論　説

The Impacts of Global Financial Crisis on Japanese Financial Market: Analysis of Interest Rate Swap Spreads

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Summary

This paper investigates the asymmetric impacts of global financial crisis on Japanese interest rate swap spreads by dividing the whole sample period into four. The uncertainty as for the future path of monetary policy is considered to cause volatility in the market after August 9, 2007 when subsidiaries of BNP Paribas announced the suspension of liquidation from asset. Thus volatility is a positive contributor to swap spreads of 2-years and 5-years. Default risk is negatively incorporated in 10-year swap spread after the Lehman shock of September 15, 2008. It is presumed that the functions of price discovery were lost.

Keywords: Global Financial Crisis, Swap Spread, Default Risk, Liquidity Premium, Monetary Policy

JEL Classifications: E43, E52, G12

1. Introduction

This paper investigates the impacts of global financial crisis on interest rate swap spreads in Japan[1]. Four determinants of swap spreads − default risk, the slope of yield curve, liquidity premium and volatility - are chosen. Even though global financial crisis gave a heavy blow to financial markets and institutions especially in US and Europe, the influences expanded to Japan through world-wildly connected financial system. Thus analyzing the impacts of global financial crisis on Japanese swap spreads has significance.

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The research for this paper is supported by Grant-in Aid for Scientific Research (KAKENHI 19530271) from JSPS.

[1] For most of the remaining parts, interest rate swap spread is described as swap spread.

So far no other previous works focused upon Japanese swap spreads in the period of financial crisis. Thus this paper distinguishes itself from other works. In addition to this, the impacts of global financial crisis on swap spreads between Japan and US are compared in the final section by citing results from Ito (2009). This paper also adds 5-year swap spread which was not analyzed in US swap spread in the period of global financial crisis. The maturity of 5-year in swap market plays an important role in Japan because Japanese financial institutions are main players in the asset liability management related activities.

The asymmetric impacts of global financial crisis on swap spreads are focused by dividing the whole sample period into four. One sample is a period for normal time. The other samples are for the period of global financial crisis which are divided into three. It is significant to check the impacts of global financial crisis in various phases because the severity of crisis varies from a period to another.

This paper regards the beginning of global financial crisis as February 8, 2007. The announcement by HSBC Holdings on a previous day that its charge for bad debts would be more than $10.5 billion for 2006 was a surprise. This number was 20% more than the expectation of financial analysts. The suspicion that subprime loan might be a big problem was disseminated in the financial market on the day. The next stage of global financial crisis was from August 9, 2007 when subsidiaries of BNP Paribas announced the suspension of liquidation from the asset because fair values of ABS related assets were difficult to get under the pressure of market. The final stage of global financial crisis was from September 15, 2008 when Lehman Brothers went bankrupt.

An interest rate swap is an agreement between two parties to exchange cash flows in the future. In a typical agreement, two counterparties exchange streams of fixed and floating interest rate payments. Thus fixed interest rate payment can be transformed into floating payment and vice versa. The amount of each floating rate payment is based on a variable rate that has been mutually agreed upon by both counterparties. For example, the floating rate payment could be based on 6 month LIBOR (London Interbank Offered Rate).

Market participants in charge of long term interest rates are closely checking the Government Bond and swap markets for the transactions of speculation, arbitrage, hedge and etc. Swap market in Japan was originally expanded for the risk management of commercial banks and long term credit banks. For example, commercial banks depending on the funding from short term deposit used swap market for the funding of long term borrowing. On the other hand, long term credit banks depending on the funding from long term financial bonds used swap market for the funding of short term borrowing.

The market for interest rate swap has grown exponentially in the 1990's. According to a survey by BIS (Bank for International Settlements), the notional outstanding volume of transactions of interest rate swap amounted to 328,114 billions of US dollars at the end of December 2008[2]. Differences between swap rates and government bond yields of the same maturity are referred to as swap spreads. If the swap and government bond markets are efficiently priced, swap spreads may reveal something about the perception of the systemic risk in the banking sector.

The remainder of this paper is as follows. Section 2 describes the literature review. Section 3 discuses determinants of swap spread Section. 4 describes data and provides summary statistics. Section 5 discusses the framework of the analysis and results. Section 6 concludes.

2. Literature Review

As for the analysis of the swap spreads in US market, previous studies such as Sun et al (1993), Brown et al (1994), Duffie and Huang (1996), Cossin and Pirotte (1997), Minton (1997), Lang et al (1998), Lekkos and Milas (2001), Fehle (2003), Huang and Chen (2007), Ito (2009) and Ito (2010a) are cited.

Sun et al (1993) examine the effect of dealers' credit reputations on swap quotations and bid-offer spreads by using quotations from two interest rate swap dealers with different credit ratings (AAA and A). The AAA offer rates are significantly higher than the A offer rates, and the AAA bid rates are significantly lower than the A bid rates. They also document the relation between swap rates and par bond yields estimated from London interbank offered rate (LIBOR) and bid rate (LIBID) data. They identify some of the problems in testing the implications of swap pricing theory.

Duffie and Huang (1996) present a model for valuing claims subject to default by both contracting parties, such as swaps and forwards. With counterparties of different default risk, the promised cash flows of a swap are discounted by a switching discount rate that, at any given state and time, is equal to the discount rate of the counterparty for whom the swap is currently out of the money (that is, a liability). The impact of credit-risk asymmetry and of netting is presented through both theory and numerical examples, which include interest rate and currency swaps.

Brown et al (1994) analyze US swap spreads to find that 1) short- term, 1-, and 3-year swaps are priced differently from longer-term, 5-, 7-, and 10-year swaps; and 2) the pricing dynamics

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[2] Statistics are cited from Semiannual OTC derivatives statistics at end-December 2008. For details, see Bank for International Settlements (2009).

for all five swap maturities changed substantially during the period spanning January 1985 to May 1991. Cossin and Pirotte (1997) conduct empirical analysis on transaction data and show support for the presence of credit risk in swap spreads. Credit ratings appear to be a significant factor affecting swap spreads not only for their pooled sample but for IRS and for CS separately as well. In IRS, the credit rating impact on prices seems to come largely at the detriment of the non-rated companies.

Lang et al (1998) argue that an interest rate swap, as a non-redundant security, creates surplus which will be shared by swap counterparties to compensate their risks in swaps. Analyzing the time series impacts of the changes of risks of swap counterparties on swap spreads, they conclude that both lower and higher rating bond spreads have positive impacts on swap spreads.

Lekkos and Milas (2001) assess the ability of the factors proposed in previous research to account for the stochastic evolution of the term structure of the U.S. and U.K. swap spreads. Using as factor proxies the level, volatility, and slope of the zerocoupon government yield curve as well as the Treasury-bill－London Interbank Offer Rate (LIBOR) spread and the corporate bond spread, they identify a procyclical behavior for the short-maturity U.S. swap spreads and a countercyclical behavior for longer maturity U.S. swap spreads. Liquidity and corporate bond spreads are also significant, but their importance varies with maturity.

Minton (1997) directly tests the analogy between short-term swaps and Eurodollar strips and finds that fair-value short-term swap rates exist in the Eurodollar future market. However, proxies for differential probability of counterparty default are statistically significant determinants of the difference between OTC swap rates and swap rates derived from Eurodollar futures prices for maturities of three and four years.

Fehle (2003) analyzes 2-year and 5-year swap spreads in 7 countries (US, UK, Japan, Germany, France, Spain and Netherland). They conclude that corporate bond spread, LIBOR spread and slope of the yield curve are components of swap spreads.

Huang and Chen (2007) analyze the asymmetric impacts of various economic shocks on swap spreads under distinct Fed monetary policy regimes. The results indicate that (a) during periods of aggressive interest rate reductions, slope of the Treasury term structure accounts for a sizeable share of the swap spread variance although default shock is also a major player. (b) On the other hand, liquidity premium is the only contributor to the 2-year swap spread variance in monetary tightening cycles. (c) The impact of default risk varies across both monetary cycles and swap maturities. (d) The effect of interest rate volatility is generally more evident in loosening monetary regimes.

Ito (2010a) analyzes impacts of financial crisis on interest rate swap spreads by dividing the whole sample period into two. First period (Sample A) is from January 3, 2005 through

February 7, 2007. Second period (Sample B) is from February 8, 2007 through March 12, 2009. First period includes relatively calm market. Second period includes financial crisis. The default risk measured both in Aaa and Baa corporate bonds are negatively incorporated in the period of financial crisis. The slope is positively incorporated in short and long term maturities in the period of financial crisis. The liquidity premium is positively incorporated in short and long term maturities in normal period and only in short term maturity in the period of financial crisis. The volatility is a positive determinant of US swap spreads in the period of financial crisis.

Ito (2009) analyzes impacts of financial crisis on US swap spreads by dividing the whole sample period into four. One sample is a period for normal time. The other samples are for the period of global financial crisis which are divided into three. The default risk measured in Aaa corporate bond is positively incorporated in 2-year and 10-year swap spreads only in Sample A. When financial crisis became worse after the collapse of Lehman Brothers, default risk measured both in Aaa and Baa corporate bonds gave negative impact on the swap spread of 10 years. The positive contribution of liquidity premium is more evident in 2-year swap spread after financial crisis surfaced. Especially after the collapse of Lehman Brothers, FRB began to take non-traditional measures. The market participants were uncertain as for the future of monetary policy by FRB. The speculation on the path of monetary policy and the uncertainty of market are considered to cause more volatility in the market. Thus the volatility can be a positive determinant of US swap spreads after the collapse of Lehman Brothers.

On the other hand, the number of previous studies analyzing swap spreads other than US is small. Castagnetti (2004) analyzes the interest rate swap spreads in Germany. Hmano (1997), Eom et al (2000), Ito (2007) and Ito (2010b) focus on the swap spreads in Japanese market. Hamano (1997) focuses not on credit risk but on market factors such as TED spread and finds that swap spreads reflect TED spread and longer term swap spreads are less influenced by TED spread. On the other hand, Eom et al (2000) focuses on the credit risk and concludes that Japanese swap spread is significantly related to proxies for the long term credit risk factor.

Ito (2007) investigates the determinants of swap spreads in Japan. Four determinants of swap spreads - TED spread, corporate bond spread, interest rate and the slope of yield curve from July 12, 1995 through January 31, 2005- are chosen. The swap spreads of 2 years through 4 years are mostly influenced by TED spread, interest rate and slope. The swap spread of 5 years is mostly decided by corporate bond spread and slope. The swap spreads of 7 years and 10 years are mostly affected by corporate bond spread.

Ito (2010b) investigates the determinants of Japanese swap spreads by considering the difference of monetary policy regimes by the Bank of Japan (BOJ). When the monetary policy was easing, swap spreads decreased as credit risk increased. When monetary policy was tightening, 10-year swap spread decreased in accordance with the increase of corporate bond spread. TED spread contributed to swap spreads positively in all maturities under tightening cycle of the monetary policy. Slope of yield curve contributed more actively to the swap spreads in all maturities in quantitative easing period and to the swap spreads of 5 years, 7 years and 10 years in tightening aspect. Volatility contributed more actively to the swap spreads in all maturities in easing phase.

3. Determinants of Swap Spread

3. 1 Liquidity Premium

For instance, during periods of weak economy, treasury bills are considered to be more liquid, and swaps thus command a larger liquidity premium. Liquidity effect may be absent in the aggregate data, but can be arguably pronounced under certain market conditions. Hamano (1997), Minton (1997), Brown et al (1994), Eom et al (2000), Lekkos and Milas (2001) check the influence of TED spread.

First, a case in which floating rate and fixed rate are swapped based on the yield curve of government bond is described in the equation (1).

$$\frac{f_1}{(1+R_1)}+\frac{E(f_2)}{(1+R_2)^2}+\cdots+\frac{E(f_n)}{(1+R_n)^n}=\frac{C}{(1+R_1)}+\frac{C}{(1+R_2)^2}+\cdots+\frac{C}{(1+R_n)^n} \qquad (1)$$

$E(\ )$ is an operator indicating expectation, C is a coupon, f_n is a floating rate, R_n is a fixed rate of government bond.

In equation (1), floating rate and fixed rate are swapped on the condition that there is no credit risk. Present values of both floating rate and fixed rate get equal. Here exchange of cash flows is presupposed to happen once a year.

In the case of swap transaction, floating rate is Euro dollar, for example, LIBOR which is usually higher than short-term government bill. Thus fixed side results in higher rates. Here the difference between Euro dollar rate, for example, LIBOR (London Interbank Offered Rate) and short-term Treasury Bill is defined as TED spread. Swap rate and TED spread are in the relationship as described in the equation (2).

$$\frac{f_1+TED_1}{(1+R_1)}+\frac{E(f_2+TED_2)}{(1+R_2)^2}+\cdots+\frac{E(f_n+TED_n)}{(1+R_n)^n}=\frac{C+SS}{(1+R_1)}+\frac{C+SS}{(1+R_2)^2}+\cdots+\frac{C+SS}{(1+R_n)^n}$$

TED_n is TED spread, SS is swap spread. (2)

Equation (2) can be rewritten into equation (3) to show that swap spread is a weighted average of present and future TED spreads.

$$\frac{TED_1}{(1+R_1)}+\frac{E(TED_2)}{(1+R_2)^2}+\cdots+\frac{E(TED_n)}{(1+R_n)^n}=SS\left(\frac{1}{(1+R_1)}+\frac{1}{(1+R_2)^2}+\cdots+\frac{1}{(1+R_n)^n}\right) \quad (3)$$

In addition to liquidity premium, default risk, slope of yield curve and volatility are considered to be determinants of interest rate swap spread in previous studies.

3. 2 Default Risk

According to Minton (1997), Brown et al (1994), Eom et al (2000), Lekkos and Milas (2001), the default risk in swaps can be proxied with the information from the corporate bond market. Any such proxy is imperfect as mentioned in the previous studies because the characteristics of swap and corporate bond are not totally comparable. Nevertheless, since swap default spreads are unobservable, the difference between the yield on a portfolio of corporate bonds and the yield on an equivalent government bond can be used as a proxy for the default premium.

3. 3 Slope of Yield Curve and Volatility

Following the Sorensen and Bollier (1994) framework, in which the slope of the term structure and interest rate volatility determine the value of the option to default, these two variables are incorporated into empirical model. It is notable that the impacts of the yield curve and interest rate volatility on swap spreads may not be symmetrical under various market conditions.

According to Alworth (1993), the impact of the slope of the term structure on swap spreads could be either positive or negative. When the yield curve is upward sloping, the fixed payer (floating receiver) is exposed to higher counterparty risk due to higher default risk exposure associated with the higher future floating payments. A lower fixed swap rate will compensate for this increased risk. Swap spreads are thus expected to be negatively related to the slope of the term structure.

On the other hand, expected default premium should be higher at the time of recession and financial instability. In this case, swap spreads are expected to be positively related to the slope of the term structure. Increasing interest rate volatility is often associated with economic uncertainty, as such, it is expected to positively influence swap spreads. Similarly, as Huang and

Chen (2007) describe, swap spreads may be more responsive to the shape of yield curve during periods of a steep yield curve due to the "flight to quality" concern.

Eom et al (2000) find that swap spreads are negatively related to the slope of the term structure. Huang and Chen (2007), Ito (2009) and Ito (2010a) use slope of yield curve and volatility. They calculate volatility of 2-year US Treasury note by using EGARCH model.

4. Data

About four years of daily data ranging from January 4, 2006 through August 27, 2009 are chosen. The whole sample is divided into four depending upon the aspects of financial crisis[3]. As Huang and Chen (2007) mention, aggregating time series data over different market condition produces results that are in favor of finding no impact of economic shocks on swap spreads because asymmetrical impacts may cancel out over different aspects of global financial crisis.

First period (Sample A) is from January 4, 2006 through February 7, 2007. Second period (Sample B) is from February 8, 2007 through August 8, 2007. Third period (Sample C) is from August 9, 2007 through September 12, 2008. Fourth period (Sample D) is from September 15, 2008 through August 27, 2009. Sample A is a calm market. Sample B is a relatively calm market in comparison with Sample C and Sample D. But the potential risk of sub-prime loan issue began to be recognized in Sample B. Sample C and Sample D are in the middle of financial crisis. Especially the degree of crisis deepened after the collapse of Lehman Brothers in Sample D.

4. 1 Japanese Interest Rate Swap Spread

Japanese interest rate swap rate minus Japanese government bond yield in the corresponding maturity is defined as swap spread. SS2 is 2-year swap spread. SS5 is 5-year swap spread. SS10 is 10-year swap spread.

As for Japanese government bond yield, par rates of Japanese Government Bond (JGB) are used[4]. These par rates for the maturities of 2 years, 5 years and 10 years are calculated by the method mentioned in Adams and Van Deventer (1994) on a daily basis. These par rates are provided by Mitsubishi UFJ Morgan Stanley Securities.

As for the Japanese interest rate swap market, rates of 2 years, 5 years, and 10 years as of 3 pm at Tokyo time are used on a daily basis. Bid rates and offer rates are indicated in the

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[3] As for the phases of global financial crisis, see section 1.

[4] JGBs are traded on a simple yield. Par rates are compounded yield.

Table 1. Descriptive statistics of swap spreads

Variable	Average	SD	Min	Max	Median
Sample A					
SS2	0.130	0.023	0.077	0.165	0.136
SS5	0.159	0.035	0.104	0.240	0.150
SS10	0.187	0.045	0.114	0.276	0.181
Sample B					
SS2	0.157	0.018	0.123	0.194	0.152
SS5	0.154	0.017	0.125	0.192	0.151
SS10	0.170	0.033	0.128	0.233	0.153
Sample C					
SS2	0.302	0.064	0.180	0.521	0.297
SS5	0.229	0.040	0.159	0.388	0.219
SS10	0.197	0.030	0.143	0.305	0.190
Sample D					
SS2	0.326	0.031	0.231	0.402	0.324
SS5	0.180	0.056	0.068	0.324	0.179
SS10	-0.001	0.081	-0.160	0.271	-0.011

Notes : Sample A = from January 4, 2006 through February 7, 2007.
Sample B = from February 8, 2007 through August 8, 2007.
Sample C = from August 9, 2007 through September 12, 2008.
Sample D = from September 15, 2008 through August 27, 2009.
SS2 = 2-year swap spread,SS = 5-year swap spread, SS10 = 10-year swap spread

market. The swap rates provided by Mitsubishi UFJ Morgan Stanley Securities are averages of bid rates and offer rates. The descriptive statistics of swap spreads in each sample period are provided in Table 1. The movements of swap spreads in 2 years, 5 years, and 10 years in each sample period are shown in Figure 1.

4. 2 Determinants of Swap Spread

Liquidity Premium

Liquidity premium is defined as TED spread between 6-month LIBOR rate and 6 month TB (Treasury Bill). These LIBOR rates are provided by the BBA (British Bankers' Association).

Default Risk

Default risk is defined as yield spread between 10- year corporate bond issued by the Tokyo

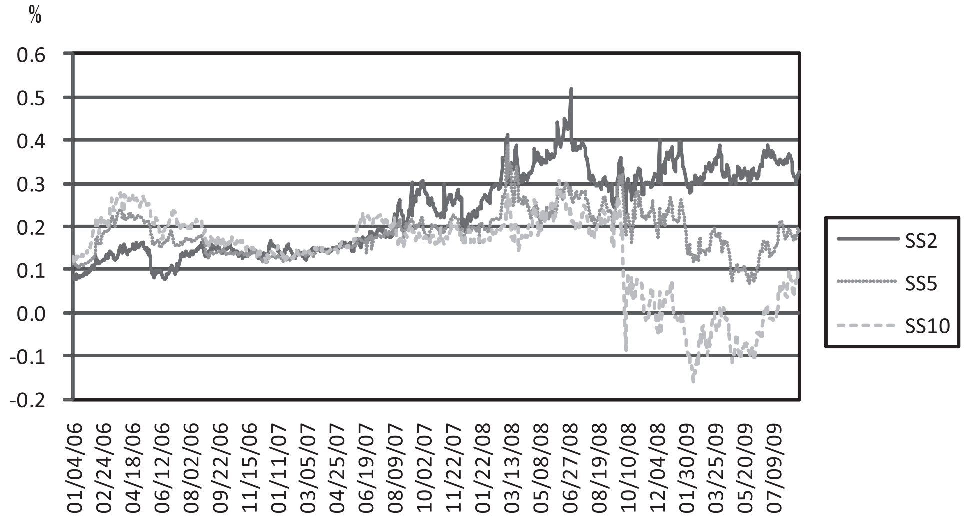

Fig.1. Swap spread

Whole sample period from January 4, 2006 through August 27, 2009.
SS2=2-year swap spread, SS=5-year swap spreadSS10=10-year swap spread

Electric Power Company and 10 year JGB par yield. Corporate bond spread is considered to represent default risk. In Japan corporate bond market is illiquid. Thus 10-year corporate bond issued by the Tokyo Electric Company is the only data available for the analysis. As for the data source the period from January 4, 2006 through July 23, 2007 is provided Mitsubishi UFJ Morgan Stanley Securities. The period from July 24, 2007 through August 27, 2009 is provided by Japan Securities Dealers Association (JASDA).

Slope of Yield Curve

Slope of yield curve is defined as the differential between 2-year and 10-year JGB par yields as in Huang and Chen (2007)[5]. These par rates are provided by Mitsubishi UFJ Morgan Stanley Securities.

Volatility

Yield volatility calculated by EGARCH model is defined as volatility[6]. The 2-year JGB par rate provided by the Mitsubishi UFJ Securities are used for the calculation since Huang and Chen (2007) use the 2 year US Treasury note for the calculation of EGARCH volatility.

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5 2-year and 10-year US Treasury rates are used by Huang and Chen (2007) and Ito (2010a).
6 See Nelson (1991) as for EGARCH model.

The descriptive statistics of determinants of swap spreads in each sample period are provided in Table 2. The movements of determinants of swap spread in the entire sample are shown in Figure 2. In Sample A and Sample B Sample, the determinants of swap spread such as TED spread and volatility are relatively calm. But in Sample C and Sample D, they get volatile.

Table 2. Descriptive statistics of determinats of swap spreads

Variable	Average	SD	Min	Max	Median
Sample A					
CBS	0.113	0.033	0.065	0.162	0.116
SLOPE	1.071	0.111	0.820	1.298	1.070
TED	0.062	0.033	-0.026	0.129	0.066
VOLA	0.056	0.024	0.004	0.127	0.054
Sample B					
CBS	0.116	0.013	0.093	0.152	0.119
SLOPE	0.847	0.042	0.778	0.991	0.846
TED	0.202	0.095	0.078	0.403	0.183
VOLA	0.032	0.009	0.018	0.054	0.031
Sample C					
CBS	0.202	0.026	0.125	0.261	0.202
SLOPE	0.794	0.050	0.666	0.926	0.798
TED	0.427	0.042	0.240	0.540	0.423
VOLA	0.057	0.036	0.018	0.198	0.047
Sample D					
CBS	0.242	0.071	0.126	0.412	0.263
SLOPE	0.942	0.146	0.633	1.189	0.901
TED	0.541	0.073	0.406	0.805	0.529
VOLA	0.033	0.027	0.006	0.140	0.019

Notes : Sample A = from January 4, 2006 through February 7, 2007.
Sample B = from February 8, 2007 through August 8, 2007.
Sample C = from August 9, 2007 through September 12, 2008.
Sample D = from September 15, 2008 through August 27, 2009.
CBS = Corporate bond spread, TED = TED spread
SLOPE = Slope of yield curve, VOLA = Volatility

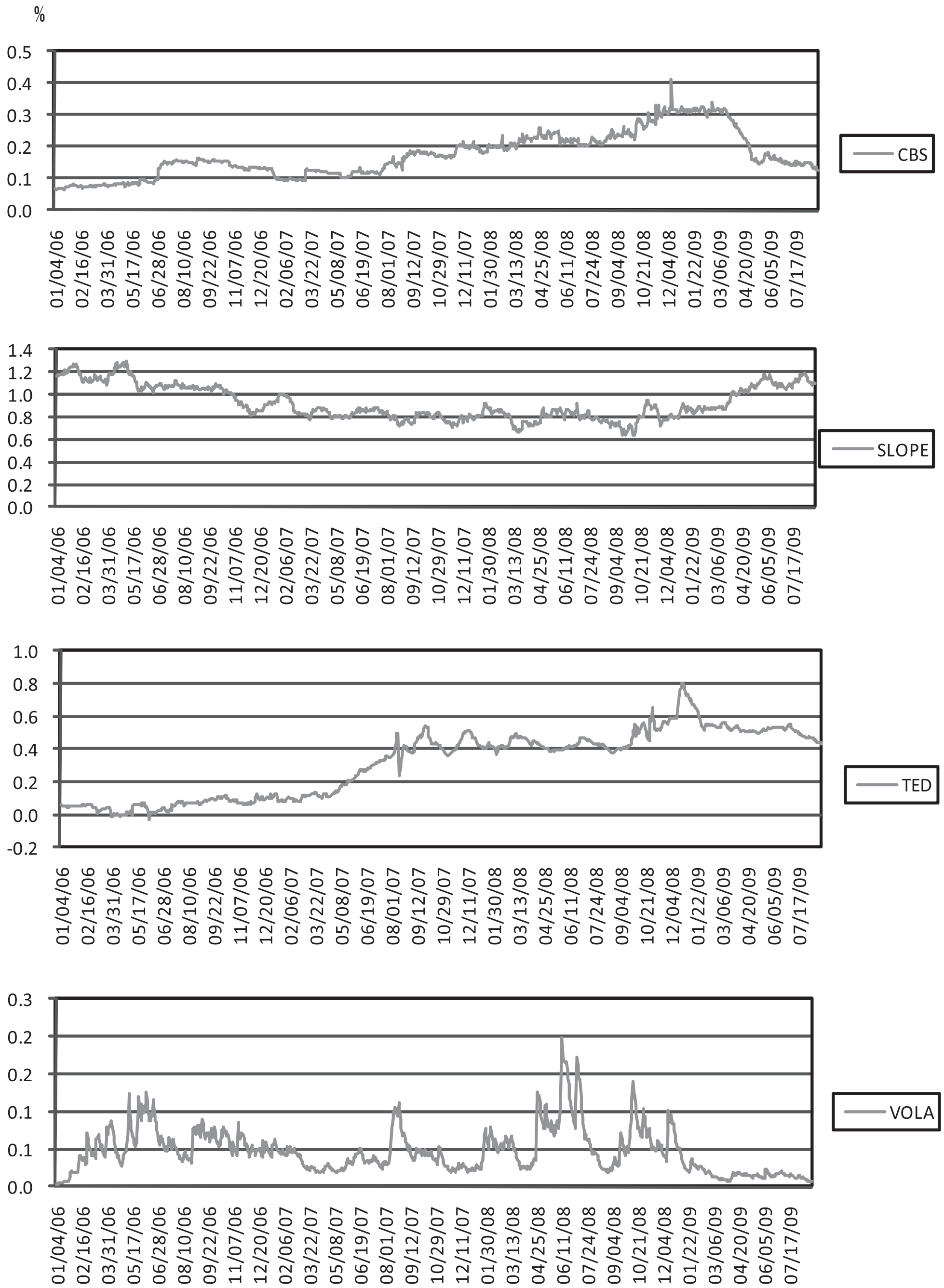

Fig. 2. Movement of determinants of swap spread

Whole sample period from January 4, 2006 through August 27, 2009.
CBS = Corporate bond spread, TED = TED spread
SLOPE = Slope of yield curve, VOLA = Volatility

5. Framework of Analysis and Result

Here how to analyze the determinants of swap spread is indicated. OLS is used to estimate equation (4). The serial correlation and heteroscedasticity of ε_t are adjusted by the method by Newey and West (1987). The lag periods of twelve are used. The analysis for each sample period is conducted. The results are shown in Table 3.

$$spread_t = \alpha + \beta_1 CBS_t + \beta_2 SLOPE_t + \beta_3 TED_t + \beta_4 VOLA_t + \varepsilon_t \quad (4)$$

CBS = corporate bond spread, SLOPE = slope of yield curve,

TED = TED spread, VOLA = volatility

First, analysis on Sample A is conducted. As for corporate bond spread, the positive coefficients of 2-year, 5-year and 10-year spreads are not significant within 5% level. As for slope, the positive coefficient of 10-year spread is significant at 1% level. As for TED spread, the negative coefficients of 5-year and 10-year spreads are significant at 1% level. As for volatility, the positive coefficient of 10-year spread is significant at 1% level.

Next, analysis on Sample B is conducted. As for corporate bond spread, the positive coefficient of 5-year spread is significant within 5% level. As for slope, the positive coefficients of 2-year, 5-year and 10-year spreads are not significant within 5% level. As for TED spread, the positive coefficients of 2-year, 5-year and 10-year spreads are significant within 1% level. As for volatility, the negative coefficient of 2-year spread is significant at 1% level.

Next, analysis on Sample C is conducted. As for corporate bond spread, the positive coefficients of 2-year, 5-year and 10 year spreads are significant at 1% levels. As for slope, the negative coefficient of 5-year spread is significant at 1% level. As for TED spread, the positive coefficient of 2 year spread is significant at 1% level. As for volatility, the positive coefficient of 2-year, 5-year and 10-year spreads are significant at 1% level.

Finally, analysis on Sample D is conducted. As for corporate bond spread, the negative coefficient of 10-year spread is significant at 1% levels. The negative coefficient of 2-year and 5-year spreads are not significant within 5% level. As for slope, the negative coefficients of 2-year and 5-year spreads are significant at 5% level. As for TED spread, the positive coefficients of 2-year is significant at 1% level. As for volatility, the negative coefficient of 2-year spread is significant at 1% level.

Table 3. Result of regression analysis

	α	β1(CBS)	β2(SLOPE)	β3(TED)	β4(VOLA)	R^2	SER
Sample A							
SS2	0.050	0.223	0.034	0.198	0.116	0.207	0.021
	(1.165)	(1.762)	(0.917)	(1.174)	(0.569)		
SS5	0.070	0.041	0.086	-0.481	0.396	0.476	0.026
	(1.281)	(0.260)	(1.840)	(-2.809)***	(1.656)		
SS10	-0.020	0.194	0.178	-0.591	0.559	0.569	0.030
	(-0.321)	(1.014)	(3.575)***	(-3.044)***	(1.958)**		
Sample B							
SS2	0.081	-0.043	0.069	0.189	-0.491	0.879	0.007
	(2.735)***	(-0.340)	(1.754)	(11.656)***	(-0.491)***		
SS5	0.105	0.149	0.002	0.156	-0.028	0.878	0.006
	(6.480)***	(3.030)***	(0.072)	(15.297)***	(-0.313)		
SS10	0.000	0.194	0.082	0.317	0.448	0.910	0.010
	(0.000)	(0.741)	(1.469)	(18.578)***	(1.630)		
Sample C							
SS2	-0.201	1.424	0.041	0.307	0.886	0.692	0.036
	(-1.745)	(10.121)***	(0.409)	(2.334)***	(8.140)***		
SS5	0.158	0.671	-0.244	0.242	0.447	0.480	0.029
	(2.180)	(5.340)***	(-3.029)***	(1.801)	(5.507)***		
SS10	0.084	0.597	-0.050	0.016	0.434	0.562	0.020
	(1.786)	(5.996)***	(-0.960)	(0.321)	(3.932)***		
Sample D							
SS2	0.184	-0.116	0.030	0.291	-0.465	0.498	0.023
	(3.614)***	(-1.229)	(0.664)	(7.031)***	(-3.864)***		
SS5	0.351	-0.123	-0.213	0.077	0.503	0.456	0.042
	(0.351)***	(-0.123)	(-2.030)**	(0.844)	(1.220)		
SS10	0.619	-0.798	-0.430	-0.077	0.584	0.392	0.063
	(2.616)**	(-2.914)***	(-2.431)***	(-0.458)	(1.091)		

Notes : Values in the parenthesis are t statistics.
***,** indicates significance at 1% and 5% levels respectively.
The serial correlation and heteroscedasticity of errors are adjusted by the method by Newey and West (1987).
CBS = corporate bond spread, SLOPE = Slope of yield curve, TED = TED spread, VOLA = Volatility

6. Concluding Remarks

This paper investigates the impacts of global financial crisis on swap spreads in Japan and provides the comparative analysis of swap spreads between Japan and US by citing the results of Ito (2009). The asymmetric impacts of global financial crisis on swap spreads are focused by dividing the whole sample period into four. One sample is a period for normal time. The other samples are for the period of global financial crisis which are divided into three. It is significant to check the impacts of global financial crisis in various phases because the severity of crisis varies from a period to another.

Daily data ranging from January 4, 2006 through August 27, 2009 are chosen. The whole sample is divided into four depending upon the aspects of financial crisis. First period (Sample A) is from January 4, 2006 through February 7, 2007. Second period (Sample B) is from February 8, 2007 through August 8, 2007. Third period (Sample C) is from August 9, 2007 through September 12, 2008. Fourth period (Sample D) is from September 15, 2008 through August 27, 2009. First period includes relatively calm market. The periods from second through fourth includes financial crisis. Four determinants of swap spreads − default risk, the slope of yield curve, liquidity premium and volatility - are chosen.

Default risk is positively incorporated in 5-year spread in Sample B and in 2-year, 5-year and 10-year spreads in Sample C. On the other hand, it is negatively incorporated in 10-year swap spread in Sample D. The fact that default risk is negatively correlated with 10-year swap spread coincides with the results of Ito (2009) which analyzed US swap spreads in the same sample period. It is presumed that financial markets were in trouble and the functions of price discovery were lost after the Lehman shock of September 15, 2008 both in Japan and US.

Slope is positively incorporated in 10-year spread in Sample A. On the other hand, it is negatively incorporated in 5-year swap spread in Sample C and 5-year and 10-year swap spreads in Sample D. When the yield curve is upward sloping, the fixed payer (floating receiver) is exposed to higher counterparty risk due to higher default risk exposure associated with the higher future floating payments. A lower fixed swap rate compensates for this increased risk. Swap spreads are thus expected to be negatively related to the slope of the term structure. But in US, according to Ito (2009), slope is a positive contributor to 2-year and 10-year swap spreads in Sample B and 2-year spread in Sample C. They are considered to be positively responsive to slope because of the higher risk premium of Treasury notes in financial crisis.

Liquidity premium is positively incorporated in 2-year, 5-year and 10-year spreads in Sample B and in 2-year spread in Sample C and Sample D. It is logical that market participants were more conscious of liquidity premium after global financial crisis began. As for Sample C and

Sample D, the results of Japan are similar to US results. But they began to recognize the risk of liquidity in Japanese swap market in the initial stage of global financial crisis. In US, according to Ito (2009), liquidity premium is not a contributor to 2-year and 5-year swap spreads in Sample B.

Volatility is positively incorporated in 10-year spread in Sample A and 2-year and 5-year spreads in Sample C. On the other hand, it is negatively correlated with 2-year spread in Sample B and Sample D. The BOJ hiked the target of overnight uncollateralized call rate on February 21, 2007 from 0.25% to 0.5% in Sample B. On the other hand, after subsidiaries of BNP Paribas announced the suspension of liquidation from assets, they were not certain as for easing policy during Sample C. The uncertainty as for the future path of monetary policy is considered to cause volatility in the market. Thus volatility is a positive contributor to swap spreads in 2-years and 5-years in Sample C.

The BOJ decided to ease monetary policy on October 31, 2008 after the Lehman shock. They lowered the target of overnight uncollateralized call rate from 0.5% to 0.3%. They further decreased the target to 0.1% on December 19, 2009. In US, according to Ito (2009), volatility is a positive contributor to 2-year and 10-year swap spreads in Sample D, but in Japan no positive contribution is observed. In Japan they were used to monetary policy with very low interest rate (virtually zero) through the experience of quantitative easing policy in the period of March 2001 through March 2006[7]. Thus volatility is not a positive contributor to swap spreads after Lehman shock in Japan.

According to Ito (2009), volatility is a positive contributor for 2-year and 10-year swap spreads in US after Lehman shock. After the collapse of Lehman Brothers, FRB began to take non-traditional measures such as CPFF (Commercial Paper Funding Facility) in addition to lowering the operating target of federal fund rate to 0.0% through 0.25% on December 16, 2008 to mitigate the shocks in the market. The lowest level of target FRB had adapted on June 25, 2003 was 1.0%. In this sense, they were uncertain as to how much degree FRB would take an easing policy because they are not used to very low interest rate policy as in Japan.

According to this article and Ito (2009), the impacts of global financial crisis on swap spreads vary from Japan to US. Further research of the comparative analysis as for the impacts of global financial crisis on financial markets are to be required.

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[7] The BOJ adopted quantitative easing policy from March 21, 2001 through March 7, 2006. They changed the operating target from the uncollateralized overnight call rate to the outstanding balance of the current accounts at the BOJ. They started the target of balance from 5 trillion yen. They increased the target up to 30 billion to 35 billion yen on January 20, 2004. The uncollateralized overnight call rate remained to be virtually zero during the time of quantitative easing.

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