



Ninth IFC Conference on "Are post-crisis statistical initiatives completed?"

Basel, 30-31 August 2018

Liquidity in the JGB cash market: an evaluation from detailed transaction data¹

Toshiyuki Sakiyama and Shun Kobayashi,
Bank of Japan

¹ This paper was prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

Liquidity in the JGB Cash Market

An Evaluation from Detailed Transaction Data

Toshiyuki Sakiyama Shun Kobayashi¹

Abstract

We create new liquidity indicators for the JGB cash market based on "big data," i.e. detailed inter-dealer transaction data. Since it has become necessary to grasp JGB market liquidity in more detail, we compile indicators from multifaceted perspectives such as volume, tightness, depth and resiliency.

An examination of indicators suggests that they have generally improved gradually since autumn of 2016, after having deteriorated at the beginning of 2016, when the "Negative Interest Rate" policy was introduced. However, we must continue to monitor future developments in liquidity, because transaction volume has not increased. We have also found that improvements in short-term and off-the-run bonds are relatively delayed.

Keywords: JGB cash market, market liquidity, detailed transaction data, transaction volume, tightness, depth, resiliency

JEL classification: E43, E52, E58, C80

¹ Financial Markets Department, Bank of Japan (E-mail: shun.kobayashi@boj.or.jp)

We would like to thank the staff of the Bank of Japan for their helpful comments. The opinions expressed here as well as any remaining errors are those of the authors and should not be ascribed to the Bank of Japan.

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Introduction

Interest in liquidity in government bond markets continues to rise at home and abroad. Strengthening of financial regulations after the Lehmann crisis, increasing presence of High Frequency Trading, and unconventional monetary policies by major central banks in advanced countries—especially the purchase of government bonds—may have effects on liquidity in the government bond markets. Especially, in Japan, it is heard that the Bank of Japan purchases massive amounts of government bonds, which affects the liquidity in the JGB markets.

Against this background, the Bank of Japan examines the liquidity in the JGB markets from a broader range of perspectives by utilizing both qualitative and quantitative information, such as comments heard at meetings and survey results from market participants, as well as liquidity indicators compiled with individual transaction data. Regarding liquidity indicators which have started to release from August 2015, it is characterized that these indicators include not only indicators for the JGB futures market (which was often taken up in past research) but also those for the JGB cash market, which had few prior studies even overseas because of data limitation. At that time, we focused on the relatively stagnant dealer-to-client transactions and compiled some indicators for dealer-to-client transactions in the JGB cash market.²

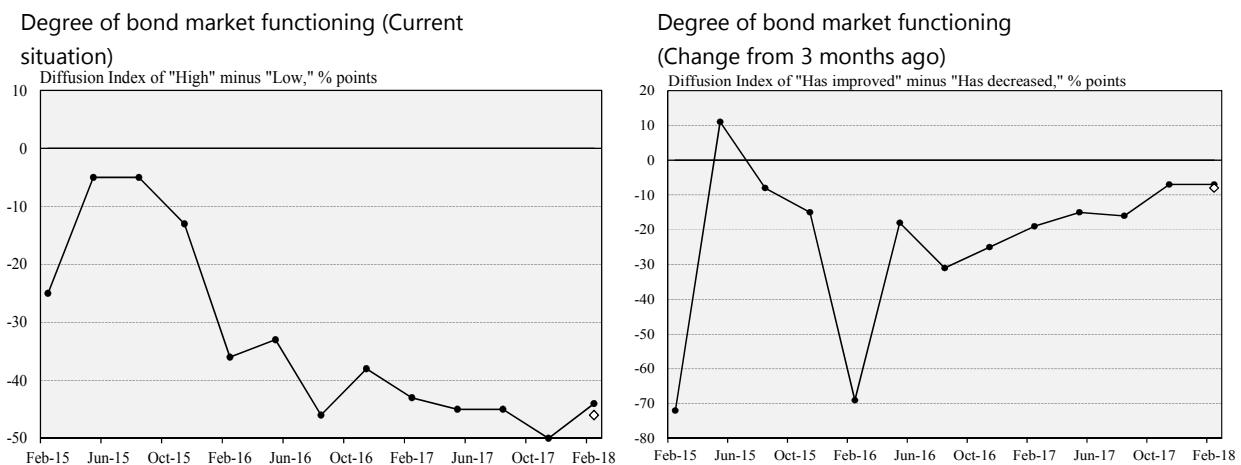
To expand existing liquidity indicators, the Bank of Japan decided to compile new indicators of inter-dealer transactions in the JGB cash market with newly acquired data. For two primary reasons, the need to finely grasp liquidity in the JGB markets is increasing, particularly within the JGB cash market (dealer-to-client transactions and inter-dealer transactions). First, the Bank of Japan is purchasing massive amounts of cash JGBs after the introduction of "Quantitative and Qualitative Monetary Easing (QQE)" in April 2013. In September 2016, the Bank introduced a new framework, "QQE with Yield Curve Control," and now operates purchase of cash JGBs to control yield curve. As a result, the Bank holds over 40% of all JGB issuances. Therefore, it is important to grasp in more detail the situation of liquidity in the JGB cash market, specifically where the Bank is purchasing JGBs under monetary operation.

Second, interest in liquidity and functioning of the JGB cash market by market participants is rising. For example, results from Bond Market Survey on the JGB cash market reveal a considerably large portion of responses claiming that market function is "low" (Chart 1). In addition, in Bond Market Group meetings, opinions on difficulty of transactions were expressed, especially concerning the difference in liquidity by issue. For this reason, it is important to compile liquidity indicators in the JGB cash market and to examine whether evaluation of market participants can be explained with objective data.

² Transactions of cash JGBs can be roughly divided into inter-dealer, dealer-to-client, and government bidding/purchase under the Bank of Japan market operation.

Bond Market Survey

Chart 1



1. The survey from February 2018 onward includes responses from major insurance companies, asset management companies, etc., in addition to those from eligible institutions for the Bank's outright purchases and sales of JGBs. 2. Regarding the figures for February 2018, the filled circle indicates the reference data which are based on responses only from eligible institutions for the Bank's outright purchases and sales of JGBs, and the hollow square indicates the data which include responses from major insurance companies, asset management companies, etc.

Source: Bank of Japan

The structure of this paper is as follows: Section 2 briefly presents initiatives by the Bank of Japan to capture the situation of liquidity in the JGB markets; Section 3 explains the details of newly acquired data, and then examines the situation of liquidity in the JGB cash market after the fall of 2015 with new liquidity indicators compiled by this data; Section 4 concludes with a summary of this paper.

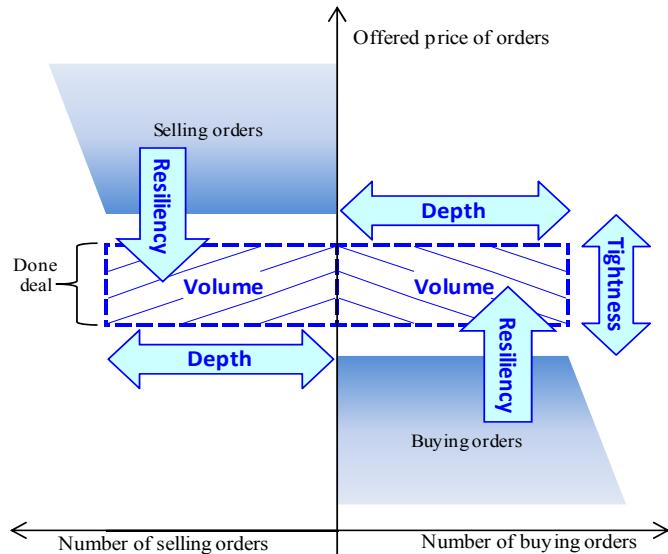
Grasping market liquidity in the JGB cash market

The situation of high market liquidity is thought as one in which "market participants are able to smoothly buy and sell their intended amount at a price close to the market price," or "purchases and sales by each market participant have little impact on the market price." The definition of "market liquidity" is not necessarily uniform and its quantitative measurement is not simple.³ Therefore, the Bank of Japan is trying to capture market liquidity from a broader range of perspectives by utilizing liquidity indicators, market surveys and dialogues with market participants, while remaining conscious of several limitations about definition and measurement of market liquidity.

³ Concerning definition discrepancies and measurement of market liquidity, see Nishizaki, Tsuchikawa, and Yagi (2013) and Kurosaki *et al.* (2015).

Liquidity indicators in the JGB markets

The Bank of Japan has been releasing "Liquidity Indicators in the JGB Markets" each quarter since August 2015. In compiling liquidity indicators, we focus on four evaluation axes: volume, tightness, depth, and resiliency. These four evaluation axes are visually captured as shown in the below chart.⁴



Source: Nishizaki, Tsuchikawa, and Yagi (2013).

- Volume: Frequent transactions and large amount transactions become easier with larger transaction volume.
- Tightness: The narrower the price range (the spread between selling and buying prices) is, the traders can execute transactions at a price closer to their intended prices, resulting in a smaller transaction cost.
- Depth: The deeper the market (larger volume of orders at the current price level) is, the smaller the difference between the investors' intended prices and the actual prices. Prices do not easily change even with large amount transactions.
- Resiliency: The more resilient the market (the speed at which prices revert to the equilibrium prices when there are shocks to prices) is, the more smoothly and rapidly traders can execute transactions, therefore less impact on prices.

Regarding the JGB futures market, we grasped market liquidity in detail by compiling indicators with individual transaction data of JGB futures listed on the Osaka Exchange from the viewpoint of the four evaluation axes mentioned above.⁵

⁴ Measurement from a multiple evaluation axes is also proposed in Kyle (1985), which is a classic study on market liquidity.

⁵ Tick data provided by Nikkei NEEDS.

Here, individual transaction data of the JGB futures market specifically indicate (1) quotation and volume of bid-ask data per minute and (2) price and volume of transaction data per transaction. Characteristically, such high frequency and granular data (sometimes called detailed transaction data) have much more information than data with only one point per day or aggregate data. On the other hand, regarding the JGB cash market, there are limitations in obtaining such detailed transaction data because most transactions of cash JGBs are bilateral among market participants. Therefore, by using daily and monthly data, we worked on compiling indicators related to volume, tightness, and depth for dealer-to-client transactions of cash JGBs in addition to an indicator related to volume for inter-dealer transactions of cash JGBs. Then we released them in "Liquidity Indicators in the JGB Markets" (Table 1).

Compiling indicators for the JGB cash market

Table 1

"Liquidity Indicators in the JGB Markets" released by the Bank of Japan

	JGB futures market	JGB cash market	
		Dealer-to-client	Inter-dealer
Volume	◎ Transaction volume	△ Transaction volume	○ Transaction volume
Tightness	◎ Bid-ask spread	○ Bid-ask spread	
Depth	◎ Volume of orders at the best-ask price	△ Best-worst quote spread	
Resiliency	◎ Price impact		

	JGB cash market
Volume	◎ Transaction volume
Tightness	◎ Bid-ask spread ○ Total observation time of bid-ask spreads
Depth	◎ Volume of orders at the best-ask (best-bid) price ○ Ratio of issues by total observation time of the best-ask (best-bid) price
Resiliency	◎ Price impact

1. ◎ : compiled with detailed transaction data, ○ : compiled with daily data, △ : compiled with monthly data.

"Bond Market Survey" and "Bond Market Group" meetings

The Bank of Japan introduced the quarterly Bond Market Survey in February 2015 to continuously understand market participants' views on the functioning of the bond market and outlook of long-term interest rates. In addition, the Bank has held Bond Market Group meetings twice per year since June 2015 to enhance dialogue with market participants in reference to the survey results.

Regarding Bond Market Survey, major institutional investors were added to eligible institutions for the Bank's outright purchases and sales of JGBs in February 2018. As a result, we are able to capture a wider coverage of market participants. The discussions at the meetings were lively, and following comments were heard at December 2017 meeting: "It has become difficult to deal off-the-run bonds," and "number and volume of bidding and offering have decreased recently," and "there is a movement to make dealing lots for transactions smaller beforehand in order to trade smoothly." These voices suggest that there are rising interests in liquidity of the JGB cash market for market participants.

Expansion of liquidity indicators in the JGB cash market — recent situation of market liquidity

Although the Bank of Japan tried to grasp liquidity in the JGB markets from a broader range of perspectives, compilation of liquidity indicators in the JGB cash market is not enough due to difficulty of obtaining detailed transaction data. Some indicators of dealer-to-client transactions are compiled from daily and monthly data, but it is not possible to comprehend situations in intraday market liquidity in detail. Furthermore, it is difficult to construct indicators of inter-dealer transactions other than transaction volume.

Hence, we decided to acquire tick data from the Japan Bond Trading, the largest company for intermediation of inter-dealer transactions, and expand liquidity indicators of inter-dealer transactions in the JGB cash market. In this section, we compile new liquidity indicators related to tightness, depth, and resiliency on the basis of detailed transaction data of inter-dealer transactions. Then, adding them to current indicators related to volume, we can examine situations about market liquidity of inter-dealer transactions in the JGB cash market using the four evaluation axes. These indicators allow us to capture market liquidity in more detail, i.e., liquidity in intraday market and of all JGB issues. In addition, we expect to evaluate some comments voiced at Bond Market Group meetings based on the indicators compiled with objective data.

Details of newly acquired detailed transaction data

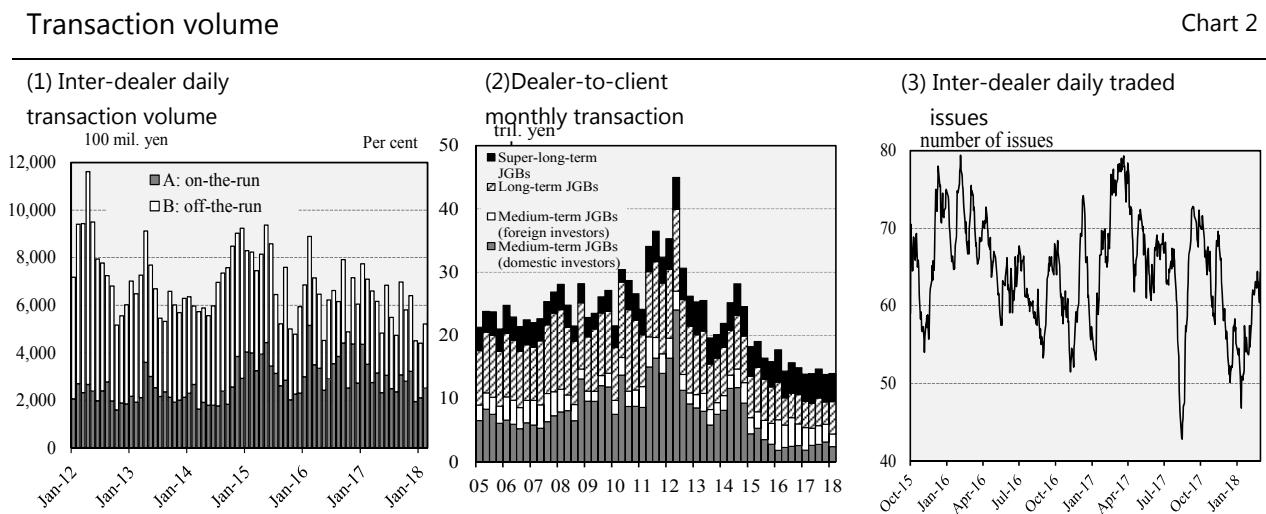
The Bank of Japan compiled new liquidity indicators by using tick data provided by the Japan Bond Trading, such as that of bonds traded and/or ordered at the electric trading system. Tick data acquired from the Japan Bond Trading consists of information related to both (1) execution such as price and amount per transaction and (2) orders such as best-bid and best-ask prices presented during intraday—best prices presented by buyers and sellers—as well as the amount of these orders (we call this information detailed transaction data). In this study, we analyzed 2-year, 5-year, 10-year, 20-year, 30-year, and 40-year JGBs; Further, we took into consideration seven hours per day.⁶

Volume

Concerning volume in the JGB cash market, we release information for both dealer-to-client and inter-dealer transactions in the current "Liquidity Indicators in the JGB Markets." From the trend of inter-dealer transactions since 2016, we found that transaction volume remained close to the same level. The ratio of transactions of on-the-run bonds to total transactions seemed to gradually increase, and the fluctuation of transaction volume became somewhat larger than before. However, from the assessment of dealer-to-client transactions in the JGB cash market,

⁶ There are about 300 issues of cash JGBs as at January 2018.

transaction volume decreased primarily because of a decrease in transactions of long-term and medium-term bonds traded by domestic investors. The volume of transactions has remained generally flat since mid-2016 (Chart 2).



(1) is the sum of 2-year, 5-year, 10-year, 20-year, 30-year, and 40-year JGBs via Japan Bond Trading. 2. Treasury Discount Bills, etc. are excluded from (2). 3. "Clients" include city banks, regional financial institutions, investors, and foreigners. Other institutions (government, Bank of Japan, Japan Post Bank, Japan Post Insurance, business corporations, other financial institutions, etc.) are excluded from "clients." 4. 10-day backward moving average is applied to (3). Latest data as at end-February 2018.

Sources: QUICK; Japan Bond Trading; Japan Securities Dealers Association.

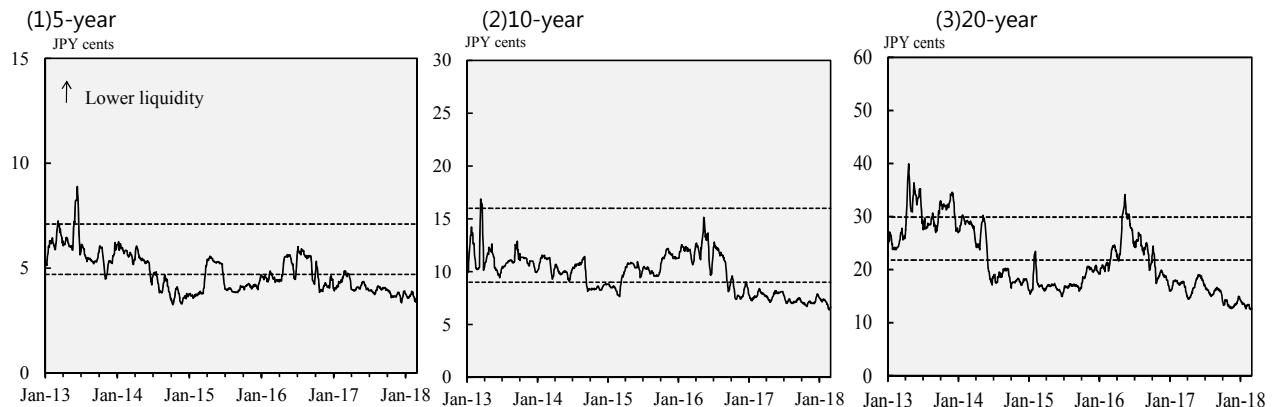
Recently, we have been able to examine the number of issues of cash JGBs traded with detailed transactional data, which amounted to 50–80 each day since the fall of 2015, and then decreased several times to less than 50 in the second half of 2017 (Chart 2).

Tightness

We release bid-ask spreads based on the data of dealer-to-client transactions of on-the-run bonds at 15:00 each day in the current "Liquidity Indicators in the JGB Markets" to understand tightness in the JGB cash market. These bid-ask spreads, once widened in the summer of 2016, gradually shrank from the fall of 2016, and were recently at the lowest level in the past five years (Chart 3).

Bid-ask spreads of dealer-to-client transactions (tightness)

Chart 3



1. Quotations through Trade web as of 3:00 p.m. Dotted lines indicate the first/third quartile spreads between January 2010 and March 2013. 2. 10-day backward moving average. Latest data as at end-February 2018.

Source: Thomson Reuters.

In addition to the bid-ask spreads, we compiled new bid-ask spreads of inter-dealer transactions as an indicator to enable analysis of liquidity in intraday market by issue. Furthermore, we will compile a new indicator named total observation time of bid-ask spreads for inter-dealer transactions to complement bid-ask spreads, because, unlike in JGB futures transactions, there are time periods during which bid and/or ask prices are not submitted.

Bid-ask spread

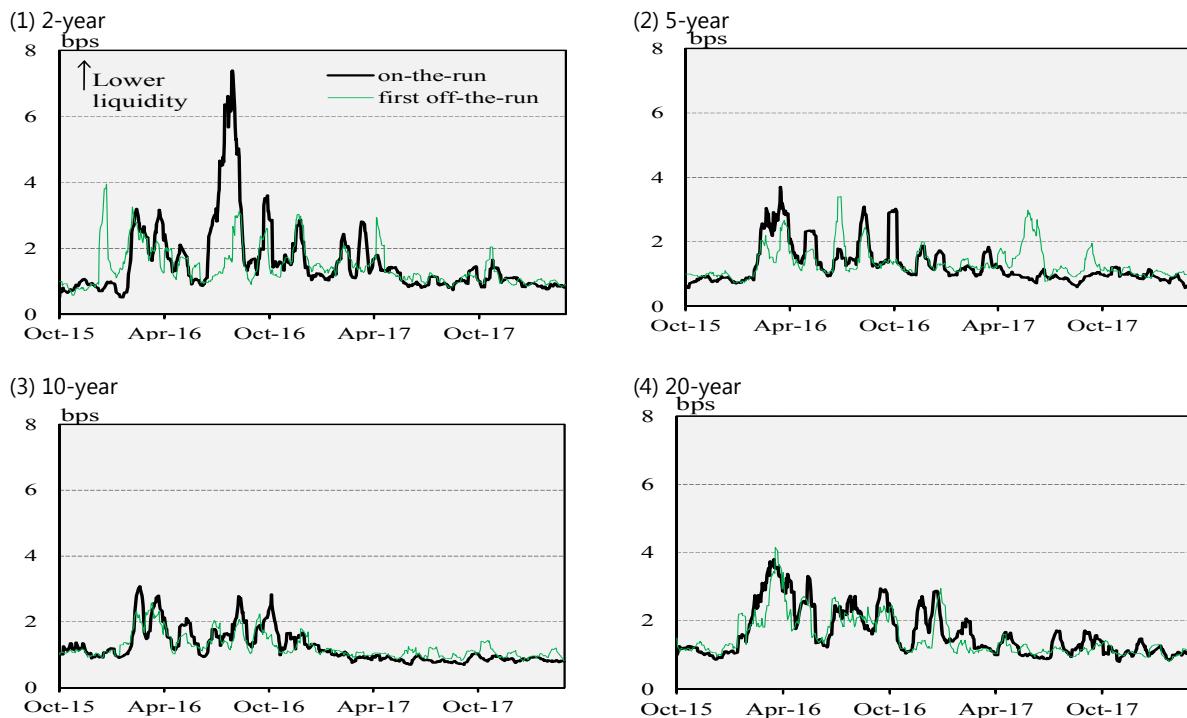
The bid-ask spreads (average of the widest 10 percent) of both on-the-run and first off-the-run bonds were compiled with detailed transaction data of inter-dealer transactions.⁷ Once they widened in the summer of 2016, then gradually shrank from the fall of 2016; however, recently they were the same or less compared to those in the latter half of 2015, similar to the development of bid-ask spreads of dealer-to-client transactions (Chart 4). This suggests that trading as a whole is easier now than during the last few years, considering the difference between prices submitted by sellers and buyers. Comments by market participants, such as "based on close communication between the BoJ and market participants, predictability about future interest rates is high, and therefore trading is easy to do," support the evidence from Chart 4. However, we must pay attention to the observation that

⁷ Average of the widest 10 percent is calculated by averaging the widest 10 percent of bid-ask spreads with a 1-second frequency. It is possible to compile an indicator with different levels of percentile and/or simple average.

there have been occasional events where bid-ask spreads have widened since the beginning of 2016 (e.g., 5-year first off-the-run bond).

Bid-ask spreads of inter-dealer transactions (tightness)

Chart 4



1. Figures indicate the average of the widest 10 percent of bid-ask spreads with a 1-second frequency. 2. Bid-ask spreads are calculated only for time periods in which both best-bid and best-ask prices were submitted. 3. 10-day backward moving average. Latest data as at end-February 2018.

Sources: Japan Bond Trading.

Total observation time of bid-ask spreads

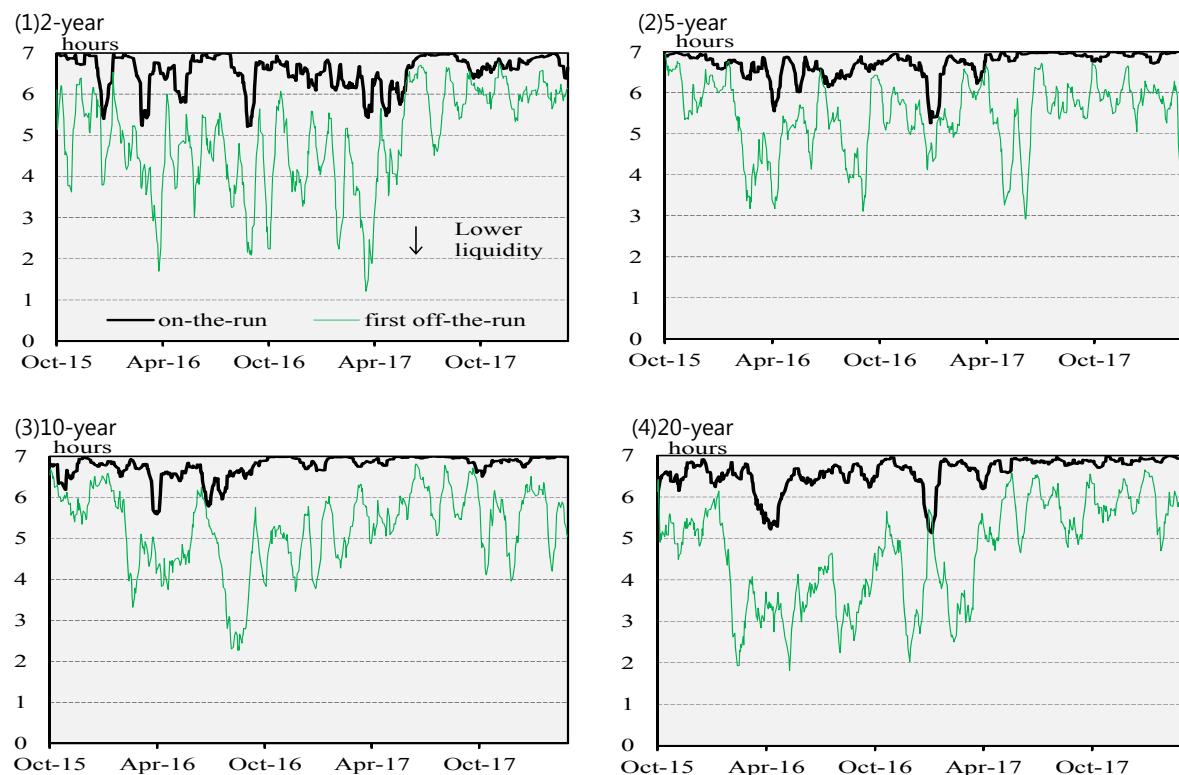
Regarding bid-ask spreads of inter-dealer transactions compiled and explained above, we first calculated spreads over each time period in which both bid and ask prices are submitted, and then filtered out 10 percent of the widest spreads and calculated the average. However, it should be noted that there are times when bid and/or ask prices are not submitted in inter-dealer transactions, differing from the fact that prices are submitted almost all the time in the JGB futures market, owing to the market-maker system. Thus, a reduction in bid-ask spreads does not necessarily mean an improvement of liquidity conditions, if bid and/or ask prices are not submitted. To compensate for this, we also compiled a new indicator of total observation time of bid-ask spreads in addition to bid-ask spreads.

The indicator we call total observation time of bid-ask spreads indicates a length of hours when both bid and ask prices were submitted within a day. First, the indicators of first off-the-run bonds are lower and the swing width of the indicators are larger compared with on-the-run bonds. Second, the indicators of both on-the-run bonds and first off-the-run bonds decreased considerably at the beginning of 2016, then gradually improved from during the fall of 2016 to the spring of 2017.

However, long- and super-long-term first off-the-run bonds had some days in which there is not enough observation time of bid-ask spreads (Chart 5). These results coincide with voices from market participants such that "with the increase of the proportion of the JGB amounts which the Bank of Japan holds, trading is difficult, especially for off-the-run issues," and "there are situations where neither bid nor ask prices are seen."

Total observation time of bid-ask spreads of inter-dealer transactions
(tightness)

Chart 5



1. Figures indicate the total length of time in which both best-bid and best-ask prices were submitted. 2. 10-day backward moving average. Latest data as at end-February 2018.

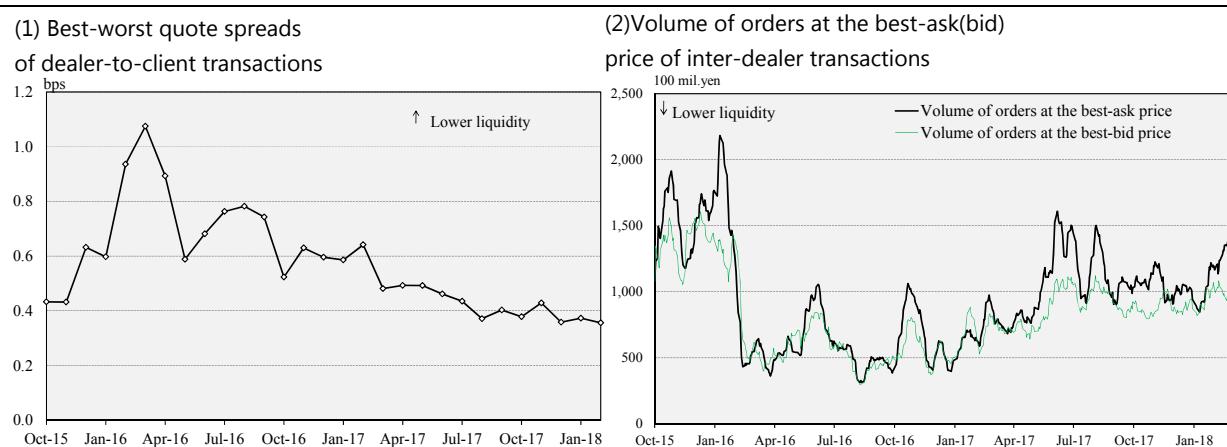
Source: Japan Bond Trading.

Depth

As for measuring depth in the JGB cash market, we release best-worst quote spreads (monthly basis) in the current "Liquidity Indicators in the JGB Markets."⁸ The spread greatly expanded at the beginning of 2016, meaning that market liquidity decreased, then it gradually shrank, and recently fell below the level which was in the latter half of 2015 (Chart 6).

Market depth (depth)

Chart 6



(1) is calculated by averaging the spreads between the best and worst quotes offered by dealers against each client request. Transactions with spreads wider than 10 bps are excluded from the calculation. (2) is calculated by summing up the median of volume of orders at the best-ask (best-bid) price with a 1-second frequency per issue. 10-day backward moving average. 3. Latest data as at end-February 2018.

Sources: Yensai.com; Japan Bond Trading.

In addition to best-worst quote spreads, we compiled two new indicators for inter-dealer transactions with detailed transaction data. The volume of orders at the best-ask (best-bid) price enables us to capture liquidity in intraday market by issue, and the ratio of issues by total observation time of the best-ask (best-bid) price represents how orders are submitted.

Volume of orders at the best-ask (best-bid) price

The indicator we call volume of orders at the best-ask (best-bid) price in inter-dealer transactions greatly decreased at the beginning of 2016, meaning that market liquidity decreased, then has gradually increased since fall 2016, similar to best-

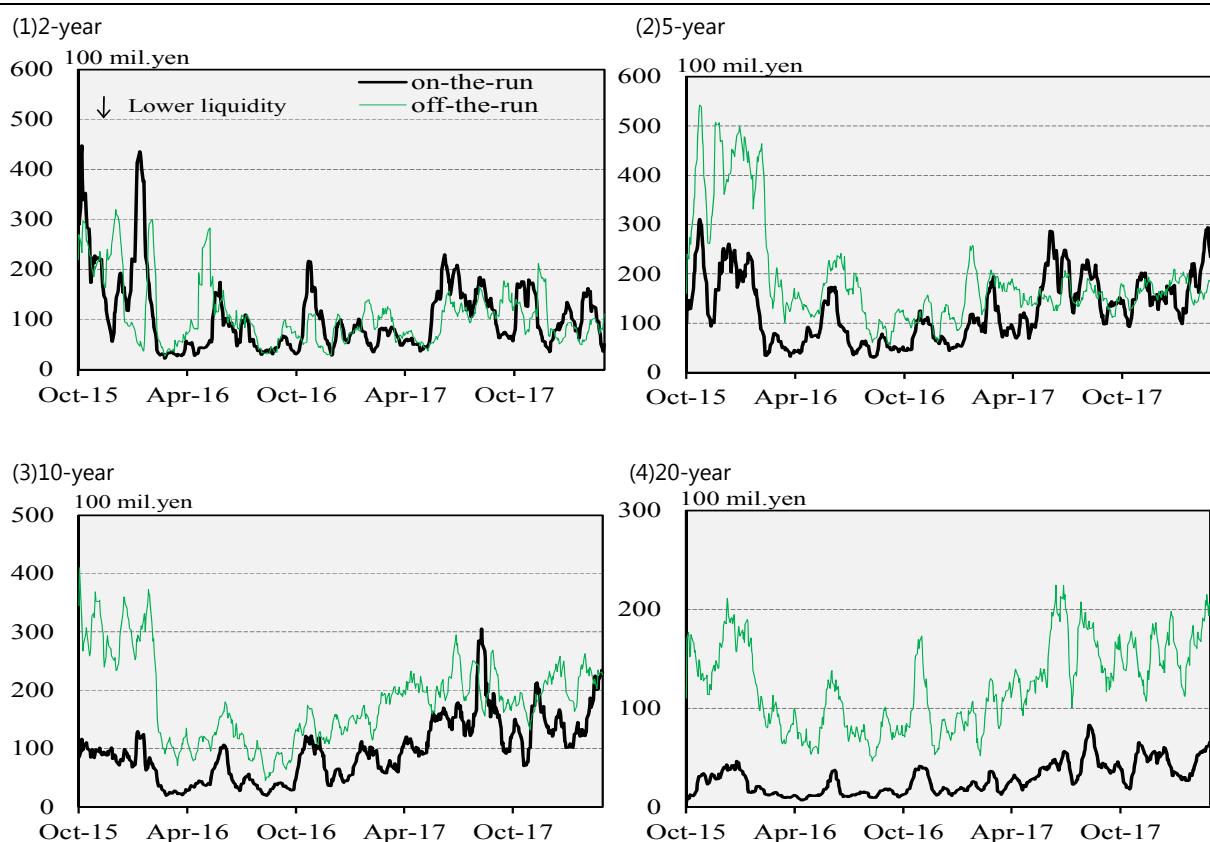
⁸ The best-worst quote spread was calculated by averaging the spreads between the best and the worst quotes offered by dealers against each client request. This spread is close to the measure of market depth, in the sense that a tight best-worst quote spread means that a client has many dealers to make transactions at a price level near the best quote.

worst quote spreads in dealer-to-client transactions⁹ (Chart 6). This suggests that trading as a whole is easier for dealers now than the last few years, reflecting that prospects for interest rates among market participants have converged since around the fall of 2016, consistent with the development of bid-ask spreads. However, we note that the volume of orders at the best-ask (best-bid) price does not recover to the level in the beginning of 2016, differing from best-worst quote spreads (monthly basis). By examining the volume of orders at the best-ask price in more detail, in terms of residual maturity per issue, we see that volumes of super-long-term bonds are recovering while short-term bonds and 10-year off-the-run bonds have a low degree of recovery (Chart 7). It is also noted that the volume of orders at the best-ask price is calculated by summing up all issues and therefore is not directly related to the ease of large amount transactions.

⁹ The volume of orders at the best-ask (best-bid) price is calculated by summing up the median of volume at the best-ask (best-bid) price with a 1-second frequency per issue.

Volume of orders at the best-ask price by residual maturity of inter-dealer transaction (depth)

Chart 7



1. Figures indicate the sum of the median of volume of orders at the best-ask price with a 1-second frequency per issue. 2. 10-day backward moving average. Latest data as at end-February 2018.

Source: Japan Bond Trading.

Ratio of issues by total observation time of best-ask (best-bid) price

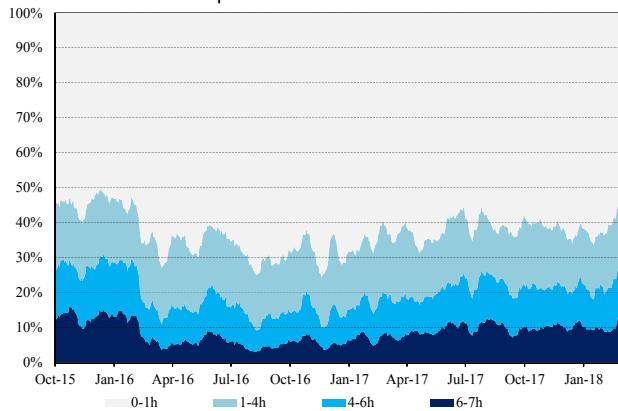
The volume of orders at the best-ask (best-bid) price shows market depth from the size of the order amount traded at the best price. Here, we tried to capture depth in the JGB cash market based on the number of issues with a lengthy observation time of the best-ask (best-bid) price. Specifically, we compiled a new indicator of ratio of issues by total observation time of the best-ask (best-bid) price, capturing the percentage of issues according to the length of time that the best-ask (best-bid) price is submitted. For example, if the ratio of issues with a lengthy observation time of the best-ask (best-bid) price is high in short-term maturity, prices of other issues with short maturities are unlikely to be affected even when supply and demand conditions for a certain issue in short-term maturity tightens. We can consider this as an indicator for market depth.

First, looking at the ratio of issues by total observation time of the best-ask price, we find that the proportion of issues whose prices were submitted for more than six hours per day (less than one hour) drastically decreased (increased) at the beginning of 2016, then gradually increased (decreased) from the fall of 2016. Recently, the proportion improved (declined) to the level it was at the beginning of 2016. Next, concerning the ratio of issues by total observation time of the best-bid price, we found that it is similar to the best-ask price, but the degree of improvement of the best-bid price has been smaller than that of the best-ask price since around fall 2016 (Chart 8).

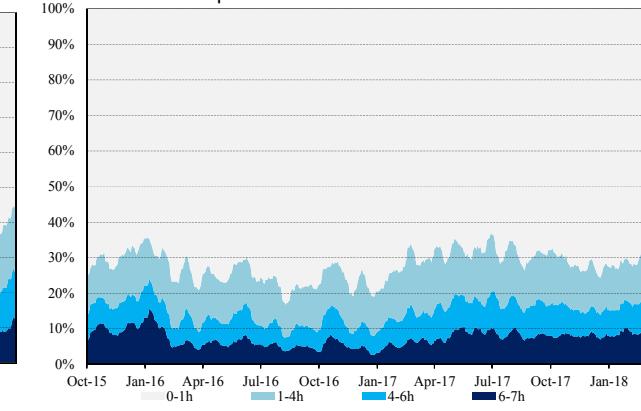
Ratio of issues by total observation time of the best-bid (best-ask) price of inter-dealer transactions (depth)

Chart 8

(1) Ratio of issues by total observation time of the best-bid price



(2) Ratio of issues by total observation time of the best-ask price



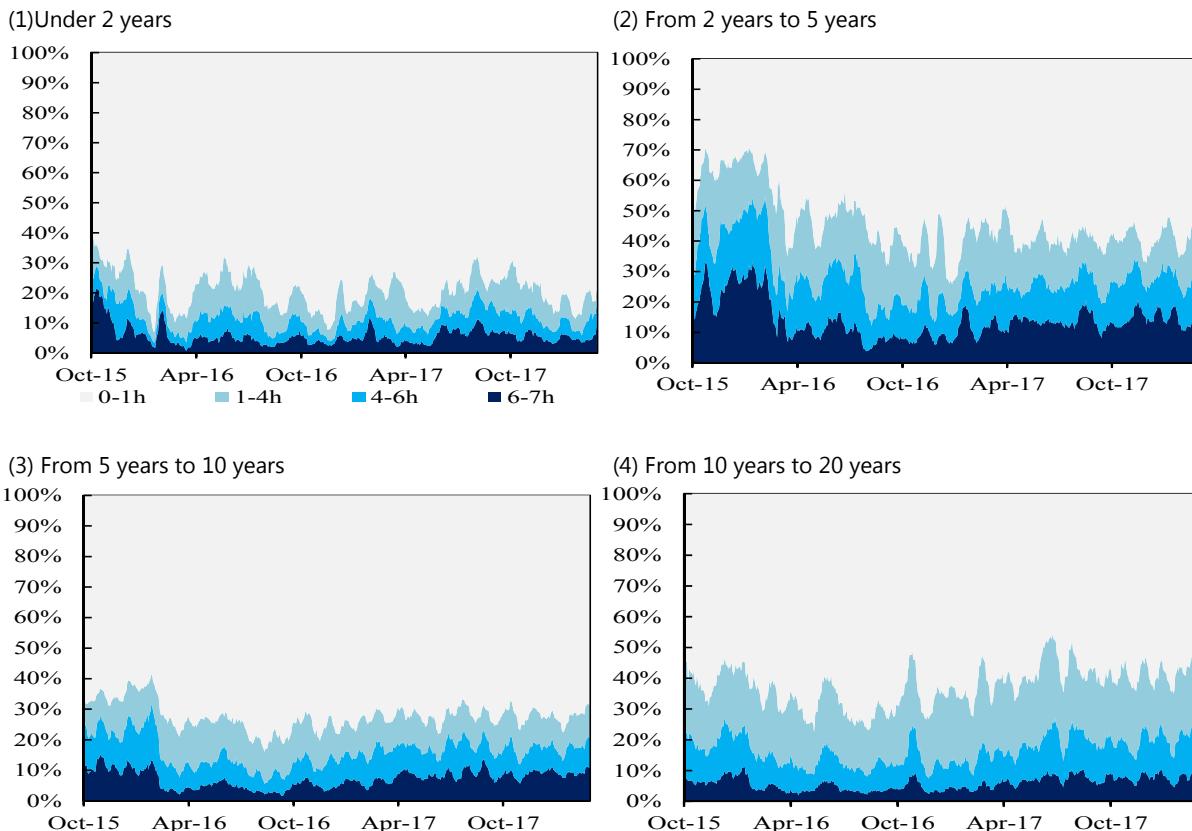
1. Figures indicate the percentage of issues by daily observation time, 0-1hours, 1-4hours, 4-6hours, 6-7 hours, of best-bid (best-ask) prices.
2. 10-day backward moving average. Latest data as at end-February 2018.

Source: Japan Bond Trading.

Thus, we observed the ratio of issues by total observation time of the best-bid price by residual maturity. We found that indicators for super-long-term maturity are recovering, while the indicator of more than six hours for short-term maturity is just slightly recovering and the indicator of less than one hour for short-term maturity is still high. This suggests a possibility that if large amount transactions of a certain bond in short-term maturity are conducted, prices of other bonds in short-term maturity are affected (Chart 9).

Ratio of issues by total observation time of the best-bid price by residual maturity
of inter-dealer transactions (depth)

Chart 9



1. Figures indicate the percentage of issues by daily observation time, 0-1hours, 1-4hours, 4-6hours, 6-7 hours, of best-bid price.
2. 10-day backward moving average. Latest data as at end-February 2018.

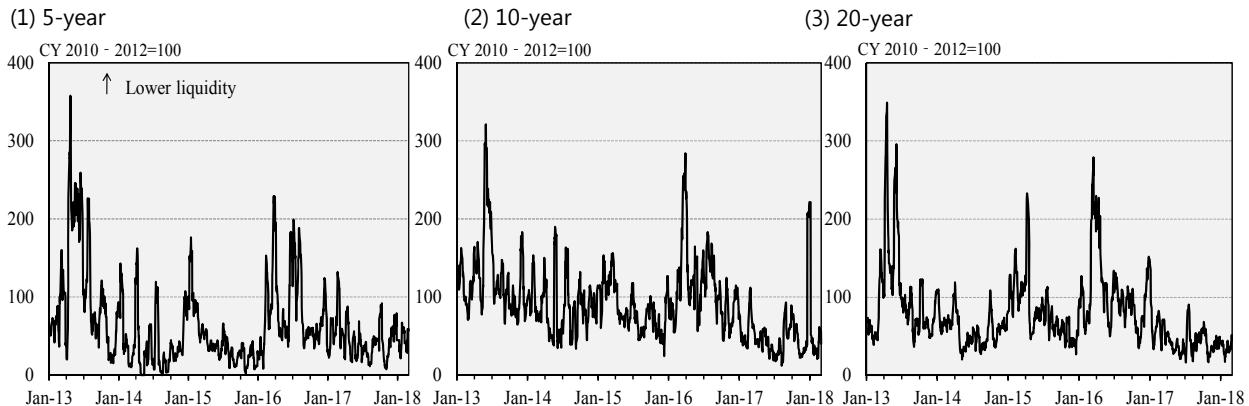
Source: Japan Bond Trading.

Resiliency

So far, we observed daily price range to transaction volume ratio as a proxy for resiliency of on-the-run bonds in inter-dealer transactions ¹⁰ (Chart 10). These indicators had large rises around the spring of 2016, and the indicator of 10-year on-the-run bond had a large increase in December 2017. However, this indicator was limited in that intraday developments cannot be grasped because it is not calculated with detailed transaction data but with only daily data.

¹⁰ The daily price range to transaction volume ratio is defined as the difference between the highest and lowest transaction prices of the day divided by the transaction volume within the day.

Daily price range to transaction volume ratio of inter-dealer transactions (resiliency) Chart 10



1. 10-day backward moving average. Latest data as at end-February 2018.

Source: QUICK

To overcome this limitation, this paper references to Cont et al. (2014) in that price impact indicator—the influence of change per unit volume of orders on the market price—was compiled with information related to orders such as the best-bid(ask) prices, and is frequently updated rather than information related to execution. Assuming that order flow imbalances (OFI) for the following equations, and we measure the impact per unit of OFI on the market price (in the JGB cash market) by dividing change width of the best-bid (best-ask) prices by OFI.¹¹

$$\begin{aligned}
 OFI_n^b &= q_n^b I_{[P_n^b \geq P_{n-1}^b]} - q_{n-1}^b I_{[P_n^b \leq P_{n-1}^b]}, \\
 OFI_n^a &= q_{n-1}^a I_{[P_n^a \geq P_{n-1}^a]} - q_n^a I_{[P_n^a \leq P_{n-1}^a]}, \\
 \beta_n^b &= \Delta P_n^b (= P_n^b - P_{n-1}^b) / OFI_n^b, \\
 \beta_n^a &= \Delta P_n^a (= P_n^a - P_{n-1}^a) / OFI_n^a, \\
 \beta &= (\sum_{n=1}^{N_b} \beta_n^b + \sum_{n=1}^{N_a} \beta_n^a) / (N_b + N_a).
 \end{aligned}$$

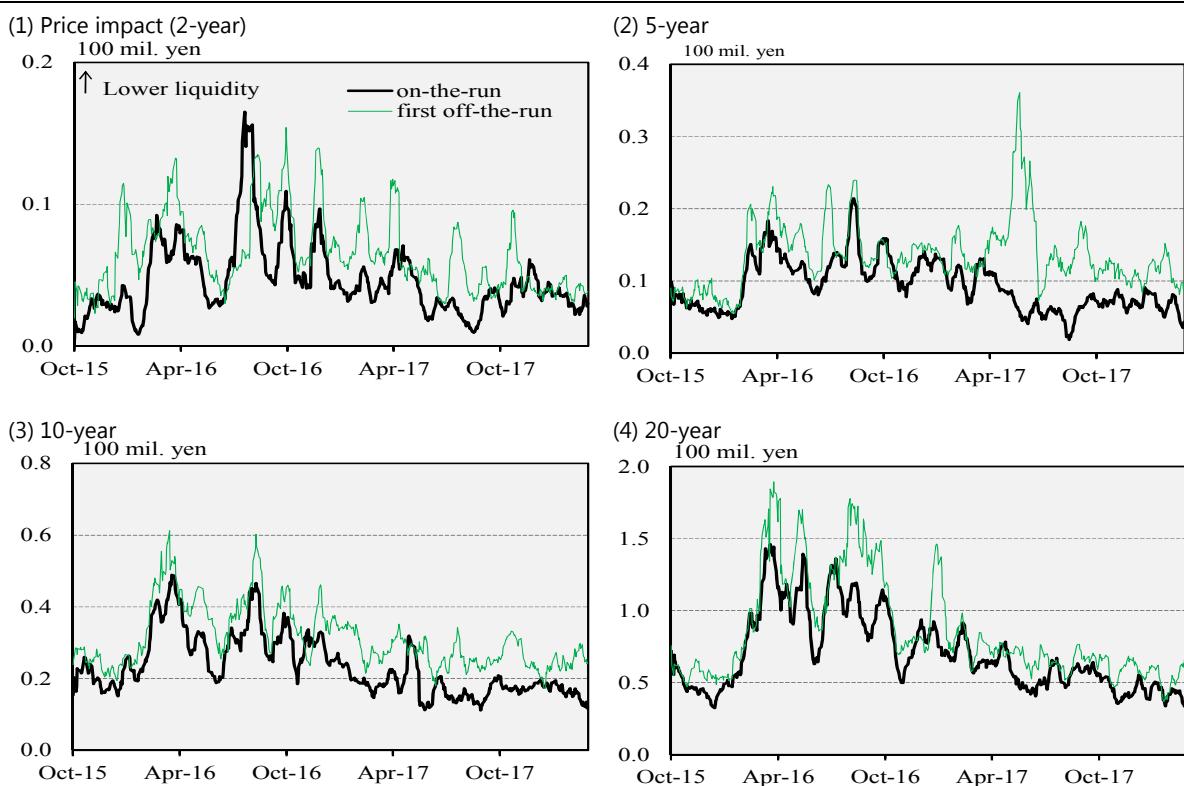
Here, N_b is a number representing the best-bid price updated on a day, N_a is a number for the best-ask price updated on a day, P_n^b is the best-bid price, P_n^a is the best-ask price, q_n^b is the volume at the best-bid price, q_n^a is the volume at the best-ask price. OFI is order flow imbalances. $I[\cdot]$ is a function that is 1 if the condition in $[\cdot]$ is satisfied and 0 otherwise.

¹¹ Consider, for example, a case where market participants strongly want to purchase cash JGBs and a new bid order (volume, q) is submitted at a price (P) higher than current best-bid price (P). In this case, OFI is q , the change width of the best-bid prices is $(P-P)$, and the price impact of this order becomes $(P-P)/q$.

The price impacts (β) of on-the-run bonds largely increased in the spring and summer of 2016, then fell from the fall of 2016, and recently were lower than the levels in the spring and summer of 2016, which is similar to indicators of daily price range to transaction volume ratio. The improvement of market resiliency indicates the market price is hard to move drastically even with large amount transactions. However, it also suggests that market liquidity in short-term maturity is still relatively low because indicators of first off-the-run bonds in short-term maturity continue to greatly fluctuate (Chart 11). In addition, a spike in the daily price range to transaction volume ratio for 10-year on-the-run bond in December 2017 was not observed in the price impact for the same bond. This may suggest that daily price range to transaction volume ratio spiked because transaction volume of 10-year on-the-run bond at that time was low, yet the price impact (β) complied with detailed transaction data did not spike because the volume of orders was higher.

Price impact (β) of inter-dealer transactions (resiliency)

Chart 11



1. 10-day backward moving average. Latest data as at end-February 2018.

Sources: QUICK; Japan Bond Trading.

We note the voices from market participants that "based on transaction volume at the market, investors and securities companies reduce the amount to a range that can be transacted smoothly". It is important to understand that this behavior of reducing the amount may have the indicator of the price impact (β) to improve.

Conclusion

This paper explained new market liquidity indicators for tightness, depth, and resiliency with detailed transaction data of inter-dealer transactions in the JGB cash market. These indicators greatly expand upon the current indicators in "Liquidity Indicators in the JGB Markets," because they can grasp intraday market liquidity of all JGB issues.

New liquidity indicators for inter-dealer transactions in the JGB cash market considerably worsened at the beginning of 2016, and then have gradually improved since the fall of 2016, as confirmed in section 3. This development is similar to indicators for the JGB futures market and dealer-to-client transactions in the JGB cash market.

Observations about the JGB cash market suggested that, from the perspective of bid-ask spreads and volume of orders, we are in a better environment for trading than after the introduction of negative interest rate policy. These bid-ask spreads and volume of orders improve as prospects of market participants' interest rates converge under QQE with Yield Curve Control.

We must pay attention that such improvement of liquidity indicators is not accompanied by an increase in transaction volume. There is no major obstacle in executing each transaction when needs for transactions are relatively small, while it is possible that stabled liquidity indicators, such as bid-ask spreads and volume of orders, will deteriorate or destabilize if needs for transactions rapidly increase with change in future market conditions.

For this reason, it is important to carefully observe various liquidity indicators for a sign of deterioration or destabilization in market liquidity, and which type of transactions is more vulnerable to change in market conditions. According to newly compiled liquidity indicators with detailed transaction data, especially for short-term and off-the-run bonds, the improvement of indicators was delayed and indicators temporarily deteriorated during intraday. We have to continue to analyze market liquidity deeply. Thus, we can capture market liquidity in more detail with newly compiled liquidity indicators. It is beneficial to continue examining the JGB markets, including these indicators.

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Ninth IFC Conference on "Are post-crisis statistical initiatives completed?"

Basel, 30-31 August 2018

Liquidity in the JGB cash market: an evaluation from detailed transaction data¹

Toshiyuki Sakiyama and Shun Kobayashi,
Bank of Japan

¹ This presentation was prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

Liquidity in the Cash Market: An Evaluation from Detailed Transaction Data



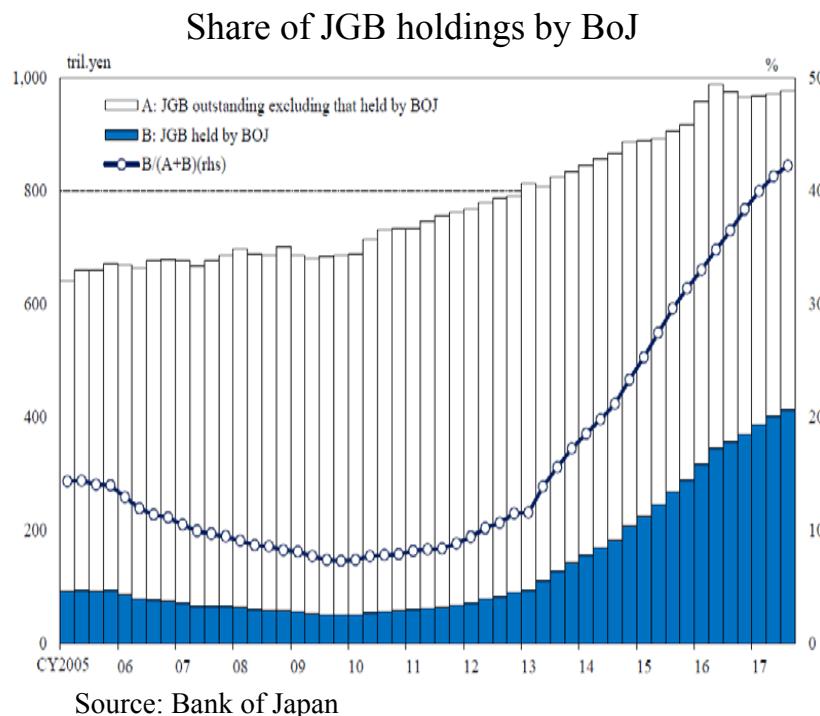
August 2018

Toshiyuki Sakiyama
Shun Kobayashi
Bank of Japan

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Importance of grasping JGB cash market liquidity

- BoJ has been purchasing massive amounts of cash JGBs since the introduction of “Quantitative and Qualitative Monetary Easing (QQE)” in April 2013 (In September 2016, BoJ introduced a new framework, “QQE with Yield Curve Control”). As a result, BoJ holds over 40% of all JGB issuances. Therefore, it is important to grasp in more detail the liquidity in the JGB cash market, from which BoJ purchases JGBs in particular.
- The definition of “market liquidity” is not necessarily uniform and its quantitative measurement is not simple. Therefore, BoJ tries to capture market liquidity from a broader range of perspectives by utilizing liquidity indicators, market surveys and dialogues with market participants.



	(i) Liquidity Indicators in the JGB Markets	(ii) Bond Market Survey
Contents	Liquidity indicators using individual transaction data to monitor liquidity in the JGB markets from multiple angles	Market participants' views on functioning of the bond market, outlook of interest rates
Focus	Indicators include both those for the JGB futures market and for the JGB cash market.	Respondents are banks, securities companies, insurance companies etc.

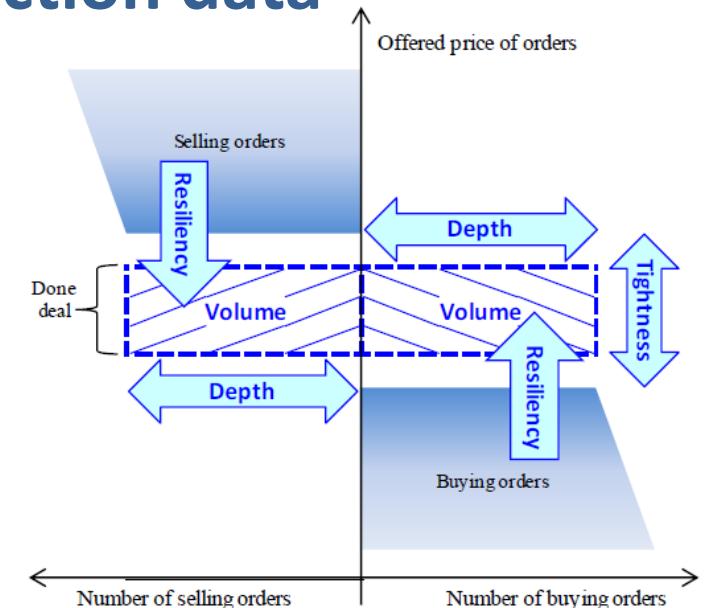
We expanded liquidity indicators by acquiring tick data

Expansion of Liquidity indicators based on detailed transaction data

- BoJ has been releasing “Liquidity Indicators in the JGB Markets” each quarter since 2015. In compiling indicators, we focus on four evaluation axes: volume, tightness, depth, and resiliency.
- However, compilation of liquidity indicators in the JGB cash market was inadequate due to difficulty of obtaining detailed transaction data. We decided to acquire tick data from Japan Bond Trading, the largest company for intermediation of inter-dealer transactions, and expand liquidity indicators.

Liquidity Indicators in the JGB Markets” released by the BoJ

	JGB futures market	JGB cash market	
		Dealer-to-client	Inter-dealer
Volume	◎ Transaction volume	△ Transaction volume	○ Transaction volume
Tightness	◎ Bid-ask spread	○ Bid-ask spread	
Depth	◎ Volume of orders at the best-ask price	△ Best-worst quote spread	
Resiliency	◎ Price impact		



Newly compiled liquidity indicators

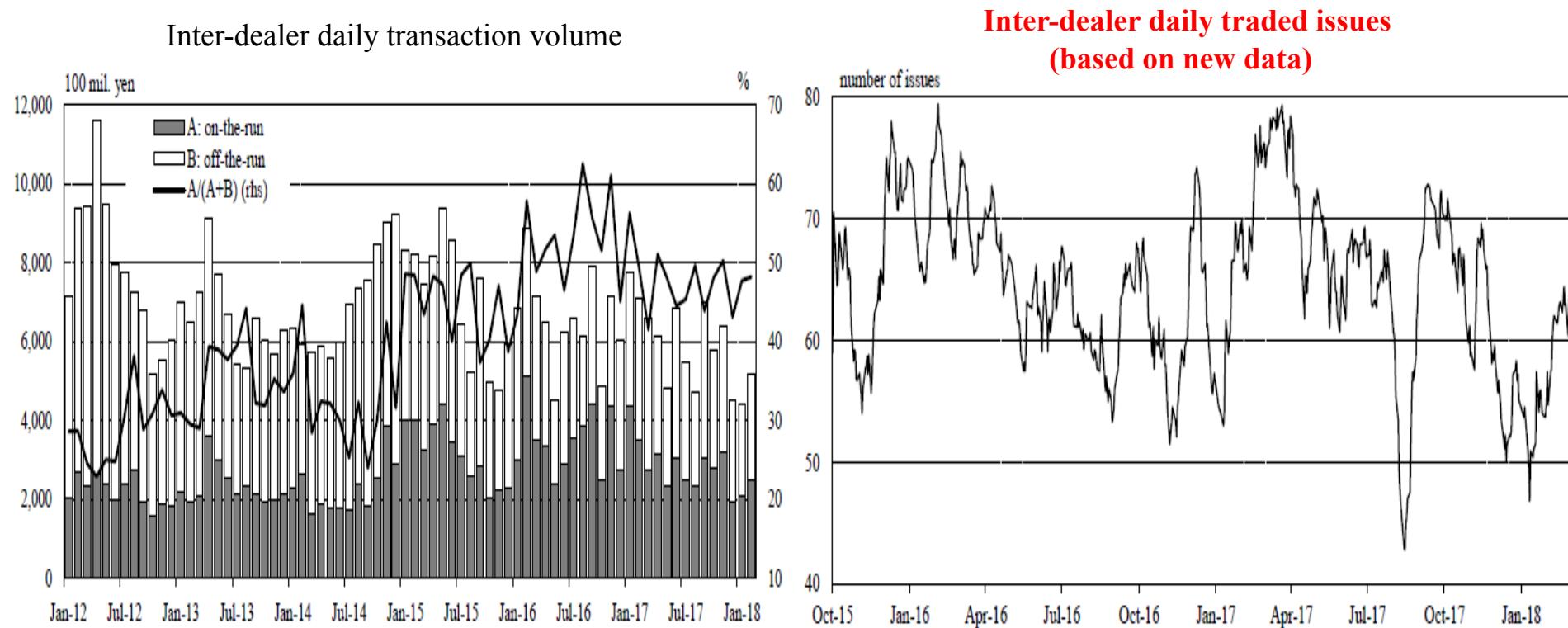
JGB cash market
Inter-dealer
◎ Transaction volume
◎ Bid-ask spread
◎ Total observation time of bid-ask spreads*
◎ Volume of orders at the best-ask (best-bid) price
◎ Ratio of issues by total observation time of the best-ask (best-bid) price*
◎ Price impact

Notes: 1. ◎ : compiled with detailed transaction data, ○ : compiled with daily data, △ : compiled with monthly data.

2. *: compiled from new perspectives.

Liquidity indicators – transaction volume

- From the trend of inter-dealer transactions since 2016, we found that transaction volume remained close to the same level.
- However, with the newly acquired detailed transaction data, we have been able to examine the number of issues of cash JGBs traded each day, which amounted to 50–80 after fall 2015, and then decreased several times to less than 50 in the second half of 2017.



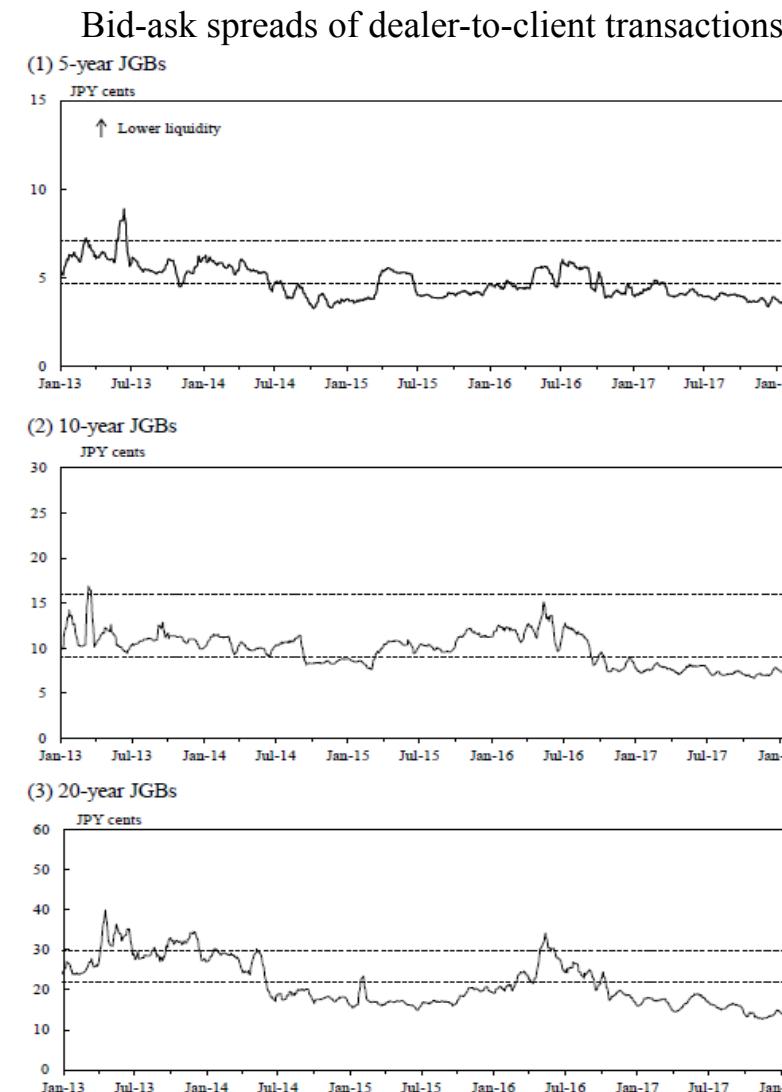
Notes: 1. Transaction volume is the sum of 2-year, 5-year, 10-year, 20-year, 30-year, and 40-year JGBs via Japan Bond Trading.

2. Number of issues indicates 10-day backward moving average. Latest data as at end-February 2018.

Sources: QUICK, the Japan Bond Trading

Liquidity indicators – tightness

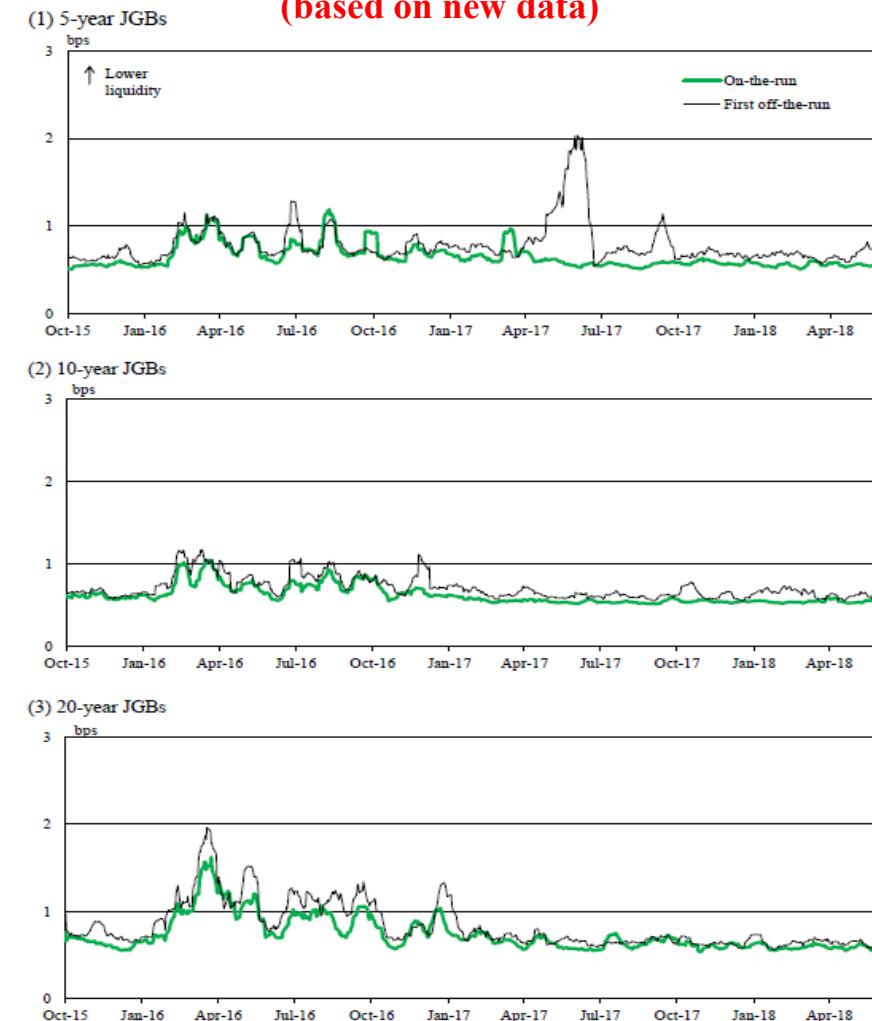
- By using new data, we can also check tightness (measured by bid-ask spreads) in more detail.



Note: Quotations through Trade web as of 3:00 p.m. Dotted lines indicate the first/third quartile spreads between January 2010 and March 2013. 10-day backward moving average. Latest data as at end-May 2018.

Source: Thomson Reuters

Bid-ask spreads of inter-dealer transactions (based on new data)

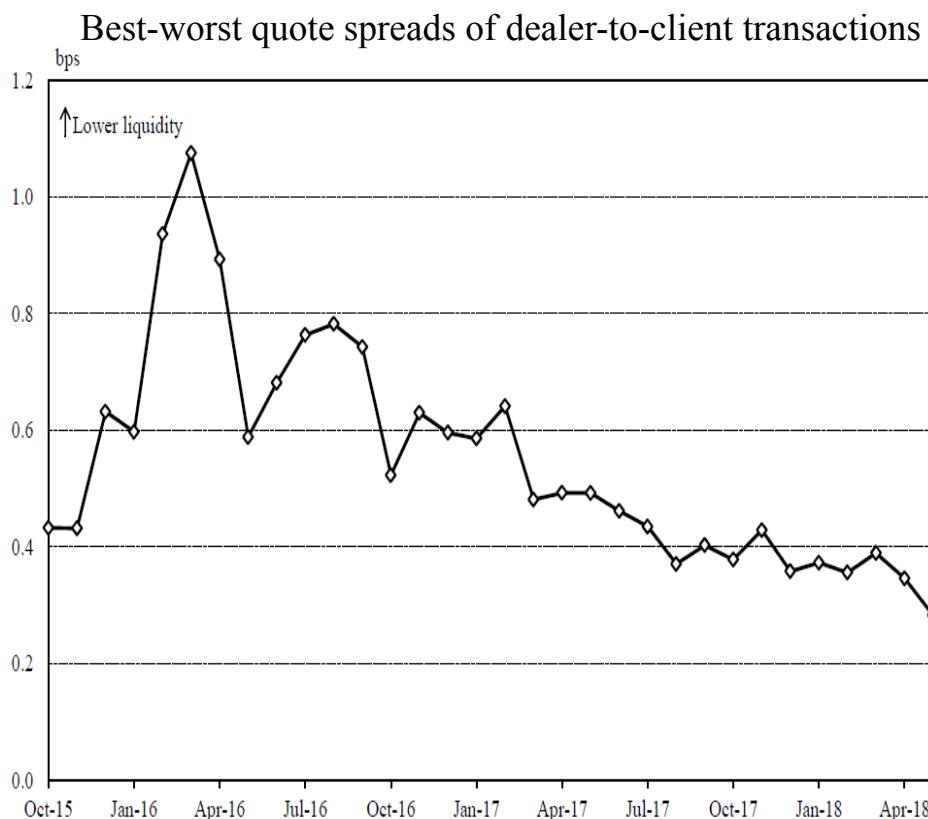


Notes: Figures indicate the average of bid-ask spreads with a 1-second frequency. Bid-ask spreads are calculated only for time periods in which both best-bid and best-ask prices were submitted. 10-day backward moving average. Latest data as at end-May 2018.

Source: Japan Bond Trading.

Liquidity indicators – depth

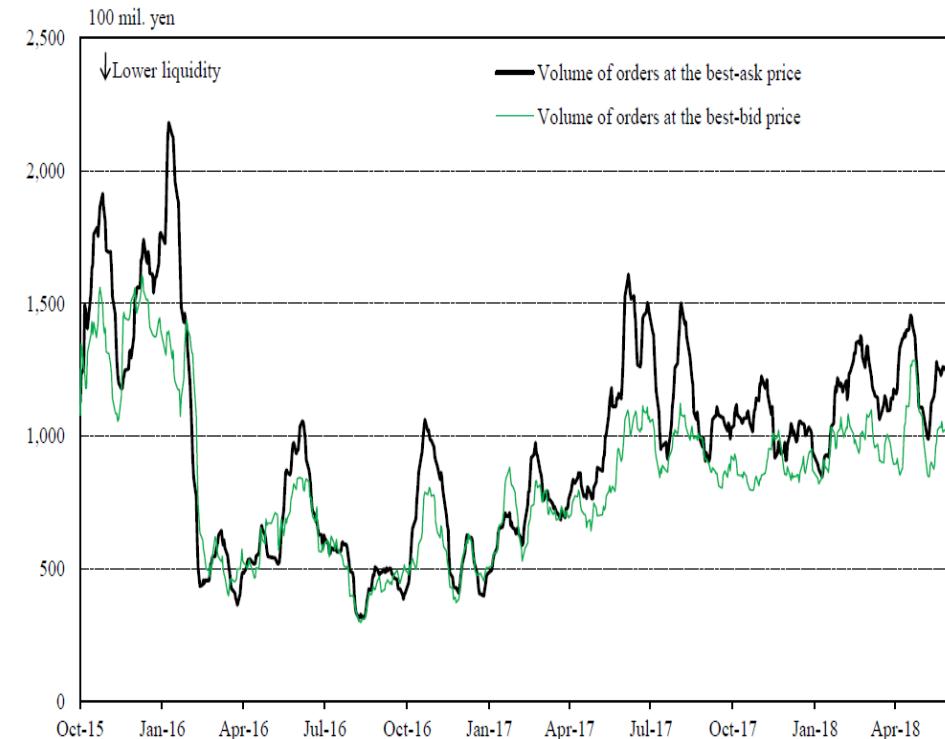
- Without newly acquired data, we couldn't construct a "depth" (The larger the volume of orders at the current price level, the smaller the difference between the investors' intended prices and the actual prices).
- Based on the new data, we can construct a new measure – "the volume of orders at the best-ask(bid) price"- which enables us to capture liquidity in the intraday market by issue.



Note: Calculated by averaging the spreads between the best and worst quotes offered by dealers against each client request. Transactions with spreads wider than 10 bps are excluded from the calculation. Latest data as at end-May 2018.

Source: Yensai.com

Volume of orders at the best-ask (best-bid) price of inter-dealer transactions (based on new data)

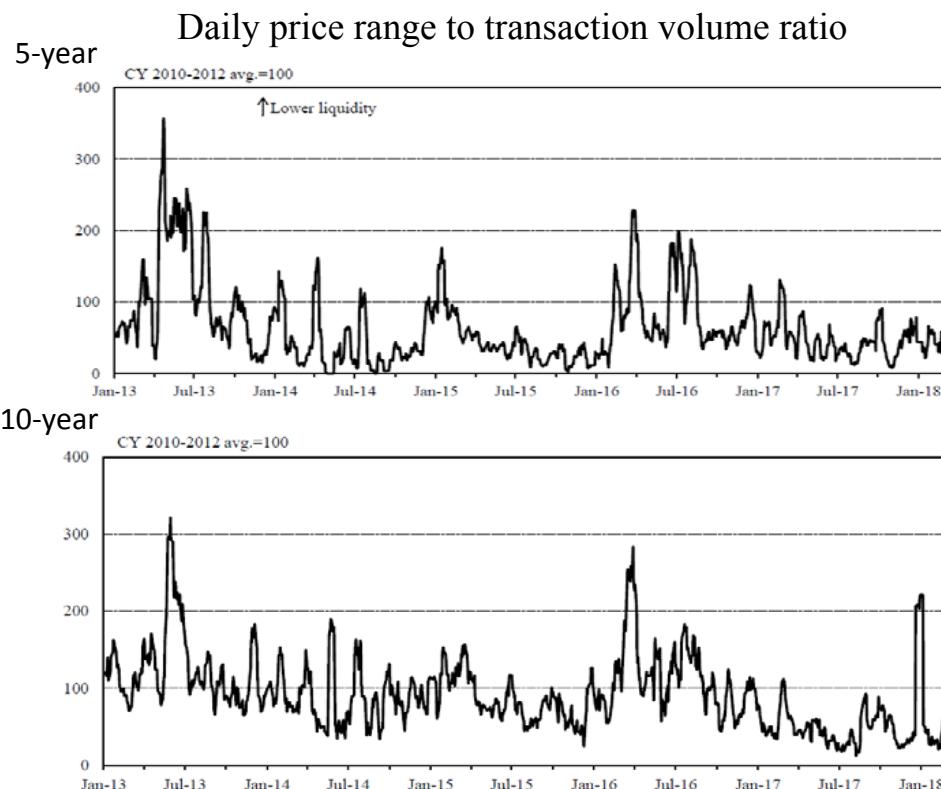


Note: Calculated by summing up the median of volume of orders at the best-ask (best-bid) price with a 1-second frequency per issue. 10-day backward moving average. Latest data as at end-May 2018.

Source: Japan Bond Trading.

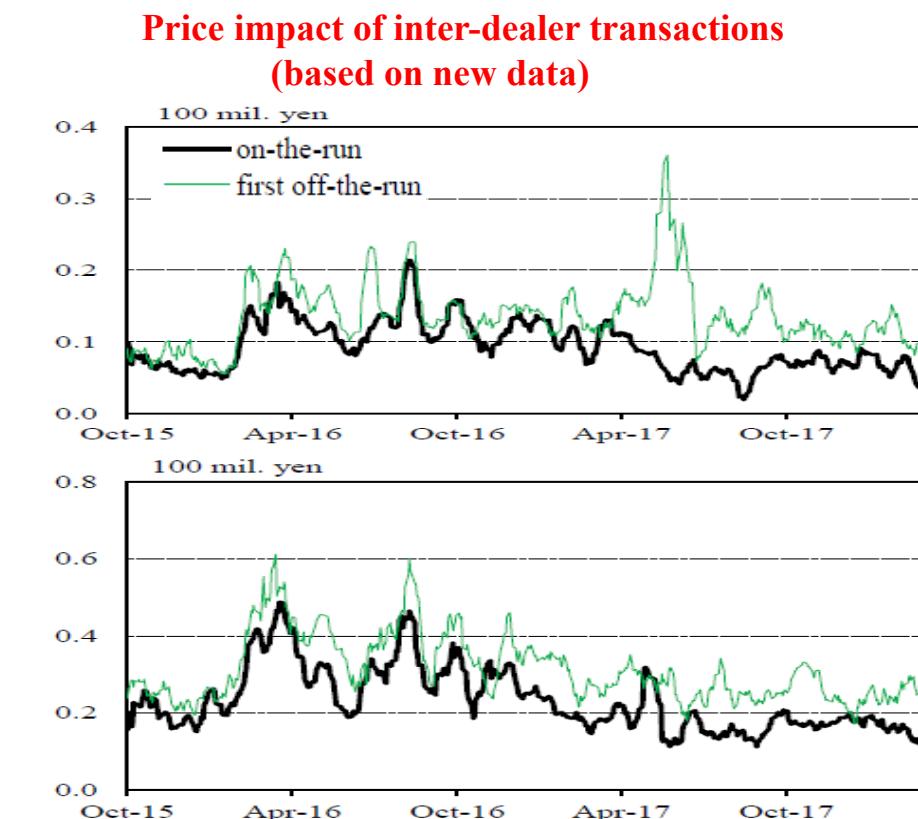
Liquidity indicators – resiliency

- So far, we depended on a crude measure – “daily price range to transaction volume ratio” – to grasp the resiliency of the JGB cash market.
- Based on the new data, we can construct a new resiliency measure. We have measured the impact of change per unit volume of orders on market prices with information related to orders such as the best-bid and best-ask prices, which is frequently updated rather than with information related to the execution of orders.



Note: Daily price range (the difference between the highest and lowest transaction prices of the day) divided by the transaction volume of the day. 10-day backward moving average. Latest data as at end-February 2018.

Source: QUICK.



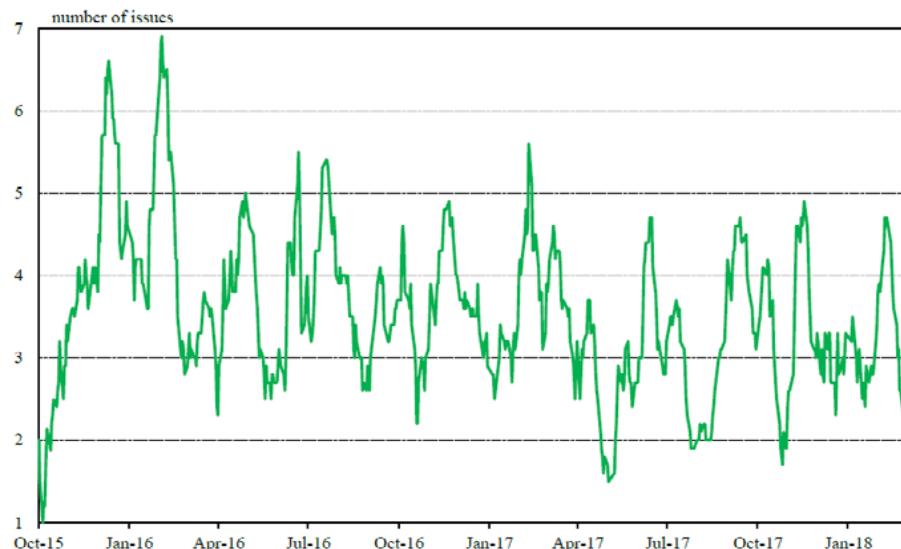
Note: The impact of change per unit of order flow imbalances (OFI, proposed by Cont, Kukanov, and Stoikov(2014)) on market prices measured by dividing change width of the best-bid (best-ask) prices by OFI. 10-day backward moving average. Latest data as at end-February 2018.

Sources: QUICK; Japan Bond Trading.

Conclusion

- Examining new liquidity indicators suggests that, as a whole, they have gradually improved since the fall of 2016, after worsening at the beginning of 2016. This suggests it is easier to trade now than it was following the introduction of “Negative Interest Rate.”
- However, we must continue to pay attention to future developments in market liquidity because transaction volume has not increased while some indicators have improved. We also found that improvement in short-term and off-the-run bonds is relatively delayed and have observed situations where liquidity temporarily deteriorates within a day.
- There are remaining points that we cannot grasp very well with indicators (e.g., difficulty in conducting large amount transactions). Thus, it is important to carefully examine these points by using communication with market participants as well as indicators.

Number of issues thought to be conducted as large amount transactions (based on new data)

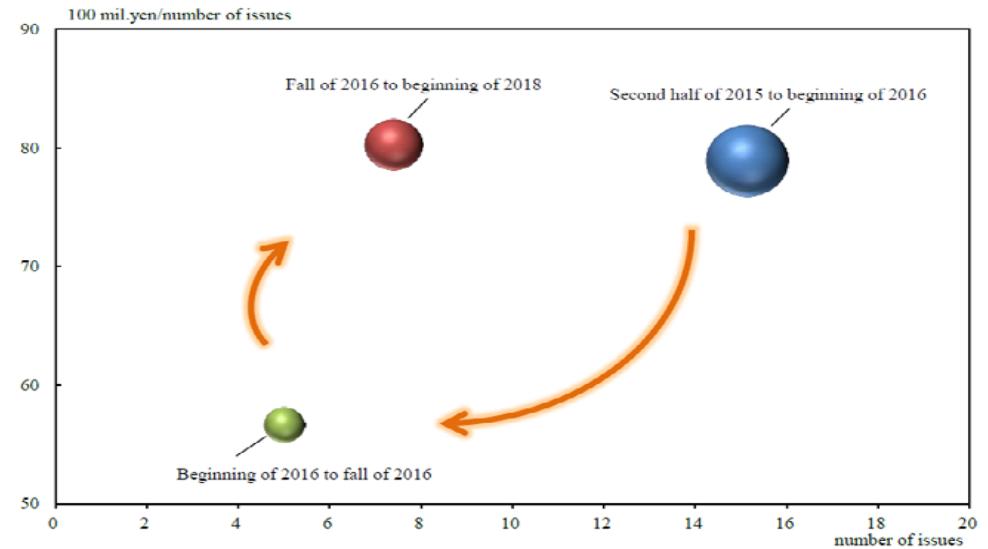


Note: Large amount transactions are 5 billion yen. 10-day backward moving average.

Latest data as at end-February 2018.

Source: Japan Bond Trading.

Number of issues and volume of orders assumed as large amount transactions (based on new data)



Note: Number of issues whose volume of orders at the best-ask exceeds 2.5 billion yen on average per day. Circle size represents the total volume of orders thought to be conducted as large amount transactions.

Source: Japan Bond Trading.