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Who is a recipient or transmitter in the CDS markets

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Abstract

We examine return and volatility spillover of credit risk across nine emerging sovereign credit default swap (CDS) markets using the spillover index model of Diebold and Yilmaz. Using weekly data from 2005 to 2016, we measure spillover index of sovereign default risk in nine CDS markets and find strong contagion effects among these CDS markets. In addition, we also find the pairwise directional spillover across these CDS markets. The net pairwise directional spillover identifies that China, Indonesia, Korea, Malaysia and Philippines are identified as the net transmitter, while remaining other markets (including Brazil, Russia, S.Africa and Thailand) are net receivers of spillovers. Therefore, our findings shed a new light on understanding the channels of risk transmission, which can be a useful to determine superior investment decisions and to create trading strategies for portfolio investors.

Keywords: Risk spillovers; directional and spillover index; Financial crisis

1. Introduction

The 2008 global financial crisis (GFC) which triggered by 2007 U.S. subprime mortgage crisis and was widely spread to global real economics is an example of an extreme negative risk event that lead to increase the sovereign credit risk in Eurozone, referred as European sovereign debt crisis (ESDC). These GFC and European sovereign debt crisis (ESDC) have intensified the need for an exhaustive measure of sovereign credit/default risk connectedness. Since there are many channels (some of which cannot be directly observed) through which a shock in one country can affect others, estimating these connectedness is central to risk transmission and management for academics and practitioners in modern financial field (Bostanci, & Yilmaz, 2015).

Sovereign credit risk affects both risk premiums (e.g. borrowing costs) and a country's ability to access global debt markets. The nature of sovereign credit risk renders to determine the capital flow and its cost structure across countries as well as diversify the risk of global debt portfolios (Longstaff et al., 2011). A relatively new financial instrument, Credit Default Swaps (CDSs), has been used to measure sovereign default probabilities. Sovereign CDS contracts function as insurance contracts that allow investors to buy protection against the event that a sovereign defaults on or restructures its debt. The buyer (the bondholder) of CDS makes regular premium payments to the seller, the premium amounts constituting the spread charged by the seller to insure against a credit event (Hull, Predescu, & White, 2004). In literature, sovereign

CDS spreads are highly correlated with global market factors, risk premiums, and liquidity patterns, implying susceptibility to global financial conditions (Chan, Fung, & Zhang, 2009; Grammatikos, & Vermeulen, 2012).

This paper attempts to extend the empirical studies, with the intensity and direction of contagion effects across nine emerging sovereign CDS markets namely, Brazil, China, Indonesia, Korea, Malaysia, Philippines, Russia, South Africa, and Thailand. Our study contributes to the existing literature in the following aspects. First, we investigate the intensity of return spillover indexes by employing the forecast-error variance decomposition framework of a VAR model proposed by Diebold, & Yilmaz (2014). This method measures the magnitude of return spillovers across nine emerging CDS markets. Second, we decompose the spillover index into directional 'from' ('to') of spillovers to calculate the net pairwise directional spillover index across nine sovereign CDS markets. As the spillover effect moves one direction and reverse direction over time, the net spillovers might identify who is a pure 'recipient' or 'transmitter' of risk spillovers across these sovereign CDS markets. Finally, we consider the market connectedness network to identify the channels of risk spillovers across pairwise markets. Thus, above findings on the risk spillovers can be used to evaluate the potential selection of risk-adjusted portfolio returns and thus can provide new information on superior portfolio investment decisions for international and domestic investors.

The remainder of this study is organized as follows. Section 2 discusses the methodology used in this study. Section 3 describes the data and conducts some preliminary analysis. Section 4 reports the empirical results. Section 5 provides concluding remarks.

2. Econometric modeling framework

We apply the generalized VAR methodology, variance decomposition and the generalized spillover index of Diebold, & Yilmaz (2014), to examine the directional spillovers and net spillovers across stock markets. Following Diebold, & Yilmaz (2014), we assume a covariance stationary n -variable VAR(p):

$$y_t = \sum_{i=1}^{p} \Phi_i y_{t-1} + \varepsilon_t , \qquad (1)$$

where y_t is $N \times 1$ vector of endogenous variables, Φ_i are $N \times N$ autoregressive coefficient matrices and ε_t is a vector of error terms that are assumed to be serially uncorrelated. The VAR model contains six variables $(N = 9)$, namely the returns of nine emerging CDS spreads.

If the VAR system above is a covariance stationary, a moving average representation is written as $y_t = \sum_{j=0}^{\infty} A_j \varepsilon_t$, where the $N \times N$ coefficient matrices A_j obey a recursion of the form $A_j = \Phi_1 A_{j-1} + \Phi_2 A_{j-2} + \ldots + \Phi_p A_{j-p}$, with A_0 being the $N \times N$ identity matrix and $A_j = 0$ for $j < 0$. The total, directional and net spillovers are generated by the generalized forecast-error variance decompositions of the moving average representation of the VAR model. The framework of generalized variance decompositions is able to eliminate any possible dependence of the results on the ordering of the variables.

The H-step-ahead generalized forecast-error variance decomposition is written as:

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

where Σ is the variance matrix of the vector of errors ε, and σ_{ij} is the standard deviation of the error term of the j th equation. Finally, e_i is a selection vector with one on the i th element, and zero otherwise. The yields a $N \times N$ matrix $\theta(H) = \lfloor \theta_{ij}(H) \rfloor_{i,j=1,2}$, where each entry gives the contribution of variable j to the forecast error variance of variable i. The own-variable and cross-variable contributions are contained in the main diagonal and the off-diagonal elements of $\theta(H)$ matrix, respectively.

Since the own and cross-variable variance contribution shares do not sum to one under the generalized decomposition, i.e., $\sum_{j=1}^{N} \theta_{ij}(H) \neq 1$, each entry of the variance decomposition matrix is normalized by its row sum, as follow:

$$\tilde{\theta}_{ij}(H) = \frac{\theta_{ij}(H)}{\sum_{j=1}^{N} \theta_{ij}(H)} , \qquad (3)$$

with $\sum_{j=1}^{N} \theta_{ij}(H) = 1$ and $\sum_{j=1}^{N} \theta_{ij}(H) = N$ by construction.

This ultimately allows defining a total spillover index as:

$$TS(H) = \frac{\sum_{i,j=1, i \neq j}^{N} \tilde{\theta}_{ij}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}(H)} \times 100 = \frac{\sum_{i,j=1, i \neq j}^{N} \tilde{\theta}_{ij}(H)}{N} \times 100 , \qquad (4)$$

This index measures the average contribution of spillovers form shocks to all (other) markets to the total forecast error variance. In addition, this index is flexible and allows obtaining the directional spillovers among all markets.

3. Data and summary statistics

This paper considers the weekly Friday closing prices for nine emerging sovereign CDSs, namely Brazil (BAL), China (CHN), Indonesia (IDN), Korea (KOR), Malaysia (MAL), Philippines (PHP), Russia (RUS), South Africa (SAF), and Thailand (THA), covering from 7 January 2005 to 15 July 2016. The sovereign CDS spreads were based on the most liquid 5-year tenor provided by the database of Markit Group (www.markit.com), which collects corporate and sovereign CDS quotes from more than 30 large banks on a daily basis. Figure 1 displays the dynamics of the nine sovereign CDS spreads over the sample period. We observe a similar trend for all nine sovereign CDS markets with a sharp decline from early 2007 subprime mortgage crisis to the summer of 2008, corresponding to the GFC. It clearly shows that, prior to September 2008, the CDS spreads were generally stable in almost all countries. The critical crisis threshold for CDS was the Lehman bankruptcy on 15 September, 2008, after which spreads for all of the countries increased very sharply. In early 2009, the global markets experienced macroeconomic deterioration followed by a phase of stabilization and tentative signs of recovery in late 2009.

After this, the price trend has suffered congestion due to the outbreak of the ESDC during 2009-2012.

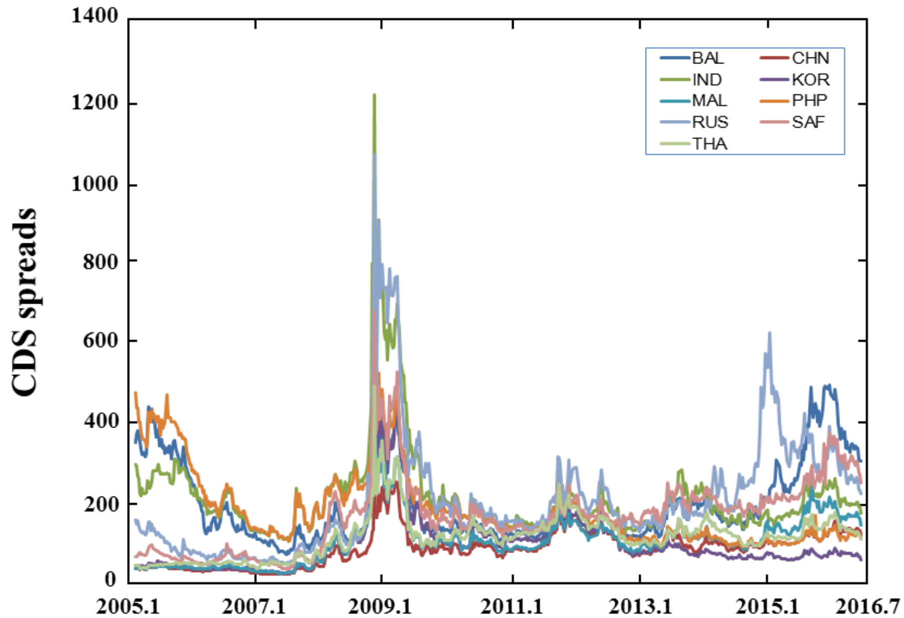

Figure 1: Dynamics of nine emerging CDS spreads

4. Empirical results

Table 1 reports the pairwise directional matrix of CDS returns. All results are based on vector autoregressions of order 4, and generalized variance decompositions of 10 week ahead forecast errors. Table 1 summarizes the total static spillover index among the nine emerging CDS returns and decomposes it by transmitters and receivers of return spillovers. It also measures the extent to which the variables are net return transmitters or net receivers. As shown in Table 1, the total return spillover index indicates average 81.50% of returns forecast error variance and shows the bi-directional return spillover effect across all nine CDS markets. More specifically, we identify that both Malaysia (MAL) and Indonesia (IDN) are the largest contributors to other countries. It contributes to the other markets on average by 106%, while it receives from the other markets 82%. Hence, in net terms, it contributes 6% more to the other market returns than it receives form the other market returns. The second largest contributor is the Philippines (PHP), with the net contribution estimated at 6%, followed by Korea (KOR; 5%) and China (CHN; 3%). However, the other markets (Brazil, Russia, S.Africa, and Thailand) are net receivers because their contributions to the all other markets less than they receive from all other markets. In particular, Russia (RUS) and S.Africa (SAF) are the largest recipients of spillovers, with the net contributions estimated at -10.7% and -8.6%, respectively. Overall, the net pairwise direction spillover indicates that China, Indonesia, Korea, Malaysia and Philippines are identified as the net transmitter, while remaining other markets (including Brazil, Russia, S.Africa and Thailand) are net receivers of spillovers.

Sovereign CDS markets have increasingly become more complex due to ongoing financial crises, which have affected the world economy and the global financial architecture. This complex system is a tough challenge that requires hedging through diversifying and other measures to provide financial stability. In this context, we consider the complex network system, to identify the channels of connectedness across sovereign CDS markets. Fig. 2 plots the risk spillover network across nine sovereign CDS markets based on the pairwise directional spillovers in Table 1. This figure shows that most of Asian sovereign CDS (red color nodes) are net transmitter of risk spillover and strongly connected with each other. In particular, Malaysia and Indonesia are the hub market of risk spillover across these markets. However, other markets (green color nodes) are net recipient of risk spillover and are weekly connected with each other. These results suggest that, the risk of Indonesia and Malaysia can help improve the channel of risk spillover other CDS markets.

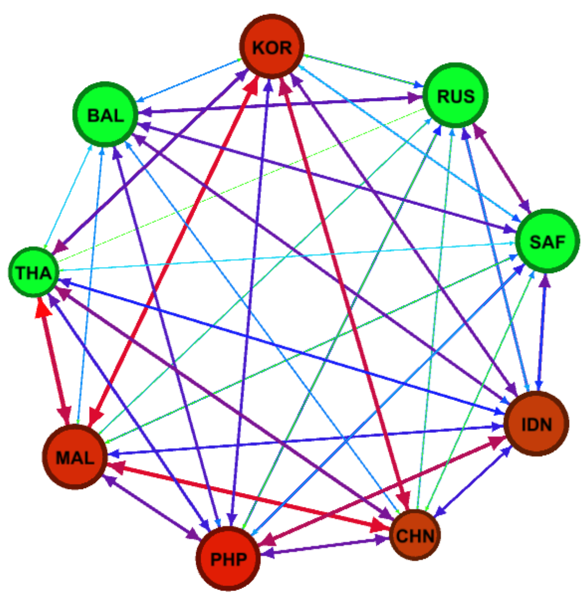

Figure 2: Connectedness network diagram.

Note: This figure shows the connectedness network among nine emerging sovereign CDS. The size of a node highlights that the magnitude of a net transmission/reception TO or FROM other variables. The red (green) color of a node shows that a variable is a net transmitter (receiver) in the system. The edge size underscores the magnitude of the pairwise directional spillover, while the magnitude is also reflected through the color type (geen (weak), light blue and blue (medium), wine and red (strong)).

Table 1: Pairwise directional return spillover index

To	From BAL	CHN	IDN	KOR	MAL	PHP	RUS	SAF	THA	**From Others**
BAL	20.34	9.06	11.27	9.01	8.94	10.93	11.07	11.04	8.35	79.7
CHN	7.91	17.44	10.65	12.8	13.15	11.34	7.33	7.79	11.58	82.6
IDN	9.55	10.49	17.2	11.31	10.45	12.5	8.74	9.79	9.97	82.8
KOR	7.73	12.54	11.26	17.13	13.16	10.78	7.98	8.33	11.09	82.9
MAL	7.69	12.68	10.31	13.1	17.09	11.29	7.22	7.91	12.71	82.9
PHP	9.17	11.14	12.41	10.8	11.57	17.54	8.06	8.74	10.57	82.5
RUS	11.58	8.98	10.73	9.62	8.79	9.93	21.17	11.84	7.35	78.8
SAF	10.81	9	11.41	9.55	9.37	10.46	11.14	20.01	8.25	80
THA	7.8	12.1	10.71	12	13.64	11.22	6.57	7.6	18.37	81.6
To Others	72.3	86	88.8	88.2	89.1	88.4	68.1	73	79.9	734
All	92.6	103.4	106	105.3	106.2	106	89.3	93.1	98.3	**Total** : 81.50
Net	-7.4	3.4	6	5.3	6.2	5.9	-10.7	-8.6	-1.7	
Conclusion	Net-recipient	Net-contributor	Net-contributor	Net-contributor	Net-contributor	Net-contributor	Net-recipient	Net-recipient	Net-recipient	

Notes: The underlying variance decomposition is based on a daily VAR of order 4 (as determined by the Schwarz information criterion) using the generalized VAR spillover framework suggested by Diebold and Yilmaz (2012). The (i,j)th element of the table shows the estimated contribution to the variance of the 10-day-ahead forecast error of *i* coming from innovation shocks to variable *j*. The diagonal elements (*i*=*j*) are the own variance share estimates, which show the fraction of the forecast error variance of market *i* that is due to its own shocks. The last column "**From others**" shows the total spillovers received by a particular market from all other markets, while the row "**To others**" shows the spillover effect directed by a particular market to all other markets. The lower right corner "**Total**" indicates the level of total spillovers.

5. Conclusion

This paper examines the risk spillover and interconnectedness across nine emerging sovereign CDS markets (Brazil, China, Indonesia, Korea, Malaysia, Philippines, Russia, South Africa, and Thailand) by employing the spillover index model of Diebold and Yilmaz (2012). In particular, we investigate the intensity and direction of risk transmission and reveal the network connectedness across these sovereign CDS markets. Our empirical results are summarized as follows. First, we measure the pairwise directional spillover across these sovereign CDS markets. Second, we identify that most of Asian CDS markets (Indonesia, Korea, Malaysia and Philippines) are net transmitters of risk spillovers to the other markets, while the remaining other markets are net receivers of risk spillovers. Third, the network system shows that both Indonesia and Malaysia is the most influence markets of risk spillover across pairwise countries. These results suggest that, the risk of Indonesia and Malaysia can help improve the channel of risk spillover other CDS markets.

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