論　説

Impact of Monetary Policy Expectation on US Long Term Interest Rates in Global Financial Crisis☆

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Summary

The purpose of this paper is to investigate the impact of monetary policy expectation on US long term interest rates in global financial crisis. Three month OIS (Overnight Indexed Swap) rate is used as market expectation of monetary policy by the FRB. As for market interest rates, US Treasury note yields and swap rates of two years, five years and ten years are used. The expectation of monetary policy formed in the market did not influence US Treasury note yields and swap rates of two years, five years and ten years. One of the reasons is that financial market was under great stress in global financial crisis. Thus the function of price discovery is considered to be lost so that ordinary transmission mechanism from overnight interest rate to long term interest rate did not work. The results of this paper have following policy implication. The FRB could not influence US Treasury note yields and swap rates of two years, five years and ten years through monetary policy expectation formed in the financial market.

Keywords: Monetary Policy Expectation, Long Term Interest Rate
JEL Classification: E44, E52, G10

1. Introduction

The purpose of this paper is to investigate the impact of monetary policy expectation on US long term interest rates in global financial crisis. So far the impact of monetary policy expectation on long term interest rates has never been investigated by using OIS rate in US. In

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addition to that, two kinds of market interest rates－US Treasury Note and interest rate swap－ are used to investigate the impacts of monetary policy expectation. This paper is also the first one to analyze the impact of monetary policy expectation on long term interest rates under global financial crisis. In view of these points, this paper distinguishes itself from other previous literatures.

As Woodford (1999) shows that the forward-looking nature of financial markets can have important implication for determining the optimal setting of monetary policy, the effectiveness of monetary policy depends on the speed and extent of the transmission of monetary policy expectations to other asset prices.

Monetary policy decisions by the FRB (Federal Reserve Board) are usually expressed in terms of a target for overnight federal fund rate. This paper uses OIS (Overnight Indexed Swap) rate as monetary policy expectation. OIS rate is on a derivative contract on the overnight rate. OIS rate is a measure of the market's expectation of the overnight funds rate over the term of the contract. There is very little default risk in the OIS market because there is no exchange of principal; funds are exchanged only at the maturity of the contract, when one party pays the net interest obligation to the other. They trade OIS based on their expectation of overnight funds rate level within a certain period.[1]

As for literatures analyzing monetary policy expectation by using futures contracts in US, Krueger and Kuntter (1996), Kuttner (2001), Söderström (2001), Lange et al (2003), Faust et al (2004), Sack (2004) and Gürkaynak et al (2007) are cited.

Krueger and Kuttner (1996) analyze the federal funds futures rates' ability to forecast the funds rate, and by extension, short-run movements in monetary policy. They conclude that although federal funds futures rate exhibits a small premium, the market efficiently incorporates virtually all publicly available quantitative information that can help forecast changes in the federal funds rate.

Kuttner (2001) estimates the impact of monetary policy actions on bill, note, and bond yields, using data from the futures market for federal funds to separate changes in the target funds rate into anticipated and unanticipated components. The conclusion is that interest rates' response to anticipated target rate changes is small, while their response to unanticipated changes is large and highly significant.

Söderström (2001) concludes that a number of occasions, the futures-based expectations have either predicted positive target changes that did not occur or predicted no target change when in fact the target was reduced. These occasions have tended to arise in the months of September

[1] Thornton (2009) explains OIS market.

and December, yielding the negative intercepts.

Lange et al (2003) indicate that factors other than the autoregressive properties of the federal funds rate appear to have played a more important role in enhancing the predictability of FOMC actions. Among these other factors, the Federal Reserve has implemented a number of changes that may have improved the transparency of the process of setting monetary policy.

Faust et al (2004) measure the impact of the surprise component of Federal Reserve policy decisions on the expected future trajectory of interest rates by analyzing prices of federal funds futures contracts. One of the conclusions is that they find that the effect of a monetary policy tightening is to reduce the price level significantly at all horizons up to about four years,

Sack (2004) demonstrates how to extract the expected path of policy under the assumption that the risk premia are constant over time, and under a simple model that allows the risk premia to vary. The results provide evidence that the risk premia on those contracts do, in fact, vary over time. The impact of this variation is fairly limited for futures contracts with relatively short horizons, but it increases as the horizon of the contract lengthens.

Gürkaynak et al (2007) evaluate the empirical success of a variety of financial instruments in predicting the future path of monetary policy. They find that federal funds futures dominate all the other securities in forecasting monetary policy at horizons out to six months.

The remainder of this paper is as follows. Section 2 describes the data and provides summary statistics. Section 3 discusses the framework of the analysis. Section 4 presents the results. Section 5 concludes.

2. Data

Three month OIS (Overnight Indexed Swap) rate is used as market expectation of monetary policy by the FRB. The daily closing data are provided by ICAP. OIS is the rate on a derivative contract on the overnight rate and is a measure of the market's expectation of the overnight funds rate over the term of the contract as mentioned in section1.

US Treasury note yields of two years, five years and ten years and interest rate swap rates of two years, five years and ten years are used as market interest rates[2]. US Treasury note yields and swap rates are daily data quoted from the Federal Reserve Statistical Release (H. 15). The movement of three month OIS rate, two year US Treasury note yield and ten year Treasury note yield are provided in Figure 1. The descriptive statistics of data are provided in Table 1.

Whole sample period is from August 1, 2007 to May 20, 2009. During sample period, the

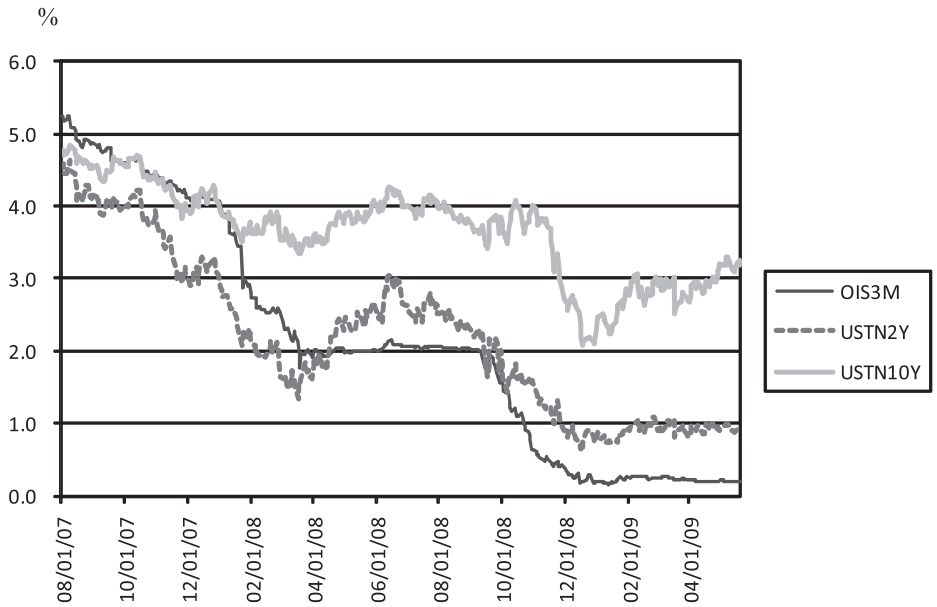
[2] Swap is used to describe interest rate swap afterwards.

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 on August 9, 2007. Lehman Brothers went bankrupt on September 15, 2008.

On the side of monetary policy, the FRB changed monetary policy five times during sample period. They started to lower the target of overnight federal fund rate from 5.25% to 4.75 on September 18, 2007 for the first time in four years and three months.

Afterwards FRB continued to ease monetary policy. Especially 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[3].

Fig. 1 The movement of 3 series



Notes:
OIS3M = Overnight Indexed Swap 3 Month
USTN2Y = US Treasury Note 2 Year
USTN10Y = US Treasury Note 10 Year
Data SourceOIS = ICAP, USTN = FRB
Whole sample period is from August 1, 2007 to May 20, 2009.

[3] The Federal Reserve Board announced the creation of the Commercial Paper Funding Facility (CPFF), a facility that will complement the Federal Reserve's existing credit facilities to help provide liquidity to term funding markets.

Table 1. Descriptive statistics of data for analysis

Variable	Average	SD	Min	Max	Median
OIS3M	2.120	1.608	0.163	5.246	2.021
USTN2Y	2.182	1.090	0.650	4.640	2.170
USTN5Y	2.874	0.856	1.260	4.690	2.910
USTN10Y	3.660	0.640	2.080	4.840	3.790
SWAP2Y	3.004	1.103	1.200	5.160	3.090
SWAP5Y	3.664	0.896	1.920	5.300	3.800
SWAP10Y	4.179	0.825	2.220	5.530	4.400

Notes:
Whole sample period is from August 1, 2007 to May 20, 2009.

3. Framework of Analysis

3. 1 Unit Root Test

It is necessary to check if the data used in this paper contain unit roots because the empirical analysis from mid-1980's through mid-1990's show that such data as interest rates, foreign exchange and stocks are non-stationary. The ADF (Augmented Dickey Fuller) test test and the KPSS (Kwiatowski / Phillips / Schmidt / Shin) test are used[4]. The PP test defines null hypothesis as 'unit roots exist' and alternative hypothesis as 'unit roots don't exist'. Fuller (1976) provides the table for the PP test. On the other hand, KPSS test defines null hypothesis as 'unit roots don't exist' and alternative hypothesis as 'unit roots exist'. First, original data are checked if they contain unit root. Next, data with first difference are analyzed if they have unit root to confirm that data are I (1) process.

3. 2 Cointegration Test

Generally OLS method is used to analyze the relationships among the variables. However when the non-stationary variables are included, ordinary hypothesis test tends to draw the mistaken results since the coefficient of determination and t-statistics do not follow a simple distribution.

Granger and Newbold (1974) called this problem 'Spurious Regression'. Phillips (1986) points out two things as to the analysis of non-stationary data — (1) the coefficient of determination tend not to measure a relationship among variables, (2) the estimated equation with low Durbin-

[4] See Dickey and Fuller (1979), Dickey and Fuller (1981) and Kwiatkowski et al (1989).

Watson ratio can possibly have a problem of spurious regression.

Non-stationary time series model is necessary to cope with the problems mentioned above. According to Engle and Granger (1987), Eq. (1) is estimated by OLS to find if the residual contains unit root. MacKinnon (1991) provides the table for critical values. Cointegarion tests are applied for 6 pairs of interest rates after it is confirmed that all the variables are I (1). A pair consists of 3 month OIS and long term interest rates. Long term interest rates are US Treasury note yields of two years, five years and ten years and swap rates of two years, five years and ten years. Eq. (1) is indicated to analyze a relationship between three month OIS rate and two year US Treasury note yield.

$$y_t = \alpha + \beta x_t + u_t \tag{1}$$

y_t = two year US Treasury note yield x_t = three month OIS rate

When series x and y are both non-stationary I (1), they are said to be in a relationship of cointegration if their linear combination is stationary I (0). The cointegration relationship between x and y implies that three month OIS rate and two year US Treasury note yield are in the long-run equilibrium. In other words, market expectation on monetary policy is incorporated in two year US Treasury note yield

In addition to testing if three month OIS rate and two year US Treasury note yield have a cointegration relationship, the cointegration vector $(1,-1)$, β in Eq. (1), is checked with the method of dynamic OLS by Stock and Watson (1993). Eq. (2) is used to test if $\beta = 1$ can be rejected. Δx_t is lead and lag variable of three month OIS rate. If $\beta = 1$ cannot be rejected, two year US Treasury note yield changes with an equivalent degree of three month OIS rate. The cointegration vector test is conducted only on a pair of samples when they have a cointegraton relationship.

$$y_t = \alpha + \beta E_t(x_t) + \sum_{i=-p}^{p} b_i \Delta x_t + u_t \tag{2}$$

The conclusion that monetary policy expectation is fully incorporated in a maturity of market interest rate can be drawn when these two variables are both in a cointegration relationship and one to one relationship.

The methods for testing whether monetary policy expectation is fully incorporated in a maturity of long term interest rate are summarized as follows.

(1) Test data if they are I (1) by unit root tests.

(2) Conduct cointegration test on pairs of data confirmed to be I (1).

(3) Conduct cointegration vector test on pairs of data confirmed to be in cointegration.

When cointegaration is confirmed, but $\beta = 1$ can be rejected, monetary policy expectation is partially incorporated in a maturity of long term interest rate.

4. Result

4. 1 Unit Root Test

ADF test and KPSS test are conducted for original series. Even though ADF tests for without trend show that three month OIS and two year US Treasury note do not have unit roots at the 5% level, ADF tests for the 2.5% level indicate that they have unit roots. Thus it is concluded that all the variables contain unit roots. The results are shown in Table 2 and Table 3.

Table 2. ADF unit root test (Original Series)

Variable	Without Trend	With Trend
OIS3M	-3.026*	-1.303
USTN2Y	-2.896*	-1.769
USTN5Y	-1.982	-1.883
USTN10Y	-1.168	-2.354
SWAP2Y	-2.585	-1.639
SWAP5Y	-1.667	-2.130
SWAP10Y	-1.386	-2.137

Notes:
* indicates significance at the 5% level.
5% critical values are −2.86 (without trend) and −3.41 (with trend).
2.5% critical values are −3.12 (without trend).
OIS3 M and USTN2Y are not siginificant at the 2.5 % level for without trend.

Next, ADF test and KPSS test are conducted for first differenced series. Even though result of KPSS test for level stationary show that three month OIS contain unit roots at the 5% level, test for the 2.5% level indicate that it does not have unit root. The tests other than 3 month OIS for level stationary indicate that they do not contain unit roots at the 5% level. Thus it is proper to judge that all variables for the analysis are non-stationary I (1). The results are shown in Table 4 and Table 5.

Table 3. KPSS unit root test (original series)

Variable	Lag = 4		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
OIS3M	8.485*	0.917*	3.321*	0.364*
USTN2Y	7.222*	0.648*	2.851*	0.260*
USTN5Y	6.771*	0.557*	2.678*	0.226*
USTN10Y	6.212*	0.486*	2.467*	0.201*
SWAP2Y	6.981*	0.707*	2.757*	0.282*
SWAP5Y	6.464*	0.739*	2.556*	0.297*
SWAP10Y	6.699*	0.730*	2.645*	0.297*

Notes:
* indicates significance at the 5% level.
5% critical values are 0.463（level stationary）and 0.146（trend stationary）.

Table 4. ADF unit root test (first difference series)

Variable	Without Trend	With Trend
OIS3M	-4.703*	-5.580*
USTN2Y	-11.676*	-11.999*
USTN5Y	-12.014*	-12.084*
USTN10Y	-11.485*	-11.425*
SWAP2Y	-6.757*	-8.159*
SWAP5Y	-7.281*	-8.643*
SWAP10Y	-21.084*	-20.756*

Notes:
* indicates significance at the 5% level.
5% critical values are －2.86（without trend）and －3.41（with trend）.

Table 5. KPSS unit root test (first difference series)

Variable	Lag = 4		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
OIS3M	0.541*	0.134	0.347	0.093
USTN2Y	0.172	0.077	0.198	0.090
USTN5Y	0.116	0.062	0.141	0.077
USTN10Y	0.081	0.055	0.088	0.061
SWAP2Y	0.092	0.088	0.102	0.098
SWAP5Y	0.074	0.069	0.088	0.083
SWAP10Y	0.069	0.064	0.079	0.074

Notes:
* indicates significance at the 5% level.
5% critical values are 0.463 (level stationary) and 0.146 (trend stationary).
2.5% critical value is 0.574 (level stationary).
OIS3M is not siginificant at the 2.5 % level for level stationarity (lag 4).

4. 2 Cointegration Test

Cointegration tests are applied for 6 pairs of interest rates because it is confirmed that all the variables are I (1). A pair consists of 3 month OIS and market interest rate. Long term interest rates are US Treasury note yields of two years, five years and ten years and swap rates of two years, five years and ten years. None of the pairs show that they are not in a relationship of cointegration. Three month OIS rate is not in the long-run equilibrium with US Treasury note yields of two years, five years and ten years and swap rates of two years, five years and ten years. In other words, market expectation on monetary policy is not incorporated in US Treasury note yields of two years, five years and ten years and swap rates of two years, five years and ten years. Cointegartion vector test is not conducted because cointegration relationship is not found in any single pair.

Table 6. Cointegration test

Variable	Test Statistics
OIS3M－USTN2Y	-2.148
OIS3M－USTN5Y	-2.241
OIS3M－USTN10Y	-2.386
OIS3M－SWAP2Y	-1.246
OIS3M－SWAP5Y	-2.295
OIS3M－SWAP10Y	-2.341

Notes:
** indicates significance at the 10 % level.
5% critical value is －3.7809 from MacKinnon (1991).
10% critical value is －3.4959 from MacKinnon (1991).

5. Conclusion

The purpose of this paper is to investigate the impact of monetary policy expectation on US long term interest rates in global financial crisis. Three month OIS (Overnight Indexed Swap) rate is used as market expectation of monetary policy by the FRB. As for market interest rates, US Treasury note yields and swap rates of two years, five years and ten years are used. None of long term interest rates are not in the relationship of cointegration with monetary policy expectation.

The conclusion of this paper suggests that expectation of monetary policy formed in the market could not influence US Treasury note yields and swap rates of two years, five years and ten years. One of the reasons is that financial market was under great stress in global financial crisis. Thus the function of price discovery is considered to be lost so that ordinary transmission mechanism from overnight interest rate to long term interest rate did not work.

The results of this paper have following policy implication. The FRB could not influence US Treasury note yields and swap rates of two years, five years and ten years through monetary policy expectation formed in the financial market in global financial crisis.

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