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OF AUSTRALIA

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Reporting Australia's Foreign Reserve Holdings

Chris Potter*

The Reserve Bank of Australia reports details of Australia's official reserve assets, foreign currency liquidity and net foreign reserves on a monthly basis. This article details changes that will make the Bank's reporting methodology consistent with current guidelines published by the International Monetary Fund (IMF). Data will be revised back to January 2015. While the new methodology implies a reduction in the reported gross level of Australia's official reserve assets, net foreign reserves will remain unchanged.

Introduction

Australia's official reserve assets (ORA) comprise foreign currency-denominated assets, gold bullion, Australia's reserve position in the IMF and Special Drawing Rights (SDRs), which is an international reserve asset created by the IMF. Aside from the reserve position in the IMF, which is owned by the Commonwealth Government of Australia, these assets reside on the balance sheet of the Reserve Bank of Australia. They are held to support the Bank's policy objectives.

The Bank regularly reports on the size and composition of Australia's ORA, as well as foreign currency liquidity (FCL) and net foreign reserves. For the most part, these data are currently prepared in accordance with guidelines published by the IMF.[1] However, over time, some differences have emerged between the Bank's reporting methodology and the IMF's guidelines (which are updated from time to time). This article identifies these differences and foreshadows changes that will bring the Bank's reporting methodology into line with the IMF's guidelines. These changes in methodology will alter the size of Australia's reported ORA, but will have no effect on Australia's net foreign reserves, which is a better measure of the capacity of the Bank to undertake foreign exchange (FX) policy operations.

The IMF's International Reserves and Foreign Currency Liquidity Framework

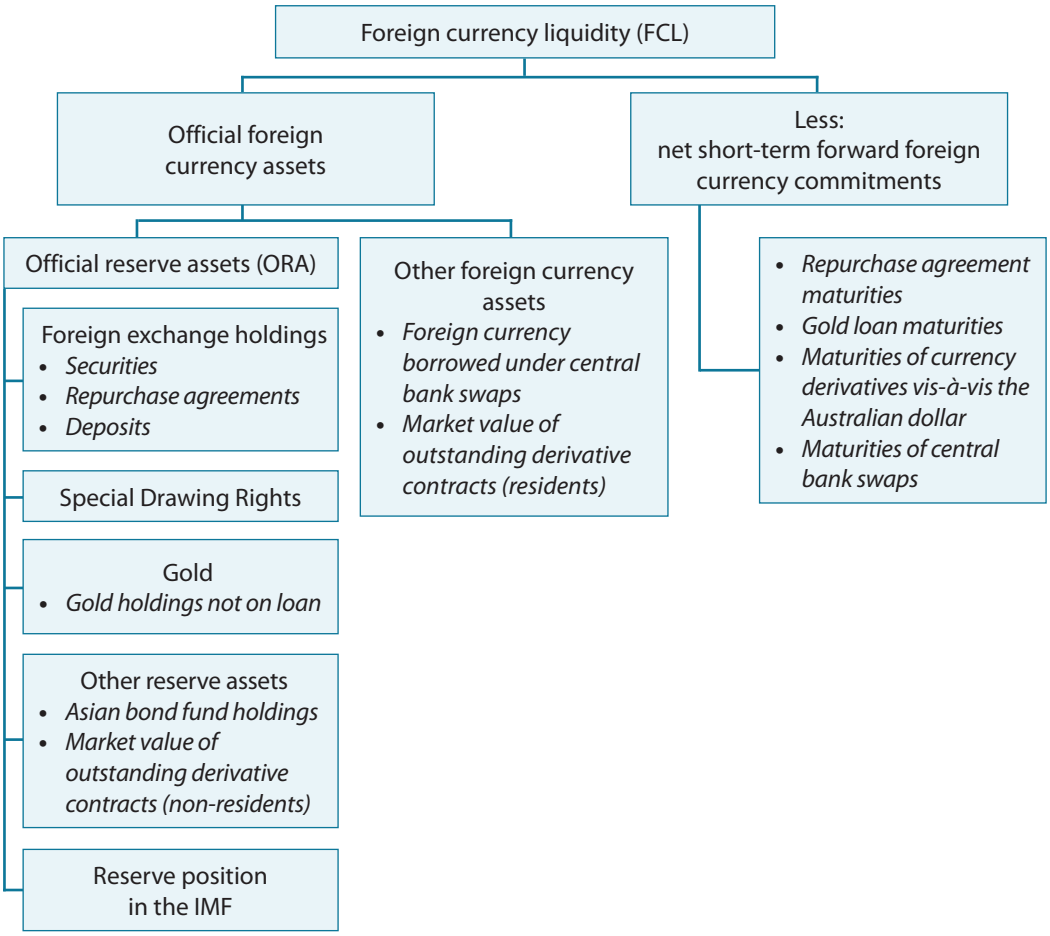
The IMF's International Reserves and Foreign Currency Liquidity (IRFCL) framework provides a means to account for the official foreign currency assets and net short-term forward foreign currency commitments of a country's authorities (Figure 1). Under this framework, FCL is defined as the difference between official foreign currency assets and net short-term forward foreign currency commitments. FCL represents the value of foreign currency that a country's authorities could deploy for policy purposes over the subsequent 12 months.

Official foreign currency assets comprise ORA, which are foreign currency claims on

* The author is from the Risk and Compliance Department.

1 Gold and foreign exchange assets reported on the Bank's balance sheet are prepared in accordance with Australian accounting standards and may therefore differ from the basis used to report ORA, FCL and net foreign reserves.

Figure 1: International Reserves and Foreign Currency Liquidity



Sources: IMF, RBA

non-residents that meet certain criteria discussed below, as well as other foreign currency assets not considered ORA, such as certain foreign currency claims on domestic residents and foreign currency borrowed under bilateral central bank swap agreements. Net short-term forward foreign currency commitments comprise future inflows and outflows of foreign currency that will affect official foreign currency assets over the next 12 months. In the case of the Bank, these include the maturities of repurchase agreements (repos), gold loans and FX derivative contracts where one currency is the domestic currency (that is, the Australian dollar).

Net foreign reserves refers to the net foreign reserve asset position of Australia's authorities and is defined as official foreign currency assets less *total* net forward foreign currency commitments. FCL and net foreign reserves are identical when all outstanding net forward foreign currency commitments are contracted to mature within 12 months, which is typically the case for the Bank. Net foreign reserves is not separately identified in the IMF's IRFCL framework.

The Bank publishes Australia's IRFCL data on its website on a monthly basis. The composition of ORA is published separately via a press release each month. Official foreign currency assets, net forward foreign currency commitments and net foreign reserves are published in Statistical Table A4.[2]

Revised Approach to Reporting Official Reserve Assets

The IMF defines ORA as foreign currency claims on non-residents that are:

- **Owned** or under the **effective control** of the monetary authorities
- **Readily available** in the most unconditional form (that is, available with few constraints; for example, loans must be payable on demand)
- A **liquid** or **marketable** asset (can be bought or sold with minimum cost and time and for which there are ready and willing sellers and buyers within a few days)
- Denominated and settled in **convertible** foreign currencies that are **freely usable** for settlements of international transactions.[3]

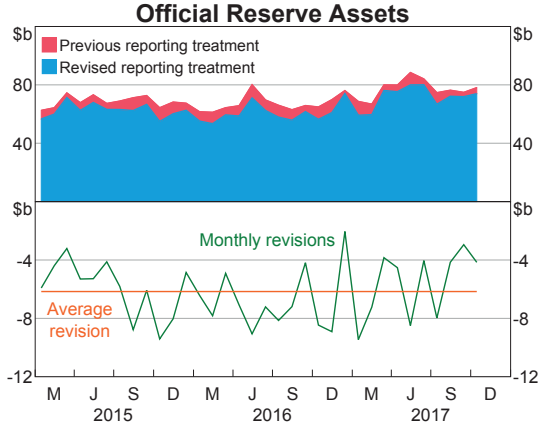
Under the IMF's IRFCL framework, ORA must satisfy these basic principles and should be reported at the market value that represents the amount of foreign currency that could be raised upon liquidation in the market. Aligning the Bank's reporting methodology with the IMF's guidelines will change the reporting treatment of repos, reverse repos, derivative contracts and gold loans. The changes are outlined in Table 1.

These changes in methodology will be reflected in the IRFCL data published on the Bank's website for the month of December 2017 onwards. Data on ORA and net forward foreign currency commitments contained in Statistical Table A4 will be revised back to January 2015. At the same time, the format of Statistical Table A4 will be changed to provide disaggregation of official foreign currency assets between ORA and other foreign currency assets, and net forward foreign currency commitments will be defined more broadly.[4] Revisions will also be reflected in the ORA press release for December 2017.

Impact of reporting changes

Revisions to data from January 2015 to October 2017 will result in a decline in the value of reported ORA of around $6.1 billion or 9 per cent, on average (Graph 1).

Graph 1
Official Reserve Assets



Source: RBA

The decline in ORA mainly reflects the effect of changes to the treatment of reverse repos, which contributed an average decline of around

2 See International Reserves and Foreign Currency Liquidity <https://www.rba.gov.au/statistics/xls/imf-monthly-survey-current.xlsx>, Official Reserve Assets <https://www.rba.gov.au/statistics/frequency/reserve-assets.html> and Statistical Table A4 - Foreign Exchange Transactions and Holdings of Official Reserve Assets <https://www.rba.gov.au/statistics/tables/xls/a04hist.xls>.

3 For more information on the IMF's definition of ORA, see IMF (2009) and IMF (2013).

4 In addition to notional values of unsettled spot and forward FX transactions where one currency is the Australian dollar, net forward foreign currency commitments will include future maturities of the Bank's gold loans, repos, reverse repos and transactions under the Bank's bilateral currency swap agreements with other central banks.

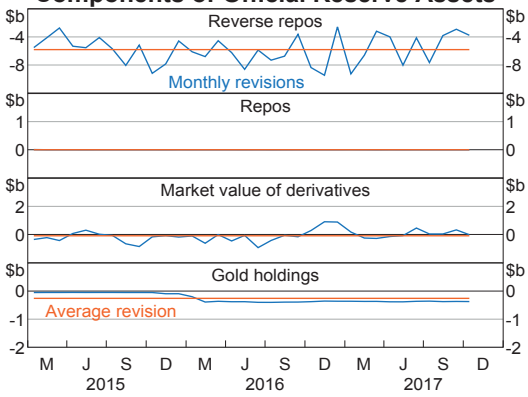
Table 1: Previous and Revised Reporting Approaches

Product	Previous treatment	Revised treatment
Reverse repurchase agreement	I. Include cash lent under repo in ORA II. Exclude collateral held under repo from ORA	I. Exclude cash lent under repo from ORA II. Exclude collateral held under repo from ORA III. Report cash lent under repo as an inflow in net short-term forward foreign currency commitments
Repurchase agreement	I. Include collateral lent under repo in ORA II. Exclude cash borrowed under repo from ORA	I. Exclude collateral lent under repo from ORA II. Include cash borrowed under repo in ORA III. Report collateral lent under repo and cash borrowed under repo, respectively, as an inflow and outflow in net short-term forward foreign currency commitments
Derivatives contracts	I. Include market values of (non-Australian dollar) interest rate and bond futures contracts in ORA II. Exclude market values of (non-Australian dollar) FX derivative contracts from ORA, but include them in other foreign currency assets III. Report notional values of FX derivative contracts vis-à-vis the Australian dollar maturing in the next 12 months as an inflow or outflow in net short-term forward foreign currency commitments	I. Include market values of (non-Australian dollar) interest rate and bond futures contracts and *all* FX derivative contracts *with non-resident counterparties* in ORA II. Include market values of (non-Australian dollar) interest rate and bond futures contracts and *all* FX derivative contracts *with resident counterparties* as other foreign currency assets III. Report notional values of FX derivative contracts vis-à-vis the Australian dollar maturing in the next 12 months as an inflow or outflow in net short-term forward foreign currency commitments
Gold loans	I. Include all gold holdings in ORA (including gold on loan) II. Exclude any collateral held (or collateral pledged) under gold loans from ORA	I. Include gold holdings not on loan in ORA II. Exclude gold on loan to *all counterparties* from ORA and other foreign currency assets III. Exclude any collateral held (or collateral pledged) under gold loans from ORA IV. Report gold on loan as an inflow in net short-term forward foreign currency commitments

Source: RBA

$5.8 billion to the drop in total ORA (Graph 2). As the Bank has had close to 10 per cent of its gold holdings on short-term loan over the past two years or so, the gold component of ORA will be revised lower by around $0.4 billion.

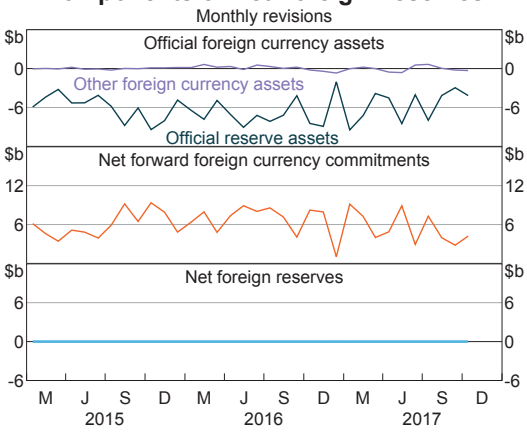
Graph 2
Components of Official Reserve Assets



Source: RBA

The revisions to ORA will be accompanied by revisions to other foreign currency assets and net forward foreign currency commitments. These revisions, in aggregate, will have no effect on net foreign reserves (Graph 3). As noted earlier in this article, FCL will be equivalent to net foreign reserves as long as the Bank continues to have no net forward foreign currency commitments with more than 12 months to maturity.

Graph 3
Components of Net Foreign Reserves

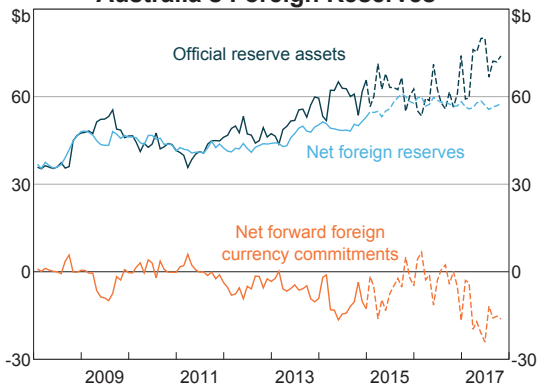


Source: RBA

Which Measure of Foreign Reserves?

This article has referred to three distinct measures of foreign reserves: ORA, net foreign reserves and FCL; for practical purposes, FCL can be considered equivalent to net foreign reserves. In recent years, Australia's ORA and net foreign reserves have diverged considerably. In October 2017, ORA exceeded net foreign reserves by $16 billion and, in June 2017, by as much as $23 billion (Graph 4). ORA have also tended to be considerably more volatile than net foreign reserves.

Graph 4
Australia's Foreign Reserves*



* Spliced series, dashed lines indicate reporting under revised methodology

Source: RBA

The difference between ORA and net foreign reserves primarily reflects net forward foreign currency commitments resulting from the Bank's domestic market operations. Over recent years, the Bank has increased its use of FX swaps when managing domestic liquidity (swapping Australian dollars for foreign currencies alters the supply of exchange settlement balances held by commercial banks at the Bank in the same way as a repo transaction).[5] Under these transactions, the Bank has mostly been a net lender of Australian dollars and a borrower of foreign currency, typically for short terms of no longer

5 For further details, see RBA (2017).

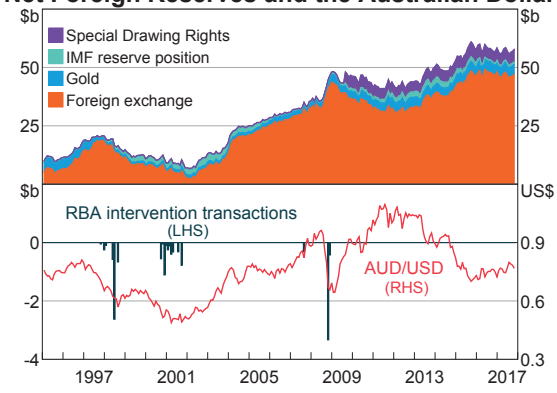
than three months. Foreign currency borrowed in this way temporarily increases both the Bank's official foreign currency assets (and ORA) and net forward foreign currency commitments until the maturity of the FX swap, when the foreign currency is returned. These transactions have contributed to most of the volatility in ORA in recent years.

Temporary increases in ORA arising from short-term borrowings are not considered as an increase in the policy capacity of foreign reserves due to the short rollover period of the Bank's FX swap book. If the Bank did deploy these borrowings for the purpose of FX market intervention amid a depreciation in the Australian dollar, it could prove very costly to repay or roll over maturing FX swaps if the exchange rate continued to depreciate in the short term. Some central banks do acquire foreign reserves for policy purposes through long-term borrowings, which defer the rollover of foreign currency-denominated liabilities for time frames of, for example, five years. However, this strategy still exposes a central bank to rollover risk if foreign reserves are run down and any depreciation in the domestic currency is sustained.[6]

Net foreign reserves constitutes the value of official foreign currency assets not subject to this type of rollover risk and can be considered the effective capacity of Australia's authorities to undertake FX policy operations. The majority of net foreign reserves are foreign exchange holdings, which, in practice, would be the component deployed by the Bank to effect FX market intervention (Graph 5). The Bank last conducted FX market intervention in November 2008.

6 For further details, see Vallence (2012).

Graph 5
Net Foreign Reserves and the Australian Dollar



Source: RBA

Summary

A change to the Bank's methodology for compiling data as part of the IMF's International Reserves and Foreign Currency Liquidity framework has resulted in downward revisions to the gross level of official reserve assets for January 2015 to October 2017. Corresponding revisions to other foreign currency assets and net forward foreign currency commitments have, however, resulted in no change in net foreign reserves, which represents the effective capacity of Australia's authorities to undertake foreign exchange policy operations.

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IMF (International Monetary Fund) (2009), *Balance of Payments and International Investment Position Manual*, 6th Edition, IMF, Washington, DC, pp 111–118.

IMF (2013), *International Reserves and Foreign Currency Liquidity: Guidelines for a Data Template,* 2nd Edition, IMF, Washington, DC.

RBA (Reserve Bank of Australia) (2017), 'Operations in Financial Markets', *Reserve Bank of Australia Annual Report 2017*, pp 47–57.

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The Reserve Bank's Collateral Framework

Yasaman Naghiloo and David Olivan*

The Reserve Bank, like other central banks, holds collateral to reduce the risk of financial loss in its domestic market operations. The Reserve Bank's collateral framework sets out how the diverse portfolio of collateral assets is managed and ensures that collateral of sufficient quality and value is held at all times. Over the past two decades, the framework has been adjusted to address changes in collateral supply, changes in market functioning during the global financial crisis, payment system innovations and new banking regulations. This article explores the rationale for these changes and discusses the key features of the current framework.

Introduction

A central bank implements monetary policy and supports the smooth running of the payments system by managing the availability of cash in the financial system. A central bank can also provide liquidity during times of financial system stress to promote financial stability. It does so by lending against collateral, that is, an asset held as security by the cash lender. If the borrower cannot repay the loan, the lender can sell the collateral and minimise the risk of financial loss. This is commonly known as secured lending.

In their domestic market operations, central banks may provide their counterparties such as banks and other regulated financial firms with cash in return for collateral of sufficient quality and value.[1] Central banks take collateral to reduce the risk of financial losses in the event that a counterparty were to default. Unless it is bound by specific laws or regulations, a central bank generally determines its own rules for what constitutes collateral of sufficient quality and value. These rules are set out in its collateral framework, which determines the policies for choosing and managing collateral. This includes an eligibility process, as well as the daily processes for managing the risks that come with holding collateral – namely credit, liquidity and market risk. This article discusses how central banks choose and manage their collateral, focussing on the Reserve Bank's collateral framework.

Some common collateral rules

Central banks typically accept a range of collateral assets in their secured lending operations.[2] The criteria typically include:

- Type of asset and issuer – generally debt securities (e.g. bonds) and their approved issuers, classified as either public sector (government) or private sector (banks or non-financial corporate issuers).

* The authors are from Domestic Markets Department.

1 Collateral provided by a central bank to a counterparty in return for cash is not discussed here, as such transactions are typically governed by a different set of rules.

2 For more information, see *Central Bank Collateral Frameworks and Practices* (BIS 2013); *Central Bank Operating Frameworks and Collateral Markets* (BIS 2015).

- Credit standards – a mix of internal and external credit rating processes are used to determine the credit worthiness of the collateral issuer and its debt securities.
- Currency and issuer jurisdiction – whether the collateral issuer must be incorporated within the central bank's jurisdiction or not and whether the collateral is issued in a foreign currency or not.
- Settlement – the form and system used to transfer the collateral between the central bank and its counterparties.

Collateral must be of sufficient quality and value to cover the amount of cash lent by the central bank to its counterparties.

A number of other things are taken into consideration in deciding the range of eligible collateral and the ways risks are managed, including whether assets are marketable, how related party risks are managed and how ownership of collateral is transferred to the central bank.

Marketable assets

High quality marketable assets, such as bonds and money market instruments issued by governments, banks or non-financial corporations provide a ready source of collateral for central bank market operations. These debt securities are traded in financial markets and, as a result, can be easily sold (or valued) in the event that a cash borrower were to default. Bonds from high-quality issuers are less risky than other marketable assets such as equities. This is because bonds represent an obligation for the issuer to make regular interest payments and to repay the debt in full at an agreed future date. For these reasons, central banks widely accept bonds in their collateral frameworks.

Limited use of non-marketable assets

Some central banks also accept assets that are less actively traded in financial markets, such as bank loans or residential mortgage-backed securities (RMBS). In such cases, specific credit criteria apply to ensure that these are performing assets, that is, they provide dependable returns and are unaffected by borrower defaults or arrears. In general, these non-marketable assets are used for specific circumstances, for example for special lending facilities or during periods of financial market stress.

Managing related-party risk

Central banks typically do not buy bonds from counterparties that are related to the issuer of the bond, because if a counterparty cannot repay the central bank, a related bond issuer may also be unable to repay its bond obligations. In some limited cases, central banks can make exceptions to this principle. For instance, a central bank can accept RMBS issued by the bank that is also the originator of the mortgage loans backing the security. The main reason for this exception is that the loans underpinning the RMBS would not be directly impaired if the issuer of the RMBS was to fail – that is RMBS are 'bankrupt remote' structures. RMBS share this characteristic with covered bonds, which are also accepted in some central banks' frameworks. The Reserve Bank permits related-party RMBS in limited cases, for example, to support the provision of liquidity for timely settlement in the payments system.

Buying versus pledging

Central banks typically obtain collateral securities by buying them in their domestic market operations. Securities can be bought 'outright', but more often, they are bought under a repurchase agreement ('repo'). Repos involve the purchase of a security for cash with

an undertaking to reverse the transaction at an agreed future date and price.[3] Alternatively, in some frameworks, collateral can be pledged to the central bank under a collateralised loan agreement. Although repos and collateral pledges are legally different, they are economically equivalent. In both cases, collateral is transferred to the central bank in return for cash, and then at a future date, the central bank returns the collateral to the counterparty when it repays the central bank.

Central banks apply different rules regarding the types of assets they will accept depending on how they implement their monetary policy and the types of liquidity facilities they run. Other differences include which counterparties can participate in their domestic market operations and legal restrictions on what asset types can be accepted as collateral. Importantly, collateral frameworks also reflect specific characteristics of domestic financial markets such as their size and level of sophistication.

Collateral frameworks for open market operations and standing facilities

Central banks that only accept marketable assets with low credit risk, such as government bonds, have a narrow framework. Often, narrow frameworks are used in routine open market operations (OMOs) to implement monetary policy.

Liquidity can also be provided via standing facilities (SFs), which are provided by the central bank for specific purposes. For example, in Australia, counterparties can borrow overnight from the Reserve Bank's SFs if there is a shortage of cash in the money market. The provision of the central bank's SFs for such a scenario can reduce the pressure for participants in the money market to trade at interest rates well above the central bank's operational target for the money market interest rate. Liquidity under the SFs can also be used to support the smooth running of the payments system. Banks can take out very short-term liquidity – such as intraday liquidity – to make their payments to other banks in advance of the payments they plan to receive from other banks. Because this liquidity smooths out the volume of payments, it can help to avoid gridlock in the payments system, where a large volume of payments are delayed to late in the day. Emergency liquidity, such as lender of last resort liquidity can also be made available under the SFs in periods of financial system stress. Under its SFs, the central bank may accept high-quality but less liquid securities, such as bank bonds and RMBS. This is called a wide framework.

The Reserve Bank, the Eurosystem national central banks and the Swiss National Bank have a wide framework for both their OMOs and SFs (Table 1). Other central banks, such as the Federal Reserve System, have historically applied a narrow framework for OMOs and a wider one for their SFs. The Bank of England also differentiates collateral types depending on the liquidity facility being accessed.

Developments in the Reserve Bank's Collateral Framework

This section reviews the collateral securities purchased by the Reserve Bank in its domestic market operations. The Reserve Bank's collateral framework has changed significantly in recent decades. This has been driven by changes in collateral supply, the response to the global financial crisis, as well as more recent payment system and regulatory developments.

3 Cash refers to exchange settlement balances that market participants transfer between each other, rather than banknotes.

Table 1: Central Bank Collateral Frameworks and Practices
Key cross-country characteristics

	Reserve Bank of Australia Australia	Bank of England United Kingdom	European Central Bank Eurosystem	Federal Reserve System United States of America
Collateral eligibility across lending operations and facilities	Differentiated	Differentiated	Uniform	Differentiated
Collateral eligibility	Wide for OMOs Varies for SFs (based on counterparty); but may be wider or narrower than OMOs	Varies across lending operations and facilities	Wide	Narrow for OMOs Wide for SFs
Collateral system	Earmarked	Mostly pooled	Mostly pooled	Earmarked for OMOs Pooled for SFs
Counterparty eligibility for lending operations and facilities	Wide	Varied	Wide	Narrow for OMOs Wide for SFs
Risk management techniques				
Margins	Yes	Yes	Yes	Yes
Valuations	Yes	Yes	Yes	Yes
Margin calls	Yes	Yes	Yes	Yes
Limits	No	Yes; can be counterparty or collateral specific	Yes; can be counterparty or collateral specific	Yes; can be counterparty or collateral specific
Tri-party collateral management services and providers	Yes, service provider: ASX Collateral	No	Yes, service providers: Bank of New York Mellon, Clearstream, Euroclear, JP Morgan, SIX SIS	Yes, service providers: Bank of New York Mellon, Clearstream, Euroclear and JP Morgan

Sources: BIS; various central banks

The Reserve Bank's domestic market operations

The Reserve Bank provides liquidity to the domestic financial system in the form of exchange settlement (ES) balances. These funds are held by banks in accounts at the Reserve Bank. The Reserve Bank supplies this liquidity through its domestic market operations, which include OMOs and SFs. In return for the liquidity provided in these operations, the Reserve Bank buys Australian dollar-denominated securities. These purchases are mainly contracted as repos.[4]

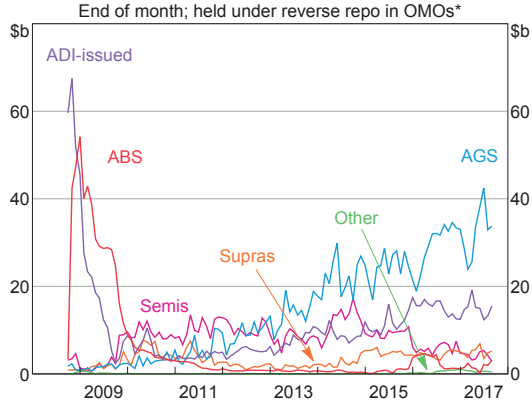
The Reserve Bank's OMOs are held every business day. OMOs are used to adjust the supply of liquidity in the interbank market so as to ensure that the cash rate remains consistent with the target rate set by the Reserve Bank Board.[5] They are conducted as competitive liquidity auctions and successful counterparties must promptly sell eligible collateral securities to the Reserve Bank in return for ES funds.[6]

Unlike OMOs where liquidity is auctioned, the Reserve Bank's SFs are made available to banks at pre-specified terms, with the cost of accessing them known in advance. SFs can be accessed by banks and a small number of other institutions that have key interbank obligations in the domestic payments system. These facilities provide intraday liquidity to help smooth the flow of interbank payments, either via intraday SF repos for payments during business hours, or via 'open' SF repos for after-hours payments such as those that will be going through the New Payments Platform.[7] The SFs can also be accessed for overnight terms if a counterparty is unable to obtain funds in the interbank market, with the Reserve Bank charging the counterparty a margin above the cash rate.[8]

Most of the securities purchased by the Reserve Bank under repo in its OMOs are issued by the Australian Government (AGS) and State and Territory governments ('semis') (Graph 1). Securities issued by authorised deposit-taking institutions (ADIs) comprise most of the remainder. In contrast, asset-backed securities (mainly RMBS) account for most of the collateral purchased by the Reserve Bank for open repos under the SFs (Graph 2). When banks enter into intraday SF repos with the Reserve Bank, the bulk of these repos are against AGS and semis.

Over the past two decades, the Reserve Bank has progressively widened its collateral framework by expanding the range of securities it is willing to accept under repo in its domestic market operations (Table 2).

Graph 1
Market Value of Eligible Collateral
End of month; held under reverse repo in OMOs*



* Includes tri-party repos
Source: RBA

4 Collateral may also be purchased by the Reserve Bank on an outright basis and generally held as an asset until maturity. Only securities issued by the Australian Government or by the central borrowing authorities of the State and Territory governments are purchased outright by the Reserve Bank in its OMOs.

5 The cash rate is defined as the weighted average of interest rates on unsecured, overnight loans between banks in the cash market. While the Reserve Bank does not participate directly in the cash market, it controls the availability of ES balances through its OMOs. For more information on the Australian cash market, see Hing, Kelly and Olivan (2016).

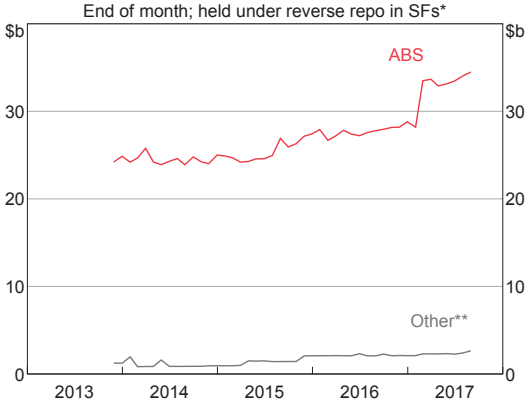
6 For further information on the Reserve Bank's OMOs, see <https://www.rba.gov.au/mkt-operations/resources/tech-notes/open-market-operations.html>.

7 For further information on the New Payments Platform, see <http://www.nppa.com.au/what-is-the-new-payments-platform/>.

8 For further information on the Reserve Bank's SFs, see <https://www.rba.gov.au/mkt-operations/resources/tech-notes/standing-facilities.html>.

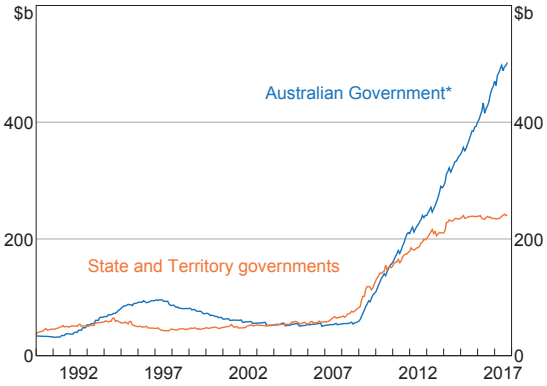
Graph 2
Market Value of Eligible Collateral

End of month; held under reverse repo in SFs*



* Includes open SF repos, but excludes intraday SF repos
** Includes all eligible collateral that are not ABS
Source: RBA

Graph 3
Government Securities on Issue



* Excludes securities purchased by the Australian Government
Sources: ABS; AOFM; RBA; State and Territory Treasury Corporations

Adapting to collateral shortages

The outstanding amount of AGS gradually declined from the late 1990s to the mid 2000s, as the Australian Government budget was in surplus during this period (Graph 3). The small amount of AGS on issue made it difficult for the Reserve Bank to conduct OMOs only using AGS as collateral so, in 1997, the Reserve Bank expanded the list of eligible collateral to include semis.[9] However, State and Territory governments were also tending to run balanced or surplus budgets at that time, so the total supply of collateral remained low.

To ensure that collateral of sufficient value and quality was available for its domestic market

Table 2: Changes in Australian Dollar Securities Eligible for Purchase by the Reserve Bank under Repo

	Date of Eligibility
Australian Government Securities	1969
Semi-government Securities	June 1997
Securities Issued by Supranationals	October 2000
ADI-issued securities	
Residual maturity less than 1 year – SFs	July 2002
Securities Issued by Foreign Governments/ Securities with a Foreign Sovereign Government Guarantee	March 2004
ADI-issued securities	
Residual maturity less than 1 year – OMOs	March 2004
Residual maturity of 1 year or more	September 2007
Asset-backed Securities of unrelated parties	October 2007
Asset-backed Securities of related parties (self-securitised)	October 2008
Securities with an Australian Government Guarantee	November 2008
Other Securities (A-1 or AAA rated)	November 2008

Source: RBA

9 For more information on the implications of the decline in Australian government debt, see Edey and Ellis (2001).

operations, the Reserve Bank widened its collateral framework throughout the 2000s. Initially, bonds from other public sector issuers were accepted. These included Australian dollar-denominated bonds issued by certain supranational agencies, such as the World Bank, in 2000. In 2002, certain ADI-issued short-term securities (with a residual maturity of less than 12 months) were permitted for use in intraday SFs. This decision preceded the go-live of Continuous Linked Settlement (CLS), a foreign exchange settlement system. In 2004, Australian dollar-denominated securities issued by foreign governments and government agencies with an explicit government guarantee were approved, and short-term ADI-issued securities already eligible for use in intraday SFs were also approved for use in OMOs.[10]

Responding to the global financial crisis

Over the course of 2007 and 2008, financial market conditions deteriorated sharply and market participants increased their demand for ES balances, which provide a risk-free source of liquidity. At the same time, segments of the domestic bond market became increasingly illiquid as banks globally became averse to lending to each other. To promote financial stability and help keep liquidity flowing in the financial markets, the Reserve Bank further widened its collateral framework. This coincided with similar changes in the collateral frameworks of other central banks, such as the Bank of England, Eurosystem national central banks and the Federal Reserve System around this time (Table 3).

In particular, following the first signs of liquidity stress in the financial markets in September 2007, the Reserve Bank decided to accept long-term ADI-issued securities ('bank bonds'). The following month, the framework was expanded to include Australian RMBS and shorter-term securities called asset-backed commercial paper (ABCP).

In September 2008, the default of Lehman Brothers triggered another bout of financial market stress. To further expand the range of funding options for financial institutions and bolster financial stability, the Reserve Bank adjusted its related-party restriction on RMBS in October 2008. This meant that certain institutions (such as banks) could use related-party RMBS in the Reserve Bank's domestic market operations. This exemption remained in place until November 2009, when related-party RMBS could no longer be used. This reflected the improvement in liquidity and funding conditions in the domestic financial markets. Consequently, the need for banks to fund themselves using internal securitisations of mortgages had passed. To support liquidity in a number of other markets, the Reserve Bank further widened its collateral framework in November 2008, including other highly rated bonds, covered bonds, other asset-backed securities (ABS), as well as ADI-issued securities with an Australian Government Guarantee.[11]

Supporting faster payment systems

In recent years, the Reserve Bank's collateral framework has also evolved in response to developments in the payments system. Direct entry (DE) payments are used by businesses and government agencies to make and receive regular payments, such as salaries and frequent bills. In 2013, the settlement process for DE payments

10 The Reserve Bank does not accept ADIs' own securities or securities for which they are a related party as collateral in its domestic market operations.

11 Although ADIs retained access to credit markets during the global financial crisis, the announcement of similar schemes in other countries and significant financial market uncertainly, led the Australian Government to introduce a Government Guarantee Scheme for Large Deposits and Wholesale Funding in October 2008. The guarantee was offered on bonds issued by eligible ADIs for a fee and was used substantially as the demand for unguaranteed debt globally diminished. The Government Guarantee Scheme ended in March 2010 and liabilities ceased to exist by October 2015. For more information on the scheme, see Schwartz and Tan (2016).

Table 3: Summary of Eligible Collateral in Selected Central Bank Open Market Operations

	Reserve Bank of Australia	European Central Bank	Federal Reserve System	Swiss National Bank
	Australia	Eurosystem	United States of America	Switzerland
Marketable securities				
Debt issued by:				
Central borrowing authorities of Federal, State or Territory governments	Yes	Yes	Yes	Yes
Government agencies	Yes	Yes	Yes	Yes
Central banks	n/a	Yes	n/a	Yes
Supranationals	Yes	Yes	No	Yes
Financial institutions (excluding covered bonds)	Yes	Yes	No	Yes
Corporations (other than financial institutions)	Yes	Yes	No	Yes
Asset-backed	Yes	Yes	No	No
Other securities (including covered bonds)	Yes	Yes	No	No
Non-securities (such as equities or gold)	No	No	No	No
Non-marketable securities				
Credit claims (such as bank loans)	No	Yes	No	No
Non-marketable asset-backed securities	No	Yes	No	No
Cross-border securities				
Currency	No	Yes	No	Yes
Issuer	Yes	Yes	No	Yes

Sources: BIS; various central banks

was enhanced so that it now occurs in a series of batches on the same day up to 9.15 pm, rather than at 9 am on the following day. To ensure that there was enough liquidity in the payments system for the evening DE batches to settle after the close of the interbank cash market, open SF repos were established.[12] They allow banks to maintain a pre-determined amount of ES balances, which are then available to settle DE payments outside of normal market business hours. Given the relatively large size of open SF repos required to support these payment processes (currently around $27 billion), the Reserve Bank permits banks to use related-party RMBS as collateral in open SF repos. Open SF repos will also be used to provide after-hours liquidity for the Fast Settlement System – the technology that supports the New Payments Platform for the 24/7 real-time settlement of retail payments.

Supporting reforms to strengthen the banking system

The Reserve Bank further amended its framework following the introduction in 2015 of the

12 For more information on the introduction of same-day settlement of direct entry obligations, see Fraser and Gatty (2014).

Liquidity Coverage Ratio (LCR) by the Australian Prudential Regulation Authority (APRA). Under the LCR, banks must hold sufficient high-quality liquid assets (HQLA) to meet their (expected) net cash outflows for a 30-day liquidity stress scenario. However, the supply of HQLA securities, which are limited to AGS and semis, is not sufficient for the banks to be able to meet their LCR requirements without unduly affecting market functioning for AGS and semis. To address this, locally incorporated banks are able to establish a Committed Liquidity Facility (CLF) with the Reserve Bank to meet their LCR requirements.[13] Not all LCR banks in Australia require a CLF and those which do must apply to APRA for approval before establishing a CLF.

A CLF is a contractual liquidity commitment from the Reserve Bank whereby a fee of 15 basis points per annum is charged on the size of the commitment. Any drawdown on the CLF must meet certain conditions, including that APRA does not object to the drawdown and the RBA assesses that the ADI has positive net worth. All SF repos for CLF banks represent a partial drawdown on the CLF, and these banks are allowed to use all eligible collateral when entering into SF repos, including related-party RMBS. However, to ensure that the Reserve Bank's collateral framework is consistent with APRA's liquidity standard, banks subject to the LCR that do not have a CLF can only use AGS and semis in the Reserve Bank's SFs.

Risk Management of Collateral

Collateral receivers continually manage the risks associated with holding collateral, such as credit, liquidity and market risk. The Reserve Bank monitors and manages the risk on the collateral it accepts by applying margins, performing daily valuations and making margin calls.

13 For more information on the CLF, see Debelle (2011).

Limiting credit risk

The Reserve Bank only buys securities with low credit risk. Apart from AGS and semis, all other securities are subject to an approval process. This involves a credit assessment for each issuer and security. As part of this process, minimum credit ratings criteria apply to each collateral type.[14] Even if a security qualifies on the basis of its credit rating, it may still be rejected if the Reserve Bank determines that its structure is overly complex.

The credit ratings of individual securities and bond issuers are constantly monitored. A credit rating downgrade generally results in the security, or issuer, being withdrawn from the list of eligible collateral. When this happens, counterparties with affected collateral outstanding must immediately provide eligible securities in place of the ineligible collateral.

The Reserve Bank's potential exposure to RMBS has increased substantially over the past decade following the introduction of open SF repos and the CLF. To ensure that this risk is properly monitored, extensive reporting requirements apply to any issuer that wants to have their RMBS deemed eligible for repo with the Reserve Bank. These requirements include providing the Reserve Bank with up-to-date reports on the RMBS and the underlying loans, including loans amounts and balances, and information about the borrower (e.g. income and employment type) and collateral (e.g. property and location).[15]

Managing other risks

Even when securities pass the eligibility test, the risk of financial loss in the event of a counterparty default is not eliminated. This is because the

14 For further details on the minimum credit ratings that apply to each collateral type, see <https://www.rba.gov.au/mkt-operations/resources/tech-notes/eligible-securities.html>.

15 For detail on the data to be reported, see <http://www.rba.gov.au/securitisations/data-to-be-reported/index.html>.

value of collateral purchased by the central bank can change over the life of the repo and may not be able to be fully realised in the event of a counterparty default. A range of risk mitigation techniques are used to ensure that the value of collateral is always sufficient. Approaches to risk management are broadly similar across central banks, with margins, valuations and margin calls typically used in lending operations and facilities (Table 1).

Applying a haircut

When the Reserve Bank buys securities against cash, the security is subject to an upfront margin, which is also known as a 'haircut' or 'initial margin'. A margin is a certain percentage of additional collateral the counterparty has to sell on top of the value of the initial cash loan (Figure 1). For example, in a $100 million repo with the Reserve Bank, the counterparty must sell $102 million worth of government securities, which is a 2 per cent haircut.

Figure 1

Source: RBA

Haircuts are designed to protect the cash lender against a potential fall in the value of the collateral. The riskiness of each security depends on its characteristics, including its maturity, price volatility, the creditworthiness of the issuer and the time it would take to sell the security. For example, long-term securities are more price sensitive than short-term securities. In addition, government securities' prices are less volatile than bank bonds' prices, where credit risk is also greater. Also, government securities could be sold fairly quickly in the event that the repo counterparty were to default, since they are actively traded in financial markets, whereas ADI-issued securities and RMBS would take more time to liquidate. To address these risks, haircuts on securities such as bank bonds and RMBS are significantly higher than for government securities in the Reserve Bank's collateral framework. Securities with lower market liquidity, greater credit and price risk, and longer terms attract a higher haircut. These haircuts are applied uniformly to securities bought in OMOs and SFs.[16]

Haircuts can be changed as new information about how collateral performs over time comes to light. For example, the Reserve Bank changed its haircuts following the global financial crisis. During this time, volatility in the market prices of bonds increased significantly. The new haircuts were introduced in February 2012. They were more sensitive to the specific credit, liquidity and maturity characteristics of each collateral type. They also reflected the new information gained about the performance of eligible securities in stressed market conditions.

Daily margining

Daily margining, also known as 'variation margin', is the process for maintaining the value of the haircut. For example, if the value of a government bond declined and represented $101 million instead of $102 million against a loan of $100 million, the Reserve Bank would make a margin call equivalent to $1 million of government bond securities. The margin call would bring the haircut-adjusted value of the government bond back to the 102 per cent.

In a collateral framework, it is important to ensure that robust processes exist to keep track of the daily value of all collateral securities.

16 For further details on the Reserve Bank's current margin schedule, see <https://www.rba.gov.au/mkt-operations/resources/tech-notes/margin-ratios.html>.

This ensures that collateral is always sufficient. For securities that trade in liquid markets, such as government securities and most ADI-issued securities, the Reserve Bank obtains the latest prices from publically available and independent sources. For securities that are less liquid, such as related-party RMBS, alternative model-based techniques are used to determine a price. For example, the Reserve Bank makes use of the updated data it receives for RMBS to independently value these securities.

Methods to Transfer Collateral

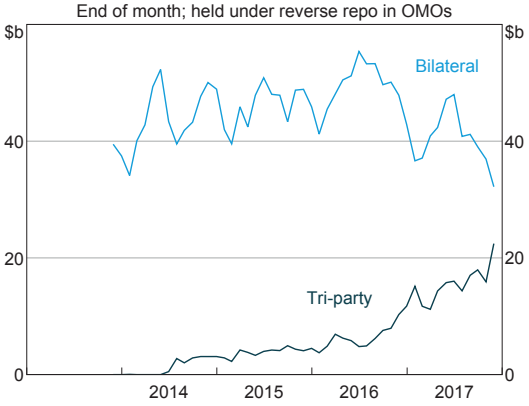
The Reserve Bank's collateral framework operates as an 'earmarked' system, where a counterparty sells individual securities under each repo. For example, a $100 million repo may involve purchases by the Reserve Bank of one or more individual securities. Repos can therefore involve many transactions. Some central banks have instead opted for a 'pooled' system, whereby a general selection of collateral securities is pledged to the central bank in the form of an aggregate pool. The loan is therefore secured by the aggregate value of the pool, not by individual purchases of securities under repo. In recent years, a number of central banks, such as the Bank of England and some Eurosystem national central banks, have moved towards collateral pooling for their operations or facilities (Table 2).

The choice of system has implications for collateral management for both the central bank and its counterparties. Pooled systems often involve the 'pre-positioning' of collateral. This means that a counterparty pledges a pool of collateral to the central bank and the central bank can lend funds to the counterparty at any time against the value of that collateral (net of haircuts). On the other hand, under an earmarked system, collateral is not pre-positioned but sold in exchange for cash each time a counterparty accesses a central bank's liquidity operations or facilities. Also, collateral can only be moved by a process of collateral substitutions. This means that counterparties can recall the securities they sold under repo, but must replace those securities with other eligible securities. This can be a time-consuming process, although in recent years tri-party arrangements have allowed for this activity to be automated.

Tri-party facilitates the automatic allocation of collateral and has been adopted by a number of central banks over the past few years. In a tri-party repo, the terms of a repo transaction – that is the repo rate, maturity of the trade and cash value – are agreed bilaterally. However, a third party takes responsibility for the settlement, collateralisation and margin maintenance of the collateral securities. This party is called the tri-party agent. In February 2014, the Reserve Bank began to accept tri-party settlement for its OMOs using ASX Collateral – a collateral management service whereby the ASX is the tri-party agent to the Reserve Bank's repos. This service provides significant operational efficiencies, including faster book entry of repo details and no manual collateral substitution activity.

Over time, the proportion of OMO repos settled in ASX Collateral has gradually increased to around 40 per cent (Graph 4). However, uptake of this service by domestic financial market participants has remained low relative to international standards. In countries such as the United States, where there is a well-established tri-party repo market, tri-party arrangements are offered by a number of service providers and are actively used by market participants.

Graph 4
Cash Value of Reverse Repos
End of month; held under reverse repo in OMOs



Source: RBA

Conclusion

When conducting OMOs and providing SFs, the Reserve Bank takes collateral of sufficient quality and value to manage the risk of financial loss. Collateral securities are carefully chosen and managed. Robust processes are in place to constantly manage credit, liquidity and market risks; such processes include eligibility criteria, prudent collateral haircuts and daily valuation and margin maintenance. Over time, the Reserve Bank has adapted its collateral framework to changes in government bond supply, the global financial crisis and more recently, new regulations to make banks better able to manage financial market stress and innovation in the payments system.

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Housing Accessibility for First Home Buyers

Gianni La Cava, Hannah Leal and Andrew Zurawski*

The ability of Australians to purchase their first home (`housing accessibility') has been an important topic of public debate recently. In this article, we construct an indicator of housing accessibility that suggests that the median potential first home buyer can currently afford about one-third of homes in Australia. However, accessibility varies significantly with geographic location, and the quality of housing affordable to potential first home buyers has declined, particularly in Sydney.

Introduction

The affordability of housing, particularly for young Australians and households with low incomes, is an important topic of public debate. The concept of affordability refers to the relative cost of purchasing housing services, which has a number of dimensions. It can refer to how much saving is required to buy a home, how much it costs to repay a mortgage or how much it costs to rent a home.

An important part of housing affordability is the accessibility of ownership; that is, the ability of non-home owners to buy their first home. This article focusses specifically on housing accessibility for young first home buyers (FHBs). We first outline some conventional estimates of housing affordability and discuss their shortcomings. We then propose an alternative indicator of housing accessibility, first discussed in Richards (2008), which tries to address some of these shortcomings. For instance, conventional estimates normally focus on the housing prices and incomes facing the average household. But FHBs are not the average household; they are usually younger, have lower incomes and are less wealthy.

* The authors are from Economic Group.

This alternative indicator of housing accessibility has two key features that distinguish it from conventional measures:

- It measures the purchasing capacity of potential FHBs, rather than all households, by using household survey data on the incomes of young renting households.
- It looks at the full spectrum of housing prices, not just the average home price, in a given location by using transaction-level data on home-sale prices.

Given the decision to buy a home is also a choice between renting and owning, the article also briefly discusses trends in the cost of renting.

Conventional Measures of Housing Affordability

Relative housing prices

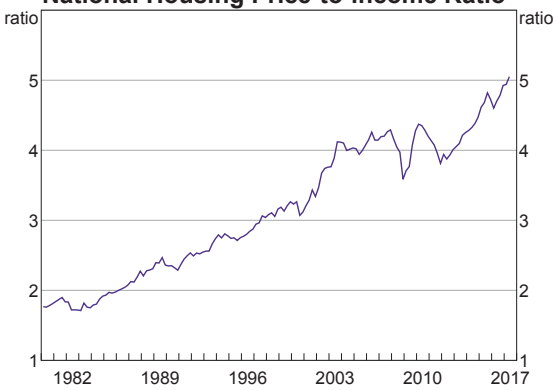
A common measure of housing affordability is the ratio of mean housing prices to mean household disposable income (or the 'housing price-to-income ratio'; median prices and incomes are also sometimes used). This indicator effectively measures the relative expense of

purchasing a home for an average household, and takes growth in real incomes and overall inflation into account. If housing prices are rising relative to household income, then housing is becoming less affordable, all else being equal. This is because a higher ratio implies that households have to borrow more to buy a home. Alternatively, they may need to save a higher share of income, or save for a longer period of time, to accumulate a larger deposit.

In Australia, the housing price-to-income ratio has increased since the early 1990s, and has increased particularly rapidly over the past five years to reach its highest level on record (Graph 1). At face value, this suggests that housing affordability is at a record low. However, this masks significant differences across states. The recent trend increase in the housing price-to-income ratio is largely due to increases in the ratios in New South Wales and Victoria (Graph 2). The housing price-to-income ratios have increased by less in other states in recent years and suggest that housing affordability in those states is at a similar level to the mid 2000s.

This housing affordability measure accounts for changes in average housing prices and household income. However, it ignores the effect of changes in interest rates on borrowing costs and other financial factors that may affect a household's purchasing capacity and therefore their ability to purchase a home.[1]

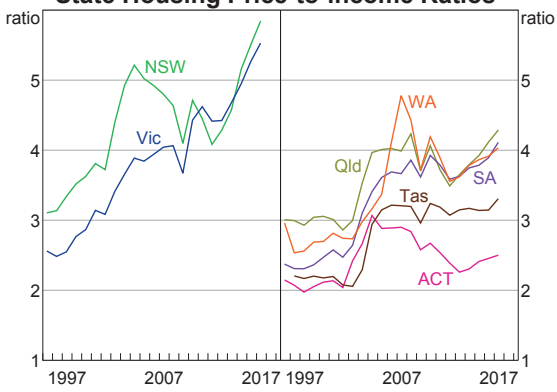
Graph 1
National Housing Price-to-income Ratio*



* Ratio of dwelling price to average household disposable income; income includes unincorporated enterprises and is before deduction of interest payments; mean dwelling prices

Sources: ABS; CoreLogic; RBA

Graph 2
State Housing Price-to-income Ratios*



* Ratio of dwelling price to average household disposable income; income includes unincorporated enterprises and is before deduction of interest payments; mean dwelling prices

Sources: ABS; CoreLogic; RBA

Mortgage repayment burden

Another common metric for measuring housing affordability is the mortgage debt-servicing ratio. This measure is based on a standard bank loan formula that assumes that mortgage borrowers make constant loan repayments over the life of a mortgage (this is known as a 'credit foncier' loan). This ratio is calculated as the monthly required repayment (M) on a new mortgage divided by monthly disposable income (Y):

$$\frac{repayment}{income} = \frac{M}{Y} = \frac{LVR * P * i(1+i)^T}{Y\left[(1+i)^T - 1\right]}$$

The required repayment is estimated based on the loan-to-valuation ratio (LVR) and dwelling price (P) at the time of loan origination, as well as the per period interest rate (i) and the number of months remaining in the term of the loan (T). This formula is designed to assess the borrowing capacity of individual borrowers. However, it is

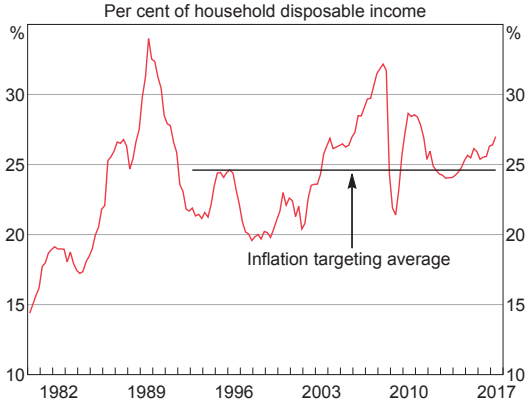
1 That housing prices and household income are also affected through interest rates in a variety of ways complicates this further.

common for this formula to be used instead to measure housing affordability at the national (or state) level using time-series data for average household income, housing prices and mortgage interest rates, and a given LVR and loan term.

As the formula shows, this measure again captures the effect of changes in the housing price-to-income ratio (*P/Y*) on housing affordability, but it also captures the effect of interest rates (*i*) at the time of origination.[2] More specifically, it captures the share of household disposable income that is needed to service a new mortgage given the interest rate, the loan size and term, and household income at the time of origination. As such, it explicitly accounts for the direct effect of interest rates on housing affordability.[3] For example, if interest rates fall, households can afford to repay a larger mortgage, all other things being equal. This would be reflected in a lower mortgage debt-servicing ratio, and would imply greater affordability. There is no role for changes to the deposit burden in the mortgage debt-servicing ratio, as the LVR is considered to be fixed.

Looking at the trends over time, the aggregate mortgage debt-servicing ratio has risen over the past year or so and is currently above the average of the inflation-targeting period but below historical peaks (Graph 3).[4] This suggests housing affordability has not declined by as much in recent times as the housing price-to-income ratio suggests. The difference is due to the current low interest rate environment in Australia.

Graph 3
Repayments on New Housing Loans*
Per cent of household disposable income

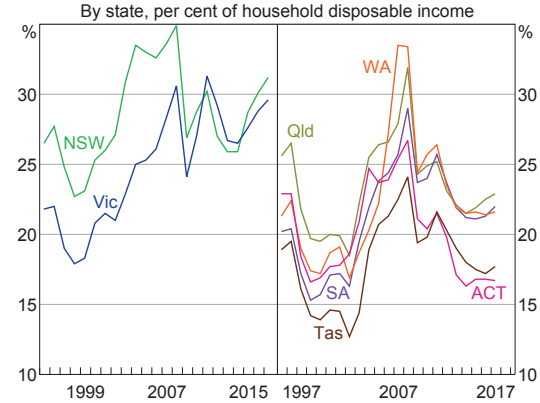


* Housing loan repayments calculated as the required repayment on a new 80 per cent LVR loan with full documentation for the nationwide mean-priced home; income includes unincorporated enterprises and is before deduction of interest payments

Sources: ABS; CoreLogic; RBA

Again, trends by state differ from those in the aggregate. According to this measure, housing affordability has declined in New South Wales and Victoria in recent years, although by less than indicated by housing price-to-income ratios (Graph 4). In most other states, housing appears as affordable as it has been in the past 20 years.

Graph 4
Repayments on New Housing Loans*
By state, per cent of household disposable income



* Housing loan repayments calculated as the required repayment on a new 80 per cent LVR loan with full documentation for each state or territory's mean-priced home; income includes unincorporated enterprises and is before deduction of interest payments

Sources: ABS; CoreLogic; RBA

2 The measure is 'static' in that it captures housing affordability at the time of purchase. For a given borrower, the measure ignores changes to mortgage interest rates and income that occur after purchase. For instance, the repayment burden of a specific loan for a given borrower tends to fall over time as income rises and the borrower makes their repayments.

3 However, lower interest rates also mean less interest is paid on savings, which makes it harder to save for a home deposit. At the same time, lower interest rates may also contribute to rising housing prices.

4 The average for the inflation-targeting period is considered a relevant comparison because prior to that period inflation and thus interest rates were much higher.

An Alternative Indicator of Housing Accessibility

A shortcoming of the conventional estimates of housing affordability is that, by focussing on the average home price and average household income, they measure affordability for the average household. But the typical FHB is not the same as the average household – they tend to be younger and less wealthy. Also, if most FHBs buy homes that are cheaper than the average, then measures that focus on the average home will provide a poor guide to the ability of FHBs to purchase their first home (i.e. housing accessibility).

To address these shortcomings, we construct a housing accessibility index that specifically focuses on the purchasing capacity of potential FHBs based on Richards (2008). The housing accessibility index is based on the same bank loan formula for the mortgage debt-servicing ratio as before. However, we impose a few assumptions, and manipulate the formula to determine the dwelling price that the median potential FHB could afford (or purchasing capacity; P^{FHB}).[5] The following assumptions are imposed:[6]

- interest rates are assumed to be equal to the annual average of banks' advertised owner-occupier discounted variable package mortgage rates
- the mortgage has a 25-year term
- the required LVR is 80 per cent and buyers have saved the required deposit equal to 20 per cent of the value of the home
- buyers are able to make loan repayments worth 30 per cent of their disposable household income.[7]

More specifically, purchasing capacity is given by the formula:

$$P^{FHB} = \frac{M\left[(1+i)^{T}-1\right]}{LVR*i(1+i)^{T}} = \frac{0.3*Y^{FHB}\left[(1+i)^{T}-1\right]}{0.8*i(1+i)^{T}}$$

where the purchasing capacity depends directly on the median income of potential FHBs (Y^{FHB}) and the nominal mortgage interest rate (i). All other things being equal, the purchasing capacity of the potential buyer increases with higher income and/or lower mortgage rates because they can borrow a higher amount without exceeding the repayment threshold.

An important component of the formula is the disposable household income of potential FHBs. This is estimated using data from household surveys conducted by the Australian Bureau of Statistics (ABS).[8] These surveys provide annual snapshots of housing and income-related data for individual Australian households. The surveys are available on an irregular basis prior to 1994/95, but are available roughly every two years between 1994/95 and 2015/16.

Using the household surveys, potential FHBs are defined as households that are renting and have a household head aged between 25 and 39 years.[9]

5 The median rather than mean income of potential FHBs is used so that very large or very low incomes do not skew our results.

6 The assumptions of a constant loan term, a constant LVR and constant repayments are clearly simplifications; however, fixing these allows us to gauge the relative contributions of household income growth, interest rates and housing prices to overall housing accessibility. Simon and Stone (2017) suggest that LVRs for FHBs have been broadly stable since 2001 at 83 per cent. We examine the sensitivity of our results to these assumptions later.

7 This is based on historical rules of thumb that imposed this repayment-to-income ratio as a criterion for determining maximum allowable loan sizes. More sophisticated serviceability tests that take borrowers' expenses and other circumstances into account generally produce implied repayment-to-income ratios of between 30 and 50 per cent.

8 In this article we use a number of ABS household surveys, all of which survey a representative sample of Australian households and provide income, age and housing status data on these households. The surveys are: the 1994/95, 1995/96, 1996/97, 1997/98, 2002/03, 2003/04, 2005/06, 2007/08, 2009/10, 2011/12, 2013/14 and 2015/16 Survey of Income and Housing; and the 1999/00 and 2000/01 Survey of Income and Housing Costs. Although the name of the survey has changed over time, it is one survey that focuses on income and housing.

9 We include all households in this defined group regardless of employment status, but exclude those on incomes below government assistance minimums.

Household survey data indicate that more than 60 per cent of FHBs come from this age group.[10] For the six states, we obtain median disposable household income for this group by capital city and by 'rest of state' (i.e. regional areas).

Growth in the purchasing capacity of the median potential FHB has generally outpaced their household income growth due to falls in nominal interest rates. FHB purchasing capacity is very sensitive to interest rates, which are currently at a very low level; if interest rates in 2016 had instead been equal to their average over the 1995 to 2016 period, the purchasing capacity of FHBs would have been about 18 per cent lower, all else being equal.[11]

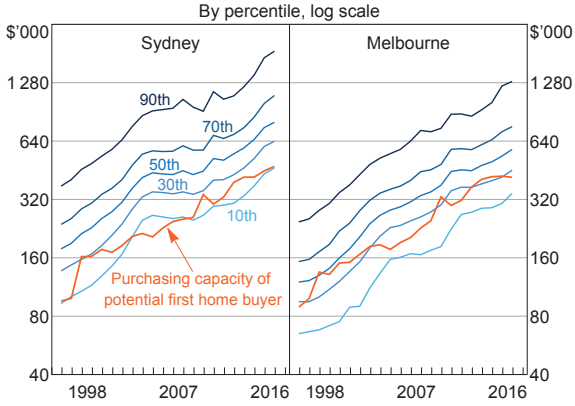
To examine trends in housing accessibility, we can look at how the purchasing capacity of FHBs has evolved over time relative to movements in actual housing prices. The housing transaction data used in this analysis are sourced from CoreLogic. The benefit of these data is that they can provide information on the distribution of housing prices within each major capital city and regional area. More specifically, the annual data can be separated into percentiles, allowing us to see how FHBs' purchasing capacity has changed relative to the housing price distribution over time. Note that these data relate to all dwellings (i.e. both houses and apartments).[12]

A useful feature of this housing accessibility measure is that the level is easy to interpret.

To take an example, the purchasing capacity of the median potential FHB in Sydney in 2016 is estimated to have been around $474 000. By comparison, the median home price was $800 000, while the housing price at the 10th percentile was $465 000 and at the 90th percentile was almost $1 900 000. Therefore, the estimates indicate that the median potential FHB in Sydney could afford just over 10 per cent of homes sold there in 2016.

Over the past 20 years, the median potential FHB could generally afford to buy around 10 to 30 per cent of the homes for sale in Sydney (Graph 5). This has varied over housing price and interest rate cycles, but the purchasing capacity of the median potential FHB has never been close to the median-priced property in Sydney. In Melbourne, the median potential FHB has generally been able to afford a greater proportion of the homes for sale, often 30 per cent and in the late 1990s, as high as 50 per cent.

Graph 5
Dwelling Prices
By percentile, log scale



Sources: ABS; CoreLogic; RBA

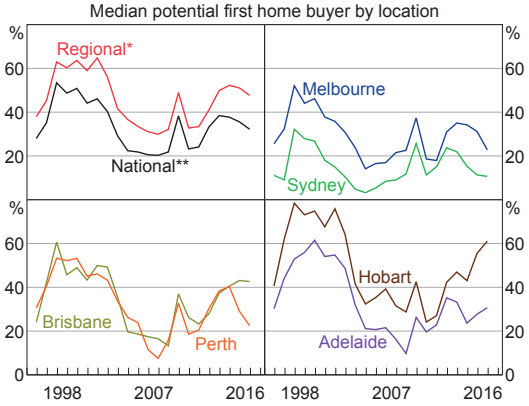
Nationally, the median potential FHB could afford around 32 per cent of all homes sold in 2016 (Graph 6). This is about the average of the past 20 years. Of the capital cities, the most accessible for FHBs has been Hobart. A decline in potential FHB incomes in Perth in recent years has decreased accessibility there despite

10 These household surveys directly identify actual FHBs but these data are ignored because the focus is on potential FHBs.

11 However, it is unlikely that all else would have been equal. Interest rates are also a key driver of housing prices. If interest rates had been higher, housing prices are likely to have been lower so that for a given level of purchasing capacity, a FHB would have been able to afford more properties than otherwise.

12 Relatively more sales may be missing in recent years due to lags in data collection (see Leal *et al* (2017) for more details). Sales with a price equal to zero in the unit record data indicate transfers of property ownership (for example, by inheritance) and are removed from the analysis. The top 1 per cent and bottom 2.5 per cent of sales by price are also removed. More transactions are removed from the bottom due to the prevalence of tokenistic transfer prices.

Graph 6
Share of Affordable Dwellings
Median potential first home buyer by location



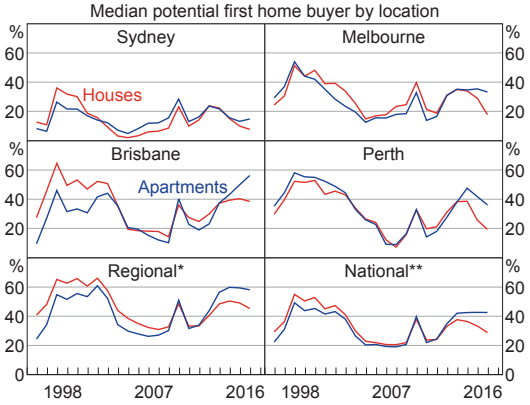
* States' regional dwelling stock weighted average, measured as areas outside of capital cities
** Capital city and rest of state dwelling stock weighted average
Sources: ABS; CoreLogic; RBA

falling housing prices. The housing accessibility indicator suggests that potential FHBs could afford more homes in regional areas than in capital cities; the median potential FHB could afford almost half of the housing stock sold in 2016 in regional areas, which was a little higher than the average of the past 20 years.

The share of homes affordable for FHBs differs by city, but the trends in accessibility have tended to follow a similar cyclical pattern. This is due to the accessibility measure being very sensitive to changes in interest rates. For example, the spike in the share of affordable properties for the median potential FHB in 2009 can be attributed to a significant decrease in interest rates, which was partially unwound over the following two years. While interest rates have declined since 2011, higher housing prices and lower income growth have lowered accessibility in around half of the cities and regions recently. Increases in potential FHB incomes have improved accessibility in other areas.

Another advantage of the CoreLogic transaction data is that they contain information on the characteristics of each property sold in Australia, so we can also examine the quality of the homes affordable to FHBs. For example, using the same methodology, a higher share of detached houses than apartments has typically been affordable using our measure (Graph 7). This can be explained by apartments typically being closer to the CBD, which is an important aspect of housing quality for many people as jobs have become more concentrated in our cities' CBDs over time (Ellis 2014). In Melbourne, for example, 45 per cent of houses sold from 1995 to 2016 were in the outer suburbs (more than 25 kilometres from the CBD) but 82 per cent of apartments sold were located in the inner and middle ring suburbs (less than 25 kilometres from the CBD). Despite this, houses have become less affordable than apartments in all cities and regions recently. This is likely to be due to an increase in the relative scarcity of houses given the large increase in the supply of apartments over the past few years (Rosewall and Shoory 2017).

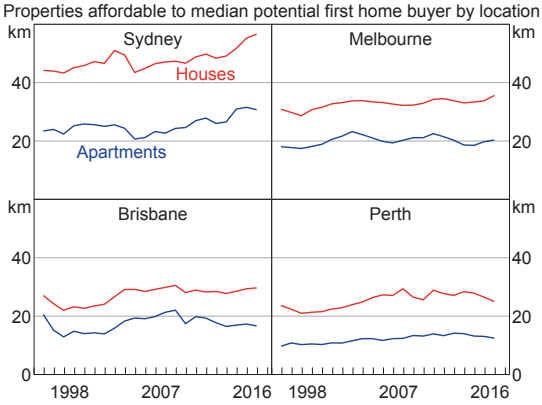
Graph 7
Share of Affordable Dwellings by Type
Median potential first home buyer by location



* States' regional dwelling stock weighted average, measured as areas outside of capital cities
** Capital city and rest of state dwelling stock weighted average
Sources: ABS; CoreLogic; RBA

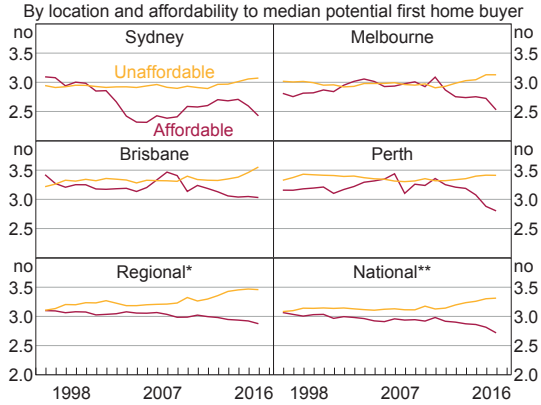
In Sydney, the average distance to the CBD of homes that our measure suggests are accessible to the median potential FHB has trended up fairly consistently over the past decade for both houses and apartments (Graph 8). In other capital cities there has been only a slight increase

Graph 8
Average Distance From CBD*
Properties affordable to median potential first home buyer by location



* Distances based on postcode
Sources: ABS; CoreLogic; RBA

Graph 9
Average Number of Bedrooms
By location and affordability to median potential first home buyer



* States' regional dwelling stock weighted average, measured as areas outside of capital cities
** Capital city and rest of state dwelling stock weighted average
Sources: ABS; CoreLogic; RBA

in the average distance of affordable homes from the CBD over the past two decades, even as city limits have expanded, and affordable homes are typically much closer to the CBD than in Sydney.

Another measure of quality is the average number of bedrooms of the dwellings affordable to median potential FHBs. In all capital cities, the average number of bedrooms in affordable housing has declined over the past 20 years, most notably in Sydney (Graph 9). This partly reflects apartments being smaller and an increased share of affordable homes, although the average number of bedrooms for affordable houses has also declined over time. In contrast, the average number of bedrooms in the housing stock assessed as being out of reach of FHBs has increased, and the average number of bedrooms of all homes sold between 1995 and 2016 has increased slightly in aggregate. This, along with the increase in the average distance from the CBD, suggests that there has been some structural decline in the quality of housing that is affordable to FHBs.

Overall, this measure suggests that housing accessibility (abstracting from quality changes) has fluctuated over the past two decades, rather than experienced a trend decline. Nevertheless, the 2016 Census data indicated that home ownership rates among younger households have decreased consistently over the past two decades. In addition, the shares of affordable dwellings calculated above are higher than FHBs' share of owner-occupier loan approvals in most years, suggesting that other factors may have restricted FHBs from entering into the market.

Sensitivity Analysis

The estimated purchasing capacity of FHBs is sensitive to the assumptions outlined earlier. For example, the required deposit was assumed to be a constant share of the dwelling price. As the dwelling price-to-income ratio increases over time, we have assumed that a household's deposit (relative to income) correspondingly increases. This ignores that households now have to save more, and often for longer, to accumulate the required deposit. Under our assumption of a 20 per cent deposit, the deposit-to-income ratio has increased over time from about 70 per cent to over 110 per cent of the median potential FHB's annual income. If we instead hold the deposit constant at 70 per cent of household income, FHBs' purchasing capacity decreases

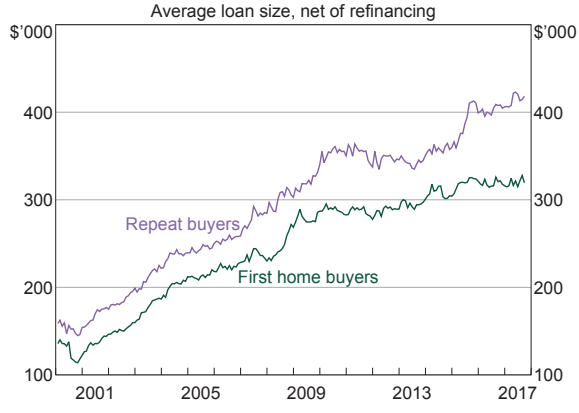
and the nationwide share of affordable dwellings would have been about 6 percentage points lower in 2016 than shown by our measure.

We also assumed that a household's borrowing capacity was limited such that repayments would equal 30 per cent of disposable household income. However, some households may be willing and able to spend more of their income on housing; lender serviceability tests that take expenses into account may result in a higher figure. Allowing potential FHBs to spend 40 per cent of their income on repayments increases the share of affordable dwellings by around 20 percentage points on average nationally. This is a significant increase, but there may be a trade-off between greater housing accessibility initially (due to relaxed financial constraints) and a higher possibility of mortgage stress (due to more income being devoted to repayments) at a later stage when incomes may fall or interest rates or expenses may rise.

This is a drawback of this housing accessibility measure more generally. It ignores the lifetime loan repayment burden and possible subsequent mortgage stress when making comparisons across time, as it takes the interest rate and income at loan origination as fixed and does not consider how these may change after the purchase is made. Prudent lenders, on the other hand, do attempt to take account of the lifetime loan repayment burden. Indeed, since 2014, the Australian Prudential Regulation Authority (APRA) has introduced measures to ensure this is the case.[13] Accordingly, although this measure of housing accessibility assumes that purchasing capacity increases with declining interest rates (all else being equal), FHBs (generally being the most financially constrained buyers) are not always able to increase their loan size in response to lower interest rates because of lenders' policies. Indeed, the average FHB loan size has been little changed over recent years while the gap between repeat buyers and FHBs' average loan sizes has widened (Graph 10). This is likely because there has been little or no change in the interest rate used to calculate allowable loan sizes, which generally does not decrease by as much as actual mortgage rates. Therefore, borrowers for whom financial constraints are not binding (typically repeat buyers who are trading up or down and investors) may have a relative advantage during low interest rate periods, as they can increase their loan size and make larger offers for specific properties (RBA 2014). Holding purchasing capacity constant to reflect these financing constraints from 2014 lowers the share of affordable dwellings for potential FHBs slightly, by about 2¼ percentage points in 2016.

There are other caveats to our analysis. The analysis focussed on the median potential FHB and did not consider differences in purchasing power and expenses across the group of potential FHBs. There may be important

Graph 10
Owner-occupier Loan Approvals
Average loan size, net of refinancing



Sources: ABS; RBA

13 In 2014, APRA stipulated that lenders must ensure borrowers are able to afford a floor rate of 7 per cent or actual rates plus 2 percentage points (whichever is highest). Mortgage interest rates have been below 5 per cent since February 2015, suggesting no real change to purchasing capacity from subsequent declines in interest rates. Prior to 2014, minimum rates and buffers were not explicitly regulated; buffers were estimated by APRA to be 1 to 2 percentage points and minimum floor rates were 6 to 7 per cent (Richards 2016). Authorised deposit-taking institutions generally had either a buffer or a floor, but not both, as is now the case.

distributional aspects to housing accessibility for FHBs that are not captured in this measure. In addition, if more higher-income renter households do not move into home ownership over time, the income of the median renter household may be skewed upwards and could mask real changes to accessibility.[14]

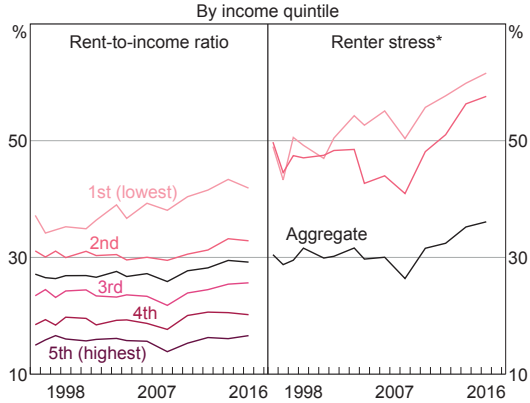
We also assumed the mortgage term was fixed at 25 years; however, 30-year terms have become increasingly common. If we instead allowed median potential FHBs to take out mortgages with 30-year terms, the national share of affordable dwellings in 2016 would be about 7 percentage points higher.

Lastly, our analysis abstracts from the effect of government incentives such as FHB grants and stamp duty savings. However, these incentives are estimated to have had little effect on the calculated shares of affordable homes.

Rental Affordability

Housing affordability is also an issue for the large number of households that rent a dwelling. The majority of Australian households are owner-occupiers, but the share of private renter households has increased over the past few decades to almost a third. One measure of rental affordability is the ratio of rent paid to household income. ABS household surveys show that over the past decade, this has trended up as rents have increased by more than households' disposable income (Graph 11). Disaggregating households by income quintile allows us to examine the distributional differences in rental affordability; about half of all renter households are in the first and second household income quintiles and pay a much higher proportion of their income in rent than renters in higher-income quintiles. For renters in the first income quintile, the ratio of rent paid to household income has been increasing over the past 20 years.

Graph 11
Rental Affordability
By income quintile



* Proportion of renter households whose rental costs are more than 30 per cent of household disposable income

Sources: ABS; RBA

Another indicator of rental affordability is the share of households whose rental costs are more than 30 per cent of their disposable income. This is considered an indicator of renter stress (at least for low-income households) and has increased markedly over the past decade for the two lowest income quintiles. Census data also show an increase in the proportion of households in renter stress in all capital cities except Darwin between 2011 and 2016, and that almost 60 per cent more Australian households are in renter stress than in mortgage stress in 2016.[15]

This suggests that housing costs are an increasing share of disposable income for often the most disadvantaged in society, which might reduce their capacity to spend on other goods and services. While Australia does have social housing and affordable housing programs,

14 Simon and Stone (2017) find that fewer people are making the transition from renter to owner-occupier following the global financial crisis than before. Those that do are more financially stable than earlier cohorts.

15 This is calculated as the percentage of total households with housing costs greater than 30 per cent of gross household income. The picture is even starker when it is considered that this level of housing costs would probably lead to more stress for low-income households, who generally rent.

reports from the Bank's liaison program suggest demand for it far outstrips supply and low-income earners are often forced into the private market. Further, there are non-rent costs associated with renting. For example, renters move more often than owners (and often not by their choice), which is costly and disruptive (Ellis 2017). Inferior housing and housing insecurity may also affect social outcomes and mental and physical health (Evans, 2003; Evans, Wells and Moch, 2003).

Summary

Housing affordability, particularly for young FHBs, can be difficult to measure. A conventional affordability measure such as the housing price-to-income ratio suggests that housing has never been less affordable in Australia. But this story has been largely confined to Sydney and Melbourne in recent years. Another conventional affordability measure, which captures the cost of servicing mortgage debt relative to income, suggests that housing affordability is around its long-run average due to the low level of mortgage interest rates in recent years.

We construct an alternative indicator to measure housing accessibility for FHBs specifically, that is, the ability of renters aged between 25 and 39 years to buy their first home. This measure combines information from household surveys with data on all housing sale transactions in Australia. It shows housing accessibility is around the long-run average in aggregate in Australia, with the median potential FHB being able to afford around one-third of all homes sold in 2016, although this share is significantly lower in Sydney, Melbourne and Perth. Moreover, the quality of homes that potential FHBs can afford has fallen over time, as measured by location and the number of bedrooms. This measure also shows accessibility is lower in capital cities, particularly in areas close to the CBD.

The cost of renting is also an important component of housing affordability and the number of households renting has trended up over the past few decades. In aggregate, rents have grown broadly in line with household incomes, although rent-to-income ratios suggest housing costs for lower-income households have increased over the past decade.

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Underlying Consumer Price Inflation in China

Iris Day*

Underlying inflation measures seek to look through the volatility often inherent in headline inflation, and can be useful for assessing inflationary pressures in a given economy. This article describes new trimmed mean measures of underlying inflation that we have constructed for China and compares their performance with other measures of underlying consumer price inflation. A range of underlying inflation measures suggest that inflationary pressures have increased gradually since early 2016, although they remain low by historical standards.

Introduction

While China's central bank, the People's Bank of China (PBC), is not an explicit inflation targeter, the Chinese authorities have indicated concern about inflation because it can affect the wellbeing of households, and extremely high inflation can harm social stability.[1] Each year, targets for consumer price inflation are set by the State Council, China's primary administrative authority, and are announced at the annual meeting of the National People's Congress (the national legislature) along with the target for economic growth. The 2017 consumer price index (CPI) inflation target was set at 'around 3 per cent'.

The headline CPI is the most commonly published measure of inflation faced by households, but it can be volatile and does not necessarily provide the best indication of overall inflationary pressures. Measures of underlying inflation that seek to look through this noise are typically monitored in conjunction with headline measures. This article examines the performance of measures of headline and underlying inflation in China, and provides an assessment of current inflationary pressures. It focuses in particular on the construction of new trimmed mean measures, which have been estimated using the detailed data published by China's National Bureau of Statistics (NBS).

Headline Inflation

China's NBS publishes a monthly headline CPI, as well as indices for eight major expenditure categories in the CPI basket: food, alcohol & tobacco; residence; clothing; transport & communication; health; household durables & services; education & recreation; and a miscellaneous category. Price indices for numerous sub-components within each of these categories are also published. For example, separate price indices are available for the grains, pork and vegetables subcomponents of the food category. In total, the NBS published price indices for more than 50 subcomponents between 2006 and 2015 and around 30 since 2016.

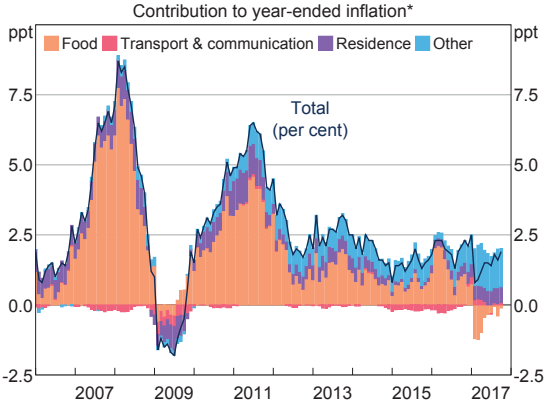
Most of the variation in China's CPI has been driven by the food component, due to its high weight in the CPI basket (around a third) and

* The author is from Economic Group and would like to thank Arianna Cowling and June Ma for their assistance.

1 For example, see Buckley (2011).

the inherent volatility that characterises food prices given their susceptibility to supply-side shocks (Graph 1). For example, a sharp food price increase in late 2010 followed a drought in China's South-Western region, which cut the area's production of commodities such as grain and vegetables (Zhang and Zuo 2010). Since 2012, CPI inflation in China has remained in a relatively narrow range, partly due to more stable food price inflation. This has reflected structural changes to food production in China, which have reduced cyclicality in prices (RBA 2016). In early 2017, lower food prices arising from an abundant supply of fresh vegetables placed downward pressure on inflation.

Graph 1
China – Consumer Price Inflation
Contribution to year-ended inflation*



* RBA estimates
Sources: CEIC Data; RBA

The residence category contributed only a little to inflation over the past decade, despite large changes in housing prices, because the NBS uses the relatively static mortgage interest rate as the measure of the cost of buying a house (Orlik 2011). A decline in fuel prices weighed modestly on China's CPI from late 2014 to early 2016, in line with lower global oil prices. As oil prices partly recovered over the subsequent year or so, fuel prices contributed a little to inflation. Although it has a relatively small weight in the CPI basket, there has been an increase in inflation in the health component in recent years, which has supported strength in 'other' inflation. This is because population ageing and rising incomes have contributed to increased demand for medical services (World Bank *et al* 2016). Year-ended inflation in the health price index is currently around 7¼ per cent, well above the inflation rate for any of the other major CPI expenditure categories.

Measures of Underlying Inflation

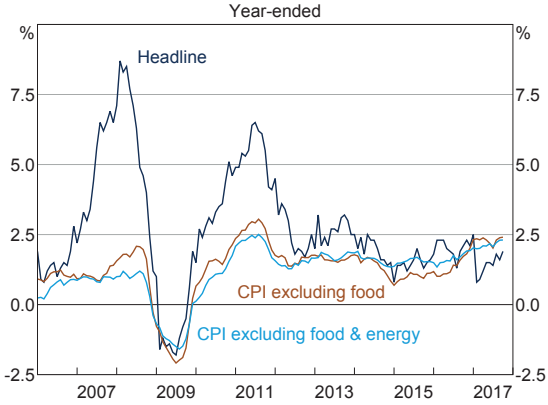
Measures of underlying inflation can be useful for gauging persistent inflationary pressure given that month-to-month movements in headline inflation can be volatile. While true underlying inflation is not observable, it is possible to construct measures of underlying inflation that abstract from or moderate the effects of short-term movements in the CPI. One desirable property of an underlying inflation measure is 'smoothness', since underlying inflation should be fairly persistent and evolve slowly based on variables such as inflation expectations and the gap between actual and potential output (Brischetto and Richards 2006). For ease of interpretation, it is desirable for the underlying measure of inflation to be unbiased with respect to the headline measure – that is, to have a similar long-run average. There are many methods used to estimate underlying inflation, but two common gauges are exclusion-based measures and trimmed means.[2]

Exclusion-based measures

Exclusion-based measures of underlying inflation are the most common measures. They exclude a set of particularly volatile items from the calculation of the headline figure (typically, fresh food and energy). The Chinese NBS publishes two exclusion-based measures: CPI excluding food, and CPI excluding food and energy (Graph 2).

2 Amstad, Huan and Ma (2014) and Shu and Tsang (2004) discuss alternative measures of underlying inflation in China.

Graph 2
China – Consumer Price Inflation
Year-ended



Sources: CEIC Data; RBA

Exclusion-based measures have the advantage of being easy to calculate and interpret. However, they may provide misleading information about inflationary pressures when items retained in the consumption basket are affected by temporary factors. In addition, excluded items may contain valuable information about inflation, especially if they exhibit different underlying trends to those retained in the basket. This is the case for China, where food makes up a large share of the CPI and rapid food price inflation has meant that exclusion-based inflation measures have been noticeably lower than other measures for most of the past decade. As a result, these exclusion-based measures do not provide an accurate gauge of the level of overall inflation faced by households over this period.

Trimmed means

Trimmed mean measures of inflation are generally calculated as the average rate of inflation after 'trimming' away outliers. They are calculated by ordering the price changes for all components in each period from lowest to highest and excluding a certain percentage of the upper and lower tails of the distribution of price changes. Average inflation is then calculated from the remaining components. For example, a 10 per cent trimmed mean (which removes 10 per cent from each end of the distribution) could be calculated for March 2016 by taking the weighted-average inflation rate of the red bars in Graph 3.

Graph 3
China – Distribution of Price Changes
Share of CPI - March 2016

Sources: CEIC Data; RBA

Trimmed-mean measures of underlying inflation temper the effect of very large price changes which may not be representative of price changes of other goods and services. For a range of advanced economies, trimmed means have been found to outperform exclusion-based measures of underlying inflation on a number of criteria, including unbiasedness and the ability to forecast inflation.[3] While trimmed-mean inflation is not published by the NBS, we describe how these measures can be estimated in the following section.

Estimation of Trimmed Mean Inflation

Chinese CPI weights estimation

While the NBS does not publish the weights assigned to the components of the CPI basket, they can be estimated using the published headline CPI inflation rate (π_t) and the published

3 For details see Khan, Morel and Sabourin (2015), Meyer and Venkatu (2014) and Brischetto and Richards (2006).

inflation rates for each of the eight major expenditure categories ($\pi_{i,t}, i = 1,\ldots,8$). A numerical optimisation method can be used to select weights $\left(\overline{w}_i, i = 1,\ldots,8\right)$ for each component that best describe changes in headline inflation. Specifically, one can use a numerical algorithm to find weights that minimise the sum of the squared differences between the published CPI inflation rate and the weighted average of the eight expenditure category inflation rates, over some pre-determined time period ($t = 1,..,T$):

$$\min_{w_i} \sum_{t}^{T} \sum_{i=1}^{8} \left(\overline{w}_i \pi_{i,t} - \pi_t\right)^2,$$

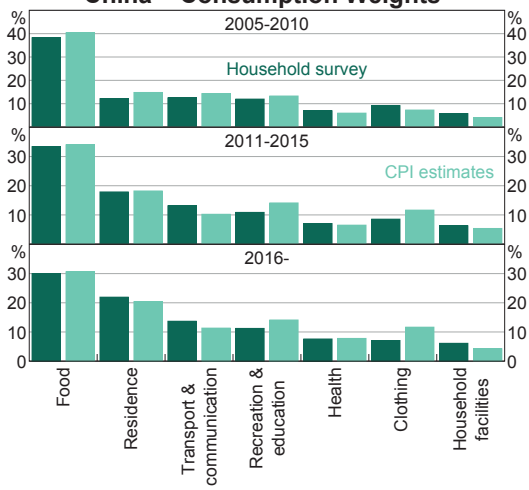
subject to the constraints $\sum_{i=1}^{8} \overline{w}_i = 1$ and $\overline{w}_i \geq 0$.

As major changes to the CPI basket and weights are made every five years, the weights are estimated separately for three periods (2005–10, 2011–15, and 2016 onwards). With only limited data available from 2016, estimates for this last period are based on the weights estimated for 2011–15, combined with the *change* in the weights provided by the NBS (NBS 2016).

One drawback of this approach is that the estimated expenditure weights are assumed to be fixed for each five-year period. However, the Chinese CPI is a Laspeyres-type price index which normally has effective weights that vary when there are relative price changes (OECD 2015). This means that the expenditure weights of components with above-average price rises increase over time, while the expenditure weights for components with below-average price rises decline over time. Nevertheless, the estimated weights are broadly in line with the expenditure shares estimated from the NBS's urban and rural household surveys (Graph 4).

The procedure can be repeated to estimate weights for subcomponents within each of the eight major expenditure categories. The weights of each of the 55 subcomponents can be calculated by multiplying their weight in the major component by the latter's weight in the overall CPI. For example, meat and poultry is estimated to account for 22 per cent of the food component and food is estimated to have a weight of 31 per cent of the CPI basket, so the estimated weight of meat and poultry in the overall CPI basket is 7 per cent.

Graph 4
China – Consumption Weights*



* Food includes alcohol and tobacco; miscellaneous category not shown
Sources: CEIC data; RBA

Choice of frequency and use of seasonal adjustment

A trimmed mean can be constructed using monthly or year-ended inflation and, in the case of monthly inflation, either seasonally or non-seasonally adjusted data. Trimmed means based on seasonally adjusted monthly inflation rates are preferable for two reasons. First, a monthly inflation rate can be used to generate monthly and year-ended growth rates based on the same underlying index. Second, trimmed means based on monthly inflation rates result in smoother profiles than those based on year-ended rates (Brischetto and Richards 2006).

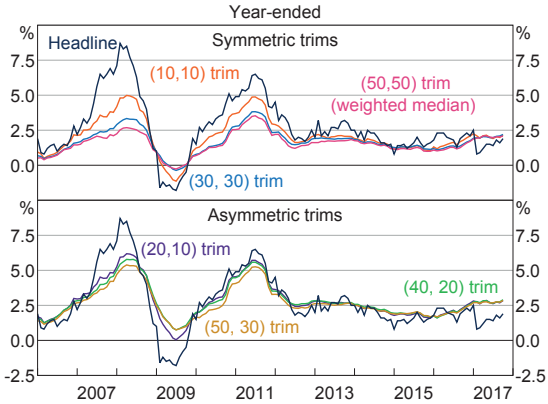
One drawback of using monthly inflation rates is that they can lead to estimates of the trimmed mean that are downwardly biased relative to

a year-ended CPI inflation rate. This is partly because items displaying large seasonal increases once or twice a year tend to be trimmed from the monthly distribution of price changes in the periods when they record their largest increases. This results in lower average inflation over the year than headline CPI (Roberts 2005).[4] This downward bias can be partly mitigated by using seasonally adjusted monthly rates. Even using seasonally adjusted inflation rates, however, results in an underlying measure of year-ended inflation that is lower on average than headline inflation over the period examined. This is because the distribution of seasonally adjusted monthly price changes is positively skewed on average (i.e. there are more large increases than large decreases). This is a relatively common problem, and could occur because of infrequent and irregular price setting. The skew in the Chinese price change distribution can be seen in Graph 3, which highlights the fact that a small number of subcomponents typically have very high monthly inflation. The downward bias can be addressed using an asymmetric trim, whereby more weight is trimmed from the bottom half of the distribution than the top half (Kearns 1998).

Trim size selection

Another key parameter choice when constructing a measure of trimmed-mean inflation is the trim size. Previous research has generally found that the performance of a wide range of trims is similar.[5] To consider whether this is true for China as well, a range of symmetric and asymmetric trims (in 10 percentage point increments on each side of the distribution) are examined (Graph 5). We refer to a trimmed mean with 'x' per cent trimmed from the lower half of the distribution of weighted price changes and 'y' per cent trimmed from the upper half as the '(x, y) trimmed mean'. In some cases, the amount of the distribution that is trimmed is quite large; the weighted median ((50,50) trim), which essentially trims away all of the distribution, is routinely constructed and analysed for other economies such as Australia and the United States. The various trimmed means are assessed based on the difference in average inflation relative to headline inflation, and their smoothness.

Graph 5
China – Consumer Price Inflation
Year-ended



Sources: CEIC Data; RBA

Reflecting the common problem of downward bias in trimmed means based on monthly inflation rates, all of the symmetric trimmed means have shown lower average inflation than headline inflation over the past decade (Table 1). The asymmetric trimmed means whose averages over this period are closest to headline inflation are the (20, 10) trim, (40, 20) trim and the (50, 30) trim. However, average rates of headline inflation have systematically shifted lower since around 2012, which implies that the assessment of the extent of 'bias' will depend to a large extent on the period

4 In the year-ended inflation data, these large monthly changes are smaller relative to the annual movements and can be offset by earlier changes in earlier months.

5 Heath, Roberts and Bulman (2004) find that a wide range of trimmed inflation measures have predictive power for Australian headline inflation over specific sample periods. Brischetto and Richards (2006) find that there is a variety of trims which offer substantial improvements relative to both the headline CPI and exclusion-based measures. Similarly, Meyer and Venkatu (2014) found that a large range of trims have statistically indistinguishable forecasting ability for the United States.

Table 1: Average Year-ended Inflation
2006–17

	Top trim				
Bottom trim	**10**	**20**	**30**	**40**	**50**
10	2.1	–	–	–	–
20	2.9	1.8	–	–	–
30	3.5	2.4	1.7	–	–
40	4.1	2.9	2.2	1.6	–
50	4.8	3.4	2.7	1.9	1.6
Headline	2.7				
(2006–11)	*3.4*				
(2012–17)	*2.1*				
Exclusion-based	1.2				

Sources: CEIC Data; RBA

being considered. In other words, different trims are likely to perform better in different periods.

The smoothness of the trimmed mean measures can be measured by their standard deviation. However, minimising the standard deviation of the measures could result in a constant, so it is more useful to look at the standard deviation of the change in inflation (Brischetto and Richards 2006). On this metric, all of the trimmed mean measures of underlying inflation have been noticeably smoother than headline inflation (Table 2).

Given the similar smoothness of the various trims, and the difficulty assessing bias in a sample over which the average rate of headline inflation has shifted discretely, it may be appropriate to monitor a range of different underlying inflation measures, rather than focusing on just one. The choice of a symmetric or asymmetric trim appears to exert the largest influence on the estimated

Table 2: Standard Deviation of Inflation
2006-2017

	Inflation		Change in inflation	
	Monthly	Year-ended	Monthly	Year-ended
Headline	0.3	2.1	0.3	0.6
(10, 10) trim	0.2	1.3	0.2	0.3
(20, 20) trim	0.1	1.0	0.1	0.2
(30, 30) trim	0.1	0.9	0.1	0.2
(40, 40) trim	0.1	0.8	0.1	0.2
(50, 50) trim (weighted median)	0.1	0.8	0.1	0.2
(20, 10) trim	0.2	1.4	0.2	0.3
(40, 20) trim	0.1	1.2	0.1	0.3
(50, 30) trim	0.1	1.1	0.1	0.2
Exclusion-based	0.1	0.9	0.1	0.2

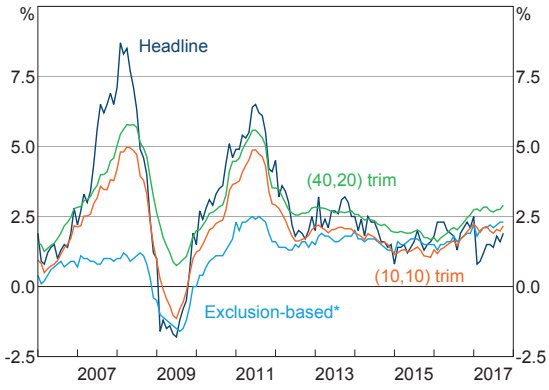
Sources: CEIC Data; RBA

pattern of underlying inflation. Thus, one of each type is included in the discussion of inflation trends below – namely, the (40, 20) trim and the (10, 10) trim. Even though a large part of the distribution has been trimmed from the (40, 20) trim, it is a useful way of understanding the central tendency of the subcomponents of inflation.

Trends in Underlying Inflation

Over the past decade, the broad trends and directions of change have been similar in measures of underlying inflation and headline CPI in China (Graph 6). However, their levels have differed substantially at times. Trends in underlying inflation measures are best considered in three distinct periods: 2006 to 2012; 2013 to 2015; and 2016 to the present.

Graph 6
China – Consumer Price Inflation
Year-ended



* Excludes food and energy
Sources: CEIC Data; RBA

Between 2006 and 2012, the exclusion-based measure was generally lower than the trimmed means and the headline measure, due to persistently high food price inflation. Even though fresh fruit, vegetables, and fuel are among the most commonly trimmed items, the asymmetric trim has been selected in such a way as to generate a similar average rate of inflation to the headline measure.

Headline inflation was lower between 2012 and 2015 than it was in the earlier period, mainly due to subdued food price inflation. In contrast, inflation in the exclusion-based measure has been a little higher than it was before the global financial crisis. Trimmed mean inflation was low during this period, which is similar to many other economies' experiences with underlying inflation, and suggests that factors other than one-off changes to relative prices have been weighing on inflation. In China, for example, over the past few years, excess capacity in a range of manufacturing industries appears to have placed considerable downward pressure on upstream producer prices at times. This has probably placed downward pressure on underlying consumer price inflation, through components such as consumer durables. Another factor that may have added to downward pressure on consumer price inflation was the trend appreciation of the Chinese renminbi (on a trade-weighted basis) up until the first half of 2015, which would have reduced the price of imported goods and services.

Since the start of 2016, measures of underlying inflation have increased steadily, as have other indicators of price pressures in the Chinese economy, such as the implicit GDP deflator and the producer price index. This is consistent with the pick-up in GDP growth since 2016, following considerable fiscal and financial accommodation by the Chinese authorities. The depreciation of the Chinese renminbi over 2016 may also have led to additional inflationary pressure. However, despite the evidence of some increasing inflationary pressures in the Chinese economy, the various measures of headline and underlying inflation remain low relative to previous episodes.

Conclusion

Headline consumer price inflation can be useful for gauging cost of living pressures faced by

Chinese consumers. However, because headline inflation can be volatile, it is also useful to monitor estimates of underlying inflation to look through large temporary movements in relative prices. While there is no single measure of underlying inflation, the Bank monitors a range of measures including newly constructed trimmed mean measures for China. Overall, these measures suggest that underlying inflationary pressures have increased gradually since early 2016, although these pressures remain low by historical standards.

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Ageing and Labour Supply in Advanced Economies

Alexandra Brown and Rochelle Guttmann*

Population ageing is a global trend, which is most evident in advanced economies. This article details the impact of demographic developments on labour supply in advanced economies. The ageing of the workforce has tended to reduce labour supply. This has been mostly offset by increased labour force participation of women and older people. These trends are occurring in Australia, although strong migration has mitigated some of the impact of ageing.

Introduction

Demographic change can greatly affect the size and shape of the workforce. Population ageing, through a long-term decline in fertility rates and increased life expectancy, is most progressed in advanced economies. It has put downward pressure on aggregate labour supply as older workers retire. Other factors have tended to offset this, however, including increasingly delayed retirement and rising female labour force participation. These long-term trends have implications for our assessment of labour market conditions in Australia and its trading partners. Australia has one of the youngest populations among advanced economies, so understanding how its peers are faring with population ageing can provide insights into future labour market trends that Australia may face. This article quantifies the effect of ageing on the supply of labour across a number of advanced economies, highlighting when and how Australian outcomes differ from those of similar economies.[1]

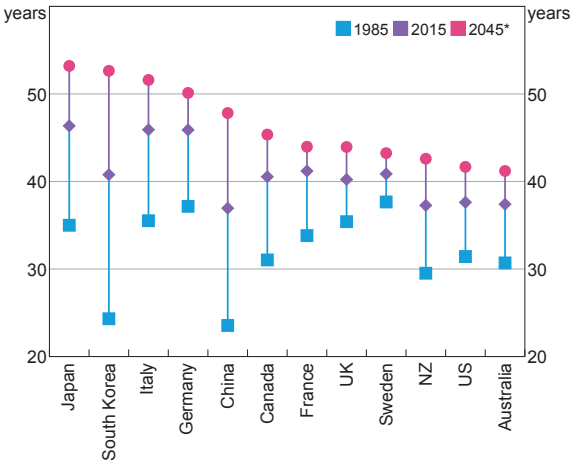
* The authors are from the Economic Analysis Department.

1 This analysis focuses on a variety of advanced economies that are either important Australian trading partners or that have demographic profiles that illustrate varied ageing developments. The euro area is analysed as a single labour market in much of this article, although labour laws differ across countries. Data are annual up to 2016.

Demographic Developments

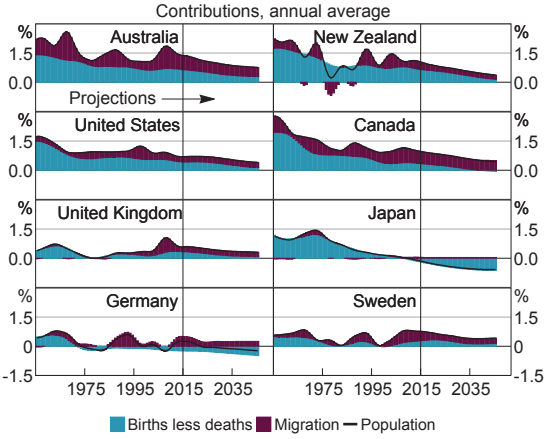
Population ageing is a global phenomenon, but is most evident in advanced economies. These economies have the highest median age – at around 40 years – although some middle-income economies, such as China, are ageing more rapidly (Graph 1). The share of the population at prime working age – those aged 25–54 years, who tend to have the greatest attachment to the labour market – peaked almost two decades ago in advanced economies. Across these economies, the speed and trajectory of demographic change varies. Ageing is most evident in parts of high-income east Asia and Western Europe, such as Japan, Italy and Germany. Korea has a smaller share of elderly people, but is ageing more rapidly than other advanced economies, and is projected to have the highest median age in the world by 2050. Australia has one of the youngest populations among advanced economies. Its relatively high net migration rate has helped offset the ageing of the native-born population (Connolly, Davis and Spence 2011). This has contributed to Australia having one of the highest rates of population growth over the past decade across advanced economies (Graph 2).

Graph 1
Median Age
Selected economies



* Medium-variant projection
Source: United Nations

Graph 2
Population Growth*
Contributions, annual average



* Data may differ from that of national sources; projections are the medium-variant projection from 2016 onwards
Source: United Nations

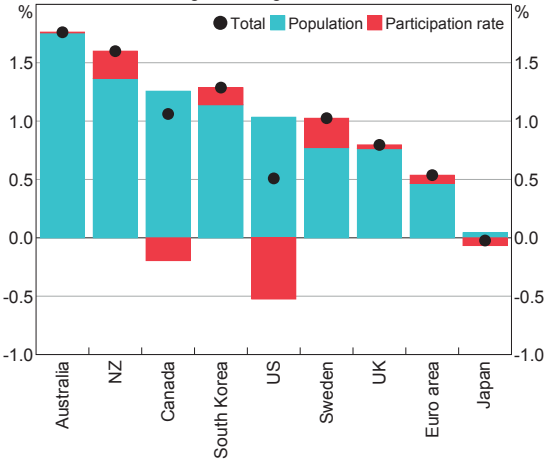
Drivers of Labour Force Growth

The size of the labour force, the part of the population that is employed or actively seeking employment, is a key measure of total labour supply in an economy. Labour force growth is determined by growth in the working-age population (generally defined as those aged 15 and over) and changes in the labour force participation rate (the propensity of working-age people to work or actively seek work). Ageing affects both of these factors through slower population growth and the lower participation of older people as they retire.

Growth in the working-age population has been the main driver of labour force growth for most advanced economies over the past decade (Graph 3). Australia has seen particularly robust growth in its working-age population of 1¾ per cent each year over the past decade. Strong net migration has been a major contributor to this growth. In contrast, Japan and the euro area, which have been ageing faster, have seen less than half a per cent growth in working-age population. This highlights the influence of ageing in putting downward pressure on population growth, and so the size of a country's labour force.

Across countries, the contribution from the participation rate to labour force growth has been mixed. Over the past decade, the participation rate has been relatively stable in Australia, while in the euro area and the United Kingdom it has added slightly to the overall growth in labour supply. Recently, high rates of

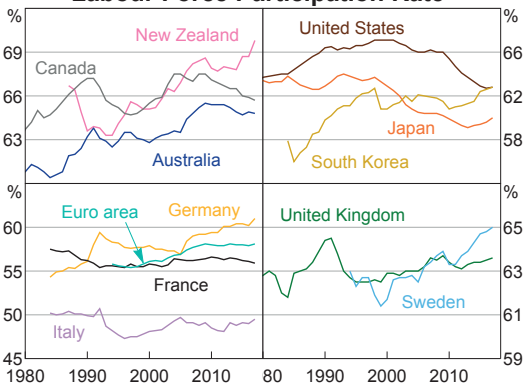
Graph 3
Labour Force Growth
Average annual growth, 2007–16



Sources: ABS; BLS; CEIC; Eurostat; RBA; Statistics Canada; Statistics Japan; Statistics New Zealand

net migration of working-age people to New Zealand and Sweden and strong growth in female participation in Korea have contributed to noticeable increases in participation rates and, as a result, labour supply growth in these countries (Graph 4). Earlier, in the mid 2000s, Australia also saw a large pick-up in labour force participation, in part associated with the acceleration in net migration at that time. The participation rates in the United States, Canada and Japan have declined substantially since around 2000, causing a noticeable drag on labour supply growth. However, more recently, the tightening of the labour market in these economies as they have recovered from the global financial crisis, appears to have helped arrest the decline.

Graph 4
Labour Force Participation Rate*



* 16 years and over for the US and UK; 15 years and over elsewhere. Methodological breaks affect some series

Sources: CEIC; Eurostat; ILOSTAT; Thomson Reuters

Ageing and Labour Force Participation Rates

The effect of the population age structure on aggregate participation

The tendency for a person to be in the labour force varies by sex and over one's life cycle. Changes in this propensity to work and the demographic structure of the population affect a country's aggregate labour force participation rate and can be separated into a cohort and a demographic effect.[2] The cohort effect is the change in the labour force participation rates for different demographic groups over time. Examples of cohort effects include the increased propensity for females at any given age to be in paid employment over time, or the increasing tendency for young people to enter the workforce later as their access to tertiary education increases.

The demographic effect is the aggregate impact of a shift in age structure of the labour force, keeping the participation rates of different age groups constant. The changing age structure of the population has been a persistent and increasing drag on labour force participation across advanced economies since the mid 1990s (Graph 5). The demographic drag has been widespread, reflecting the broad-based decline in the share of the prime-age population. It has been the largest in Japan, averaging around one-third of a percentage point per year over the past two decades.

Rising female workforce participation over the past few decades has largely made up for the demographic effects of ageing. This positive contribution from rising female participation has been common across advanced economies, although the timing has differed, with changes having occurred earliest and fastest in the United States and Canada. Australia has seen a consistent rise in female participation. Across advanced economies, the increasing participation of females has been incentivised by government policy changes, such as parental leave, child care and part-time work entitlements, alongside changing social attitudes and increased education (Blau and Kahn 2013).

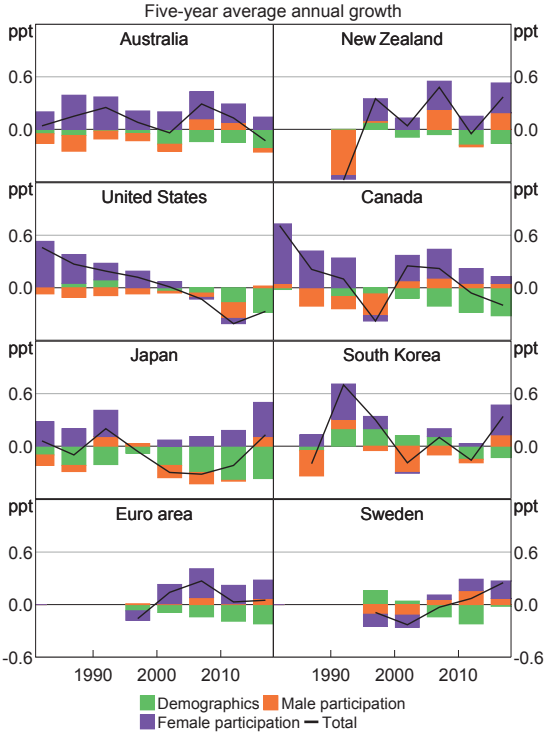
Male participation rates have declined considerably in most advanced economies, partly driven by demographic change. Nonetheless, in

2 To do this we follow the methodology of Hotchkiss (2009).

recent years, the male cohort effect has tended to be slightly positive, on average, especially in New Zealand and Europe as older workers delay their retirement. The largest negative contribution has been in the United States, reflecting a multi-decade long trend in falling prime-age participation, which has only recently subsided (CEA 2016).

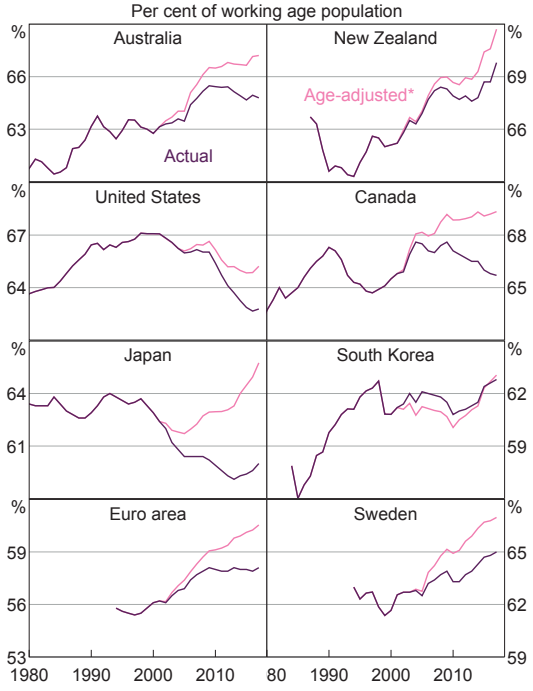
Another way to look at the effect of demographic change is to consider the participation rates that would have resulted if the population share in each age cohort had been unchanged from 2000 – which approximately corresponds to the peak of the prime-age labour share in the population of many advanced economies. This exercise shows that aggregate labour force participation rates would have been higher and mostly increasing across advanced economies (Graph 6). The rise largely reflects the increase of women and older workers in the workforce. The role of ageing in depressing labour force participation is most notable in Japan. Without ageing, Japan's labour force participation rate would be almost 6 percentage points higher. Australia's participation rate would be around 2–3 percentage points higher if there had been no demographic change since 2000; the decline in participation earlier this decade also appears to have been driven by ageing effects. A limitation of this exercise is that ageing and cohort effects are assumed to be independent of each other. However, if the population were not ageing, it is likely that people would make different decisions about their employment.

Graph 5
Labour Force Participation Rate Contributions*
Five-year average annual growth



* Data are averaged over five-year buckets from 1981–2016
Sources: ABS; BLS; CEIC; Eurostat; ILOSTAT; RBA; Statistics Canada; Statistics Japan; Statistics New Zealand

Graph 6
Labour Force Participation Rate
Per cent of working age population



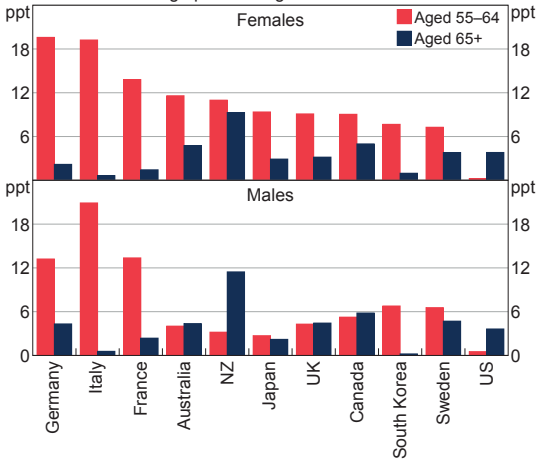
Sources: ABS; BLS; CEIC; Eurostat; ILOSTAT; RBA; Statistics Canada; Statistics Japan; Statistics New Zealand

Participation of older workers and retirement policies

The increasing participation of older cohorts in the workforce has occurred alongside significant improvements in health outcomes and life expectancy. Furthermore, increasing longevity incentivises people to work longer to ensure they have adequate savings for retirement. The labour force participation rate of people aged 55 and over has been rising steadily since the mid 2000s across advanced economies, partially reversing a multi-decade decline in the average age of retirement (OECD 2015a). Over the past decade, the participation rate of people in advanced economies aged 55–64 years old and 65 years and over has increased by an average of 9 and 4 percentage points, respectively (Graph 7). For most countries, participation rates of older women have increased by more than those of older men from comparable age cohorts over this period.

Australia's experience of older workers' participation in the workforce is typical for an advanced economy. While euro area countries such as Germany, Italy and France have seen a much larger increase in the labour force participation of older people over the past decade, this represents a catch-up to retirement norms in other advanced economies; the average age of retirement among the euro area countries remains relatively low.

Graph 7
Older Cohorts Labour Force Participation
Percentage point change from 2006 to 2016



Sources: ABS; BLS; CEIC; Eurostat; Statistics Canada; Statistics Japan; Statistics New Zealand

Across advanced economies, the gap between the participation rates of older people and those of prime-age workers is gradually narrowing. This is particularly the case for the 55–64-year-old cohort, which now has a participation rate of less than 20 percentage points below the prime-age cohort in most advanced economies. While there is a limit to the additional labour supply that can be generated by increased participation by older cohorts, the lower participation rates for those over 65 years old suggest there may be some scope to increase labour supply from this cohort. New Zealand, for example, has seen a large increase in labour force participation of this cohort. The New Zealand Treasury (2016) attributes this increase to factors such as labour market flexibility and government policy changes to pension access eligibility. In Japan and Korea, the share of the population over the age of 75 who are in the labour force has been gradually increasing over the past few years.

Rising workforce participation of older workers in advanced economies can be attributed to multiple factors. As well as improving health outcomes and increasing life expectancies across advanced economies, it also reflects: changes to workplace culture that support older workers to remain in the labour force; a shift away from physically demanding employment; and workers' concerns about inadequacy of pension or retirement savings (especially in light of increasing longevity) (OECD 2015b). The official retirement age – the age when individuals are entitled to access retirement savings or government-provided pensions – can also affect retirement decisions. However, given the gradual nature of changes in official retirement ages and the small amount of cross-country variation,

these are unlikely to explain the rapid and varied pace of increasing labour force participation by older workers. The effective retirement age – the average age when people actually withdraw from the labour market – differs from the official retirement age, partially because of differences in tax laws, pension access requirements and pension amounts. In Australia, the ability to access the aged pension or superannuation savings is cited by older workers as the main reason for leaving the workforce. For example, the gradual increase in the age that women become eligible for a pension in Australia, from 60 to 65 between 1995 and 2013, was accompanied by an increase in labour force participation of almost 30 percentage points over this period. In Korea, the high effective retirement age mostly reflects financial need; the government-provided pension is low and the elderly poverty rate is high (OECD 2015a).

Labour force projections

As the population in advanced economies ages further it will continue to put downward pressure on the supply of labour; the participation rates of specific cohorts are also likely to continue to change. The potential changes to labour supply over the next 25 years can be illustrated with three scenarios based on different assumptions about how participation rates for different cohorts might change, along with population projections from the United Nations. The scenarios are as follows (Table 1):

1. The 'ageing only' scenario assumes there are no changes to cohort participation rates from 2016. It illustrates the strong downward pressure that ageing will exert on labour supply. Future participation rates in all economies trend lower as the share of the population accounted for by older cohorts increases. Australia's participation rate is projected to have one of the smaller declines under this scenario.
2. An assumption of no change in participation rates by cohort is likely to be pessimistic, so the second 'cross-country benchmark' scenario assumes that each economy's cohort-specific participation rate converges to the highest participation rate observed among the included countries since 2000 (the benchmark).[3] This illustrates the impact that a broad-based increase in participation could achieve, although full cross-country convergence is likely to be too optimistic.[4] By 2040, most of the economies are projected to increase their overall participation rates, although those ageing more slowly, such as Australia, converge to participation rates that are around 5–10 percentage points higher than the rapidly ageing Asian and European economies.
3. The 'delayed retirement' scenario explores the effect of delayed retirement, by projecting the rising participation of older workers.[5] Under this scenario, the aggregate participation rate would remain broadly stable or decrease slightly because the increased participation of older cohorts is offset by the ageing of the workforce.

These scenarios suggest that, while ageing will put downward pressure on participation rates in all advanced economies, increases in cohort-specific participation rates could largely offset this. Despite this, labour force growth is still expected to slow sharply in advanced economies

3 Following Holzmann (2005), the benchmark is the highest participation rate since 2000 for that cohort among a set of advanced economies. These are mostly from Japan for males and Sweden and New Zealand for females. Each cohort's participation rate is increased by 1 percentage point per year until the benchmark level is reached. Demographic shifts are the UN projections.

4 There has been some convergence in cross-country female participation rates since 2000 (IMF 2017).

5 The participation rates for older workers (aged over 50) are assumed to increase at the same pace observed over the past five years for each economy, but are constrained to be at or below the current prime-age participation rate. The participation rates for the younger cohorts are held at their 2016 level.

Table 1: Labour Force Participation Rate Projections
Total percentage point change

	Australia	Canada	Euro area	Japan	New Zealand	South Korea	Sweden	US
2000–16	1.5	0.1	1.5	–2.3	4.5	1.5	4.4	–4.3
2017–40 projections:								
Ageing only	–4.6	–6.9	–7.4	–5.6	–5.8	–5.6	–4.0	–3.7
Benchmark	6.0	2.9	6.2	0.6	–0.1	1.5	4.0	7.8
Delayed retirement	–1.8	–2.8	–2.2	–0.1	0.0	1.1	0.3	–2.6

Sources: ABS; BLS; CEIC Data; Eurostat; ILOSTAT; RBA; Statistics Canada; Statistics Japan; Statistics New Zealand; United Nations

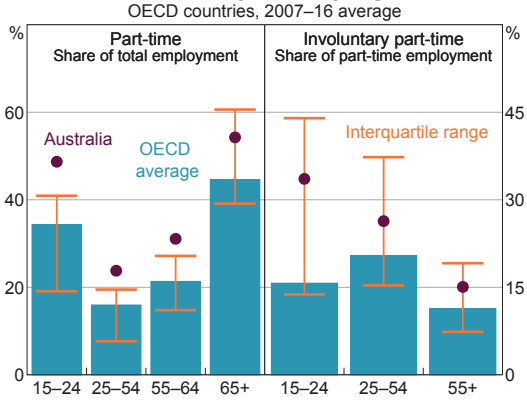
due to slower population growth. This reduction in labour supply is likely to tighten the labour market, all else being equal.

Ageing and Hours Worked

Workers can also adjust their labour supply by changing their hours worked. For example, a worker around retirement age may choose to exit the labour force (thereby supplying no labour) or they may decide to partially retire by transitioning from full- to part-time work. As health outcomes improve, the elderly may work full time for longer, but it is also plausible that many elderly workers will choose partial retirement at some point.

Both older and younger workers are more likely to work part time than prime-age workers (Graph 8). This phenomenon is broad based across countries. Australia's total part-time employment share is high by international standards, although it is less of an outlier for the older age cohort.[6] For those aged above 65 years, part-time work is more prevalent in many European countries. Most part-time workers in the older age cohorts voluntarily work part-time, suggesting reduced work hours is an important element of transitioning to retirement. Pension eligibility also plays a role. In some countries workers are incentivised to limit their hours so

Graph 8
Part-time Employment by Age Group
OECD countries, 2007–16 average



Sources: OECD; RBA

they can receive the pension. The part-time employment shares for those aged 55–64 years have been roughly stable over the past decade across advanced economies. They have generally increased for those aged over 64 years. However, in countries that saw substantial increases in the participation rates of their oldest cohort, such as Canada and New Zealand, the part-time employment share declined as more workers remained working full time rather than retire.

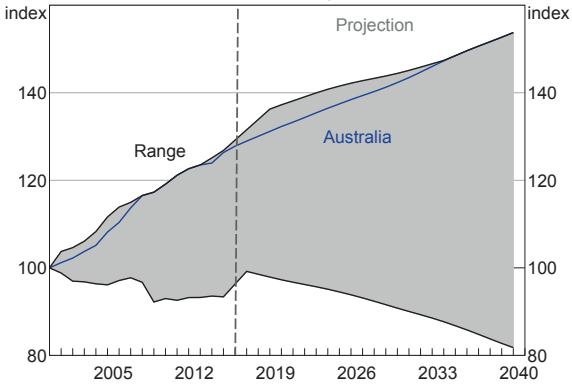
Over the past decade, the increase in part-time work has led to a decline in average hours worked per worker. However, within the part-time worker cohort for those aged over 55 years, average hours have increased. Both demand and supply factors are likely to be driving this increase in part-time hours, such as

6 See Cassidy and Parsons (2017) for a detailed review of part-time work trends in Australia.

increased availability of flexible work, financial need and improved health.

In aggregate, total labour hours supplied are likely to continue increasing in less rapidly ageing economies, including Australia, although at a slowing pace as labour force growth slows (Graph 9).[7] In the more rapidly ageing economies, increases in labour force participation rates have kept the supply of hours fairly stable since 2000. However, without further increases to the labour supply (such as migration or increased participation by older or female workers), total labour hours supplied in these economies are likely to fall sharply over the next few decades.

Graph 9
Total Hours Supplied
Advanced economies, 2000=100



Sources: ABS; BLS; CEIC Data; Eurostat; ILOSTAT; OECD; RBA; Statistics Canada; Statistics Japan; Statistics New Zealand; United Nations

Conclusion

Demographic change is a key driver of labour supply trends. Population ageing has reduced growth in the labour force across advanced economies, although strong migration has lessened some of this impact in Australia. Increased female and elderly workforce participation has partially offset the downward pressure from ageing. Projections show that continued growth in participation by these groups can continue to counterbalance some of the substantial effects of ageing on aggregate participation. Nonetheless, overall growth in the labour force and total hours supplied will continue to slow, all else being equal.

The broader macroeconomic consequences of these developments are uncertain, as demographic change can influence both potential and actual output. Subdued trend growth in labour supply will lower potential output growth and tighten the labour market, all else being equal. This would put upward pressure on wages and inflation. However, there may be offsetting changes in the demand for labour, if, for example, an older population consumes less or labour scarcity leads firms to innovate in order to improve labour productivity (raising potential output). Labour shortages could also see societies open themselves up to increased migration, which would boost labour supply. Overall, while the most likely implication of ageing is a tighter labour market in the longer term, the ageing phenomenon will shape the behaviour of households, firms and governments in ways that are difficult to predict and may go some way to reversing these trends.

7 The graph projects total hours supplied by holding participation rates and hours worked by each age cohort fixed at their 2016 levels, and then calculating the hours supplied by each age cohort using UN population projections. This likely represents a lower bound estimate if participation rates of older cohorts and women increase further.

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Recent Developments in the ATM Industry

Stephen Mitchell and Chris Thompson*

The ATM industry in Australia is undergoing a number of changes. Use of ATMs has been declining as people use cash less often for their transactions, though the number of ATMs remains at a high level. The total amount spent on ATM fees has fallen, and is likely to decline further as a result of recent decisions by a number of banks to remove their ATM direct charges. This article discusses the implications of these changes for the competitive landscape and the future size and structure of the industry.

Introduction

In 2009, a set of reforms was introduced to the ATM industry, with support from the Reserve Bank, aimed at strengthening competition and efficiency in the ATM market. In part, the reforms focused on making it easier for new entrants to directly participate in the ATM system by clarifying their right to connect to the system and removing the potential for discriminatory pricing. It also introduced greater competition and transparency in ATM fees by removing the highly inflexible and opaque system of interchange fees and instead allowing ATM owners to set their own fees ('direct charges') to compete directly with one another for transactions. The reforms have had a number of effects, including encouraging the entry of new ATM deployers and increasing the number of ATMs, including in locations where they would not previously have been commercially viable.[1]

Since the reforms were introduced, the Bank has periodically undertaken surveys on the ATM industry to better understand trends in the market structure, ATM usage and direct charging. The Bank recently completed its fourth survey of ATM participants, which asked for information as at June 2017 (or the year to June 2017 for transactions).[2] The survey, which provides disaggregated data by ATM deployer, is reasonably comprehensive, covering over 95 per cent of all ATMs.

Drawing on the results of this survey and other data sources, this article discusses recent changes in the size and structure of the ATM industry, ATM use and fee arrangements. It finds that ATM use has continued to decline in recent years but that the number of ATMs remains close to its peak level. The total amount spent on ATM direct charges has fallen, mostly reflecting a reduced number of ATM withdrawals, and is likely to decline further given the recent decisions by a number of banks to scrap their ATM direct charges. The article discusses some of the possible implications of this change in fee arrangements and declining ATM use for the industry, including how it might affect the competitive landscape, as well as future consolidation and fleet rationalisation initiatives.

* The authors are from Payments Policy Department.

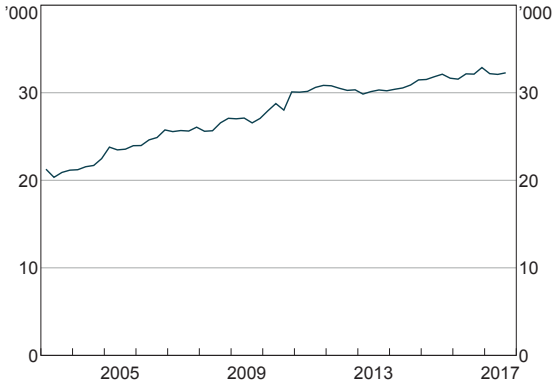
1 For more information on the 2009 ATM reforms and their impact, see Flood and Mitchell (2016).

2 Previous surveys were conducted in mid 2015 (Flood and Mitchell (2016)), late 2010 (Flood, Hancock and Smith (2011)), and early 2010 (Filipovski and Flood (2010)).

Trends in the Number and Use of ATMs

Data on the total number of ATMs in Australia are compiled and published by Australian Payments Network (AusPayNet). These data show that the number of ATMs has increased by about 25 per cent since the 2009 reforms were introduced, though there has been little net increase over the past two years (Graph 1). As at September 2017, there were 32 275 ATMs, only slightly below the peak of nearly 32 900 in December 2016. This represents over 1 300 ATMs per million inhabitants, which is relatively high by international standards (Graph 2).

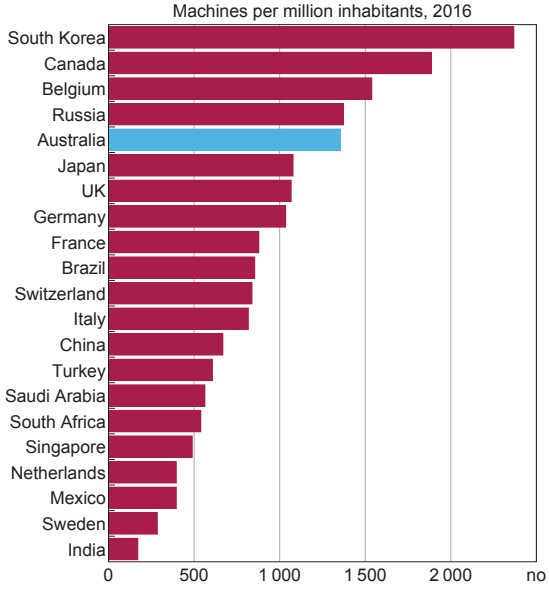
Graph 1
Number of ATMs in Australia



Source: AusPayNet

The share of the national ATM fleet owned by independent deployers has been rising over the past decade and this trend continued in the past few years according to the Bank's latest survey. Independent deployers operate standalone ATM networks that are not affiliated with any financial institution and which are often focused on convenience locations like petrol stations and licensed venues. They rely on the revenue generated by charging fees on all transactions, irrespective of the cardholder's financial

Graph 2
Number of ATMs
Machines per million inhabitants, 2016



Source: BIS

institution, to support their networks.[3] By contrast, financial institutions primarily provide ATMs as a free service to their own cardholders, and have typically only charged ATM fees to cardholders of other financial institutions.

As at June 2017, 57 per cent of ATMs in Australia were independently owned, up from 55 per cent in mid 2015 and 49 per cent in 2010. The remaining 43 per cent were owned by financial institutions. The increase in the independent deployers' share reflects strong growth in their ATMs, while the number of bank-owned ATMs has declined over the past few years.

There has been significant consolidation in the independent deployer market over recent years. Cardtronics, an independent deployer, had the largest fleet in Australia in June at nearly 10 500 ATMs, which is around one-third of all ATMs (Table 1). Cardtronics is part of a US-based group

3 Some independent deployers also own and operate some ATMs under outsourcing arrangements with financial institutions, which are usually fee-free for the financial institutions' cardholders.

Table 1: Number of ATMs – Major Deployers[a]

	July 2015	June 2017
Cardtronics (acquired DC Payments in 2017)	7 251	10 428[b]
Commonwealth Bank & Bankwest	3 806	3 733
Westpac Group (incl. St. George)	3 055	2 933
Banktech	1 857	2 415
ANZ	2 606	2 337
Next Payments	1 080	2 300
NAB[c]	1 374	1 386
Cuscal[c]	1 130	1 111
First Data	4 691	–[b]
Bendigo Bank	868	756
Bank of Queensland[c]	591	619
Suncorp[c]	681	522
Stargroup	40	509[d]
Other independent deployers	*2 700*	*2 700*
Other financial institutions	*350*	*500*

(a) A small number of ATMs that carry financial institutions' branding but are owned and operated by an independent deployer are recorded in data for independent deployers; other similar arrangements may be recorded under financial institutions. This also applies to all other tables in this article.
(b) In late 2016, DC Payments acquired First Data's Cashcard ATM business.
(c) NAB, Cuscal and Bank of Queensland, along with a number of other smaller financial institutions, are part of the rediATM network, which allows customers of member institutions to access about 3 000 ATMs (as at June 2017) within that network on a fee-free basis. From August 2017, Suncorp also joined the rediATM network.
(d) In November 2017, Stargroup was placed in administration after it was unable to complete a restructure of its debt.
Source: RBA

that is also the largest deployer of ATMs globally. It entered the Australian market around the start of 2017 when it acquired DC Payments, which was the largest domestic independent deployer at the time. DC Payments had itself acquired a number of smaller independent networks over earlier years, including First Data's Cashcard ATM business in late 2016. Other large independent deployers, such as Banktech and Next Payments, have also expanded their ATM fleets since 2015, partly through acquisitions.

Despite the increase in the share of independently owned ATMs, most Australian cardholders have had access to large networks of fee-free ATMs provided by their financial institutions. As at June 2017, three of the four major banks each had fleets of at least several thousand ATMs; NAB had the smallest fleet among the majors, but it is also part of the rediATM network, which means its customers had access to about 3 000 ATMs in that network on a fee-free basis (Table 1).[4] As discussed further below, a number of the banks, including all the majors, have recently removed the ATM withdrawal fees they used to charge non-customers. This means Australian cardholders can now generally access cash free of charge at around 11 000 financial institution

4 rediATM is an ATM network operated by Cuscal on behalf of over 90 partner financial institutions. The partners' cardholders can use any of the rediATMs across Australia without paying a direct charge fee. Suncorp recently joined the rediATM network, which will increase the number of ATMs in the network from about 3 000 to 3 300.

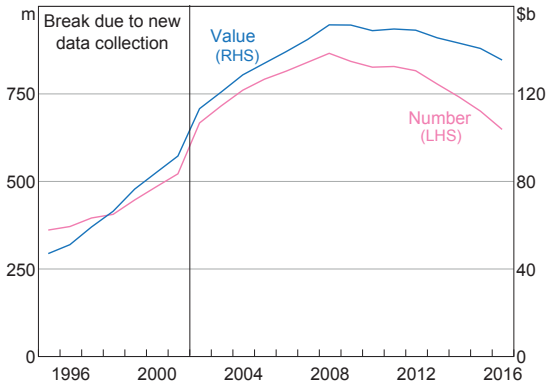
ATMs across the country, which is a significant increase in access to fee-free ATM services.

While the number of ATMs in Australia remains close to all-time highs, the use of ATMs has been falling for a number of years. Data on ATM transactions are collected separately as part of the Bank's monthly Retail Payments Statistics collection. These data show that the number and value of ATM cash withdrawals have been declining since 2008, with the decline having accelerated over the past few years (Graph 3). Since 2013, the number of ATM withdrawals has fallen by an average of 5 per cent each year and is now about 25 per cent below its 2008 peak. Factoring in the rise in the number of ATMs over this period, the average number of withdrawals per ATM has nearly halved, from about 90 per day in 2007/08 to a little over 50 per day in 2016/17 (Graph 4).

The decline in ATM withdrawals primarily reflects a fall in the use of cash for transactions, with consumers increasingly opting to use electronic payment methods, particularly payment cards. The Bank's latest Consumer Payments Survey (CPS) indicated that cash payments fell from about 70 per cent of the number of consumer payments in 2007 to 37 per cent in 2016.[5] The widespread adoption of contactless card payments and the increasing use of cards for lower-value transactions have contributed to this trend. The reduced use of cash for transactions has meant that consumers are using ATMs less frequently to replenish their cash supplies. Consumers made an average of 0.4 cash top-ups per week at ATMs according to the 2016 CPS, compared with almost 1 in the 2010 survey. The number of eftpos cash-outs at supermarkets and other shops has also been declining since 2013 and is now about 25 per cent below its 2013 peak.

5 Refer to Doyle *et al* (2017).

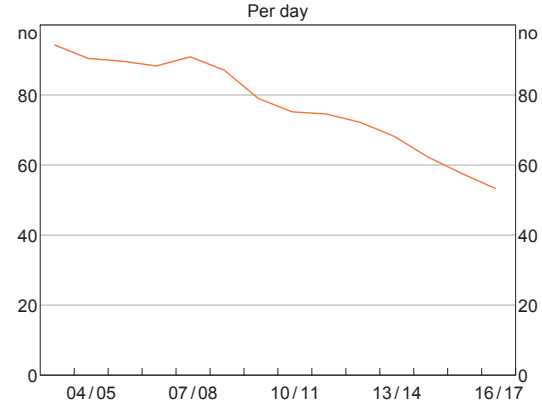
Graph 3
ATM Withdrawals*
Annual levels



* Includes both domestic and international ATM cash withdrawals on Australian-issued cards

Source: RBA

Graph 4
Withdrawals per ATM*
Per day



* Annual transaction volumes, with the number of ATMs as at June

Sources: AusPayNet; RBA

Because a large proportion of transactions at financial institution ATMs are fee-free, those ATMs tend to generate much higher transaction volumes than independently owned ATMs. Even though financial institutions made up less than half the national fleet, around 75 per cent of all ATM withdrawals and over 90 per cent of balance enquiries in the year to June 2017 took place at financial institution ATMs (Table 2). This equates to an average of 113 transactions (including balance enquiries) per machine per day at financial institution ATMs, compared with 24 per day at independently owned machines.

Table 2: ATM Activity by Type of Owner

	Number of ATMs	Number of withdrawals	Number of balance enquiries	Transactions per machine per day
	June 2017	2016/17 (millions)	2016/17 (millions)	
Financial institutions	13 467	435.3	120.4	113
Per cent of total	*43*	*74*	*93*	
Independent deployers	17 891	150.6	8.6	24
Per cent of total	*57*	*26*	*7*	
Total[(a)]	**31 358**	**585.8**	**129.0**	**62**

(a) This excludes a small number of ATMs not covered by the Bank's survey.
Source: RBA

ATM Direct Charges

As noted earlier, as part of the 2009 reforms ATM owners were given the freedom to charge cardholders directly for ATM transactions, provided that the direct charge was disclosed clearly to the cardholder and the cardholder was given an opportunity to cancel the transaction without paying the fee, if they wished.[6] This was an improvement over the previous arrangement where fees for using a foreign ATM were charged to the cardholder's account, usually appearing on their statement well after the transaction had occurred. The direct charging model provides deployers with greater flexibility to determine their own pricing, which has made it possible to deploy ATMs in locations where it might not otherwise have been economic to do so.

The Bank's periodic ATM surveys have collected information on direct charges that ATM owners impose on withdrawals and balance enquiries. As at June 2017, the average direct charge for a foreign withdrawal (that is, from an ATM not owned by the cardholder's financial institution) was $2.37 (Table 3). This is only slightly higher than the previous survey in mid 2015, but about 20 per cent higher than the typical $2.00 'foreign fee' that was charged before the 2009 ATM reforms.[7] This increase in the average fee for a withdrawal is broadly in line with CPI inflation over this period and has occurred in an environment where there has been a shift away from the use of cash and a decline in ATM withdrawals, which has increased unit costs.

The increase in the average direct charge for withdrawals has primarily been driven by higher fees at independent deployer ATMs. Direct charges on these ATMs averaged $2.63 in June, around 6¢ higher than in 2015, and up from $2.15 in 2010, an increase of 20 per cent. Among financial institution ATMs, the average direct charge was $2.04 in June, only about 5 per cent higher than in 2010.

While there has been a modest rise in the average direct charge for foreign ATM transactions since 2010, the number of transactions on which a fee is charged has been declining as more people seek out fee-free options. Estimates from the latest survey indicate that a direct charge was paid on around 29 per cent of all withdrawals in

6 With the encouragement of the Bank, the industry has also recently introduced new requirements that any ATM fees be clearly disclosed on the screen of the ATM before the cardholder begins a transaction, making it easier for the cardholder to leave and go to a machine with cheaper fees, if they wish.

7 A foreign fee is a fee charged by a cardholder's own financial institution for a transaction on an ATM not owned by that institution. Financial institutions stopped charging these fees after the 2009 reforms when bilateral interchange fees were removed.

Table 3: ATM Direct Charges
Average across ATMs for which direct charges apply, $

	Withdrawals			Balance Enquiries		
	December 2010	July 2015	June 2017	December 2010	July 2015	June 2017
Financial institutions	1.94	2.02	2.04	1.68	2.01	1.27
Independent deployers	2.15	2.57	2.63	1.96	2.26	2.25
Total	**2.04**	**2.33**	**2.37**	**1.82**	**2.15**	**1.82**

Source: RBA

2016/17, similar to that from the previous survey, but down from 33 per cent in the 2010 survey. It is estimated that cardholders paid around $420 million in ATM withdrawal fees in 2016/17. More than three-quarters of these fees were paid at independent deployer ATMs reflecting that those machines typically charge for all transactions and have higher average withdrawal fees than financial institution ATMs. Factoring in the decline in ATM use, the number of charged ATM withdrawals declined by around 30 per cent between 2010 and 2016/17, suggesting that cardholders paid around $110 million less for withdrawals in 2016/17 than in 2010. Combining ATM withdrawals and eftpos cash-outs, around 80 per cent of all cash withdrawals in 2016/17 did not attract a fee.

Since the Bank's survey was conducted, a number of banks have removed the fees they charge for ATM debit card withdrawals and balance enquiries. Commonwealth Bank of Australia (CBA) made the announcement on 24 September that it was removing its $2.00 ATM withdrawal fee charged to non-CBA customers, effective immediately. The other major banks followed suit on the same day by announcing that they would also remove their ATM withdrawal fees by early October; Bankwest and Suncorp have also subsequently removed their withdrawal fees.[8] Fees charged for balance enquiries were also abolished, with at least two of the major banks having already dropped this fee during the past year.

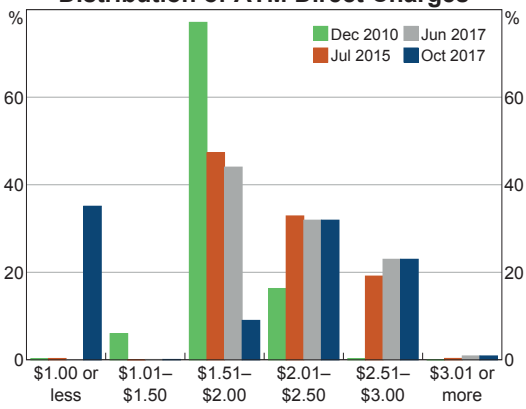
These recent pricing changes mean that close to 11 000 ATMs (about 80 per cent of all financial institution ATMs and around one-third of all ATMs) are now fee-free for Australian cardholders. This is a significant increase in access to fee-free ATM services given that previously the largest fee-free ATM network, that belonging to CBA, provided fee-free access to about 4 300 ATMs for CBA and Bankwest customers (including some ATMs outsourced to an independent deployer).

Assuming other deployers have kept their fees at the same level as when the Bank's survey was conducted, the average direct charge for a withdrawal, where it applies, is now estimated to be a little under $2.60. Among the 20 per cent of financial institution ATMs that still have direct charges, the average withdrawal fee is about $2.20.

The various ATM fee changes are reflected in the shifting distribution of ATM fees. In 2010, three-quarters of ATMs charged $2.00 for a withdrawal, with only 17 per cent charging more (Graph 5). While $2.00 was still the most common withdrawal fee in June this year, close to one-third of ATMs charged $2.50 at that time, and around one-quarter charged from $2.75 to $3.00. However, following the removal of withdrawal fees by various banks, the distribution has changed significantly: there is now no charge

8 Across all of these banks, the fee changes apply only to withdrawals made using Australian-issued debit cards, with customers using overseas-issued cards continuing to pay withdrawal fees. Direct charges for credit card cash advances also continue to apply.

Graph 5
Distribution of ATM Direct Charges



Source: RBA

for foreign withdrawals at around one-third of ATMs, whereas most of these ATMs had previously charged $2.00.

Independent deployer ATMs have the greatest variation in ATM fees; as at June this year, their withdrawal fees ranged from zero to $8.00, though most were around $2.50 to $3.00. About 300 ATMs (less than one per cent of all ATMs) charged more than $3.00; many of these ATMs are located in pubs/clubs and other adult entertainment venues. Interestingly, there are a small number of independently owned ATMs that operate a variable pricing model, levying a direct charge based on a percentage of the amount withdrawn.

The average direct charge on balance enquiries was lower than for withdrawals, at $1.82 in June, and had declined since 2015. This was largely due to two major banks removing their balance enquiry charges during the past year. Following the recent decisions by a number of other banks to scrap their ATM fees, the average balance enquiry fee (when charged) is now estimated to have risen to about $2.30, though only a small fraction of enquiries are now charged.

Implications of the Removal of Direct Charges

The decisions by a number of the banks to remove their ATM fees could have a number of implications for the ATM industry. With the removal of withdrawal fees providing a much larger network of fee-free ATMs, it will now be even easier for cardholders to avoid paying fees. As a result, those ATM deployers that continue to charge withdrawal fees – particularly independent deployers, who typically charge the highest average fees – may face additional competitive pressure, especially where they have ATMs in close proximity to fee-free bank ATMs. That said, many independently owned ATMs are in convenience locations not serviced by bank ATMs (such as pubs and clubs) and so they may be shielded somewhat from this competitive pressure.

For those banks that eliminated their withdrawal fees, the direct reduction in their revenue will be relatively small, especially given the decline in ATM use over recent years. In particular, based on the Bank's survey, it is estimated that withdrawal fees paid at ATMs owned by the major banks in 2016/17 totalled around $50 million. As noted earlier, the bulk of ATM fees has been paid at independent deployer ATMs rather than bank-owned ATMs.

Given that cardholders can now effectively use most bank ATMs on a fee-free basis, it is likely that having a large ATM fleet will be viewed as less of a source of competitive advantage to banks than it was in the past. With ATM use declining rapidly and the costs of ATM deployment continuing to rise, the removal of ATM fees may strengthen the case for deployers to reduce the size of their ATM fleets. Having multiple bank ATMs side-by-side or in close proximity (as can often be seen in shopping centres, for example) will make less economic sense now that all or most of those ATMs are fee-free.

Fleet rationalisation could occur in a number of ways. Some banks (and possibly independent deployers) might look to better optimise their own fleets by removing ATMs in low-density or low-use areas. Banks may look to pool part or all of their fleets with other banks under generically branded, shared service or 'utility' ATM models as a way to improve efficiency, while still maintaining adequate access for cardholders. A pooled network may enable the participants to remove ATMs that are co-located or in close proximity, which would reduce costs and help them sustain, and possibly grow, their joint network coverage. Indeed, before the recent announcements on direct charges, some banks had been in discussions about pooling their ATM fleets into a shared utility.

Facing similar downward trends in cash and ATM use, a number of other countries, particularly in northern Europe, have successfully implemented or are considering shared ATM models. For example, bank ATMs in Finland were outsourced to a single operator in the mid 1990s, while Sweden's five largest banks adopted a utility model earlier this decade. The large Dutch banks are currently looking to set up a joint ATM network to help ensure the continued wide availability of ATMs in the Netherlands even as cash use is decreasing.

While it is too early to assess the full impact of the recent announcements by the major banks, it is likely that they will focus attention on the growing disparity between the number of ATMs in Australia and the demand for ATM services. Some consolidation seems likely, and may even be desirable for the efficiency and sustainability of the ATM network, though it will be important that adequate access to ATM services is maintained, particularly for people in remote or regional locations, where access to alternative banking services is often limited.

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The Availability of Business Finance

Ellis Connolly and Ben Jackman*

Access to business finance has improved markedly since the global financial crisis, and debt-servicing costs are near historic lows. Nevertheless, small businesses continue to face challenges accessing finance. This article looks at the sources and availability of finance for Australian businesses. It also explores several innovations, such as comprehensive credit reporting and alternative finance platforms. These could make financing more accessible for small businesses in the start-up or expansion phase.

Introduction

The Reserve Bank monitors the availability of business finance using information from a wide range of sources. These include financial data collected by the Australian Prudential Regulation Authority (APRA) or reported by companies, surveys and the Bank's regular liaison with financial institutions and businesses. Every year for the past 25 years, the Bank has convened a Small Business Finance Advisory Panel to better understand the challenges faced by innovative small businesses. To gain a variety of perspectives, the Bank invites entrepreneurs from a range of industries and locations across Australia to join the panel for terms of three years. Access to finance for small businesses in the start-up and expansion phase of their existence is important, since these firms generate employment, drive innovation, and boost competition in markets.

Overall, external finance has become more readily available over recent years. Interest rates on business loans and corporate bonds are near historic lows, mainly because monetary policy is expansionary and credit spreads have narrowed.

* The authors are from Domestic Markets Department.

Foreign banks have been expanding their operations in Australia, competing vigorously with the domestic banks to lend to large established businesses. Surveys and the Bank's business liaison indicate that businesses generally face little difficulty accessing finance. Despite this, growth in business borrowing has only been moderate over recent years and equity raisings have been relatively subdued. This has been partly because the domestic banks have scaled back their exposures to certain higher-risk sectors, such as commercial property. More generally, large businesses have demanded less finance to fund mergers and acquisitions. Resource companies have also reduced debt recently, using the boost to their cash flows from higher commodity prices.

In contrast to large businesses, it remains challenging for young small businesses to fund their expansion plans. Prudent lenders require evidence that a business can service the loan from its cashflow; this is difficult for an entrepreneur starting a business to demonstrate. To obtain a bank loan of sufficient size at a reasonable interest rate, entrepreneurs often need to provide personal guarantees and collateral. This concentrates their risk and

excludes those who do not have existing wealth to draw upon. Given the risk profile of start-up businesses, equity financing would often be more appropriate, but there have been few avenues for such financing in Australia.

There are several innovations that could improve access to finance for start-up businesses. In particular, comprehensive credit reporting should provide all lenders with richer information about potential borrowers, reducing the costs of credit assessment. In addition, large technology companies have started to exploit rich data from their sales or payments platforms to identify promising business lending opportunities. Alternative funding platforms also offer new sources of finance for entrepreneurs. While these developments remain in their infancy, take-up is likely to expand over the period ahead.

The Sources and Uses of Business Funding

Looking at the balance sheet of the business sector in Australia, businesses are financed by around 60 per cent equity and 40 per cent debt and trade credit (Table 1). Equity liabilities include the equity of larger businesses listed on stock exchanges and the unlisted equity of smaller businesses, foreign subsidiaries and public corporations. Business debt is dominated by loans from financial institutions, with debt securities playing a relatively minor role.
This capital structure is similar to most other comparable advanced economies (Graph 1). The United States, to which Australia is often compared, is actually something of an outlier. Overall, bank loans are a much smaller share of business funding in the US.

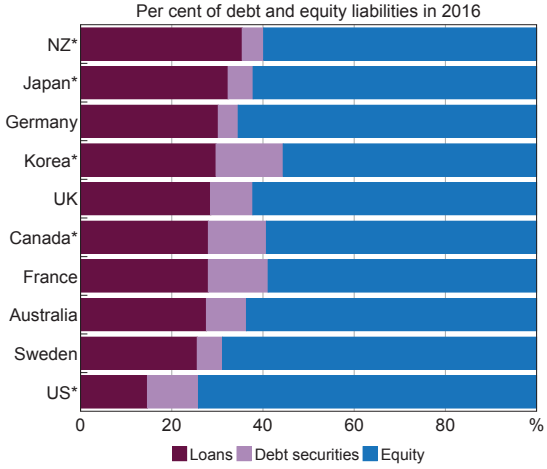
Table 1: Balance Sheet of the Business Sector[(a)]
End June 2017

Liabilities	$ billion	Share of total liabilities	Assets	$ billion	Share of total assets
		Per cent			Per cent
Debt	1 340	34	**Financial assets**	1 178	27
Loans	1 050	26	Deposits and cash	502	12
Debt securities	290	7	Debt securities and loans	92	2
Equity	2 425	61	Equity assets	336	8
Listed equity	1 066	27			
Unlisted equity	1 359	34			
Trade credit					
Accounts payable	216	5	Accounts receivable	248	6
			Non-financial assets	3 164	73
Total liabilities	3 980	100	**Total Assets**	4 342	100
Balancing item	*361*				

(a) The finances of the business sector are challenging to measure, since the boundary between businesses, households and the government is not clearly defined and evolves over time. Unincorporated businesses tend to be closely intertwined with the households that own them and, as a result, it is virtually impossible to separately identify their balance sheets. In addition, the privatisation of many public corporations over recent decades has shifted the responsibility for financing these businesses from the public sector to the private sector. To deal with these challenges, the business sector is defined here to include all private and public non-financial corporations. The balance sheet of the business sector is presented on a consolidated basis, where claims between businesses within the sector have been netted to remove double counting.

Sources: ABS; RBA

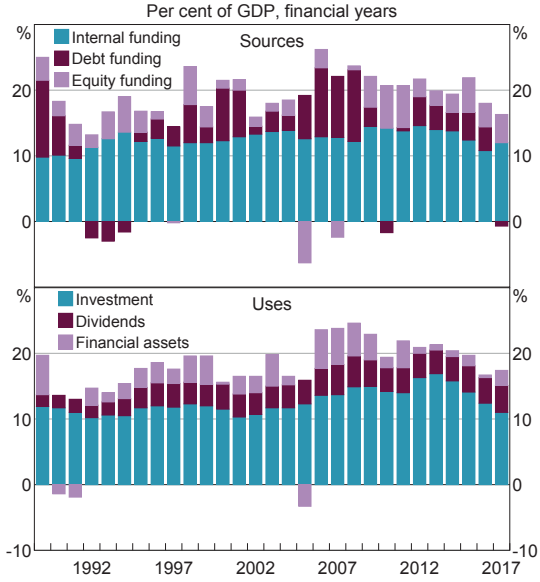
Graph 1
Business Sector Capital Structure
Per cent of debt and equity liabilities in 2016



* Business sector liabilities are not consolidated for these countries; 2015 data for Japan and New Zealand

Sources: OECD; RBA

Graph 2
Sources and Uses of Business Funding
Per cent of GDP, financial years



Sources: ABS; RBA

The liabilities of the business sector are mainly used to finance productive non-financial assets, such as commercial buildings, machinery and intellectual property. This accounts for about three-quarters of the balance sheet, while the remainder is invested in financial assets.

The primary source of new finance for businesses is internal funding (that is, profits net of interest and tax), supplemented by funds raised externally (Graph 2). Funds are largely used to finance productive investment, but some share is used to pay dividends and invest in financial assets. Businesses tend to finance their investment from internal funding, because raising funds externally is more costly and can involve investors demanding a level of control over the business.[2] Investment has moved broadly in line with the amount of internal funding available.

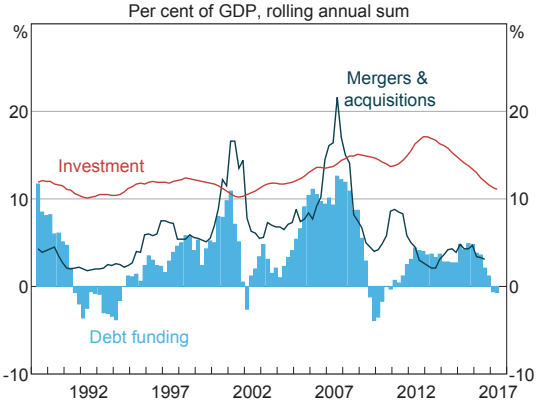
Over the past 10 years or so, the pattern of internal funding for Australian businesses overall has been affected by the commodity price cycle. Resource companies largely used their higher profits from the mid 2000s to the mid 2010s to finance the resource investment boom. As commodity prices fell from 2011 to 2015, resource companies scaled back their investment, and returned a higher proportion of their profits to shareholders as dividends. Following the recovery in commodity prices from the lows of early 2016, resource companies have been using the boost to internal funds to repay debt and rebuild their deposit balances.

In contrast to internal funds, those raised externally are often used to finance mergers and acquisitions (M&A) activity. This is evident in the aggregate data, where debt funding moves more closely with M&A activity than with investment (Graph 3).[3] The period leading up to the global

2 Previous RBA research has found a significant relationship between investment and variables such as the user cost of capital, cash flow, sales, business confidence and the terms of trade: La Cava (2005) and Cockerell and Pennings (2007).

3 The ABS data on business debt funding, which is a broad measure of loans and debt securities, have been weaker over the past year than RBA business credit, which measures lending to businesses by financial institutions that report to APRA. The weaker ABS data are likely to reflect companies repurchasing debt securities and reducing offshore borrowing, particularly in the resources sector, and the repayment of government loans following the privatisation of some public corporations.

Graph 3
Debt Funding, Investment and Mergers & Acquisitions
Per cent of GDP, rolling annual sum



Sources: ABS; RBA; Thomson Reuters

financial crisis was a clear example, when several highly leveraged M&As took place.

When businesses choose to raise external funds, they are influenced by the relative costs of the various funding sources. Internal funds are generally viewed as the cheapest source, then external debt, while equity is the most expensive option, since it involves diluting the ownership of the business. Over recent decades, there has tended to be an inverse relationship between debt and equity funding; businesses raised larger amounts of debt during economic upswings, and raised more equity at times when the supply of debt funding was less favourable, such as following the early 1990s recession and the global financial crisis.

Over recent years, a higher share of business borrowing has been from foreign institutions (Table 2). Foreign banks, particularly those domiciled in Asia, have been increasing their share of the domestic loan market. This has occurred both through their Australian branches (included in lending by authorised deposit-taking institutions (ADIs) in Table 2) and from their head offices participating in loan syndications (included in offshore lending in Table 2). Offshore debt securities funding has also become more important, at least for large corporations with investment-grade credit ratings. The domestic bond market is small, as Australian investment funds invest relatively little of their assets in fixed-income products.

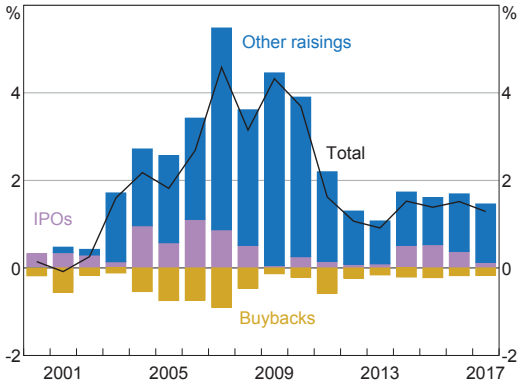
Table 2: Business Sector Liabilities by Source of Funding
Per cent

	Average over 10 years to:			
	1997	2007	2017	End June 2017
Debt, *share lent by:*				
Authorised deposit-taking institutions (ADIs)	54	59	54	49
Investment funds	8	9	6	5
Government	14	9	10	9
Households	0	0	0	0
Offshore	24	23	31	38
Equity, *share owned by:*				
ADIs	2	2	1	1
Investment funds	18	27	29	29
Government	30	19	15	15
Household	25	22	20	20
Offshore	26	31	35	36

Sources: ABS; RBA

Listed equity raisings have been subdued over the past 10 years, with relatively little capital raised through initial public offerings (IPOs) (Graph 4). This followed a period of significant equity raisings during the 2000s, partly driven by a number of privatisations through public floats. Over recent years, privatisations have increasingly been through private sales to investment funds and offshore investors, which do not contribute to listed equity raisings. As a result of these privatisations, the share of government ownership of the business sector has halved since the 1990s (Table 2).

Graph 4
Listed Equity Raisings*
Per cent of GDP

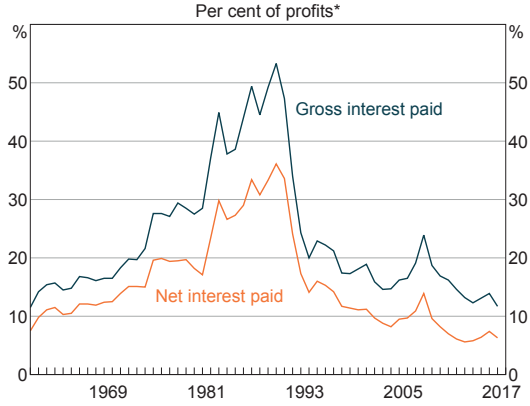


* Financial year; excludes financials
Sources: ASX; RBA

Cost and Availability of Finance

Overall, external finance has become more readily available over recent years. Monetary policy (in Australia and abroad) is accommodative and interest rates on business loans and corporate bonds are near historic lows. Consistent with this, the interest being paid by businesses relative to their operating profits is around its lowest level since the early 1960s (Graph 5). The decline in interest paid since the late 1980s has been driven entirely by lower interest rates; the ratio of debt relative to operating profits has increased a little over this period. In addition, the messages from

Graph 5
Interest Paid by Businesses
Per cent of profits*

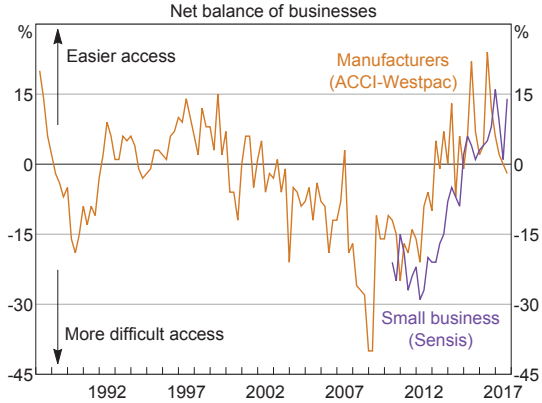


* Profits are the gross operating surplus of non-financial corporations
Sources: ABS; RBA

business surveys and the Bank's liaison program are that funding conditions have improved over the past five years (Graph 6). One notable exception has been the commercial property sector, where the domestic banks have sought to rein in their exposures. This has partly been in response to active prudential supervision from APRA (Byres 2017). In addition, small businesses tend to find it more challenging to obtain finance than large businesses.

Despite finance generally being available, growth in business borrowing has been relatively moderate, suggesting demand has been

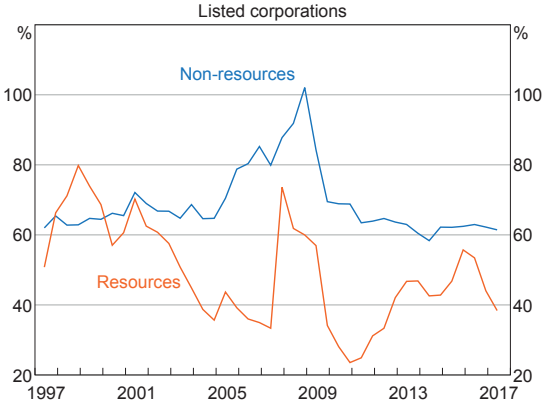
Graph 6
Ease of Accessing Finance
Net balance of businesses



Sources: RBA; Sensis; Westpac

soft. Following the global financial crisis, the corporate sector deleveraged, and outside the resources sector, gearing has remained low since then (Graph 7). Recently, non-mining business investment has been growing and the outlook for investment has improved. Demand for external finance nonetheless remains moderate, consistent with subdued M&A activity and firms relying on internal funding for investment. Even in the resources sector, while gearing rose between 2011 and 2015, it did not reach the levels that prevailed immediately before the crisis. It has since declined again, as companies have used their higher cash flows to pay down debt.

Graph 7
Gearing Ratios by Sector*
Listed corporations



* Ratio of book value gross debt to equity; excludes foreign-domiciled companies listed on the ASX

Sources: Bloomberg; Morningstar; RBA

Finance for Small Businesses

A consistent theme from the Small Business Finance Advisory Panel over the years has been that access to finance for small businesses remains challenging. According to the Australian Bureau of Statistics (ABS), small businesses were around twice as likely as large businesses to identify a lack of access to additional funds as a barrier for their business. In this context, it is important to distinguish between small businesses that are in the start-up or expansion phase, which have a strong demand for external finance, and the many small businesses that are not expanding and have little need for external finance; according to the ABS, less than a fifth of small businesses actually sought external finance in 2015/16. RBA research has found that financial constraints can discourage potential entrepreneurs from starting businesses and prevent small businesses from undertaking investment.[4] The remainder of this section focusses on the issues affecting access to finance for small businesses in the start-up or expansion phase. These businesses are more likely than other small businesses to boost employment, innovate and provide a degree of competition for established businesses.

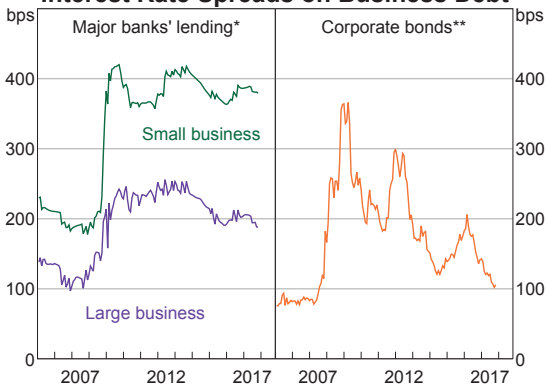
According to lenders, smaller businesses find it harder to obtain external finance since, on average, they are riskier investments and there is less information available to lenders and investors about their prospects. Lenders want evidence that borrowers can repay loans from the cash flow of their businesses. This is particularly challenging for new businesses. Applications from start-up businesses require more detailed risk assessment than for existing small businesses, which raises the cost of originating the loan. Lenders typically manage these risks by charging higher interest rates than for large business loans. They also reject or modify a greater proportion of small business credit applications. In particular, lenders noted in liaison that they were less likely to lend to a start-up in a new or emerging industry.

The reduction in the risk appetite of lenders following the global financial crisis appears to have had a more significant and persistent effect on the cost of finance for small business. The average spread of business lending rates to the cash rate widened, but most markedly for small

4 See La Cava and Windsor (2016), Kenney, La Cava and Rodgers (2016) and Connolly, La Cava and Read (2015).

business (Graph 8). This reflected an increase in the assessed riskiness of small business loans. In turn, this reflected a larger increase in non-performing loans for small businesses than for residential mortgages or large business lending portfolios (apart from commercial property exposures, which experienced higher defaults). This experience has been built into the default probabilities that the major banks apply to their lending portfolios (Graph 9).

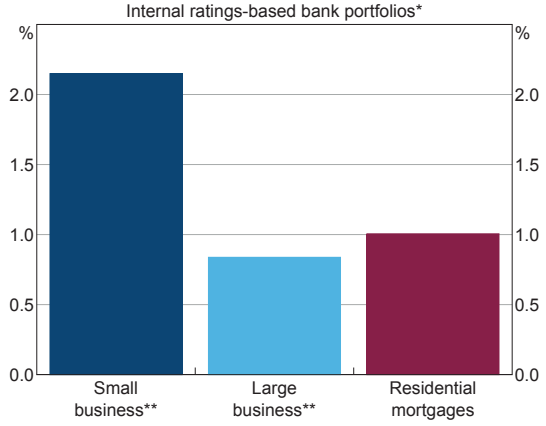
Graph 8
Interest Rate Spreads on Business Debt



* Rates on outstanding lending; spread to cash rate
** Five-year secondary market non-resource corporate bond spreads over AGS

Sources: APRA; Bloomberg; Financial Reports; RBA; UBS AG, Australian Branch

Graph 9
Default Probabilities
Internal ratings-based bank portfolios*



* On-balance sheet exposures of major banks; June-2017 data
** 'Small business' is SME retail and SME corporate categories in APRA's capital framework; 'Large' is the corporate category

Sources: APRA; RBA

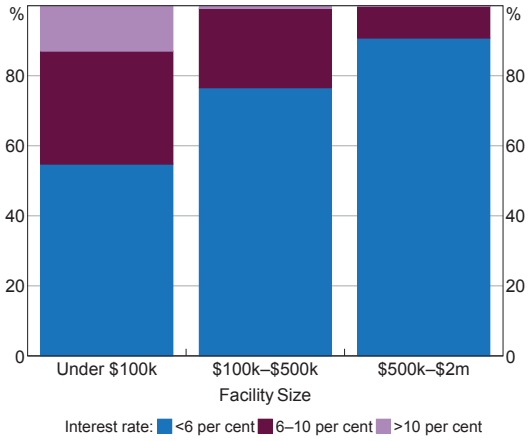
Over recent years, there has been strong competition for large business lending. Large businesses have access to deeper funding markets than small businesses, including global markets for corporate bonds and syndicated lending. Much of the competition from banks for large business loans has been driven by an expansion in activity by foreign banks. That expansion has been reflected in a decline in the interest rate spread on large business lending. According to the Bank's liaison with businesses and banks, these foreign banks are most interested in lending to large highly rated Australian companies.

In contrast, competition has been less vigorous for small business lending and the interest rate spread for this lending has remained relatively high. Consistent with this, the share of lending provided by the major banks is over 80 per cent for small businesses; this compares to around two-thirds for large businesses. Small businesses continue to use loans from banks for most of their debt funding because it is often difficult and costly for them to raise funds directly from capital markets.

The Bank's liaison with lenders and businesses has highlighted that the availability of housing collateral by small business borrowers has a significant effect on the cost and availability of debt finance (Connolly, La Cava and Read 2015). Lenders place most weight on evidence of the capacity of small business borrowers to service their debts on an ongoing basis from their cash flows. Pledging collateral nonetheless demonstrates the borrower's willingness to repay, and serves as a backstop that would help protect the lender in the event of default. Lenders have indicated that at least three-quarters of their small business lending is collateralised and that they have a limited appetite for unsecured lending. A high proportion of larger lending facilities tend to be lent at interest rates close to those

that apply to housing loans, suggesting that housing collateral has been provided. In contrast, small facilities are more likely to be lent at much higher rates consistent with unsecured lending (Graph 10). This suggests that the availability of housing collateral influences the interest rate charged and the size of the loan. Entrepreneurs are often uncomfortable with providing their personal residence as collateral for their business borrowing, since it concentrates the risk they face if the business fails. Entrepreneurs have limited options for providing alternative collateral, as banks are far more likely to accept marketable, physical assets than 'soft' assets, such as software and intellectual property.

Graph 10
Small Business Lending
Value share on 30 June 2017

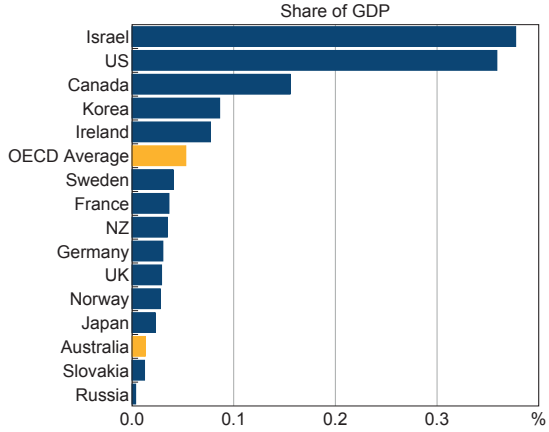


Sources: APRA; RBA

Small businesses have also raised concerns about the unfavourable trade credit terms they face from suppliers and customers with more market power, such as larger businesses and government. According to the ABS, around 15 per cent of small businesses identified cash flow constraints due to the provision of trade credit as an impediment to their business, compared to only 2 per cent of large businesses. In response to these concerns, the Australian Small Business Ombudsman conducted a Payment Times and Practices Inquiry in April 2017. Following this, the Australian Government has recently committed to expedite its payment of invoices from small businesses. Business-to-business payments data from illion (formerly Dunn and Bradstreet) indicate that more businesses have been settling their invoices on time in recent months.

Given the higher risk associated with small businesses, particularly start-ups, equity financing would appear to be more appropriate than traditional bank finance. However, small businesses often face difficulty accessing equity financing beyond the founders' contributions. Small businesses have little access to listed equity markets. While venture capital funding has risen in recent years, its supply to small businesses is limited in Australia, particularly relative to many other advanced economies (Graph 11). Private companies can only offer investments to professional, sophisticated or experienced investors, or make small-scale personal offers. Small businesses also report that the cost of equity financing is high, and they are often reluctant to sell equity to professional investors since this usually involves relinquishing significant control over their business.

Graph 11
Venture Capital Funding*
Share of GDP



* 2016 data or most recent available; venture capital definitions can vary across countries

Sources: OECD Entrepreneurship Financing Database; RBA

Innovations Improving Access to Business Finance

There are several innovations that could improve access to finance. These provide lenders with more information about the capacity of borrowers to service their debt, or connect risk-seeking investors with start-up businesses that could offer high returns.

Comprehensive credit reporting and open banking

Comprehensive credit reporting would provide more information to lenders about the credit history of potential borrowers compared with the current standard of making only negative credit information publicly available. This would reduce the cost of the credit assessment process by allowing lenders to price risk more accurately. It could also reduce the need for lenders to seek additional collateral and personal guarantees for small business lending, particularly for established businesses. In particular, the use of personal guarantees is more widespread in Australia than other countries, such as the United Kingdom and the United States, that have well-established comprehensive credit reporting regimes.

For several years, there have been industry-led efforts to establish a voluntary comprehensive credit reporting regime in Australia. A recent report by the Productivity Commission highlighted that participation has so far been limited and suggested that widespread use of such a regime could improve access to credit for small business borrowers (Productivity Commission 2017). Consistent with the recommendations of the Productivity Commission, the Australian Government has announced that it will legislate for a mandatory regime to come into effect in mid 2018. In response to these developments, several of the major banks have announced commitments to begin contributing their credit data over the year ahead.

The introduction of an open banking regime would make it easier for entrepreneurs to share their transactions data securely with third-party service providers, such as potential lenders. The Australian Government has announced that it will introduce an open banking regime and is currently conducting an independent review, which is to report by the end of the year.

Large technology companies

Large technology companies can use data on their business customers to provide financial services, such as term loans and trade finance, in competition with the banks. In particular, technology firms can use the transactional data from their sales or payments platforms to identify creditworthy borrowers, and can provide loans to these businesses from their own balance sheets. This could provide small, innovative businesses that are active on these online platforms with a new source of finance. However, a disadvantage from the perspective of the business borrower is that, if a loan were to fall into arrears, the technology firms would be able to freeze assets or restrict access to the platform.

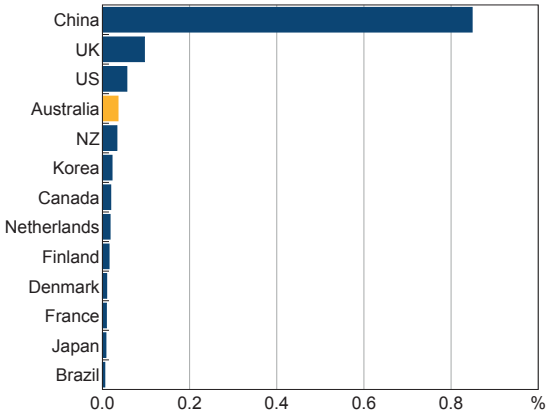
Amazon and PayPal, for example, provide finance to some businesses that use their platforms, primarily in the United States. According to company announcements, Amazon and PayPal have each lent more than US$3 billion to businesses over recent years. Some large Chinese technology firms, such as Alibaba and Tencent, have also started providing financial services in recent years. Some of these companies use algorithms to identify businesses with good sales histories and offer them finance on an invitation-only basis. For one provider, loans are reported to range up to US$750 000 for terms of up to one year at interest rates between

6 and 14 per cent, with repayments automatically deducted from the borrower's sales proceeds. Providers of online accounting software are also offering loans to small business customers based on the health of their accounts.

Alternative finance platforms

Alternative finance platforms, including marketplace lending and crowdfunding platforms, use new technologies to connect fundraisers directly with funding sources. Their aim is to avoid the costs and delays involved in traditional intermediated finance. While alternative financing platforms are growing rapidly, at this stage they remain a very minor source of funding for businesses, including in Australia. The Australian market is reported to have commenced around 2013 and provided around $600 million in finance to businesses in 2016.[5] The largest alternative finance markets are in China, followed by the United Kingdom and the United States. However, all of these markets remain small relative to the size of their economies (Graph 12).

Graph 12
Alternative Financing for Businesses
Share of GDP*



* 2015 data for European countries, 2016 for all others
Sources: Cambridge Centre of Alternative Finance; RBA

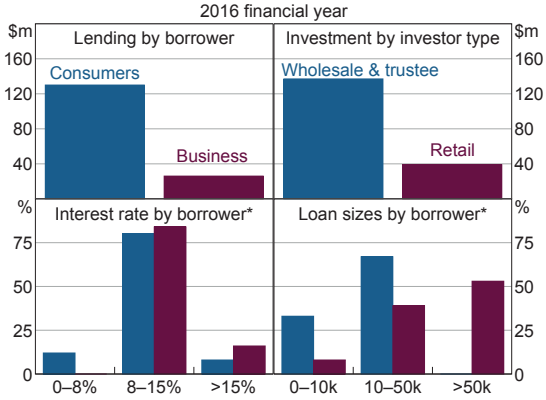
5 See Cambridge Centre for Alternative Finance and Australian Centre for Financial Studies (2017).

The Australian Government and financial regulators are seeking to facilitate innovation in business financing. The Australian Securities and Investments Commission (ASIC) has set up an Innovation Hub to assist financial technology start-ups to navigate the regulatory system. The Australian Government has made several legislative changes to facilitate sustainable growth in these markets, including allowing small unlisted public companies to raise crowd-sourced equity.

Marketplace lending platforms provide debt funding by matching individuals or groups of lenders with borrowers. These platforms typically target personal and small business borrowers with low credit risk by offering lower-cost lending products and more flexible conditions than traditional lenders. Data collected by ASIC indicate that most marketplace lending in Australia is for relatively small loans to consumers at interest rates comparable to personal loans offered by banks (Graph 13; ASIC 2017).

It is unclear whether marketplace lending platforms are significantly reducing financing constraints for small businesses. Marketplace lenders do not have an information advantage

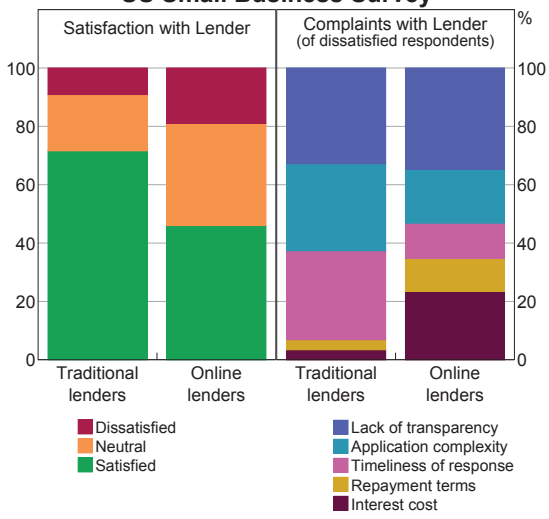
Graph 13
Marketplace Lending in Australia
2016 financial year



* Share of loans by value in each bucket
Source: ASIC Marketplace Lending Survey 2017

over traditional lenders. As a result, they need to manage risks with prices and terms in a similar manner to traditional lenders. Moreover, a survey by the Federal Reserve found that US small businesses were noticeably less satisfied with online lenders than with traditional lenders. There were more complaints about the interest rates charged and the repayment terms imposed by online lenders (Graph 14; Federal Reserve 2017). Nevertheless, these platforms could provide some competition to traditional lenders since they process applications quickly and offer rates below those on credit cards.

Graph 14
US Small Business Survey



Sources: New York Federal Reserve; RBA

Crowdfunding platforms could make financing more accessible for start-up businesses, but their use for business funding has been limited to date. Crowd-sourced equity funding platforms typically involve a large number of investors taking a small equity stake in a business. As a result, entrepreneurs can receive finance without having to give up as much control as demanded by venture capitalists. Some crowdfunding platforms also allow businesses to raise funds through presales of a new product.

These platforms offer some advantages to small business since they receive direct funding from customers, require no collateral and can gauge market interest. However, success on these markets is unpredictable and the sites are geared towards providing consumer-oriented products. Even so, crowdfunding has some high-profile success stories in Australia.

Conclusion

Access to finance is important for the economy, since businesses need funding for their day-to-day operations and to undertake investment. Overall, external finance has become more readily available since the global financial crisis, and business interest rates are near historic lows. Large established businesses have access to a wide range of funding sources. However, it remains more challenging for young, small businesses to fund their expansion plans. There are several financial innovations that could improve their access to finance, such as comprehensive credit reporting and access to alternative funding platforms.

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Foreign Currency Exposure and Hedging in Australia

Laura Berger-Thomson and Blair Chapman*

The latest Survey of Foreign Currency Exposure confirms that Australian entities' financial positions are well protected against a depreciation of the Australian dollar. Consistent with previous surveys, the net foreign currency exposures of the banking sector are fully hedged. This means that the sector's overall foreign currency liability position would not in itself be a source of vulnerability in the event of a sudden depreciation of the Australian dollar.

Introduction

Since the float of the Australian dollar more than 30 years ago, Australia's flexible exchange rate has contributed to macroeconomic stability by cushioning the economy from external shocks and allowing monetary policy to more effectively smooth the business cycle.[1] The benefits of a flexible exchange rate, however, depend on how exposed individual entities are to currency movements. If individual entities hold large foreign currency liabilities or have trade payment obligations denominated in foreign currency, a sharp depreciation of the exchange rate could adversely affect their balance sheets or cash flows. In turn, this could have implications for financial stability and macroeconomic performance. It is therefore important to understand the size and distribution of foreign currency exposures and the extent to which firms protect themselves against the exchange rate risk arising from these exposures.

Given the importance of hedging behaviour for reducing the vulnerability of particular sectors in the Australian economy to exchange rate movements, the Reserve Bank initiated, and has provided funding for, the Australian Bureau of Statistics (ABS) to regularly survey firms' foreign currency exposures and the extent to which they are hedged. The first Survey of Foreign Currency Exposure (SFCE) was conducted in 2001 and subsequent surveys have been conducted every four years.[2]

Broadly speaking, there are two ways in which firms can hedge, both of which are captured by the survey. First, firms can use derivatives – financial instruments that insure against movements in the exchange rate. Alternatively, firms can have 'natural' hedges. Natural hedges occur when foreign currency payment obligations or receipts are offset by other payment obligations or receipts. An example of a natural hedge would be a bank using US dollar deposits to purchase US Treasury securities. The 2017 SFCE asked firms about their natural hedges for the first time, allowing for a more

* The authors are from International Department, and would like to thank Megan Garner, David Halperin and Callan Windsor for their contributions to the preparation of the Survey of Foreign Currency Exposure (SFCE) and to this article. The authors would also like to thank the Australian Bureau of Statistics for the preparation and distribution of the SFCE on which this article draws heavily.

1 See Stevens (2013) for a fuller discussion of the role of a floating exchange rate in promoting macroeconomic stability.

2 See ABS (2017a) for the primary source of this information. The results of the previous survey are discussed in Rush, Sadeghian and Wright (2013).

complete assessment of hedging behaviour. The 2017 SFCE results also include more information on the hedging of expected trade payments and receipts than the results of the previous survey.

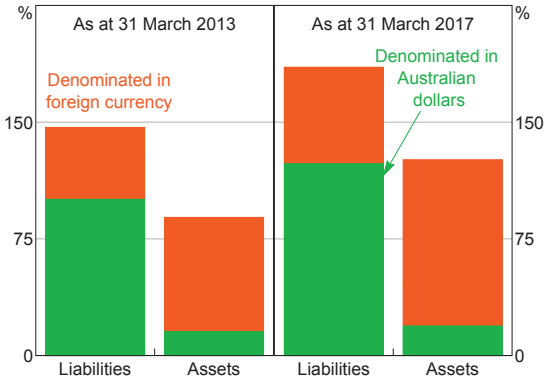
Australia's Net Foreign Currency Position

Australia has historically had a net liability position with the rest of the world, which is the result of domestic investment exceeding domestic saving over a long period.[3] This position has averaged between 55 and 60 per cent of GDP for the past decade or so. However, Australia's foreign liabilities are largely denominated in Australian dollars, but Australia's foreign assets are largely denominated in foreign currency. As a result, Australia has consistently had a net foreign currency *asset* position with the rest of the world. This means that a significant depreciation of the Australian dollar increases the Australian dollar value of foreign currency assets relative to foreign currency liabilities. This is true even before hedging of exchange rate risk is taken into account.

In 2017, Australia's net foreign currency asset position amounted to 45 per cent of GDP (ABS 2017b). Around two-thirds of Australia's foreign liabilities were denominated in Australian dollars, compared with around 15 per cent of Australia's foreign assets (Graph 1). Since 2013, foreign currency assets and liabilities have both increased as a share of GDP. Since the dollar increase in assets has been greater than that in liabilities, there has been an increase in Australia's net foreign currency asset position of around 15 percentage points of GDP.

Foreign currency assets and liabilities have risen by more than Australian dollar-denominated foreign assets and liabilities since 2013. That is, the shares of both assets and liabilities that

Graph 1
Currency Composition of Australia's External Position
Per cent of GDP



Sources: ABS; RBA

are in foreign currency have increased. Several factors have contributed to this change. The Australian dollar has depreciated by around one-quarter since 2013, as the terms of trade declined and the mining investment boom unwound. This depreciation would have boosted foreign currency positions when translated into Australian dollars.[4] Foreign currency assets have also grown because of the performance of foreign equity indices and continued purchases of foreign equities by Australian superannuation funds. Finally, there has been an increase in foreign currency borrowing and loans by non-financial corporations. These sector-level trends are discussed in more detail below.

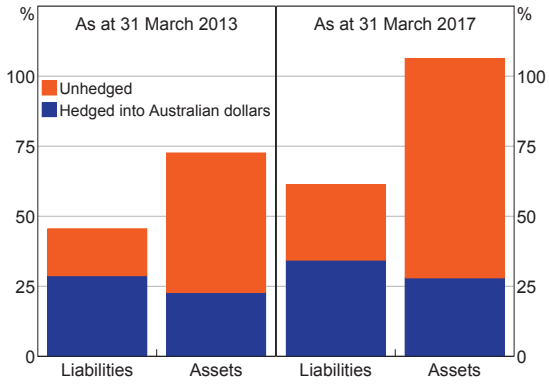
The Effect of Hedging

Hedging continues to increase Australia's net foreign currency position, as has been the case for some time. After accounting for hedging with derivatives, Australia's *effective* net foreign currency asset position was equivalent to around 50 per cent of GDP as at the end of March 2017 (Graph 2). This larger figure reflects

3 For a discussion of the trends in saving and investment, see Bishop and Cassidy (2012).

4 However, this is partly offset by the lower Australian dollar reducing the amount of foreign currency borrowing required to fund a given amount of Australian dollar assets.

Graph 2
Australia's External Foreign Currency Position
Per cent of GDP



Sources: ABS; RBA

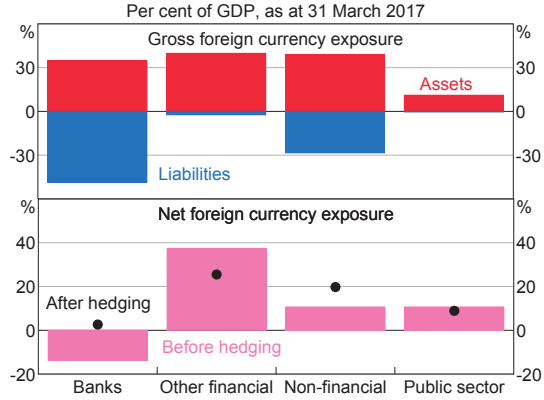
the fact that more than half of foreign currency liabilities are hedged back into Australian dollars, compared with around one-quarter of foreign currency assets.

A smaller proportion of both assets and liabilities were hedged in March 2017 than in March 2013. In large part, this reflected significant growth over that period in the foreign currency assets and liabilities of non-financial corporations, which tend to use derivatives for hedging much less than firms in other sectors. Assets of non-financial corporations accounted for 31 per cent of foreign currency assets in 2017, up from 28 per cent in 2013, while the share of foreign currency liabilities accounted for by the sector increased from 26 per cent to 36 per cent. Hedging of liabilities also declined a little within most sectors, possibly reflecting some change in hedging behaviour.

Sectoral Results

While most sectors of the Australian economy had a net foreign currency asset position at 31 March 2017 (even before accounting for hedging), the banking sector was the main exception. The banks account for almost 40 per cent of Australia's foreign liabilities and a large share of the country's foreign currency liabilities. Because of this, and their important role in the financial system, the hedging of exposures by banks is of particular interest. However, the banking sector continues to be fully hedged in net terms and, after accounting for hedging, had a small net foreign currency asset position. As at March 2017, the non-bank private financial corporations (other financial corporations) had the largest net foreign currency asset position, while non-financial corporations and the public sector also had small net foreign asset positions (Graph 3).

Graph 3
Foreign Currency Exposure by Sector
Per cent of GDP, as at 31 March 2017



Sources: ABS; RBA

Banks

The 2017 SFCE confirmed that the banking sector had a small net foreign currency asset position once hedging by derivatives had been taken into account. However, as discussed above, the banking sector was the only sector with a net foreign currency liability position before hedging, equivalent to 14 per cent of GDP as at the end of March 2017 (Table 1). This consisted of a foreign currency asset position of 35 per cent of GDP and a foreign currency liability position of 49 per cent of GDP. The large foreign currency liability position for the banking sector reflects the fact that Australian banks continue to use offshore wholesale funding markets, although

Table 1: Private Sector Foreign Currency Exposures
As at 31 March 2017

	Banks		Other financial corporations		Non-financial corporations	
	Before hedging	After hedging	Before hedging	After hedging	Before hedging	After hedging
A$ billion						
Assets	603	305	687	463	674	664
Liabilities	841	259	40	23	490	323
Net balance sheet exposure	–238	45	647	441	184	341
Per cent of GDP						
Assets	35	18	40	27	39	38
Liabilities	49	15	2	1	28	19
Net balance sheet exposure	–14	3	37	26	11	20

Sources: ABS; RBA

these markets comprise a smaller share of banks' overall funding than they did before the financial crisis.[5] In 2017, these markets accounted for a little under 20 per cent of total bank funding, almost all of which was denominated in foreign currency. The share of banking sector funding sourced from offshore has been roughly constant since March 2013; however, the value of foreign currency exposures has increased, reflecting the growth in the banking system over this time. As foreign currency liabilities and assets have increased by similar dollar amounts, the sector's net foreign currency exposure has remained roughly constant as a share of GDP.

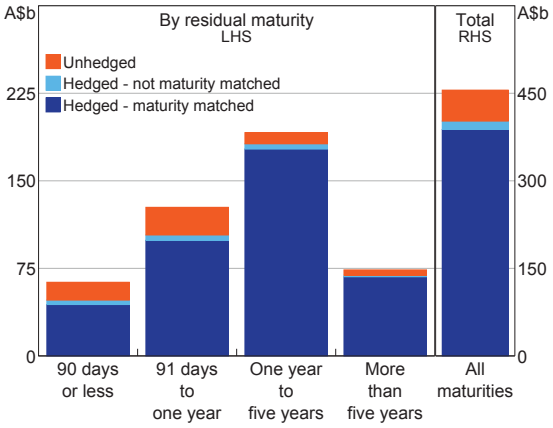
The change in banks' net foreign currency position after hedging by derivatives is taken into account reflects the fact that banks explicitly hedge 70 per cent of their foreign currency liabilities with derivatives, but only 50 per cent of their foreign currency assets. The overall net foreign currency asset position means that hedging fully offsets the exposure to the exchange rate risk that arises from the banks taking advantage of offshore markets to diversify their funding mix.

5 For a discussion of recent developments in the composition of Australian banks' funding, see Cheung (2017).

Debt security liabilities are the main source of foreign currency exposure for the banking sector, accounting for over half of the sector's foreign currency liabilities. The increase in banks' debt security liabilities since the previous survey has been proportionate to the increase in total bank balance sheets. The 2017 SFCE indicated that around 85 per cent of these liabilities were hedged using derivatives, with hedging more prevalent for long-term debt securities than short-term ones based on the remaining (residual) maturity of the security (Graph 4). Moreover, the SFCE indicated that the maturities of the derivatives used to hedge against foreign currency risk were well matched to the maturities of the underlying debt securities. This means that an entity will not be exposed to foreign currency risk for the duration of the underlying exposure and avoids the risk that it might not be able to obtain replacement derivatives if the original derivatives used for hedging did not cover the full maturity of the original exposures (that is, it avoids rollover risk).

For the relatively modest share of banking sector liabilities that were not hedged with derivatives, there was typically a matching asset in the same

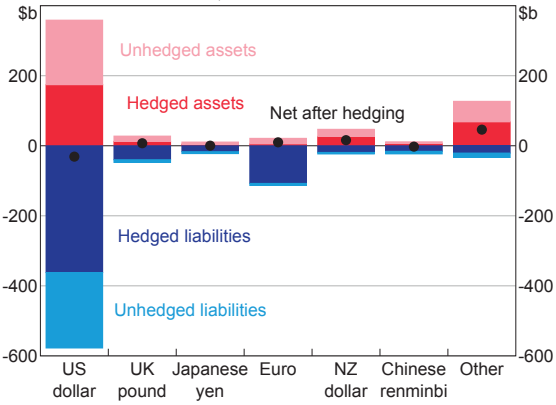
Graph 4
Banks' Hedging of Foreign Currency Debt Security Liabilities
As at 31 March 2017



Sources: ABS; RBA

foreign currency. Indeed, the banking sector reported that, of those liabilities that were not hedged with derivatives, around two-thirds had a natural hedge. As a result, after hedging is taken into account for individual currencies, there were only very small net foreign currency exposures for the sector as a whole (Graph 5). The extent of natural hedges looks to have increased over recent years, as banks have increased their foreign currency liabilities that are not hedged

Graph 5
Composition of Foreign Currency Exposures
Banks, as at 31 March 2017



Sources: ABS; RBA

with derivatives and matched this with increased lending in the same foreign currency. In part, this increase in matched assets and liabilities reflects growth in lending by the Australian operations of foreign banks to non-residents. It may also partly reflect Australian banks' acquisition of high-quality liquid assets.

Other financial corporations

The other financial corporations sector includes non-bank financial corporations, including superannuation funds, fund managers and insurance corporations.[6] These entities generally invest on behalf of households and other firms with the aim of providing high risk-adjusted returns. These firms seek to diversify their investment portfolios by holding a variety of assets including foreign equities and assets that pay a fixed income, such as government and corporate bonds. For example, foreign equities represented 45 per cent of superannuation funds' equity holdings and foreign fixed income assets represented around one-third of their fixed income holdings as at 31 March 2017 (APRA 2017).

Since the previous survey, foreign currency assets of the other financial sector have increased notably, while the sector's foreign currency liabilities have decreased slightly. The increase in foreign currency assets is consistent with continued purchases of foreign equity assets, particularly by superannuation funds, as well as the increased Australian dollar value of the existing stock of assets arising from the depreciation of the Australian dollar since the previous survey (Black, Chapman and Windsor 2017). Superannuation funds have also increased their holdings of international fixed income and international infrastructure funds since the previous survey.

6 Superannuation funds hold most of the sector's foreign currency assets.

At the end of March 2017, other financial corporations had a net foreign currency asset position equivalent to 37 per cent of GDP. Foreign equity assets accounted for most of the sector's total foreign currency assets. These financial corporations used derivatives to hedge around one-third of their foreign currency assets. After accounting for the use of derivatives for hedging, the net foreign currency asset position of other financial corporations decreases to be equivalent to 26 per cent of GDP. The SFCE does not split the hedging of foreign currency assets by type, but Australian Prudential Regulation Authority data (APRA 2017) indicate that superannuation funds hedge around 65 per cent of their international debt holdings and listed infrastructure funds but only hedge 30 per cent of their international equity holdings.

Non-financial corporations

Non-financial corporations had a net foreign currency asset position equivalent to 11 per cent of GDP as at the end of March 2017 (Table 1).[7] This net position consisted of a significant amount of foreign currency assets, around two-thirds of which were equity assets.[8] However, the sector also had a significant amount of foreign currency liabilities, almost all of which were either long-term debt securities or loans. The sector's asset and liability positions were noticeably larger in 2017 than in the previous survey. This growth partly reflects valuation effects from the Australian dollar depreciation and, for assets, the performance of foreign equities. After accounting for the use of derivatives to hedge, non-financial corporations had a net foreign currency asset position of 20 per cent of GDP at the end of March 2017.

Non-financial corporations do not use derivatives for hedging as much as other sectors. The 2017 SFCE indicated that derivatives were used to hedge only around one-third of their foreign currency liabilities and a negligible amount of the foreign currency assets. This difference is related to the composition of the sectors' assets and liabilities. The foreign currency equity assets of the sector include the foreign operations (subsidiaries and branches) of multinational corporations, which are offset by foreign currency borrowing in the form of loans and debt securities. In addition, some non-financial corporations conduct much of their trade in foreign currency, so foreign currency borrowing is matched to trade payments. For example, a large share of Australia's resource exports is invoiced in US dollars (ABS 2016). Mining firms generally borrow in US dollars to match the currency of their debt payment obligations to these trade receipts.

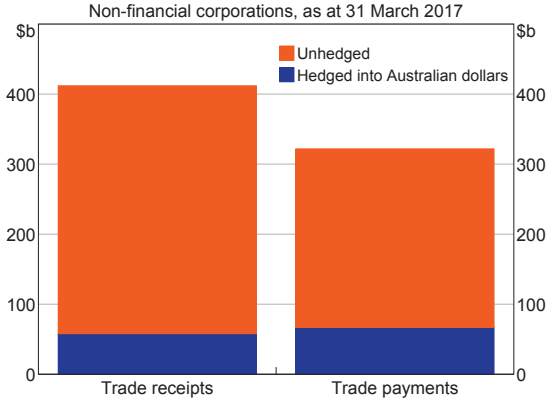
Changes to cash flows arising from exchange rate movements affect trade payment and receipts, and are a potential source of vulnerability for non-financial corporates. This is important because a large share of Australia's exports is invoiced in foreign currency. Non-financial corporations represent almost all of Australia's expected foreign currency trade receipts and a vast majority of Australia's expected foreign currency trade payments.[9] Hedging of these flows by derivatives is low. At the end of March 2017, non-financial corporations used derivatives to hedge around one-fifth of their foreign currency trade payments and around 15 per cent of their trade receipts (Graph 6). After accounting for the use of derivatives, the sector had around $350 billion in expected trade receipts and $250 billion in expected trade payments over the next four years.

7 The SFCE reports the foreign currency exposures and hedging of other resident sectors. However, financial account data (ABS 2017c) suggest that non-financial corporations account for most of these sectors' exposures and hedging.

8 The bulk of these assets reflect direct equity holdings of non-financial corporations, which consist of foreign operations and subsidiaries.

9 Expected trade receipts and payments denominated in Australia dollars are not included in the survey. Around one-third of Australia's imports are denominated in Australian dollars, while only 15 per cent of Australia's exports are denominated in Australian dollars (ABS 2016).

Graph 6
Expected Trade Receipts and Payments in Foreign Currency
Non-financial corporations, as at 31 March 2017



Sources: ABS; RBA

Public sector

The public sector's foreign currency assets and liabilities are relatively small (Table 2). The general government sector, which includes federal, state and local governments, had a net foreign currency asset position of $108 billion before accounting for the use of derivatives for hedging purposes. The net foreign currency asset position has roughly doubled in its proportion relative to GDP since the previous survey to 6 per cent. This increase has been mainly driven by an increase in foreign currency assets. Foreign currency equity assets account for around two-thirds of the general government's total foreign currency assets. The Australian Government's Future Fund continues to hold a significant proportion of the foreign currency assets of the general government sector. The Future Fund had a net foreign currency asset position of around $85 billion at the end of the 2017 financial year (Future Fund 2017).

The Reserve Bank had a foreign currency asset position equivalent to 4 per cent of GDP as at 31 March 2017. This position represents the net foreign reserve holdings of the Reserve Bank. Before hedging is taken into account, these reserves reflect the use of foreign exchange swaps to manage domestic liquidity.[10]

Derivative Holdings

As well as providing information about Australian entities' foreign currency exposures and hedging, the SFCE also contained detailed information on derivative holdings as at the end of March 2017.

Table 2: Public Sector Foreign Currency Exposures
As at 31 March 2017

	General Government		Reserve Bank of Australia	
	Before hedging	After hedging	Before hedging	After hedging
A$ billion				
Assets	115	102	76	53
Liabilities	7	1	0	0
Net balance sheet exposure	108	101	76	53
Per cent of GDP				
Assets	7	6	4	3
Liabilities	0	0	0	0
Net balance sheet exposure	6	6	4	3

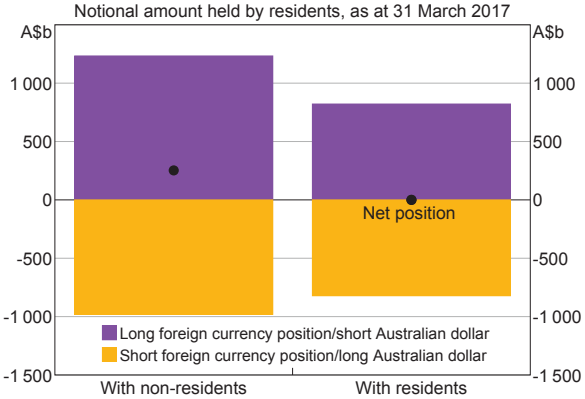
Sources: ABS; RBA

10 See RBA (2017) for a discussion of reserves management at the Reserve Bank.

These are recorded on a notional basis (that is, the total value of the exposure the derivative is covering). Some of these derivatives are used to hedge foreign currency exposures, which have been the focus of much of this article, but the survey also captures derivatives used to gain exposure in particular foreign currency markets. Consistent with the finding that the use of derivatives for hedging increases Australia's net foreign currency asset position, the survey indicated that Australian entities were positioned such that they would profit from a depreciation of the Australian dollar (that is, they had a net short Australian dollar position or a net long foreign currency position against non-residents) (Graph 7).

Cross-currency swaps continue to be the main instrument used to hedge foreign currency exposures; holdings of these instruments are concentrated in the banking sector.[11] Cross-currency swaps, which are generally used to hedge longer-term foreign currency risk, accounted for slightly more than two-thirds of total notional long foreign currency positions (or short Australian dollar positions) and around half of short foreign currency derivative positions (or long Australian dollar positions). Forwards, which are generally used to hedge shorter-term foreign currency risk, accounted for most of the remainder of the positions. These shares were relatively unchanged from the previous survey, in line with relative stability in the maturity of banks' new offshore wholesale funding over this period. The shares had increased noticeably in the four years before the previous survey (Arsov *et al* 2013).

Graph 7
Foreign Currency Derivative Positions*
Notional amount held by residents, as at 31 March 2017



* Derivatives involving the Australian dollar
Sources: ABS; RBA

11 For further discussion of how cross-currency swaps are used, see Arsov *et al* (2013).

Summary

Australia's high level of investment relative to saving over a long period has been supported by capital inflows from the rest of the world. This has resulted in Australia having a net foreign liability position. However, due to the country's liabilities being mostly denominated in Australian dollars and assets being mostly denominated in foreign currency, Australia has a net foreign currency asset position, even before hedging by derivatives is taken into account. This means that a depreciation of the exchange rate increases the value of Australia's external position. By sector, only the banking sector had a net foreign currency liability position before hedging by derivatives is taken into account. However, the net foreign currency exposures of the banking sector are fully hedged by derivatives, which results in the sector having a small net foreign currency asset position after accounting for hedging. The banking sector's debt security liabilities, which account for more than half of the sector's total foreign currency liabilities, are almost fully hedged, and the maturities of the derivatives used to hedge the exchange rate risk are matched to the maturities of the underlying exposures. Moreover, there are no significant currency mismatches either for the banking sector or for the country as a whole. Overall, the 2017 SFCE indicated that the Australian economy, despite

having an overall foreign liability position of close to 60 per cent of GDP, is well protected from a sharp depreciation of the exchange rate.

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Foreign Exchange Derivative Markets in Asia

Megan Garner*

Activity in foreign exchange derivative markets in Asia has increased in recent years, along with greater incentives to hedge exchange rate risk. But these markets are more developed for the currencies of advanced Asian economies than emerging Asian economies. Foreign exchange derivative markets also tend to be deeper for Asian economies that are more integrated into global financial markets and have flexible exchange rates.

Introduction

Many Asian entities – including Australian entities – have exposure to exchange rate risk. For entities with foreign currency assets, liabilities or trade exposures, changes in exchange rates can alter the domestic currency value of their balance sheets or cash flows. In this way, large changes in exchange rates can potentially affect economic activity and even financial stability. Firms can limit exchange rate risk by hedging with financial instruments known as derivatives.[1] (Exchange rate risk can also be hedged 'naturally'; for example, a firm with US dollar income may take out a US dollar loan in preference to a loan in local currency terms.) A key factor in a firm's ability to hedge exchange rate risk is the availability and cost of foreign exchange derivatives in financial markets. Liberalisation of financial markets and economies more generally may also prompt demand for these products – and thereby spur further development of derivative markets – as firms manage the exchange rate risk associated with a rise in cross-border flows of capital and more flexible exchange rate regimes.

This article explains the importance of hedging exchange rate risk for economies in the Asian region, including Australia. It examines the significant variation with respect to the development of foreign exchange derivative markets across Asia. It also considers a broad set of factors that are likely to be associated with the development of foreign exchange derivative markets, including a country's exchange rate regime, degree of integration with international financial markets and extent of financial market development.

The Importance of Hedging Exchange Rate Risk

The importance of hedging exchange rate risk has been evident during the Asian financial crisis of 1997–98 and subsequently. In the lead-up to that crisis, exchange rates were relatively stable because they were heavily managed by the local authorities. This coincided with a build-up of foreign currency debt in these economies, and the exchange rate risk associated with these loans went largely unhedged (Stevens 2007).

* The author is from International Department and would like to thank Ellana Brand and Melissa Wilson for their help with this work.

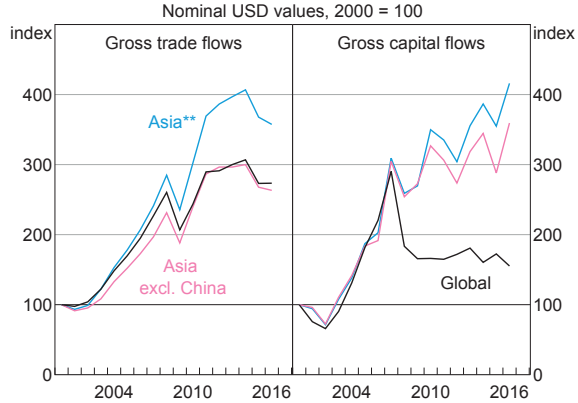
1 For an update on foreign currency hedging in Australia, see Berger-Thomson and Chapman (2017).

When the exchange rates of those economies depreciated sharply during the Asian financial crisis, the repayments on the foreign currency loans increased significantly when measured in domestic currency terms. In many instances, borrowers were unable to repay their debts. This contributed to financial instability throughout the region.

Following the Asian financial crisis, exchange rates in the region – including in Thailand, Indonesia and South Korea – became more market determined. For some exchange rates, volatility has been higher than it was before the Asian financial crisis, thereby increasing the importance of sound exchange rate risk management. Cross-border financial flows declined substantially during the Asian financial crisis, but recovered and continued to grow (notwithstanding a temporary decline during the global financial crisis). In aggregate, gross capital flows between each Asian economy and the rest of the world have risen significantly over the past decade or so even though global capital flows have declined (Graph 1). Gross trade in goods between each Asian economy and the rest of the world has also risen as a whole over the past decade, faster than the increase in global trade. This has coincided with an increase in Asian economies' share of global trade in goods, driven by China, which increased its share of global trade from 5 per cent in 2005 to around 10 per cent in 2016. A sizeable share of these capital and trade flows are denominated in foreign currency, such that the incentive to hedge against the exchange rate risk increases as these flows grow over time.

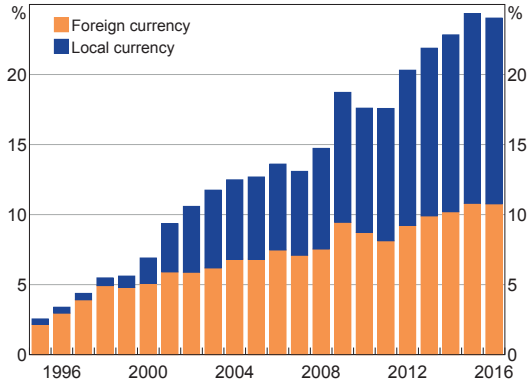
Financial systems in the region continued functioning during the global financial crisis in 2008–09 despite significant volatility in exchange rates during that period (Ryan 2016). To some extent this was because exchange rate risk management had improved since the Asian financial crisis. But concerns about exchange rate risk remain. These largely relate to the steady increase in the extent of borrowing by corporations that is denominated in foreign currencies (see, for example, IMF (2015)). The stock of foreign currency bonds issued by corporations in the region has grown faster than GDP in recent years (Graph 2). This is in contrast to the official sector, as most Asian governments have little reliance on foreign currency funding.

Graph 1
Asia Trade and Capital Flows*
Nominal USD values, 2000 = 100



* Sum of gross flows for each Asian economy, which necessarily double counts any flows between Asian economies
** Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea and Thailand
Sources: IMF; RBA; WTO

Graph 2
Corporate Bonds Outstanding*
Per cent of nominal GDP



* Includes Australia, Hong Kong, India, Indonesia, Malaysia, New Zealand, the Philippines, Singapore, South Korea, Taiwan, Thailand and Vietnam
Sources: Dealogic; IMF; RBA

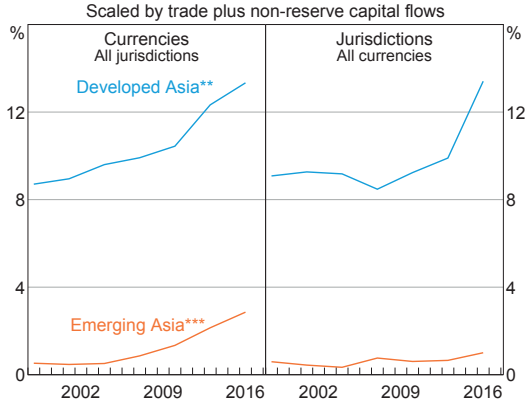
Considerable growth in Asian foreign exchange and interest rate derivative markets since the early 2000s has enabled corporations to better manage the risks associated with foreign currency exposures. The existence of natural hedges, such as foreign currency export income, also partly addresses concerns about corporations' foreign currency borrowing. However, derivative markets remain small and relatively underdeveloped in some economies, and much of the exchange rate risk associated with foreign currency exposures is likely to remain unhedged.

The Development of Foreign Exchange Derivative Markets in Asia

The rest of this article draws heavily on the results of the 2016 Bank for International Settlements (BIS) Triennial Central Bank Survey of Foreign Exchange Markets. This survey captures global foreign exchange derivative activity by currency across all markets, which provides a broad measure of the ability of market participants to hedge exchange rate risk. This is particularly important for currencies where a significant proportion of activity occurs outside of the domestic market. Another measure used in this article captures foreign exchange derivative activity denominated in all currencies in a given market. This provides one indication of the extent of domestic financial development and the availability of foreign exchange derivatives in a given location.

For most Asian currencies, the value of foreign exchange derivative activity has grown substantially over the past 15 years or so (Graph 3).[2] Part of this rise in activity is consistent

Graph 3
Foreign Exchange Derivative Turnover*
Scaled by trade plus non-reserve capital flows



* Daily average for the month of April
** Australia, Hong Kong, Japan, New Zealand, Singapore and South Korea
*** China, India, Indonesia, Malaysia, the Philippines and Thailand
Sources: BIS; IMF; RBA

with an increase in the gross capital and trade flows between each Asian economy and the rest of the world. These flows provide some indication of the extent of transactional demand for foreign exchange hedging, given that a sizeable share of capital and trade flows are denominated in foreign currencies.[3]

Even when scaled by a measure of transactional demand, foreign exchange derivative activity in Asian currencies has increased over the past decade or so. While these types of financial markets have grown in aggregate since the early 2000s, most of this growth has occurred in the currencies of more financially developed economies in the region, such as the Japanese yen and the Australian dollar. Foreign exchange derivative activity in emerging Asian currencies accounts for only a small share of activity in the region when scaled by the corresponding estimate of transactional demand for these currencies. In addition to a higher value of turnover, developed derivative markets typically

2 Foreign exchange derivative activity data are not available for the Indonesian rupiah, Malaysian ringgit, Philippine peso and Thai baht. Total foreign exchange activity (that is, including spot activity) is used as a proxy for foreign exchange derivative activity in these currencies. This represents an upper bound for foreign exchange derivative activity in these currencies.

3 Much of the analysis in this article is based on foreign exchange derivative activity scaled by gross cross-border trade and capital flows. One alternative scaling measure is nominal GDP; using this measure does not materially change the results.

also feature more sophisticated contracts (Upper and Valli 2016).

One Asian currency that has experienced rapid growth in foreign exchange derivative activity in recent years is the Chinese renminbi. Growth in renminbi foreign exchange derivative activity has been underpinned by Chinese financial market liberalisation. This includes the exchange rate and domestic interest rates gradually becoming more market determined (Ballantyne *et al* 2014). A range of initiatives designed to partly liberalise the Chinese financial and capital accounts have also expanded access to Chinese financial markets and encouraged Chinese capital flows to the rest of the world in recent years.

A substantial proportion of the rise in renminbi-denominated foreign exchange derivative turnover has occurred outside of China, largely in Hong Kong and Singapore (Garner, Nitschke and Xu 2016). Growth in these larger offshore foreign exchange markets is likely to have been encouraged by the Chinese authorities' efforts to internationalise the renminbi together with the lower trading costs available in these markets. Within China, foreign exchange derivative activity remains small relative to trade and capital flows.

A large proportion of foreign exchange derivative turnover denominated in Australian dollars, Japanese yen and New Zealand dollars is also conducted outside of the domestic market or consists of cross-border transactions between foreign and domestic entities (rather than conducted between domestic entities). This is facilitated by these currencies being fully convertible, that is, the domestic currency can be easily exchanged for a foreign one. The high degree of capital account openness and flexible exchange rate regimes in these jurisdictions is also likely to encourage offshore derivative activity (see further detail below). Together, these factors may encourage cross-border financial flows denominated in domestic currency and the movement of foreign exchange trading to the most cost-effective locations.

What Factors Drive the Development of Foreign Exchange Derivative Markets?

A broad set of factors, including a country's degree of integration with international financial markets, exchange rate regime, and extent of financial market development, are likely to be associated with the development of foreign exchange derivative markets. However, as these factors are all inter-related, it is hard to distinguish the role of any one factor by itself.

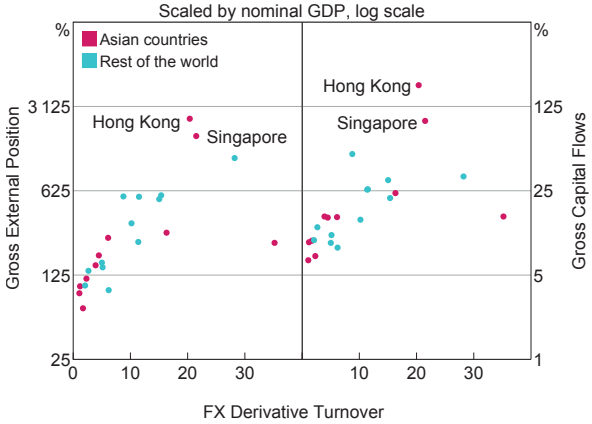
More financially open economies are likely to have a larger volume of cross-border capital flows and more free-floating (and therefore more volatile) currencies, and thus a greater demand for foreign exchange derivatives for hedging purposes.[4] A free-floating currency, such as the Australian dollar, is market determined and therefore tends to be more volatile than a managed currency, such as the Hong Kong dollar. This volatility creates uncertainty around fluctuations in the value of exposures denominated in floating currencies, which generally leads to a greater prevalence of hedging. The additional uncertainty associated with movements in free-floating exchange rates may also encourage speculative position-taking in foreign exchange derivative markets. Consistent with this, Australian foreign exchange

4 The IMF classifies exchange rate arrangements into various categories. *Floating* exchange rates are largely market determined without a prescribed target, but intervention is conducted occasionally. *Free-floating* exchange rates are floating rates but intervention is rare; limited to three instances of intervention over six months. For the purpose of this article, we classify all other IMF categories, which are less market determined, as *managed* arrangements (for example, an exchange rate pegged to the US dollar). This article applies the exchange rate classification from the 2016 IMF *Annual Report on Exchange Arrangements and Exchange Restrictions*.

derivative markets grew quickly following the floating of the Australian dollar (Debelle 2006).[5]

Two common measures of financial openness are the stock of a country's total external liabilities and assets, and the gross flow of capital between an economy and the rest of the world (Quinn, Schindler and Toyoda 2011; Lane and Milesi-Ferretti 2006). Asian economies with larger external financial positions, when measured as the stock of external assets and liabilities relative to GDP, tend to have higher levels of foreign exchange derivative activity in their currencies relative to GDP (Graph 4, left panel). This relationship is still positive, though weaker, when openness is measured using a country's gross capital flows relative to GDP (Graph 4, right panel). However, there is no evidence of a relationship between changes over time in these variables and the growth of foreign exchange derivative markets. Capital flows are more volatile than the stock of a country's external assets, which could make it difficult to identify temporal relationships with any degree of precision (Quinn, Schindler and Toyoda 2011).

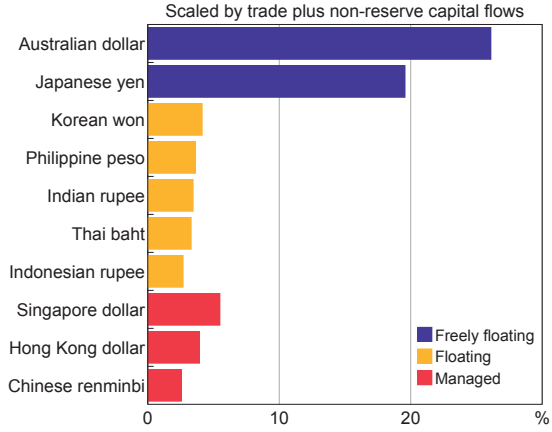
Graph 4
FX Derivative Activity and Financial Openness
Scaled by nominal GDP, log scale



Sources: BIS; IMF; RBA

There is also some evidence of a positive association between a given Asian currency's level of foreign exchange derivative activity, when scaled by an estimate of transactional demand, and its exchange rate regime. The level of foreign exchange derivative activity denominated in freely floating currencies, such as the Australian dollar or Japanese yen, is much higher compared with those currencies that have managed exchange rate regimes, such as the Singapore dollar (Graph 5).[6] As discussed above, this result is consistent with the additional exchange rate volatility associated with a floating exchange rate providing the incentive for hedging and position-taking in a currency.

Graph 5
Foreign Exchange Derivative Turnover*
Scaled by trade plus non-reserve capital flows



* Daily average for the month of April 2016
Sources: BIS; IMF; RBA

There is little evidence of a positive association between foreign exchange derivative activity in a given Asian currency and the level of exchange rate volatility. This is true when measured over various time horizons or in terms of changes in these variables. Market participants' expectations for volatility, rather than observed volatility, may be driving this result. More specifically, managed exchange rates may lead market participants to

5 This also coincided with the liberalisation of Australia's capital account and domestic financial markets.

6 These results are broadly consistent with those derived from a broader sample of advanced and emerging economies' currencies.

expect a lower level of exchange rate volatility and discourage hedging activity, although realised volatility may be quite different.

The variation in foreign exchange derivative market development across Asian currencies is also consistent with developed economies in the region generally having more developed financial markets and regulatory frameworks, stronger institutional settings and greater foreign participation in their domestic bond markets. Indeed, McCauley and Scatinga (2011) find evidence that countries with a higher level of per capita economic activity tend to have a higher amount of foreign exchange turnover for the purposes of financial trading, rather than for the hedging of exchange rate risk associated with trade or capital flows.

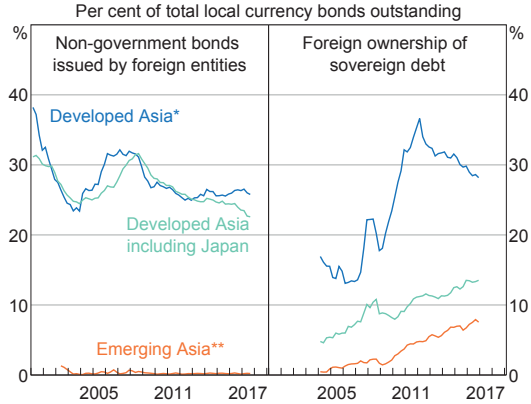
Foreign participation in local currency bond markets can foster the development of foreign exchange derivative markets. The ability to insure against exchange rate risk depends on the existence of two willing parties to a derivatives trade. Consider the case of Australia. Australian banks diversify their funding sources by raising some of their funds in a foreign currency. They then swap these back into Australian dollars for the purpose of extending loans in Australian dollars to Australian borrowers. In order to do so, there must be a party that wants to participate in the other side of this foreign exchange swap transaction. This includes foreign entities that have issued debt in Australian dollars (that is, via the so called 'Kangaroo' market), but ultimately want funding in the foreign currency.

However, potential parties to foreign exchange derivative trades in emerging Asian currencies are still limited. The available data suggest there has been a pick-up in foreign issuance of local currency non-government bonds in emerging Asian currencies, driven by bonds denominated in Chinese renminbi. However, as a share of non-government bonds outstanding, the stock of these bonds remains low compared with the share for developed Asian economies (Graph 6, left panel).

Similarly, the share of emerging Asian economies' local currency sovereign debt that is held by foreign investors has also increased over time, but remains below the share for developed Asian economies (Graph 6, right panel). Although foreign investor participation remains relatively modest in emerging Asian economies, an increase in foreign holdings of local currency government debt has tended to be associated with growth in foreign exchange derivative turnover. Despite this, liaison by the Asian Development Bank suggests that many non-resident investors in local currency bond markets choose not to hedge their exchange rate risk (Asian Development Bank 2015).

Other factors, such as trade in goods and services between an economy and the rest of the world, may also be associated with foreign exchange derivative market development. International trade gives rise to exchange rate risk and thus hedging transactions. While the evidence for this

Graph 6
Foreign Participation in Local Currency Debt Markets
Per cent of total local currency bonds outstanding



* Includes Australia, New Zealand and South Korea for ownership as well as Hong Kong and Singapore for stock issued
** Includes China, India, Indonesia, Malaysia, the Philippines and Thailand
Sources: ABS; Dealogic; IMF; RBA

is mixed (see Upper and Valli (2016)), trade flows may be an important determinant of foreign exchange derivative activity at lower levels of national income.

Conclusion

Activity in Asian foreign exchange derivative markets has increased in recent years, along with greater incentives to hedge exchange rate risk. These markets are more developed for the currencies of advanced economies in the Asian region, when compared with those of emerging economies. There is some evidence that floating exchange rate regimes and financial markets that are more integrated with the global economy are associated with larger foreign exchange derivative markets. Country experiences also demonstrate that foreign exchange derivative activity need not occur within the domestic market.

The development of foreign exchange derivative markets can usefully be considered in the context of broader financial market development. As emerging Asian economies grow and their financial systems develop, foreign exchange derivative activity in these currencies is likely to increase. Willing parties are essential for each foreign exchange derivative transaction. In particular, the costs need to be low enough to be mutually beneficial. Irrespective of how they develop, highly liquid and low-cost derivative markets, combined with adequate risk management practices, can help to limit the build-up of systemic risk.

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Central Counterparty Margin Frameworks

Louise Carter and Duke Cole*

A central counterparty's (CCP's) margin framework can affect the activity of market participants and the broader functioning of the financial system. This potential impact on financial stability is an area of focus for authorities – in Australia and overseas – particularly as central clearing has grown in recent years. Additionally, the margin collected by CCPs is the first layer of financial resources held by a CCP to cover counterparty credit risk, so it is critical that a CCP's margining system is effective.

Introduction

A key role of a CCP is to manage counterparty credit risk (the risk that a counterparty does not fully meet its financial obligations) and liquidity risk (the risk that a counterparty has insufficient funds to meet its obligations) (Hancock, Hughes and Mathur 2016). CCPs stand between counterparties to a financial market trade. When a bilateral trade is 'novated' to a CCP, the original trade is replaced by two identical contracts between the CCP and each of the counterparties.[1] In this way, participants in centrally cleared markets are not directly exposed to credit or liquidity risks arising from the participant on the other side of the trade, though they remain exposed to market risk (the risk of financial losses due to price and valuation changes) on their positions. By contrast, a CCP is not exposed to market risk in the usual course of business because it stands between counterparties with opposite positions.

However, if a clearing participant defaults, the CCP must continue to meet its obligations to its surviving participants. The CCP therefore faces potential losses from further changes in the value of the defaulting participant's portfolio until it is able to close out or liquidate that participant's positions. CCPs manage this risk by holding prefunded financial resources in the form of margin and a default fund. Clearing participants must meet any margin requirements and contributions to the default fund by posting collateral (cash or high-quality liquid assets) with the CCP.

The Reserve Bank has supervisory responsibilities for the four CCPs licensed to operate in Australia (ASX Clear, ASX Clear (Futures), LCH Ltd's SwapClear service and CME Inc).[2] It carries out these responsibilities partly by assessing CCPs against a set of Financial Stability Standards (FSS) (RBA 2012).[3] One of the areas the Bank pays particular attention to is CCPs' margin frameworks. CCP Standard 6 (Margin) in the FSS

* The authors are from Payments Policy Department and would like to thank Mark Chambers and Peter Wallis for their contributions to the preparation of this article.

1 In markets that use an 'open offer' system, there is never a contractual relationship between the buyer and seller. Instead, when the counterparties agree to a trade, contracts are immediately established between the CCP and each of the counterparties.

2 The Bank works closely with the Australian Securities and Investments Commission in its supervision of CCPs.

3 The Bank's assessments of the licensed CCPs are available at <https://www.rba.gov.au/payments-and-infrastructure/financial-market-infrastructure/clearing-and-settlement-facilities/assessments.html>.

sets out the Bank's expectations for the design and operation of a CCP's margining framework.[4]

This article describes the role of margin in CCP risk management. It also discusses the broader effect that CCP margin can have on participants and the financial system, and outlines international regulatory work to enhance CCPs' financial risk management in relation to margin.

How Margin Works

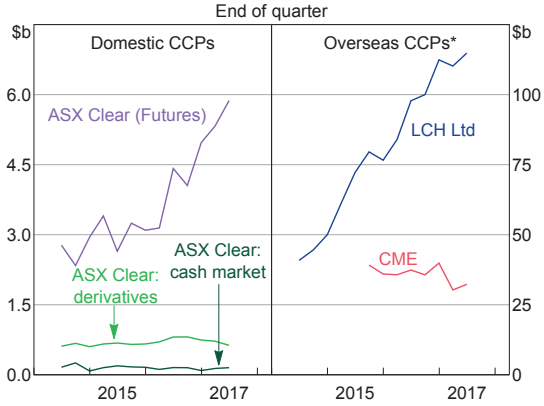
CCPs regularly collect three types of margin from their participants:

- *Variation margin*, which covers changes in the value of a participant's positions resulting from actual changes in market prices. Variation margin prevents the build-up of current exposures; it is typically collected at least daily from participants with mark-to-market losses on their positions and is typically (although not always) paid out to participants with gains
- *Initial margin*, which is intended to cover a CCP's potential future exposures on a participant's positions in the event that the participant defaults. Initial margin is sized to cover adverse price changes, up to a specified amount (known as the confidence interval), during the length of time the CCP expects it will take to terminate or hedge its exposures to the defaulter's positions. This period is known as the close-out period or margin period of risk. Initial margin is typically estimated with a model (see 'Box A: Initial Margin Models')
- *Additional margin*, which is levied to cover risks that are not necessarily captured in a CCP's initial margin model. For example, CCPs may collect additional margin to account for the risk that bid/ask spreads widen in periods of market stress, or the risk that it may take longer than expected to close out illiquid or highly concentrated portfolios.

As initial margin is an estimate of the potential future exposures of the CCP to its participants, it is an indicator of the magnitude of risks managed by a CCP (Graph 1). There is substantial variation between CCPs in the value of initial margin they collect, broadly in line with the size and nature of risks in the markets they serve. The total value of initial margin held at ASX Clear (Futures) and LCH Ltd SwapClear has increased significantly in recent years. This largely reflects increasing use of central clearing – especially for over-the-counter (OTC) derivatives, certain classes of which are subject to mandatory central clearing requirements in some jurisdictions, including Australia (CFR 2015).

Changes in initial margin held by a CCP can also reflect changes in the models used to estimate margin, the parameters used in those models, and the composition of participant portfolios. For example, initial margin held by ASX Clear (Futures)

Graph 1
Initial Margin – Australian-licensed CCPs
End of quarter



* OTC interest rate derivatives services only (covering all currencies); AUD equivalent

Sources: ASX; CME; LCH Ltd; RBA

4 The FSS implement the financial stability-related requirements in the international Principles for Financial Market Infrastructures (PFMI), published by the Committee on Payment and Market Infrastructures (CPMI) and the International Organisation of Securities Commissions (IOSCO) (2012).

increased in June 2016 as the CCP increased margin rates in response to the UK referendum on EU membership. The increase since mid 2016 has been driven largely by strong growth in trading in 10-year Treasury bond futures.

The effectiveness of a CCP's margining framework also depends on the broader operational and technological arrangements of the CCP. Margin calculations require a large amount of accurate and timely data on positions and prices. These calculations need to be done at least daily, and ad hoc calculations may need to be produced quickly in response to significant market developments. CCPs also need to issue margin calls and receive and pay margin amounts quickly and accurately, so margining systems must be well integrated with operational processes.

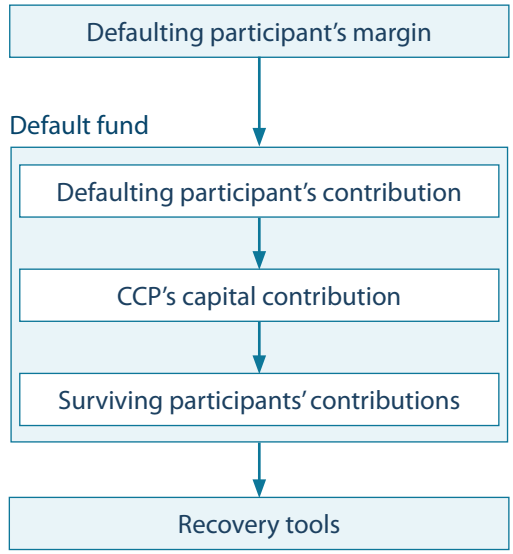
Margin and the default waterfall

CCPs maintain prefunded resources (in the form of margin and a default fund) to cover losses incurred during the close-out of a defaulting participant's portfolio. The order of application of these resources, as well as the CCP's other loss-allocation tools, is known as the CCP's default waterfall (Figure 1).

In a typical CCP default waterfall, the defaulting participant's margin (initial margin and any additional margin held by the CCP) is used first to cover losses during the close-out process. Margin is a 'defaulter-pays' resource; it is not mutualised, so the margin of non-defaulting participants cannot be used to cover losses.

In contrast, the default fund (which generally comprises contributions from the CCP and its participants) is mutualised. This means contributions from surviving participants can be used to cover losses of the defaulting participant if the defaulting participant's margin is exhausted. Typically, losses are first applied to

Figure 1: Typical CCP Default Waterfall



Source: RBA

the defaulting participant's contribution to the default fund, then the CCP's contribution and, lastly, to the surviving participants' contributions. In the event that the CCP's total prefunded resources are not sufficient to cover losses on a defaulting participant's positions, CCP rulebooks provide for 'recovery tools' to allocate remaining losses (for more detail on recovery tools, see CPMI-IOSCO (2017a)). Globally, authorities are also establishing resolution regimes for CCPs so that CCPs' critical services continue to operate even in times of extreme stress (which could include scenarios in which a CCP is unable to effectively implement its recovery tools).

The four CCPs licensed to operate in Australia size their total prefunded resources (margin and default fund) to cover the default of the largest two participants and their affiliates in extreme but plausible market conditions. This is the 'Cover 2' regulatory requirement, and is the internationally agreed standard that applies to CCPs that clear complex products or are systemically important in more than one jurisdiction.

Box A
Initial Margin Models

The FSS and Principles for Financial Market Infrastructures (PFMI) impose principles-based requirements, and do not prescribe the type of model CCPs must use to determine initial margin requirements. Instead, they set standards for how these models are designed to ensure they are robust and appropriately conservative. CCPs commonly use either a Standard Portfolio Analysis of Risk (SPAN) model or a Historical Value at Risk (HVaR) model to calculate their initial margin requirements.

In SPAN models, margin requirements are determined based on hypothetical market shocks, which in turn are derived using historical data on changes in price and volatility. Initial margin requirements are calculated separately for each product cleared by the CCP. Inter-product offsets may then be applied, which reduce the margin requirement on a portfolio of positions. This recognises the fact that prices of economically related products tend to be correlated. For example, the prices of Treasury bond futures with different durations tend to move together; therefore, at ASX Clear (Futures), a portfolio with long positions in 10-year Treasury bond futures and short positions in 3-year Treasury bond futures receives an inter-product offset because losses from one contract are likely to be partly offset by gains in the other contract.

In HVaR models, the margin requirement is calculated by valuing the participant's entire portfolio using historical price moves. The portfolio is valued for each day in a historical time series, as if the participant's current portfolio faced the same price moves as occurred in each period in the past. The initial margin requirement is set to cover losses up to a certain level implied by the resulting distribution of historical valuations. Because the margin requirement is calculated at the portfolio level (rather than for each product individually), explicit adjustments to recognise offsets are not required. CCPs may also make certain adjustments to the basic HVaR model to better capture current market conditions.

Neither SPAN nor HVaR models consistently produce higher margin requirements than the other. Instead, it depends on how they are implemented. In particular, there are three key parameters on which all initial margin models rely:

- *Lookback period*, which is the sample period of historical price data used in the model. A lookback period that includes periods of market stress will produce a higher margin requirement
- *Margin period of risk (close-out period)*, which is the assumed length of time that it would take to close out or hedge a defaulting participant's portfolio, during which the CCP is exposed to adverse price movements. A longer margin period of risk tends to produce higher margin requirements
- *Confidence interval*, which is the target coverage of initial margin over potential future exposures. The FSS require CCPs to size their initial margin to be able to cover at least 99 per cent of estimated future exposures (for example, due to potential future price

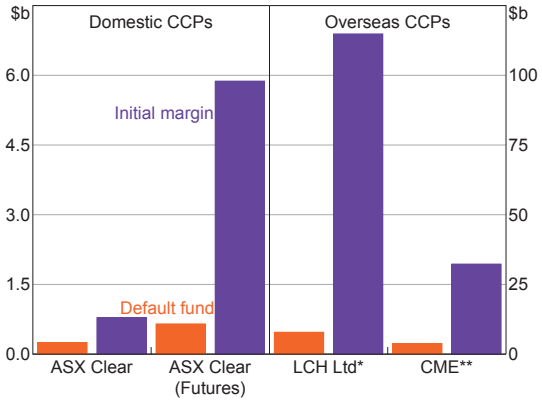
changes). A higher confidence interval will produce a higher margin requirement.

CCPs most commonly use SPAN models to margin exchange-traded derivatives, while variants of the HVaR model are most common for OTC interest rate derivatives (CPMI-IOSCO 2016). This partly reflects that in a SPAN model, the hypothetical market shocks for each product need to be set explicitly. Although this is relatively simple for exchange-traded futures and options, it is burdensome for complex products such as OTC interest rate derivatives. The Bank's periodically published assessments of the ASX CCPs, LCH Ltd's SwapClear service and CME Inc provide further detail on the margin models used by these CCPs.

The FSS require that CCPs conduct rigorous analysis of their initial margin models to ensure that they adequately capture the risks associated with the products they clear.

Despite the important loss-absorbing role of CCP default funds, in most cases they are a relatively small proportion of a CCP's total balance sheet (Graph 2). That said, while initial margin holdings in aggregate are large, in general the only part that can be used to cover losses arising from a participant default is the margin posted by that particular participant.

Graph 2
Prefunded Financial Resources – Australian-licensed CCPs
As at 30 June 2017



* Initial margin for OTC interest rate derivatives service only (covering all currencies); default fund covers OTC interest rate derivatives and listed rates services; AUD equivalent

** OTC interest rate derivatives service only (covering all currencies); AUD equivalent

Sources: ASX; CME; LCH Ltd; RBA

The trade-off between margin and the default fund

The FSS give CCPs discretion over the composition of their prefunded resources, providing they meet minimum requirements. As described above, margin and the default fund are tools for meeting the same objective – covering exposures to potential future losses. However, how a CCP allocates its prefunded resources between (i) defaulter-pays resources (initial and additional margin), and (ii) mutualised resources and a CCP's own resources (together, the default fund) affects the costs and incentives faced by participants. When potential future exposures are covered with initial margin, an individual participant bears the costs of the trades it brings to the CCP. By contrast, when they are covered with the default fund, costs are shared across participants and also borne by the CCP.

These costs and incentives play out through several channels, most notably:

- the cost of trading, which increases with margin requirements; as well as affecting participants, this also affects CCPs through reduced revenues

- the risk that a participant or the CCP itself will bear losses resulting from the default of another participant; this risk declines as margin requirements increase.

Ultimately, the balance of margin and default fund chosen by a CCP will depend on the weight placed on each of these factors.[5] These trade-offs are discussed further in Carter and Garner (2015).

From a system-wide perspective, authorities may take a different set of factors into account when considering a CCP's margin framework. Factors may include the moral hazard associated with low margin requirements (whereby participants may not fully bear the costs of their positions, which may encourage riskier behaviour) and the effect on incentives facing participants to appropriately manage risk and monitor the CCP. In part to avoid the risk that CCPs respond to competitive pressures to reduce margin rates below a prudent level, the PFMI and FSS place some limits on the composition of a CCP's prefunded resources by requiring CCPs to cover at least 99 per cent of potential future exposures with initial margin.

System-wide Effects of CCP Margin

As discussed above, the robustness of a CCP's margin framework is critical for its risk management, and is therefore a key focus for the Bank in its oversight of licensed CCPs. But CCP margin requirements can have broader implications for market participants and the financial system more generally. This is recognised in the PFMI and FSS, which require CCPs to consider the stability of the financial system and other relevant public interest considerations in their decision-making. In addition, the *Corporations Act 2001* states that a clearing and settlement facility must, as well as complying with the FSS, do all other things necessary to reduce systemic risk, to the extent that it is reasonably practicable to do so.

Interdependencies and demand for collateral

The greater use of central clearing over recent years has increased the amount of risk managed by CCPs. Consequently, CCP initial margin (and default fund) requirements have also risen. For example, aggregate initial margin held by LCH Ltd's global SwapClear service has more than tripled since 2014 to $115 billion (Graph 1). Participants must meet margin requirements and default fund contributions by posting collateral to the CCP. CCPs restrict the types of collateral they accept to cash or high-quality liquid non-cash collateral to ensure that it can be liquidated in a timely manner, with minimal loss of value. Although CCPs require these resources for the narrow purpose of managing their counterparty credit risk, this demand for high-quality liquid assets has broader effects on the financial system.

CCP margin has been identified as an important driver of the increasing demand for high-quality liquid assets, adding to demands resulting from other reforms such as Basel III capital requirements and initial margin requirements for non-centrally cleared derivatives (Manning 2014). Authorities and market participants continue to debate the effect of these demands on the functioning of collateral markets. For example, it is possible that participants that do not typically have holdings of high-quality collateral may need to borrow it, further increasing links among financial institutions (Committee on the Global Financial System 2013).

The large and growing collateral holdings of CCPs are also increasing these entities' systemic importance, although these collateral holdings

5 Haene and Sturm (2009) and Carter, Hancock and Manning (2016) develop models of a CCP's choice between margin and default fund, taking into account these incentive effects under different scenarios.

are driven by necessary CCP risk management. CCPs invest cash collateral they receive from participants, typically through outright purchases of government bonds, reverse repurchase agreements (secured by government bonds) or deposits at commercial banks or central banks. This means that CCPs are also exposed to the risks of their investment counterparties defaulting. Recent international analysis on interdependencies between 26 of the largest global CCPs and their clearing participants and service providers found that a relatively small set of large counterparties provided investment services to many of these CCPs. There is also evidence that more active clearing participants are also likely to be CCPs' main investment counterparties (BCBS, CPMI, FSB and IOSCO 2017). The PFMI and FSS require a CCP to monitor and mitigate the risks its investment counterparties pose. International work continues in order to better understand the potential risks that arise from CCPs' links to the rest of the financial system.

Variation margin may also have a systemic impact by affecting the distribution of liquidity among participants. Most notably, to meet variation margin payments, participants with mark-to-market losses may need to liquidate assets or positions relatively quickly (Pirrong 2011). Although variation margin calls can impose significant liquidity costs on individual participants with mark-to-market losses, a CCP typically directly passes this through to participants with gains. Such variation margin calls therefore do not directly affect the aggregate liquidity available in the financial system.

Procyclicality

Margin requirements are procyclical if they are positively correlated with market fluctuations. For example, it is not unusual for margin to increase in periods of heightened volatility. Such increases may be appropriate and necessary to ensure the CCP maintains sufficient coverage against counterparty credit risk. However, rapid increases in margin requirements during a period of heightened volatility may exacerbate market stress. This is because margin calls must be funded with cash or other high-quality collateral, potentially at a time when participants already face high demand for this collateral and shortages in liquidity.

A notable example of the effects of procyclicality on the broader market occurred during the 2011 eurozone sovereign debt crisis. In November 2011, as the spread between yields on Italian and German government securities widened, two CCPs that clear repurchase agreements (LCH SA and Cassa Di Compensazione e Garanzia SPA) significantly increased their margin requirements on Italian securities (IMF 2013). The Italian central bank has suggested that these margin calls led to a further widening of this spread and reduced liquidity in the system when it was most needed (Banca d'Italia 2012).

Consequently, procyclicality in margin requirements has been a focus of authorities over recent years. Under the PFMI and FSS, CCPs should limit destabilising procyclical changes in margin – to the extent practicable and prudent – by adopting forward-looking, conservative and relatively stable margin requirements. This recognises that, while mitigating procyclicality is important, CCPs should ensure they still maintain adequate margin coverage.

CCPs commonly mitigate procyclicality by placing floors on margin rates or model parameters, and by including data from stressed market episodes in the calibration of margin models. Imposing floors can limit declines in margin rates in periods of low volatility, so that margin rates do not increase so much when volatility does. Including stressed market

episodes in the lookback period results in higher margin requirements, even when current conditions are relatively stable.[6] For example, the lookback period for ASX Clear (Futures)' OTC derivatives model starts in June 2008, so it includes the global financial crisis.

International Regulatory Developments

As part of international efforts to enhance the resilience of CCPs, CPMI and IOSCO monitor the implementation of the PFMI, both by relevant authorities within jurisdictions as well as by specific financial market infrastructures. In 2016, CPMI and IOSCO published a report examining the financial risk management practices, including margin arrangements, of 10 derivatives CCPs (CPMI-IOSCO 2016). This report found that, although the surveyed CCPs had made important and meaningful progress in implementing the PFMI, there were some differences in interpretation or approach that could materially affect resilience. With respect to CCP margin arrangements, the report highlighted that not all surveyed CCPs systematically took into account all relevant factors in their choice of margin model. It also noted some differences across CCPs in the conservatism of assumptions for key model parameters.

The results of this exercise were a key motivating factor behind the July 2017 publication by CPMI and IOSCO of additional guidance on the PFMI (CPMI-IOSCO 2017b). The additional guidance seeks to clarify and elaborate on existing requirements in the PFMI related to CCP resilience, including margin practices. Notably, the guidance clarifies the expectation that CCPs should have clear analytical justification for the assumptions behind key margin model parameters, provides further detail regarding margin model testing and review, and sets further expectations regarding the management of procyclicality of margin.

The Bank has adopted the new guidance and will apply it in interpreting the relevant standards in the FSS. The Bank will consider how the Australian-licensed clearing and settlement facilities' risk management aligns with this guidance as part of its supervision over the period ahead.

Conclusion

Margin is fundamental to how a CCP manages counterparty credit risk. In the event that a participant defaults, this participant's initial margin is the first layer of resources available to the CCP to cover any losses incurred while it closes out the defaulting participant's portfolio. Given the importance of margin, the PFMI and FSS require that CCPs ensure their margin frameworks are effective and robust, and that margin is set at levels commensurate with the risks of the products the CCP clears.

As this article has discussed, the design of a CCP's margin framework also affects the broader financial system. CCP margin requirements have contributed to increased demand for high-quality liquid assets, alongside increasing demand arising from regulatory reforms to financial markets more broadly. The need for CCPs to invest this collateral may also further increase the links these entities have to the broader financial system. In addition, potential procyclical changes in CCP margin requirements might exacerbate stress in volatile market conditions.

Authorities internationally continue to consider the effect of these reforms on financial markets, and the interdependencies of CCPs to other financial institutions. The new international guidance for CCPs clarifies existing requirements in the PFMI to further enhance the resilience of

6 See Murphy, Vasios and Vause (2014) for more information on procyclicality in initial margin models.

CCPs while recognising the possible systemic impact of margin frameworks (and risk management more broadly).

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Conference volumes have been published on the Bank's website since 1993. The most recent titles are:

- *Structural Change in China: Implications for Australia and the World,* March 2016
- *Small Business Conditions and Finance,* March 2015
- *Financial Flows and Infrastructure Financing*, July 2014

Other Publications

The Bank periodically produces other publications that may take the form of submissions to inquiries, surveys or consultation documents. Some recent examples include:

- Submission to the Review into Open Banking in Australia, September 2017
- Submission to the Productivity Commission Inquiry into Competition in the Financial System, September 2017
- Submission to the Review of the Operation of the Sunsetting Provisions in the *Legislation Act 2003*, July 2017
- *Safe and Effective Competition in Cash Equity Settlement in Australia*, March 2017
- *Dual-Network Cards and Mobile Wallet Technology*, December 2016

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Recent Speeches

Security Printing: A Central Banker's Perspective – Welcome Address to High Security Printing Asia, Lindsay Boulton, Assistant Governor (Business Services), December 2017

Skills for the Modern Workforce, Alexandra Heath, Head of Economic Analysis Department, December 2017

Some Evolving Questions, Philip Lowe, Governor, November 2017

Mortgage Insights From Securitisation Data, Marion Kohler, Head of Domestic Markets Department, November 2017

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Where is the Growth Going to Come From?, Luci Ellis, Assistant Governor (Economic), November 2017

Business Investment in Australia, Guy Debelle, Deputy Governor, November 2017

Opening Statement to the House of Representatives Standing Committee on Tax and Revenue Inquiry into Taxpayer Engagement with the Tax System, Tony Richards, Head of Payments Policy Department and David Emery, Senior Manager, Payments Policy Department, October 2017

Uncertainty, Guy Debelle, Deputy Governor, October 2017

Remarks at the Australian Shareholders Association, Michele Bullock, Assistant Governor (Financial System), October 2017

Panel participation at the 9th Annual Australian & New Zealand Investment Conference, Luci Ellis, Assistant Governor (Economic), October 2017

Speech on the FX Global Code of conduct , Guy Debelle, Deputy Governor, October 2017

Central Bank Independence in Retrospect, Guy Debelle, Deputy Governor, September 2017

Panel participation at the Where to from here? – Briefing hosted by Lander & Rogers and Westpac, Michele Bullock, Assistant Governor (Financial System), September 2017

The Next Chapter, Philip Lowe, Governor, September 2017

The Current Global Expansion, Luci Ellis, Assistant Governor (Economic), September 2017