Liquidity in JGB markets
- Analysis on the Intraday Bid-Ask Spreads -

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Liquidity in the Japanese government bond (JGB) market has improved significantly as a result of a series of market reforms implemented since 2000. Market liquidity is a measure of “the level of ease with which trading can be conducted in the market.” In order to facilitate trading in the JGB market, or in other words to enhance overall liquidity in the market, it is necessary to have a clear understanding of the changing mechanisms in market liquidity, together with main factors which have an impact on this. Detailed information known as “tick data,” which records trading patterns over the course of a day, is a very useful tool when conducting a detailed analysis of market liquidity. Our empirical analysis, based on the intraday bid-ask spread, shows that as is the case in the US Treasury bond market, the longer the remaining maturity, the wider the bid-ask spread. Moreover, we find that wider bid-ask spreads are observed when market prices are volatile. These empirical findings are consistent with the general perception held by market participants.

Introduction

The yield on the currently-issued ten-year JGB, which hit the lowest level of 0.44% on June 12 2003, had reached 1.67% on September 3. As this marked a sudden turnaround from a protracted period of extremely low interest rates beginning in 1999, this probably had an effect on market liquidity as well. When interest rates fluctuate dramatically over a short period of time, market participants may need to exercise more caution than usual when showing bid (buying) and ask (selling) prices. Whether or not their bid or ask prices are significantly cheaper or more expensive than prevailing market prices, or whether transaction costs are appropriate prices for liquidity, are key factors to be taken into consideration. In this article, when looking at factors influencing short-term price formations in the JGB market, we focus on movements in the intraday bid-ask spread (i.e., the difference between the buying price and selling price).

Reforms in the JGB market and improvements in market liquidity

In 2000, the BIS Committee on the Global Financial System published a report1 on government securities market liquidity that examined three dimensions of market liquidity.

1. The degree of separation between transaction prices and mid-market prices (tightness). This is generally measured by the bid-ask spread.
2. The volume of trades possible without affecting prevailing market prices (depth). This is measured using market makers’ order volume and trade execution volume or changes in prices just after execution.
3. The speed of the restoration of normal market conditions, or the speed at which supply and demand imbalances in order flows can be adjusted (resiliency).

Based on these three dimensions, the report concluded that JGB market liquidity was “the lowest among the G7 nations” (Chart 1). In particular, the report notes that when the JGB outstanding volume rises sharply, the cash market is not sufficiently liquid with respect to the volume of securities issued.

Chart 1: Comparison of basic market liquidity measures (BIS report)

<table>
<thead>
<tr>
<th></th>
<th>Canada</th>
<th>Italy</th>
<th>Japan</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bid-ask spread:</td>
<td>5-year</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Fixed coupon *</td>
<td>10-year</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>30-year</td>
<td>10</td>
<td>14</td>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Volume outstanding (a) **</td>
<td>285</td>
<td>1,100</td>
<td>1,919</td>
<td>458</td>
<td>3,457</td>
</tr>
<tr>
<td>Yearly Trading Volume (b) **</td>
<td>3,243</td>
<td>8,419</td>
<td>13,282</td>
<td>3,222</td>
<td>75,901</td>
</tr>
<tr>
<td>Turnover ratio (b/a) **</td>
<td>21.9</td>
<td>7.7</td>
<td>6.9</td>
<td>7.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Issue size per issue **</td>
<td>8.7</td>
<td>12.3</td>
<td>7.7</td>
<td>18.2</td>
<td>17.5</td>
</tr>
</tbody>
</table>

* Units: 1/10,000 of face value (for example, for two-year bonds, this equates to 5 sen for a Y100 face value. Note that 100 sen=1yen).
** Units: US $1 billion.

*Bank Examination and Surveillance Department

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1Bank of Japan Financial Markets Department January 2004
However, since then, JGB market liquidity has been improved through a series of reforms (BOX). For example, the BIS report highlighted the small issue size per issue and concentration of ten-year JGBs in the whole product mix as key constraints on liquidity. To rectify these problems, the issue ratio for medium-term JGBs has risen and modified the concentration of ten-year JGBs in the whole product mix (Chart 2). Since FY2001, the integration of the medium-term JGBs to five-year JGBs as a benchmark issue, has led to an increase in the turnover ratio of medium-term JGBs (Chart 3). In addition, the average issue size has risen as a result of an introduction of a re-opening system (Chart 4). Therefore, problems pointed out in the BIS report have been steadily resolved.

Chart 5 illustrates the improvement in market liquidity in terms of a smoother price formation in the market resulting from market reforms in the primary market, secondary market and payment system. The smoothness of the yield curve shows the degree of price distortion for each issue, and when the distortion is small, this indicates that the price formation mechanism is functioning efficiently. This index also suggests that JGB market liquidity has been consistently improving.

Characteristics of the bid-ask spread
- tends to be wider with longer the remaining maturity

In order to empirically analyze the impact of liquidity on transaction costs, it is necessary to use transaction records known as "tick data" (Chart 6). There are few previous analyses of JGB market liquidity using tick data partly due to data constraints. Below we present the results of our analysis using tick data from April 2002 to September 2003.

Looking at descriptive statistics for bid-ask spreads classified by original maturities, we can observe a positive correlation between the original maturity and bid-ask spread in the JGB market (Chart 7). This also applies to the case of the US.

It should be noted that each maturity zone has issues for a variety of remaining maturities. Among the ten-year bonds, there is a clear correlation between the remaining maturity and bid-ask spread (Chart 8).

The main factors affecting market participants' bid and ask prices include transaction volume, price
fluctuation risk, and market participants’ risk appetite (i.e., degree of risk aversion). The mechanism is as follows: Suppose that prices are volatile in a market. This makes it more difficult for dealers to predict whether the bid and ask prices shown are appropriate considering the closing prices on that day or prevailing market prices. This leads to more cautious bid and ask prices than in a normal period and consequently the bid-ask spread widens.

To verify this point, as an indicator of price fluctuation risk, we conduct a panel analysis using interest rate volatility (Chart 9). Assuming that the bid-ask spread is correlated with interest rate levels, we have added interest rates to the explanatory variables in one of our models.

These results reveal that both interest rate levels and volatility significantly impact the bid-ask spread. In short, the bid-ask spread tends to be larger for higher and more volatile interest rates. For the sample period, from April 2002 to July 2003, the pattern that emerged was the longer the remaining maturity, the higher the interest rate and volatility, and therefore the longer the remaining maturity, the greater the bid-ask spread.

The bid-ask spread widens when the market becomes more volatile

We would like to present an example of the relationship between bid-ask spreads and fluctuations in market prices. First, as shown in Chart 10, in the autumn of 2002 and summer of 2003, when the 10-year JGB auction was undersubscribed and interest rates fluctuated widely, there were dramatic increases in bid-ask spreads. 

<table>
<thead>
<tr>
<th>Remaining maturity</th>
<th>2-5 years</th>
<th>5-7 years</th>
<th>7-10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year bonds</td>
<td>0.8</td>
<td>0.9</td>
<td>1.1</td>
</tr>
<tr>
<td>5-year bonds</td>
<td>0.9</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>10-year bonds</td>
<td>1.1</td>
<td>0.9</td>
<td>1.5</td>
</tr>
<tr>
<td>20-year bonds</td>
<td>1.4</td>
<td>1.2</td>
<td>1.7</td>
</tr>
<tr>
<td>30-year bonds</td>
<td>2.7</td>
<td>2.1</td>
<td>2.3</td>
</tr>
</tbody>
</table>

* For 2-year JGBs, the figures exclude bonds with a remaining maturity of less than a year.
Chart 11 shows the risk of future price fluctuations measured by implied probability distributions for short-term interest rates computed from 10-year JGB future option prices. The fatness of each distribution's tail represents the level of uncertainty with regards to future interest rate movements. According to this chart, in the early May, when the bid-ask spread was both low and stable, the tail of the distributions was narrow. However, from June onwards, when the bid-ask spread widened, the tails of the distributions expanded. This indicates that when market participants' expected range for future interest rates widens, the bid-ask spread also expands.

Furthermore, in looking at trends in bid-ask spreads by original maturity, from mid-June, the bid-ask spread for the current issues of 10-year and 20-year bonds expanded (Chart 12). From mid-August to September, in the medium-term zone, the bid-ask spread for 2-year bond current issues also widened and the spread for 5-year bond current issues exceeded that for 10-year bond current issues. In order to look at market price fluctuations for each term over this period, Chart 13 shows the term structure of forward rates. This shows that while from mid-June onwards, forward rates mainly for the long-term zone rose, forward rates for the medium-term zone also rose from August. Consequently, these results suggest that the bid-ask spreads expanded for maturity zones where market prices fluctuated widely.

When volatility rises, for example in June 2003, turnover increases (Chart 14). Despite this increased turnover, some market participants have upheld the view that "the JGB market is illiquid." This can stem from the fact that "the bid-ask spread is wider than usual when participants want to make a transaction." There is a tendency to believe that the greater the turnover, the more active the trading, and the greater the liquidity. However, as market liquidity is gauged in terms of transaction costs, in some situations, turnover alone does not draw the full picture.
## Recent Reforms in the JGB market

### Primary market

#### Variety of products and maturities

- 1994: Issuance of 6-year JGBs
- 1999: Issuance of 1-year TBs
- 2000: Issuance of 5-year JGBs
- 2004: Issuance of 10-year inflation-indexed bonds (scheduled)

#### Review of issue procedures

- [Reduction of syndicate group underwriting (10-year JGBs)]
- 1998: Introduction of partial competitive bidding (share 40%)
- 1990: Expansion of the competitive bidding limit (share 60%)
- 2002: Further expansion of competitive bidding limit (share 75%)
- 2003: Further expansion of competitive bidding limit (share 80%)

#### Improvement of bidding procedures

- 1991: Introduction of same-day announcement of bidding results
- 1999: Introduction of prior announcement of auction calendar and issue amount
- 2000: Time of announcement of bidding results brought forward
- 2003: Reduction in days between auction and issue dates

### Secondary market

#### Creation of new markets and transactions

- [Futures and options markets]
  - 1985: Creation of JGB futures market
  - 1989: Creation of JGB options market
  - 1996: Full-scale commencement of securities lending transactions against cash collateral

#### Easing of restrictions on the trading front

- 1984: Lifting of the ban on bank dealing
- 1987: Lifting of the ban on short sales by securities houses
- 1989: Lifting of the ban on short sales by banks
- 1996: Removal of interest rate regulations of securities lending against cash collateral

#### Taxation

- 1992: Lifting of taxes on profits from TB redemptions for foreign institutions
- 1999: Exemption of withholding taxes on interest from JGBs held by foreign investors

#### Settlemnet system and practices

- 1980: Creation of transfer book-entry settlement system
- 1990: BOJ-NET JGB services came into operation
- 1994: JGB DVP system came into operation
- 2001: BOJ-NET real time gross settlement (RTGS) took effect
- 2003: Establishment of Japan Government Bond Clearing Corporation

#### Dialogue with the market

- 2000: Inauguration of the Meeting on the JGB Market
- 2002: Inauguration of the Meeting of the JGB Investors
Conclusion

Smooth price discovery in the JGB market is prerequisite for robust functioning of the financial market as a whole. In addition to price formation based on expectations for long-term economic trends, the smoothness with which each individual transaction can be carried out also has a significant impact on price discovery in the JGB market. In order to make transactions even smoother, we need to enhance the functioning of the market based on a clear understanding of market liquidity.

Market liquidity analysis using tick data given in this article sheds light on the current condition of transaction costs in the JGB markets and provides a useful tool in further understanding the changing mechanisms in market liquidity. However, as there are various indicators to assess liquidity in the market, we need to carefully examine the consistency between these indicators and also their relationship with related factors such as interest rates and their volatility, remaining maturity and original maturity. The Financial Markets Department will continue to analyze this area, which provides useful viewpoints for market reforms in practice as well as infrastructure to enhance market liquidity.

2 Japan Bond Trading Co., Ltd. "JGB Market Information," includes executed information and quoted information. Quoted information is comprised of best bid and best offer (simple interest), as well as time of occurrence, change, security code, bond name and delivery date.
4 In the US Treasury market, there is a positive correlation between the bid-ask spread and remaining maturity (Fleming (2003)).

US Treasury bond bid-ask spread

<table>
<thead>
<tr>
<th>Remaining maturity</th>
<th>2-5 years</th>
<th>5-7 years</th>
<th>7-10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average interest rates</td>
<td>0.21</td>
<td>0.49</td>
<td>0.84</td>
</tr>
<tr>
<td>Volatility</td>
<td>0.018</td>
<td>0.033</td>
<td>0.042</td>
</tr>
</tbody>
</table>

* Unit = 1/32 point. 1 point = 1%.

5 Average interest rate and average volatility for each zone during the sample period (April 4 2002 to July 25 2003) are as follows:

<table>
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6 Analyzing the relationship between bid-ask spreads and fluctuations in market prices using the Granger causality test reveals a relationship where "after fluctuations in intraday prices become more volatile, the bid-ask spread subsequently widens."

(Reference) The Granger causality test

<table>
<thead>
<tr>
<th>Null hypothesis (H0)</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraday price fluctuations doesn't Granger cause bid-ask spread</td>
<td>15.8*</td>
<td>0.00</td>
</tr>
<tr>
<td>Bid-ask spread doesn't Granger cause intraday price fluctuations</td>
<td>1.4</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Sample period is April 1 2002 to August 14 2003. * denotes statistical significance at 1% level. For each variable, stationarity is verified using the ADF test. The lag used for the presumptions is three business days.