

Graduate School of Development Economics

### Determinants of Return and Volatility Spillovers in the International Equity Markets

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Yuthana Sethapramote, Ph.D. Graduate School of Development Economics National Institute of Development Administration,

## **Topics of Presentation**



Introduction and literature reviews

How to measure return and volatility spillovers

Empirical estimation of return and volatility spillovers

Determinants of Spillovers in International Financial Markets

Yuthana Sethapramote, Ph.D.,

### Introduction



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The spread of market turbulence from one country to the others are frequently occurred in international financial market, e.g. the ERM crisis(1992); the East Asian crisis (1997); the Brazilian Crisis (1999); the US subprime crisis (2007); the eurozone debt crisis (2010)

Therefore, spillover measures provide important information for monitoring the risk of financial crisis over time & provide crucial information for explaining contagion mechanism.

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## Literature Review



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Previous empirical studies apply the correlation coefficients to investigate market interdependent. The results typically conclude the existent of spillovers among markets.

Shinagawa (2014) uses the dynamic correlation to investigate determinants of financial market spillover and finds that the amount of portfolio exposure in another countries and the degree of home bias are the main factors that determined the financial market spillover.

However, strong linkages between countries are not necessarily implied financial contagion. Therefore, correlations should be applied in the study of the determinants of market "interdependence", not "spillovers"

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## Literature Review



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Recently, Diebold and Yilmaz (2009, 2012) propose the spillover index constructed from the variance decomposition of the Vector AutoRegression (VAR) models.

Since then, many empirical studies apply their methodology to investigate the spillovers among the international financial markets (e.g. McMillan and Speight, 2010; Zhou et al, 2012) and among several asset classes (e.g. Cronin, 2014).

Those empirical results provide supportive evidence for the application of Diebold-Yilmaz indices in explains timing and magnitude of financial contagion in the international financial markets.

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# **Research Question**



#### Research Question?

• What is determinants factors of spillovers given by each country?



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• What is determinants factors of spillovers received by each country?

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# How to measure spillovers?



Diebold and Yilmaz (2009) proposed a quantitative measure of spillovers based on the information from Variance
 Decomposition (VD) of forecast error associated with the *N*-variables Vector AutoRegressive (VAR) model

Cholesky decomposition and the generalized VAR framework of Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998) (KPPS, henceforth) are used to calculate Variance Decomposition.

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# How to measure spillovers?



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The econometric methodology of Diebold and Yilmaz (2009, 2012) can be summarized as follows

Consider the simple case of the standard the p-lag N-variable stationary VAR model,

$$X_t = \Phi_1 X_{t-1} + \dots + \Phi_p X_{t-p} + Bc + \varepsilon_t$$

where  $X_t = \{X_{1,t}, X_{2,t}, \dots, X_{N,t}\}$  is a matrix of endogenous variables

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# How to measure spillovers?



□ The VDs  $(\theta_{i,j}(H))$  represent the contribution of a one-standard deviation shock of  $X_j$  to the variance of the *H*-step ahead forecast error of  $X_i$ .

The key difference of the VDs computed from the generalized method of KPPS and that of Chaloski factorization is that the sum of the contribution to the variance of the forecast error in the KPPS method is not necessarily equal to one.

Therefore, Diebold and Yilmaz (2012) suggest normalizing the VD by the row sum

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# Spillover Index



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The total spillover index that measures the contribution of spillovers across N variables to total forecast error variances is then calculated as follow,

$$TS(H) = \frac{\sum_{i,j=1,i\neq j}^{N} \widetilde{\theta}_{i,j}(H)}{\sum_{i,j=1}^{N} \widetilde{\theta}_{i,j}(H)} \times 100 = \frac{\sum_{i,j=1,i\neq j}^{N} \widetilde{\theta}_{i,j}(H)}{N} \times 100$$

□ where  $\tilde{\theta}_{i,j}(H)$  represent variance decomposition the contribution of a one-standard deviation shock of  $X_j$  to the variance of the Hstep ahead forecast error of  $X_i$ .

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# Spillover Index



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□ The directional spillovers gauge the direction spillovers GIVEN by country i to all other countries j  $(DS_{i\rightarrow}.(H))$ 

$$DS_{i \to \cdot}(H) = \frac{\sum_{j=1, j \neq i}^{N} \tilde{\theta}_{j,i}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{j,i}(H)} \times 100 = \frac{\sum_{j=1, j \neq i}^{N} \tilde{\theta}_{j,i}(H)}{N} \times 100$$

The amounts of spillovers RECEIVED by country i from all other countries j  $(DS_{\rightarrow i}(H))$  can be measured by

$$DS_{\to i}(H) = \frac{\sum_{j=1, j\neq i}^{N} \tilde{\theta}_{i,j}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{i,j}(H)} \times 100 = \frac{\sum_{j=1, j\neq i}^{N} \tilde{\theta}_{i,j}(H)}{N} \times 100$$

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# Spillover Index



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- Specifically, the directional spillover indices separate the total spillover into those coming from (or to) a particular source.
- Diebold and Yilmaz (2012) also introduce the net spillovers and net pairwise spillovers indices. However, our paper will focus on the total spillovers as the indicators of global financial conditions and the directional spillovers for investigating the determinants of spillovers in both directions.

### Data



Country	Abbreviation	Equity market index
The United States	U.S.	S&P500
The United Kingdom	U.K.	Ftse 100 Index (UKX)
France	FRA	Cac 40 Index (CAC)
Germany	GER	Deutsche Boerse Ag German Stock Index Dax (DAX)
Hong Kong	HKG	Hong Kong Hang Seng Index (HIS)
Japan	JPN	Nikkei 225 Index (NKY)
Australia	AUS	Australian Stock Exchange All Ordinaries Index (AS30)
Indonesia	IDN	Jakarta Stock Exchange Composite Index (JCI)
Korea	KOR	Korea Stock Exchange Kospi Index (KOSPI)
Malaysia	MYS	KLSE composite
Philippines	PHL	Philippines Stock Exchange Ps Ei Index (PCOMP)
Singapore	SGP	MSCI – Singapore
Taiwan	TAI	Taiwan Stock Exchange Weighted Index (TWSE)
Thailand	THA	SET index
Argentina	ARG	Buenos Aires Stock Exchange Merval Index (MERVAL)
Brazil	BRA	Bovespa Index
Chile	CHL	Santiago Stock Exchange Ipsa Index (IPSA)
Mexico	MEX	Mexican Stock Exchange Mexican Bolsa Ipc Index (MEXBOL)
Turkey	TUR	Borsa Istanbul 100 (XU100)

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## **Descriptive Statistics**



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Panel A	Panel A. Returns of International Equity Markets																		
	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR
Mean	0.07	0.04	0.03	0.07	0.08	-0.03	0.05	0.10	0.03	0.04	0.07	0.03	-0.04	0.02	0.21	0.60	0.15	0.12	0.32
Med	0.07	0.00	0.00	0.11	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13	0.03
Max	27.61	23.65	26.70	27.21	43.46	33.35	15.29	33.08	28.44	52.46	40.77	27.65	19.10	28.60	66.00	174.67	29.74	44.96	44.79
Min	-23.86	-23.35	-23.87	-22.36	-37.13	-30.52	-19.00	-32.08	-32.27	-60.87	-32.98	-24.78	-24.47	-43.82	-190.8	-174.7	-19.32	-54.83	-50.35
Std.D	2.83	2.78	3.48	3.57	4.00	3.78	2.16	3.69	4.17	3.28	3.68	3.11	4.06	4.08	6.90	10.89	2.86	4.60	6.60
Skew	-0.24	-0.13	-0.03	-0.12	0.00	-0.13	-0.37	-0.07	-0.23	0.34	0.18	-0.05	-0.25	-0.18	-2.67	0.76	0.21	-0.10	0.02
Kur	9.17	6.48	4.76	4.87	10.12	5.78	5.87	9.96	4.81	50.86	9.27	6.99	3.40	8.74	97.23	113.87	6.64	12.23	4.52
Obs.	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521	6,521
	Panel B. Volatilities of International Equity Markets																		
Panel B	. Volatili	ties of In	ternation	al Equity	y Markets	5													
Panel B	. Volatili US	ties of In UK	ternation FRA	al Equity GER	y Markets HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR
Panel B Mean	. Volatilit US 15.59	ties of Int UK 15.59	ternation FRA 20.03	al Equity GER 20.22	y <mark>Market</mark> s HKG 22.39	JPN 22.18	AUS 12.58	IDN 21.11	KOR 23.88	MYS 16.58	PHL 21.80	SGP 17.64	TAI 23.30	THA 23.92	ARG 36.51	BRA 58.16	CHL 16.47	MEX 25.78	TUR 38.71
Panel B Mean Med	. Volatilit US 15.59 13.66	ties of In UK 15.59 13.83	ternation FRA 20.03 18.42	al Equity GER 20.22 18.19	v Markets HKG 22.39 19.45	5 JPN 22.18 20.89	AUS 12.58 11.67	IDN 21.11 18.62	KOR 23.88 20.77	MYS 16.58 13.54	PHL 21.80 19.96	SGP 17.64 15.55	TAI 23.30 21.09	THA 23.92 21.66	ARG 36.51 30.58	BRA 58.16 43.66	CHL 16.47 15.05	MEX 25.78 23.06	TUR 38.71 35.49
Panel B Mean Med Max	. Volatili US 15.59 13.66 74.27	ties of Int UK 15.59 13.83 72.28	ternation FRA 20.03 18.42 71.77	al Equity GER 20.22 18.19 70.47	V Markets HKG 22.39 19.45 98.87	<ul> <li>JPN</li> <li>22.18</li> <li>20.89</li> <li>90.52</li> </ul>	AUS 12.58 11.67 49.13	IDN 21.11 18.62 77.33	KOR 23.88 20.77 84.23	MYS 16.58 13.54 153.42	PHL 21.80 19.96 74.74	SGP 17.64 15.55 83.27	TAI 23.30 21.09 84.44	THA 23.92 21.66 158.22	ARG 36.51 30.58 354.11	BRA 58.16 43.66 512.20	CHL 16.47 15.05 72.48	MEX 25.78 23.06 123.49	TUR 38.71 35.49 127.40
Panel B Mean Med Max Min	<b>Volatilit</b> US 15.59 13.66 74.27 5.19	ties of Int UK 15.59 13.83 72.28 6.30	ternation FRA 20.03 18.42 71.77 9.42	al Equity GER 20.22 18.19 70.47 8.22	<ul> <li>Markets</li> <li>HKG</li> <li>22.39</li> <li>19.45</li> <li>98.87</li> <li>9.42</li> </ul>	<ul> <li>JPN</li> <li>22.18</li> <li>20.89</li> <li>90.52</li> <li>8.96</li> </ul>	AUS 12.58 11.67 49.13 5.56	IDN 21.11 18.62 77.33 5.78	KOR 23.88 20.77 84.23 8.12	MYS 16.58 13.54 153.42 4.31	PHL 21.80 19.96 74.74 9.16	SGP 17.64 15.55 83.27 5.64	TAI 23.30 21.09 84.44 8.22	THA 23.92 21.66 158.22 9.34	ARG 36.51 30.58 354.11 13.98	BRA 58.16 43.66 512.20 17.41	CHL 16.47 15.05 72.48 5.81	MEX 25.78 23.06 123.49 10.73	TUR 38.71 35.49 127.40 13.34
Panel B Mean Med Max Min Std.D	<ul> <li>Volatilit</li> <li>US</li> <li>15.59</li> <li>13.66</li> <li>74.27</li> <li>5.19</li> <li>7.42</li> </ul>	ties of Int UK 15.59 13.83 72.28 6.30 6.84	ternation FRA 20.03 18.42 71.77 9.42 7.41	al Equity GER 20.22 18.19 70.47 8.22 8.59	<ul> <li>Markets</li> <li>HKG</li> <li>22.39</li> <li>19.45</li> <li>98.87</li> <li>9.42</li> <li>9.73</li> </ul>	<ul> <li>JPN</li> <li>22.18</li> <li>20.89</li> <li>90.52</li> <li>8.96</li> <li>7.58</li> </ul>	AUS 12.58 11.67 49.13 5.56 4.54	IDN 21.11 18.62 77.33 5.78 9.96	KOR 23.88 20.77 84.23 8.12 11.15	MYS 16.58 13.54 153.42 4.31 11.12	PHL 21.80 19.96 74.74 9.16 7.73	SGP 17.64 15.55 83.27 5.64 8.24	TAI 23.30 21.09 84.44 8.22 10.50	THA 23.92 21.66 158.22 9.34 9.80	ARG 36.51 30.58 354.11 13.98 19.94	BRA 58.16 43.66 512.20 17.41 48.66	CHL 16.47 15.05 72.48 5.81 6.51	MEX 25.78 23.06 123.49 10.73 11.03	TUR 38.71 35.49 127.40 13.34 15.60
Panel B Mean Med Max Min Std.D Skew	Volatilit US 15.59 13.66 74.27 5.19 7.42 2.53	ties of Int UK 15.59 13.83 72.28 6.30 6.84 2.30	ternation FRA 20.03 18.42 71.77 9.42 7.41 1.92	al Equity GER 20.22 18.19 70.47 8.22 8.59 1.72	<ul> <li>Markets</li> <li>HKG</li> <li>22.39</li> <li>19.45</li> <li>98.87</li> <li>9.42</li> <li>9.73</li> <li>2.23</li> </ul>	<ul> <li>JPN</li> <li>22.18</li> <li>20.89</li> <li>90.52</li> <li>8.96</li> <li>7.58</li> <li>2.17</li> </ul>	AUS 12.58 11.67 49.13 5.56 4.54 2.39	IDN 21.11 18.62 77.33 5.78 9.96 1.72	KOR 23.88 20.77 84.23 8.12 11.15 1.45	MYS 16.58 13.54 153.42 4.31 11.12 3.54	PHL 21.80 19.96 74.74 9.16 7.73 1.57	SGP 17.64 15.55 83.27 5.64 8.24 1.86	TAI 23.30 21.09 84.44 8.22 10.50 2.00	THA 23.92 21.66 158.22 9.34 9.80 2.68	ARG 36.51 30.58 354.11 13.98 19.94 4.76	BRA 58.16 43.66 512.20 17.41 48.66 4.06	CHL 16.47 15.05 72.48 5.81 6.51 2.03	MEX 25.78 23.06 123.49 10.73 11.03 2.75	TUR 38.71 35.49 127.40 13.34 15.60 1.22
Panel B Mean Med Max Min Std.D Skew Kur	<ul> <li>Volatilit</li> <li>US</li> <li>15.59</li> <li>13.66</li> <li>74.27</li> <li>5.19</li> <li>7.42</li> <li>2.53</li> <li>10.87</li> </ul>	ties of Int UK 15.59 13.83 72.28 6.30 6.84 2.30 9.06	ternation FRA 20.03 18.42 71.77 9.42 7.41 1.92 5.47	al Equity GER 20.22 18.19 70.47 8.22 8.59 1.72 3.76	<ul> <li>Markets</li> <li>HKG</li> <li>22.39</li> <li>19.45</li> <li>98.87</li> <li>9.42</li> <li>9.73</li> <li>2.23</li> <li>8.57</li> </ul>	<ul> <li>JPN</li> <li>22.18</li> <li>20.89</li> <li>90.52</li> <li>8.96</li> <li>7.58</li> <li>2.17</li> <li>10.27</li> </ul>	AUS 12.58 11.67 49.13 5.56 4.54 2.39 10.62	IDN 21.11 18.62 77.33 5.78 9.96 1.72 4.02	KOR 23.88 20.77 84.23 8.12 11.15 1.45 2.77	MYS 16.58 13.54 153.42 4.31 11.12 3.54 23.21	PHL 21.80 19.96 74.74 9.16 7.73 1.57 3.36	SGP 17.64 15.55 83.27 5.64 8.24 1.86 6.14	TAI 23.30 21.09 84.44 8.22 10.50 2.00 6.04	THA 23.92 21.66 158.22 9.34 9.80 2.68 17.90	ARG 36.51 30.58 354.11 13.98 19.94 4.76 47.51	BRA 58.16 43.66 512.20 17.41 48.66 4.06 20.75	CHL 16.47 15.05 72.48 5.81 6.51 2.03 7.38	MEX 25.78 23.06 123.49 10.73 11.03 2.75 11.98	TUR 38.71 35.49 127.40 13.34 15.60 1.22 2.03

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# Return Spillover Table



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Spillover Table, International Equity Market Returns: January 1990 – December 2014

											Fr	om								
То	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR	Contribution from others
US	22.6	7.6	7.7	8.3	1.5	1.2	0.1	0.3	1.0	0.2	0.3	1.8	0.5	0.7	3.5	2.0	5.1	8.5	1.1	51
UK	7.0	20.6	13.3	11.0	2.4	2.0	0.1	0.8	1.3	0.6	0.3	2.4	0.5	1.2	2.1	1.1	3.6	4.8	1.5	56
FRA	6.6	13.0	20.0	13.7	2.1	1.9	0.1	0.7	1.0	0.4	0.2	2.2	0.7	1.0	2.1	1.1	3.4	4.5	1.4	56
GER	6.8	11.0	13.9	21.6	2.5	1.7	0.0	0.8	1.3	0.5	0.3	2.3	0.8	1.2	1.6	1.1	3.0	4.4	1.6	55
HKG	4.6	4.3	3.5	3.6	32.4	4.9	0.1	4.3	4.1	3.9	2.5	9.4	2.5	4.4	1.8	1.2	2.6	4.2	0.8	63
JPN	5.7	5.1	5.0	4.8	4.5	56.9	0.2	1.6	3.6	1.5	0.8	4.3	2.4	1.5	1.4	0.8	2.4	3.6	1.0	50
AUS	4.5	4.5	3.8	3.9	8.2	7.1	97.1	3.5	4.8	2.3	2.9	6.0	2.4	2.5	1.6	1.0	2.8	3.5	1.1	66
IDN	2.4	2.0	1.9	1.9	5.6	2.1	0.3	61.4	2.8	3.7	4.4	6.5	1.8	5.4	1.0	0.8	2.4	2.8	0.9	49
KOR	3.5	3.1	2.8	3.3	4.8	4.5	0.3	2.4	59.2	1.6	1.2	4.8	4.1	3.4	1.1	0.8	2.2	3.2	1.1	48
MYS	2.4	1.7	1.5	1.7	5.6	2.2	0.1	4.4	1.9	67.0	2.5	8.2	1.4	5.7	0.8	0.5	1.3	1.9	0.5	44
PHL	4.4	3.1	2.8	2.8	3.8	1.3	0.1	4.2	1.6	2.8	74.0	4.2	1.4	4.1	1.9	1.5	2.8	3.9	0.8	47
SGP	3.9	3.4	3.2	3.4	10.3	4.6	0.1	5.6	4.2	6.6	3.0	29.5	2.9	5.8	1.4	0.9	2.1	3.2	1.1	66
TAI	2.8	1.9	2.2	2.6	3.9	4.0	0.4	2.1	4.7	1.9	1.6	4.5	73.9	2.3	0.9	0.4	1.7	2.1	1.4	41
THA	2.2	2.2	2.0	2.3	5.7	2.1	0.4	5.1	3.7	5.5	3.5	6.9	1.8	55.4	1.2	0.8	2.0	2.3	1.5	51
ARG	3.6	2.9	3.0	2.3	0.9	0.4	0.1	0.4	0.6	0.2	0.4	1.1	0.2	0.7	63.4	3.1	5.3	5.6	0.6	31
BRA	2.3	1.5	1.6	1.6	0.8	0.3	0.0	0.2	0.4	0.2	0.6	0.7	0.1	0.4	3.6	75.5	4.1	4.1	0.5	23
CHL	4.8	4.3	4.2	3.6	1.6	0.7	0.2	0.7	1.1	0.4	0.7	1.6	0.6	1.1	4.9	3.4	44.5	7.0	1.0	42
MEX	8.1	5.4	5.3	5.2	2.0	1.1	0.1	0.6	1.3	0.5	0.6	1.9	0.5	1.2	5.0	3.3	6.9	28.4	1.2	50
TUR	2.0	2.4	2.3	2.6	1.3	1.1	0.2	1.1	1.5	0.5	0.5	1.8	1.5	1.9	0.8	0.8	1.5	1.9	80.9	26
Contribution to others	77	79	80	78	68	43	3	39	41	33	26	70	26	45	37	25	56	72	19	916
Contribution including own	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	Spillover index 48.2%

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# Volatility Spillover Table



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Spillover Table, International Equity Market Volatility: January 1990 – December 2014

											Fro	m								
То	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR	Contribution from others
US	19.7	4.0	6.0	6.4	2.9	3.6	0.6	8.4	2.6	0.9	8.4	1.0	1.1	1.0	5.1	0.5	3.7	4.6	7.1	68
UK	8.1	11.1	10.0	8.9	3.8	0.9	2.4	4.6	4.1	1.5	4.6	1.6	0.2	3.0	3.3	3.0	5.1	5.7	1.0	72
FRA	7.9	10.2	18.2	14.5	2.7	3.0	2.2	4.5	2.7	0.1	5.0	1.1	0.4	4.2	5.7	0.7	1.8	2.9	0.2	70
GER	7.5	10.5	17.3	21.7	1.1	1.5	0.6	3.5	1.4	0.1	3.7	0.8	0.5	1.9	6.0	0.1	1.4	4.2	1.3	63
HKG	1.7	1.2	0.3	1.0	28.8	0.1	3.1	0.4	1.4	11.6	9.1	22.3	8.4	0.7	0.3	8.3	1.5	5.5	6.6	84
JPN	9.3	4.1	4.3	3.8	2.0	54.6	4.2	2.0	5.1	1.2	4.9	1.1	0.8	2.7	1.0	2.3	2.8	4.4	5.2	61
AUS	2.1	0.3	0.4	0.7	9.7	1.8	48.4	0.5	4.3	4.7	12.4	7.5	2.5	2.7	1.0	7.3	1.9	8.8	5.0	74
IDN	8.2	2.7	2.5	1.5	1.0	3.5	7.4	60.6	5.5	5.2	0.5	1.7	5.2	1.3	1.0	0.7	2.4	1.2	4.2	56
KOR	2.7	2.0	0.9	0.8	4.3	6.7	1.4	1.9	43.2	1.0	1.7	0.9	6.8	1.4	4.8	9.8	7.1	3.4	2.7	60
MYS	0.4	6.7	2.0	1.9	3.8	3.8	7.1	0.6	1.5	29.7	1.7	4.5	0.4	4.7	1.8	6.6	5.0	9.1	1.0	63
PHL	3.2	8.1	3.8	3.4	1.7	3.8	1.3	0.2	6.9	4.6	23.2	1.6	2.2	7.9	0.8	4.2	12.6	5.7	1.2	73
SGP	2.1	5.0	4.2	3.8	8.5	1.4	1.5	1.8	0.7	13.0	4.7	24.3	2.5	2.8	2.9	6.3	3.8	7.5	3.1	76
TAI	6.0	2.3	5.6	5.3	8.3	6.0	0.8	0.6	1.2	2.4	3.6	7.5	46.8	0.5	3.3	4.5	2.1	3.2	5.6	69
THA	0.6	7.0	6.6	4.5	2.9	1.0	0.8	0.7	1.5	2.2	2.4	5.8	2.4	47.2	8.8	0.6	6.2	2.3	6.9	63
ARG	1.6	4.0	4.8	3.4	0.6	2.5	2.4	4.0	3.8	2.5	2.4	5.2	0.9	8.0	43.1	3.9	3.9	2.0	2.1	58
BRA	5.2	1.7	1.3	2.2	6.7	0.7	6.2	1.8	2.2	3.4	5.1	5.9	17.2	2.2	1.2	26.4	4.2	4.2	1.8	73
CHL	7.0	4.2	2.7	2.4	5.2	0.9	1.6	1.8	5.5	0.7	2.8	1.9	0.8	2.1	3.5	5.5	21.5	4.3	2.5	56
MEX	3.3	6.8	4.3	5.1	4.9	0.3	6.7	0.6	2.1	12.0	3.4	3.1	0.5	3.2	3.3	6.6	5.2	13.1	1.1	73
TUR	3.4	8.0	4.8	8.8	1.2	3.9	1.3	1.2	4.4	3.2	0.4	2.2	0.4	2.3	3.1	2.5	7.7	7.7	41.3	66
Contributio n to others	80	89	82	78	71	45	52	39	57	70	77	76	53	53	57	74	78	87	59	1277
Contributio n including own	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	Spillover index 67.2%

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#### Spillover Plot, International Equity Market Returns and Volatility: October 1990 – December 2014



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#### Directional return spillovers, RECEIVED from the others



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#### Directional return spillovers, GIVEN to the others



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#### Directional volatility spillovers, RECEIVED from the others





### Directional volatility spillovers, GIVEN to the others











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#### **International trade linkages**

- 1. the degree of openness
  - $Open_{i,t} = (Export_{i,t} + Import_{i,t})/GDP_{i,t}$

#### 2.the trade share in

• 
$$Share_{i,t} = \frac{Export_{i,t}}{Export_t^w}$$

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#### **Financial risks**

1. TED spread (TEDi,t) which defined as the difference between London Interbank Offered Rate (LIBORt) and each country's short term interest rate (ii,t);  $TED_{i,t} = LIBOR_t - i_{i,t}$ ,

2. the percentage change in foreign reserves ( $RES_{i,t}$ )

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#### **Global risk factors**

Volatility index from the US market  $(VIX_t)$ ,

#### Gold price $(GOLD_t)$

Crude oil price  $(OIL_t)$  to represent the global risk factor.

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## Economic Policy Coherence & Business Cycle Synchronization



The panel data regressions are used to estimate determinants of financial market spillover across market.

 $Ret_{R,i,t} = \alpha_1 + \beta_1 Open_{i,t} + \gamma_1 Share_{i,t} + \delta_1 TED_{i,t} + \theta_1 RES_{i,t} + \lambda_1 VIX_t + \rho_1 Gold_t + \tau_1 Oil_t + u_{1,i,t}$ 

 $Vol_{R,i,t} = \alpha_2 + \beta_2 Open_{i,t} + \gamma_2 Share_{i,t} + \delta_2 TED_{i,t} + \theta_2 RES_{i,t} + \lambda_2 VIX_t + \rho_2 Gold_t + \tau_2 Oil_t + u_{2,i,t}$ 

 $Ret_{G,i,t} = \alpha_3 + \beta_3 Open_{i,t} + \gamma_3 Share_{i,t} + \delta_3 TED_{i,t} + \theta_3 RES_{i,t} + \lambda_3 VIX_t + \rho_3 Gold_t + \tau_3 Oil_t + u_{3,i,t}$ 

 $Vol_{G,i,t} = \alpha_4 + \beta_4 Open_{i,t} + \gamma_4 Share_{i,t} + \delta_4 TED_{i,t} + \theta_4 RES_{i,t} + \lambda_4 VIX_t + \rho_4 Gold_t + \tau_4 Oil_t + u_{4,i,t}$ 

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#### **Summary of finding from panel regression**

	$Ret_R$		$Vol_R$		Ret <sub>G</sub>		$Vol_G$				
OPEN	0.0976	**	0.1100	***	-0.0763		-0.0494				
SHARE	0.0409	***	0.0018		0.0928	***	0.0632	***			
TED	0.0001	***	0.0001	***	0.0003	***	0.0002	***			
RES	0.2317		0.1167		0.1852		0.0980				
VIX	0.0330	***	0.0183	***	0.0333	***	0.0189	***			
GOLD	0.2533	***	0.1649	***	0.2625	***	0.1671	***			
OIL	0.4421	***	0.1860	***	0.4705	***	0.2239	***			
R-squared	0.5395		0.2604		0.4135		0.1747				

\*\*\*, \*\* and \* represent significance at 1%, 5% and 10%, respectively.

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Empirical Results: Panel Regression

#### Summary of finding from panel regression

#### 1. Trade intensity & Export share

- The degree of openness are positively significant at 5% level in the 'receive' direction for both return and volatility spillovers. Increasing contribution of exports and imports in domestic economy, rising chance that external shocks could affect to the financial markets in both returns and volatilities.
- Export share in world market is not significant for the "given" direction

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Empirical Results: Panel Regression

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#### **Summary of finding from panel regression**

### 1. Trade intensity & Export share

- For 'give' direction, we find the opposite results from those of 'receive' direction.
- The coefficients from degree of openness are negative but not statistically significant for both return and volatility. Nonetheless, the export share provides significant impact to both return and volatility spillovers.

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Empirical Results: Panel Regression

#### **Summary of finding from panel regression**

### 1. Trade intensity & Export share

• The spillovers spread more from countries with bigger share in world export values, while the level of openness has no significant effect in this case.

While Shinagawa (2014) cannot find relationship between trade linkage and financial market spillover in bilateral level, our results provide the evidence supporting the role of international trade linkages to the financial spillovers using directional spillovers.

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Empirical Results: Panel Regression WISDOM for Char

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#### **Summary of finding from panel regression**

#### 2. Financial risk factors

- Both return and volatility spillover increase when TED spread widen in either directional.
- Conversely, the results from the foreign reserves are not significant in every case.

These results show that the TED spread represent to country risk better than the foreign reserves.

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#### **Summary of finding from panel regression**

#### 3. Global risk factors

• VIX, Gold and Oil, are significantly able to explain the spillovers in every case. Moreover, magnitudes of their influence in each regression are also close to each other, for both return and volatility spillovers.

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Thank you