Credit Default Swap and Japanese Government Bond Markets under Negative Interest Rate Policy

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Abstract

Structural changes have taken place in the markets of credit default swap (CDS) and Japanese Government Bond (JGB) after the Bank of Japan (BOJ) introduced yield curve control (YCC) under a negative interest rate policy. CDS and JGB markets were segmented before the introduction of YCC. Whether CDS markets function as insurance against JGB market or not cannot be confirmed because no causalities were found between CDS and JGB markets. However, they are integrated under a negative interest rate policy with YCC. The CDS market does not function as insurance because unilateral causalities from CDS to JGB markets were found. The purpose of YCC introduction was an upward adjustment of the yield curve because the flattening of the yield curve damaged bank profits. A positive yield in a 10-year JGB has become an incentive to investors. The markets of CDS and JGB have started to be integrated because JGB has regained a market and price discovery function with the introduction of YCC.

Keywords: Credit default swap, Japanese Government Bond, negative interest rate policy, yield curve control

1.Introduction

Markets with long-term interest rates have experienced unprecedented movement since the Bank of Japan (BOJ) introduced a negative interest rate policy on January 29, 2016. For example, the yield of 10-year Japanese Government Bond (JGB) had declined to about -0.3％ by mid-July, 2016. The BOJ adopted yield curve control (YCC) for upward adjustment of the yield curve as its flattening was damaging bank profits.

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Focusing on this unprecedented movement, this paper investigates the relationship between credit default swap (CDS) and the underlying JGB markets under a negative interest rate policy. The paper has three purposes. Firstly, it analyzes any potential co-movement of CDS and JGB markets. Duffie (1999) points out that a "theoretical no-arbitrage condition between the cash and synthetic price of credit risk should drive investment decisions and tie up the two markets in the long run". As indicated in Ito(2015), "when this condition is applied to CDS and JGB markets, co-movement between them can be confirmed". If co-movement is found, CDS and JGB markets are integrated with a market and price discovery function; however, if not, they are segmented.

Secondly, this paper investigates whether CDS propels JGB or vice versa. If the former is confirmed, then CDS do not function as insurance; if the latter, they do. Thirdly, this paper splits the sample of when the BOJ introduced the YCC policy. An asymmetrical impact of negative interest rate policy on CDS and JGB depends on whether YCC is applied to negative interest rate policy or not.

There is some related literature analyzing the relationship between CDS and government bond markets; however, these focus on markets other than Japan. This paper is the first to analyze CDS and JGB markets in Japan under a negative interest rate policy. In addition, this paper analyzes the impact of YCC under a negative interest rate policy, giving it originality over previous work.

Fontana and Scheicher (2015) focused on the euro area sovereign CDS and the underlying government bonds markets, using weekly CDS and bond spreads of ten euro-area countries for the period from January 2006 to June 2010. They found that "CDS spreads have on average exceeded bond spreads", and concluded that "since September 2008, market integration for bonds and CDS varies across countries". Palladini and Portes (2011) examined "whether the non-stationary CDS and bond spreads series are bound by a cointegration relationship over the period from January 2004 to March 2011", and found that "the two prices should be equal to each other in equilibrium". They concluded that "the CDS market moves ahead of the bond market in terms of price discovery".

Moessner (2018) found that "the term premia of euro area countries with higher sovereign risk, as measured by sovereign CDS spreads, decreased more in response to the announcements of asset purchases and financial stability measures". Singh et al. (2021) indicated that "traditional indicators of sovereign risk (CDS, bond yields, and credit rating) do not take into consideration

the priority structure of creditors and are highly influenced by market sentiment".

Tampakoudis et al. (2019) found that "during periods of economic turbulence the CDS market leads the bond market in price discovery, incorporating the new information about sovereign credit risk faster and more efficiently than the bond market does". Bedowska-Sojka and Kliber (2019) verified "the direction of sovereign risk transmission between sovereign CDS and sovereign bond markets in Central European economies".

Agiakloglou and Deligiannakis (2020) investigated "the short run and the long run relationship between government bond yields and their associated credit default swaps (CDS), using co-integration and Granger causality techniques, for eight major European Union countries, over three different periods, considering the global financial and resultant European debt crises".

Andries et al. (2021) found that "a higher number of cases and deaths and public health containment responses significantly increase the uncertainty among investors in European government bonds by assessing the impact of the pandemic in Europe on sovereign CDS spreads during the COVID-19 pandemic".

2. Background of the BOJ's Negative Interest Policy and YCC

The BOJ adopted a negative interest rate policy on January 29, 2016. This policy is not included in the classification proposed by Bernanke and Reinhart (2004). The Danish Central Bank introduced the first negative interest rate policy in the world on July 5, 2012. According to the BOJ (2016a), "they 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. They purchase JGBs so that 10-year JGB yield remains more or less at the current level (around zero percent)".

The BOJ introduced the YCC policy on September 21, 2016, indicated in the BOJ (2016b): "In addition to maintaining a -0.1% interest rate for policy-rate balance, they purchase JGBs so that the 10-year JGB yield remains more or less at the current level (around 0%). Even though they introduced a YCC, there was a consensus in the market that the BOJ would permit JGBs to move from -0.1% to 0.1%".

Mr. Haruhiko Kuroda, Governor of the BOJ, said at a press conference on July 31, 2018 that "the 10-year JGB yield would move within the range of -0.2% to 0.2%", as indicated by the BOJ (2018). According to the BOJ (2021), they expanded the range to between -0.25% to 0.25% on

March 19, 2021.

3.Data

Daily data of CDS and JGB with a maturity of two, five, and 10 years are used in this analysis. The sample period runs from January 29, 2016 to December 3, 2021. Data are provided by Datastream. CDS and government bonds are quoted by basis point and percentage, respectively, in the market. The descriptive statistics of the dataset are shown in Table 1. The movements of CDS and JGB are shown in Figures 1 and 2. The descriptive statistics are shown in Table 1.

Figure 1

Figure2

Table 1

The sample period began from when the BOJ introduced YCC under a negative interest rate policy on September 21, 2016 and is divided into two parts. The sample period from January 29, 2016 to September 20, 2016 is named Sample A. The sample period from September 21, 2016 to December 3, 2021 is Sample B.

4.Methodology

4.1 Unit Root Test

The Augmented Dickey-Fuller (ADF) test and the Kwiatowski-Phillips-Schmidt-Shin (KPSS) test were used. According to Dickey and Fuller (1979; 1981), "the ADF defines the null hypothesis as *unit roots exist* and the alternative hypothesis as *unit roots do not exist*". Fuller (1976) provided a table for the ADF test. According to Kwiatkowski (1992), "the KPSS test defines the null hypothesis as *unit roots do not exist* and the alternative hypothesis as *unit roots exist*". As shown in Ito (2015) "the original data are checked to verify whether they contain unit roots". Following this, "the data with first difference are analyzed to determine whether they have unit roots to confirm that they are I (1) process".

4.2 Cointegration Test

"A cointegration framework is presented to analyze the relationship between CDS and JGB markets", as indicated in Ito (2015). "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 long-run dynamics". This is called "cointegration" by Engle and Granger (1987). In the test of co-movement between CDS and JGB markets by cointegration, "equation (1) is estimated by Ordinary Least Squares (OLS) to find out whether the residual contains unit roots."

$$CDS_t = \alpha + \beta\, JGB_t + u_t \qquad (1)$$

CDS_t = CDS

JGB_t = Japanese Government Bonds

According to Engle and Granger (1987) "when series CDS_t and JGB_t are both non-stationary *I* (1), they are said to be in the relationship of cointegration if their linear combination is stationary *I* (0)". Ito (2015) concludes that "the cointegration relationship between CDS_t and GB_t implies that CDS and JGB markets move together in the long run equilibrium".

4.3 Granger Causality Test

According to Granger (1969) "with regard to the variables CDS_t and JGB_t, the Granger causality test checks whether CDS_t affects JGB_t or JGB_t affects CDS_t or CDS_t and JGB_t mutually in a time series model". Toda and Yamamoto (1995) indicated that "original data are usually transformed into the change ratio to avoid a problem of spurious regression, but using these data causes an error". They developed a Granger causality test in which non-stationary data are directly used. In the present study, the null hypothesis H_0 concerning the influence of JGB_t to CDS_t and the influence of CDS_t to JGB_t is tested. According to this method, "trend term *t* and *p* + 1 (original lag plus one) are added for the estimation". The original lag length is decided by the AIC standard.

$$CDS_t = u_0 + u_t + \sum_{i=1}^{p+1} \alpha_i CDS_{t-i} + \sum_{i=1}^{p+1} \beta_i JGB_{t-i} + u_t \qquad (2)$$

H_0: $\beta_1 = \beta_2 = \cdots \beta_p = 0$

H_1: $Either\ \beta_i \neq 0 \quad (i = 1,2,\cdots,p)$

$$JGB_t = v_0 + v_t + \sum_{i=1}^{p+1} \gamma_i GB_{t-i} + \sum_{i=1}^{p+1} \delta_i CDS_{t-i} + u_t \qquad (3)$$

H_0: $\gamma_1 = \gamma_2 = \cdots \gamma_p = 0$

H_1: $Either\ \gamma_i \neq 0 \quad (i = 1,2,\cdots,p)$

As described in Ito (2015), "the F test is conducted by estimating equations (3) and (4) through OLS and summing the squared error". "If the null hypothesis of H_0 in equation (3) is rejected, JGB_t is considered to explain CDS_t (i.e., government bonds cause CDS)". "If the null hypothesis of H_0 in the equation (4) is rejected, CDS_t is considered to explain JGB_t (i.e., CDS causes government bonds)". Pair-wise analyses on CDS and JGB at maturity of two, five, and 10 years were conducted.

5.Results

5.1 Unit Root Test

The results of the ADF tests without trend show that all the data do not have a unit root even though there are some exceptions on the tests with trend. The results of KPSS tests on both level stationary and trend stationary indicate that all the data have unit roots. Accordingly, it is safe to conclude that all the data have unit roots to avoid a problem of spurious regression as explained in Granger and Newbold (1974). Results are shown in Tables 2 and 3.

Table 2

Table 3

The results of all ADF and KPSS tests on first differenced data show that they are stationary because they do not have unit roots. It can be concluded that all data used for the analyses of this paper are non-stationary I (1). Results are shown in Tables 4 and 5.

Table 4

Table 5

5.2 Cointegration Test

The results of the cointegration test show that there is no cointegration relationship between JGB and CDS markets in any maturity in Sample A. On the other hand, a cointegration relationship is found between JGB and CDS markets in every maturity in Sample B. After the BOJ introduced YCC, the JGB and CDS markets moved together in the maturities of two, five and 10 years. Results are shown in Table 6.

Table 6

5.3 Granger Causality Test

The results of the Granger causality test show that there is no causality found in any maturity in Sample A. On the other hand, unilateral causalities from CDS to JGB markets are found in every maturity in Sample B. After the BOJ introduced YCC, the CDS propelled JGB markets. Results are shown in Table 7.

Table 7

6. Concluding Remarks

This paper investigates the relationship between CDS and the underlying JGB markets under a negative interest rate policy. When the BOJ adopted a negative interest rate policy without YCC, CDS and JGB markets did not co-move and did not propel each other. On the other hand, CDS and JGB markets co-moved under a negative interest rate policy with YCC. The CDS propelled JGB markets.

These structural changes took place in the markets of CDS and JGB markets after the BOJ introduced YCC. The CDS and JGB markets were segmented before the introduction of YCC. Whether CDS functions as insurance against JGB markets or not cannot be confirmed because no causalities were found between the CDS and JGB markets; however, they are integrated under a negative interest rate policy with YCC. The CDS market does not function as insurance because causalities from CDS to JGB markets were found.

The median yields of JGB in the maturities of two, five, and 10 years were higher after the introduction of YCC. In particular, the median yields of the 10-year JGB were -0.093% and 0.035% before and after the introduction of YCC, respectively. The purpose of the YCC introduction was the upward adjustment of the yield curve because its flattening damaged bank profits. A positive yield of 10-year JGB became an incentive to investors. The markets of CDS and JGB have started to be integrated because the JGB market has regained a market and price discovery function with the introduction of YCC.

This paper focuses on the CDS and JGB markets. There is room to analyze the impact of YCC on the markets of JGB and interest rate swap markets because they are major long-term interest rates. I would like to make this a further study.

References

Andries, A.M., Ongena, S., and Sprincean, N. (2021). The COVID-19 pandemic and sovereign bond risk. *North American Journal of Economics and Finance*, 58, 101527.

Agiakloglou, C., and Deligiannakis, E. (2020). Sovereign risk evaluation for European Union countries. *Journal of International Money and Finance*, 103, 102117.

Bank of Japan (2016a). http://www.boj.or.jp/en/announcements/release_2016/ k160129a.pdf.

Bank of Japan (2016b). http://www.boj.or.jp/en/announcements/release_2016/ k160921a.pdf.

Bank of Japan (2018). http://www.boj.or.jp/en/announcements/release_2018 /k180731a.pdf.

Bank of Japan (2021). https://www.boj.or.jp/en/announcements/release_2021 /k210319a.pdf.

Bernanke, B. S., and Reinhart, V. R. (2004). Conducting monetary policy at very low short-term interest rates. *American Economic Review,* 94, 85-90.

Bedowska-Sojka, B., and Kliber, A. (2019) Risk transmission between sovereign credit default swaps and government bonds during the global financial crisis. The case of the Czech Republic, Hungary and Poland. *Central European Journal of Economic Modelling and Econometrics,* 11(3), 153-172.

Dickey, D. A., and Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74(366), 427-431.

Dickey, D. A., and Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica* ,49(4), 107-1072.

Duffie, D. ,(1999). Credit swap valuation. *Financial Analysts Journal* ,55 (1),73-87.

Engle, R. F., and Granger, C.W.J. (1987). Co-integration and error correction: representation, estimation and testing. *Econometrica*, 55(2), 251-276.

Fontana, A., and Scheicher, M. (2015). An analysis of euro area sovereign CDS and their relation with government bonds European Central Bank. *Journal of Banking & Finance*, 62, 126-140.

Fuller, W. A. (1976). *Introduction to statistical time series*. John Wiley & Sons, Inc. New York, USA.

Granger, C. W. J. (1969) Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, 37(3), 424–438.

Granger, C. W. J., and Newbold, P. (1974). Spurious regressions in econometrics. *Journal of*

Econometrics, 2(2), 111-120.

Johansen, S. (1988). Statistical analysis of cointegrated vectors. *Journal of Economic Dynamics and Control,* 12(2-3), 231-254.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., and Shin, Y. (1992), Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics*, 54(1-3), 159-178.

Ito, T. (2015). The behavior of sovereign CDS and government bond in the euro zone crisis. *International Journal of Monetary Economics and Finance*, 9(2), 102-114.

MacKinnon,J.(1991), 'Critical values for cointegration tests', Engle,R.F and C.W.J.Granger ed, Long-run economic relationships: readings in cointegration, Oxford University Press, 267-276.London,UK.

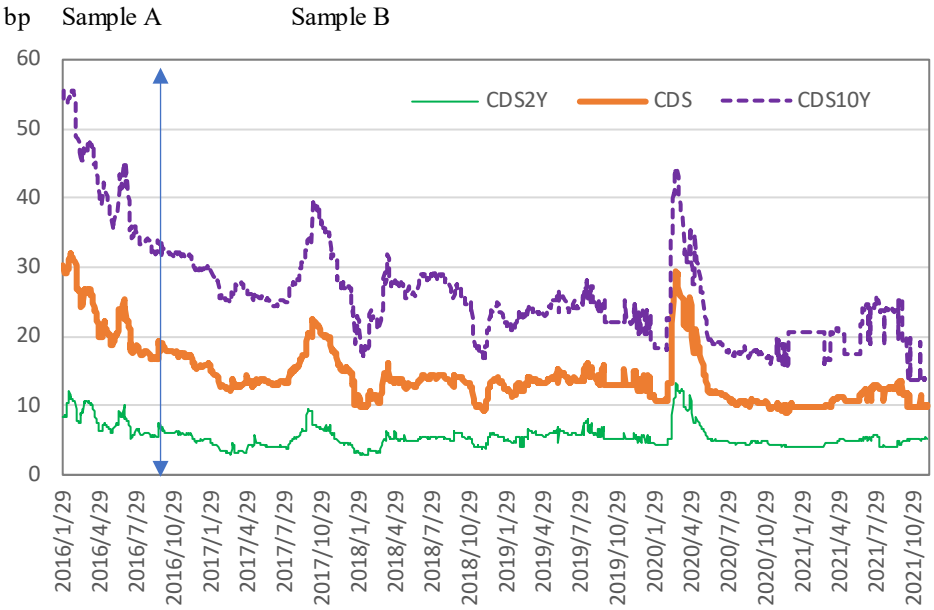
Moessner, R. (2018) Effects of asset purchases and financial stability measures on term premia in the euro area. *Applied Economics*, 50(43), 4617–4631.

Palladini, G., and Portes, R. (2011). Sovereign CDS and bond pricing dynamics in the euro area. *CEPR Discussion Papers*: 8651.

Singh, M. K., Gomez-Puig, M., and Sosvilla-Rivero, S. (2021), Quantifying sovereign risk in the euro area, *Economic Modelling*, 95, 76-96.

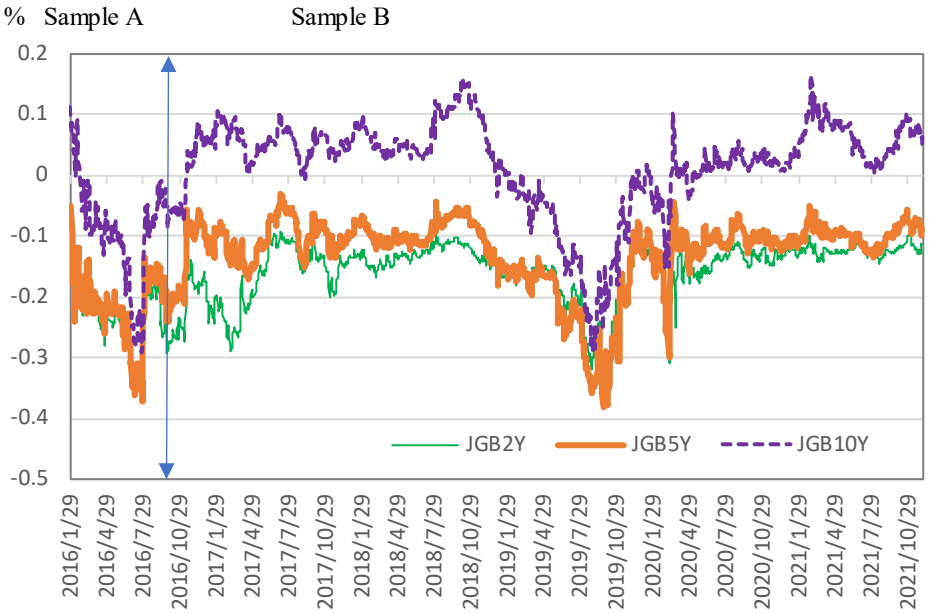
Toda, H. Y., and Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66(1-2), 225-250.

Figure 1 CDS



Note: Sample A is from January 29, 2016 to September 20, 2016.
Sample B is from September 21 to December 3, 2021
CDS = Credit Default Swap (bp)
Data source = Datastream

Fgure 2 JGB



Note: Sample A is from January 29, 2016 to September 20, 2016.
Sample B is from September 21 to December 3, 2021
JGB = Japanese Government Bond (%)
Data source = Datastream

Table 1

Descriptive statistics of data for analysis

Variable	Average	SD	Min	Max	Median
Sample A					
CDS2Y	7.499	1.627	5.090	10.780	7.210
CDS5Y	21.806	3.972	16.580	31.060	20.830
CDS10Y	40.712	6.442	31.930	55.360	39.930
JGB2Y	-0.235	0.052	-0.364	-0.060	-0.234
JGB5Y	-0.220	0.059	-0.372	-0.050	-0.216
JGB10Y	-0.102	0.078	-0.291	0.114	-0.093
Sample B					
CDS2Y	5.188	1.390	2.910	13.390	5.040
CDS5Y	13.397	3.143	8.960	29.410	13.080
CDS10Y	24.173	5.327	13.650	44.210	24.110
JGB2Y	-0.156	0.047	-0.338	-0.085	-0.139
JGB5Y	-0.126	0.059	-0.383	-0.030	-0.109
JGB10Y	0.018	0.077	-0.287	0.165	0.035

Notes:
Sample A is from January 29, 2016 to September 20, 2016.
Sample B is from September 21 to December 3, 2021
CDS = Credit Default Swap (bp)
JGB = Japanese Government Bond (%)

Table 2

ADF unit root test (Original Series)

Variable	Without Trend	With Trend
Sample A		
CDS2Y	-0.535	-3.568*
CDS5Y	-1.693	-1.769
CDS10Y	-2.143	-2.068
JGB2Y	-0.268	-2.806
JGB5Y	-0.395	-2.649
JGB10Y	-1.083	-1.943
Sample B		
CDS2Y	-1.093	-4.168*
CDS5Y	-1.194	-4.443*
CDS10Y	.-1.209	-4.824*
JGB2Y	-1.495	-3.754*
JGB5Y	-1.549	-2.969
JGB10Y	-2.093	-2.258

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).

Sample A is from January 29, 2016 to September 20, 2016.

Sample B is from September 21 to December 3, 2021

CDS = Credit Default Swap JGB = Japanese Government Bond

Table 3

KPSS unit root test (Original Series)

Variable	Lag = 2		Lag = 6	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
Sample A				
CDS2Y	3.534*	0.146*	1.603*	0.073
CDS5Y	4.608*	0.454*	2.042*	0.214*
CDS10Y	4.846*	0.423*	2.152*	0.201*
JGB2Y	1.192*	0.571*	0.578*	0.278*
JGB5Y	1.527*	0.655*	0.510*	0.319*
JGB10Y	2.931*	0.829*	0.919*	0.388*
Sample B				
CDS2Y	1.347*	1.317*	0.594*	0.581*
CDS5Y	8.736*	0.754*	3.819*	0.330*
CDS10Y	17.298*	0.318*	7.575*	0.140*
JGB2Y	5.407*	2.248*	2.386*	0.994*
JGB5Y	3.403*	3.423*	1.493*	1.502*
JGB10Y	4.676*	4.209*	2.032*	1.830*

Notes:

* indicates significance at the 5% level.

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

Sample A is from January 29, 2016 to September 20, 2016.

Sample B is from September 21 to December 3, 2021

CDS = Credit Default Swap JGB = Japanese Government Bond

Table 4

ADF unit root test (first difference series)

Variable	Without Trend	With Trend
Sample A		
CDS2Y	-11.165*	-11.564*
CDS5Y	-11.040*	-10.984*
CDS10Y	-11.565*	-11.358*
JGB2Y	-7.507*	-7.520*
JGB5Y	-7.551*	-7.620*
JGB10Y	-8.206*	-8.300*
Sample B		
CDS2Y	-43.600*	-43.030*
CDS5Y	-8.621*	-9.621*
CDS10Y	-9.824*	-9.829*
JGB2Y	-10.153*	-10.174*
JGB5Y	-12.499*	-12.500*
JGB10Y	-12.532*	-12.530*

Notes:

* indicates significance at the 5% level.

5% critical values are −2.86 (without trend) and −3.41 (with trend).

Sample A is from January 29, 2016 to September 20, 2016.

Sample B is from September 21 to December 3, 2021

CDS = Credit Default Swap JGB = Japanese Government Bond

Table 5

KPSS unit root test (first differenced series)

Variable	Lag = 4		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
Sample A				
CDS2Y	0.076	0.069	0.058	0.056
CDS5Y	0.133	0.053	0.112	0.044
CDS10Y	0.121	0.046	0.099	0.038
JGB2Y	0.152	0.057	0.152	0.057
JGB5Y	0.155	0.039	0.169	0.041
JGB10Y	0.245	0.032	0.289	0.041
Sample B				
CDS2Y	0.028	0.024	0.027	0.024
CDS5Y	0.031	0.029	0.028	0.027
CDS10Y	0.023	0.023	0.023	0.023
JGB2Y	0.020	0.019	0.023	0.022
JGB5Y	0.027	0.027	0.027	0.027
JGB10Y	0.041	0.041	0.042	0.043

Notes:

* indicates significance at the 5% level.

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

Sample A is from January 29, 2016 to September 20, 2016.

Sample B is from September 21 to December 3, 2021

CDS = Credit Default Swap JGB = Japanese Government Bond

Table 6

Cointegration test

Variable	Test Statistics
Sample A	
CDS2Y, JGB2Y	-2.780
CDS5Y, JGB5Y	-1.500
CDS10Y, JGB 10Y	-1.490
Sample B	
CDS2Y, JGB2Y	-4.161*
CDS5Y, JGB5Y	-3.740*
CDS10Y, JGB 10Y	-3.675*

Notes:

* indicates significance at the 5% level.

5% critical value is −3.3377 from MacKinnon (1991).

Sample A is from January 29, 2016 to September 20, 2016.

Sample B is from September 21 to December 3, 2021

CDS = Credit Default Swap JGB = Japanese Government Bond

Table 7

Granger Causality Test

Variable		Variable	
CDS to JGB		JGB to CDS	
Sample A			
CDS2Y → JGB2Y	0.732	JGB2Y → CDS2Y	0.655
CDS5Y→ JGB5Y	0.605	JGB5Y → CDS5Y	0.061
CDS10Y→ JGB 10Y	1.437	JGB10Y → CDS10Y	0.342
Sample B			
CDS2Y → JGB2Y	4.202*	JGB2Y → CDS2Y	0.674
CDS5Y→ JGB5Y	2.881*	JGB5Y → CDS5Y	1.693
CDS10Y→ JGB 10Y	1.890*	JGB10Y → CDS10Y	1.472

Notes:
* indicates significance at 5 % level.
As for the number of lags, one ia added to AIC selection.
Sample A is from January 29, 2016 to September 20, 2016.
Sample B is from September 21 to December 3, 2021
CDS = Credit Default Swap JGB = Japanese Government Bond