Risk premium spillovers among stock markets: Evidence from higher moments

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Why

- The Global Financial Crisis has been the toughest challenge for financial markets around the world.
- The crisis has highlighted the importance of understanding the risk transmissions among stock markets, namely, risks occurring in one market are transmitted to other markets as well.
- A great attention has been given to the premium that investors require for bearing various risks such as the
  - variance risk premium
  - skewness risk premium
  - kurtosis risk premium

  See e.g., Bollerslev, Tauchen and Zhou (2009, RFS), Bekaert and Hoerova (2014, JoE) and Sasaki (2016, AoF).

Why

- A widely accepted definition of the variance risk premium in the literature is the difference between implied and realized variance (or volatility) suggesting that investors are willing to pay to hedge against upward movements in variance (Bakshi and Madan, 2006, MS; Carr and Wu, 2009, RFS; Bollerslev, Tauchen and Zhou, 2009, RFS).
- Studies have shown that this investors' willingness to ensure against variance risk increases especially, after a market crash and has a strong predictive power for the stock returns (Drechsler and Yaron, 2011, RFS; Ait-Sahalia, Karaman and Mancini, 2015).

Why

- In addition to the preferences for mean and variance of portfolio returns, investors might have preferences for the higher moments (skewness and kurtosis)
- Indeed, several studies show that investors prefer stocks with a high positive realized skewness and a low realized kurtosis (Brunnermeier, Gollier, and Parker, 2007, AER; Barberis and Huang, 2008, AER; Guidolin and Timmermann, 2008, RFS).
- Therefore, higher moments-averse investors might require a reward for bearing the potential risk spillover that may reflect either the likelihood of a downside jump in the stock market (negative skewness) or the likelihood of tail risk (excess kurtosis).
- Given the possible aversion of investors about volatility and higher moments, is important to better understand the relations among their risk premia, which reflect their willingness to pay a premium for insuring against future changes in the volatility, downside and tail risks.

What

- The contribution is:
  - The analysis of time-varying risk premium spillovers among stock markets of four main advanced economies (US, UK, Germany and Japan)
- How?
  - The approach of Diebold and Yilmaz (2012, 2014) and Greenwood-Nimmo, Nguyen and Shin (2015) for spillovers among aggregate stock markets over risk premium moments and aggregate risk premia over stock markets.

- Daily option and high frequency data of the equity indices for the US, UK, Germany and Japan.
- Data are taken from Thomson Reuters Tick History and covers the period from January 2008 to December 2016.
- We compute the realized moments, namely, volatility, skewness and kurtosis as in the study of Amaya, Christoffersen, Jacobs and Vasquez (2015, JFE) and risk-neutral moments following the model-free methodology of Bakshi, Kapadia and Madan (2003, RFS).
- In line with the studies of Menkhoff, Sarno, Schmeling and Schrimpf (2012, JoF) and of Greenwood-Nimmo, Nguyen and Rafferty (2016, JFM), we recover the innovations in each of the risk premia from a first order autoregressive AR (1) model.

- Diebold and Yilmaz (2012, 2014) suggest a p-th order reduced-form VAR for the $d \times 1$ vector of variables $\mathbf{x_t}$:

$$\mathbf{x_t} = \Sigma_{j=1}^{p} \mathbf{\Phi_j x_{t-j}} + \mathbf{e_t} \tag{1}$$

- The H-step-ahead generalized forecast error variance decomposition for risk premium of the i-th stock market is given by (Pesaran and Shin, 1998):

$$\vartheta_{i \leftarrow j}^{(H)} = \frac{\sigma_{e,jj}^{-1} \sum_{h=0}^{H-1} \left(\epsilon_{\mathbf{i}}^{\prime} \mathbf{A_h \Sigma_e} \epsilon_{\mathbf{j}} \right)^2}{\sum_{h=0}^{H-1} \epsilon_{\mathbf{i}}^{\prime} \mathbf{A_h \Sigma_e A_h^{\prime}} \epsilon_{\mathbf{i}}} \tag{2}$$

- We then define the percentage interpretation of the forecast error variance shares by normalizing each entry of the variance decomposition matrix by the row sum such as: $\psi_{i \leftarrow j}^{(H)} = 100 \times \left(\vartheta_{i \leftarrow j}^{(H)} / \sum_{j=1}^{d} \vartheta_{i \leftarrow j}^{(H)} \right) \%$.

- Finally, using $\psi_{i\leftarrow j}^{(H)}$ we can write the $d \times d$ connectedness matrix $\mathbf{C}^{(H)}$ and then we can use the approach of Greenwood-Nimmo, Nguyen and Shine (2015, JFM) that exploits the block aggregation of this connectedness matrix to define the:
  - Total within spillovers

$$M_{i\leftarrow i}^{(H)} = \frac{1}{m}\boldsymbol{u}_{\boldsymbol{m}}^{\prime}\mathbf{B}_{i\leftarrow i}^{(H)}\boldsymbol{u}_{\boldsymbol{m}} \tag{3}$$

  - Total between spillovers

$$S_{i\leftarrow j}^{(H)} = \frac{1}{m}\boldsymbol{u}_{\boldsymbol{m}}^{\prime}\boldsymbol{B}_{i\leftarrow j}^{(H)}\boldsymbol{u}_{\boldsymbol{m}} \tag{4}$$

Connectedness among risk premia

To\From		US VRP	US SRP	US KRP	UK VRP	UK SRP	UK KRP	Germany VRP	Germany SRP	Germany KRP	Japan VRP	Japan SRP	Japan KRP
US	VRP	72.24	3.92	1.30	15.44	0.06	0.12	5.44	0.94	0.06	0.37	0.05	0.08
	SRP	4.38	81.44	11.05	1.16	0.13	0.43	1.00	0.20	0.03	0.07	0.04	0.07
	KRP	1.43	10.74	79.90	0.48	0.29	4.82	0.68	0.02	0.03	0.17	0.42	0.99
UK	VRP	5.20	1.13	0.57	85.23	0.02	0.47	6.04	0.83	0.39	0.09	0.02	0.01
	SRP	0.06	0.24	0.38	0.00	94.29	1.18	0.09	3.08	0.17	0.21	0.14	0.17
	KRP	0.23	0.16	5.30	0.62	0.93	84.77	0.61	0.19	6.02	0.08	0.85	0.23
Germany	VRP	7.32	0.88	0.71	25.74	0.04	0.46	62.27	1.38	0.07	1.06	0.03	0.03
	SRP	1.15	0.23	0.07	3.22	1.74	0.37	1.95	81.60	9.55	0.03	0.07	0.02
	KRP	0.17	0.02	0.03	1.04	0.09	1.67	0.22	10.18	86.37	0.06	0.03	0.11
Japan	VRP	5.50	0.78	0.32	7.30	0.28	0.25	4.25	0.84	0.10	78.83	1.05	0.50
	SRP	0.10	0.04	0.49	0.06	0.01	1.30	0.03	0.05	0.03	1.34	93.49	3.06
	KRP	0.07	0.22	1.09	0.37	6.06	10.92	0.57	1.26	1.71	0.46	2.51	74.75

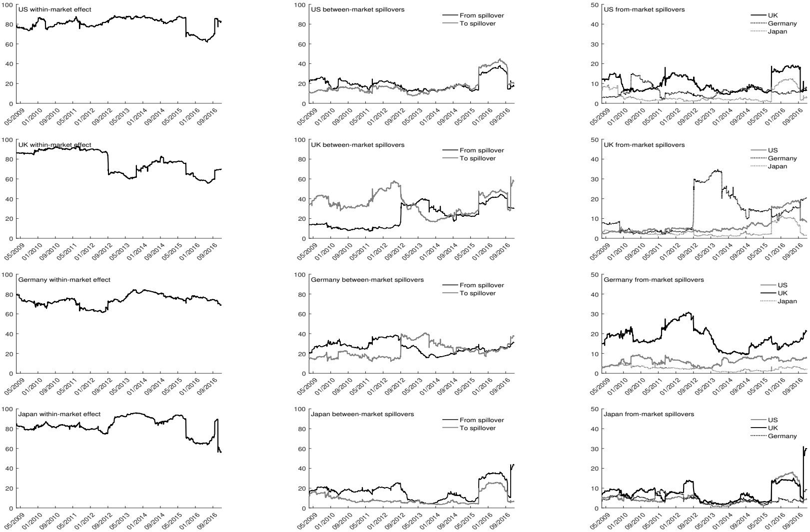
- Aggregate connectedness among stock markets

To\From	US	UK	Germany	Japan
US	88.80	7.64	2.80	0.76
UK	4.42	89.17	5.81	0.60
Germany	3.53	11.46	84.53	0.48
Japan	2.87	8.85	2.94	85.33

- Aggregate connectedness among risk premia

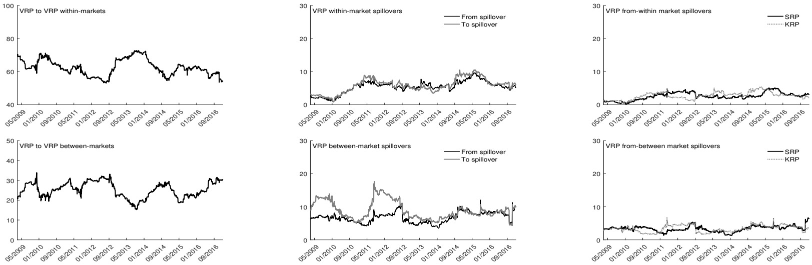
To\From	VRP	SRP	KRP
VRP	95.58	3.06	1.36
SRP	3.71	89.20	7.09
KRP	1.82	8.50	89.68

Time-varying connectedness among stock markets

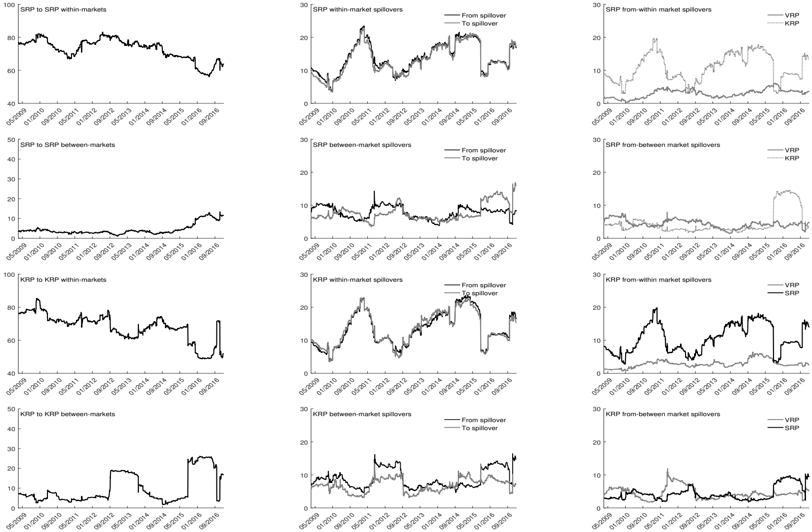


Time-varying connectedness among risk premia

- The volatility risk premium relations



Time-varying connectedness among risk premia



- On the whole, our findings highlight that the risk premium spillovers among stock markets are characterized by
  - (i) a home-bias mechanism giving importance to domestic outcomes, but with
  - (ii) an increasing attention given to the cross-market effects, especially during periods of stress and
  - (iii) the prominent role played by volatility risk premium