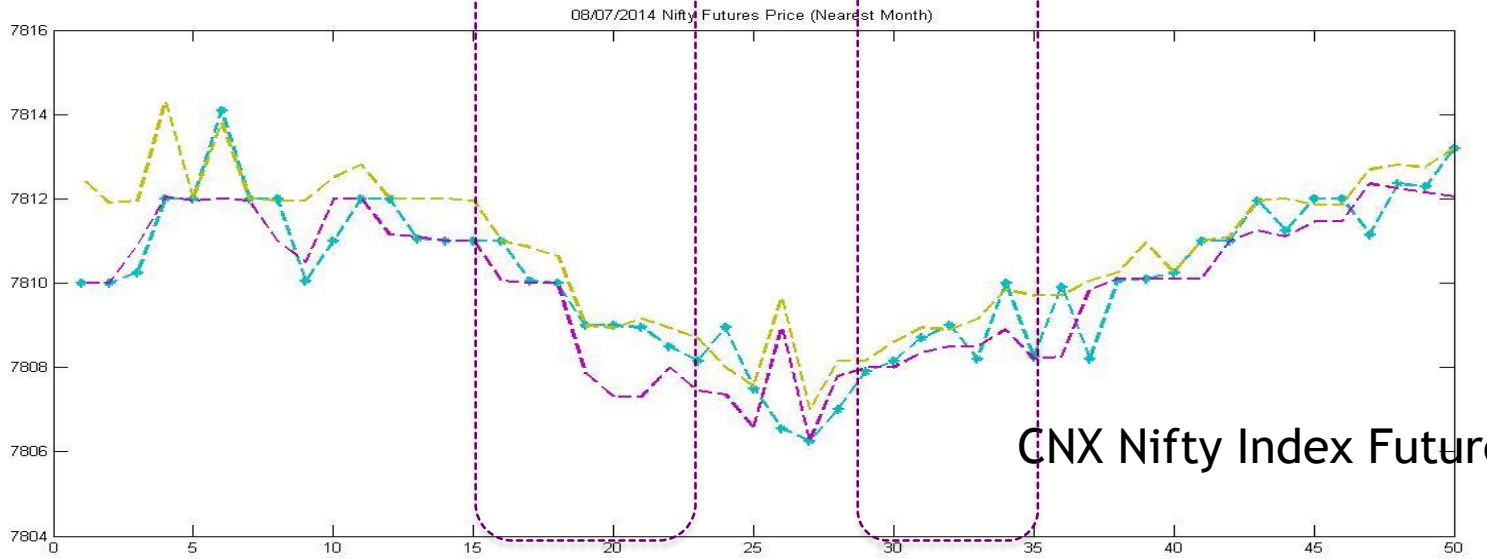
Day Movement



50 Sec Movement



SGX Nifty Index Futures



CNX Nifty Index Futures

Lot Sizes

	Lot Sizes					
CNX Nifty Index	≤2	3 to 5	6 to 10	11 to 20	>20	Lot Ratios
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:

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

$$s.t. : \beta' p_t = stationary$$

Methodology

- Estimate a VECM:

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

- 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***					-0.032***
		(-3.07)					(-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<Foreign, i.e. SGX follows Foreign

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

T-1

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

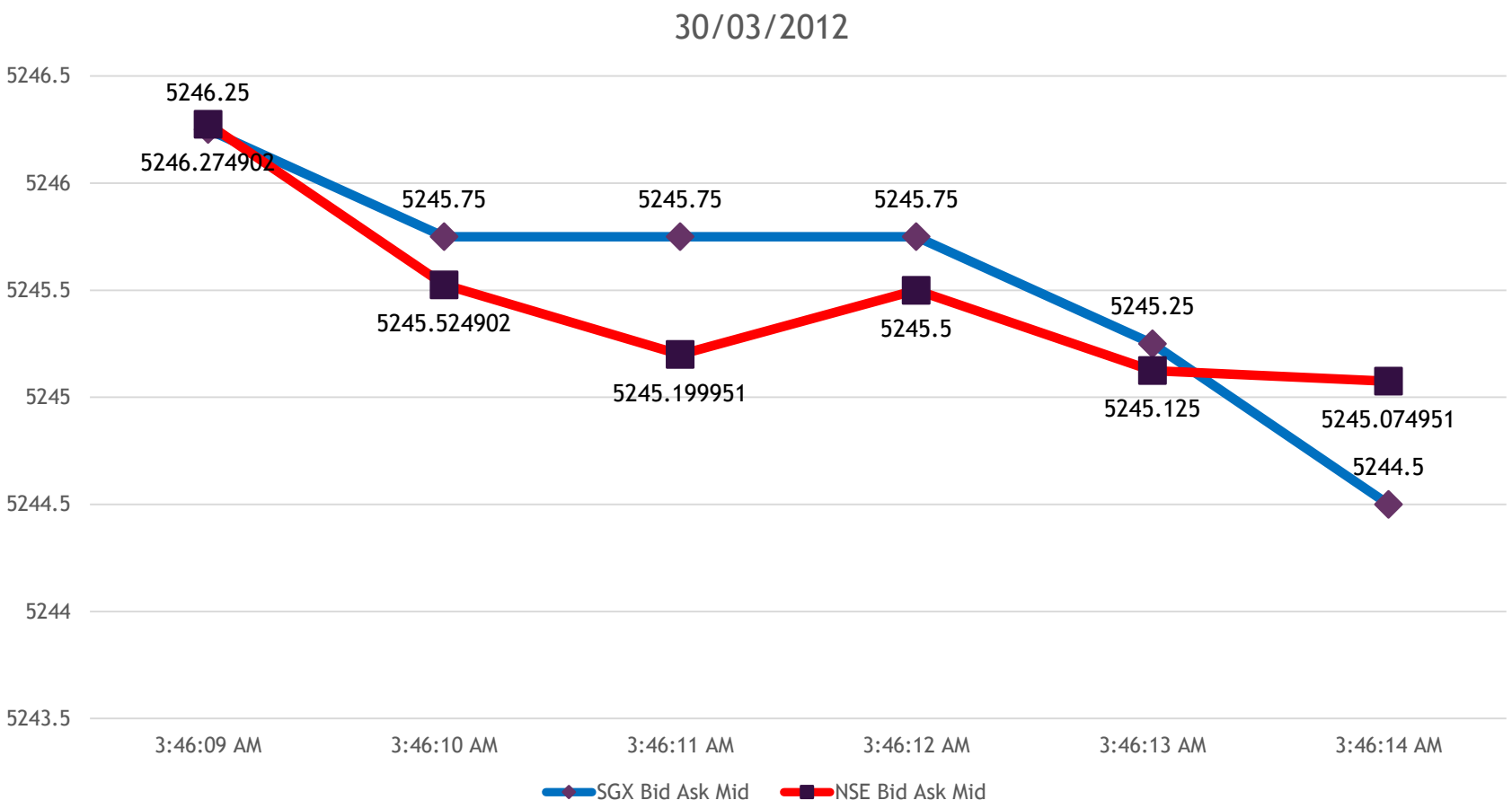
Long/Short in Lag Market

T

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.