Do the Basel III bail-in rules increase investors' incentives to monitor banking risks?

Evidence from the subordinated debt market

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Abstract

This study examines the extent to which a bail-in risk premium is embedded in the credit spreads of bank subordinated debt securities issued with a discretionary point of non-viability trigger mechanism under the Basel III rules. Using monthly credit spreads of subordinated bonds issued by Australian banks and traded in the secondary market from 2013 to 2017, the results suggest that the Basel III point of non-viability trigger mechanism is assessed by investors when they price the subordinated debt securities issued by banks. The average bail-in risk premium is estimated to be approximately 73 basis points for fixed-rate subordinated bonds and 45 basis points for floating-rate subordinated bonds relative to old-style subordinated bonds without the bail-in mechanism. In addition, this study finds the pricing of Basel III bail-in subordinated debt has become more sensitive to bank-specific risk, as captured by market-based risk measures, than the old-style subordinated debt securities.

JEL classification: G21, G28

Keywords: Commercial banks, Bank regulation, Point of non-viability, Subordinated debt

1 Introduction

One objective of promoting market discipline in the banking industry is to engage private investors (including a bank's existing security holders) as monitoring agents, to mitigate excessive risk-taking behaviour brought about by industry safety nets (Flannery & Bliss 2019). The intention is that the monitoring provided by market investors will complement the monitoring provided by official supervisory agencies. The Basel Committee on Banking Supervision introduced Pillar 3 as part of the Basel II framework to embrace the idea of market discipline and to ensure that banks disclose sufficient information for their security investors to assess the bank's financial condition and risk profile (Bank for International Settlements 2006). Existing research on the role of private investors in exerting market discipline through monitoring bank risks and influencing banks' behaviour, has focused on subordinated debt holders and uninsured depositors (Goldberg & Hudgins 2002, Hannan & Hanweck 1988, Krishnan, Ritchken & Thomson 2005, Flannery & Sorescu 1996, Nguyen 2013). As creditors of banks, these investors bear the downside risks of bank default without benefiting from the potential upside gains from the risky activities banks undertake, which makes them less likely to support a bank's high-risk activities than ordinary shareholders. If market discipline works effectively, the prices of a bank's securities, especially its debt instruments, will fall if there is an increase in the bank's probability of failure. The fall in security values would provide an indication to official supervisors and market investors alike that they need to pay more attention to the target bank.

With increases in deposit insurance coverage in many jurisdictions since the 1990s, a greater reliance has been placed on subordinated debt investors monitoring and pricing bank risks. Results of research on market discipline in the 1990s are broadly consistent with the presence of market monitoring of banking risks; however, it also shows that the credit spreads on subordinated debt are not responsive to changes in default risk for all banks in all time periods (Kwast, Covitz, Hancock, Houpt, Adkins, Barger, Bouchard, Connolly, Brady, English & Evanoff 1999, Flannery & Sorescu 1996). In the lead-up to the 2007-2009 financial crisis, subordinated debt prices did not reflect the risks building up in banks and the financial system. The crisis also demonstrated an additional drawback of conventional subordinated debt: banks must go through a formal bankruptcy process for losses to be imposed on subordinated debt holders. In many countries, governments intervened to recapitalise banks and provide extraordinary liquidity support before losses were imposed on subordinated debt holders. These actions exposed taxpayers to potential future losses and have exacerbated moral hazard problems in the banking industry (Noss & Sowerbutts 2012, Acharya, Anginer & Warburton 2016). The limitations of bank capital regulation in addressing the distortions in investor incentives to monitor banking risks have stimulated policy debate about new mechanisms to complement capital requirements. Policy-makers are concerned about improving the efficiency of capital instruments in providing investor exposure to banking risks and improving banks' loss-absorbing capacity.

As part of the Basel III capital reforms, new loss absorption requirements for tier 2 capital instruments have been introduced to help resolve failed banks before formal bankruptcy proceedings are initiated.[1] These capital instruments must have principal loss absorption through either conversion to common shares or have their principal value written down when a bank is assessed to be non-viable (Bank for International Settlements 2010). A newly designed discretionary point of non-viability trigger is required for subordinated debt securities to qualify as tier 2 capital under the Basel III rules. Domestic supervisors have full discretion to decide whether a bank is non-viable based on their review of the financial condition and risk profile of the bank. In circumstances where the trigger is activated, the tier 2 capital instrument provides additional loss-absorbing capacity for the bank. This loss absorption feature is designed to facilitate the bail-in of junior creditors when a bank is non-viable before capital needs to be injected from the public sector; thereby minimising the exposure of taxpayers to failed banks. The new trigger mechanism is designed to improve the resolvability of banks and provide investors with limited liability for losses incurred through banks' risk-taking activities. The Australian banking regulator implemented the Basel III capital reforms from 1 January 2013, and Australian banks are transitioning to the new loss absorbency requirements over a ten-year phase-in period from 1 January 2013 to 1 January 2023. During the transition phase, subordinated debt securities with the new point of non-viability trigger trade concurrently in the secondary market with old-style subordinated debt securities without the trigger. This provides an appropriate experimental environment to test whether investors price the Basel III loss absorption feature when they transact the securities in the secondary market.

[1] Tier 2 capital includes other components of capital that, to varying degrees, fall short of the quality of tier 1 capital but nonetheless contribute to the overall strength of a bank and its capacity to absorb losses.

Since the new loss absorption feature potentially increases the exposure of subordinated debt investors to banking losses, it is expected that investors would demand an additional risk premium to hold the securities. If this is the case, there will be a positive difference between the credit spreads of the new-style subordinated debt securities issued with the loss absorption feature and the credit spreads of the conventional subordinated debt securities, i.e. those issued under the Basel I and Basel II regimes. As the majority of subordinated debt investors are institutional investors (Nguyen 2013), it can be expected that these investors are relatively well informed about the reasons for banks issuing subordinated debt, the likelihood of being bailed in and the potential losses that may be imposed if the local regulator calls for conversion or principal write-down. This study examines whether investors demand an additional risk premium to compensate for the possibility of being called upon to absorb losses when a point of non-viability trigger is activated for Basel III tier 2 subordinated debt. Focusing on secondary market credit spreads on subordinated debt issued by Australian banks over the period from January 2013 to December 2017, the study provides evidence about the impact of the regulatory discretionary loss absorption feature on the pricing of bank subordinated debt. The analysis is undertaken separately for fixed-rate and floating-rate subordinated debt. After controlling for other factors that can be expected to influence credit spreads, we find that credit spreads are higher by approximately 73 basis points and 45 basis points on fixed-rate bonds and floating-rate bonds respectively, that include the new discretionary loss absorption trigger, relative to subordinated debt securities that do not include the trigger. These results are statistically significant for both fixed-rate bonds and floating-rate subordinated bonds. These results suggest that the loss absorption feature is priced when subordinated debt investors trade the securities in the secondary market.

Previous research examining the sensitivity of subordinated debt spreads to banks' default risks has produced mixed evidence (Kwast, Covitz, Hancock, Houpt, Adkins, Barger, Bouchard, Connolly, Brady, English & Evanoff 1999, Flannery & Sorescu 1996, Sironi 2003, Balasubramnian & Cyree 2011, Evanoff, Jagtiani & Nakata 2011). The findings of Davis & Saba (2016) suggest that an additional risk premium for Basel III subordinated debt may derive from the uncertainty associated with the conversion mechanism rather than from increased sensitivity to bank default risks. To further investigate whether this bail-in risk premium can be attributed to uncertainty about potential future regulatory assessments or a heightened sensitivity to bank default risk, we test whether the credit spreads on subordinated debt are more sensitive to banks' risk profiles with the introduction of the Basel III loss absorbency requirement. The regression results for both fixed-rate bonds and floating-rate bonds show a heightened sensitivity of subordinated debt spreads to market-based measures of bank risk, in particular, the Merton distance-to-default and equity volatility. However, the heightened sensitivity is not evident in relation to accounting-based measures of banking risk (which typically provide a less timely indication of changes in a bank's risk profile).

2 Literature review

In the banking literature, market discipline refers to the process by which market investors, i.e., depositors, creditors and stockholders, scrutinise the investing and financing decisions of banks, as an adjunct to official supervision (Bliss & Flannery 2002, Berger 1991). In particular, the banking industry policy may seek to facilitate oversight by private investors of banks' risk-taking activities. This concept gained momentum from the mid-1970s, and it became a prominent feature of bank capital regulation with the adoption of the Basel II framework in 2004. Subsequently, several barriers to effective market discipline were identified during the 2007-2009 financial crisis, and these barriers have been used as the rationale for key elements of the Basel III capital reforms. Market discipline itself is not a theory but a collection of ideas on the role of market investors in assisting regulatory authorities to supervise banks. For market discipline to work effectively, there are two steps involved: monitoring and influence (Bliss & Flannery 2002). To maximise their own payoffs, security holders, especially bank debt investors, monitor the risk profiles of banks and incorporate the information they collect in the pricing of new security issuances and in the pricing of secondary market transactions. With regard to influence, the role of investors can be separated into direct influence and indirect influence. Direct influence pertains to the pressure from the monitoring activities of market investors, which influences bank managers to adjust their risk-taking behaviour. Indirect influence pertains to the actions of third parties, mainly official supervisors, in responding to monitoring provided by market investors and resulting in changes in bank behaviours (Flannery & Bliss 2019). There are both *ex ante* and *ex post* forms of market discipline. *Ex ante* discipline refers to the way in which investors' monitoring influences banks and leads them to take prudently-calculated risks, while *ex post* discipline refers to the way in which investors' monitoring leads banks to reverse unjustifiably reckless risk-taking behaviours.

In the equilibrium constructed by Diamond & Dybvig (1983), there is a costly consequence in terms of bank runs of relying on depositors to scrutinise bank risks. However, some studies portray a less-destabilising monitoring role for uninsured depositors. Calomiris & Kahn (1991) describe how uninsured demandable-debt depositors can help monitor bankers' activities when the depositors make decisions about their next investment or whether to roll over their existing deposits. Flannery (1994) also argues that depositors have a disciplining effect in terms of discouraging bank managers from undertaking risky investment strategies that expropriate depositors' wealth. Diamond & Rajan (2001) emphasise the disciplining advantages of demandable deposits. As demandable deposits are redeemed on a first-come-first-served basis, depositors have an incentive to acquire information and prevent banks from engaging in excessive risk-taking behaviours. Uninsured depositors penalise banks' excess risk-taking by asking for their money back. Poorly performing banks will be unable to raise additional uninsured deposits and will be compelled to increase the interest rates on their existing deposit offerings (Maechler & McDill 2006).

A number of studies focus on large certificates of deposit (CDs), which constitute a substantial proportion of uninsured bank liabilities. Fama (1986) shows that the spreads between the interest rates on bank CDs and risk-free treasury bills are time-varying. However, this time-varying spread can be attributed to market imperfections, market liquidity or taxation differences, and is not necessarily attributable to differences in bank risk. After the eleven largest national banks in the United States were deemed by the Comptroller of the Currency in 1984 to be too-big-to-fail, investors in bank CDs plausibly had less incentive to monitor bank risks and incorporate risk assessments in the traded credit spreads of CDs. Because it is difficult to distinguish insured deposits from uninsured deposits, most of the early studies included both insured and uninsured deposits in the analysis and produced mixed evidence on the disciplining effects of bank deposits. Hannan & Hanweck (1988) find that the yields on partially insured CDs are positively correlated with bank risk measures, capturing financial leverage and asset risk. However, their risk measures indicate no significant effect on the CD rates paid by the largest banks in their sample. In contrast to those findings, Ellis & Flannery (1992) estimate time series models of individual banks' CD rates and find that the interest rates paid on CDs by large money centre banks in the US contain rational risk premia.

It is widely contended that deposit insurance distorts market discipline within the banking system and potentially creates moral hazards within banks. Some studies investigate how banks change their propensity to raise deposit financing and how depositors adjust their deposit holdings when bank conditions change. Billett, Garfinkel & O'Neal (1998) report that banks rely more on insured deposits as bank risk increases. However, they find a costly consequence of increasing reliance on insured deposits, in the form of negative abnormal returns on bank shares that are associated with credit rating downgrades and increased bank risks. Goldberg & Hudgins (2002) examine the role of uninsured deposits as a funding source for thrift institutions from 1984 to 1994. They find that uninsured depositors, responding to market forces such as indications of impending failure, adjusted their holdings of deposit contracts at thrifts and that this reaction changed over time with the implementation of new regulation. The findings of their study suggest that the actions of uninsured depositors are consistent with an active monitoring role and that reducing the insurance limits on deposits will increase market discipline on thrifts. Egan, Hortaçsu & Matvos (2017) provide empirical evidence that banks' demand for uninsured deposits decreases with their default risk, while this is not the case for insured deposits.

According to the hierarchy of claimants on a bank's assets, holders of bank debt-equity hybrid securities are second in line, after common equity holders to bear bank losses, followed by subordinated debt holders. For market discipline to be effective in the banking industry, the prices of banks' debt instruments need to be risk-sensitive, which requires that investors price banks' risk profiles diligently when they transact in the securities. Also, investors must perceive that there will be no government rescue if a bank becomes insolvent (Nguyen 2013). In this case, investors in hybrid securities and subordinated debt securities can reasonably expect higher compensation in return for assuming a more junior claim than other creditors. However, far-reaching public rescue packages and central bank lending programs, such as those initiated in response to the 2007-2009 financial crisis, have encouraged perceptions of government support for distressed banks. In many jurisdictions, taxpayers were called upon to bear the risks before hybrid security and subordinated debt investors forfeited their capital (Acharya, Anginer & Warburton 2016, Noss & Sowerbutts 2012, Krishnan, Ritchken & Thomson 2005).

To address the various impediments to market discipline in the banking industry, financial economists and policy-makers have advocated that banks be required to issue unsecured debt instruments to promote the efficient pricing of bank risks. Since the 1980s, proposals to include subordinated debt in bank capital have been evaluated as a means to increase market discipline (see Evanoff & Wall 2000). Subordinated debt is not the only bank debt instrument that could potentially facilitate market discipline in the banking sector; however, subordinated debt has several characteristics that potentially make it conducive to improving market discipline (Kwast, Covitz, Hancock, Houpt, Adkins, Barger, Bouchard, Connolly, Brady, English & Evanoff 1999). First, subordinated debt securities are uninsured and represent the most junior debt obligations among bank liabilities.[2] Therefore, subordinated debt holders should be the first, after equity holders, to absorb losses when a bank fails (Ellis & Flannery 1992). In theory, its yield should be sensitive to bank risk factors. Second, as distinct from the holders of ordinary shares who potentially benefit from the unlimited upside associated with a bank's risky activities, the holders of subordinated debt securities do not realise any exceptional upside gains but are exposed to losses in the case of bank default. As shown by Black & Cox (1976) and Gorton & Pennacchi (1990), when a bank starts from a solvent position, and its asset risk increases, the market value of subordinated debt claims decreases. This gives subordinated debt holders a strong incentive to monitor the risk-taking behaviour of their invested banks and demand higher compensation if the bank takes additional risks. This process helps to limit the excessive risk-taking activities of banks and potentially works in a similar fashion to official supervision. Third, the investors, who are active in the subordinated debt market are mostly institutional investors who are more sophisticated and capable of examining banks' condition and taking actions accordingly (Nguyen 2013). Fourth, subordinated debt securities generally have longer maturities than senior bonds. Fixed income instruments with longer maturities are more responsive to the risk profile changes of the issuing firm. This feature is likely to result in a magnified sensitivity of subordinated debt prices to changes in bank risk profiles (Hart & Zingales 2012).

An extensive literature examines the question of whether subordinated debt yields are sensitive to banks' risk-taking activities and presents mixed conclusions. In a study conducted on behalf of the US Federal Reserve Board, Kwast, Covitz, Hancock, Houpt, Adkins, Barger, Bouchard, Connolly, Brady, English & Evanoff (1999) reviewed eleven proposals for using mandatory issuances of subordinated notes and debentures (SND) as a tool for protecting the

[2] Hybrid securities are more junior than subordinated debt securities. In most countries, hybrid securities including preferred equity securities are classified as part of shareholders' equity. However, in some jurisdictions, hybrid securities are classified as liabilities according to accounting standards.

safety and soundness of the banking industry. These proposals vary on the SND primary issuance details and also on the extent to which subordinated debt investors were expected to exert their direct and indirect market influence. This study supports the argument that the regular issuance of SND will assist in increasing market liquidity for the securities and in providing signals via primary issue prices. In these proposals, changes in primary SND yields were designed to trigger mandatory responses by banks and their regulators. Early studies, in the pre-FDICIA period, find that subordinated debt yield spreads are not sensitive to bank risk and that the securities are not likely to provide useful pricing signals (Avery, Belton & Goldberg 1988, Gorton & Santomero 1990). However, studies in the post-FDICIA period provide evidence of the risk-based pricing of bank subordinated debt. In their seminal paper, Flannery & Sorescu (1996) examine whether investors have the ability to price bank risks by examining secondary market yields on subordinated debt issued by banks in the period of 1983 to 1991. Their results suggest that market pricing is more risk-sensitive in the period 1989 to 1991, leading up to the implementation of the FDICIA, which sought to improve the resolution process for too-big-to-fail banks. However, they do not find supporting evidence for the risk sensitivity of subordinated debt spreads during the period prior to the passage of the FDICIA. Sironi (2003) provides similar evidence using data for European banks over the formation period for the European Monetary Union. Berger, Davies & Flannery (2000) provide evidence that subordinated debt markets may produce more accurate and timely information than regulatory examinations in relation to the risk-adjusted performance of a bank.

Later studies examining bank subordinated debt suggest that the yields on the securities are either insensitive or weakly sensitive to bank risk factors. Controlling for market and liquidity risks, Krishnan, Ritchken & Thomson (2005) find no strong and consistent evidence that the credit spreads for subordinated debt securities are responsive to changes in bank default risk proxies. Neither do they find evidence that the first issue of subordinated debt changes the risk-taking behaviour of a bank. Balasubramnian & Cyree (2011) provide evidence that the lack of risk sensitivity of yield spreads on subordinated debt is caused by expectations of government bailouts of large banks and the selling of new trust-preferred securities that are junior to subordinated debt. Their empirical findings suggest that expectations of government bailouts were exacerbated by the government rescue of a non-bank financial firm, Long Term Capital Management, in the late-1990s. Using pooled data for senior and subordinated bonds issued by US banks, Acharya, Anginer & Warburton (2016) provide evidence that risk-based pricing is impeded by too-big-to-fail perceptions. They find a flat credit spread-risk relationship for large financial institutions, which runs contrary to an upward-sloping relationship for smaller financial institutions and for non-financial firms. Moreover, bond pricing is relatively insensitive to the risks of large financial institutions. Balasubramnian & Cyree (2014) examine the impact of the Dodd-Frank Act of 2010 on the pricing of subordinated debt securities and provide evidence that too-big-to-fail pricing distortions were reduced but not eliminated after the passage of the reform package.

As a response to the market distortions brought about by implicit government protection for the banking industry, the Basel III capital reforms introduced minimum loss absorbency requirements for bank subordinated debt to qualify as tier 2 gone-concern regulatory capital. Within the original Basel capital framework, tier 2 capital instruments were to contribute to a bank's overall loss-absorbing capacity and to facilitate the orderly resolution of the bank in the event that it failed. This role of tier 2 capital, including subordinated debt, was undermined by government actions during the financial crisis of 2007-2009. As part of the Basel III capital reforms adopted after the crisis, tier 2 capital instruments must include a contractual loss absorption mechanism that converts the claims into common equity or extinguishes them completely at the point of non-viability (Bank for International Settlements 2010, 2011). The non-viability trigger event is determined at the discretion of the regulator and no guidance is required to be provided by the regulator about how it will exercise its discretion for supervised banks. In this way, subordinated debt holders may be bailed in by the banking regulator to support the resolution of a failed bank, thus obviating the need for taxpayers to be called upon to bail out the bank. In contrast with market-value-based loss absorption triggers examined in previous research (Sundaresan & Wang 2015), the regulatory discretionary trigger for tier 2 subordinated debt overcomes the multiple price equilibrium problem and issues associated with the unreliability of book-value accounting data. However, a potential criticism is that the ambiguity about the regulatory discretionary non-viability decisions will inevitably create market uncertainty regarding the nature of trigger events (Avdjiev, Kartasheva & Bogdanova 2013). In addition, the bail-in process relies upon the integrity with which the regulator performs its role, and regulatory actions have often been observed to be deficient (Flannery 2014).

We examine whether the bail-in arrangements for subordinated debt under the Basel III framework, introduced to mitigate the moral hazard problem created by implicit government support for banks, are perceived by investors as a credible mechanism for exposing them to possible future bank losses. The study investigates whether the regulatory discretionary loss absorption feature is priced when subordinated debt investors transact in the secondary market for the securities. In addition, we examine whether the transaction data are consistent with subordinated debt investors having an increased incentive to monitor bank risks after the implementation of the Basel III regulatory discretionary bail-in requirement. If the loss absorption mechanism is priced by investors and incentivises them to monitor banks' risk profiles more diligently, we hypothesise that:

H1: The credit spreads on banks' Basel III tier 2 subordinated debt with the regulatory discretionary point of non-viability trigger will be higher than for subordinated debt issued without the trigger.

H2: The credit spreads on Basel III tier 2 subordinated debt will be more sensitive to changes in a bank's risk profile compared with subordinated debt issued without the regulatory discretionary loss absorption trigger.

3 Basel III bail-in rules for bank subordinated debt

As part of initiatives to improve the loss absorbing capacity of non-common equity capital instruments, the Basel III reforms introduced new loss absorbency requirements for subordinated debt securities to qualify as tier 2 regulatory capital instruments. In the previous versions of the Basel Accord, eligible subordinated debt securities had been allowed to be included as gone-concern tier 2 regulatory capital. However, the 2007-2009 financial crisis highlighted significant shortcomings in the arrangements by which subordinated debt capital would be used to resolve an insolvent bank, as well as moral hazard problems caused by government support for systemically important financial institutions. In many countries, subordinated debt holders were spared from the contractual requirements to absorb bank losses according to the juniority of their claims because governments intervened to recapitalise the banks before they were subject to bankruptcy proceedings. The Basel III loss absorption mechanism introduced for tier 2 subordinated debt securities requires them to be issued with a loss absorbency feature, such that the securities are converted to common equity or have their principal values written-down once a point of non-viability trigger is activated. The responsibility to decide whether a bank is non-viable is exercised by the national banking regulator. This bail-in feature represents an additional risk, over and above the risks to which conventional subordinated debt investors are exposed.

In Australia, the domestic prudential regulator, the Australian Prudential Regulation Authority (APRA) began the implementation of the Basel III capital reforms from January 2013. The new loss absorbency requirements were introduced for tier 2 subordinated debt according to a phase-in timeline running from 2013 to 2023. Australian banks were generally in a strong position to meet the Basel III rules and started to issue Basel III bail-in subordinated debt in both domestic and offshore markets from May 2013. Bail-in subordinated debt securities are mostly traded over the counter, except a small number that are listed and traded on public securities exchanges including the Australian Securities Exchange (ASX). Any subordinated debt issued since 1 January 2013 must include a regulatory discretionary point of non-viability trigger to be eligible to be included as part of tier 2 capital under the Basel III regime. There is no specific guidance provided to the market about how the local supervisor, APRA, will assess and decide when a bank is to be declared non-viable. The assessment could potentially be based on a high proportion of non-performing loans, a lack of sufficient liquidity or a weakened capital position. The uncertainty associated with the issuing bank's regulatory standing in relation to the non-viability provisions and the lack of transparency about how the regulator will assess the bank's condition contribute to the risk profile of the bail-in subordinated debt securities. Under the Basel III rules, the pre-defined mechanical 5.125% CET1 capital ratio trigger applies to additional tier 1 capital instruments, but it does not apply to tier 2 capital instruments (including subordinated debt).

Transitional arrangements have been implemented for the old-style subordinated debt securities issued under the Basel I and Basel II regimes. These securities can continue to be counted towards tier 2 regulatory capital, but will be phased out from their first available call date (if any), or as determined by APRA. The proportion of the transitional instruments included in the base amount of tier 2 capital is to be reduced over a ten-year period from 2013 to 2023, with a 10 per cent reduction each year. The regulatory discretionary loss absorption mechanism only applies to new issues of bail-in subordinated debt from 1 January 2013. If the point of non-viability trigger is activated by the regulator, Basel III bail-in subordinated debt is to be written off or converted to common equity. However, the old-style subordinated debt securities issued under Basel I and Basel II frameworks will not be converted or written off in this case. This, in turn, gives the old-style subordinated debt securities a higher effective ranking in the hierarchy of claims on the bank. During the period that both the old-style and Basel III bail-in subordinated debt securities are trading in the market place, it is expected that the bail-in mechanism will be taken into account by investors when they price the subordinated debt securities issued with the Basel III bail-in feature.

4 Empirical implementation

4.1 Data and sample

This study focuses on 75 subordinated debt securities issued by 9 Australian banks and traded in the secondary market from January 2013 to December 2017. The sample bonds included in the study comprise 28 old-style subordinated bonds (i.e. subordinated debt issued under the Basel I and Basel II regimes) and 47 bail-in subordinated bonds (i.e. Basel III tier 2 subordinate debt) issued since 1 January 2013, that is, the start date of Basel III implementation in Australia. Table 1 presents the sample Australian banks, the number of subordinated bonds and number of monthly observations involved in the analysis. Observations for subordinated bonds with less than one year remaining to effective maturity are excluded from the sample data. As can be seen from the table, the sample comprises a reasonably balanced number of observations for subordinated bonds issued with and without the Basel III point of non-viability trigger. Subordinated bonds represents a more junior claim on the bank than senior bonds and are issued with an offer to compensate investors with periodic interest payments, which are relatively higher compared with senior bonds and can be either fixed or floating rate. The higher yields that investors demand can be attributed to the higher risks associated with subordinated bonds, which include interest rate risk and default risk, but also the potential for conversion into common equity or write down for bonds issued under the Basel III rules.

Table 1: Sample banks with subordinated debt observations

This table presents the sample Australian domestic banks included in the analysis. The sample period is January 2013 to December 2017. This table presents the number of subordinated bonds and month-end observations for the subordinated bonds with the Basel III point of non-viability trigger and for those without the point of non-viability trigger.

Fixed-rate bonds

	No. of subordinated bonds		No. of observations	
Bank name	**Without trigger**	**With trigger**	**Without trigger**	**With trigger**
Westpac Banking Corporation	3	10	126	153
Commonwealth Bank of Australia	4	6	208	135
National Australia Bank Limited	3	4	148	74
Australia and New Zealand Banking Group Limited	2	9	85	238
Macquarie Bank Limited	3	2	170	62
All banks	15	31	737	662

Floating-rate bonds

	No. of subordinated bonds		No. of observations	
Bank name	**Without trigger**	**With trigger**	**Without trigger**	**With trigger**
Westpac Banking Corporation	2	3	81	116
Commonwealth Bank of Australia	0	2	0	57
Australia and New Zealand Banking Group Limited	3	2	136	69
National Australia Bank Limited	3	3	120	60
Bendigo and Adelaide Bank Limited	1	2	25	55
Bank of Queensland Limited	3	1	50	20
MyState Bank Limited	0	1	0	27
Auswide Bank Limited	1	2	22	62
All banks	13	16	434	466

The subordinated bonds in the sample are issued in eight different currency denominations. We collect issue-level information on the subordinate debt securities from Bloomberg, including their issue dates, maturity types, contractual maturity dates, coupon rates, coupon types, coupon frequency, par value, issue amounts, call features and the Basel III loss absorbency treatment of each individual bond. To determine the effective maturity date of a subordinated bond, we consider both the call schedule and maturity type of the bond. Because the market convention is such that all callable subordinated bonds issued by Australian banks are called by the issuing bank at the first call date, we use the first call date as the effective maturity date for all subordinated bonds that are callable bonds. For bonds that are not callable, we use the contractual maturity date as the bond's effective maturity date. We collect daily prices for the subordinated bonds from Capital IQ and Bloomberg, then select calendar month-end observations and calculate credit spreads for the subordinated debt securities.[3] For fixed-rate subordinated bonds, we obtain the maturity dates and monthly yields-to-maturity of government bonds in the eight relevant currencies from Bloomberg to be used as the benchmark risk-free interest rates. For floating-rate subordinate bonds, we collect bank bill swap rates from the Australian Financial Markets Association to be used as the benchmark risk-free interest rate.[4]

To construct bank risk measures and control variables that can be used in the analysis to disentangle the effect of the point of non-viability trigger from other possible factors that may impact the credit spreads of banks' subordinated bonds, we collect data from a variety of sources. we collect daily data on bank equity returns and market capitalisation from Thomson Reuters Datastream. Semi-annual data from banks' financial reports are obtained from Worldscope, including the total assets, total liabilities, shareholders' equity, net income, non-performing loans, total loans, trading assets and cash and liquid assets of the bank. For macroeconomic factors, interest rates on bank accepted bills and generic Australian Government bonds of different maturities are collected from the Reserve Bank of Australia. Average redemption yields for bonds in the S&P/ASX Australian Corporate Bond Index are obtained from Thomson Reuters Datastream. The values of the S&P/ASX 200 VIX index are collected from Bloomberg.

4.2 Point of non-viability trigger, bank risk and control variables

The key variable of interest is the gone-concern loss absorption feature for a subordinated debt security. Bloomberg reports whether a subordinated debt instrument qualifies as Basel III tier 2 capital, and the trigger type and trigger action under the Basel III rules. Banks are required under APRA's prudential standard APS330, to disclose the main features of instruments included in their regulatory capital. Combining the information from Bloomberg and from banks' disclosure documents, we determine whether a subordinated debt security issued by an Australian bank meets the Basel III loss absorbency requirement. In the capital disclosure document, the bank specifies if a tier 2 subordinate debt instrument has the regulatory

[3] We use Capital IQ as the first source for pricing data due to better data quality and coverage. For bonds with no pricing data from Capital IQ, we use data from Bloomberg to calculate credit spreads.

[4] The floating-rate subordinated bonds in the sample are all Australian dollar-denominated bonds.

discretionary point of non-viability trigger. Alternatively, if a subordinated debt security is specified as 'Tier 2' capital under 'Post-transitional Basel III rules', the security is designated as a bail-in subordinated debt instrument, i.e., one issued with the Basel III gone-concern loss absorption feature, otherwise, the security is designated as an old-style subordinated debt instrument, i.e., one issued without the loss absorption feature.

Table 2 lists the bank risk measures, subordinated debt security characteristics, bank-level characteristics and macroeconomic variables and the anticipated effects on credit spread levels. We employ five alternative proxies to measure bank default risk. Following Hillegeist, Keating, Cram & Lundstedt (2004), Duffie, Saita & Wang (2007) and Acharya, Anginer & Warburton (2016), the first risk variable used is the distance-to-default value calculated using the Merton (1974) structural default model. The Merton distance-to-default is shown in previous studies to have significant explanatory power in generating a term structure of bank default probabilities (Duffie, Saita & Wang 2007). The Merton model is an application of option pricing theory, which treats a firm's equity as a European call option on the firm's assets, where the value of the firm's liabilities represents the strike price. The number of standard deviations away from the default point, i.e., the point at which the assets of the bank are just equal to its liabilities, is the distance-to-default value estimated for the bank. If the market value of the bank's total assets falls below the book value of its total liabilities, the call option is out of the money and will be left unexercised. The insolvent bank will be passed over to its debt holders (Hillegeist, Keating, Cram & Lundstedt 2004). To enhance the readability of the regression results, we use the negative value of the Merton distance-to-default as the risk measure (following Gropp, Vesala & Vulpes 2006). In this way, a higher value of the negative Merton distance-to-default indicates a bank with higher default risk.

As Campbell, Hilscher & Szilagyi (2008) identify limitations of the Merton distance-to-default measure in predicting bank default risk, we use two additional market-based risk measures, common equity volatility and idiosyncratic common equity volatility. Atkeson, Eisfeldt & Weill (2017) demonstrate theoretically that one can estimate a firm's distance-to-default using data on the inverse of the volatility of that firm's equity returns. Following Acharya, Anginer & Warburton (2016), we use equity return volatility ($Equity\ volatility$) as a risk measure. This measure transcends the assumptions underpinning the Merton structural model. Equity volatility is computed using daily stock return data

Table 2: List of risk measures, subordinated-debt characteristics, bank-characteristics and macroeconomic variables

	Proxy for	Expected effect on credit spreads
Panel A: Bank risk variables		
Negative Merton distance-to-default (*-MertonDD*)	Bank default risk	Positive
Common equity volatility (*Equity volatility*)	Bank equity risk	Positive
Common equity idiosyncratic volatility (*Idiosyncratic volatility*)	Bank idiosyncratic equity risk	Positive
Non-performing loan/Toal loans (*NPL*)	Bank asset risk	Positive
Trading assets/Total assets (*Trading Assets*)	Bank asset risk	Positive
Panel B: Subordinated bond characteristics		
Logarithm of issue size (*Log issue size*)	Counterparty availability	Negative
Logarithm of time-to-maturity (*Log TTM*)	Interest rate risk	Positive
Callable feature (*Callable*)	Bond callable by issuer	Positive
Panel C: Other bank-level variables		
Return on assets (*ROA*)	Profitability/Operational efficiency	Negative
Common equity to total assets ratio (*Common equity ratio*)	Bank solvency position	Negative
Cash holdings to total assets ratio (*Cash holdings*)	Bank liquidity position	Negative
Panel D: Macro variables		
10 year government bond yield - 90-day bank bill rate (*Term premium*)	Term premium	Positive
S&P/ASX corporate bond index yield spread (*Default premium*)	Default premium	Positive
S&P/ASX 200 VIX (*VIX*)	Equity market volatility	Positive

over the past 12 months. Also, as substitute risk measure, we use idiosyncratic equity volatility (following Balasubramnian & Cyree 2011 and Balasubramnian & Cyree 2014). It is documented by Campbell & Taksler (2003) that idiosyncratic equity volatility has a direct relationship with the credit spreads on corporate bonds. Using their method, idiosyncratic equity volatility (*Idiosyncratic volatility*) is calculated as the residual standard error obtained by estimating a rolling market index model, that is, by regressing excess returns on the bank's common equity against excess returns on the market index over the past 130 trading days. We use the S&P ASX 200 total return index and the 90-day bank bill swap rate as the equity market index and the risk-free rate respectively.

To the extent that investors anticipate government support for distressed firms in the banking industry, the distance-to-default and other equity market-based measures of bank risk may understate the risks inherent in their business models (Gandhi & Lustig 2015, Kelly, Lustig & Van Nieuwerburgh 2016). To address this concern, we use two accounting-based risk measures to test the robustness of the results. Following previous studies examining banks' bond spreads, including Sironi (2003), Brewer & Jagtiani (2013) and Balasubramnian & Cyree (2014), we use non-performing loans (*NPL*) as a risk measure. Morgan & Stiroh (2001) find evidence that bond investors price the risks implicit in banks' trading assets. Thus, we use the relative size of a bank's trading book (*Trading assets*) as an additional risk measure.

To allow for other factors that could potentially impact on the pricing of subordinated debt securities, we control for specific characteristics of the securities, bank profitability and financial strength, and macroeconomic factors. As debt securities with larger issue sizes and shorter maturities can be expected to be more liquid and have lower yield spreads, we compute the logarithm of the amount issued of the bond in constant 2017 dollar terms (*Log issue size*), i.e., adjusted using the historical consumer price index, and the logarithm of the term-to-maturity of the bond (*Log TTM*) to assess the influence of these factors on the pricing of subordinated bonds. We also use a zero-one dummy variable to identify callable bonds. A subordinated bond is callable if the issuer has the option to call the security on one or more pre-defined dates. This option is valuable to the issuer and can be expected to result in higher yield spreads on the securities. Following Acharya, Anginer & Warburton (2016), we consider variables relating to the financial strength and profitability of the bank when it issues a bond: the common equity to total assets ratio (*Common equity ratio*), cash holdings to total assets ratio (*Cash holdings*) and the return on assets (*ROA*). A bank with a higher common equity ratio, and a higher level of cash holdings is a bank that is financially sounder and is expected to be associated with lower credit spreads. A bank with a higher return on assets is one that operates more efficiently and is expected to be associated with lower credit spreads. we include three macroeconomic variables in the analysis. *Term Spread* is calculated as the yield spread between 10-year Australian Government bonds and 90-day bank bills. $Default\ Premium$ is the yield spread between bonds in the S&P/ASX corporate bond index and Australian Government bonds with the nearest average time to maturity, and is used as a proxy for default risk. The S&P/ASX 200 VIX index (VIX) is used to measure the aggregate uncertainty in the securities market, which is calculated by the index provider using the 30-day implied volatilities of S&P/ASX 200 put and call options.

5 Results

5.1 Descriptive statistics

Table 3 reports descriptive statistics of key variables for the sample subordinated bond monthly observations used in the analysis.[5] Descriptive statistics for characteristics of the fixed-rate bonds and floating-rate bonds are reported separately. The average credit spreads in the secondary market are 178 bps and 196 bps for fixed-rate and floating-rate bonds respectively from January 2013 to December 2017. The average term to effective maturity for the sample subordinated bonds trading in the secondary market is around 5 years for fixed-rate bonds and 3 years for floating-rate bonds. The average issue size of the sample subordinated bonds is around 720 million and 640 million Australian dollars for fixed-rate and floating-rate bonds respectively.

Figures 1 and 2 illustrate the average credit spreads and total amount outstanding of subordinated debt securities issued by Australian banks quarter-by-quarter over the sample

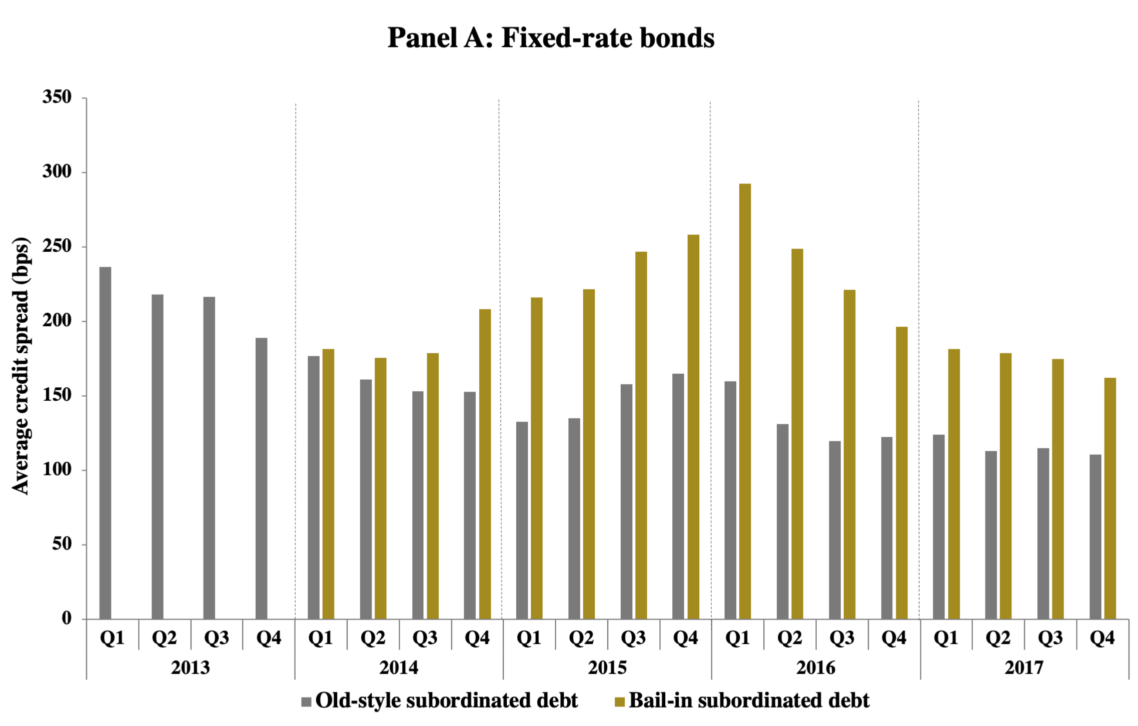
[5] For the bank-level and macroeconomic variables, the descriptive statistics are based on the fixed-rate bond monthly observations. The descriptive statistics based on the floating-rate bond monthly observations are similar and are omitted for brevity.

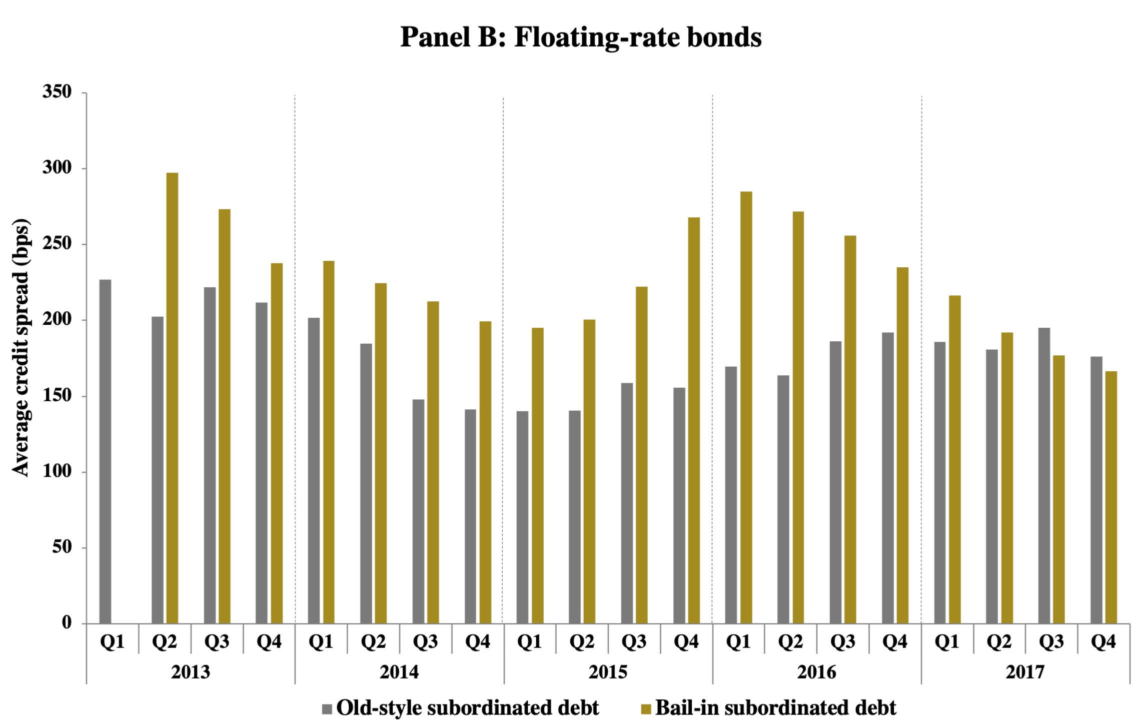
Table 3: Descriptive statistics for bank subordinated debt observations

This table presents summary statistics for bank subordinated debt observations. The sample period is from January 2013 to December 2017. *Issue size* is the issue size of the subordinated debt security in constant 2017 dollars. *Time-to-maturity* is the the time-to-effective maturity of the subordinated debt security. For fixed-rate securities, *Credit Spread* is the difference in yields between the subordinated debt security and the nearest maturity government bond. For floating-rate securities, *Credit Spread* is the discount margin, which is the difference between the internal rate of return on the subordinated debt cash flows and the reference bank bill swap rate, assuming that the reference rate does not change over the life of the security. *Merton distance-to-default* is the distance-to-default calculated using the Merton model. *Equity volatility* is the standard deviation of daily equity returns over the past twelve months. *Idiosyncratic volatility* is the residual standard error estimated for the bank's common equity using a rolling market index model over the past 130 trading days. *Non-performing loans* is non-performing loans divided by total loans. *Trading assets* is the bank's trading book to total assets ratio. *Total assets* is the book value of total assets. *Common equity ratio* is the book value of common equity divided by the book value of assets. *Cash holdings* is cash holdings divided by total assets. *Return on assets* is the return on assets, computed as net income divided by average assets. *Term spread* is the term structure premium, measured by the yield spread between 10-year Australian Government bonds and 90-day bank accepted bills. *Default premium* is the default risk premium, measured by the yield spread between bonds in the S&P/ASX corporate bond index and Australian Government bonds with nearest average time-to-maturity. *S&P ASX 200 VIX* is the level of the S&P/ASX 200 VIX index.

Data item	**Mean**	**Standard deviation**	**Lower quartile**	**Median**	**Upper quartile**
Subordinated bond characteristics					
– Fixed rate bonds					
Issue size $mil	720.4	436.0	355.1	777.0	1034.1
Time to maturity years	5.3	2.3	3.6	5.0	6.9
Credit spread bps	178	62	136	174	213
– Floating rate bonds					
Issue size $mil	641.4	476.4	256.3	566.8	887.1
Time to maturity years	3.2	1.2	2.2	3.2	4.1
Credit spread bps	196	72	143	180	229
Bank risk variables					
Merton distance-to-default	4.9	1.3	3.8	5.0	5.9
Equity volatility % pa	19.3	5.2	15.3	17.8	23.4
Idiosyncratic volatility % pa	12.3	7.5	9.4	10.8	12.8
Non-performing loans %	1.71	1.00	0.71	2.05	2.60
Trading assets %	7.6	3.9	4.9	6.0	10.4
Other bank-level variables					
Total assets $bil	764.3	264.9	788.8	856.1	923.3
Common equity ratio %	6.5	0.7	6.1	6.5	6.9
Cash holdings %	6.1	3.9	3.1	5.2	8.2
Return on assets % pa	1.3	0.2	1.1	1.4	1.5
Macro variables					
Term spread bps	66	40	36	66	94
Default premium bps	107	23	86	111	121
S&P ASX 200 VIX %	13.3	3.4	10.9	12.3	15.1

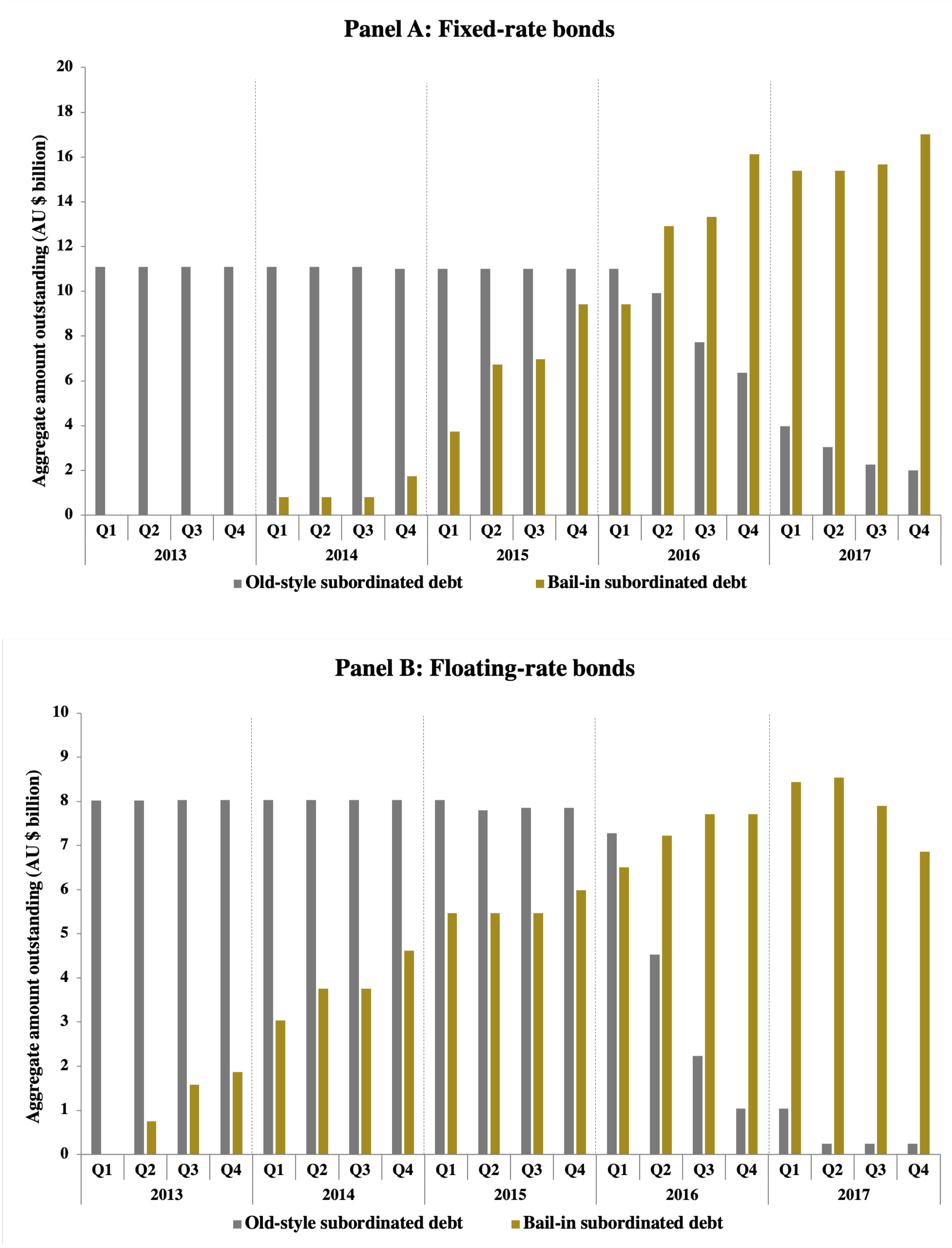
Figure 1: Average credit spreads for old-style and bail-in subordinated debt





This figure shows the quarterly average credit spreads of subordinated debt securities issued by the sample Australian banks, presented for fixed-rate bonds (panel A) and floating-rate bonds (panel B). *Credit Spread* (y-axis) is in basis points. For fixed-rate subordinated debt, *Credit Spread* is the difference in yields between the subordinated debt security and a maturity-matched government bond. For floating-rate subordinated debt, *Credit Spread* is the discount margin, which is the difference between the internal rate of return on the subordinated debt cash flows and the reference bank bill swap rate, assuming that the reference rate does not change over the life of the subordinated debt security. The time period (x-axis) is from quarter 1 2013 to quarter 4 2017. The gold bars represent the credit spreads of bail-in securities, which are subordinated debt securities issued under the Basel III regime, i.e., with the point of non-viability trigger. The grey bars represent the credit spreads of conventional subordinated debt securities, which are issued under the Basel I and II regimes, i.e., without the trigger.

Figure 2: Total market size for old-style and bail-in subordinated debt



This figure shows the aggregate amount on issue of subordinated debt securities for the sample Australian banks in billions of Australian dollars, presented for fixed-rate bonds (panel A) and floating-rate bonds (panel B). The time period (x-axis) is from quarter 1 2013 to quarter 4 2017. The gold bars represent the total amount outstanding of bail-in debt, which are subordinated debt securities issued under the Basel III regime, i.e., with the point of non-viability trigger. The grey bars represent the amount outstanding of conventional subordinated debt securities, which are issued under the Basel I and II regimes, i.e., without the trigger.

Table 4: Pearson correlation coefficients for key variables of the sample bank subordinated debt observations

PONV is a dummy variable which equals to 1 if a subordinated debt security is issued with the Basel III loss absorption feature, i.e. a point of non-viability trigger. *LOGT* is the logarithm of the term to effective maturity of the subordinated debt security. *LOGS* is the logarithm of the issue size of the subordinated debt security in constant 2017 dollars. *-MDD* is the negative distance-to-default calculated using the Merton model. *SIGE* is the standard deviation of daily equity returns over the past twelve months. *IDIO* is the residual standard error estimated for the bank's common equity using a rolling market index model over the past 130 trading days. *NPL* is non-performing loans divided by total loans. *TRAD* is bank's trading book to total assets ratio. *CEQU* is the book value of common equity divided by the book value of assets. *CASH* is cash holdings divided by total assets. *ROA* is the return on assets, computed as net income divided by average assets. *TERM* is the term structure premium, measured by the yield spread between 10-year Australian Government bonds and 90-day bank accepted bills. *DEF* is the default risk premium, measured by the yield spread between bonds in the S&P/ASX corporate bond index and Australian Government bonds with nearest average time-to-maturity. *VIX* is the level of the S&P/ASX 200 VIX index. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

	PONV	LOGT	LOGS	-MDD	SIGE	IDIO	NPL	TRAD	CEQU	ROA	CASH	TERM	DEF
LOGT	0.54***												
LOGS	-0.22***	0.20***											
-MDD	0.05	0.06*	0.14***										
SIGE	0.04	0.04	0.12***	0.94***									
IDIO	-0.11***	0.17***	0.16***	0.39***	0.38***								
NPL	0.21***	-0.07*	0.12***	0.01	-0.08**	-0.23***							
TRAD	-0.23***	0.05	0.34***	0.25***	0.24***	0.37***	-0.01						
CEQU	0.12***	0.22***	-0.03	0.15***	0.27***	0.41***	-0.59***	0.26***					
ROA	-0.09**	-0.09***	-0.09***	-0.20***	0.02	-0.07**	-0.39***	0.01	0.39***				
CASH	-0.02	0.15***	0.26***	0.26***	0.23***	0.23***	0.09***	0.56***	0.16***	-0.16***			
TERM	-0.02	0.09**	-0.08**	-0.32***	-0.35***	0.10***	-0.22***	-0.12***	0.11***	-0.12***	-0.05*		
DEF	0.01	-0.11***	0.09***	0.62***	0.65***	0.00	0.16***	0.11***	-0.09***	0.10***	0.07*	-0.78*	
VIX	-0.09**	-0.07**	0.10***	0.61***	0.63***	0.06*	0.12***	0.13***	-0.15***	0.12***	0.08**	-0.45***	0.68***

period, displayed for fixed-rate bonds (Panel A) and floating rate bonds (Panel B). The grey bars represent the old-style subordinated debt issued under the Basel I and Basel II regimes (without the point of non-viability trigger), while the gold bars represent bail-in subordinated debt issued under the Basel III regime (with the point of non-viability trigger). Regarding the average credit spreads in figure 1, except in the September and December quarter of 2017 when most of the old-style floating-rate subordinated debt securities have been redeemed, in every quarter for which comparable data are available, there is a higher credit spread on bail-in subordinated debt issued with the point of non-viability trigger than on the old-style subordinated debt. The wider credit spreads can be expected to be contributed to by the additional risk premium required by investors in bail-in subordinated debt due to the point of non-viability trigger. However, it may also be a consequence of other factors that have an impact on the yield spreads of subordinated bonds. As illustrated in figure 2, the amount outstanding of bail-in subordinated debt increased steadily from 2013, while that of old-style subordinate debt declined from the second quarter of 2016. By the end of the sample period, the amount outstanding of fixed-rate subordinated debt issued with the Basel III point of non-viability trigger is greater than that of floating-rate subordinated debt issued with the trigger.

Table 4 presents the correlations between key explanatory variables included in the analysis. The key variable of interest, *PONV*, is a dummy variable used to identify whether a subordinated debt security is issued with the Basel III point of non-viability trigger. As shown in the correlation table, the *PONV* dummy variable is positively correlated with the ratio of non-performing loans to total loans, suggesting that banks with lower quality credit portfolios may have raised subordinated debt funding to buttress their regulatory capital positions under the Basel III rules. However, the *PONV* dummy variable is negatively correlated with idiosyncratic equity volatility and the proportion of trading assets to total assets, suggesting that banks that have issued the new-style securities have a safer profile overall. The *PONV* dummy variable is positively correlated with the issuing bank's common equity ratio, indicating that the pricing observations for subordinated debt with the point of non-viability trigger are for banks with generally stronger capital positions compared with the pricing observations for the old-style subordinated debt without the trigger.

5.2 Impact of the point of non-viability trigger on subordinated debt pricing

To determine whether investors may be concerned about the possibility of being bailed-in to support the resolution of a gone-concern bank, this subsection examines whether credit spreads are wider for subordinated debt issued with the Basel III regulatory discretionary point of non-viability trigger, relative to subordinated debt issued without the trigger. We regress the secondary market credit spreads of subordinated bonds on the indicator variable for the Basel III point of non-viability trigger mechanism, alternative bank risk variables, subordinated bond characteristics, the issuing bank's profitability and financial strength, and macroeconomic factors (following the modelling strategy of Flannery & Sorescu 1996 and Krishnan, Ritchken & Thomson 2005). Using a panel regression approach, we include year fixed effects and bank fixed effects to control for any omitted variables at these levels and cluster the standard errors in the estimations by security and month-end date to allow for heteroskedasticity and panel-related correlation in the regression residuals.[6]

The specification of the regression is as follows:

$$\begin{aligned} Spread_{i,t} = &\alpha_1\ PONV_i + \beta_1\ Bank\ risk_{i,t-1} + \gamma_1\ Common\ equity\ ratio_{i,t-1} \\ &+ \delta_B\ Bank\ control\ factors_{i,t-1} + \delta_S\ Subordinated\ bond\ characteristics_{i,t} \\ &+ \delta_M\ Macroeconomic\ factors_t + YearFE + BankFE + \varepsilon_{i,t} \end{aligned}$$

where, for fixed-rate subordinated bonds, $Spread_{i,t}$ is the spread between the month-end yield-to-effective-maturity of the bank subordinated bond traded in month t, and the month-end yield-to-maturity of the benchmark government bond with the same currency-denomination and nearest maturity date. As the observation month t changes, the benchmark government bond for a fixed-rate subordinated bond can, in some cases, be replaced by another newly-issued government bond with a closer maturity date. For floating-rate subordinated bonds, $Spread_{i,t}$ is the discount margin, which is the difference between the internal rate of return on the bond cash flows and the reference bank bill swap rate, assuming that the reference rate does not change over the life of the bond. $PONV$ is a dummy variable which equals 1 if the subordinated debt

[6] There are insufficient clusters to cluster the standard errors by bank and year.

Table 5: Impact of the point of non-viability trigger on subordinated debt pricing

This table presents regression results for the specification, $Spread_{i,t} = \alpha_1 PONV_i + \beta_1 Bank\ risk_{i,t-1} + \gamma_1 Common\ equity\ ratio_{i,t-1} + \delta_B Bank\ control\ factors_{i,t-1} + \delta_S Subordinated\ bond\ characteristics_{i,t} + \delta_M Macroeconomic\ factors_t + YearFE + BankFE + \varepsilon_{i,t}$. The sample period is from January 2013 to December 2017. For fixed-rate securities, *Spread* is the difference in yields between the subordinated debt security and the nearest maturity government bond. For floating-rate securities, *Spread* is the discount margin, which is the difference between the internal rate of return on the subordinated debt cash flows and the reference bank bill swap rate, assuming that the reference rate does not change over the life of the security. *PONV* is a dummy variable which equals 1 if a subordinated debt security is issued with the Basel III loss absorption feature, i.e. a point of non-viability trigger. *-MertonDD* is the negative distance-to-default calculated using the Merton model. *Equity volatility* is the standard deviation of the bank's equity returns over the past twelve months. *Idiosyncratic volatility* is the residual standard error estimated for the bank's common equity using a rolling market index model over the past 130 trading days. *NPL* is non-performing loans divided by total loans. *Trading assets* is the bank's trading book to total assets ratio. *Common equity ratio* is the book value of common equity divided by the book value of assets. *ROA* is the return on assets, computed as net income divided by average assets. *Cash holdings* is cash holdings divided by total assets. *Log issue size* is the logarithm of the issue size of the subordinated debt security in constant 2017 dollars. *Log TTM* is the logarithm of the term-to-effective maturity of the subordinated debt security. *Callable* is a dummy variable which equals 1 if the security is callable by the issuer on a pre-defined date. *Term spread* is the term structure premium, measured by the yield spread between 10-year Australian Government bonds and 90-day bank accepted bills. *Default premium* is the default risk premium, measured by the yield spread between bonds in the S&P/ASX corporate bond index and Australian Government bonds with nearest average time-to-maturity. *VIX* is the level of S&P/ASX 200 VIX index. Robust t-statistics in parentheses are based on standard errors clustered at both the security and month-end date levels. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

Panel A: Fixed-rate bonds

	Dependent variable: Credit spread				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Independent variables	**- MertonDD**	**Equity volatility**	**Idiosyncratic volatility**	**NPL**	**Trading assets**
PONV (α_1)	0.732***	0.732***	0.743***	0.756***	0.752***
	(3.48)	(3.48)	(3.50)	(3.43)	(3.54)
Bank risk (β_1)	0.057**	0.016***	0.021	-0.059	-0.022
	(2.47)	(3.14)	(0.55)	(-0.89)	(-1.26)
Common equity ratio (γ_1)				-0.028	-0.016
				(-0.38)	(-0.23)
ROA (δ_1)	-0.583***	-0.619***	-0.643***	-0.708***	-0.661***
	(-3.69)	(-4.07)	(-3.96)	(-3.76)	(-4.22)
Cash holdings (δ_2)	0.002	0.002	0.002	0.001	0.002
	(0.52)	(0.45)	(0.42)	(0.16)	(0.56)
Log TTM (δ_3)	0.022	0.022	0.020	0.018	0.016
	(0.60)	(0.61)	(0.54)	(0.46)	(0.44)
Log issue size (δ_4)	-0.029	-0.029	-0.026	-0.028	-0.025
	(-0.48)	(-0.48)	(-0.43)	(-0.46)	(-0.42)
Callable (δ_5)	0.410***	0.411***	0.411***	0.404***	0.404***
	(4.70)	(4.72)	(4.70)	(4.65)	(4.61)
Term premium (δ_6)	0.039	0.033	0.078	0.065	0.083
	(0.42)	(0.38)	(0.79)	(0.64)	(0.86)
Default premium (δ_7)	0.728***	0.701***	0.837***	0.825***	0.857***
	(3.60)	(3.48)	(4.01)	(3.87)	(4.17)
VIX (δ_8)	0.023***	0.022***	0.032***	0.032***	0.032***
	(3.74)	(3.64)	(3.99)	(3.97)	(3.83)
Observations	1,389	1,389	1,389	1,389	1,389

No of banks	5	5	5	5	5
No of subordinated bonds	46	46	46	46	46
Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.571	0.571	0.567	0.568	0.569

Panel A: Floating-rate bonds

	Dependent variable: Credit spread				
Independent variables	**(1) - MertonDD**	**(2) Equity volatility**	**(3) Idiosyncratic volatility**	**(4) NPL**	**(5) Trading assets**
PONV (α_1)	0.446***	0.447***	0.449***	0.454***	0.485***
	(3.47)	(3.50)	(3.52)	(3.40)	(3.74)
Bank risk (β_1)	0.015	0.007	0.079	-0.063*	-0.017
	(0.50)	(0.96)	(0.53)	(-1.92)	(-0.78)
Common equity ratio (γ_1)				-0.164***	-0.133**
				(-3.60)	(-2.40)
ROA (δ_1)	-0.667***	-0.679***	-0.674***	-0.634***	-0.507**
	(-3.31)	(-3.51)	(-3.38)	(-3.19)	(-2.26)
Cash holdings (δ_2)	0.004	0.003	0.004	0.005	0.006***
	(1.07)	(1.03)	(0.97)	(1.51)	(9.17)
Log TTM (δ_3)	0.086*	0.087*	0.084*	0.087*	0.087*
	(1.77)	(1.78)	(1.78)	(1.87)	(1.91)
Log issue size (δ_4)	-0.407**	-0.406**	-0.406**	-0.421***	-0.390**
	(-2.51)	(-2.49)	(-2.51)	(-2.61)	(-2.58)
Callable (δ_5)	-0.738***	-0.731***	-0.732***	-0.735***	-0.775***
	(-3.57)	(-3.47)	(-3.52)	(-3.50)	(-3.85)
Term premium (δ_6)	0.374***	0.361***	0.377***	0.386***	0.389***
	(4.38)	(4.35)	(5.02)	(5.33)	(5.52)
Default premium (δ_7)	0.965***	0.926***	0.973***	1.048***	1.120***
	(4.34)	(3.94)	(4.35)	(4.87)	(5.09)
VIX (δ_8)	0.013**	0.012*	0.015**	0.015**	0.016***
	(2.16)	(1.95)	(2.30)	(2.35)	(2.67)
Observations	861	861	861	861	800
No of banks	8	8	8	8	8
No of subordinated bonds	29	29	29	29	29
Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.812	0.812	0.812	0.817	0.771

security has the Basel III point of the non-viability trigger; and equals 0 if the subordinated debt security was issued under the Basel I or Basel II regimes, i.e., without the Basel III point of non-viability trigger. Five alternative measures are used to capture bank risk (*Bank risk*), which are the negative of the Merton distance-to-default ($-MertonDD$), common equity volatility ($Equity\ volatility$), the residual standard error ($Idiosyncratic\ volatility$) estimated for the bank's common equity, the ratio of non-performing loans to total loans (*NPL*), and the ratio of trading assets to total assets (*Trading assets*). The regression model controls for the bank's profitability, liquidity position and common equity position (*Bank control factors*) using the return on assets (*ROA*), the ratio of cash and liquid assets to total assets (*Cash holdings*) and the ratio of the book value of common equity to total assets (*Common equity ratio*). To control for subordinated debt characteristics (*Subordinated bond characteristics*), we include the logarithm of the amount issued of the security in millions of constant 2017 Australian dollars (*Log issue size*), the logarithm of the time-to-maturity in years (*Log TTM*), and a dummy variable which equals 1 if the security is callable by the issuer (*Callable*). Considering that macroeconomic factors could also result in credit spread differences between old-style and bail-in subordinated bonds, we further control for the default risk premium in the corporate bond market in general (*Default premium*), the term structure premium (*Term premium*) and the level of S&P/ ASX 200 VIX index (*VIX*).

If investors anticipate the possibility of being exposed to potential future bank loses on account of the Basel III loss absorbency mechanism for tier 2 capital instruments when pricing bail-in subordinated debt, it is expected that the coefficient on the *PONV* dummy variable will be significantly positive. The regression results for fixed-rate and floating-rate subordinated bonds are reported in panels A and B of table 5. Consistent with the prior expectation, the coefficient on the *PONV* dummy variable in all regressions, applying the different risk proxies, is positive and statistically significant. The regression results provide evidence that investors in the Basel III bail-in subordinated bonds take account of the Basel III point of non-viability trigger when making their pricing decisions. The coefficient on the *PONV* dummy variable suggests that investors demand an additional risk premium of approximately 73 basis points and 45 basis points for fixed-rate and floating rate securities respectively when investing in the Basel III bail-in subordinated debt, relative to the risk premium they demand for investing in the old-style subordinated bonds. The results are consistent across all regressions, which use bank fixed effects to control for omitted bank-specific factors and use year fixed effects to control for any other factors that are common to all sample banks.

If investors in subordinated debt securities demand higher compensation for trading securities issued by riskier banks, the coefficients on the five alternate variables for measuring bank risk are expected to be positive and significant. In panel A, the significantly positive coefficients in front of two of the risk measures (columns 1 and 2), namely, $-$*MertonDD* and

Equity volatility, provide support for the idea that subordinated debt investors demand higher compensation for investing in banks with a higher risk of insolvency, as captured by the negative distance-to-default and common equity volatility. However, the estimated coefficients on the other risk measures are statistically insignificant or negative (columns 3 to 5 in panel A and columns 1 to 5 in panel B). There is no evidence that investors price subordinated bonds based on bank risk captured by idiosyncratic equity volatility, non-performing loans or trading assets. Analysis on whether the Basel III point of non-viability trigger may result in an increased sensitivity of credit spreads to bank risk is reported in the next subsection.

To disentangle the effect of the Basel III bail-in mechanism from other factors that might impact on the credit spreads of subordinated debt securities, the model includes variables to control for other subordinated debt characteristics, bank-level characteristics and macroeconomic conditions. With regard to variables measuring subordinated debt security characteristics, the significant and negative coefficient on *Log issue size* in the floating-rate security regressions (panel B) is consistent with a benefit of larger issues to subordinated debt investors, derived from better liquidity in the secondary market. However, the coefficient on this variable is insignificant in the fixed-rate subordinated debt regressions (panel A). The estimated coefficient on *Log TTM* is positive and significant at the 10% level in all of the floating-rate subordinated debt regressions, which suggests that the default premiums are higher for floating-rate subordinated debt securities with longer times remaining to maturity. The results indicate a significantly positive relationship between credit spreads and the dummy variable *Callable* in the fixed-rate security regressions. With bonds that have a call option, the issuer may buy back the bonds from investors at a pre-defined call date, which is valuable to the issuer when interest rates go down and bond prices increase. However, the coefficient on *Callable* in the floating-rate security regressions is significantly negative. This result is unexpected, but likely arises from the unbalanced sample, with almost all of the floating-rate bonds being callable by the issuer.

In relation to characteristics of the bank that has issued the subordinated bond, the regressions include the ratio of common equity to total assets to control for the bank's solvency position, the return on assets to control for the bank's profitability and the ratio of cash holdings to total assets for the bank's liquidity position. The book value of the bank's total assets is excluded from the regressions, due to its high collinearity with the issue size of the subordinated bonds and with the bank fixed effects. Also, to avoid collinearity with the bank risk measures, the common equity ratio is omitted as an explanatory variable if the risk measure incorporates the bank's capital adequacy (as is the case for $-MertonDD$, $Equity\ volatility$ and $Idiosyncratic\ volatility$). It is expected that the coefficient on the $Common\ equity\ ratio$ will be negative and significant if the credit spreads for the subordinated bonds are sensitive to the bank's capital position. The results show a significant and negative coefficient on the $Common\ equity\ ratio$ in the floating-rate bond regressions having NPL and $Trading\ assets$ as the risk variables, which suggests that the credit spreads are sensitive to the banks' common equity position. If investors take account of a bank's profitability and operating efficiency, we expect to observe a negative coefficient on the bank's lagged return on assets. The negative and significant coefficient on ROA in all of the regressions for both fixed-rate and floating-rate subordinated bonds suggests that investors view banks with better profitability and greater operating efficiency as less likely to become financially distressed. The coefficient on cash holdings is expected to be negative if investors in subordinated bonds perceive that banks with more liquid assets have greater capacity to meet future payment obligations. However, the coefficient on $Cash\ holdings$ is not significantly negative in any of the regressions.

To allow for changes in credit market conditions over the sample period, the regressions include the term premium, the default premium and the level of S&P/ASX 200 VIX index. It is expected that the credit spreads for subordinated debt securities will be positively related to the slope of the yield curve. Consistent with this expectation, in all of the floating-rate bond regressions, the coefficient on the $Term\ premium$ variable is positive and significant. The coefficient on the $Default\ premium$ variable is positive and significant in all of the regressions in both panel A and panel B. This suggests that changes in credit spreads for banks' subordinated bonds are closely related with conditions prevailing in the Australian corporate bond market. The regression results for both fixed-rate and floating-rate securities indicate a significantly positive relationship between the credit spreads for bank subordinated bonds and the level of S&P/ASX 200 VIX index, which suggests that aggregate uncertainty in the securities market has a significant influence on the pricing of bank subordinated debt.

5.3 Impact of the point of non-viability trigger on the relation between bank risk and subordinated debt pricing

One explanation for the results reported in table 5 is that investors in Basel III bail-in subordinated debt securities demand an additional risk premium compared with old-style securities because they anticipate being exposed to potential future bank losses if the bank breaches the discretionary point of non-viability trigger. However, previous studies argue that the additional risk premium might be attributable to the uncertainty associated with the way in which the regulator will exercise its discretion in relation to the non-viability trigger, rather than to an increased exposure to potential bank losses (see for example, Davis & Saba 2016). If investors in Basel III bail-in subordinated bonds have greater exposure to potential bank losses than those in conventional securities issued without the loss absorption feature, they can be expected to be more sensitive to the bank's risk profile when pricing the securities. To address this question, the analysis reported in this subsection examines whether the Basel III bail-in feature affects the risk-sensitivity of the credit spreads for subordinated bonds. The pricing regression model is augmented with an interaction term between the *PONV* dummy variable and the measure of bank risk, as well as an interaction term between the *PONV* dummy variable and the equity capital ratio. Using this approach, the main effects of the risk variable and the equity capital ratio capture the sensitivity of credit spreads to bank risk and equity capital for investors in the old-style subordinated bonds, while the interaction terms capture the incremental sensitivity of credit spreads to bank risk and equity capital for investors when investing in bail-in subordinated bonds with the Basel III point of non-viability trigger. Investors are expected to be better incentivised to monitor bank risks if the loss absorbing capacity of the subordinated bonds is improved, which would be reflected in an increased sensitivity of security credit spreads to bank risk and equity capital. If investors are more sensitive to bank risk, we expect to observe positive and significant coefficients on the interaction terms between the *PONV* dummy variable and bank risk and between the *PONV* dummy variable and equity capital.

Table 6 presents the regression results for fixed-rate bonds (panel A) and floating-rate bonds (panel B). The estimated coefficients on the main risk variables are not positive and significant in any of these regressions for either fixed-rate or floating-rate subordinated

Table 6: Impact on the relation between bank risk and subordinated debt pricing

This table presents regression results for the specification, $Spread_{i,t} = \alpha_1 PONV_i + \beta_1 Bank\ risk_{i,t-1} + \beta_2 PONV_i \times Bank\ risk_{i,t-1} + \gamma_1 Common\ equity\ ratio_{i,t-1} + \gamma_2 PONV_i \times Common\ equity\ ratio_{i,t-1} + \delta_B Bank\ control\ factors_{i,t-1} + \delta_S Subordinated\ bond\ characteristics_{i,t} + \delta_M Macroeconomic\ factors_t + YearFE + BankFE + \varepsilon_{i,t}$. The sample period is from January 2013 to December 2017. For fixed-rate securities, *Spread* is the difference in yields between the subordinated debt security and the nearest maturity government bond. For floating-rate securities, *Spread* is the discount margin, which is the difference between the internal rate of return on the subordinated debt cash flows and the reference bank bill swap rate, assuming that the reference rate does not change over the life of the security. *PONV* is a dummy variable which equals 1 if the subordinated debt security is issued with the Basel III loss absorption feature, i.e. a point of non-viability trigger. *-MertonDD* is the negative distance-to-default calculated using the Merton model. *Equity volatility* is the standard deviation of the bank's equity returns over the past twelve months. *Idiosyncratic volatility* is the residual standard error estimated for the bank's common equity using a rolling market index model over the past 130 trading days. *NPL* is non-performing loans divided by total loans. *Trading assets* is the bank's trading book to total assets ratio. *Common equity ratio* is the book value of common equity divided by the book value of assets. *ROA* is the return on assets, computed as net income divided by average assets. *Cash holdings* is cash holdings divided by total assets. *Log issue size* is the logarithm of the issue size of the subordinated debt security in constant 2017 dollars. *Log TTM* is the logarithm of the term-to-effective maturity of the subordinated debt security. *Callable* is a dummy variable which equals 1 if the security is callable by the issuer on a pre-defined date. *Term spread* is the term structure premium, measured by the yield spread between 10-year Australian Government bonds and 90-day bank accepted bills. *Default premium* is the default risk premium, measured by the yield spread between bonds in the S&P/ASX corporate bond index and Australian Government bonds with nearest average time-to-maturity. *VIX* is the level of S&P/ASX 200 VIX index. Robust *t*-statistics in parentheses are based on standard errors clustered at both the security and month-end date levels. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

Panel A: Fixed-rate bonds

	Dependent variable: Credit spread				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Independent variables	**- MertonDD**	**Equity volatility**	**Idiosyncratic volatility**	**NPL**	**Trading assets**
PONV (α_1)	1.291***	0.107	0.502**	0.856	0.970*
	(3.81)	(0.47)	(2.02)	(0.65)	(1.70)
Bank risk (β_1)	0.022	0.005	0.019	-0.058	-0.016
	(1.03)	(0.88)	(0.51)	(-1.27)	(-0.81)
PONV × Bank risk (β_2)	0.122***	0.030***	0.331*	-0.006	-0.021
	(3.03)	(3.12)	(1.84)	(-0.04)	(-0.72)
$\beta_1 + \beta_2$	0.144***	0.035***	0.351*	-0.064	-0.037
	(4.52)	(4.68)	(1.89)	(-0.41)	(-1.31)
Common equity ratio (γ_1)				-0.026	-0.014
				(-0.35)	(-0.19)
PONV × Common equity ratio (γ_2)				-0.014	-0.003
				(-0.10)	(-0.03)
$\gamma_1 + \gamma_2$				-0.040	-0.017
				(-0.26)	(-0.15)
ROA (δ_1)	-0.668***	-0.733***	-0.680***	-0.704***	-0.568***
	(-4.19)	(-4.60)	(-4.12)	(-3.52)	(-3.20)
Cash holdings (δ_2)	0.000	0.000	0.001	0.001	0.003
	(0.05)	(0.10)	(0.36)	(0.14)	(0.67)
Log TTM (δ_3)	0.023	0.022	0.020	0.018	0.011
	(0.63)	(0.62)	(0.54)	(0.44)	(0.27)
Log issue size (δ_4)	-0.016	-0.022	-0.023	-0.028	-0.022
	(-0.26)	(-0.36)	(-0.38)	(-0.45)	(-0.36)
Callable (δ_5)	0.415***	0.411***	0.415***	0.404***	0.389***
	(4.66)	(4.68)	(4.73)	(4.75)	(4.83)

Term premium (δ_6)	0.034	0.037	0.075	0.065	0.094
	(0.39)	(0.44)	(0.77)	(0.66)	(0.98)
Default premium (δ_7)	0.635***	0.613***	0.807***	0.823***	0.900***
	(3.12)	(3.09)	(3.75)	(3.74)	(4.30)
VIX (δ_8)	0.022***	0.022***	0.031***	0.032***	0.031***
	(3.60)	(3.79)	(3.92)	(4.00)	(3.84)
Observations	1,389	1,389	1,389	1,389	1,389
No of banks	5	5	5	5	5
No of subordinated bonds	46	46	46	46	46
Adjusted R-squared	0.579	0.580	0.568	0.567	0.571

Panel B: Floating-rate bonds

	Dependent variable: Credit spread				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Independent variables	**- MertonDD**	**Equity volatility**	**Idiosyncratic volatility**	**NPL**	**Trading assets**
PONV (α_1)	0.962***	-0.118	0.343**	0.713	-0.833
	(4.70)	(-0.82)	(2.19)	(1.04)	(-0.89)
Bank risk (β_1)	-0.028	-0.006	0.021	-0.077**	-0.029
	(-1.36)	(-0.92)	(0.15)	(-2.14)	(-1.35)
PONV $\times$ Bank risk (β_2)	0.108***	0.029***	0.151	0.030	0.043*
	(3.73)	(4.21)	(0.84)	(0.38)	(1.89)
$\beta_1+\beta_2$	0.080**	0.023**	0.172	-0.047	0.014
	(2.12)	(2.85)	(0.92)	(-0.73)	(0.55)
Common equity ratio (γ_1)				-0.160***	-0.223***
				(-2.88)	(-3.12)
PONV $\times$ Common equity ratio (γ_2)				-0.048	0.168
				(-0.46)	(1.20)
$\gamma_1+\gamma_2$				-0.021**	-0.055
				(-2.27)	(-0.56)
ROA (δ_1)	-0.729***	-0.711***	-0.707***	-0.617***	-0.585**
	(-3.56)	(-3.59)	(-3.55)	(-3.13)	(-2.58)
Cash holdings (δ_2)	0.006*	0.006***	0.004	0.003	0.006**
	(1.91)	(3.43)	(1.38)	(0.09)	(1.99)
Log TTM (δ_3)	0.075	0.082*	0.082*	0.081*	0.080*
	(1.59)	(1.70)	(1.73)	(1.72)	(1.71)
Log issue size (δ_4)	-0.413***	-0.410***	-0.411**	-0.426**	-0.391***
	(-2.61)	(-2.58)	(-2.52)	(-2.53)	(-2.60)
Callable (δ_5)	-0.855***	-0.827***	-0.814***	-0.686**	-1.122***
	(-4.04)	(-3.72)	(-3.26)	(-2.48)	(-2.92)
Term premium (δ_6)	0.374***	0.373***	0.377***	0.381***	0.389***
	(4.58)	(4.75)	(5.04)	(5.27)	(5.43)
Default premium (δ_7)	0.931***	0.902***	0.959***	1.052***	1.110***
	(4.15)	(3.87)	(4.30)	(4.86)	(5.05)
VIX (δ_8)	0.014**	0.013**	0.015**	0.015**	0.018***
	(2.38)	(2.19)	(2.36)	(2.35)	(2.90)
Observations	861	861	861	861	800
No of banks	8	8	8	8	8
No of subordinated bonds	29	29	29	29	29
Adjusted R-squared	0.819	0.822	0.812	0.817	0.773

bonds. There is no evidence that the credit spreads for conventional subordinated debt securities are sensitive to the risks captured by the market value-based measures ($-MertonDD$, *Equity volatility* and *Idiosyncratic volatility*) or the accounting-based measures (*NPL* and *Trading assets*). This can possibly be explained by the fact that, before the Basel III reforms were implemented, subordinated debt investors were not required to absorb bank losses until a bank entered a formal bankruptcy process. The Basel III bail-in rule attempts to increase the exposure of subordinated debt investors to bank losses by applying a discretionary point of non-viability trigger mechanism to these securities. Among the interaction terms between the *PONV* dummy variable and bank risk, those involving the negative distance-to-default and equity volatility are positive and significant in the regressions for both fixed-rate and floating-rate bonds (columns 1 and 2 in panel A and panel B). In addition, for fixed-rate bonds, the coefficient on the interaction term between the *PONV* dummy variable and *Idiosyncratic volatility* is positive and statistically significant at the 10% level. However, the coefficients on the interaction terms between the *PONV* dummy variable and the accounting-based risk measures, *NPL* and *Trading assets*, are not statistically significant, which may be a consequence of less timely nature of the accounting data. The results based on the market-derived risk measures suggest that investors in the Basel III bail-in subordinated bonds are more responsive to banking risks in their pricing decisions than investors in the old-style subordinated bonds. This finding is consistent with the idea that the point of non-viability trigger is recognised by investors as giving them greater potential exposure to bank losses.

The regressions reported in columns 4 and 5 include the main effect of the *Common equity ratio* and the interaction term between the *PONV* dummy variable and *Common equity ratio*. The coefficient on the interaction term can be expected to be negative if the probability of the non-viability trigger being activated is lower for better capitalised banks. As reported in table 6 panel B, the coefficient on the main effect of the *Common equity ratio* is negative and significant. However, the coefficient on the interaction term $PONV \times Common\ equity\ ratio$ is insignificant in all of the regressions for both fixed-rate and floating-rate bonds. Thus, there is no evidence that investors are more responsive in their pricing decisions to a bank's equity capital position on account of the gone-concern loss absorption mechanism.

In summary, the results reported in table 6 suggest that, compared with the conventional subordinated debt securities, the pricing of bail-in subordinated debt is more sensitive to bank default risk as captured by market-based measures i.e., the negative Merton distance-to-default, common equity volatility and idiosyncratic equity volatility. There is no evidence that the pricing of Basel III bail-in subordinated debt is more sensitive to the bank's common equity position. In general, the results provide evidence about the credibility assigned by investors to the Basel III point of non-viability trigger mechanism, which is consistent with investors anticipating that they have greater potential exposure to bank losses under the new regime.

6 Conclusion

To address the moral hazard problems highlighted by the 2007-2009 financial crisis and shortcomings in the resolution procedures for gone-concern banks, the Basel III reforms introduced a regulatory discretionary loss absorbency requirement for subordinated debt to qualify as tier 2 capital under international standards. Australian banks began transitioning to the new requirement from the beginning of 2013. If the regulator declares the bank to be non-viable, subordinated bonds with the non-viability trigger are converted to common equity or written-off, which gives the regulator greater flexibility in imposing losses on subordinated creditors. While Australian banks started to issue Basel III bail-in subordinated bonds, the conventional subordinated bonds, i.e., those without the point of non-viability trigger, are being phased out over a ten-year period to 2023. Using secondary market data for subordinated debt securities issued by Australian banks and traded by investors in the period from January 2013 to December 2017, this study examines the impact of the Basel III point of non-viability trigger on the credit spreads of the subordinated bonds. We find evidence suggesting that the loss absorption mechanism is taken into account by investors when they are pricing the Basel III bail-in debt securities. The results suggest that investors require a bail-in risk premium associated with the discretionary point of non-viability trigger mechanism. This pricing effect is evident when controlling for other debt security characteristics, bank profitability and financial strength, and macroeconomic factors. The average bail-in risk premium is estimated to be approximately 73 basis points for fixed-rate subordinated bonds and 45 basis points for floating-rate subordinated bonds.

To further elucidate about the credibility of the discretionary trigger mechanism for imposing potential bank losses on subordinated creditors, this study examines whether the Basel III discretionary bail-in feature has resulted in an increased sensitivity of the credit spreads on subordinated debt securities to bank risks. The results suggest that the pricing of Basel III bail-in subordinated bonds has become more sensitive to bank risk as captured by market-based measures, i.e., the negative Merton distance-to-default, common equity volatility and idiosyncratic equity volatility. These findings are consistent with the idea that investors in the Basel III bail-in subordinated bonds have greater potential exposure to banking losses than investors in the old-style subordinated bonds.

In a financial system in which banks take risks and authorities are prepared to tolerate the possibility of bank failure, the Basel III loss absorption requirements may provide a credible way to impose bank losses on creditors and to facilitate recovery planning and resolution planning. The empirical evidence reported generally supports the vision of the Financial Stability Board, which has advocated for additional loss-absorbing capacity within systemically important banks, to reduce the frequency of banking crises and to support the resolution process for banks when crises occur (Austrlian Prudential Regulation Authority 2018). The Basel III capital adequacy framework seeks to create additional loss-absorbing capacity within banks by modifying the contractual terms for existing capital instruments. The framework delineates between going-concern and gone-concern regulatory capital and mandates a mechanical capital ratio-based trigger and a regulatory discretionary trigger in each case. The efficiency with which these trigger mechanisms can be activated remains to be tested in stressed market conditions. However, the results presented in this study suggest that investors anticipate greater potential exposure to banking losses, with the inclusion of the Basel III discretionary bail-in trigger in particular.

With the early phase-in of the Basel III framework in Australia, the data available during the transitional period have allowed me to undertake research on the impact of key features of the reforms on the funding cost advantage of systemically important banks and on the pricing and liquidity of bank capital instruments, using the local banking industry as an experimental environment. Other countries have implemented the reforms in line with the international phase-in timeline, in many cases using the flexibility within the framework to allow for differences in local conditions. Future research can examine the impact of different approaches to implementing the Basel III capital reforms on the outcomes identified in this study. Recent events in other jurisdictions will also allow for an examination of the impact of the activation of the Basel III loss absorption mechanisms on market discipline. For example, the European Central bank deemed Banco Popular, a Spanish bank, as "failing or likely to fail" and the point of non-viability trigger was activated. Future research can investigate the impact of loss absorption trigger events on the pricing of bank capital instruments and the implications for the broader banking sector.

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Appendix 1

Calculation of Merton distance-to-default

We follow Hillegeist, Keating, Cram & Lundstedt (2004) in calculating Merton's (1974) distance-to-default. The market value of equity is modelled as a European call option on the value of the bank's assets:

$$V_E = V_A e^{-\delta T} N(d_1) - X e^{-rT} N(d_2) + (1 - e^{-\delta T}) V_A \tag{A1}$$

$$d_1 = \frac{log(\frac{V_A}{X}) + (r - \delta + \frac{\sigma_A^2}{2})T}{\sigma_A \sqrt{T}} \tag{A2}$$

$$d_2 = d_1 - \sigma_A \sqrt{T} \tag{A3}$$

where V_E is the market value of equity, V_A is the market value of the bank's assets, X is the face value of debt maturing at time T, r is the continuously compounded risk-free interest rate, δ is the continuously compounded dividend rate expressed in terms of V_A and σ_A is the standard deviation of asset returns. The values of V_A and σ_A are estimated by simultaneously solving equation (A1) and the optimal hedge equation:

$$\sigma_E = \frac{V_A e^{-\delta T} N(d_1) \sigma_A}{V_E} \tag{A4}$$

where σ_E is the standard deviation of equity returns. V_E is set equal to the current market value of equity and σ_E is computed as the annualised standard deviation of daily equity returns over the past twelve months. The strike price X is set equal to the book value of total liabilities at the most recent semi-annual reporting date. T equals one year and r is the 90-day bank bill rate. The dividend rate, δ, is the log return represented by the sum of the prior year's common and preferred dividends with respect to the approximate market value of assets (defined as the book value of total liabilities plus the book value of preferred stock plus the market value of common stock). The Newton method is used to solve the two equations. For starting values, we use $V_A = X + V_E$ and $\sigma_A = \sigma_E V_E / (V_E + X)$.

Finally, we calculate Merton's (1974) distance-to-default as:

$$Mertondd = \frac{log(\frac{V_A}{X}) + (\mu - \delta - \frac{\sigma_A^2}{2})T}{\sigma_A \sqrt{T}} \tag{A5}$$

where μ is the continuously compounded expected return on assets. We set μ equal to the natural logarithm of 1 plus after-tax profit before preferred dividends divided by the approximate market value of assets.

The default probability is the normal transform of the distance-to-default measure:

$$PD = N(-MertonDD) \tag{A6}$$