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Japanese Interest Rate Swap and Cross-Currency Basis Swap Markets under Non-traditional Monetary Policy

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Abstract

The five-, 10-, and 20-year interest rate swap (IRS) rates co-move with the 6-month basis swap rates under the quantitative and qualitative easing policy regime introduced by the Bank of Japan (BOJ). The 10- and 20-year IRS rates co-move with the 12-month basis swap rates under the quantitative and qualitative easing policy regime. The 10- and 20-year IRS rates are in a one-to-one relationship with the six- and 12-month basis swap rates. A cheaper yen gives foreign investors strong incentives to invest in 10- and 20-year IRS in the quantitative and qualitative easing policy regime. A cheaper yen gives foreign investors some incentives to invest in a 5-year IRS by funding yen in the six-month basis swap market. On the other hand, the IRS rate does not co-move with the basis swap rate under the negative interest rate policy regime. A cheaper yen does not give foreign investors incentives to invest in IRS. After the BOJ introduced the negative interest rate policy, the trend observed under the quantitative and qualitative easing policy regime changed.

Keywords: Basis Swap, Japanese Interest Rate Swap, Non-traditional Monetary Policy

1. Introduction

Not only Japanese government bonds (JGBs) but also the Japanese interest rate swap (IRS) were traded on a very low yield after the Bank of Japan (BOJ) introduced a quantitative and qualitative easing policy. This trend became more apparent after the BOJ decided to introduce a negative interest rate policy on January 29, 2016. Under the phenomenon of low yield, overseas investors capitalize on the brisk demand for dollars with highly profitable currency swaps.

Cross-currency basis swaps are often used as a tool for foreign-currency funding or currency-risk hedging by banks and institutional investors. Foreign exchange (FX) swaps are contracts in which one party simultaneously borrows one currency and lends another currency to a second party. Hedge funds and other institutional investors often borrow dollars on the swap market to hedge against exchange-rate risk when investing in foreign bonds and other interest rate instruments.

A pickup in such trades would heighten demand for dollar swaps. With the spread on dollar-yen basis swaps factored in, investing in IRS could be very attractive to overseas investors. The 12-month dollar-yen basis swap rate was about minus 70 basis points in the middle of July 2016. The five-year IRS rate was about minus 20 basis points in the same period. Exchanging dollars for yen and investing the proceeds in five-year or five-year JGBs with negative yields could produce an annual return of around 50 basis points for one year. Japanese banks have a great demand for US dollar funding as US banks are hesitant to lend US dollars because they are under the great pressure of downsizing the size of their balance sheet due to tighter regulation (the Volcker rule).

The related literatures such as Arai et al. (2016), Baba et al. (2008), Baba et al. (2009), Viviana (2016) and Wenxin et al. (2017) focus on cross currency markets. Ito (2017) shows that a cheaper yen gives foreign investors strong incentives to buy 10- and 20-year JGBs in the quantitative and qualitative easing policy regime in Japan. A cheaper yen gives foreign investors some incentives to buy 5-year JGBs in the same regime. On the other hand, the JGB yield does not co-move with basis swap rate in the regime of negative interest rate policy. After the BOJ introduced negative interest rate policy, the trend observed under the regime of quantitative and qualitative easing policy has changed.

This study focuses on the cross-currency swap and IRS markets. It investigates whether a cheaper yen gives foreign investors strong incentives to invest in IRS under the quantitative and qualitative easing policy and negative interest rate policy regimes. None of the related studies cited above analyzes the cross-currency swap and IRS markets. Thus, this paper distinguishes itself from other previous works.

The remainder of this paper is organized as follows: Section 2 describes the data and provides summary statistics, section 3 discusses the methodology, section 4 presents the results, and section 5 concludes the paper.

2. Data

Basis swap rates of six and 12 months and Japanese IRS rates of five, 10, and 20 years are used. The daily closing data are provided by Bloomberg. Basis swap rates moved in the negative territory. The sample period is from March 1, 2013 to August 31, 2016. The entire sample period is divided into two on the January 29, 2016, the date when the BOJ decided to introduce a negative interest rate policy.

The sample period running from March 1, 2013 to January 28, 2016 is named Sample A; the BOJ introduced a quantitative and qualitative easing policy during this period. The BOJ introduced a negative interest rate policy during the Sample B period. The Sample B period finishes at the end of August 2016 because the BOJ introduced a yield curve control policy on September 21, 2016. The yield curve control policy is as follows: The BOJ will apply a negative interest rate of minus 0.1 percent to the policy-rate balances in current accounts held by financial institutions at the

Bank. The Bank will purchase JGBs so that the 10-year JGB yields will remain at around zero percent.

The movements of the 12-month basis swap rate and the yields of JGBs with maturities of three and 12 months are shown in Figure 1, and the descriptive statistics are provided in Table 1.

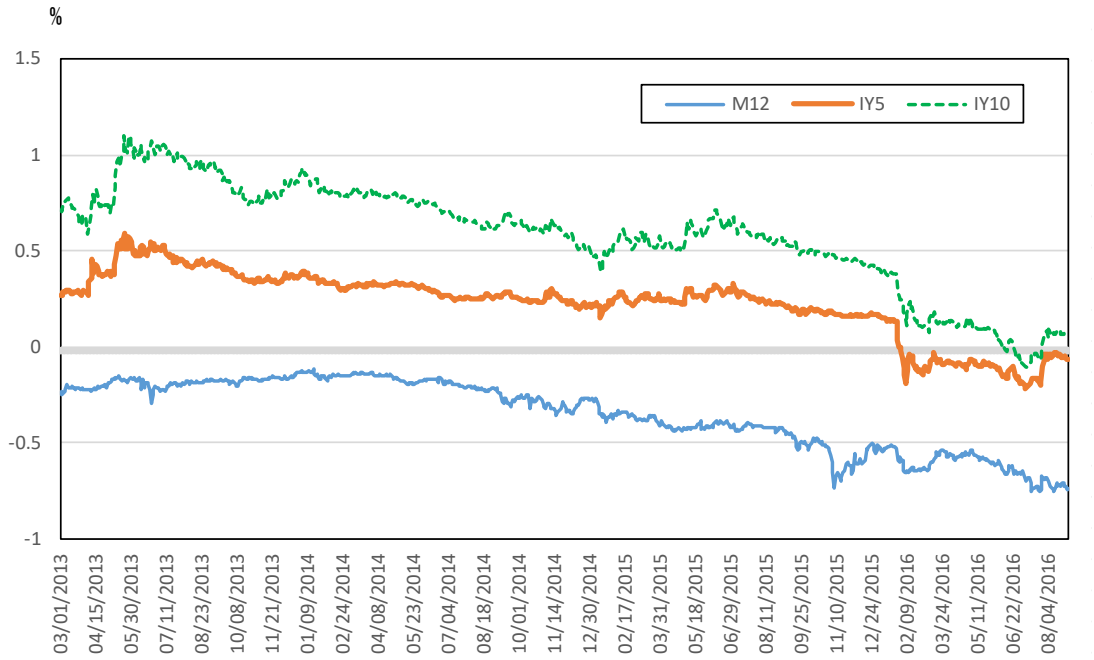

Fig.1 The movement of 3 Series

Notes:
M12 = Basis Swap Rate, IY10 = IRS 10Y, IY20 = IRS20Y
Data Source : Bloomberg
Whole sample period is from March 1, 2013 to Augst 31, 2016.

Table 1

Descriptive Statistics of Data for Analysis

Variable	Average	SD	Min	Max	Median
Sample A					
M6	-0.249	0.138	-0.698	-0.086	-0.204
M12	-0.292	0.140	-0.733	-0.117	-0.229
IY5	0.299	0.094	0.133	0.589	0.281
IY10	0.688	0.171	0.375	1.101	0.661
IY20	1.385	0.234	0.935	1.835	1.404
Sample B					
M6	-0.569	0.108	-0.776	-0.410	-0.530
M12	-0.631	0.061	-0.753	-0.538	-0.628
IY5	-0.099	0.048	-0.214	0.033	-0.092
IY10	0.079	0.083	-0.108	0.279	0.096
IY20	0.425	0.186	0.078	0.859	0.419

Notes:
Sample period from A is from March 1, 2013 to January 28, 2016.
Sample period from B is from January 29, 2016 to Augsut 31, 2016.
M is basis swap rate. IY is Japanese IRS rate.

3. Methodology

3.1 Unit Root Test

Because empirical analysis from the mid-1980s through to the mid-1990s shows that such data as interest rates, foreign exchanges, and stocks are non-stationary, it is necessary to check whether the data used in this paper contain unit roots. The augmented Dickey-Fuller (ADF) test and the Kwiatowski-Phillips-Schmidt-Shin (KPSS) test are used. The ADF test defines the null hypothesis as “unit roots exist” and the alternative hypothesis as “unit roots do not exist.” Fuller (1976) provides a table for the ADF test. The KPSS test defines the null hypothesis as “unit roots do not exist” and the alternative hypothesis as “unit roots exist.” First, the original data are checked to verify whether they contain unit roots. Next, the data with first difference are analyzed to determine whether they have unit roots in order to confirm that they are I (1) process.

3.2 Cointegration Test and Theoretical Background

A cointegration framework is presented to analyze the relationship between IRS rate and basis swap rate. Non-stationary time series wander widely with their own short-run dynamics, but a linear combination of these series can sometimes be stationary so that they show co-movement with the long-run dynamics. Engle and Granger (1987) call this cointegration. In the test of the

co-movement between IRS rate and basis swap rate by cointegration, equation (1) is estimated by ordinary least squares (OLS) to find out whether the residual contains unit roots.

$$IRS_t = \alpha + \beta\, basis_t + u_t \qquad (1)$$

IRS_t = IRS rate $\qquad$ $basis_t$ = basis swap rate

When series IRS_t and $basis_t$ are both non-stationary I (1), they are said to be in a cointegration relationship if their linear combination is stationary I (0). The cointegration relationship between IRS_t and $basis_t$ implies that IRS rate and basis swap rate move together in the long-run equilibrium. If IRS rate co-moves with basis swap rate, it is assumed that the IRS rate decreases when the funding cost of Japanese yen gets lower. In other words, a cheaper yen gives foreign investors incentives to invest in IRS.

In addition to testing whether IRS rate and basis swap rate are in a cointegration relationship, the cointegration vector (1,-1), β in the equation (1), is checked using the dynamic OLS method developed by Stock and Watson (1993). Equation (2) is used to test if β = 1 can be rejected. $\Delta basis_{t-j}$ is the lead variable and the lag variable of basis swap rate. As for the number of lead and lag terms, 12 is used. Hirayama and Kasuya (1996) provide empirical analysis using Rats procedure SWDYNAMIC.PRG. If β = 1 cannot be rejected, IRS rate changes to the same degree as basis swap rate. The test of the cointegration vector is only conducted on a pair of samples when they are in a cointegration relationship.

$$IRS_t = \alpha + \beta\, basis_t + \sum_{i=-p}^{p} b_i \Delta basis_{t-i} + u_t \qquad (2)$$

The methodology is summarized as follows: First, analyses are conducted on the pair-wise relationship between IRS rate and basis swap rate, respectively. In other words, the co-movement of IRS rate with basis swap rate is investigated using the cointegration test. Next, whether IRS rate and basis swap rate are in a one-to-one relationship is tested using the cointegration vector test. An interpretation of the results divided into three cases can be made in the following way:

Interpretation of cointegration analysis

Case	Cointegration	Cointegration Vector
Ⅰ	No	--
Ⅱ	Yes	β＝1 cannot be denied
Ⅲ	Yes	β＝1 can be denied

The IRS rate does not co-move with the basis swap rate. A cheaper yen does not give foreign investors incentives to invest in IRS.

Ⅱ The IRS rate co-moves with the basis swap rate. The IRS rate is in a one-to-one relationship with the basis swap rate. A cheaper yen gives foreign investors strong incentives to invest in IRS.

Ⅲ The IRS rate co-moves with the basis swap rate. The IRS rate is not in a one-to-one relationship with the basis swap rate. A cheaper yen gives foreign investors some incentives to invest in IRS.

4. Results

4.1 Unit Root Test

First, ADF and KPSS tests are conducted on the original series. All the results of the ADF and KPSS tests except for the ADF tests with a six-month basis swap trend and a 10-year IRS in Sample A contain a unit root. The results do not eliminate the doubt that the original data have unit roots because all the results of the KPSS test show that they contain unit roots. The KPSS test is considered to have more statistical power than the ADF test. The results are shown in Table 2 and Table 3.

Next, ADF and KPSS tests are conducted for the data with a first difference. The results show that all the data with a first difference are stationary. Thus, it is appropriate to think that all of the variables used for the analysis are non-stationary $I(1)$ variables and to judge that non-stationary time series can be used. The results are shown in Table 4 and Table 5.

4.2 Cointegration Test

Pair-wise analyses are conducted to check the relationships between the IRS rate and the basis swap rate. The results of all the tests show that in Sample A, the IRS rate is in a cointegration relationship with the six-month basis swap rate in the maturities of five, 10, and 20 years. The IRS rate is in a cointegration relationship with the 12-month basis swap rate in the maturities of 10 and 20 years. On the other hand, the results of all the tests show that in Sample B, the IRS rate is not in a cointegration relationship with the basis swap rate. The results are shown in Table 6.

Next, the dynamic OLS method of Stock and Watson (1993) is used to check whether the β indicated in equation (2) equals 1 for Sample A. The results of tests show that $\beta = 1$ cannot be rejected in the analysis of the swap rate in the maturities of 10 and 20 years, which means that a 1% increase in the basis swap rate leads to a 1% increase in the JGB yield. The results are shown in Table 7.

Table 2

ADF unit root test (Original Series)

Variable	Without Trend	With Trend
Sample A		
M6	-0.137	-3.476*
M12	0.763	-3.246
IY5	-1.049	-2.987
IY10	-0.632	-4.142*
IY20	-0.697	-3.994
Sample B		
M6	1.213	-2.906
M12	0.667	-2.389
IY5	-0.969	-2.091
IY10	-2.397	-1.811
IY20	-2.273	-1.829

Notes:

* indicates significance at the 5% level.

5% critical values are −2.864 (without trend) and −3.415 (with trend).

1% critical values are −3.437 (without trend) and −3.964 (with trend).

M is basis swap rate. IY is Japanese IRS rate.

Table 3

KPSS unit root test (Original Series)

Variable	Lag = 3		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
Sample A				
M6	11.907*	1.662*	4.654*	0.699*
M12	11.831*	2.439*	4.614*	0.987*
IY5	10.939*	1.208*	4.310*	0.507*
IY10	11.524*	0.507*	4.524*	0.215*
IY20	12.253*	0.546*	4.792*	0.230*
Sample B				
M6	2.368*	0.560*	0.976*	0.246*
M12	1.822*	0.593*	0.762*	0.258*
IY5	0.473*	0.228*	0.203*	0.118
IY10	1.900*	0.258*	0.818*	0.124
IY20	2.235*	0.390*	0.937*	0.178*

Notes:

* indicates significance at the 5% level.

5% critical values are 0.463 (level stationary) and 0.146 (trend stationary).

M is basis swap rate. IY is Japanese IRS rate.

Table 4

ADF unit root test (first difference series)

Variable	Without Trend	With Trend
Sample A		
ΔM6	-26.623*	-26.378*
ΔM12	-21.815*	-21.635*
ΔIY5	-17.737*	-19.295*
ΔIY10	-17.537*	-18.031*
ΔIY20	-17.608*	-17.984*
Sample B		
ΔM6	-10.251*	-10.837*
ΔM12	-13.079*	-12.714*
ΔIY5	-10.240*	-11.297*
ΔIY10	-6.583*	-6.404*
ΔIY20	-10.588*	-11.025*

Notes:

* indicates significance at the 5% level.

5% critical values are −2.864 (without trend) and −3.415 (with trend).

M is basis swap rate. IY is Japanese IRS rate.

Table 5

KPSS unit root test (First Diffrenced Series)

Variable	Lag = 4		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
Sample A				
ΔM6	0.057	0.048	0.06	0.05
ΔM12	0.14	0.035	0.153	0.038
ΔIY5	0.143	0.073	0.16	0.088
ΔIY10	0.256	0.116	0.26	0.115
ΔIY20	0.314	0.116	0.31	0.117
Sample B				
ΔM6	0.105	0.047	0.153	0.072
ΔM12	0.127	0.053	0.163	0.069
ΔIY5	0.145	0.044	0.204	0.066
ΔIY10	0.212	0.056	0.261	0.077
ΔIY20	0.417	0.057	0.340	0.068

Notes:

* indicates significance at the 5% level.

5% critical values are 0.463 (level stationary) and 0.146 (trend stationary).

M is basis swap rate. IY is Japanese IRS rate.

Table 6

Cointegration test

Variable	Test Statistics	Variable	Test Statistics
Sample A		Sample B	
M6,IY5	-3.163**	M6,IY5	-0.034
M6,IY10	-3.466*	M6,IY10	-0.593
M6,IY20	-3.521**	M6,IY20	-1.418
M12,IY5	-2.614	M12,IY5	-0.745
M12,IY10	-3.049*	M12,IY10	-1.291
M12,IY20	-3.434*	M12,IY20	-1.170

Notes:
*,** indicates significance at the 5% and 10% levels respectively.
5% critical value is −3.3377 from MacKinnon (1991).
10% critical value is −3.0462 from MacKinnon (1991).
M is basis swap rate. IY is Japanese IRS rate.

Table 7

Cointegration vector test

Variable	β	Modified SE	Modified t Value
Sample A			
M6,IY5	0.528	0.170	3.106
M6,IY10	1.046	0.260	0.176*
M6,IY20	1.503	0.332	1.515*
M12,IY10	0.974	0.305	0.085*
M12,IY20	1.445	0.349	1.275*

Notes:
* means that β = 1 cannot be rejected since modified t value is smaller than 5% critical value (1.96).
M is basis swap rate. IY is Japanese IRS rate.

5. Concluding Remarks

This study focuses on the cross-currency swap and IRS markets. It investigates whether a cheaper yen gives foreign investors strong incentives to invest in IRS under the regimes of the quantitative and qualitative easing and negative interest rate policies. Basis swap rates moved in the negative territory. This indicates that foreign investors could fund Japanese yen on a negative basis. The five-, 10-, and 20-year IRS rates co-move with the six-month basis swap rates under the quantitative and qualitative easing policy regime. The 10- and 20-year IRS rates co-move with the 12-month basis swap rates under the quantitative and qualitative easing policy regime.

The 10- and 20-year IRS rates are in a one-to-one relationship with the six- and 12-month basis swap rates. A cheaper yen gives foreign investors strong incentives to invest in 10- and 20-year IRS under the quantitative and qualitative easing policy regime. A cheaper yen also gives foreign investors some incentives to invest in 5-year IRS by funding yen in the six-month basis swap market. On the other hand, the IRS rate does not co-move with the basis swap rate under the negative interest rate policy regime. A cheaper yen does not give foreign investors incentives to invest in IRS.

The BOJ introduced a quantitative and qualitative easing policy in April 2013. The yield curve of IRS flattened sharply in the 10- and 20-year yields, declining from the beginning of 2013 because market practitioners anticipated that the BOJ would introduce a large-scale easing policy. The investment in IRS by foreign investors using the cheaper yen funded on a negative basis in the cross-currency market contributed to the decline of long-term IRS rates. After the BOJ introduced a negative interest rate policy, the trend observed under the quantitative and qualitative easing policy regime changed.

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