Liquidity crunch and interdependence among major financial institutions during global financial turmoil

Evidence from credit default swap spreads

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Abstract—**This study examined ripple effects of the global financial crisis triggered by the subprime loan debacle on major financial institutions. Uncertainty in the macroeconomic environment as well as tightened liquidity in international interbank markets is implicated as a cause of an increase in the CDS spreads for various financial institutions. A loss spiral and liquidity crunch spiral are inferred to have occurred, and the jagged plummeting of stock prices and tightened liquidity were amplified in accordance with the concerns to creditworthiness of financial institutions that had been severely harmed in the global turmoil. This paper also shows that the hikes of the CDS spreads of the major monoline insurers and AIG spilled over worldwide.**

Keywords; CDS spreads; Liquidity crunch; Counterparty risk; Global financial crisis

I. INTRODUCTION

Recent years have been disastrous for financial institutions because of sharp and abrupt asset price declines, liquidity dry-ups, and fear for chain risk transfers of counterparty risks. This paper presents examination of the transmission mechanism of the global financial crisis onto credit default swap (CDS) spreads of major financial institutions including commercial banks, investment banks, and insurance companies. Special attention is devoted to the effect of common factors on the CDS spreads as well as their interdependence.

During the global financial crisis, we observed CDS spreads skyrocket, which were incompatible with changes in credit rating of a reference entity. That soaring of the CDS spreads should reflect changes in market participants' attitude related to risks as well as their perception of uncertainty in future macroeconomic conditions. Reference [7] argues that risk premia must depend not only on the riskiness of assets but also on the degree to which investors accept uncertainty (risk aversion) and the level of uncertainty itself (uncertainty about macroeconomic prospects). Reference [6] describes that periodic shifts in market sentiment witnessed over time are more likely to be driven by the macroeconomic environment rather than by changes in the risk aversion of investors. Reference [1] also asserts that a market participant's attitude related to risk can further

depend on liquidity constraints; financial institutions under severe liquidity constraints are unwilling to bear risk. Funding liquidity and uncertainty in the macroeconomic environment are therefore likely to affect CDS spreads as common factors.

A CDS is a bilateral contract between the buyer and seller of protection. Its price is presumably determined reflecting conditions affecting their behaviors. When the seller of protection is facing a liquidity constraint, the seller might raise CDS spreads even though the solvency of a reference entity does not decrease. The tighter the liquidity, the more the seller might require a risk premium for bearing fundraising risk. The seller, who has a pessimistic expectation about future macroeconomic conditions, is also likely to raise the spread.

Bankruptcy scenarios for financial institutions include two types: insolvency because of excessive debt, and bankruptcy caused by fundraising difficulties. Therefore, the abrupt hike of CDS spreads of financial institutions during the midst of the global turmoil, especially those that had used highly leveraged, short-term financing, might also be a result of market participants' assessment of the probability of bankruptcy. In fact, investors can buy and sell protection without owning any debt of the reference entity. In a case in which investors who do not own the underlying debt rush into speculation on bankruptcy of the reference entity which is on the verge of bankruptcy because of a liquidity squeeze, and sellers of protection, on the other hand, evaporate for fear of loss, its CDS spread presumably soars sharply.

A reverse transmission might also exist. During the global financial crisis, financial institutions raised their doubts and fears of one another in the interbank market, triggering a sharp rise in the interbank interest rate. Under such circumstances, the rise in the CDS spread of financial institutions, particularly those that had used highly leveraged, short-term financing, was likely to further deteriorate the credit tightening.

Recent studies of the global financial crisis include those of [5] and [6] among others. Reference [6] used the dynamic conditional correlation – generalized autoregressive conditional heteroskedasticity (DCC-GARCH) model and estimated the conditional correlation coefficients between

CDS spreads and the liquidity index. Reference [5] used a principal component analysis of CDS spreads to examine the effect of the so-called Lehman shock. They suggested the influence of liquidity as a significant common factor.

In addition to the effects of the common factors including liquidity, the authors specifically examines interdependence among the major financial institutions. The recent global financial crisis has highlighted the reemergence of counterparty risk. Asset-backed securities (ABS) or asset-backed security collateralized debt obligations (ABS-CDO) guaranteed by insurers such as monoline companies were sold to investors worldwide. In accordance with the worsening of the residential market, fears for credit downgrading of monoline insurers was followed by concerns related to the soundness of financial institutions holding enormous ABS-CDO with protection from the monolines.

The recent financial market structure has become increasingly complex primarily because of an expansion in financial guarantee trading and various derivative transactions. In such a highly complex financial market, how far the effect of bankruptcy event of a financial guarantor, or the effect of concerns to a financial guarantor on the verge of bankruptcy would reach is extremely unpredictable. A typical case is the crisis of American International Group, Inc. (AIG): the largest guarantor in the CDS market. During the financial crisis, its lack of transparency became a concern to regulators, as was the trillion dollar size of the market, which threatened the economy with systemic risk.

Numerous studies of the yield spreads of corporate bonds, which, like CDS spreads, are regarded as an indicator of default risk of the issuing entity, have been made in the past ([2] and [4] etc.), emphasizing the effect of liquidity. Reference [8], however, points out that CDS spreads are superior to corporate bond yield spreads, which are sensitive to the choice of the benchmark risk-free rate and which can reflect other factors that are not related to default risk, such as tax differences between Treasury bonds and corporate bonds, and issuing conditions including coupon rate and maturity. Reference [9] also provides empirical evidence that the CDS market leads the bond market in terms of price discovery.

This study has examined the factors affecting CDS spreads of financial institutions using a structural VAR model. In particular, emphasis is placed on the common factors and interdependence of the financial institutions. Indicators of uncertainty in the macroeconomic environment and an indicator of funding liquidity are used as the common factors. Moreover, this study was undertaken to examine the counterparty risks and attempts to examine the ripple effect from the monoline crisis and the AIG crisis specifically on the CDS spreads of other domestic and overseas financial institutions.

The remainder of this paper is organized as follows. The data and the econometric methodology used for the analysis are presented respectively in section 2 and section 3. The empirical results are reported in section 4. Finally, the major findings are summarized and the implications are presented.

II. DATA USED

This analysis uses weekly CDS spreads and indicators of macroeconomic conditions and funding liquidity, all of which were downloaded from *Datastream*, Thomson Reuters. The sample period ranges from January 5, 2007 through November 20, 2009. This study specifically examines CDS spreads of 59 major international financial institutions. All CDS spreads that are used are five-year US-dollar-denominated spreads.

Assuming that the expected uncertainty in the future macroeconomic environment is reflected in stock prices, the MSCI world index denominated in US dollar is used as an indicator of uncertainty in the world macroeconomic environment. In addition, the ECRI weekly leading index published by the Economic Cycle Research Institute is used as an indicator of the world macroeconomic uncertainty, on the assumption that the US real economic condition is influential for the performance of financial institutions outside the US as well. As for the indicator of funding liquidity, TED is employed: the three-month US T-bill yield subtracted from the three-month US dollar LIBOR.

III. EMPIRICAL MODEL

This study investigates the effect on the CDS spreads for major financial institutions using a structural VAR model as shown below.

$$A(L)X_t = u_t \qquad (1)$$

$A(L)$ is matrix polynomials in the lag operator defined as

$$A(L) = A_0 - A_1 L - \cdots - A_k L^k$$

where A_0 is specified as a recursive form to avoid the parameter identification problem, and k is the maximum lag. The structural form disturbances u are orthogonal.

X_t is a 5×1 vector of endogenous variables defined as the following.

$$X_t' = [MSCI_t, ECRI_t, TED_t, CDS_{guarantor,t}, CDS_{other,t}]$$

Therein, $MSCI_t$ and $ECRI_t$ respectively signify the weekly differences in the logarithmic MSCI world index and ECRI leading index. Here, TED_t represents the weekly differences in TED. $CDS_{guarantor,t}$ and $CDS_{other,t}$ respectively represent the weekly differences in the CDS spreads of a guarantor facing financial crisis and its counterparty financial institution. In this analysis, the sample for guarantors includes major monoline insurers and AIG.

IV. RESULTS OF EMPIRICAL ANALYSES

In this section, variance decompositions and historical decompositions are reported while the empirical evidence of impulse responses is omitted. Results of unit root test reveal that all sample data used in this analysis satisfy stationarity.

A. Variance Decompositions

Table 1 reports variance decompositions of the CDS spread of each counterparty financial institution, in a case where Ambac is adopted as a guarantor. The numerical values in table 1 are the averaged contribution of variance of the one-step forecast error through that of the ten-step forecast error for each component.

The impact of the MSCI index among the common factors is dominant; its averaged contribution to the variance of each CDS spread reach to 17.41%. This empirical evidence shows that insurance companies, notably MetLife, Aegon and AXA tend to be affected strongly by stock prices relative to banks and securities companies, which presumably result from the differences in percentages of stocks held in their respective portfolios. This analysis has used the stock price index as an indicator of uncertainty in the macroeconomic environment. This presumption implies that worsening prospects for future economic conditions indicated by a decline in the stock price index make market participants raise CDS premiums to compensate for increased uncertainty. Moreover, declines in stock prices can directly degrade the creditworthiness of financial institutions whose equity capital is eroded by the downturn of stock markets. Insurance companies holding a large weight of stock investments are susceptible to falling stock prices. Aside from insurance companies, investment banks including Goldman Sachs were confirmed to be affected considerably by changes in the MSCI index[1].

Although the contribution of TED to CDS spreads of financial institutions as a whole is reported as only 4.67%, its respective contributions to CDS spreads of some specific financial institutions exceed 10%. A financial institution that was strikingly affected by TED is Morgan Stanley. The contribution of TED to its CDS spread reached 26.27%. While commercial banks and investment banks depending on short-term fundraising are more prone to be affected by liquidity conditions than insurance companies, insurance companies such as Hartford, MetLife and Aegon are also identified as vulnerable to liquidity tightening. This is because their major products are myriad variable annuities with guaranteed minimum payments through the extensive use of derivative instruments, whose markets were severely hit by liquidity crunch in the midst of global financial crisis.

The CDS spread of Ambac is more dominant for insurance companies and its contribution exceeds 10% to CDS spreads of MetLife, Prudential Financial, Prudential plc., Swiss Reinsurance and Sompo Japan. It seems that the monoline crisis was more critical for insurance companies. The impact on the CDS spread of Citigroup, which was expected to have suffered extensive damage from the downgrading of Ambac, is also identified.

Table 2 and 3 present variance decompositions for the MSCI world index and TED respectively, as estimated by adopting the CDS spread of AIG as a guarantor. Regarding

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[1] Although the contribution of the MSCI index to the variance of the CDS spreads of Morgan Stanley and Fortis is relatively small, impulse response estimation reveal that the CDS spreads of those financial institutions significantly react to the MSCI index.

TABLE I.   VARIANCE DECOMPOSITION FOR CDS SPREAD OF COUNTERPARTY FINANCIAL INSTITUTION

	MSCI	*ECRI*	*TED*	*CDS of Ambac*	*CDS of counterparty*
Hartford	23.31	2.32	10.68	7.82	55.87
MetLife	31.89	2.01	11.40	10.46	44.23
Prudential Fin.	27.26	3.58	9.90	12.08	47.17
Citigroup	22.21	1.80	3.08	14.09	58.83
Goldman Sachs	24.84	1.53	14.46	2.06	57.12
Morgan Stanley	12.39	2.78	26.27	2.43	56.14
Aegon	34.73	1.58	17.72	5.91	40.06
AXA	31.19	1.13	7.16	7.85	52.66
Prudential plc.	23.86	0.74	0.84	11.76	62.80
Swiss Re.	24.18	1.07	4.05	13.43	57.27
Fortis	14.97	6.99	11.92	1.28	64.85
RBS	8.17	2.00	12.44	5.92	71.46
Mitsubishi UFJ	18.12	1.95	11.38	3.27	65.28
Sompo Japan	27.99	1.97	1.23	15.91	52.90
Average	17.41	2.14	4.67	6.47	69.31

the variance decomposition of the MSCI index, results show that, on average, 86.75% of its variance is explainable by shocks in the world stock markets; other structural shocks have negligible effects. For a case in which an investment bank such as Goldman Sachs or Morgan Stanley or a bankassurance such as Fortis, which received the government financial bailout funds, is presumed as a counterparty financial institution for AIG, shocks in the CDS spreads of the financial institutions described above reveal a large contribution to the variance of the MSCI index. The CDS spread of Morgan Stanley, for example, explains 15.5% of the variance of the forecast error for the MSCI index. The CDS spread of another severely damaged financial institution in the turmoil, AIG, shows no significant impact on the MSCI index.

Although the greater part of variance of TED – similar to that of the MSCI index, on average – can include a contribution from its own shocks resulting from the interbank market, some financial institutions are verified to have a strong impact on TED. Financial institutions that represent a markedly high impact on TED are those such as Goldman Sachs and RBS, whose contributions to TED exceed 20%. The results imply the possibility that hikes in the CDS spreads of the troubled financial institutions attributable to the fundraising difficulty aggravated the situation in which financial institutions' doubts and fears of one another had been increasing, resulting in a sharp rise in interbank market rates. The CDS spread of AIG, contrary to our expectations, has a negligible effect on TED when any other financial institution is adopted as its counterparty.

TABLE II.   VARIANCE DECOMPOSITION FOR MSCI WORLD INDEX

	MSCI	ECRI	TED	CDS of AIG	CDS of counterparty
Goldman Sachs	73.96	5.40	3.33	2.62	14.69
Morgan Stanley	71.93	5.82	3.81	2.93	15.50
Fortis	76.63	6.02	3.55	2.41	11.38
Average	86.75	3.71	3.86	2.89	2.79

TABLE III.   VARIANCE DECOMPOSITION FOR TED

	MSCI	ECRI	TED	CDS of AIG	CDS of counterparty
Goldman Sachs	5.01	1.00	71.55	0.71	21.73
Morgan Stanley	5.62	0.87	78.29	0.44	14.78
Barclays	3.90	1.02	76.45	0.48	18.15
HBOS	6.73	0.87	77.69	0.30	14.42
Lloyds TSB	5.46	1.37	76.86	0.72	15.59
RBS	4.50	1.29	73.21	0.61	20.40
UBS	4.46	1.42	76.88	1.08	16.16
Average	6.69	0.77	84.89	0.35	7.30

Coupled with the evidence that the CDS spreads of financial institutions such as Goldman Sachs has been largely affected by the MSCI index, a vicious cycle between declines in stock prices and hikes in CDS spreads for financial institutions which were facing the deleveraging problem can be inferred. Reference [3] argues that a loss spiral arises for leveraged investors because a decline in the value of assets erodes the investors' net worth much faster than their gross worth. Similarly, considering the results reported in table 1 that TED has a significant impact on the CDS spreads of financial institutions described above, liquidity crunch spiral probably emerged, whereby the increased CDS spreads attributable to tightened liquidity, which raised mutual doubts and fears in the interbank market, had reinforced the liquidity crunch.

B. Historical Decompositions

In this subsection, the results of historical decomposition are reported. By rewriting (1) as the moving average representation, *X* at time *T+k* can be formalized as presented below.

$$X_{T+k} = \sum_{s=0}^{k-1} \Psi_s u_{T+k-s} + \sum_{s=k}^{\infty} \Psi_s u_{T+k-s} \qquad (2)$$

The first sum on the right hand side of (2) represents the part of X_{t+k} attributable to innovations during periods *T+1* to *T+j*. The second term is the forecast based on information available at time *T*. Fluctuations of the five variables in vector *X* after time *T+1* are traceable to the time path of the components in the first term.

Fig. 1 and 2 display a historical decomposition for the CDS spread of Morgan Stanley and MetLife, respectively. Both CDS spreads soared sharply during October 2008; an extraordinary hike is observed in the CDS of Moran Stanley, which exceeded 1200 basis point at the peak. October 2008 is a period of severe financial market dysfunction with an accompanying substantial rise in interest rate. The hikes in CDS spreads during this period are likely to be explained by the liquidity squeeze.

In contrast to Morgan Stanley, the CDS spread of MetLife is identified as more affected by shocks in stock prices, and soared in March 2009, when the MSCI world index reached a new low. This is consistent with the results of variance decompositions, implying that CDS spreads of insurance companies are susceptible to stock plunges because their creditworthiness is definitely connected with the performance of stock investments.

Fig. 3 depicts the historical decomposition for TED, where AIG and Goldman Sachs are adopted respectively as a guarantor and its counterparty. It is apparent that shocks in the CDS spread of Goldman Sachs as well as shocks in TED strongly affected movements in TED. In March 2008, when Bear Sterns was sold to JP Morgan Chase and in October of the same year soon after the bankruptcy of Lehman Brothers, TED sharply increased, accompanied by the increase in the CDS spread of Goldman Sachs. The historical decomposition reflects possibility that not only transmission from TED to the CDS spreads of financial institutions facing severe difficulty in the global turmoil existed, but also the reverse transmission.
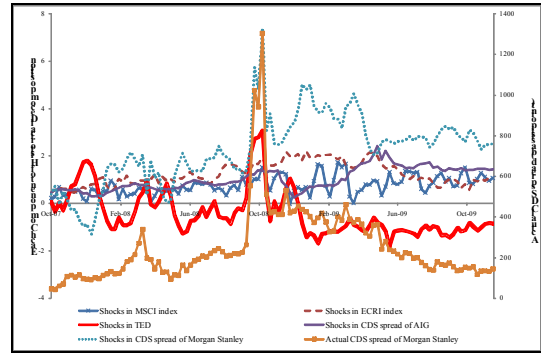

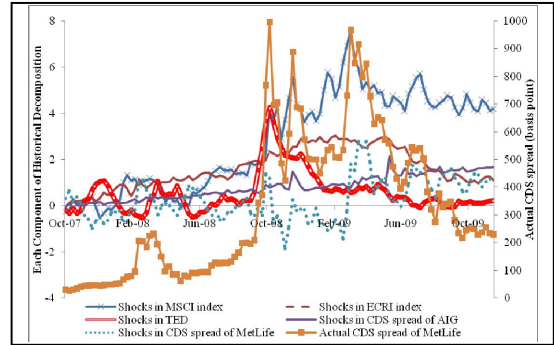Figure 1.   Historical decomposition for CDS spread of Morgan Stanley

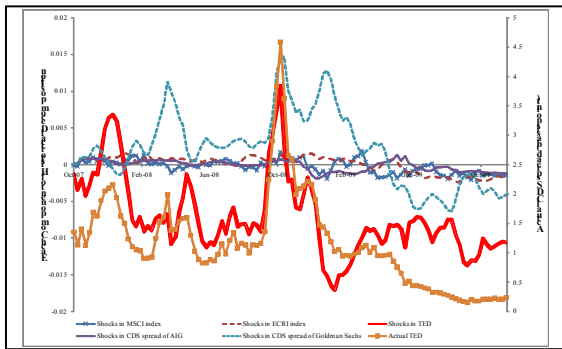Figure 2.   Historical decomposition for CDS spread of MetLife

Figure 3. Historical decomposition for TED

V. CONCLUSION

The following describes the conclusions of the empirical analysis of this study.

First, uncertainty in the macroeconomic environment is implicated as a cause of an increase in the CDS spreads for various financial institutions. The effects of the MSCI index are dominant. In particular, the corporate value of those financial institutions engaging in asset management as their core business was affected considerably by stock price trends.

These results should therefore be interpreted in the following two ways. The first interpretation is that market participants, who observed declines in stock prices as a signal of stagnation of world economic activities, quoted higher prices on CDS to make up for unforeseeable losses. A second interpretation is that the hike in CDS spreads definitely reflected worsened creditworthiness of financial institutions whose equity capital was eroded because of the plunge in stock prices.

The effect of liquidity was especially significant for U.S. investment banks and other institutions with short-term debts comprising a large part of their fundraising structure. Banks tended to be more susceptible to the effects of liquidity than insurance companies were. The impact on insurance companies whose major line of products was related to variable annuity products with guaranteed minimum payments provided through the extensive use of derivatives was also prominent.

The effect of liquidity can also be interpreted in two ways. Market participants facing with tightened liquidity probably increased CDS premiums to compensate the increased fundraising risks with a higher risk premium. Alternatively, the increased CDS spreads might reflect the possibility of failures of financial institutions which were on the verge of bankruptcy because of the liquidity squeeze.

Results of the analysis also suggest that the CDS spreads of financial institutions that were strongly affected by stock prices and funding liquidity furthermore had dominant impacts on the MSCI index and TED. A loss spiral and liquidity crunch spiral are inferred to have occurred, and the jagged plummeting of stock prices and tightened liquidity were amplified in accordance with the concerns to creditworthiness of financial institutions that had been severely harmed in the global turmoil. The causality among those variables should be confirmed rigorously.

The financial crisis of U.S. monoline insurers and AIG proved to have affected the markets both inside and outside the U.S. Although some argue that banks and insurance companies were using CDS as a measure to mitigate capital requirements and to liberate capital for additional loan intermediation, the study findings suggest that the crisis of AIG, which was the greatest seller of CDS, had spread to other banks and insurance companies as counterparty risk. The monoline crisis seems to have larger impacts on insurance companies than on banks because insurance companies were closely connected with monoclines through the financial reinsurance business as well as investment in securitized products with guaranteed. The impacts of the monoline and AIG crises on TED are not significant, which might be an unexpected result. The robustness of this result should be confirmed.

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