Liquidity in the Australian Treasury Bond Futures Market

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Australian Treasury bond futures contracts are used by market participants to manage interest rate exposures. Relative to other financial instruments, the market generally has high turnover and low transaction costs. However, the global financial crisis saw a decline in liquidity, with market participants reacting to increased volatility by trading smaller parcels more frequently, and at a higher cost. More recently, liquidity in the market has improved. Intraday data suggest that liquidity is deepest following the opening of the market, and that liquidity is affected by the release of economic and financial news, particularly the announcement of the outcome of Reserve Bank Board meetings.

Introduction

An Australian Treasury bond futures contract is a derivative that provides a means of protecting against, or gaining exposure to, interest rate risk – the risk that a change in market interest rates will affect the value of assets and liabilities. In Australia, the Treasury bond futures market is the primary market for managing this risk, with turnover significantly larger than in the physical Treasury bond market. Because of the ease and low cost of transacting in the Treasury bond futures market, it is also important for the pricing of the medium- to long-term 'risk-free' rate of return in Australia – a key determinant in the price of other financial instruments.[1] In these ways, a well-functioning Treasury bond futures market provides broad benefits for Australian financial markets. This article examines developments in a range of measures of liquidity for this market, focusing on how the market functioned during the global financial crisis and the intraday patterns of liquidity.

Overview of the Market

In general, a futures contract is a standardised, exchange-traded derivative contract to buy or sell a specified asset on a future date for a price agreed today. Treasury bond futures contracts are settled with cash payments and therefore physical delivery of the Treasury bond itself is not required. The Treasury bond futures market consists of two contracts: a 3-year futures contract and a 10-year futures contract, which are traded on the Australian Securities Exchange (ASX). These contracts reference the yield on a basket of Treasury bonds with a notional face value of $100 000, a standardised coupon rate of 6 per cent per annum and an average term to maturity of 3 and 10 years. The contracts can be traded nearly 24 hours a day, separated into a day session and night session.[2]

Treasury bond futures provide an avenue to manage interest rate risk. For instance, an investor purchasing a 3-year fixed-rate corporate debt security is exposed

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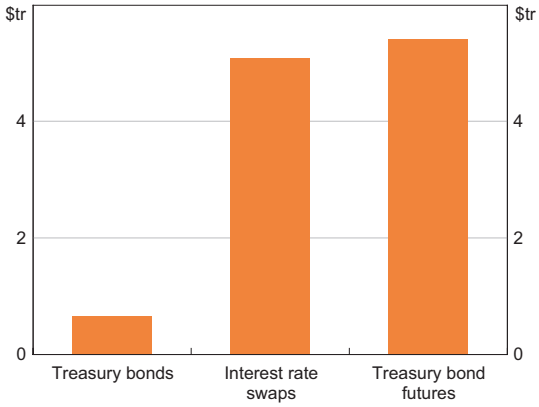
1 For details on the risk-free rate of return in Australia, see Finlay and Olivan (2012).

2 These contracts expire quarterly. At any one time, there are two quarterly contracts outstanding in each of the 3- and 10-year futures, although almost all positions are held in the contract with the earlier expiry. For more information on contract specifications, see <http://www.asx.com.au/documents/products/3-and-10-year-treasury-bonds-20120117.pdf>.

to the risk of an increase in interest rates and therefore a fall in the price of the debt security. To manage this risk, the investor can sell 3-year Treasury bond futures contracts. If interest rates of that maturity subsequently rise, the profit from the Treasury bond futures will offset the loss in the investment of the corporate debt security.[3] In a similar manner, dealers in the physical Treasury bond market can use Treasury bond futures contracts to manage interest rate risk on their inventories.

Market participants can also manage medium- to long-term interest rate risk using the physical bond market or the interest rate swaps market. However, a key benefit of derivative markets over physical markets is that contracts can be bought or sold without requiring the investors to hold or deliver the physical asset, reducing the funding requirement to establish interest rate positions. As a result, the bond derivatives market in Australia is significantly more liquid than the physical market. For example, turnover in both the futures and swaps markets exceeded $5 trillion in the 2010/11 financial year, more than eight times that in the physical market (Graph 1).

Graph 1
Annual Turnover
2010/11



Source: Australian Financial Markets Association

3 The profit from the futures contract may not fully offset the fall in the price of the debt security due to basis risk – the risk that the value of the futures contract does not change exactly in line with the financial instrument being managed.

The standardised, exchange-traded nature of Treasury bond futures also offers benefits to market participants over the interest rate swaps market. This is mainly due to the futures exchange acting as a central counterparty to all trades and trading in the market being concentrated in only two contracts. By comparison, the interest rate swaps market is an over-the-counter (OTC) market with customised arrangements. Transacting in this market is relatively costly and participants need to manage counterparty risk and replacement-cost risk separately.[4] As a result, trading in the swaps market is generally limited to large financial institutions.

Measuring Liquidity

Liquidity is a difficult concept to define and therefore measure. In general terms, a liquid market is one where transactions can take place readily, with low transaction costs and with little impact on price.[5] In theory at least, liquidity in the Australian Treasury bond futures market, like other financial markets, can be described along three key dimensions: the speed at which trades can be executed; the transaction cost of trading a given size; and the size of a trade that can be arranged at a given cost.[6] In practice, however, these dimensions are difficult to measure directly. Instead, two broad categories of liquidity measures are constructed:

- trade-based measures, which include market turnover, trade size and the number of trades; and
- order-based measures, which use order books to assess bid-ask spreads and market depth.

4 Counterparty risk is the risk that the other party in an agreement will default, and replacement-cost risk is the risk that the original agreement may have to be replaced at current market prices. Recent developments have resulted in the majority of OTC derivatives being covered by collateral agreements that assist in the management of counterparty risk. For more information, see CFR (2011).

5 In this article we focus on transactional liquidity, as distinct from funding liquidity which is the ability of an intermediary to raise finance to fund its chosen set of assets. For details, see Stevens (2008).

6 For more information on the key dimensions of liquidity, see Harris (2003).

Traditionally, market analysts have used trade-based measures to assess liquidity in financial markets. These measures do not directly capture liquidity, but rather measure transactions in the market. Hence, order-based measures are used in conjunction with trade-based measures to provide a richer description of liquidity conditions in the market.

Calculating order-based measures is more complicated and data intensive than trade-based measures because data for the order book are required. The order book is a record of trade instructions (not transactions) that have been submitted to the exchange to trade a set number of securities at a specified price or better, but which have not yet been executed. In general, a trade takes place when an order is executed against an instruction to trade at the best price currently available.

To illustrate how order-based measures are calculated, an example of an order book for the Australian Treasury bond futures market is presented in Table 1.

From data in the table below, the following measures of liquidity can be calculated:[7]

- **The bid-ask spread** is the difference between the lowest price of the sell order (best ask-price) and the highest price of the bid order (best bid-price). Hence, the bid-ask spread in this example is 0.5 basis points (96.155 – 96.150).
- **Best depth** is the average of the volume (or notional value) available at the best bid-price and best ask-price. Best depth in this example is 75 contracts [(50 + 100)/2] or $7.5 million, for contracts of $100 000.
- **Total depth** is the average of the volume (or notional value) available at each bid-price and ask-price throughout the visible order book. Total depth in this example is 225 contracts [(250 + 200)/2] or $22.5 million, for contracts of $100 000.

Liquidity in the Australian Treasury Bond Futures Market

To examine liquidity in the Australian Treasury bond futures market, intraday data from the Thomson Reuters electronic trading platform is used.[8] The following analysis is based on data for the 10-year futures contract, although similar patterns are evident in the 3-year futures contract.

Table 1: Order Book Example

Buyers (Bid)		Sellers (Ask)	
Volume	Price[(a)]	Price[(a)]	Volume
50	96.150	96.155	100
100	96.145	96.160	40
30	96.140	96.165	40
20	96.135	96.170	15
50	96.130	96.175	5
250			**200**

(a) The futures price is quoted as 100 minus the yield to maturity expressed in per cent per annum
Source: RBA

7 This example only considers the order book at a specific point in time. These measures are usually averaged across a selected interval, such as 10 minutes throughout the trading day, and then averaged across the three months of the contract to obtain a single daily average measure for each quarter.

8 The data are supplied by the Securities Industry Research Centre of Asia-Pacific (SIRCA) on behalf of Thomson Reuters.

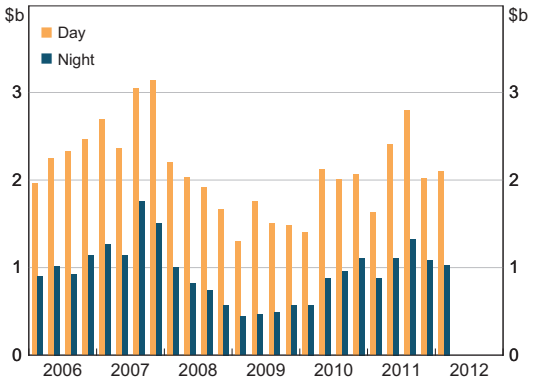
Trade-based measures

Broadly speaking, a higher turnover indicates a greater level of liquidity in the market. Nominal turnover in the day session of the 10-year futures market was $2.1 billion per day in the March quarter of 2012, averaging around twice that of the night session (Graph 2). By way of comparison, turnover in the Treasury bond futures market has averaged four times that of the ASX SPI 200 futures market in the past five years, consistent with relatively high levels of trading activity and liquidity in the Treasury bond futures market.[9] In general, turnover in both day and night sessions has followed similar patterns in the 10-year futures market, increasing in 2006 and 2007 before falling off significantly during the onset of the global financial crisis. Since its trough in early 2009, turnover has increased by around 60 per cent.

The level of turnover in the Treasury bond futures market has likely been influenced by the stock of physical Treasury bonds outstanding over time, although the nature of this interaction is not clear-cut. For instance, a low level of Treasury bonds outstanding may cause a higher level of futures turnover as market participants use the more liquid futures market to manage their exposures. Prior to the global financial crisis, the level of Treasury bonds outstanding was around $50 billion (4 per cent of GDP) and the market was seen as having relatively low liquidity, which may have increased futures market turnover. In contrast, the level of liquidity in the Treasury bonds market has improved more recently as the stock of outstanding securities has increased to around $200 billion (15 per cent of GDP), although this may have added to futures market activity as bond dealers have sought to manage larger inventories.

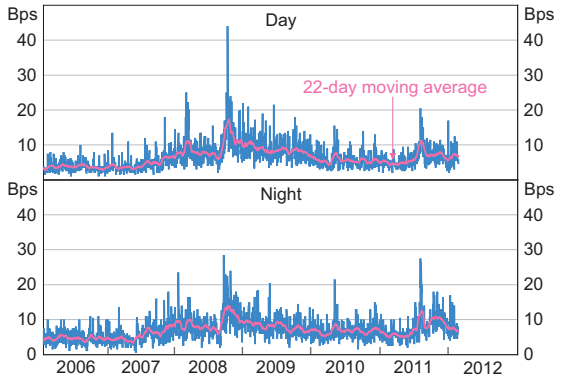
Although turnover data are a good starting point for assessing liquidity in a market, they can also reflect the influence of uncertainty rather than actual liquidity. The global financial crisis is a good example of increased uncertainty – price volatility in the Treasury bond futures market increased significantly at the onset of the crisis, with the intraday price range of the 10-year futures price roughly doubling between 2007 and 2008 (Graph 3). The precise interaction between volatility and turnover, however, is not clear, complicating a turnover-based analysis.[10] For example, increased uncertainty may lead traders to hedge their positions more frequently, causing a rise in turnover. On the other hand, elevated uncertainty

Graph 2
Nominal Turnover
10-year contract, face value, daily average



Sources: RBA; Thomson Reuters

Graph 3
Price Volatility
10-year contract, intraday price range



Sources: RBA; Thomson Reuters

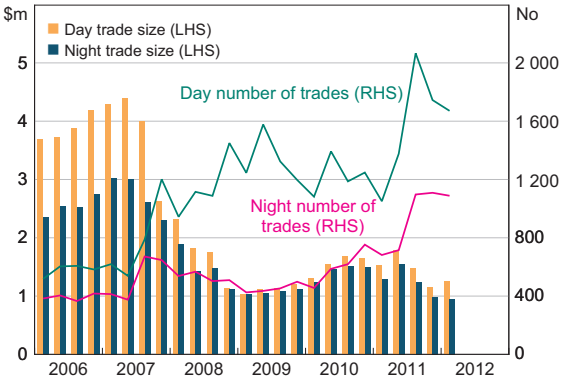
9 The ASX SPI 200 futures contract is the benchmark equity index futures contract for investors trading and managing risk in the Australian equity index market. Although turnover in this market is not directly comparable to the Treasury bond futures market, the level of turnover in the ASX SPI 200 futures market is widely considered to reflect a high level of liquidity. For details on turnover in the ASX SPI 200 futures market, see AFMA (2011).

10 For details on the relationship between volatility and derivatives turnover, see Jeanneau and Micu (2003).

may correspond with a decline in turnover due to higher risk exposures.

Disaggregating market turnover into trade size and the number of trades provides an insight into the reaction of market participants to increased volatility in the Treasury bond futures market. Over the past several years, trade size has followed a similar pattern to turnover, rising during 2006 and 2007, and falling during the global financial crisis, although by more than turnover (Graph 4). In contrast, the number of trades per day more than doubled for the day contracts during the global financial crisis. This suggests that market participants were managing their risk exposures and transaction costs more actively due to higher volatility during this period. By trading smaller parcels more frequently, traders may reduce both the risk of volatile prices moving against them and the impact their trades have on prices.

Graph 4
Trade Size and Number of Trades
10-year contract, daily average



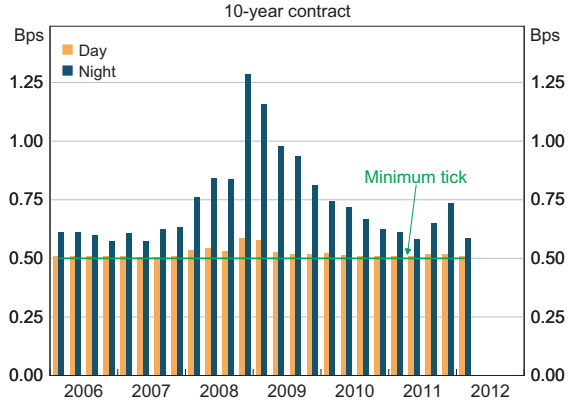
Sources: RBA; Thomson Reuters

Order-based measures

The second set of liquidity measures gives an indication of transaction costs. As discussed previously, the 'bid-ask spread' measures the difference at any point in time between the lowest price of a sell order and the highest price of the bid order in the market. A narrower bid-ask spread means that market participants can trade at a lower cost and implies a more liquid market.

An institutional feature of the 10-year futures market is that the ASX sets a 'minimum tick' of half a basis point (Graph 5).[11] During the day session of the 10-year futures market, the average bid-ask spread has rarely deviated from the minimum tick over the past several years suggesting that it has acted as a binding price floor (although it averaged marginally above the minimum tick in late 2008 and early 2009). The bid-ask spread in the night session is more indicative of liquidity conditions in the market, averaging around 0.6 basis points in 2006 and 2007 before doubling during the height of the global financial crisis. This highlights the greater liquidity in the day session relative to the night session, which is also implied by the trade-based measures.

Graph 5
Average Bid-ask Spread
10-year contract

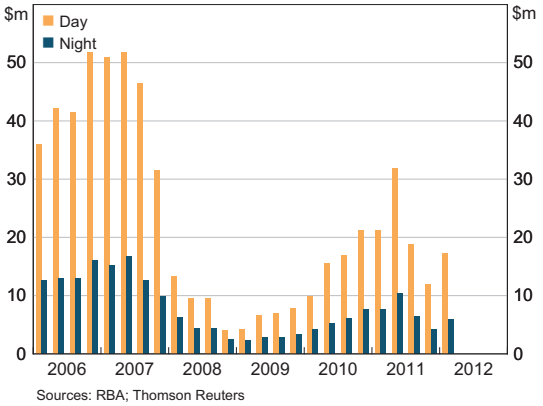


Sources: RBA; Thomson Reuters

A second order-based measure of liquidity is 'best depth', which indicates the size of a trade that can be carried out (as a single trade) without incurring a price impact. This is calculated as the average of the volume available at the best bid-price and best ask-price, with an increase in this average indicating a more liquid market. Again, according to this measure market liquidity improved over 2006 and 2007 and then declined significantly during the global financial crisis (Graph 6). Best depth in the 10-year futures

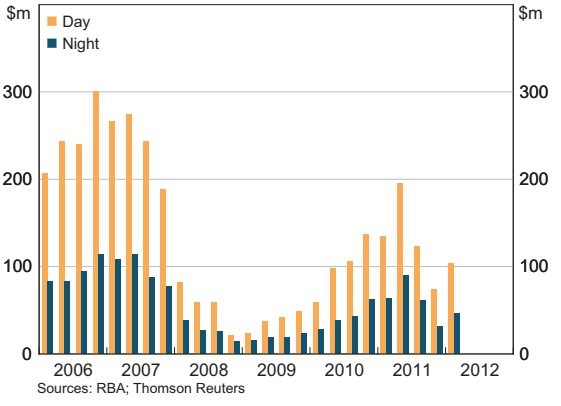
11 In contrast, the 3-year futures market has a minimum tick of one basis point. For details on the minimum tick, see Lepone and Flint (2010).

Graph 6
Average Best Depth
10-year contract, face value



Sources: RBA; Thomson Reuters

Graph 7
Average Total Depth
10-year contract, face value



Sources: RBA; Thomson Reuters

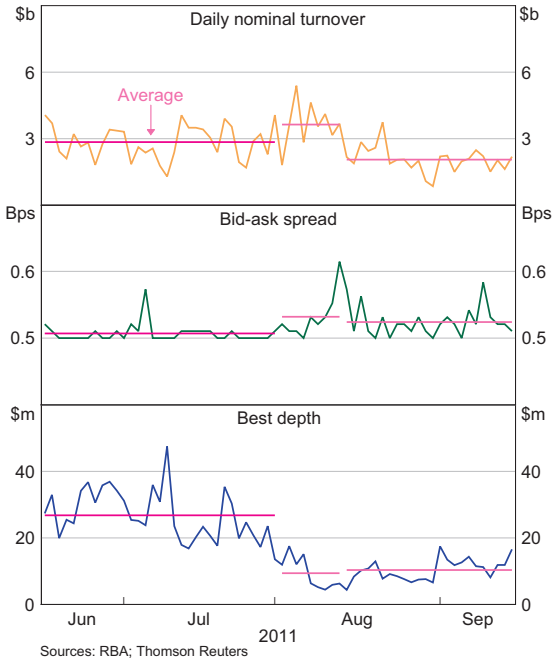
market fell from an average of around $45 million in the day session in 2007 to below $5 million in late 2008. This suggests that market participants were offering to trade a smaller number of contracts in the order book to minimise the increased risk associated with an adverse price movement in the market. Since the height of the global financial crisis, best depth in the 10-year market has increased, although it remains around a third of pre-crisis levels.

The bid-ask spread and best depth measures potentially understate the cost of large trades. Large trades may need to be transacted at prices beyond the best on offer in the visible order book and, as a result, their true cost will include a price impact. 'Total depth' attempts to take the price impact into account by measuring the average volume available at each bid-price and ask-price throughout the visible order book. This measure shows similar patterns to the other measures of liquidity, with the decline in total depth being similar to the decline in best depth during the global financial crisis (Graph 7). The reduction in total depth further suggests that investors were attempting to minimise risk as explained above. In addition, there was a larger effect on prices associated with trading large orders during this period. For the March quarter of 2012, the visible order book had a total depth of around $110 million for the day session and $50 million for the night session, approximately six and eight times greater than best depth, respectively.

The Relationship Between Trade- and Order-based Measures

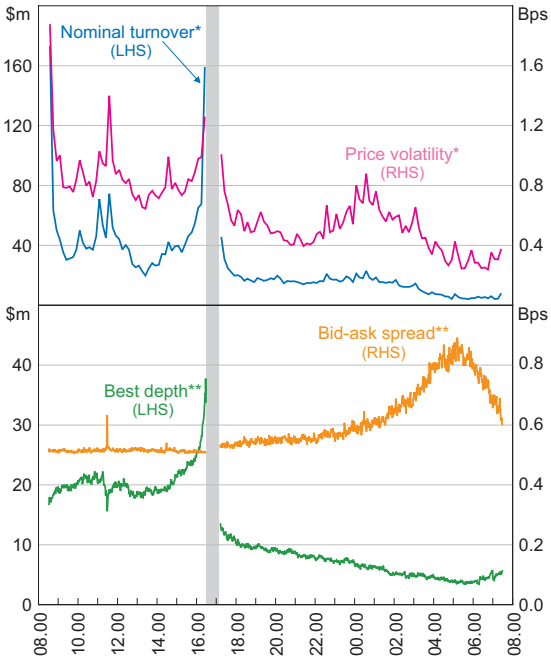
While for the most part, trade- and order-based measures provide similar conclusions about market liquidity in the Australian Treasury bond futures market, they can provide contrary results during periods of market stress. The heightened uncertainty surrounding European sovereign debt concerns and the credit rating downgrade of the United States at the beginning of August 2011 provides an illustrative example. As shown in Graph 8, during this period, trade-based measures of liquidity (daily turnover) increased while order-based measures deteriorated (bid-ask spreads widened and best depth declined). This highlights the risk of relying solely on trade-based measures to assess market liquidity – during this period the increase in trading was likely to have been the result of traders responding to new information, notwithstanding the higher cost and greater price impact of trades at such times (as implied by the wider bid-ask spreads and lower best depth).

Graph 8
Treasury Bond Futures Liquidity
10-year day contract



Sources: RBA; Thomson Reuters

Graph 9
Intraday Liquidity
10-year contract, average from 15 December 2010 to 15 March 2012



* Measured at 10-minute intervals, AEST adjusted for daylight saving
** Measured at 1-minute intervals, AEST adjusted for daylight saving
Sources: RBA; Thomson Reuters

Intraday Liquidity in the Futures Market

Liquidity is not evenly distributed throughout the trading day, but can be concentrated around certain times. Analysis of liquidity indicators on an intraday basis provides insights into the periods during each trading session when most market activity occurs. Intraday measures of liquidity can also shed light on market participants' behaviour around the release of economic data or financial news.

As shown previously, liquidity during the day session is consistently higher than the night session across all measures: intraday turnover and best depth are higher, and bid-ask spreads are lower (Graph 9). The average level of turnover and volatility are at their highest at the opening of the day session. This likely reflects the fact that at this time of day market participants are adjusting their positions in response to developments overnight and incorporating price sensitive information that the night session might not have fully captured. It also reflects trades conducted to rebalance portfolios at the opening of the market associated with replicating benchmarks. Turnover and volatility also peak towards the close of the day session, which reflects, among other things, market participants closing positions to avoid unwanted price exposures in the overnight session. Despite the market being open for nearly 24 hours a day, these intraday patterns of liquidity suggest that specialist knowledge is relatively concentrated among active traders in the day session, rather than in the night session.

Liquidity is also affected by the dissemination of economic data and financial news. This is most evident at 11.30 am Australian Eastern Standard Time (AEST) when the Australian Bureau of Statistics regularly publishes economic and financial data.

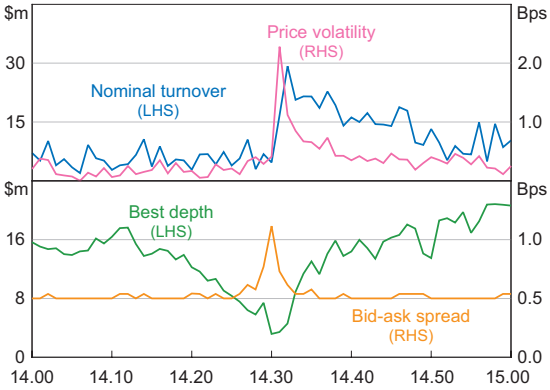
In the few minutes prior to the release of data, there is a fall in best depth and an increase in the bid-ask spread as fewer orders are offered by market participants in the order book. This reflects the uncertainty about the data release – market participants attempt to avoid taking an open position into the announcement to minimise the risk associated with any adverse effect that the new information may have on prices – and therefore the market becomes less liquid. In the few minutes following the news, best depth in the market increases to average levels and the bid-ask spread returns to the price floor set by the minimum tick. Following the release of data, there is also a sharp increase in turnover and volatility, reflecting trading based on the new information. This sharp increase in market activity typically only lasts for a few minutes following the release of data, suggesting that prices adjust quickly to new information.

Similar intraday spikes in liquidity occur periodically at 11.00 am AEST and 2.30 pm AEST. These times correspond to the announcements of the Australian Treasury Bond tender results by the Australian Office of Financial Management and the monthly announcement of the Reserve Bank's monetary policy decision, respectively. The impact of the Reserve Bank's monetary policy decision on liquidity is particularly strong, although this depends upon the degree of uncertainty regarding the announcement. On average, bid-ask spreads widen to 1.1 basis points and best depth declines to around $3 million in the minutes prior to the announcement (Graph 10). Following the announcement, there is an immediate fall in the bid-ask spread and best depth recovers to around average levels before 2.40 pm AEST. There is also a sharp increase in turnover and volatility immediately following the announcement, but they gradually return to more normal levels by 3.00 pm AEST.

Graph 10

Intraday Liquidity around Monetary Policy Annoucements*

10-year contract, average from 1 February 2011 to 6 March 2012



* Measured at 1-minute intervals, AEST adjusted for daylight saving

Sources: RBA; Thomson Reuters

Summary

Liquidity in the Australian Treasury bond futures market is important as it allows market participants to hedge or gain interest rate exposures efficiently. It supports the functioning of other Australian financial markets by helping to provide an indication of the medium- to long-term 'risk-free' interest rate. Although market liquidity is a difficult concept to define and measure, available indicators suggest that in general, liquidity in the market is high. However, liquidity did deteriorate during the global financial crisis as market participants reacted to heightened uncertainty and volatility by reducing the size of trades and best depth, and by widening bid-ask spreads. More recently, these indicators suggest that liquidity in the market has recovered from the relatively low levels reached during the global financial crisis. In terms of intraday liquidity, various measures indicate that the market is most liquid at the open and close of the day session, and respond to economic and financial news in expected ways – liquidity declines immediately before data releases due to uncertainty and then increases as the market prices in the new information.

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