

DETERMINANTS OF COMMON FACTORS IN KOREAN BANKS' CREDIT DEFAULT SWAP PREMIUMS

¹Seungjun Lee, ²Jaewoon Koo and ³Youngsik Kwak

^{1,2}Department of Economics,
Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju, Korea 500-757, Korea

³Department of Accounting, Economics and Finance,
Delaware State University, 1200 North DuPont Highway, Dover, DE 19901, Delaware

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ABSTRACT

Using the panel analysis of non-stationarity in idiosyncratic and common component method, we decompose Credit Default Swap (CDS) premium data of 11 Korean banks into common factors and idiosyncratic shocks. We find that the CDS premium of all 11 banks is mostly explained by one common factor. We also find that the common factor of the banks' CDS premium is mainly affected by the level and the volatility of stock market prices in developed markets and oil prices. It suggests that the Korean banking industry is susceptible to foreign shocks due to the heavy dependency of the Korean economy on export. We also find that a structural break in the common part of CDS premium occurred in mid-2007, implying that the exposure of credit risk in Korean banks jumped up after the 2007 financial crisis.

Keywords: Credit Default Swap Premium, Common Factor, Capital Flows, Credit Risk

1. INTRODUCTION

The explosion and dramatic reversal of capital flows among international markets since the 1990s have ignited a heated debate. Some people argue that globalization has gone too far and that international capital markets have become extremely erratic. Conversely, others claim that globalization allows capital to move to where it is mostly needed in promoting economic growth. After the currency crisis in the late 1997, Korea has gradually opened its financial markets to promote foreign investment. Since the currency crisis, a series of institutional changes was implemented to facilitate the direct foreign investment. The changes included (1) opening the corporate bond market (December 1997), (2) allowing the purchase of short-term financial products (February 1998), (3) abolishing the limit of domestic equity investment (May 1998), (4) allowing hostile M&A activities (April 1998), (5) opening more industries for foreign investment (May

1998) and (6) enacting the Foreign Investment Promotion Act (November 1998). Especially, in September 1998 the Foreign Exchange Management Act was abolished. Subsequently, in April 1999 the Foreign Exchange Trade Act was enacted and implemented to minimize regulations on foreign trade and to expand foreign exchange trading. With a series of institutional changes, Korean financial markets have become more volatile and more vulnerable to foreign shocks. When negative economic news comes from foreign countries, Korean financial markets could immediately be slashed by large capital outflows. Skeptical expectations on the Korean economy due to a decrease in exports and changes in portfolio may lead foreign investors to withdraw their fund from the Korean markets. As a result, sequential capital outflows induced shortage of liquidity in the domestic market, which had negative impacts on the Korean economy in the short run.

In particular, more liberalized Korean financial markets were thrown into turmoil when the subprime mortgage

Corresponding Author: Youngsik Kwak, Department of Accounting, Economics and Finance, Delaware State University, 1200 North DuPont Highway, Dover, DE 19901, Delaware Tel: 302-857-6900

crisis in the United States broke out in September 2008. The subprime crisis is attributed to the problem of the United States economy due to the failures of asset management strategy of the U.S. financial institutions.

The crisis unfortunately affected Korean financial markets and the economy through withdrawal of foreign funds which led the Korean economy to be in severe liquidity shortage and a credit crunch. As Korean financial markets could not function well under a credit crunch, credit risks of lending increased and accordingly the credit default swap (hereafter CDS) premium soared. Korean banks' CDS premiums seemed to especially be susceptible to foreign shocks. Financial institutions would be exposed to a higher credit risk of lending due to the increase in bankruptcy risk of Korean firms. Therefore, their CDS premium rises.

Various methods have been employed to measure bank risk in the existing literature. Those methods include some alternative measures of firm risk such as subordinated debt spread (Krishnan *et al.*, 2006) and expected default frequency calculated by an option pricing model (Altman and Hotchkiss, 2005). In addition, the CDS premium or spread has been increasingly popular as a simple indicator of bank credit risk. A CDS is a bilateral transaction under which the buyer is insured against credit risk and pays premium to the seller. The CDS premium is expressed as a function of the nominal value of the contract. Previous studies investigating the pricing of CDS premium claim that CDS premium is an efficient measure of credit risk. For example, Longstaff *et al.* (2005) claim that CDS spreads appropriately reflect credit risk. Kim *et al.* (2010) finds that the CDS spreads for Asian borrowers widened during the 2007-2009 crisis because of high expected default frequency.

Besides individual risk, researchers become more interested in systemic risk in the financial sector after a financial crisis. For instance, Bijlsma *et al.* (2010) review main literature investigating reasons for systemic risk and policy implications of systemic risk. Because of externalities, contagion and spillover inherent in financial markets, we must be concerned about systemic risk as well as individual risk. Systemic risk is measured by various indicators: principal components of the banks' CDS (Billio *et al.*, 2010), spillover index (Diebold and Yilmaz, 2009), dynamic conditional correlation (Rahman, 2014) and co-risk measures (Adrian and Brunnermeier, 2011) and so on.

A few studies exploit the common factor as a measure of systemic risk. Kool (2006) investigates the role of common factors in European bank CDS

spreads for financial stability and documents that the common factor is related to the European P/E ratio and the European 2-year nominal interest rate. Applying a dynamic factor model to the distance-to-default of EU banks, Brasili and Vulpes (2006) find that the commonality in bank risk appears to have increased since 1999. Eichengreen *et al.* (2012) recently report that common movement of banks' CDS spreads rose after the subprime crisis, using principal components analysis. Rahman (2014) also finds the extreme co-movements of financial institutions' default swap contracts in the aftermath of the subprime crisis.

We focus on common factors of Korean banks' CDS premium measure to estimate an indicator of systemic risk. Following the Bai and Ng (2004) method, we extract common factors of banks' CDS premium. After exploring the properties of the common factors, we attempt to select an optimal number of common factors and to find determinants of the common factors.

The main empirical findings are as follows: First, most variation of individual bank CDS premium is explained by a common factor. Second, the common factor of bank CDS premium is strongly affected by the level and volatility of stock prices in the developed market. In addition, the common factor is affected by spot oil price and sovereign bond rate. Finally, there was a structural break in the common part in August 2007 as a result of contagion of the subprime crisis in the U.S.

We offer some policy implications from the findings. First, individual bank's CDS premium has a strong tendency to move in the same direction, indicating that the Korean banking industry is exposed to a substantial systemic risk. Second, because systemic risk is strongly susceptible to foreign capital outflows due to changes in the foreign macro-financial economic condition, regulatory efforts should be made to minimize the impact of foreign capital outflows on Korean financial markets and economy.

2. METHODOLOGY

The factors affecting the CDS premium can be categorized into macro-financial variables and firm specific variables mostly reflecting balance sheet information. The firm's specific variables include leverage, equity return, idiosyncratic volatility, the price to book ratio and credit ratings. On the other hand, macro-financial variables cover interest rates, term structure, equity market returns, equity market volatilities, macroeconomic conditions, sovereign bond yields and country credit ratings for sovereign bonds. In

particular, the bank CDS premium in emerging markets would respond to the movements of the capital flows due to changes in macroeconomic conditions.

Because changes in the aggregate macroeconomic environment would affect CDS premium of all banks, the common factors extracted from CDS premium of banks would be explained by macro-financial variables. An approximate factor model is intuitively appealing in observing how the common factors of individual banks have reacted to the changes in the macroeconomic environment.

We decompose the CDS spreads across Korean banks into one or more common factors and idiosyncratic components attributable to individual firms by identifying common factors suggested by Bai and Ng (2004). Next, we attempt to find out what macro-financial variables have determined the common factors among CDS premiums of Korean banks. The determinants might be closely related to the stability of the Korean banking industry and ultimately to the stability of the Korean economy.

2.1. Factor Model

Let X_{it} be the observed CDS spread for the i th bank at time t , for $i=1, \dots, N$ and $t=1, \dots, T$. Consider the following model:

$$X_{i,t} = \mu_i + \lambda_i' F_t + e_{i,t} \tag{1}$$

where, e_{it} is the idiosyncratic component of X_{it} with a zero mean and is orthogonal to F_t , which is a vector of common factors. λ_i is a vector of factor loadings related to F_t . $\lambda_i' F_t$ is called the common component of X_{it} . Equation 1 is then the factor representation of the data which has two unobserved components-common factor and idiosyncratic components.

Common factor F_t can be estimated by taking the first difference of Equation 1 as follows:

$$\Delta x_{i,t} = \lambda_i' f_t + \Delta e_{i,t} \tag{2}$$

where, $f_t = \Delta F_t$. By applying the principal component analysis to $\Delta x_{i,t}$, estimates of r factors of \hat{f}_t are obtained.

Then calculating $\hat{F}_t = \sum_{s=2}^t \hat{f}_s$ for $t = 2, \dots, T$ and estimating Equation 1 via OLS, we obtain the estimators of μ_i and λ_i and the residuals $\hat{e}_{i,t}$.

To determine the number of common factors r in Equation 2, the following criterion is adopted, which is the most robust under the presence of cross correlations among the idiosyncratic components:

$$IC(r) = \ln(V(r, \hat{F})) + r \left(\frac{N+T}{NT} \right) \ln \left(\frac{NT}{N+T} \right) \tag{3}$$

Where:

$$V(r, \hat{F}) = \frac{1}{NT} \sum_{i=1}^N \sum_{t=1}^T (\Delta x_{i,t} - \lambda_i' f_t)$$

The information criteria reflect the trade-off between the goodness-of-fit and over fitting. The first term on the right shows the goodness-of-fit given by the residual sum of squares, which depends on the estimates of the number of factors. If the number of the factors r increases, variance of the factors f_t also increases while the sum of squared residuals decreases. The penalty of over fitting, which is the second term on the right, is an increasing function of the cross-section size N and time series length T . The optimal number of factors minimizes $IC(r)$.

After the optimal number of the common factors is determined based on Equation 3, CDS spread data was decomposed into r common factors and idiosyncratic component of bank i 's premium. With the calculated common factor premium among Korean banks, this study investigates what affects common factor premium by employing regression analysis.

2.2. Data

Data consists of a balanced panel of daily CDS premium of 11 major Korean banks as a direct measure of credit spreads. The periodic payment expressed in basis points is called CDS premium. By definition, it provides a pure measure of the default risk of the reference entity. The sample covers data from January 23, 2006 to April 18, 2011 and includes 1,366 observations. The Korean banking industry consists of seven major commercial banks, five specialized banks and six local banks. Because of some banks having insufficient trading records, the data includes only seven major banks and four specialized banks. Specialized banks were established with specific purposes of bolstering financing in specific areas facing funding difficulties due to profitability and expertise, based on the Special Act and run by the Korean government. The CDS data was extracted from Bloomberg. Other data-representing macroeconomic conditions was derived from the Korean Center for International Finance.

Table 1 reports summary statistics for the CDS premium of each bank. Most banks experienced a mean premium of 121.2 to 157.8 basis points over the sample period. The first four banks and Citibank Korea Inc. demonstrate relatively lower mean than the rest.

Table 1. Descriptive statistics of Korean bank CDS

| Bank | Mean | Maximum | Minimum | Standard deviation |
|-------------------------------|-------|---------|---------|--------------------|
| Korea Exim bank | 121.2 | 832.2 | 11.9 | 124.4 |
| Korea Development Bank | 123.0 | 841.4 | 12.3 | 125.6 |
| Nonghyup Bank | 129.2 | 804.7 | 12.7 | 127.6 |
| Industrial Bank | 130.2 | 848.1 | 12.6 | 132.1 |
| Kukmin Bank | 135.5 | 857.4 | 12.4 | 133.0 |
| Shinhan Bank | 146.7 | 852.9 | 13.7 | 143.5 |
| Woori Bank | 156.7 | 881.7 | 12.3 | 155.3 |
| Hana Bank | 147.5 | 863.0 | 13.3 | 144.3 |
| Citi Bank | 125.0 | 880.3 | 13.2 | 130.5 |
| Korea Exchange Bank | 141.8 | 812.1 | 16.2 | 137.4 |
| Standard Chartered First Bank | 157.8 | 882.4 | 16.5 | 159.8 |

Unit: basis points

Table 2. Unit root test results

| Bank | Level | | First difference | |
|-------------------------------|------------|----------------|------------------|----------------|
| | Lag length | Test statistic | Lag length | Test statistic |
| Korea Exim bank | 9 | -1.155 | 6 | -18.381 |
| Korea Development Bank | 9 | -1.215 | 8 | -14.320 |
| Nonghyup | 23 | -0.959 | 22 | -8.865 |
| Industrial Bank | 19 | -1.362 | 8 | -7.344 |
| Kukmin Bank | 7 | -1.004 | 6 | -17.525 |
| Shinhan Bank | 14 | -1.338 | 13 | -8.293 |
| Woori Bank | 9 | -1.117 | 8 | -12.049 |
| Hana Bank | 9 | -1.051 | 8 | -13.113 |
| Citi Bank | 1 | -1.428 | 0 | -48.058 |
| Korea Exchange Bank | 1 | -1.346 | 0 | -47.547 |
| Standard Chartered First Bank | 17 | -1.195 | 16 | -8.580 |

Note: Test critical value for 5% level is -1.941. The lag length was set based on Schwartz information criteria

Since the first four banks are special banks considerably controlled by the Korean government, they would be perceived as relatively less risky. Standard deviations for most banks range from 124.4 to 169.8 basis points. In general, the larger the mean, the larger the standard deviation is. Private banks, in particular, experienced more volatile movements of premium over the sample period. The CDS premium for most banks soared above 800 basis points around late October 2008 right after the financial crisis triggered by the Lehman Brothers collapse in the United States. Since then, the CDS premium demonstrated a low and stable movement around 11.9 to 16.5 basis points until June 2007.

We implement unit root tests to check the stationarity of the CDS premium of Korean banks. The results in **Table 2** show that every series is non-stationary in level while they are stationary in the first difference.

3. EMPIRICAL ANALYSIS

3.1. Common Part of CDS Premium

We use the method proposed by Bai and Ng (2004) to extract the common factors corresponding to the latent

risk dimensions in the CDS premium. Before determining the number of common factors, we conduct the cross-section dependence test suggested by Breusch and Pagan (1980) in order to check whether the cross-section dependence exists among banks' CDS premium. The test result provides evidence that the CDS premium series are dependent upon each other. The results are presented in **Table 3**.

In order to find the optimal number of common factors, we employ Equation 3 and calculate the value of $IC(r)$. The number of common factors is tested up to 8.

The result in **Table 4** shows that the lowest value is 7.042 when the number of common factor is one ($r = 1$). Here, r represents a number of common components while IC stands for value of information criteria suggested by Bai and Ng (2002). Hence, the CDS premium data of 11 Korean banks is decomposed into one common factor and eleven idiosyncratic series.

The estimated common factor explains approximately 98.5% of the total variations of the CDS premiums. That is, the variations of the CDS premium are mostly explained by the estimated common factor.

Table 3. Breusch and Godfrey’s cross-section dependence test

| Test type | Statistics | Critical value ($\chi^2_{55,0.05}$) | P- value |
|-----------|------------|---------------------------------------|----------|
| LM Test | 73137.654 | 38.985 | 0.000 |

Table 4. Bai and Ng (2002)’s Information Criteria

| r | IC(k) |
|----|--------|
| 0 | -4.865 |
| 1* | -7.042 |
| 2 | -6.947 |
| 3 | -6.792 |
| 4 | -6.837 |
| 5 | -6.725 |
| 6 | -6.714 |
| 7 | -6.535 |
| 8 | -6.366 |

Note: * indicates the optimal number of common factors

In other words, variations of the CDS premium explained by idiosyncratic component were surprisingly insignificant.

The common factor of Korean banks’ CDS premium in **Fig. 1** demonstrates that it reached the bottom on May 4th of 2007 recording -0.31 in logarithm and approximately -0.08 on average over the period between January 24, 2006 and May 4, 2007. After reaching the bottom, it soared and reached the top on October 27, 2008, recording 1.54. The average during that period increased to 0.46. A major reason for continuous increase in the CDS premium is that the Korean capital market was so closely linked to the U.S. capital market and hence was affected by the subprime mortgage turmoil and global financial crisis. A tremendous outflow of foreign funds drove the Korean economy into a damaging situation due to a sharply decreasing liquidity supply. Naturally, the sequential credit crunch led to difficulties in financing for business firms. As the financial status of Korean firms worsened, the CDS premium of banks sharply increased. After adjusting and recovering from the financial crisis shock, the CDS premium gradually lowered down to 0.55 on January 12, 2010. It increased to around 0.69 since then but never returned to the same level that it reached in 2006 for a substantial period of time. This indicated that the global financial system was not yet fully recovered and stable. That is, the Korean economy could not completely be independent from financial crisis shocks and the Korean economy and banking industry were still in danger.

3.2. Determinants of Common Factor of the CDS Premium

Because of the frequency of the daily CDS premium, we select the macro-financial data publicly announced daily. The variables are limited to the movements of foreign and domestic financial markets, currency

markets and commodity markets. Suh and Lee (2011) take into account per capita GDP, GDP growth rate, foreign reserves, fiscal balance, current balance as macro variables that determine the CDS premium. Considering the limitation of daily data availability, we initially employ a FTSE index for the developed markets (hereafter FTSED) and a FTSE index for the emerging markets (hereafter FTSEE), KOSPI500 (hereafter KOSPI), the CDS premium of Korean sovereign bond matured in 2025 (hereafter Korea bond CDS premium) and the Dubai oil spot price (hereafter Oil price) in the regression analysis. In addition, the volatility of each variable is added in the model for a better specification. Each variable is measured as moving averages of 20 trading days while the volatility of each variable is measured as moving standard deviations of 20 trading days. Looking at movements of volatilities in **Fig. 2**, we suspect a co-movement of volatilities and the common part of the CDS premium.

A cointegration test is conducted in order to check if variables are cointegrated. Level data would be used if cointegrated. Otherwise, the differenced data would be chosen in order to avoid a spurious regression problem. Johansen’s Trace test is conducted with the lag length 2 and the result is presented in **Table 5**. The result indicates that there is one cointegrating relationship among the variables at the 0.05 level. Hence we employ the level data in regressions.

The empirical model including the volatilities is shown in Equation 4 below. All variables are in logarithm:

$$\begin{aligned}
 CF_t = & \alpha + \beta_1 FTSED_{t-1} + \beta_2 FTSEE_{t-1} \\
 & + \beta_3 KOSPI_{t-1} + \beta_4 KRBOND_{t-1} + \beta_5 DUBAI_{t-1} \\
 & + \beta_6 VOL_FTSED_{t-1} + \beta_7 VOL_FTSEE_{t-1} \\
 & + \beta_8 VOL_KOSPI_{t-1} + \beta_9 VOL_KRBOND_{t-1} \\
 & + \beta_{10} VOL_DUBAI_{t-1} + \varepsilon_t
 \end{aligned}
 \tag{4}$$

Where:

- CF* = Common factor of CDS premium
- FTSE* = FTSE for developed markets announced by Financial Times
- FTS* = FTSE for emerging markets announced by Financial Times
- KOSPI* = Korea Stock Market Price Index
- KRBOND* = CDS premium of Korea sovereign bond
- DUBAI* = Spot price of oil in Dubai
- VOL* = Volatility

Table 5. Cointegration rank test (Trace)

| Hypothesized no. of CE(s) | Eigenvalue | Trace statistic | 0.05 critical value | P-value** |
|---------------------------|------------|-----------------|---------------------|-----------|
| None* | 0.031855 | 94.62371 | 83.93712 | 0.0068 |
| At most 1 | 0.014574 | 51.14647 | 60.06141 | 0.2250 |
| At most 2 | 0.012855 | 31.42894 | 40.17493 | 0.2843 |
| At most 3 | 0.007654 | 14.05341 | 24.27596 | 0.5327 |
| At most 4 | 0.002478 | 3.734848 | 12.32090 | 0.7488 |
| At most 5 | 0.000300 | 0.403310 | 4.129906 | 0.5888 |

* Denotes rejection of the hypothesis at the 0.05 level

**MacKinnon *et al.* (1999)'s p-values

Table 6. Structural break test (August 1, 2008-April 18, 2011)

| Test type | F-statistics (6, 1334) | Critical value ($F_{6,1334}$) | P-value |
|-----------|------------------------|---------------------------------|---------|
| Chow test | 529.262 | 3.670 | 0.000 |

Table 7. Regression results of determinants of the common component model with dummy

| Variable | Model I | | | Model II | | |
|-----------------------------|-------------------------|---------------------------------|---------|-------------------------|---------------------------------|---------|
| | Coefficient | Standard error | P-value | Coefficient | Standard error | P-value |
| C | 4.725* | 0.262 | 0.000 | 4.096* | 0.233 | 0.000 |
| FTSED _{t-1} | -1.179* | 0.090 | 0.000 | -1.288* | 0.094 | 0.000 |
| FTSEE _{t-1} | 0.155 | 0.164 | 0.342 | | | |
| KOSPI500 _{t-1} | -2.098* | 0.163 | 0.000 | -1.639* | 0.081 | 0.000 |
| KRBOND _{t-1} | 0.857* | 0.035 | 0.000 | 0.767* | 0.034 | 0.000 |
| DUBAI _{t-1} | 1.399* | 0.015 | 0.000 | 1.391* | 0.037 | 0.000 |
| VOL_FTSED _{t-1} | | | | 4.779* | 0.717 | 0.000 |
| VOL_KOSPI500 _{t-1} | | | | -0.352 | 0.604 | 0.560 |
| VOL_KRBOND _{t-1} | | | | 0.248 | 0.149 | 0.096 |
| VOL_DUBAI _{t-1} | | | | 0.730 | 0.407 | 0.073 |
| Dummy | 0.440* | 0.015 | 0.000 | 0.413* | 0.014 | 0.000 |
| | R ² = 0.958 | Adjusted R ² = 0.958 | | R ² = 0.961 | Adjusted R ² = 0.961 | |
| | F statistics = 5113.316 | | | F statistics = 3695.906 | | |
| | P-value = 0.000 | | | P-value = 0.000 | | |

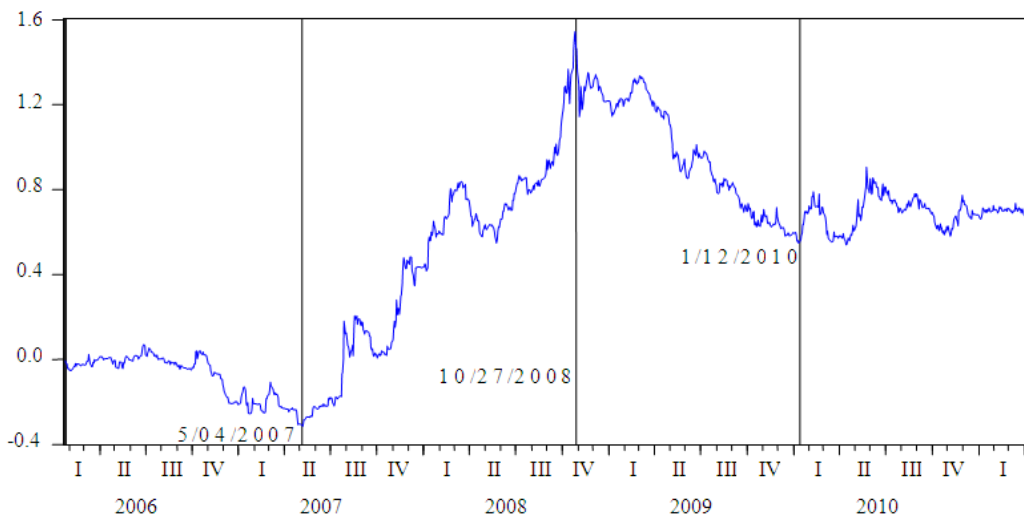


Fig. 1. Common Factor of Korean Banks' CDS premium

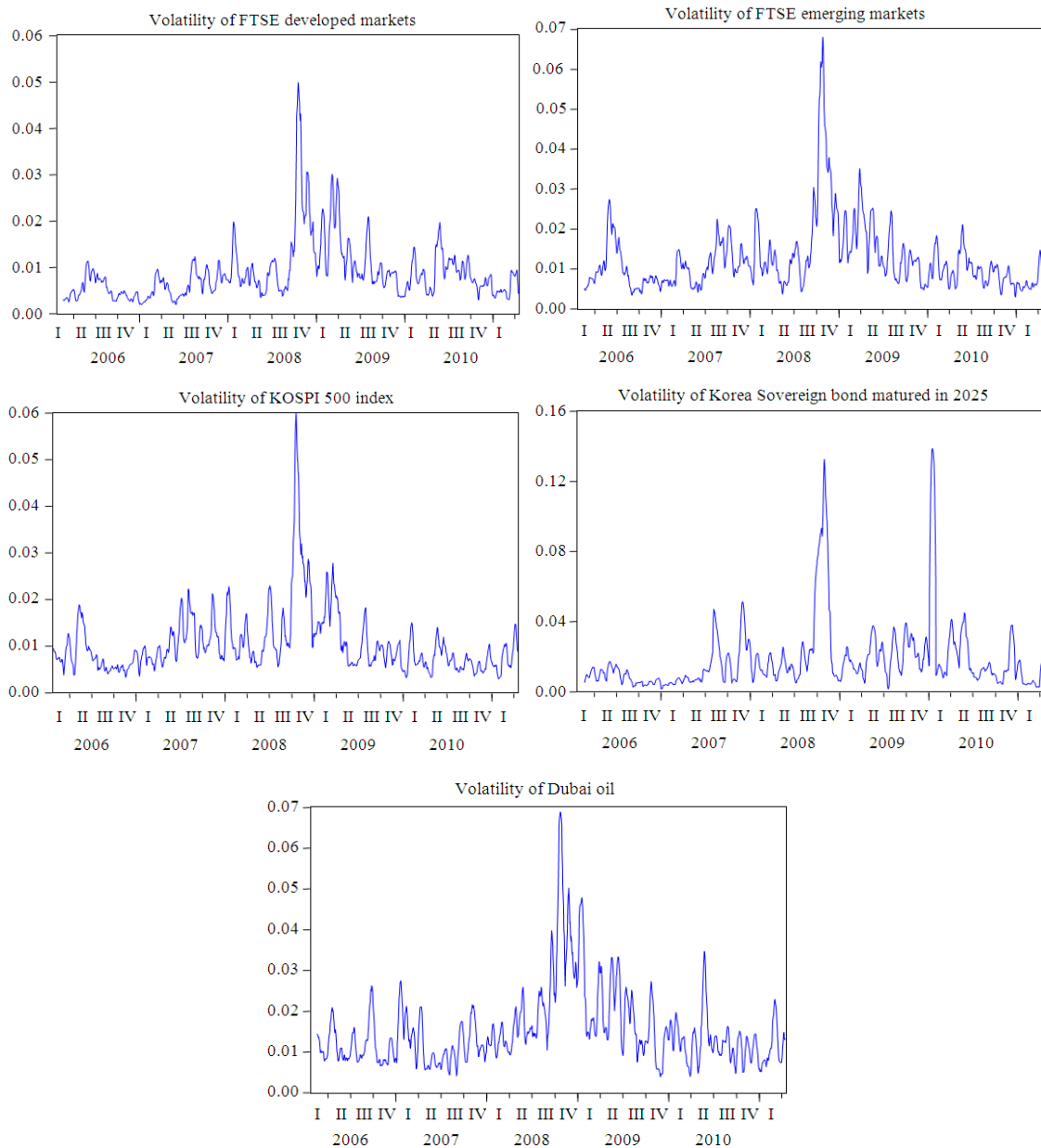


Fig. 2. Volatilities of variables

Observing the common factor movement in **Fig. 1**, we suspect the existence of a structural break occurred in mid-2007. The structural break test suggested by Chow is conducted to detect structural breaks. As presented in **Table 6**, the null hypothesis of no structural break on August 1, 2007 is rejected at the P-value 0.00. That is, the CDS premium seems to jump due to the subprime crisis at that time. We add a

dummy variable to Equation 4 to reflect the actual events which were related to the subprime mortgage crisis initiated in April 2007 and the following financial crisis in September 2008. In April 2007, New Century Financial filed for bankruptcy and triggered U.S. subprime mortgage crisis. Korea was affected when the American Home Mortgage Investment (AHMI) filed for bankruptcy protection in the court in August 2007.

Model I includes FTSED, FTSEE, KOSPI, Korea bond CDS premium, oil price and a dummy. All variables except the dummy are in logarithm because of its convenience for sensitivity analysis. To check if volatilities affect the common risk, Model II is estimated by adding the volatilities of each variable and also by dropping a statistically insignificant variable, FTSEE. Simple OLS method is used for estimation. As shown in **Table 7**, Model II offers a higher adjusted R² than Model I. Adding the volatilities and dropping FTSEE improve the explanatory power of the model. FTSED, KOSPI, Korea bond CDS premium, oil price and the volatility of FTSED appear to be statistically significant at 5%. The sign of the estimate of every statistically significant variable seems to be consistent with what we predicted. The estimate of the dummy variable is also statistically significant at 5% and positive.

4. DISCUSSION

This study examined what factors determine Korean banks' credit default swap premiums. As described in section 3, we first identify common factors in the CDS premium and further examine the determinants of the common factor employing an empirical model shown in Equation 4. We discuss the major findings of the study as follows.

First, the estimates of FTSED and KOSPI were negative and statistically significant at 5%. It suggests that both foreign and domestic stock market movements had a negative impact on the CDS premium. When the developed foreign stock markets such as NYSE and EU sharply fell or collapsed, the foreign capital outflows for switching to a safer asset immediately exploded. The Korean banks were therefore faced with the shortage of liquidity and an increase in the default risk of loans. Accordingly, the CDS premium surged up. By the same token, when Korean stock markets fell sharply, exactly the same phenomena happened. Hence both movements of foreign and domestic stock markets negatively affect the CDS premium. The magnitude of responsiveness to KOSPI (-1.62) was slightly greater than that of the FTSED (-1.31).

Second, the volatility of FTSED and the Korean banks' common factor of the CDS premium turn out to be positively related. The common factor of the CDS premium jumps up as the foreign stock market gets more volatile. In addition, the common factor of the CDS premium appears to be the most responsive to the volatility of FTSED. The magnitude of the sensitivity to the volatility of FTSED is estimated at 4.78, which is approximately 3.5 times of FTSE developed markets and 2.8 times of KOSPI in terms of the absolute value. As the

movement of FTSE developed markets became more unpredictable and riskier, it induced the foreign capital outflows to increase and caused the CDS premium to rise. However, the volatility of the Korean stock market had surprisingly no impact on the CDS premium.

Third, the CDS premium rises as the oil price increases. This implies that an increase in oil price tends to have negative impacts on the profits of Korean business firms by raising their production costs. The default risk of loans increases because of the weak profit structure and thus the CDS premium rises.

Fourth, as noticed, the structural break, which was caused by the subprime mortgage crisis, is incorporated into the model by adding a dummy variable. The estimate of the dummy variable turned out to be 0.41. That is, the subprime mortgage crisis period from August 1, 2007 to April 18, 2011 shifted the CDS premium up by 0.41. Consequently, the magnitude of the increase was considered to be an adjustment to the increased risk due to the subprime mortgage crisis and the following financial crisis.

Fifth, the estimate of the CDS premium of Korean sovereign bond variable appears to be positive and statistically significant at 5%. Since the Korean sovereign bond is issued by the Korean government in foreign currencies, the CDS premium is mainly affected by the country risk. As the country risk increases for various reasons, the CDS premium of bond rises and the CDS premium of banks increases accordingly.

Sixth, FTSEE is found to be statistically insignificant at 5%. That is, the movements of the CDS premium in the Korean market seem to be rather closely linked to the movements of the developed markets than on the emerging markets.

Lastly, the volatility of KOSPSI, the volatility of the CDS premium of Korea bond and the volatility of oil price appeared to be statistically insignificant at 5%. Only the volatility of FTSED is statistically significant at the conventional level. This implies that the Korean bank CDS premium is strongly affected by the volatility of the stock market in developed countries.

5. CONCLUSION

To find the determinants of the common factor of the CDS premium of Korean banks, we first decomposed the CDS premium of 11 Korean banks into common factors and idiosyncratic series by employing the method suggested by Bai and Ng (2004). We find that there is only one common factor deriving the CDS premium of Korean banks. Surprisingly, the most variation of each banks' CDS premium is explained by the common factor. It implies that the Korean banking industry confronts a substantial degree of systemic risk.

Next, we attempted to find the determinants of the common factor by regressing the common factor on macro-financial economic variables such as the daily stock composite index of foreign and domestic markets, Korean sovereign bond CDS premium, volatilities of each asset markets and the commodity prices. The regression results showed that the common factor was determined by the composite index of FTSE developed markets, KOSPI500, the Korea sovereign bond CDS premium, the Dubai spot oil price and the volatility of FTSE developed markets for the sample period. In particular, the common factor of the CDS premium appeared to be very sensitive to the FTSE level and its volatility. We also found a structure break for the CDS premium movement, which appeared to be affected by the subprime crisis in the United States since August 1, 2007.

These findings suggest that Korean banks are very susceptible to foreign capital movements, which are caused by changes in foreign economies. Not only is the Korean economy heavily dependent upon foreign economy through export, but also Korean financial markets are liberalized enough for foreign capital flows at foreign investors' convenience. In particular, an excessive amount of withdrawal of the foreign capital would induce a reduction in liquidity and a credit crunch. Accordingly, business firms' default rates of repayment rise and the CDS premium of the Korean banks increases.

The empirical findings suggest that the policy authority must pay heed to foreign stock markets to sustain the stability of banking industry. It is necessary to consider the stabilization of Korean financial asset markets, the maintenance of an appropriate level of foreign exchange reserves for emergencies and the expansion of foreign exchange swap agreements. In addition, financial supervision is needed to induce financial institutions to be less dependent on short-term financing to cushion against shocks resulting from exogenous capital outflows.

6. REFERENCES

- Adrian, T. and M. Brunnermeier, 2011. CoVaR. NBER Working Papers 17454. National Bureau of Economic Research, Inc.
- Altman, E. and E. Hotchkiss, 2005. Corporate Financial Distress and Bankruptcy: Predict and Avoid Bankruptcy: Analyze and Invest in Distressed Debt, 3rd Edn., ISBN-10: 978-0-471-69189-1, pp: 252.
- Bai, J. and S. Ng, 2002. Determining the number of factors in approximate factor models. *Econometrica*, 70: 191-221. DOI: 10.1111/1468-0262.00273.
- Bai, J. and S. Ng, 2004. A PANIC attack on unit roots and cointegration. *Econometrica*, 72: 1127-1177.
- Bijlsma, M., J. Klomp and S. Duineveld, 2010. Systemic risk in the financial sector: A review and synthesis. CPB Newsletter.
- Billio, M., M. Getmansky, A.W. Lo and L. Pelizzon, 2010. Econometric measures of systemic risk in the finance and insurance sectors. University of Venice, Italy.
- Brasili, A. and G. Vulpes, 2006. Banking Integration and Co-movements in EU Banks' Fragility. University Library of Munich, Germany.
- Breusch, T. and A.R. Pagan, 1980. The lagrange multiplier test and its applications to model specification in econometrics. *Rev. Econ. Studies*, 47: 239-53. DOI: 10.2307/2297111
- Diebold, F.X. and K. Yilmaz, 2009. Measuring financial asset return and volatility spillovers, with application to global equity markets. *Economic J.*, 119: 158-171. DOI: 10.1111/j.1468-0297.2008.02208.x.
- Eichengreen, B., A. Mody, M. Nedeljkovic and L. Sarno, 2012. How the subprime crisis went global: Evidence from bank credit default swap spreads. *J. Int. Money Finance*, 31: 1299-1318.
- Kim, D.H., M. Loretan and E.M. Remolona, 2010. Contagion and risk premia in the amplification of crisis: Evidence from Asian names in the global CDS market. *J. Asian Econ.*, 21: 314-326.
- Kool, C., 2006. Financial stability in European banking: The role of common factors. *Open Econ. Rev.*, 17: 525-540. DOI: 10.1007/s11079-006-0363-9
- Krishnan, C.N.V., P. Ritchken and J.B. Thomson, 2006. On credit spread slopes and predicting bank risk. *J. Money, Credit Bank.*, 38: 1545-1574. DOI: 10.1353/mcb.2006.0084.
- Longstaff, F., S. Mithal and E. Neis, 2005. Corporate yield spreads: Default risk or liquidity? New evidence from the credit default SWAP market. *J. Finance*, 60: 2213-2253. DOI: 10.1111/j.1540-6261.2005.00797.x
- MacKinnon, J.G., A.A. Haug and L. Michelis, 1999. Numerical distribution functions of likelihood ratio tests for cointegration. *J. Applied Econometrics*, 14: 563-577. DOI: 10.1002/(SICI)1099-1255(199909/10)14:5<563::AID-JAE530>3.0.CO;2-R
- Rahman, D., 2014. Are banking systems increasingly fragile? Investigating financial institutions' CDS returns extreme co-movements. *Quantitative Finance*, 14: 805-830.
- Suh, C. and Y. Lee, 2011. Determinants of Banks' CDS spreads and policy implications. *Seoul J. Econ.*, 24: 575-591.