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How does standardization work in derivative markets?

Evidence from the options on JGB Futures

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Special Report

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Abstract

To be listed on the exchange market, derivative products are standardized, which contributes to the existence of the highest liquid derivative market. However, standardization could deteriorate liquidity if it does not appropriately match market conditions and investor needs. In this study, we take advantage of the Japan Exchange Group's（JPX） reform of the standardization of Japanese Government Bond (JGB) futures options. Under low yield and volatility in the JGB market, the JPX has changed the strike price intervals of the JGB futures options from JPY 0.5 to JPY 0.25, which is the first attempt by the Exchange to change the strike prices of bond futures options as far as we know. Using this reform, we empirically demonstrate that the JPX reform improves liquidity in the options on JGB Futures market.

JEL codes: G12, E43, N45

Keywords: Futures option, Standardization, Japanese Government Bond, Liquidity

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1. Introduction

In the bond market, a large number of bonds with different coupons and maturities are issued; therefore, bonds such as the US Treasury are traded in the over-the-counter (OTC) market. To allow fixed-income security tradable in exchange markets, such as the Chicago Mercantile Exchange (CME), futures and futures options have been developed for listing in the exchange market. In bond futures, the underlying asset is standardized, and investors can deliver actual bonds at the maturity date.[1] By standardizing underlying assets, many buyers and sellers concentrate the trader on one asset, enabling the futures market to be the most liquid market.

This study focuses on the important features of this standardization. When financial products are more standardized, many trades should be concentrated into the same product; therefore, liquidity should increase. However, there are some risks that standardization does not match investors' need for derivative contracts, especially when it does not fit investors' needs. In this respect, the proper adjustment for standardization is important, especially when the market conditions for investors have changed.

To evaluate how this adjustment works, we focus on the institutional reform of the options on Japanese Government Bond (JGB) futures conducted by the Japan Exchange Group (JPX). The Bank of Japan (BOJ) continues to conduct an accommodative policy, and the interest rate and its volatility in JGB have decreased. Therefore, since the JPX standardized the strike price of the options on JGB Futures during the 1980s, the strike prices were set at JPY 0.5 intervals. However, interest rates are too low, and price volatility has become much lower than in the 1980s, so this 0.5

[1] Most of advanced countries use physical settlement in bond futures but there are some exceptions. For example, Australian bond futures is cash-settlement instead of physical settlement.

interval has become too wide to trade. Therefore, in September 2021, the JPX changed this interval from JPY 0.5 to JPY 0.25. To the best of our knowledge, this is the first attempt by the Exchange to change the strike prices of bond futures options.

Using this institutional reform, we evaluate whether the adjustment of standardization could improve the market liquidity of the JGB futures options market. If the previous strike is too wide to trade and the newly standardized strike-matched investors' needs, this new standardization should increase transactions and improve market liquidity in the JGB futures options market. To capture liquidity, we use intraday data of turnover in the options on JGB Futures.[2] More specifically, we compare the turnover of the options on JGB Futures before and after the institutional change and conclude that the JPX successfully improved its liquidity. This finding suggests that the liquidity of the futures market could improve if the Exchange can properly reform the standardization of futures products.

The caveat is that we find just three to six trades per hour have increased after this institutional reform. In this sense, we cannot conclude that this institutional change could drastically alter liquidity. In particular, the BOJ conducts yield curve control (YCC), and the volatility of JGB has become extremely low (See Hattori and Yoshida (2021) regarding YCC). Therefore, further analysis is needed, especially after the BOJ normalizes its monetary policy.

Literature review: The literature has long investigated the quality of the futures market. Many studies evaluate the quality of the futures market in terms of efficiency and liquidity. As previously described, we try to utilize the institutional reforms introduced by the JPX. This approach is often

[2] The bid ask spread could be also the other proxy for capturing liquidity, but JPX does not has the intraday data of the options on JGB Futures.

utilized in previous studies. For example, Bortoli et al. (2006) take advantage of the institutional change of the Sydney Futures Exchange in January 2001, when it increased limit order book disclosure and the transparency of the futures market affected trading behavior. Tse and Zabotina (2001) compare market quality using the event when the London International Financial Futures and Options Exchange (LIFFE) tries to transfer FTSE 100 Index futures from the outcry market to the electronic market. Chen and Locke (2004) investigate the consequences of the Chicago Mercantile Exchange's 1997 redesign of S&P 500 futures contracts. Banerjee and Banerjee (2020) discuss minimum trading unit (MTU) revisions in the context of high-frequency trading.

Regarding institutional changes to futures products, previous studies tend to focus on how futures contracts affect the futures market. Karagozoglue and Martell (1999) examine the relationship between contract size and liquidity using the case of the Sydney Futures Exchange. Bjursell et al. (2010) investigate the effect of a change in contract size on the use of a particular futures market. Park and Ryu (2021) study the effects of contract size on market efficiency and investor behavior using the options market. Nordén (2006) focuses on the Swedish futures exchange split OMX-index futures contract with a factor of 4:1 to investigate whether the split affects futures market trading activity.[3]

Although the literature has long investigated the quality of the futures market, few empirical studies discuss how standardization works in this market. Standardization is especially important since most bond futures and bond futures options use physical settlement, and they rely

[3] Nordén (2009) examines that the OMX Nordic Exchange reduced the exchange fee for trading the OMXS 30 index futures with more than 22%. Wu and Zhang (2019) examine the effects of changes in commission fees on market liquidity, trading volume, and return volatility in an order-driven futures market.

on standardized assets. For example, under CME's US Treasury bond futures, investors trade standardized US Treasury bonds, and sellers can deliver any government bonds with more than 15 years and less than 25 years to maturity on specific dates in the delivery month. To the best of our knowledge, the reform of the standardization in the futures options market is the first attempt by the JPX. Our study first investigates the standardization of the bond market and demonstrates that proper standardization contributes to liquidity in the Exchange market.

The remainder of this paper is organized as follows. Section 2 describes the institutional features of the options on JGB Futures. Section 3 discusses the model and data. Section 4 presents our empirical results. Finally, concluding remarks are presented in section 5.

2. Institutional change by JPX regarding JGB futures

2. 1 Institutional detail of JGB futures

The options on JGB Futures is the right to buy (sell) JGB futures at a specific price until the end of a month.[4] As with JGB futures, the options on JGB Futures are listed on JPX. The similar institutional design as that of JGB futures is used, including margin requirements, contract month, and trading hours. For example, in the case of April 2022, the May, June, and September contracts are listed, but the options with the closest maturity tend to be traded.

The central strike price is based on the price closest to the futures price on the business day prior to the trade opening date (sometimes referred to as ATM). Settlement is made, for example, by closing the futures contract at the end of trading (3:15 p.m.) on the strike date.

[4] Shioji (2021) use the data of the options on JGB Futures to evaluate fiscal sustainability in JGB market.

There are two types of options trading: European, which can be exercised only on the maturity date, and American, which can be exercised at any time. Investors who buy the options on JGB Futures can exercise the option at any time until the end of the month, but in practice, they are rarely exercised before maturity. In effect, some practitioners interpret these as being traded as European-type options.

2. 2 Revision of intervals for strike prices

A feature of the options on JGB Futures is that they are listed at each strike price (the price at which JGB futures can be purchased). Specifically, there are 41 strike prices, 20 above and 20 below the central price (e.g., options are set and listed in increments of JPY 0.25, such as 145.00 yen and 145.25 yen, respectively). As previously mentioned, these strike price intervals can also be interpreted as standardization for listing (on the other hand, in the case of OTC market instruments, such as swaptions and physical options on JGBs, it is possible to make strike prices tailor-made).

On September 22, 2021, the JPX changed the strike prices from increments of JPY 0.5 to JPY 0.25. The reason behind this reform is that the product design with JPY 0.5 increments is based on the assumption of an environment in which interest rates and volatility were high. In the past, when interest rates were high, it was not unusual for them to fluctuate widely and for futures to move JPY 0.5 or JPY 1. However, in the current environment of low interest rates and low volatility, JPY 0.5 increments are too large to trade. As previously mentioned, strike price increments can only be interpreted as standardization to create liquidity, so it is reasonable to modify them.

3. Empirical method and data

The reform of strike prices of the options on JGB Futures was implemented on September 22, 2021. We therefore evaluate the liquidity of the options on JGB Futures by comparing liquidity before and after that date. We use the model below:

$$Turnover_t = \alpha + \beta dummy_t + \gamma control_t + \varepsilon_t, \quad (1)$$

where $Turnover_t$ is the turnover of the options on JGB Futures and $dummy_t$ is a dummy variable that takes one after September 22, 2021, and zero before September 22, 2021. $control_t$ is the control variable and ε_t is an error term. t is time.

To increase the number of observations, we use intraday data from JPX.[5] To capture liquidity, we use the turnover of the options on JGB Futures. Since many options on JGB Futures with different strike prices are listed simultaneously, we sum all listed options to construct $Turnover_t$. The times series of the daily turnover of JGB futures is illustrated in Figure 1. The monthly turnover of the options on JGB Futures with different strike prices is reported in Table 1.

As $control_t$, we include the intraday data on JGB futures and the JGB VIX. JGB futures can capture the aggregate liquidity in the JGB market. We also include the JGB VIX to capture the volatility in the JGB market. These data are constructed using the implied volatility of the options on JGB Futures. On July 10, 2019, S&P and JPX launched the S&P/JPX JGB VIX Real-time Index

[5] JPX does not provide the intraday data of bid and ask price.

to reflect the intraday moves of the S&P/JPX JGB VIX Index.

For estimation, we use one-minute level data. Our main analysis compares the turnover before and after one week. However, for the robustness check, we also compare that before and after two weeks and one month. In addition, we use one-minute data as our main analysis because it is the highest frequency of the data in the JGB futures options market. As a robustness check, we also check our results using a 30-minute interval.

4. Empirical results

Our main result based on eq. (1) is presented in Table 2. The first column shows the results when we regress the turnover of the futures option on the dummy variable using one-minute data. This column shows that the dummy has a positive and significant effect on turnover at the 1 percent level. The coefficient is 0.064, so we can interpret that 0.064 (3.84) trades per one minute (per hour) have increased after the institutional change in strike prices. The second column shows the results when we control for the turnover of JGB futures and JGB VIX. The estimated coefficient is 0.049, which is slightly lower than 0.064, but still positive and significant at the 1 percent level.

The robustness results when we compare two weeks and one month before and after the institutional reform, instead of one week are reported in Table 3. Columns (1) and (2) show the results for the two weeks. The estimated coefficients are 0.108 and 0.097, respectively, and both are positively significant at 1 percent level. This suggests that institutional reform increased about 0.1 (6) trades per minute (per hour). Columns (3) and (4) show the estimation results for one month. The estimated coefficients are 0.067 and 0.055, respectively, which are slightly lower, but again, still positive and significant at the 1 percent level. In summary, we can conclude that this

institutional reform has increased trades by roughly 4～6 per hour.

Table 4 also presents the estimation results when we use a 30-minutes interval instead of a one-minute interval. Columns (1) and (2) show the estimation results when we compare one week before and after the institutional change. The estimated coefficients are 1.87 and 1.36, respectively, which are positively significant at the 5 percent level. Columns (3) to (6) show the results based on two weeks and one week, respectively, and again, the result is positive and significant at the 1 percent level. These demonstrate that the result is quite robust, even when we use different intervals.

5. Conclusion

This study evaluates the effect of institutional reform by the Exchange in terms of the standardization of listed products. We take advantage of JPX's reform, where JPX changed the strike price interval of the options on JGB Futures since the JGB interest rate and volatility have become too low and the strike price set during the 1980s has become too wide to trade. We empirically demonstrate that this institutional reform has changed market liquidity in the Exchange market. To the best of our knowledge, this is the first attempt by the Exchange market to change the strike price to adjust, and many exchanges should learn from JPX's attempt because many tend to suffer from low interest rates and volatility.

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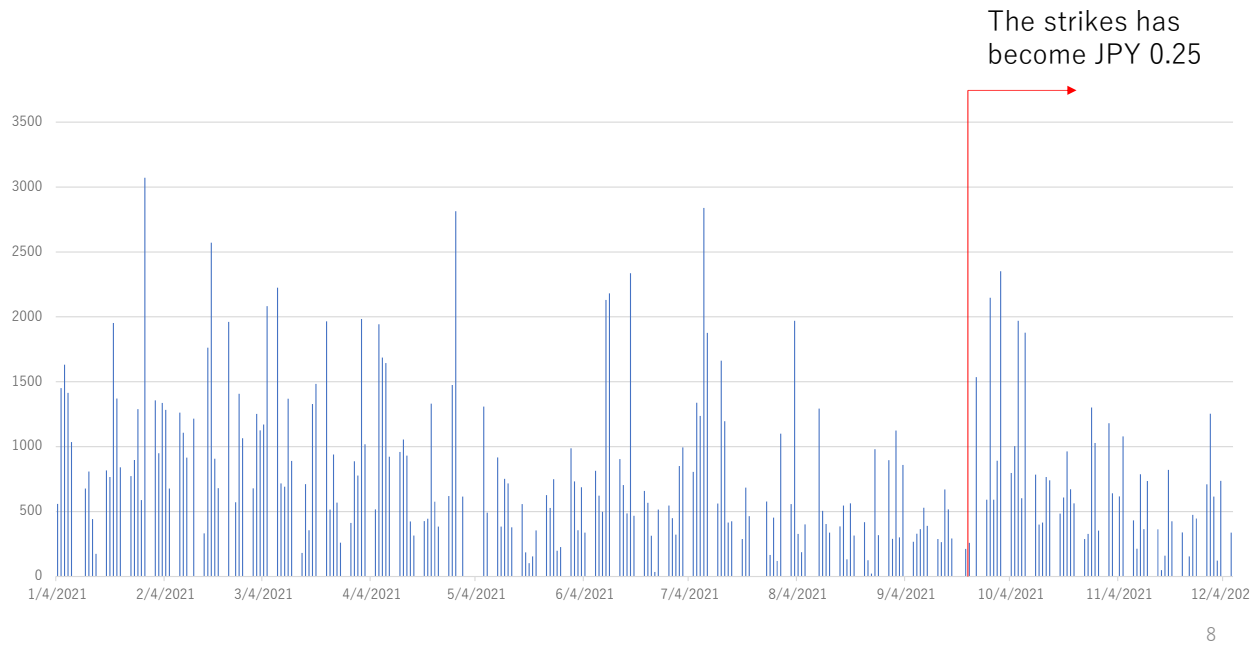

Fig. 1. The time series of turnover of the options on JGB Futures.

This figure depicts the time series of turnover of the options on JGB Futures. The data is obtained from JPX.

Table 1 The turnover of the options on JGB Futures in terms of strike prices

	Strike Price															
	145.5	146	146.25	146.5	146.75	147	147.25	147.5	147.75	148	148.25	148.5	148.75	149	149.25	149.5
Jan, 2021																96
Feb, 2021				2						25		125		41		215
Mar, 2021	2	62		180		127		28		48		210		581		1,341
Apr, 2021								2		1				3		335
May, 2021		1								3		1		1		
Jun, 2021		1								2		3		122		
Jul, 2021								2								1
Aug, 2021								1						2		
Sep, 2021						1						4		1		50
Oct, 2021		201						1		1					1	61
Nov, 2021			101											1		3

	Strike Price															
	149.75	150	150.25	150.5	150.75	151	151.25	151.5	151.75	152	152.25	152.5	152.75	153	153.25	153.5
Jan, 2021		328		300		2,009		6,330		9,215		2,105		130		50
Feb, 2021		733		1,911		7,399		7,757		3,064		92				
Mar, 2021		2,993		5,791		3,511		5,979		1,398		334				10
Apr, 2021		1,338		2,602		6,548		10,656		592		10				
May, 2021		83		441		2,391		6,165		540						
Jun, 2021		6		234		2,992		9,181		3,642		476		10		
Jul, 2021		6		35		609		3,223		7,284		5,005		1,893		
Aug, 2021		6		2		12		944		4,868		4,014		1,131		
Sep, 2021		489	15	63	205	854	633	4,765	485	4,249	41	359		220		
Oct, 2021		30	29	635	936	4,228	3,939	3,635	3,199	1,165	245					
Nov, 2021	20	4	15	62	290	456	1,373	2,470	3,316	2,391	602	130	15			

Source: JPX

Table 2 The estimation result

	(1)	(2)
dummy	0.064***	0.049***
	(0.015)	(0.014)
JGB futures		0.001***
		(0.000)
JGB VIX		0.076***
		(0.009)
constant	0.064***	-0.029***
	(0.008)	(0.008)
N	4074	4074
adj. R-sq	0.004	0.054

Note: This table shows the regression result based on Equation (1). The period is from September 15, 2021, to September 28, 2021. The dependent variable is the turnover of the options on JGB Futures. The dummy is a dummy variable that takes value one if the date is later than September 22, 2021. JGB futures is the turnover of JGB futures. JGB VIX is S&P/JPX JGB VIX Index. Robust standard errors are in parentheses, and note as follows: *, **, and *** stand for 10%, 5%, and 1% significance, respectively. The data is a 1-minutes base.

Table 3 The estimation result

	2 weeks		1 month	
	(1)	(2)	(3)	(4)
dummy	0.108***	0.097***	0.067***	0.055***
	(0.015)	(0.015)	(0.011)	(0.011)
JGB futures		0.001***		0.001***
		(0.000)		(0.000)
JGB VIX		0.086***		0.088***
		(0.008)		(0.007)
constant	0.072***	-0.033***	0.104***	-0.015***
	(0.006)	(0.007)	(0.007)	(0.006)
N	8148	8148	16296	16296
adj. R-sq	0.006	0.031	0.002	0.031

Note: This table shows the regression result based on Equation (1). The period of two weeks is from September 8, 2021, to October 5, 2021, while the period of one month is from August 25, 2021, to October 19, 2021. The dependent variable is the turnover of the options on JGB Futures. The dummy is a dummy variable that takes value one if the date is later than September 22, 2021. JGB futures is the turnover of JGB futures. JGB VIX is S&P/JPX JGB VIX Index. Robust standard errors are in parentheses, and note as follows: *, **, and *** stand for 10%, 5%, and 1% significance, respectively. The frequency of data is 1-minutes.

Table 4 The estimation result

	1 weeks		2 weeks		1 month	
	(1)	(2)	(3)	(4)	(5)	(6)
dummy	1.871**	1.361**	3.157***	2.560***	1.950***	1.557***
	(0.765)	(0.604)	(0.807)	(0.654)	(0.592)	(0.526)
future		0.001**		0.001***		0.001***
		(0.000)		(0.000)		(0.000)
vix		1.684**		1.440**		1.721***
		(0.663)		(0.591)		(0.502)
_cons	1.857***	-0.802**	2.086***	-1.108***	3.018***	-0.632**
	(0.410)	(0.339)	(0.265)	(0.286)	(0.360)	(0.266)
N	140	140	280	280	560	560
adj. R-sq	0.035	0.376	0.049	0.246	0.017	0.204

Note: This table shows the regression result based on Equation (1). The dependent variable is the turnover of the options on JGB Futures. The dummy is a dummy variable that takes value one if the date is later than September 22, 2021. JGB futures is the turnover of JGB futures. JGB VIX is S&P/JPX JGB VIX Index. Robust standard errors are in parentheses, and note as follows: *, **, and *** stand for 10%, 5%, and 1% significance, respectively. The frequency of data is 30-minutes.