Common Cycles and Spillovers in International Equity Markets

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Motivation

- Rapid globalization has led to massive transformations in the international financial system
- Large literature on international stock market comovement, especially for:

  → Specific country groups

  → Contagion/crisis periods

- Important to understand the source of international stock market comovement

  → Common vs. country-specific factors

  → Macro vs. monetary policy vs. financial variables

- Understanding the extent of financial market connectedness and its underlying drivers is important towards:

  → proper management of domestic financial conditions

  → trilemma vs. dilemma debate

  → diversification strategy for portfolio management

This Paper

- Utilizes the Diebold and Yilmaz (2012) framework to measure connectedness in weekly global equity market returns

  → Spillover of shocks are investigated as a system

  → Provides information about the direction of spillovers

  Other approaches: correlation coefficients (King and Wadhwani, 1994; Forbes and Rigobon, 2002), multivariate ARCH and GARCH models (Hamao et al., 1990; Berben and Jansen, 2005), cointegration techniques (Kasa, 1992; Longin and Solnik, 1995).

- Extracts common cycles via dynamic factor models (DFM) and examine their role in driving spillovers

- Investigates the importance of macro/ monetary policy/ financial variables in explaining the movements of the common cycle using variance decompositions (VDCs) pre and post GFC

Related Literature

- **Stock market connectedness:** Diebold and Yilmaz (2009, 2012, 2014), Guimares-Filho and Hong (2016), IMF (2016)
- **Determinants of stock market comovement**: Flavin et al. (2002) Pretorius (2002); Dellas and Hess (2005); Sun and Psalida (2009); Kourestas (2011); Beine and Candelon (2011); Syllignakis and Hwang et al (2013); Shinagawa (2014); Narayan et al. (2014); Tsai (2017); Beirne et al. (2019)
- **Factor analysis of asset returns and macro-financial linkages:** Chinn and Forbes (2004); Ludvigson and Ng (2009); Abbritti et al. (2013); Bonciani and Ricci (2018); McKinnon (2019)
- **Global financial cycle and its drivers**: Rey (2013); Cerutti et al. (2017); Jorda et al. (2017); Habib and Venditti (2018, 2019); Converse et al. (2018); Miranda-Agrippino and Rey (2020, forthcoming); Aldasoro et al. (2020).

Measuring Connectedness

Following Diebold and Yilmaz (2012), we consider the following covariance stationary N-variable VAR(p):

$$X_t = \phi_1 X_{t-1} + ... + \phi_p X_{t-p} + \epsilon_t$$

which can be rewritten as:

$$X_t = \sum_{i=0}^{\infty} A_i \epsilon_{t-i}$$

where $\epsilon_t \sim (0, \Sigma)$, $A_i = \phi_1 A_{i-1} + \phi_2 A_{i-2} + ... + \phi_p A_{i-p}$, and A_0 is an identity matrix.

Forecast Error Variance Decomposition

Then, the H-step ahead forecast error variance decomposition can be written as:

$$\theta_{ij}(H) = \frac{\sigma_{ii}^{-1} \sum_{h=0}^{H-1} (e_i' A_h \sum e_j)^2}{\sum_{h=0}^{H-1} (e_i' A_h \sum A_h' e_i)}$$

where σ_{ii} is the standard deviation of the error term for the i^{th} equation and e_i is the $N \times 1$ selection vector.

We normalize each entry of the variance decomposition by the row sum:

$$\tilde{\theta}_{ij}(H) = \frac{\theta_{ij}(H)}{\sum_{j=1}^{N} \theta_{ij}(H)}$$

to ensure $\sum_{j=1}^{N} \tilde{\theta}_{ij}(H) = 1$ and $\sum_{i,j=1}^{N} \tilde{\theta}_{ij}(H) = N$.

Spillover Indices

Total Spillovers:

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

Directional Spillovers Received and Transmitted:

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

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

Net Spillovers:

$$NS(H) = DS_{i\rightarrow\cdot}(H) - DS_{\cdot\rightarrow i}(H).$$

Dynamic Factor Model

Similar to Miranda-Agrippino and Rey (2020), we let y_t be a series of N weekly demeaned stock returns with the following representation:

$$y_t = \Lambda_t F_t + \xi_t$$

The factors follow a VAR process of order p:

$$F_t = \phi_1 F_{t-1} + ... + \phi_p F_{t-p} + \varepsilon_t$$

with $\varepsilon_t \sim$ i.i.d. $N(0, Q)$.

Dynamic Factor Model (cont.)

The common component is partitioned into a global and several regional factors via imposing zero restrictions on Λ, ϕ_i and Q:

$$\begin{pmatrix} \Lambda_{1,g} & \Lambda_{1,r} & 0 & 0 & 0 \\ \Lambda_{2,g} & 0 & \Lambda_{2,r} & 0 & 0 \\ \Lambda_{3,g} & 0 & 0 & \Lambda_{3,r} & 0 \\ \Lambda_{4,g} & 0 & 0 & 0 & \Lambda_{4,r} \end{pmatrix} \begin{pmatrix} f_t^g \\ f_t^{r1} \\ f_t^{r2} \\ f_t^{r3} \\ f_t^{r4} \end{pmatrix} + \xi t$$

$$\phi_i = \begin{pmatrix} \phi_{1,g} & 0 & 0 & 0 & 0 \\ 0 & \phi_{1,r} & 0 & 0 & 0 \\ 0 & 0 & \phi_{2,r} & 0 & 0 \\ 0 & 0 & 0 & \phi_{3,r} & 0 \\ 0 & 0 & 0 & 0 & \phi_{4,r} \end{pmatrix}, Q = \begin{pmatrix} Q_g & 0 & 0 & 0 & 0 \\ 0 & Q_{1,r} & 0 & 0 & 0 \\ 0 & 0 & Q_{2,r} & 0 & 0 \\ 0 & 0 & 0 & Q_{3,r} & 0 \\ 0 & 0 & 0 & 0 & Q_{4,r} \end{pmatrix}.$$

in which the state space model is estimated via the Kalman Filter/Smoother and the EM algorithm.

Variance Decomposition

Following Crucini et al. (2011), we transform the factors/driving variables into orthogonal regressors and run the regression:

$$var(Y_{i,t}) = (\beta_1)^2 var(X_t^1) + ... + (\beta_n)^2 var(X_t^n) + var(\eta_{i,t})$$

The fraction of $Y_{i,t}$ variation explained by each factor/variable X_t^j is computed as:

$$\frac{(\beta_j)^2 var(X_t^j)}{var(Y_{i,t})}$$

Data

Sample under investigation: 1/1994 - 12/2018

- Stock Market Indices

  Annualized weekly and monthly return series computed from daily nominal local currency stock market indexes (EOW and EOM log changes) for 24 countries, grouped as:

US and Advanced EU	**Asia Pacific ex ASEAN**	**ASEAN**	**LATAM**
US, UK, Canada, France Germany, the Netherlands Sweden, Spain, Switzerland	Australia, Hong Kong, Japan, South Korea, India, China, Taiwan	Thailand, Indonesia, Malaysia, the Philippines	Argentina, Brazil Chile, Mexico

- Macro and Financial Variables

  Monthly time series of the following:

Macro	**US Monetary policy**	**Financial**
Common factor of oil, commodities excl oil, industrial production, exports	FFR, Real FFR, FFF SSR, MPU	EPU (US, Euro, CN), VIX, GZ spread, TED spread, Excess bond premium S&P ETFs, UST10Y3M, Dollar index

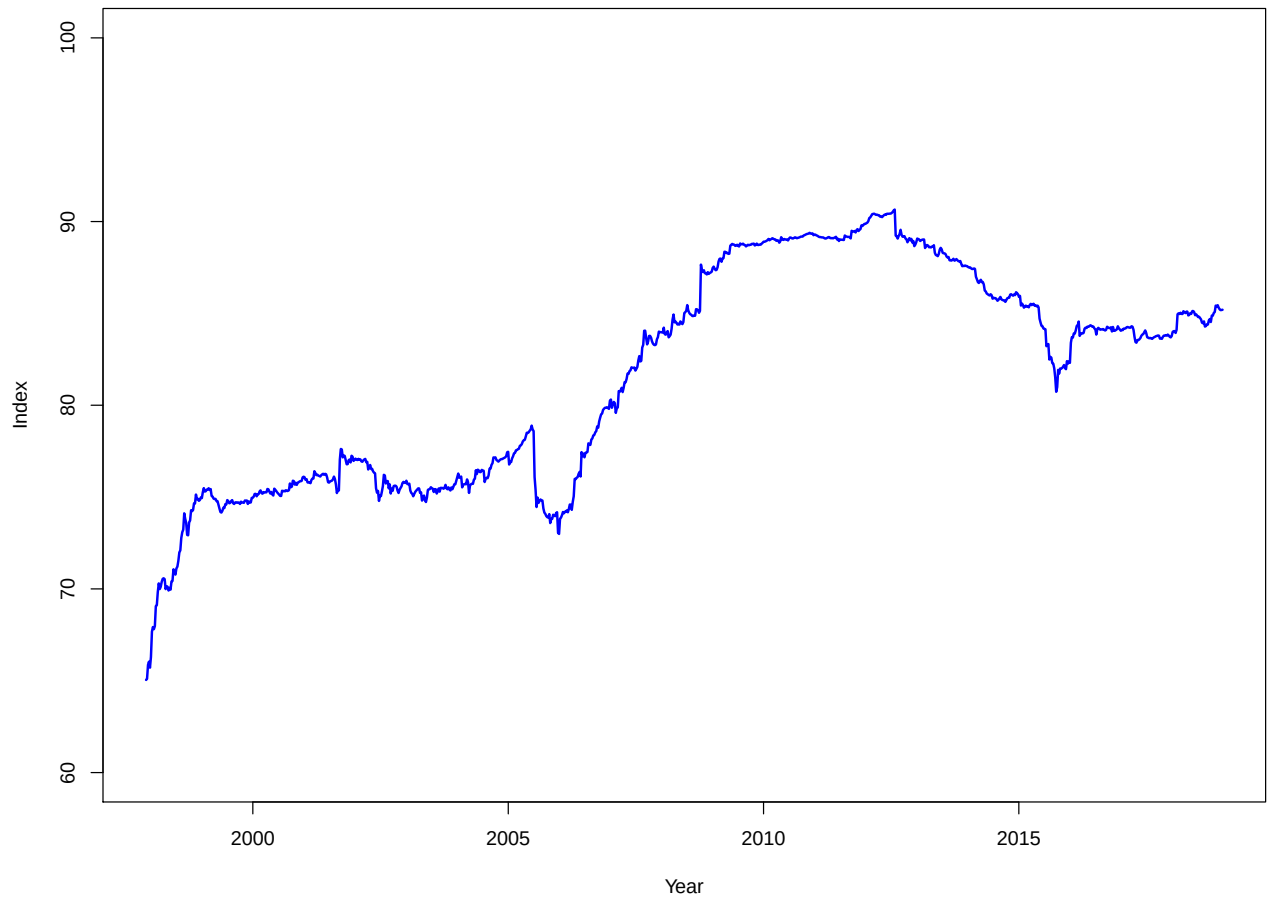
Baseline Results

Table 1: Spillover Table for Global Equity Market Returns

BASELINE (WEEKLY)

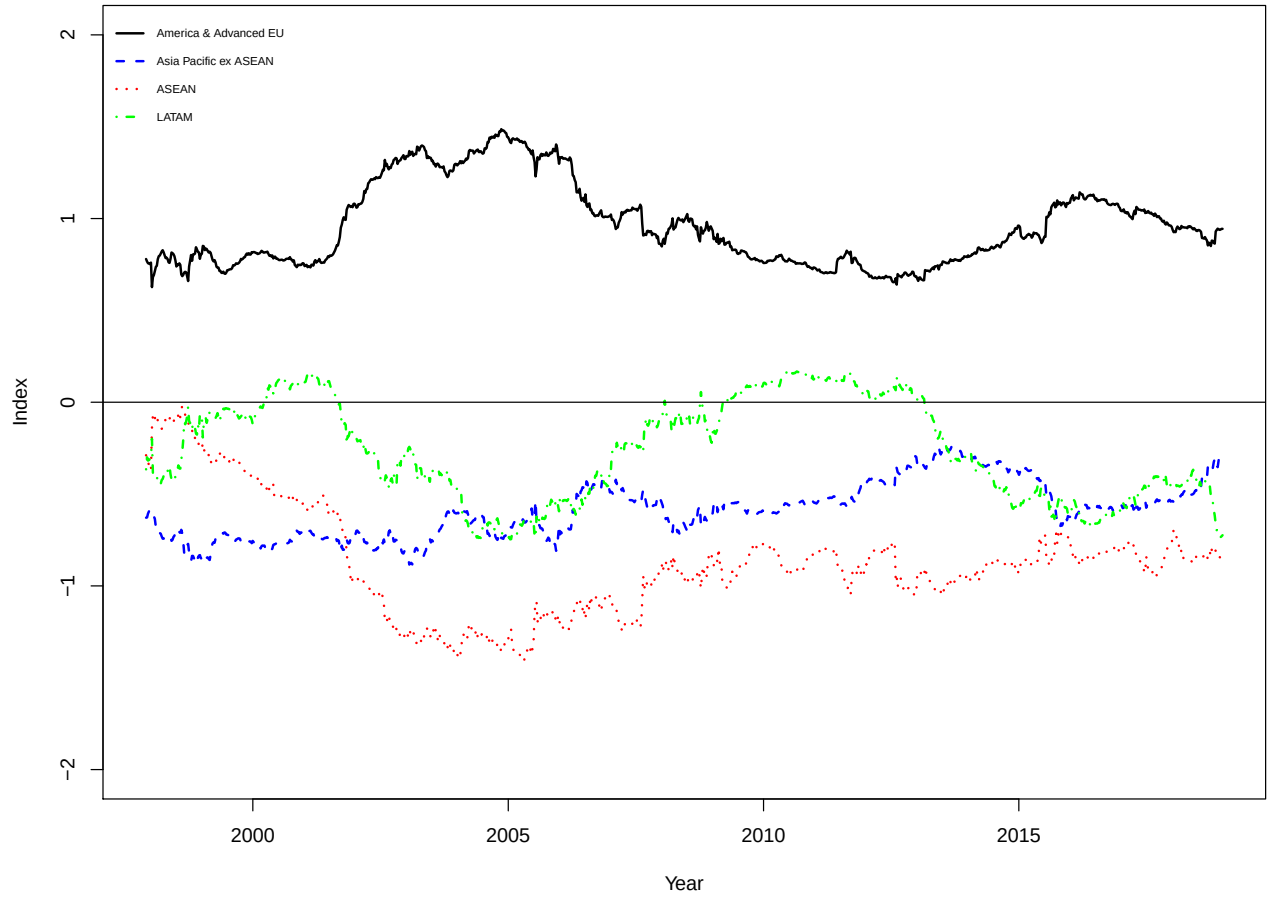
To	From																									
	America & Advanced Europe									Asia Pacific Exclude ASEAN							ASEAN				LATAM				From Others
	US	UK	CA	GE	FR	SP	NL	SE	SW	AU	HK	JP	TW	KR	IN	CN	MY	PH	TH	ID	BR	CL	AR	MX	
US	12.03	7.27	7.18	6.87	6.99	5.67	6.79	6.66	5.88	4.76	3.36	3.38	1.34	2.05	1.80	0.08	0.79	1.43	1.33	1.19	3.01	3.00	2.58	4.55	87.97
UK	6.79	11.23	5.50	7.31	8.06	6.19	8.04	6.85	6.81	4.87	3.84	3.21	1.20	2.17	1.81	0.09	0.86	1.57	1.54	1.23	2.36	2.61	2.42	3.46	88.77
CA	7.90	6.49	13.23	5.76	6.32	4.92	6.12	6.46	4.69	5.59	3.58	3.32	1.47	2.32	2.12	0.12	1.32	1.70	1.95	1.84	3.26	2.76	2.79	3.99	86.77
GE	6.44	7.32	4.91	11.23	8.85	7.05	8.60	7.50	6.74	3.89	3.30	3.17	1.39	2.26	1.85	0.11	0.84	1.35	1.39	1.34	2.51	2.29	2.29	3.37	88.77
FR	6.33	7.82	5.23	8.55	10.85	7.53	8.69	7.33	6.65	4.29	3.20	3.38	1.24	2.03	1.73	0.08	0.72	1.34	1.35	1.25	2.32	2.43	2.39	3.26	89.15
SP	5.90	6.89	4.69	7.89	8.69	12.62	7.82	6.78	6.34	4.21	3.14	3.01	1.34	2.09	1.93	0.05	0.78	1.36	1.47	1.21	2.71	2.59	2.79	3.69	87.38
NL	6.29	7.94	5.15	8.48	8.85	6.88	11.07	7.06	7.08	4.40	3.20	3.21	1.30	2.16	1.70	0.07	0.86	1.42	1.41	1.47	2.31	2.23	2.20	3.25	88.93
SE	6.58	7.22	5.79	7.93	8.00	6.37	7.57	11.88	5.99	4.57	3.36	3.27	1.39	2.40	1.98	0.10	0.77	1.19	1.29	1.28	2.38	2.68	2.41	3.60	88.12
SW	6.45	7.98	4.65	7.88	7.99	6.62	8.43	6.67	13.24	4.67	3.06	3.43	1.14	1.72	1.58	0.08	0.74	1.67	1.38	1.38	2.05	2.62	1.87	2.70	86.76
AU	5.87	6.26	6.05	5.02	5.72	4.77	5.73	5.49	5.02	14.21	4.75	4.41	1.61	2.84	2.45	0.17	1.45	2.43	2.10	1.99	2.62	2.95	2.40	3.66	85.79
HK	4.67	5.53	4.42	4.77	4.81	4.00	4.69	4.57	3.68	5.31	15.84	3.82	2.44	4.18	2.75	0.44	2.93	3.38	3.27	3.09	2.57	2.47	2.73	3.63	84.16
JP	5.38	5.28	4.66	5.37	5.77	4.40	5.44	5.18	4.76	5.68	4.41	18.32	1.82	3.51	2.42	0.22	1.41	2.02	2.05	2.07	2.51	2.10	2.15	3.09	81.68
TW	4.79	4.34	4.40	5.14	4.93	4.12	4.75	4.60	3.27	3.45	4.66	3.12	21.53	4.61	2.90	0.24	2.15	1.91	2.87	1.66	2.36	2.14	2.64	3.40	78.47
KR	3.77	4.19	3.77	4.37	4.05	3.60	4.32	4.46	2.78	4.35	5.75	4.19	3.26	21.88	3.32	0.21	1.98	2.39	4.57	3.28	2.38	2.13	1.91	3.09	78.12
IN	4.05	4.24	4.16	4.37	4.13	3.88	4.12	4.29	3.05	4.33	4.57	3.27	2.10	3.78	24.81	0.32	1.99	2.50	2.48	3.22	2.65	2.34	1.83	3.50	75.19
CN	1.34	1.19	1.17	1.49	1.28	1.10	1.11	1.03	0.96	1.19	3.11	0.91	1.37	0.72	1.26	71.87	1.36	0.84	0.49	1.63	0.88	0.95	1.68	1.08	28.13
MY	2.34	2.58	3.40	2.65	2.23	1.95	2.55	2.33	1.79	3.25	5.91	2.39	2.64	3.00	2.46	0.27	31.13	5.44	6.02	6.66	1.54	2.31	1.96	3.21	68.87
PH	3.06	3.46	3.23	3.02	2.99	2.64	3.19	2.51	3.08	4.28	5.37	2.61	2.06	2.80	2.29	0.14	4.23	23.96	6.03	6.08	2.64	3.43	2.91	4.00	76.04
TH	2.97	3.44	3.70	3.10	3.02	2.78	3.14	2.67	2.46	3.66	5.00	2.77	2.60	5.04	2.34	0.11	4.27	5.68	24.10	5.77	2.76	2.79	2.62	3.20	75.90
ID	2.63	2.82	3.63	3.04	2.89	2.42	3.37	2.75	2.63	3.64	4.88	2.89	1.78	3.98	3.29	0.51	5.10	6.14	6.15	24.96	2.41	3.08	2.22	2.80	75.04
BR	5.13	4.31	5.10	4.61	4.38	4.44	4.30	4.13	3.17	3.75	3.33	2.75	1.51	2.26	1.93	0.14	0.99	2.13	2.22	1.84	20.61	5.53	5.24	6.20	79.39
CL	5.15	4.86	4.35	4.22	4.64	4.29	4.22	4.70	4.15	4.31	3.20	2.38	1.30	2.02	1.77	0.12	1.45	2.67	2.37	2.45	5.62	20.87	3.91	4.99	79.13
AR	4.61	4.66	4.59	4.43	4.76	4.80	4.33	4.41	3.09	3.66	3.66	2.47	1.80	1.90	1.56	0.17	1.28	2.30	2.19	1.85	5.52	3.97	21.66	6.33	78.34
MX	6.35	5.17	5.08	5.03	5.00	4.93	4.91	5.06	3.46	4.14	3.74	2.73	1.45	2.35	2.08	0.12	1.69	2.60	1.93	1.78	5.02	3.90	4.77	16.70	83.30
To Others	114.77	121.26	104.81	121.31	124.34	105.37	122.25	113.48	97.53	96.25	92.38	70.09	39.57	62.18	49.33	3.95	39.94	55.45	57.86	55.55	64.42	63.30	60.72	84.07	**80.01**

Time-varying Spillovers



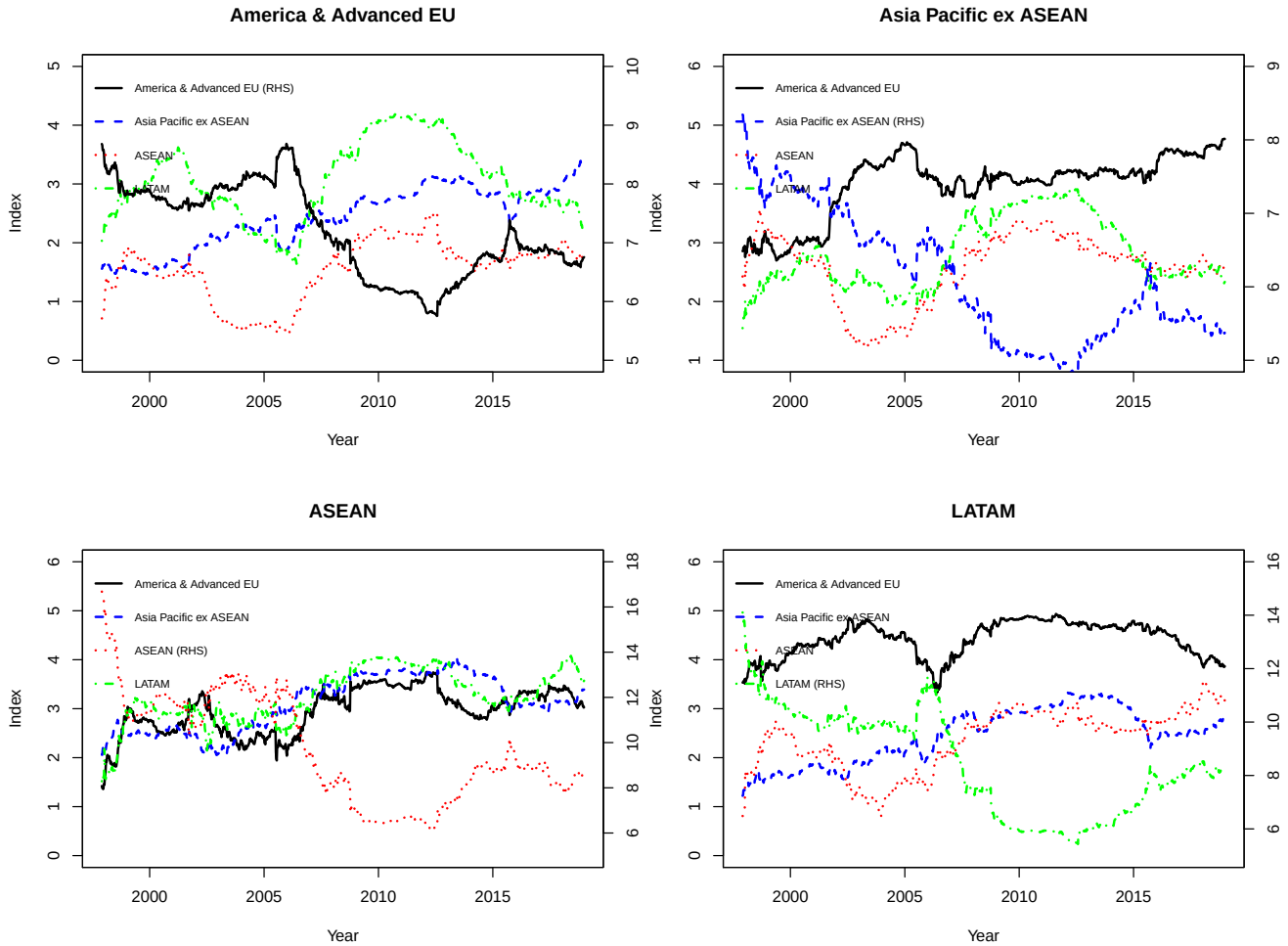
Note: Plotted are total return spillover indices based on a 200-week rolling estimation window. The corresponding date in the plot denotes the end of the rolling estimation window.

Average Net Return Spillovers



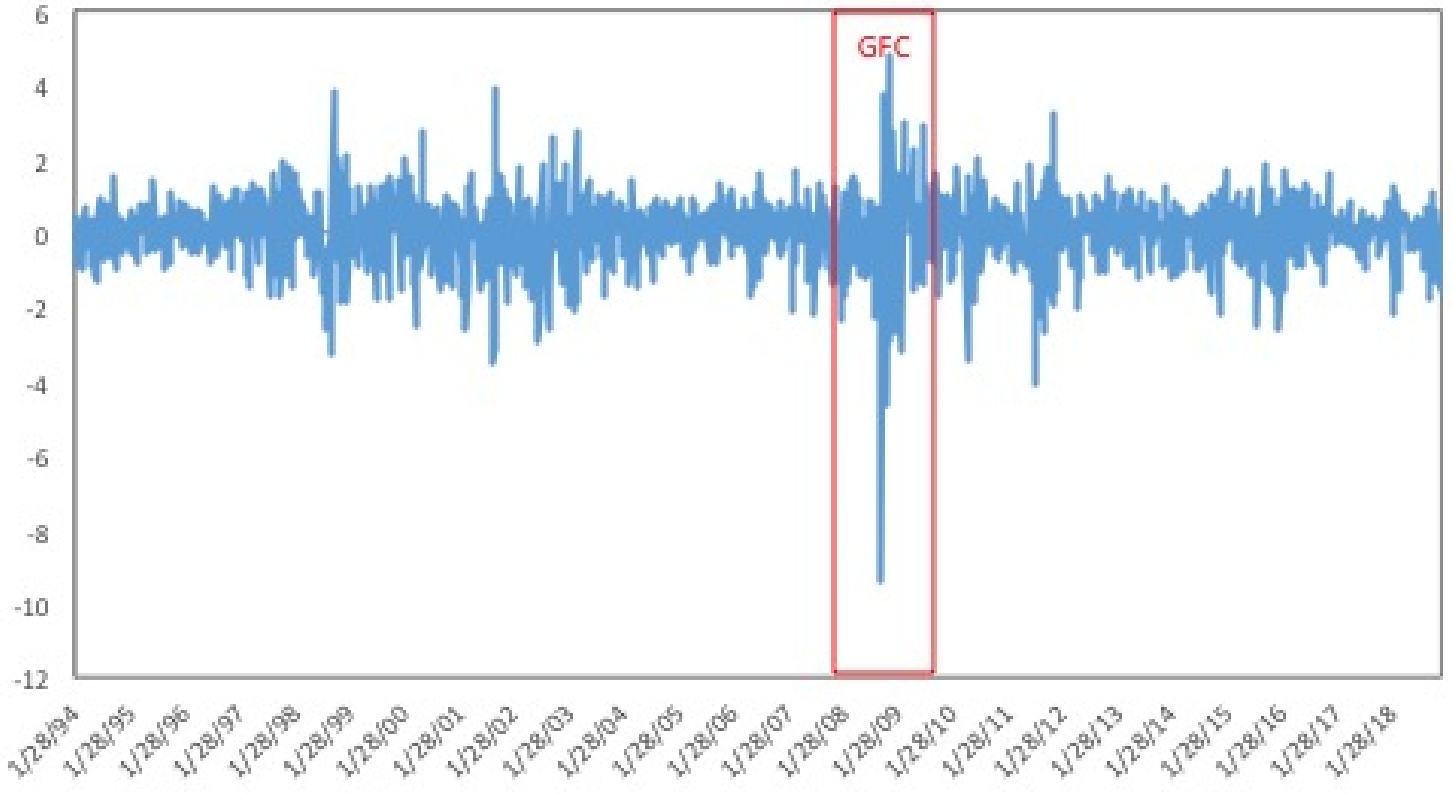
Note: Plotted are the average net return spillover indices based on a 200-week rolling estimation window. The corresponding date in the plot denotes the end of the rolling estimation window.

Average Return Spillover Received

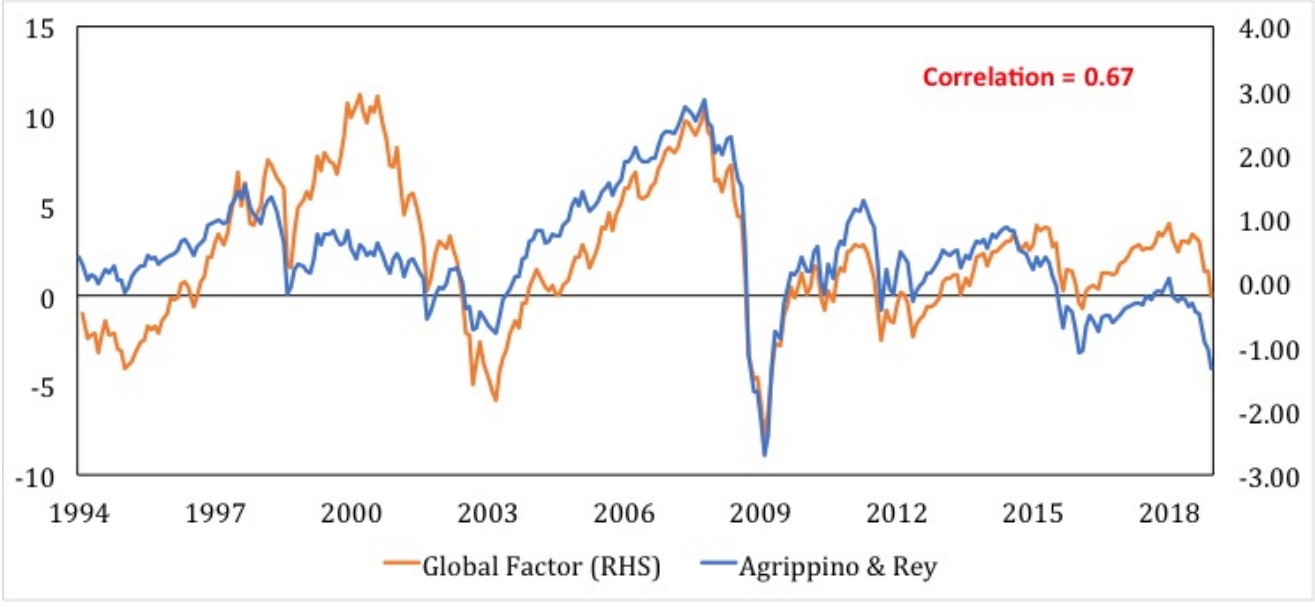


Note: Plotted are the average return spillover indices received by each country group based on a 200-week rolling estimation window. The corresponding date in the plot denotes the end of the rolling estimation window.

Global Equity Factor



Global Equity Factor (cont.)



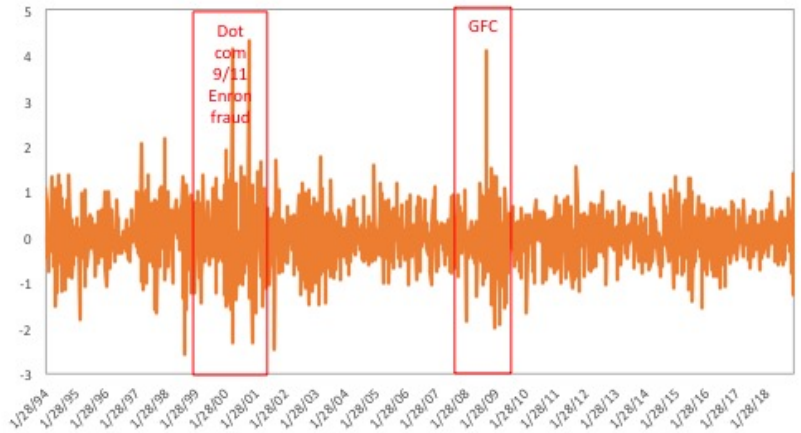
Spillover with Global Factor

Table 2: Spillover Table for Global Equity Market Returns (with Global Factor)

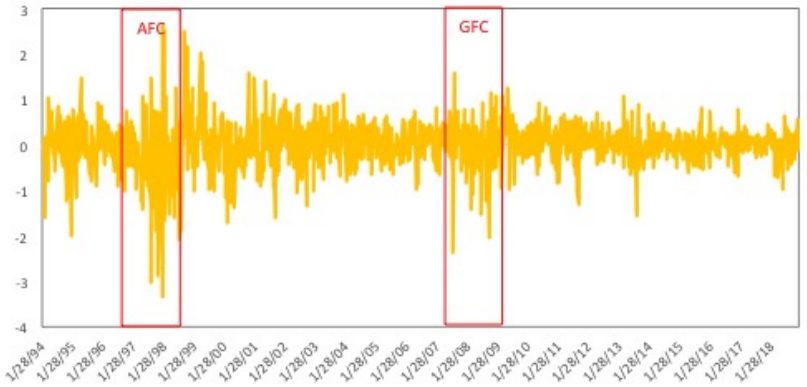
To	From																									From Others
	America & Advanced Europe									Asia Pacific Exclude ASEAN							ASEAN				LATAM					
	US	UK	CA	GE	FR	SP	NL	SE	SW	AU	HK	JP	TW	KR	IN	CN	MY	PH	TH	ID	BR	CL	AR	MX		
US	64.87	0.61	3.05	4.12	9.39	2.90	8.08	0.84	1.13	0.09	0.04	0.01	0.01	0.20	0.07	0.01	0.26	0.11	0.37	0.47	0.62	0.57	0.28	1.92	35.13
UK	0.94	82.84	2.58	4.23	0.97	2.21	0.07	1.18	0.45	0.44	0.40	0.46	0.38	0.12	0.11	0.02	0.46	0.01	0.06	0.71	0.71	0.08	0.20	0.38	17.16
CA	3.03	1.38	56.14	9.14	9.05	3.69	7.58	0.25	3.82	1.60	0.19	0.07	0.10	0.08	0.18	0.05	1.04	0.20	0.46	0.41	0.83	0.11	0.25	0.36	43.86
GE	4.36	3.08	10.77	67.13	0.82	0.10	0.64	0.01	0.04	5.26	0.72	0.66	0.01	0.33	0.16	0.04	0.30	0.71	0.56	0.38	0.38	1.76	0.69	1.11	32.87
FR	8.66	0.69	9.19	0.76	58.40	1.47	0.62	0.80	0.32	3.08	1.76	0.39	0.56	1.21	0.74	0.10	1.34	1.25	1.30	1.15	1.74	1.08	0.58	2.79	41.60
SP	3.71	1.99	5.41	0.10	2.07	81.00	0.19	0.38	0.32	0.58	0.38	0.47	0.00	0.27	0.05	0.15	0.38	0.19	0.27	0.33	0.81	0.01	0.69	0.23	19.00
NL	8.14	0.05	8.59	0.62	0.50	0.09	64.51	1.53	0.91	1.91	1.47	0.95	0.23	0.34	0.69	0.08	0.38	0.47	0.69	0.07	1.50	2.59	1.46	2.22	35.49
SE	1.47	1.25	0.74	0.19	0.80	0.59	2.06	86.49	1.01	1.08	0.16	0.11	0.05	0.14	0.03	0.02	0.32	1.39	0.63	0.32	0.61	0.08	0.17	0.31	13.51
SW	0.95	0.43	5.69	0.19	0.63	0.02	0.73	0.89	80.93	0.09	0.60	0.06	0.34	1.04	0.45	0.02	0.31	0.05	0.65	0.17	1.30	0.02	1.68	2.78	19.07
AU	0.88	0.05	1.83	5.12	3.40	0.47	1.82	0.13	0.13	66.38	4.18	3.20	0.52	1.73	1.28	0.24	1.40	2.41	1.50	1.34	0.26	0.80	0.25	0.66	33.62
HK	0.42	0.25	0.16	0.59	1.67	0.24	1.29	0.10	0.83	3.40	56.06	2.18	2.42	5.34	2.19	1.22	5.56	4.78	4.34	4.16	0.50	0.39	0.98	0.96	43.94
JP	0.56	0.35	0.05	0.90	0.56	0.44	0.88	0.23	0.44	4.24	2.93	76.39	0.89	3.21	1.17	0.47	1.13	1.67	1.21	1.72	0.27	0.02	0.15	0.12	23.61
TW	0.08	0.45	0.21	0.03	0.61	0.00	0.43	0.01	0.54	0.64	3.40	0.93	74.17	5.99	1.97	0.51	2.59	1.41	2.91	1.04	0.47	0.21	0.82	0.57	25.83
KR	0.16	0.13	0.42	0.13	1.40	0.09	0.41	0.15	0.85	1.61	6.06	2.99	3.88	63.14	2.85	0.25	2.01	1.71	6.40	3.77	0.57	0.27	0.16	0.58	36.86
IN	0.18	0.10	0.24	0.18	1.20	0.11	0.85	0.04	0.50	1.47	2.96	1.18	1.40	3.39	73.89	0.59	1.95	2.01	1.77	3.43	0.91	0.52	0.10	1.06	26.11
CN	0.07	0.03	0.07	0.06	0.14	0.08	0.15	0.07	0.02	0.34	2.30	0.84	0.79	0.48	0.65	90.29	0.85	0.29	0.07	1.27	0.15	0.17	0.73	0.12	9.71
MY	0.14	0.12	0.71	0.27	1.48	0.25	0.41	0.37	0.34	1.09	5.58	0.96	1.98	1.96	1.38	0.30	57.84	6.32	7.21	8.44	0.18	0.77	0.52	1.39	42.16
PH	0.15	0.01	0.19	0.58	1.49	0.13	0.51	0.66	0.03	1.99	4.77	0.66	1.30	1.75	1.12	0.11	5.97	54.14	8.55	8.77	1.07	2.28	1.65	2.12	45.86
TH	0.56	0.09	0.46	0.44	1.45	0.09	0.67	0.42	0.23	1.09	4.15	0.80	2.10	5.49	1.20	0.07	6.11	7.69	53.65	8.13	1.29	1.29	1.22	1.32	46.35
ID	0.47	0.51	0.50	0.32	1.18	0.22	0.25	0.20	0.14	1.14	3.96	1.04	0.93	3.68	2.52	0.75	7.63	8.46	8.45	54.07	0.76	1.61	0.65	0.58	45.93
BR	0.32	0.58	1.15	0.60	2.19	0.06	1.53	0.50	1.11	0.29	0.80	0.25	0.45	0.57	0.44	0.09	0.21	1.23	1.42	0.75	66.63	6.38	6.09	6.35	33.37
CL	0.41	0.07	0.30	1.73	1.51	0.01	2.36	0.06	0.01	0.85	0.48	0.03	0.29	0.46	0.27	0.06	0.86	2.25	1.80	1.86	6.82	69.74	3.48	4.29	30.26
AR	0.03	0.13	0.29	0.75	0.71	0.26	1.54	0.08	1.49	0.23	1.12	0.08	1.19	0.29	0.17	0.20	0.59	1.43	1.25	0.86	6.51	2.78	71.13	6.88	28.87
MX	1.92	0.30	0.38	1.12	2.92	0.01	2.21	0.10	2.24	0.43	1.24	0.06	0.32	0.69	0.52	0.06	1.62	2.30	1.03	0.64	6.17	2.92	5.94	64.89	35.11
To Others	37.59	12.66	52.98	32.17	46.15	13.54	35.27	8.98	16.89	32.96	49.64	18.36	20.13	38.75	20.19	5.41	43.26	48.32	52.91	50.17	34.43	26.70	28.71	39.09	**31.89**

Regional Factors

US and Advanced EU

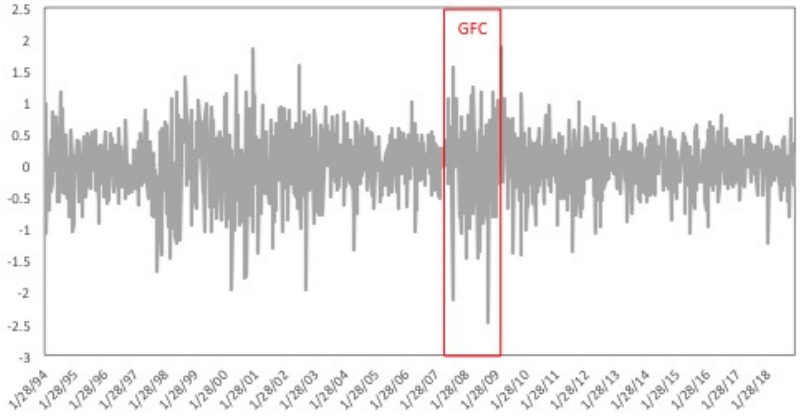


ASEAN

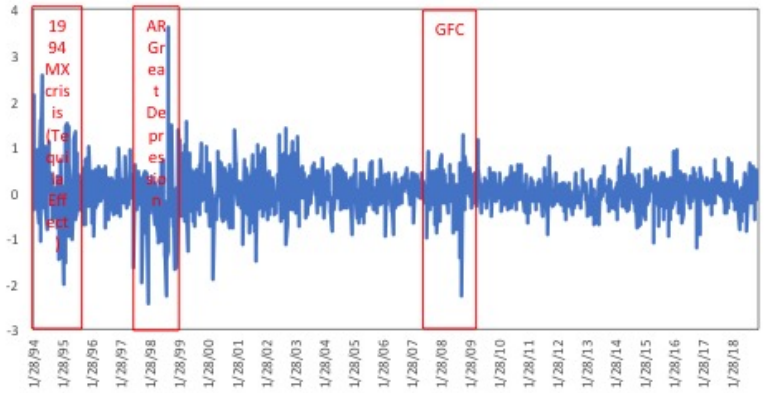


Regional Factors (cont.)

Asia Pacific ex ASEAN



LATAM



Spillover with Regional Factors

Table 1: Spillover Table for Global Equity Market Returns (with Global and Regional Factors)

To	From																									From Others
	America & Advanced Europe									Asia Pacific Exclude ASEAN							ASEAN				LATAM					
	US	UK	CA	GE	FR	SP	NL	SE	SW	AU	HK	JP	TW	KR	IN	CN	MY	PH	TH	ID	BR	CL	AR	MX		
US	57.36	0.58	35.80	0.54	0.48	0.12	0.45	1.28	0.68	0.75	0.13	0.14	0.17	0.01	0.04	0.02	0.05	0.15	0.13	0.08	0.11	0.02	0.32	0.60	42.64
UK	0.45	77.97	5.09	5.74	2.06	2.54	0.51	1.10	0.46	0.58	1.03	0.46	0.36	0.10	0.09	0.03	0.26	0.23	0.09	0.48	0.11	0.18	0.09	0.01	22.03
CA	32.56	3.42	52.61	0.73	2.76	0.39	1.79	1.23	0.32	0.08	0.23	0.19	0.17	0.11	0.06	0.10	0.39	0.60	0.08	0.19	0.70	0.29	0.15	0.86	47.39
GE	0.78	5.23	1.30	71.60	5.21	2.21	4.73	0.04	1.98	2.34	0.03	0.24	0.40	0.56	0.10	0.26	0.57	0.18	0.13	0.23	0.76	1.01	0.07	0.03	28.40
FR	0.27	1.80	3.57	5.41	72.92	0.30	6.63	1.17	5.67	0.17	0.24	0.22	0.28	0.04	0.00	0.09	0.32	0.14	0.06	0.03	0.03	0.11	0.16	0.38	27.08
SP	0.03	2.73	0.63	2.55	0.49	84.17	5.71	0.38	1.31	0.03	0.08	0.14	0.14	0.14	0.23	0.03	0.00	0.01	0.21	0.13	0.16	0.53	0.12	0.03	15.83
NL	0.53	0.24	2.57	3.74	6.68	4.96	73.17	2.18	1.17	0.41	0.26	0.17	0.13	0.25	0.09	0.02	0.09	0.22	0.48	0.35	0.40	1.41	0.47	0.01	26.83
SE	3.44	1.19	2.06	0.14	1.20	0.44	2.59	84.17	1.08	0.94	0.14	0.07	0.16	0.39	0.11	0.01	0.14	0.55	0.15	0.16	0.25	0.51	0.01	0.11	15.83
SW	0.63	0.35	0.68	2.20	7.12	1.03	0.27	0.93	80.80	0.69	0.03	0.41	0.12	0.55	0.09	0.07	0.16	0.37	0.79	0.40	0.15	1.06	0.52	0.57	19.20
AU	2.39	0.28	0.56	2.53	1.88	0.02	0.15	0.13	0.93	74.26	3.12	0.54	3.15	4.96	1.18	0.70	0.11	0.45	0.61	0.57	0.20	0.39	0.43	0.46	25.74
HK	0.10	0.90	0.15	0.12	0.03	0.15	0.13	0.12	0.07	3.12	70.74	6.36	3.76	7.65	4.12	0.59	0.65	0.18	0.18	0.35	0.16	0.02	0.25	0.11	29.26
JP	0.28	0.40	0.42	0.28	0.75	0.15	0.14	0.08	0.56	0.26	7.27	81.26	2.24	2.96	1.57	0.57	0.05	0.20	0.11	0.13	0.17	0.08	0.02	0.05	18.74
TW	0.16	0.49	0.78	0.50	0.50	0.13	0.09	0.04	0.06	3.71	4.61	2.18	81.54	1.24	1.70	0.74	0.45	0.13	0.20	0.43	0.07	0.04	0.16	0.04	18.46
KR	0.16	0.11	0.43	0.55	0.20	0.12	0.15	0.33	0.44	5.56	7.97	2.51	1.18	73.54	1.39	2.10	0.52	0.65	1.71	0.10	0.05	0.05	0.12	0.09	26.46
IN	0.09	0.09	0.11	0.10	0.30	0.31	0.33	0.08	0.14	1.21	4.73	1.59	1.71	1.74	84.27	0.28	0.17	0.48	0.28	1.17	0.15	0.01	0.59	0.07	15.73
CN	0.03	0.04	0.17	0.32	0.04	0.08	0.06	0.09	0.08	0.85	1.32	0.80	0.31	2.92	0.29	90.36	0.33	0.04	0.65	0.75	0.07	0.00	0.30	0.08	9.64
MY	0.07	0.01	0.12	0.33	0.02	0.06	0.11	0.47	0.28	0.25	0.55	0.74	0.18	0.45	0.11	0.17	75.31	6.89	5.62	7.43	0.20	0.07	0.01	0.54	24.69
PH	0.18	0.21	0.78	0.15	0.05	0.00	0.18	0.15	0.47	0.44	0.34	0.08	0.01	0.65	0.07	0.03	6.46	71.14	7.08	11.02	0.14	0.09	0.03	0.24	28.86
TH	0.42	0.13	0.17	0.02	0.01	0.11	0.13	0.05	0.13	0.08	0.17	0.25	0.13	1.52	0.22	0.48	5.18	7.74	70.47	10.89	0.25	0.48	0.01	0.95	29.53
ID	0.13	0.37	0.35	0.10	0.20	0.16	0.34	0.18	0.06	0.18	0.70	0.32	0.37	0.21	0.52	0.51	6.32	10.46	10.75	67.13	0.18	0.10	0.07	0.29	32.87
BR	0.31	0.14	1.05	0.46	0.37	0.05	0.46	0.22	0.58	0.18	0.37	0.26	0.27	0.26	0.06	0.01	0.37	0.24	0.34	0.13	62.13	5.57	12.15	14.04	37.87
CL	0.12	0.14	0.45	0.47	0.09	0.08	0.32	0.15	1.15	0.37	0.15	0.11	0.07	0.26	0.01	0.00	0.05	0.07	0.09	0.28	7.19	76.71	5.61	6.06	23.29
AR	0.50	0.05	0.28	0.11	0.27	0.12	0.17	0.06	0.66	0.12	0.57	0.02	0.54	0.11	0.24	0.08	0.02	0.01	0.29	0.27	14.20	5.28	72.77	3.28	27.23
MX	0.86	0.02	1.31	0.02	0.51	0.01	0.10	0.01	0.57	0.14	0.08	0.09	0.20	0.02	0.05	0.05	0.75	0.20	0.40	0.24	15.77	5.52	3.04	70.01	29.99
To Others	44.50	18.92	58.80	27.10	31.21	13.55	25.55	10.47	18.85	22.46	34.13	17.89	16.03	27.12	12.33	6.93	23.44	30.17	30.43	35.81	41.49	22.81	24.71	28.88	**25.98**

Importance of Factors

Country	Global	Region	Country
US	74.98	3.84	16.56
UK	79.01	0.02	17.32
CA	67.33	10.28	12.14
GE	79.67	1.62	11.52
FR	83.71	1.43	7.79
SP	67.13	1.36	25.48
NL	81.45	1.42	10.19
SE	74.07	0.00	22.75
SW	65.27	0.97	28.52
AU	47.11	5.36	37.90
HK	34.53	13.18	33.45
JP	33.42	6.97	48.73
TW	10.09	10.04	67.32
KR	21.97	12.50	48.38
IN	18.50	7.33	64.03
CN	0.57	4.05	91.08
MY	8.64	20.10	53.60
PH	14.36	22.62	42.72
TH	15.09	21.55	43.91
ID	13.11	26.05	37.77
BR	25.72	17.36	32.65
CL	25.62	9.46	50.82
AR	24.79	11.25	47.58
MX	37.01	9.84	37.76

Average	Global	Region	Country
US&EU	74.74	2.33	16.92
Asia Pacific	23.74	8.49	55.84
ASEAN	12.80	22.58	44.50
LATAM	28.28	11.98	42.20
Total	**41.80**	**9.11**	**37.08**

Drivers: Baseline Results

	Before crisis	After crisis
EPUUS	11.67	25.74
>EPUEU	-	-
>EPUCN	-	-
VIX	9.10	22.89
>GZ spread	-	-
>Ted spread	-	-
>Excess bond prem	-	-
>S&P ETFs	-	-
>UST10Y3M	-	-
Dollar Index	-	-
Oil Factor	7.01	0.36
>Comm ex oil	-	-
IP Factor	6.86	16.79
>Export Factor	-	-
FFR	11.51	1.00
>RFFR	-	-
>FFF	-	-
>SSR	-	-
>MPU	-	-
RESIDUAL	36.99	23.58
TOTAL	83.14	90.36

Robustness Check: EPU

	BASELINE		*EPUEU*		*EPUCN*		*3 EPUs*	
	Before crisis	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**
EPUUS	11.67	25.74	34.08	7.44	24.69	7.69	34.10	10.72
>EPUEU	-	-	1.71	0.92	-	-	2.75	1.25
>EPUCN	-	-	-	-	0.05	6.60	0.04	1.74
VIX	9.10	22.89	15.00	39.52	10.61	31.08	15.24	38.12
>GZ spread	-	-	-	-	-	-	-	-
>Ted spread	-	-	-	-	-	-	-	-
>Excess bond prem	-	-	-	-	-	-	-	-
>S&P ETFs	-	-	-	-	-	-	-	-
>UST10Y3M	-	-	-	-	-	-	-	-
Dollar Index	-	-	-	-	-	-	-	-
Oil factor	7.01	0.36	3.80	0.06	5.72	0.92	3.63	0.04
>Comm ex oil	-	-	-	-	-	-	-	-
IP Factor	6.86	16.79	3.46	11.58	7.88	10.65	3.72	13.26
>Export Factor	-	-	-	-	-	-	-	-
FFR	11.51	1.00	8.10	2.09	11.55	0.68	8.22	2.50
>RFFR	-	-	-	-	-	-	-	-
>FFF	-	-	-	-	-	-	-	-
>SSR	-	-	-	-	-	-	-	-
>MPU	-	-	-	-	-	-	-	-
RESIDUAL	36.99	23.58	35.06	22.84	36.91	22.45	35.05	19.86
TOTAL	83.14	90.36	101.20	84.46	97.40	80.06	102.76	87.50

Robustness Check: Financial Variables

	Baseline		*Ted spread*		*Excess Bond Prem*		*ETF*	
	Before crisis	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**
EPUUS	11.67	25.74	9.41	15.45	15.71	17.34	9.82	25.56
>EPUEU	-	-	-	-	-	-	-	-
>EPUCN	-	-	-	-	-	-	-	-
VIX	9.10	22.89	10.94	39.76	10.31	30.70	13.36	27.33
>GZ spread	-	-	-	-	-	-	-	-
>TED spread	-	-	7.65	1.17	-	-	-	-
>Excess bond prem	-	-	-	-	0.47	3.80	-	-
>S&P ETFs	-	-	-	-	-	-	0.56	0.01
>UST10Y3M	-	-	-	-	-	-	-	-
Dollar Index	-	-	-	-	-	-	-	-
Oil Factor	7.01	0.36	13.88	0.82	6.76	0.13	8.37	0.51
>Comm ex oil	-	-	-	-	-	-	-	-
IP Factor	6.86	16.79	7.36	16.17	8.31	5.99	6.44	10.84
>Export Factor	-	-	-	-	-	-	-	-
FFR	11.51	1.00	1.62	0.94	10.69	1.75	11.60	1.10
>RFFR	-	-	-	-	-	-	-	-
>FFF	-	-	-	-	-	-	-	-
>SSR	-	-	-	-	-	-	-	-
>MPU	-	-	-	-	-	-	-	-
RESIDUAL	36.99	23.58	34.07	19.20	36.68	21.24	36.28	23.57
TOTAL	83.14	90.36	84.94	93.52	88.94	80.94	86.43	88.92

Robustness Check: Dollar, Oil, Real Activity

	BASELINE		*Dollar Index*		*Commodity*		*Export*	
	Before crisis	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**
EPUUS	11.67	25.74	20.66	25.11	10.85	17.36	10.88	34.06
>EPUEU	-	-	-	-	-	-	-	-
>EPUCN	-	-	-	-	-	-	-	-
VIX	9.10	22.89	1.62	24.35	11.19	31.23	9.88	23.46
GZ Spread	-	-	-	-	-	-	-	-
>TED Spread	-	-	-	-	-	-	-	-
>EXCESSBond	-	-	-	-	-	-	-	-
>S&P ETFs	-	-	-	-	-	-	-	-
>UST10Y3M	-	-	-	-	-	-	-	-
Dollar Index	-	-	7.41	0.48	-	-	-	-
Oil Factor	7.01	0.36	3.20	2.49	0.40	7.00	8.16	7.91
> Comm ex oil	-	-	-	-	0.48	0.96	-	-
IP Factor	6.86	16.79	3.64	16.48	8.12	47.29	-	-
>Export Factor	-	-	-	-	-	-	10.35	13.84
FFR	11.51	1.00	9.34	2.02	8.27	4.72	7.49	0.04
>RFFR	-	-	-	-	-	-	-	-
>FFF	-	-	-	-	-	-	-	-
>SSR	-	-	-	-	-	-	-	-
>MPU	-	-	-	-	-	-	-	-
RESIDUAL	36.99	23.58	33.25	23.48	36.93	21.89	36.40	30.14
TOTAL	83.14	90.36	79.12	94.41	76.23	130.46	83.16	109.45

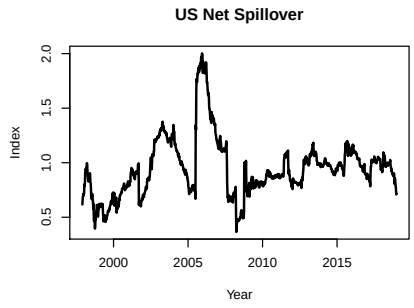
Robustness Check: US Monetary Policy

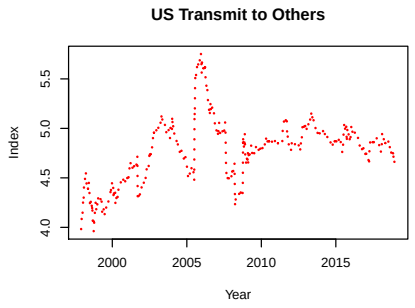
	Baseline		*FFF*		*SSR*		*MPU*	
	Before crisis	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**	**Before crisis**	**After crisis**
EPUUS	11.67	25.74	11.83	25.45	11.85	26.77	35.20	14.48
>EPUEU	-	-	-	-	-	-	-	-
>EPUCN	-	-	-	-	-	-	-	-
VIX	9.10	22.89	9.15	22.77	10.65	50.85	7.06	30.21
>GZ spread	-	-	-	-	-	-	-	-
>TED spread	-	-	-	-	-	-	-	-
>Excess bond prem	-	-	-	-	-	-	-	-
>S&P ETFs	-	-	-	-	-	-	-	-
>UST10Y3M	-	-	-	-	-	-	-	-
Dollar Index	-	-	-	-	-	-	-	-
Oil Factor	7.01	0.36	6.89	0.35	5.74	24.65	9.35	5.24
>Comm ex oil	-	-	-	-	-	-	-	-
IP Factor	6.86	16.79	6.84	16.84	6.42	9.16	7.47	14.12
>Export Factor	-	-	-	-	-	-	-	-
FFR	11.51	1.00	-	-	-	-	-	-
>RFFR	-	-	-	-	-	-	-	-
>FFF	-	-	11.11	1.00	-	-	-	-
>SSR	-	-	-	-	9.33	4.45	-	-
>MPU	-	-	-	-	-	-	2.42	3.93
RESIDUAL	36.99	23.58	37.36	23.59	39.53	23.18	47.13	24.51
TOTAL	83.14	90.36	83.18	89.99	83.52	139.05	108.64	92.49

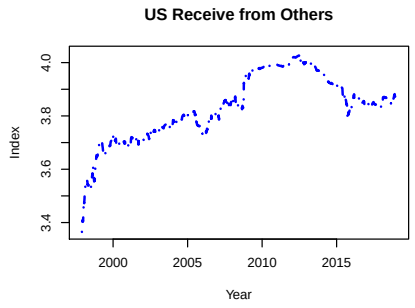
Conclusion

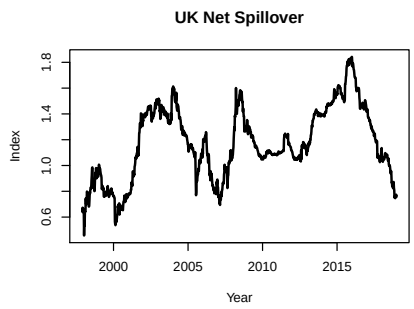
- Connectedness in global equity markets is strong, with a gradual increasing trend over time
  → Approximately 80 percent of equity market shocks come from other countries
  → While intraregional connectedness is still strong, spillover received from cross-country groups have doubled while within group shocks have declined
  → US and advanced Europe are consistently net transmitters of shocks, ROW are net receivers
- A global equity factor can explain a substantial portion of total spillovers in international equity markets
  → The global factor is driven by US and advanced EU markets
  → The global factor explains about one fifth of the variation in ROW stock market returns
  → Country specific factors still play a dominant role
- Macro and financial variables can explain approximately two thirds of the variation in the global equity cycle
  → US monetary policy played a key role pre GFC with a muted role thereafter
  → VIX, EPU, and World Industrial Production exerted a more important role in the post GFC period

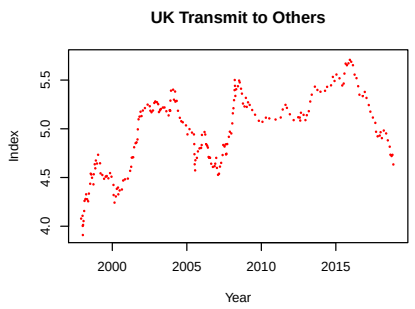
Sample Country Return Spillovers (US and Advanced EU)

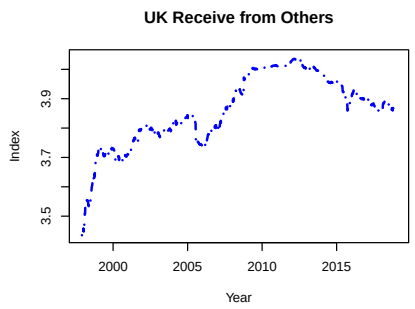


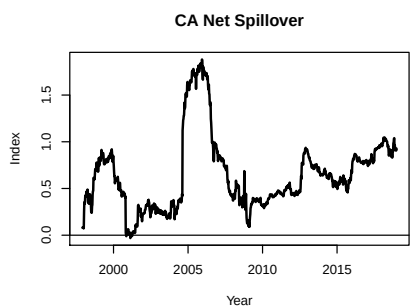


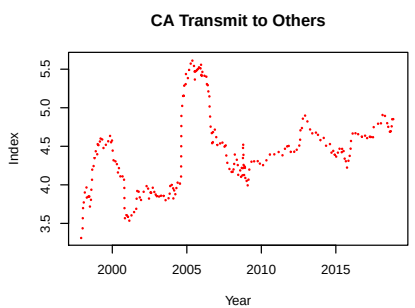


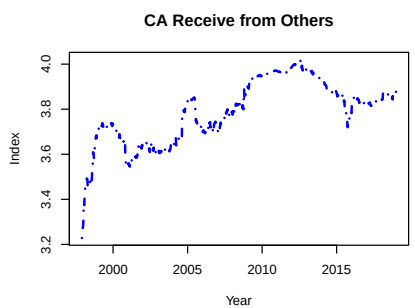




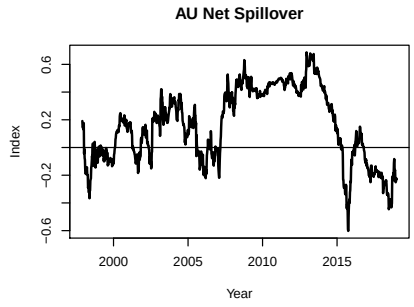


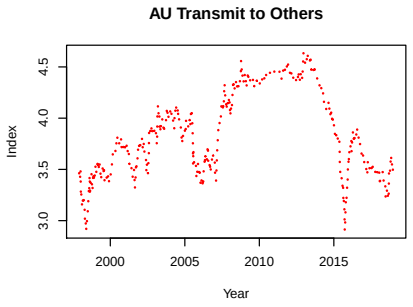


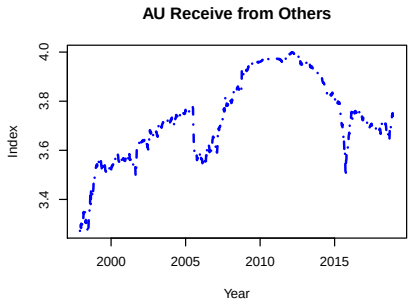


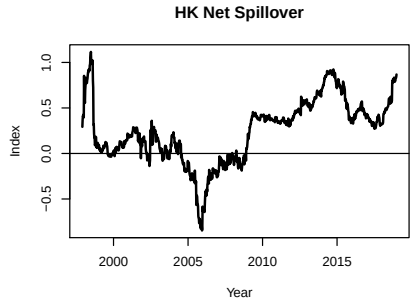


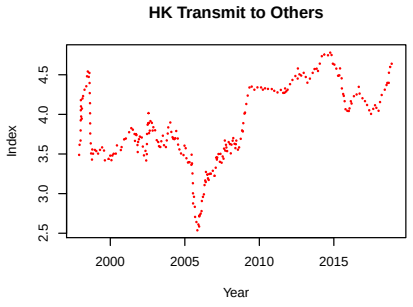
Sample Country Return Spillovers (Asia Pacific ex ASEAN)

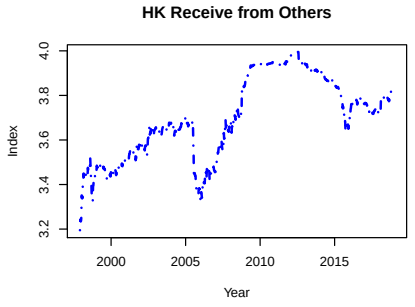


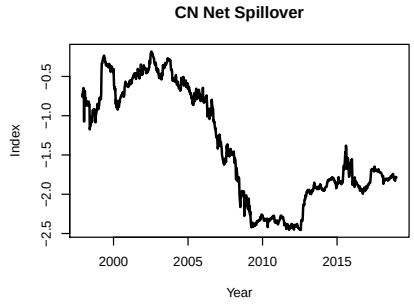


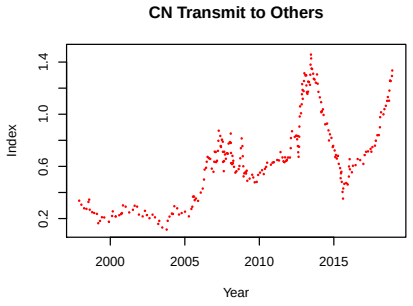


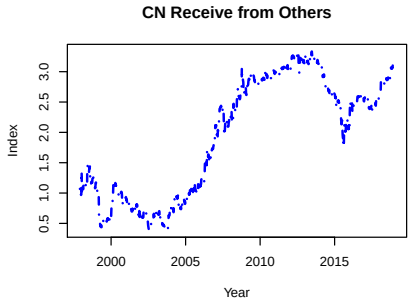




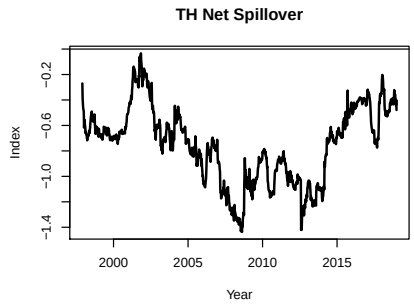


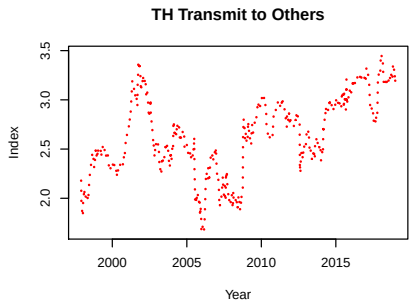


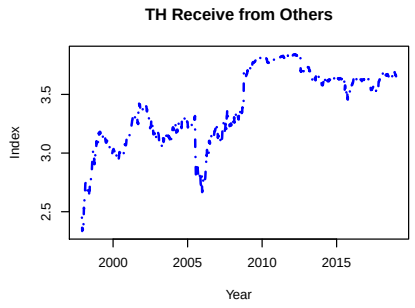


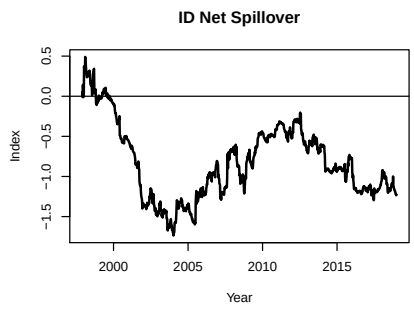


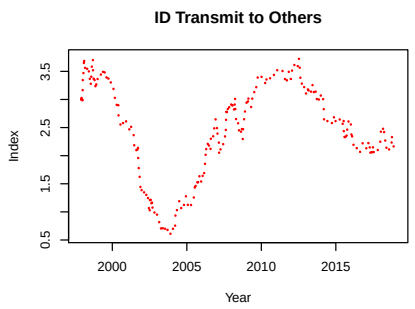
Sample Country Return Spillovers (ASEAN)

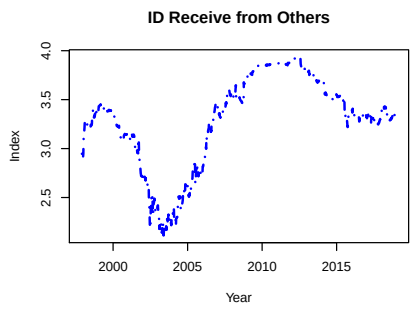


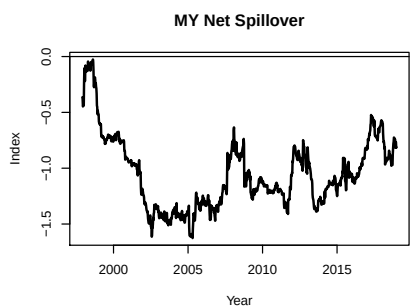


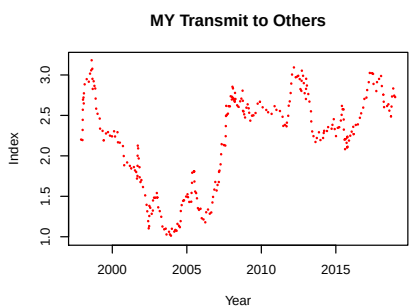


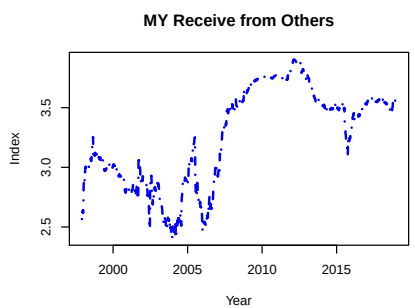












Sample Country Return Spillovers (LATAM)