Government Bond Market Functioning and COVID-19

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Photo: bunhill – Getty Images

Abstract

The market for Australian Government Securities is a critical fixed income market in Australia, including because it serves as a pricing benchmark for many other interest rates in the economy. The extreme economic and financial uncertainty caused by the onset of the COVID-19 pandemic led to this market becoming dysfunctional, with investors unable to transact in reasonable size. In response to the pandemic, on 19 March 2020 the Reserve Bank announced a number of new policy measures, which, among other things, have been successful in restoring the functioning of government bond markets. This article discusses various measures of market functioning, their deterioration, and subsequent improvement.

Introduction

The outbreak of COVID-19 in many countries – and the associated adoption of measures to reduce the spread of the virus – had a significant effect on the outlook for economic activity and global financial markets.[1] In particular, the growing realisation that COVID-19 would not be confined to just a handful of countries, and that the economic costs would be severe, saw the value of financial assets, including equities, decline sharply in Australia and around the world in late February and through March, and volatility in financial markets rise sharply. These price falls and the spike in volatility were also accompanied by periods of dysfunction in a number of financial markets, both in Australia and overseas.[2]

On 19 March – and as flagged three days earlier on 16 March – the Reserve Bank Board announced a package of policy measures aimed at reducing the economic and financial disruption associated with the pandemic (RBA 2020a, RBA 2020b). This article discusses how functioning in the government bond market – the benchmark fixed income market in Australia and a key market for the transmission of

monetary policy – as well as in the semi-government bond market, was impaired during the initial phase of the crisis, and how the Bank's policy measures helped to address this dysfunction.

Market functioning in the government bond market deteriorated through March

In late February, concerns about the global spread of COVID-19 and the associated economic costs escalated. This led to falls in the value of risky assets, such as shares, and broad-based demand for risk-free assets. Risk-free assets – that is, bonds issued by highly rated governments – have historically increased in value during periods of heightened economic uncertainty, and this happened initially as COVID-19 concerns grew: the yields on Australian Government Securities (AGS) declined to record lows, with similar moves in many other advanced economy government bond markets (Graph 1).

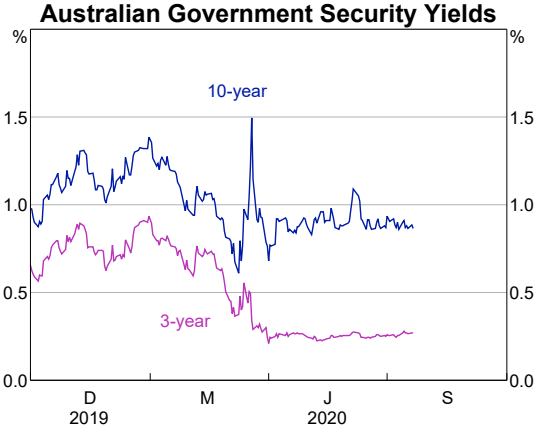
However, this typical response of a fall in yield (that is, increase in price) of government bonds in response to a deteriorating economic outlook soon gave way to an unexpected sharp rise in yields (fall in prices). The fall in risky asset prices, and the dramatic increase in economic uncertainty that drove it, led to a sharp increase in volatility as a range of investors needed to raise cash to reduce leverage, meet margin calls, and meet redemptions (Graph 2). Many investors chose to sell government bonds to do this because they are relatively liquid. Government bonds can typically be sold in size without adversely moving the price; this is something that is not true of many other asset classes. Among those selling government bonds to raise cash were portfolio managers – both domestic and foreign – who needed to meet redemption requests and margin calls, and foreign central banks. There were also sales by investors who had purchased government bonds using substantial leverage in order to profit from small differences in price between otherwise similar bonds, or between bonds and the futures contracts that were tied to them, and who saw their trades move against them and/or faced margin calls due to the heightened volatility. The large increase in uncertainty around future government bond issuance may also have contributed to the rise in volatility and yields.

Bond dealers initially absorbed sales of government bonds, but their capacity to undertake further trades and assist the process of price discovery deteriorated as their own balance sheets began to run up against internal and regulatory risk limits, contributing to volatility and impaired market liquidity. In response to limited balance sheet space, dealers widened their bid-offer spreads (or opted not to quote prices), which contributed to an increase in the cost of transacting in these critical markets (Graph 3). Work-from-home arrangements were also reported to have reduced the ability of some investors who typically buy AGS to transact, which further reduced trading activity.

As noted, dysfunction in the government bond market was in part driven by leveraged investors – with positions based on small pricing anomalies – unwinding their positions in a hurry. A common

Graph 1

Australian Government Security Yields

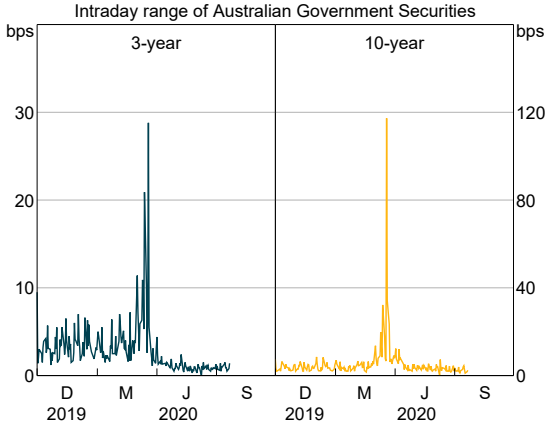


Source: Yieldbroker

Graph 2

Bond Volatility

Intraday range of Australian Government Securities



Sources: Bloomberg; RBA

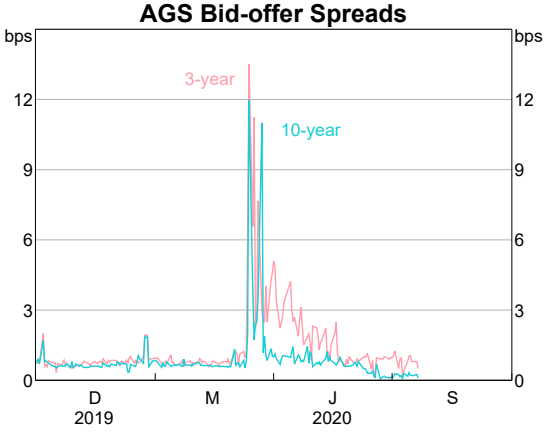
strategy, known as relative value trading, relies on buying government bonds that appear 'cheap' relative to otherwise similar bonds and selling those that appear 'expensive'. Over time, these investors expect such a strategy to make money, and their activities can aid the functioning of the government bond market by helping to remove pricing anomalies. During times of stress, however, certain government bonds – for example those that have most recently been issued, and those that are referenced by futures contracts – tend to be more liquid, and therefore in greater demand, than otherwise similar bonds. This can lead to the yields of similar bonds diverging, and relative value strategies losing money. One way to measure the extent of pricing anomalies is to fit an estimated smooth yield curve to government bond yields, and examine the fitting errors: small errors suggest that a simple, smooth curve captures most of the variation seen in yields; conversely, larger fitting errors suggest that there are significant variations in yield between otherwise similar bonds which are not being arbitraged away. Applying this technique to the recent episode confirms the picture of market dysfunction: the root mean squared error (RMSE) from fitting a yield curve to AGS spiked to around 3½ basis points late in March after averaging ½ to 1 basis point over 2019 and early 2020, suggesting a large temporary increase in pricing anomalies in March (Graph 4; see Box A for further discussion on yield curve fitting errors as a measure of market function).

A deterioration in market functioning also occurred in the bond futures market …

An important market closely related to the government bond market is the bond futures market. The payoff of a bond futures contract is linked to the average yield on a basket of underlying AGS, and so bond futures can be used to hedge (or take on) the interest rate risk associated with government bonds. Bond futures allow investors to take on a relatively large position for a relatively small initial outlay. They are also exchange traded, and so are typically more liquid than AGS. Nonetheless, as volatility rose sharply, liquidity providers withdrew from the bond futures market and the ability to trade in futures without moving prices deteriorated significantly. One measure of futures market function is the number of contracts that can be bought or sold at the best available price – the lower the number of 'top-of-book' futures contacts available to trade, the smaller the trade that can be executed without adversely moving the price. As market conditions deteriorated over March, this measure of market function fell significantly, with the average number of best bid or best offer futures contracts available for the 3-year contract at one point lower by 85 per cent compared with the level earlier in the year. The decline in this measure for the 10-year contract was even more pronounced, at 95 per cent (Graph 5).[3] (The subsequent sharp increase in market depth for the 3-year contract relates to the Bank's 3-year yield target, as described further below).

Graph 3

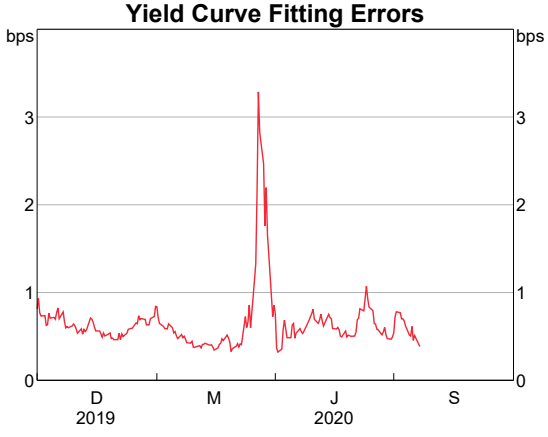
AGS Bid-offer Spreads



Sources: RBA; Yieldbroker

Graph 4

Yield Curve Fitting Errors



Sources: Bloomberg; RBA

While the value of a futures contract is tied to that of the underlying basket of bonds at futures expiry, there is no automatic mechanism to keep futures prices in line with bond prices prior to expiry. Instead, this is achieved by investors acting on any arbitrage opportunities that emerge due to prices being misaligned, and trading to remove these (and make a profit in the process). This strategy is known as bond-futures basis trading, and, in normal times, it keeps bond and futures prices within a basis point or so of each other (the difference between the futures contract yield and the yield of the underlying bonds is known as the 'basis'). As with relative value strategies, bond-futures basis trading typically relies on significant leverage and, as the government bond market became dislocated, basis traders' positions moved against them and they were forced to unwind trades. This led to bond and futures prices diverging, and basis trades incurring losses (Graph 6 and Graph 7).[4] See Box B for a further discussion of basis trading, and Schrimpf, Shin and Sushko (2020) for a discussion of similar events in the US Treasury market.

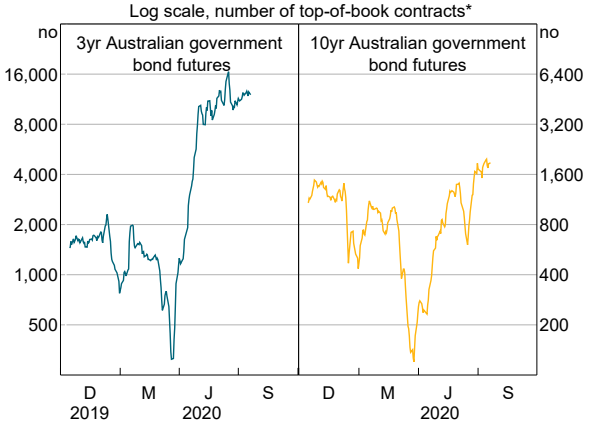
… and in other key Australian fixed income markets

Semi-government securities – that is, bonds issued by Australian state and territory central borrowing authorities, and known as semis – are also considered to be high-quality liquid assets (Bergmann, Connolly and Muscatello, 2019), although the semis market is not as large or liquid as the AGS market. As with AGS, market function in the semis market deteriorated significantly over March. This was driven by the need of some investors to raise cash to reduce leverage or meet redemption flows, by a reduction in demand as heightened volatility saw some investors tighten their risk limits around semi holdings, and by the inability of bond dealers to absorb large, one-sided flows. Expectations that the states and territories would need to increase debt issuance also contributed to the imbalance of supply and demand. Similar to AGS, dealers responded to the mismatch between sellers and buyers by widening their bid-offer spreads dramatically: wider spreads discourage some counterparties from selling bonds given the higher costs involved, and also give dealers more financial buffer to on-sell the bonds (Graph 8).[5] The result of the wider bid-offer spreads was a fall in trading activity as investors became

Graph 5

Futures Market Depth

Log scale, number of top-of-book contracts*

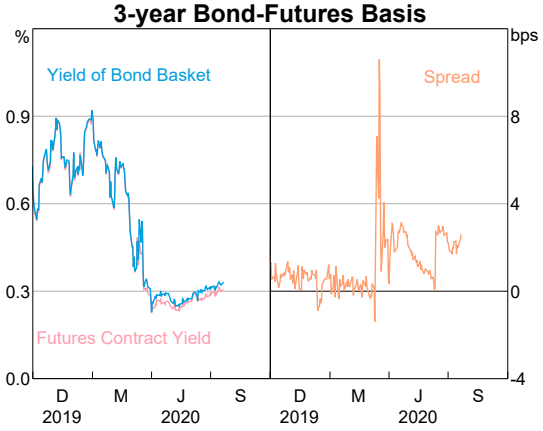


* 5 day moving average

Sources: Bloomberg; RBA

Graph 6

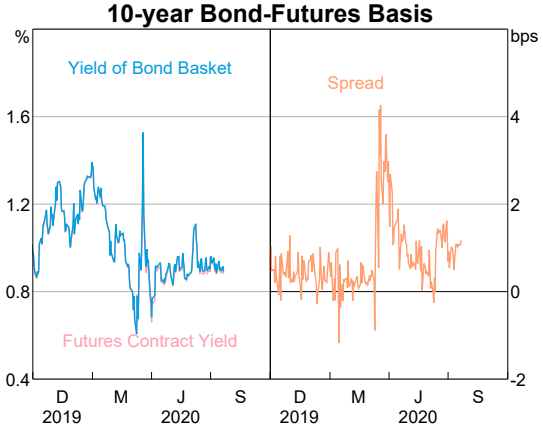
3-year Bond-Futures Basis



Sources: RBA; Thomson Reuters

Graph 7

10-year Bond-Futures Basis



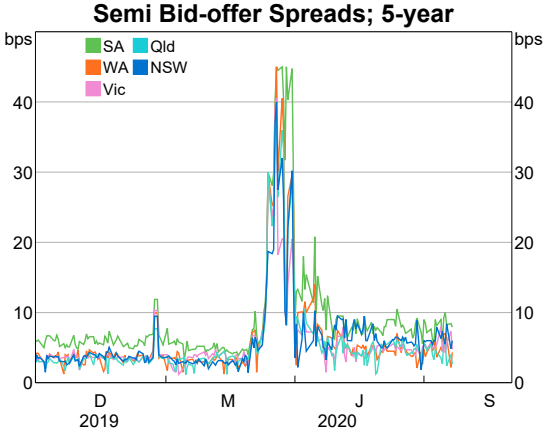
Sources: RBA; Thomson Reuters

hesitant to transact in illiquid conditions, despite their ongoing need to sell. Dealers were also hesitant to tighten their bid-offer spreads after selling subsided, as they feared renewed selling once liquidity conditions improved.

In addition to wider bid-offer spreads, the difference in yield between semis and AGS widened dramatically over March, albeit to levels that were not out of line with historical norms (Graph 9). The widening in yield spreads appears to have reflected the more marked deterioration in semi market liquidity and the lesser ability of the semis market to absorb supply of bonds, relative to AGS, rather than credit risk concerns.

Graph 8

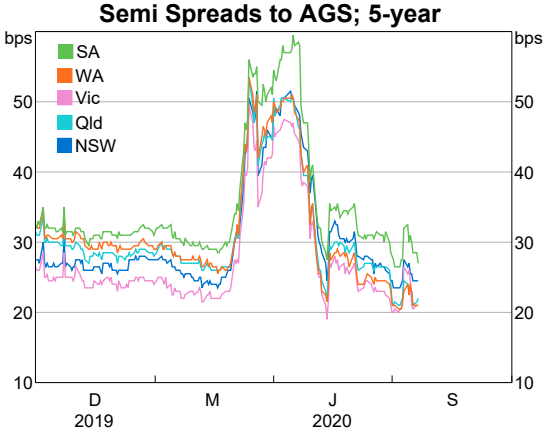
Semi Bid-offer Spreads; 5-year



Sources: RBA; Yieldbroker

Graph 9

Semi Spreads to AGS; 5-year



Sources: RBA; Thomson Reuters

The Reserve Bank announced a range of policy measures …

Given the critical role that risk-free government bond yields play as financial benchmarks, the stress in these markets in early March was transmitted to markets for other financial securities, and contributed to a general tightening in financial conditions.

In response to this and to the deteriorating economic outlook more generally, on 19 March the Reserve Bank announced a package of policy measures to support the Australian economy, aimed at lowering funding costs across the economy and supporting the provision of credit. This package also included measures to address the significant dislocation in government bond markets. Next to other policy measures, the Bank announced that it would purchase government bonds across a range of maturities in secondary markets to achieve a yield target of 0.25 per cent for 3-year AGS and to address market dysfunction.

The Reserve Bank commenced government bond purchases on 20 March, buying $5 billion face value of AGS with between 2 and 8 years residual maturity. Bond purchases were initially daily, and remained so until late April, although they were reduced in size in response to improved market functioning. The Bank also purchased semis once a week to assist market functioning. The first day the Bank chose not to conduct a purchase operation was on 24 April, and purchases have become less frequent, and smaller, since then.[6]

… which contributed to a substantial improvement in market functioning

The policy actions taken by the Reserve Bank, together with a broader lessening in the extreme economic and financial uncertainty present at the beginning of the crisis, resulted in market functioning improving significantly over late March and through April. Subsequently, market functioning returned to be close to pre-crisis levels.

The extreme volatility seen in financial markets reduced rapidly, with actions taken by the Reserve Bank and other central banks helping to reassure market participants that authorities would not allow

important markets to remain dysfunctional. In Australia, this reduction in volatility was especially marked for AGS with maturities of around 3 years, with the Reserve Bank's target for the 3-year AGS yield of around 0.25 per cent serving as a strong anchor (Graphs 1 and 2). The reduction in volatility, in turn, contributed to an improvement in market functioning. This is particularly evident in 3-year futures market depth (Graph 5), where the number of contracts available to buy or sell at the best price increased to be well above pre-crisis levels: market participants, knowing that the Reserve Bank would act to keep 3-year yields close to 0.25 per cent, became confident to trade in large size at that level given the price was unlikely to move against them.[7] In contrast, the reduction in volatility for longer-dated yields was less marked, and the 10-year futures contract took a little longer to regain pre-crisis levels of liquidity.

AGS bid-offer spreads also fell rapidly over late March, although did not return to pre-crisis levels until around May (Graph 3). While market functioning improved over late March, bond dealers were still left with greater-than-usual stocks of government bonds, as traditional buyers were slow to return to the market and significant client demand to sell bonds to raise funds remained for some time. It took a while for these imbalances to unwind, with the Reserve Bank's bond purchases a significant contributor to the improvement.

The bond-futures basis fell from its extremes relatively quickly, although has remained above pre-crisis levels (Graphs 6 and 7). Here, financial market participants whose trades previously kept the basis narrow may have reassessed the risks inherent in the trading strategy and increased their required returns.

Conditions in semis markets took a little longer to improve, although bid-offer spreads again returned to be close to pre-crisis levels within a few months (Graph 8). This reflects the fact that dealers allocate a smaller share of their balance sheet to semis relative to AGS, which limits their ability to absorb sizable buy or sell orders without having to widen spreads. Market liaison also suggests that investors' investment allocation decisions can be slower for semis compared with AGS, leading to a slower normalisation in market conditions.

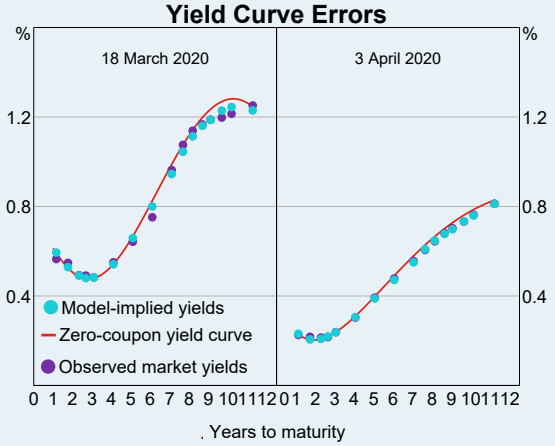
Box A – Yield Curve Fitting Errors as a Measure of Market Function

A bond can be seen as series of cash flow payments, comprising regular coupon payments over the life of the bond and a larger payment – the principal – at bond maturity. The price of the bond represents the value an investor receives from each of those payments, appropriately discounted. As the payments occur at different times, the appropriate discount rate for each payment will in general vary; near-term payments are typically discounted using a lower yield, and more distant payments are typically discounted using a higher yield. This is because, in general, investors prefer to receive money sooner rather than later, and so demand a higher return for having to wait longer. The overall yield of all payments taken together – that is, the yield of the bond – is a weighted average of the yields applying to each payment, with weight approximately equal to the size of the payment.

Thinking about bond yields in this way is useful as it allows the yields of different bonds to be compared in a consistent way. Bond yields observed in the market can be used to estimate an underlying 'zero-coupon' yield curve – that is, a yield curve that would apply to individual payments. The estimated curve can then be used to price each payment in a bond, calculate what the yield of each bond 'should' be, and see if any bonds appear cheap or expensive relative to other bonds with similar maturities.[8]

In a well-functioning market, observed bond yields would be expected to be close to those implied by an estimated zero-coupon yield curve. If this were not the case, it would imply that similar payments were being valued differently in different bonds, whereas arbitrage should prevent this from happening. Conversely, large discrepancies between observed yields and those implied by a fitted zero-coupon yield curve would suggest that some bonds are being mispriced, and that market participants are not taking advantage of arbitrage opportunities arising from the mispricing (and, through trading, reducing the pricing differences).

Graph A1
Yield Curve Errors



Graph A1 demonstrates this: the red lines represent fitted zero-coupon yield curves as at 18 March and 3 April, the purple dots are closing bond yields observed in the market, and the light blue dots are bond yields as implied by the fitted zero-coupon yield curves. On 18 March the difference between the observed and fitted yields (the purple and light blue dots) of some bonds was relatively large, with an RMSE of around 2 basis points. Conversely, on 3 April yield discrepancies had declined substantially, and the RMSE had fallen to less than ½ basis point.

More generally, large discrepancies between observed market yields and yields fitted from an estimated zero-coupon yield curve are indicative of bonds being mispriced, while small errors are suggestive of a well-functioning market.

Box B – The Bond-Futures Basis

Bond-futures basis trading is an arbitrage trade that involves taking offsetting positions in a bond futures contract and the physical bonds that underlie the same contract when their prices are misaligned (after accounting for the cost of financing the bonds).[9] The price of physical bonds often trades a little below the price implied from futures contracts, although it tends to converge to zero as the futures contract approaches expiry (discussed further below). Given this, basis trades in Australia typically involve buying physical bonds and selling the futures contracts, with the long bond position financed in the repo market. At expiry of the futures contract, these trades are reversed. With the basis typically small, investors generally look to increase their profit from a basis trade through leverage; for example, market participants can typically borrow in the order of 99 dollars for every 100 dollars of AGS collateral that they pledge in a repo. Participants in a basis trade only need a small capital outlay to hold a significant position.

Basis trading can deliver a steady stream of returns for investors when volatility is low. However, if market conditions force the trades to be unwound (to cover margin payments, for example, during periods of heightened volatility), the resulting flows can lead to significant losses and exacerbate mispricing, with bond and futures prices diverging significantly.

We measure the basis – defined as the theoretical average forward yield of the bond basket less the observed futures yield – as per Frino, He and Lepone (2014), and adjust for any coupons paid and for the cost of financing the bonds via repo. Most input data are readily observable in the market, with traded repo rates the main exception. For these we interpolate using repo rates from the Reserve Bank's daily open market operations, or, if there are no data, we interpolate the overnight indexed swap rate (adjusted for the appropriate spread); note, however, that the actual funding rate that leveraged investors can obtain may be different.

Moves in the basis

As the economic outlook worsened dramatically and volatility increased through early March, AGS yields declined less rapidly than those implied by futures contracts. That is, bond prices fell relative to futures prices, which is likely to have reflected relatively poorer liquidity and higher bid-offer spreads in the bond market. Leveraged investors, whose trades were designed to profit from the opposite happening, experienced significant mark-to-market losses. Some were forced to unwind their positions either to meet margin calls or to fulfil internal risk limits, putting further pressure on an already dysfunctional market and starting a spiral whereby a higher basis led to an even higher basis. Ultimately, the 3-year basis widened from one basis point to around 11 basis points, while the 10-year basis reached around 4 basis points.[10]

Participants who may have wanted to exploit the rise in the basis faced considerable risks: liquidity in both the futures and AGS markets deteriorated significantly over March and bid-offer spreads widened; and, while the basis was very attractive, it could have widened even further, resulting in losses for any new arbitrage trades. Counterparty liaison suggests the Bank's purchases of AGS, and the subsequent improvement in liquidity conditions and bid-offer spreads, contributed to the subsequent reduction in the basis.

Although usually small, the basis is, on average, positive rather than hovering around zero. There are a few reasons for this. First, there is some risk in obtaining and rolling repo funding, which leveraged investors must do to take advantage of these arbitrage opportunities. Second, even a well-executed trade held to expiry is not risk free, since futures are an imperfect hedge for the underlying bonds (in other jurisdictions,

the cheapest-to-deliver bond from the deliverable basket can be used to satisfy the short futures position at contract expiry; in Australia, bond futures are settled using a cash payment based on the price of a hypothetical bond with a 6 per cent coupon and yield equal to the average yield of the bonds in the basket). Third, in times of market volatility, other impediments including execution risk and mark-to-market risk manifest, and investors demand compensation for this.

Footnotes

[*] The authors are from Domestic Markets Department and would like to thank Matt Boge, Guy Debelle, Chris Kent, Marion Kohler, David Olivan, Carl Schwartz, and the members of Market Operations for their help with this article.

[1] See RBA (2020c) and Debelle 2020 for further discussion of the economic and financial market consequences of COVID-19, and the Reserve Bank's response.

[2] While there is no single definition, or measure, of 'market dysfunction', BIS (2019) notes that a well-functioning market 'allows timely, efficient market access to participants who wish to trade, obtain funding or invest, and it creates price signals that reflect fundamentals'.

[3] Futures contracts are most actively traded for the three months immediately prior to their expiry, with trading volume moving to the next contract over the final few days of this period; market depth typically falls around this time. The period of peak market dysfunction coincided with this changeover from one futures contract to the next, when futures market depth tends to dip, although the fall in market depth was much more pronounced than is typical.

[4] Note that the reduction in the basis over June is related to the approaching expiry of the June futures contract. Once trading moves to the next contract, this forced equalisation in yields breaks down and the basis can re-widen.

[5] Bond market makers aim to profit by selling bonds for a little more than they bought them for, and vice versa, after accounting for any hedges that they have in place to minimise their exposure to changes in the overall level of yields. This difference in selling versus buying price is captured by the bid-offer spread. If market makers are confident that they can quickly sell a bond that they have purchased, they can offer a relatively tight bid-offer spread with confidence, whereas if they might have to hold the bond for a substantial period of time, they need to quote a wider bid-offer spread to cover the costs of holding the bond and to insure themselves against adverse price movements.

[6] See Kent (2020) for further discussion of the Bank's bond purchase operations.

[7] Note that the Reserve Bank's package of policy measures, including the 3-year yield target, were aimed at supporting the economy by keeping borrowing costs low and credit available, with the sharp reduction in volatility for AGS with maturities of around 3 years a by-product of this.

[8] There are a number of different ways to estimate a zero-coupon yield curve, which give slightly differing results. As we are primarily interested in fitting errors, however, the exact method is less important, since, all else being equal, fitting errors will tend to increase as bond yields become more misaligned. In this article we use the method outlined in Appendix A of Finlay and Chambers (2008) and restrict our analysis to bonds with residual maturity between 1 and 12 years; as noted by Debelle (2020), longer tenor nominal bonds (and inflation-linked bonds) play a less important role as pricing benchmarks than do nominal bonds with tenors up to around 10 years, and few other financial instruments price off them.

[9] A bond futures contract gives investors exposure to changes in bond prices for minimal initial outlay; while the futures price is set by supply and demand over the life of the contract, the final settlement value is based on the average yield of a pre-specified basket of bonds, and so, in principle, the yield before maturity should be closely tied to the yields of the bonds in the basket. See also Cheung (2014).

[10] We discuss the basis in terms of yield for convenience, but futures contracts are traded and margined in terms of price; given its longer duration, a 4 basis point basis on the 10-year contract is roughly equivalent, in dollar terms, to a 12 basis point basis on the 3-year contract.

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